APPENDIX J
Biodiversity development assessment report



Evolution MINING

EMM creating opportunities

Cowal Gold Operations Open Pit Continuation Project

Biodiversity Development Assessment Report

Prepared for Evolution Mining (Cowal) Pty Limited

May 2023

Cowal Gold Operations Open Pit Continuation Project

Biodiversity Development Assessment Report

Evolution Mining (Cowal) Pty Limited

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May 2023

Version	Date	Prepared by	Approved by	Comments
1.0	21 November 2022	Dr Hayden Beck and Benjamin Parkin	Dr Steven Ward	Draft
2.0	9 March 2023	Dr Hayden Beck and Benjamin Parkin	Dr Steven Ward	Draft release to client for initial review
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Approved by



Dr Steven Ward
Associate Ecologist
29 May 2023

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This report has been prepared in accordance with the brief provided by Evolution Mining (Cowal) Pty Limited and, in its preparation, EMM has relied upon the information collected at the times and under the conditions specified in this report. All findings, conclusions or recommendations contained in this report are based on those aforementioned circumstances. The contents of this report are private and confidential. This report is only for Evolution Mining (Cowal) Pty Limited's use in accordance with its agreement with EMM and is not to be relied on by or made available to any other party without EMM's prior written consent. Except as permitted by the Copyright Act 1968 (Cth) and only to the extent incapable of exclusion, any other use (including use or reproduction of this report for resale or other commercial purposes) is prohibited without EMM's prior written consent. Except where expressly agreed to by EMM in writing, and to the extent permitted by law, EMM will have no liability (and assumes no duty of care) to any person in relation to this document, other than to Evolution Mining (Cowal) Pty Limited (and subject to the terms of EMM's agreement with Evolution Mining (Cowal) Pty Limited).

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BDAR declaration

Certification under clause 6.15 Biodiversity Conservation Act 2016 and conflict of interest

I certify that this report has been prepared based on the requirements of, and information provided under, the Biodiversity Assessment Method and clause 6.15 of the *Biodiversity Conservation Act 2016* (BC Act).

Signature: 

Date: 29/05/2023

BAM Assessor Accreditation no: BAAS17062

This BDAR has been prepared to meet the requirements of BAM 2020.

Actual, perceived or potential conflict of interest

I wish to openly declare the following actual, perceived or potential conflict of interest and the management strategies employed:

- EMM is currently engaged by Evolution to undertake biodiversity survey and assessment for other Projects.

We believe this could represent a perceived, rather than actual, conflict of interest and this declaration has been made in the interests of full disclosure to the decision-maker. Full disclosure has also been provided to the client.

Details and experience of author/s and contributors

In this report an assessment of the biodiversity values and impacts associated with the proposal have been undertaken in accordance with the Biodiversity Assessment Method 2020 (DPIE 2020a). The Biodiversity Development Assessment Report has been prepared by accredited assessors Dr Hayden Beck (BAAS19000) and Dr Steven Ward (BAAS17062), with assistance by Benjamin Parkin. EMM staff and sub-contractors that contributed to fieldwork and data collection as identified in the table below.

Personnel	Qualifications	Tasks carried out
Dr Steven Ward	Associate Ecologist Accredited Assessor (BAAS17062)	Project Director, responsible Accredited Assessor for the project BDAR report preparation, BAM calculations, strategic lead
Dr Hayden Beck	Senior Ecologist Accredited Assessor (BAAS19000)	Project Manager from July 2022 BDAR report preparation, BAM calculations, direction of field teams, conduct targeted flora surveys
Benjamin Parkin	Ecologist	Project Coordinator from September 2022 BDAR report preparation, direction of field teams, targeted fauna surveys for Southern Bell Frog, Koala and Bush-stone Curlew
Glenn Stuckey	Senior Ecologist	Project Co-ordinator until July 2022 BAM plots, Sloane's Froglet and waterbird surveys

Personnel	Qualifications	Tasks carried out
Eugene Dodd	Senior Ecologist Accredited Assessor (BAAS17009)	Project Manager from January 2020 to January 2021 Survey planning, threatened flora and fauna surveys, vegetation mapping
Ryl Parker	Ecologist	BAM plots and threatened flora surveys
Jason Brown	Senior Ecologist Accredited Assessor (BAAS21017)	Lead waterbird surveys
Dr Chad Beranek	Zoologist	Lead Koala drone surveys, raptor nest surveys and diurnal bird surveys.
Ryan Tate	Accredited koala dog handler	Lead Koala Detection Dog surveys
Claire Chiotti	Accredited koala dog handler	Assist with Koala Detection Dog surveys
Stephen Dalleywater	Accredited koala dog handler	Assist with Koala Detection Dog surveys
Simone Popp	Accredited koala dog handler	Assist with Koala Detection Dog surveys
Justin Chey	Ecologist	Threatened flora surveys
Paul Rossington	Associate Ecologist Accredited Assessor (BAAS18065)	Threatened flora surveys
Jennifer Lindsay	Ecologist	Threatened flora surveys
Sam Jones	Field Ecologist	Threatened flora surveys
Sarah Glauert	Senior Botanist Accredited Assessor (BAAS17097)	Threatened flora surveys and diurnal bird surveys
Bianca Seal	Senior Ecologist	Threatened flora surveys
Tom O'Sullivan	Botanist Accredited Assessor (BAAS20024)	BAM plots
Madeleine Hunt	Graduate Ecologist	Assisted data management
Maya Potapowicz	Associate Ecologist Accredited Assessor (BAAS18157)	Threatened flora surveys
Kirstin Vine	Ecologist	Sloane's Froglet surveys, diurnal bird surveys, targeted flora surveys, vegetation mapping and BAM plots
George Madani	Ecologist	Sloane's Froglet surveys, Diurnal bird surveys
Christopher Portway	Zoologist	Frog surveys
Ireni Clarke	Senior Ecologist	Sloane's Froglet surveys, diurnal birds habitat assessment
Cassandra Kottaras	Ecologist	Targeted flora surveys
Steven Williams	Senior Ecologist	Targeted flora surveys, vegetation mapping
Lilly Marsh	Ecologist	Targeted flora surveys
Sam Turbill	Ecologist	Targeted flora surveys

Personnel	Qualifications	Tasks carried out
Chloe Broome	Ecologist	Migratory bird survey
Lui Webber	Ecologist	Vegetation mapping

Executive Summary

ES1 Project description

Evolution Mining (Evolution) operates the Cowal Gold Operations (CGO) gold mine located at Lake Cowal with mining commencing in 2005. Evolution is seeking approval for further open pit mining operations at CGO through the Open Pit Continuation Project (OPC; the Project). This will involve further development of the existing E42 Pit and the development of open pit mining in three new adjacent orebodies, known as the 'E46', 'GR' and 'E41' pits. A new Lake Protection Bund (LPB) will be created to provide a hydrological separation between the mine and Lake Cowal. Once constructed, a lake foreshore will be rehabilitated extending 30 m from the toe of the LPB. This Biodiversity Development Assessment Report (BDAR) assesses the impact of the OPC Project on biodiversity values.

The study area within which surveys were undertaken for this BDAR extended across 1,759.67 ha. The Project will also use 1,713.64 ha existing and approved disturbance area (hereafter referred to as the Existing and approved disturbance area) which was not surveyed due to previous disturbance.

The Project would impact on an additional 1,030.68 ha (hereafter referred to as the Additional disturbance area). Within the Additional disturbance area, the Project would clear 930.72 ha of native vegetation, much of which is degraded by past agricultural activities.

ES2 Landscape features

The study area is located in the South West Slopes Interim Biogeographic Regionalisation of Australia (IBRA) bioregion and Lower slopes subregion, and within the Lachlan River catchment. The Project will extend into Lake Cowal, a large ephemeral inland lake. The study area represents a transition zone from a lake environment through riparian habitat on the Lake Cowal shoreline, extending through an alluvial floodplain to floodplain transition woodland. Small, low relief hills are located to the northwest and south of the study area.

Two streams that feed into Lake Cowal pass through the Existing and approved disturbance area and have already been realigned. The Project will involve relocation of the upstream catchment diversion system (UCDS) to ensure water draining into Lake Cowal continues to be isolated from CGO operations.

The total area of native vegetation within a buffer to 1,500 m of the Additional disturbance area (referred to as the buffer area) was assessed as being 4,296.04 ha, or 63% native vegetation. Most of this vegetation is derived native grassland (DNG) occurring due to a long history of agriculture in the region, including intensive livestock grazing and cropping. Intact woodland within the buffer area is sparse.

There are no important geological features present in the buffer area, apart from cracks and crevices within existing mine pits in the Existing and approved disturbance area, which are not usable by fauna due to the current active mining activities.

ES3 Native vegetation

The study area contains a naturally complex mosaic of woodlands across the alluvial plain, with most vegetation largely cleared/disturbed by agriculture. The assignment of native vegetation communities to their original Plant Community Types (PCTs) was informed by discussions with the NSW Biodiversity Conservation Division (BCD) for a past approval to allocate some areas previously impacted by a prior modification to the CGO approval to their original Plant Community Types (PCTs), as well as discussions with BCD specifically on the OPC Project. This vegetation mapping method was also applied to the Project study area, resulting in eight PCTs impacted by the Project:

- PCT 17 Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)

- PCT 26 Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
- PCT 53 Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains
- PCT 55 Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions
- PCT 82 Western Grey Box – Poplar Box – White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion
- PCT 185 Dwyer's Red Gum – White Cypress Pine – Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
- PCT 244 Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)
- PCT 249 River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW.

All vegetation zones of PCT 26 were consistent with the NSW *Biodiversity Conservation Act 2016* (BC Act) listed *Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions* Endangered Ecological Community (EEC), whilst only the medium condition zone was consistent with the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) listed *Weeping Myall Woodlands* EEC.

Medium condition PCT 244 was consistent with the EPBC Act listed *Poplar Box Grassy Woodland on Alluvial Plains* EEC. This vegetation community is not listed as threatened under the BC Act.

All zones of PCT 82 are consistent with BC Act Inland *Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions* EEC, and the EPBC Act listed *Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia* EEC.

ES4 Threatened species

Substantial previous surveys have been conducted to inform the original impact assessment (NSR Environmental Consultants 1995), modifications (e.g. AMBS 2018), as well as part of ongoing monitoring as part of ongoing CGO operations. In addition to previous surveys, targeted flora surveys were undertaken over 68 days (202 person days) between September 2020 and January 2023. Targeted threatened fauna surveys were undertaken between August 2020 and January 2023, including hollow-associated birds (68 hours over 20 days), raptors (34 hours over 7 days and drone surveys over 9 days), owls (5 nights and dusk-watches over four evenings at 23 locations), bush-stone curlew (13 nights), squirrel glider (120 trap nights), koala (detection dog surveys over 4 days and drone surveys over 5 nights), microbats (39 acoustic detection nights by EMM Consulting, and recent harp-trap surveys for microbats by AMBS 2018) and frogs (20 nights).

The Austral Pillwort (*Pilularia novae-hollandiae*; BC Act: Endangered) was the only species credit species recorded during surveys.

Excluding wetland birds (covered in Section ES5), ecosystem credit species recorded on or near the study area were the following:

- Diamond Firetail (*Stagonopleura guttata*; BC Act: Vulnerable; EPBC Act: Not Listed)
- Glossy Black-Cockatoo (*Calyptorhynchus lathami*; BC Act: Vulnerable; EPBC Act: Vulnerable)
- Grey-crowned Babbler (*Pomatostomus temporalis*; BC Act: Vulnerable; EPBC Act: Not Listed)
- Superb Parrot (*Polytelis swainsonii*; BC Act: Vulnerable; EPBC Act: Vulnerable)
- Square-tailed Kite (*Lophoictinia isura*; BC Act: Vulnerable; EPBC Act: Not Listed)
- White-bellied Sea-Eagle (*Haliaeetus leucogaster*; BC Act: Vulnerable; EPBC Act: Not Listed)
- White-fronted Chat (*Epthianura albifrons*; BC Act: Vulnerable; EPBC Act: Not Listed)
- Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*; BC Act: Vulnerable; EPBC Act: Not Listed) was detected during acoustic recorder surveys.

ES5 Wetland/migratory bird species

Targeted waterbird surveys were also undertaken for this BDAR across 8.7 hours over 5 days. Waterbird surveys undertaken three times annually from 1989 to 2022 by Evolution, and University of NSW waterbird surveys undertaken from 2008 to 2022, also informed assessments. In total, 21 species of BC Act and/or EPBC Act listed waterbirds were detected across Evolution or UNSW monitoring programs, or in surveys undertaken for this BDAR.

Six BC Act and/or EPBC Act listed threatened waterbirds were recorded, being:

- Australasian Bittern (*Botaurus poiciloptilus*; BC Act: Endangered; EPBC Act: Endangered)
- Blue-billed Duck (*Oxyura australis*; BC Act: Vulnerable; EPBC Act: Not Listed)
- Brolga (*Grus rubicunda*; BC Act: Vulnerable; EPBC Act: Not Listed)
- Curlew Sandpiper (*Calidris ferruginea*; BC Act: Endangered; EPBC Act: Critically Endangered and Migratory)
- Freckled Duck (*Stictonetta naevosa*; BC Act: Vulnerable; EPBC Act: Not Listed)
- Magpie Goose (*Anseranas semipalmata*; BC Act: Vulnerable; EPBC Act: Not Listed).

Of the above species, the Curlew Sandpiper is considered a dual credit species, but Lake Cowal is not mapped as important habitat for this species, as per Important Habitat Mapping in the NSW Biodiversity Offset and Agreement Management System (BOAMS), so it was not considered to be a species credit species for this BDAR.

A total of 15 species listed as migratory under the EPBC Act were recorded, being:

- Caspian Tern (*Hydroprogne caspia*)
- Common Greenshank (*Tringa nebularia*)
- Curlew Sandpiper (*Calidris ferruginea*)
- Double-banded Plover (*Charadrius bicinctus*)

- Glossy Ibis (*Plegadis falcinellus*)
- Gull-billed Tern (*Gelochelidon macrotarsa*)
- Latham's Snipe (*Gallinago hardwickii*)
- Little Curlew (*Numenius minutus*)
- Marsh Sandpiper (*Tringa stagnatilis*)
- Pacific Golden Plover (*Pluvialis fulva*)
- Pectoral Sandpiper (*Calidris melanotos*)
- Red-necked Stint (*Calidris ruficollis*)
- Sharp-tailed Sandpiper (*Calidris acuminata*)
- White-winged Black Tern (*Chlidonias leucopterus*).

ES6 Groundwater-dependent ecosystems

Based on current groundwater depth, ten PCTs were identified as having at least some dependence on groundwater. PCTs 10 and 249 were considered entirely/obligate dependent, whilst PCTs 75, 105, 184 and 279 were categorised as facultative – proportional dependent and PCT 24 as facultative – opportunistic. Sensitivity analysis modelling the 'proposed recovery case', which considers water balance modelling within extracted pits, suggested that PCTs 10 and 249 may experience drawdown in some areas that may make it difficult for eucalypts to access groundwater. Due to the current uncertain impacts to GDEs, adaptive management of groundwater impacts is recommended, including that potentially affected GDEs are ground-truthed and monitored via vegetation plots. Piezometers are also recommended to be installed to monitor groundwater in these areas.

ES7 Aquatic and riparian biodiversity

Impacts to aquatic biodiversity values are addressed in a separate assessment (EMM 2023a). Nonetheless the BDAR considers and addresses prescribed impacts in relation to water quality.

ES8 Impact avoidance, minimisation and mitigation

Impacts to native vegetation were avoided and minimised where possible within the design phase. Design changes made to avoid or mitigate impacts included:

- backfilling of mine E46 pit to avoid the need to expand Waste Rock Emplacement (WRE) to the south
- relocating stockpiles to heavily cropped land
- using existing infrastructure and plant to process gold
- using existing access roads and avoiding road widening or construction of new access points
- avoid the need to construct a temporary lake protection bund (in front of the LPB) by using the existing LPB to provide a hydrological separation with Lake Cowal

- reconstructing a lake foreshore in front of the new LPB to provide habitat for waterbirds, fish and woodland fauna.

Residual direct, indirect and potential prescribed impacts of vehicle strike and water quality (including cyanide handling) associated with construction and operations will be addressed through established management plans, which have been developed in correspondence with relevant regulators, audited annually and employed since commencement of operations in 2005.

Adaptive management plans as detailed in this BDAR will be applied to detect and respond to uncertain impacts associated with the Project, including noise (construction, operations and blasting), water quality, air quality on threatened and migratory waterbirds within Lake Cowal.

ES9 Assessment of impacts under other relevant biodiversity legislation

The BDAR has considered impacts on species and ecological communities listed under the EPBC Act. The Project is expected to likely result in significant impacts on:

- Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia EEC (EPBC Act: Endangered)
- Weeping Myall Woodlands EEC (EPBC Act: Endangered)
- Australasian Bittern (*Botaurus poiciloptilus*; EPBC Act: Endangered)
- Latham's Snipe (*Gallinago hardwickii*; EPBC Act: Migratory)
- Sharp-tailed Sandpiper (*Calidris acuminata*; EPBC Act: Migratory)
- Glossy Ibis (*Plegadis falcinellus*; EPBC Act: Migratory)
- Habitat important to EPBC Act listed migratory shorebirds.

The Project may possibly result in significant impacts on:

- Australian Painted Snipe (*Rostratula australis*; EPBC Act: Endangered)
- Painted Honeyeater (*Grantiella picta*; EPBC Act: Vulnerable)
- Superb Parrot (*Polytelis swainsonii*; EPBC Act: Vulnerable; foraging habitat only).

ES10 Biodiversity impacts and offsets

The BOS offset liability for the Project is:

- 20,046 ecosystem credits to compensate for impacts on native PCTs and ecosystem credit species, consisting of:
    - 512 credits for PCT 17 Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)
    - 2,477 credits for PCT 26 Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
    - 9,609 credits for PCT 53 Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains

- 3,604 credits for PCT 55 Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions
- 2,207 credits for PCT 82 Western Grey Box – Poplar Box – White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion
- 39 credits for PCT 185 Dwyer's Red Gum – White Cypress Pine – Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
- 190 credits for PCT 244 Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)
- 1,408 credits for PCT 249 River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW.

- 39 species credits for the Austral Pillwort.

ES11 Biodiversity offsets

Evolution will pursue biodiversity offsets required for the Project, with steps to be taken to meet the biodiversity credit liability being:

- Establishment of Stewardship sites on Evolution-owned land. Evolution has already undertaken vegetation mapping and anticipated potential credit generation from their landholdings and commenced discussions with the NSW Credits Supply Taskforce. It is expected that sufficient credits can be generated for PCTs 17, 53, 82, 185, and 249. A credit shortfall is anticipated for PCTs 26, 55 and 244 which will be addressed via the steps below.
- Purchase of credits (or land) from external landholders to meet the anticipated credit shortfall will be pursued. Evolution has commenced discussions and preliminary investigations of lands.
- Limited use of the NSW Government Biodiversity Conservation Fund (BCF).

The offset package will be staged to meet the offset liability prior to construction of the five stages of the Project.

It is also anticipated that the Commonwealth specific offsets for EPBC Act listed Australasian Bittern, Latham's Snipe, Glossy Ibis, Sharp-tailed Sandpiper and other migratory bird species will be met by the establishment of Stewardship site(s) over Evolution-owned land within or immediately adjacent to Lake Cowal.

Glossary

Term	Definition
Alluvial	Relating to or derived from alluvium. Alluvium refers to loose clay, silt, sand or gravel that has been deposited by running water in a stream bed, floodplain or similar setting.
Aquifer	An underground body of porous rock or sediment that stores and transmits water.
Aquitard	A geological formation that prevents or slows down the transmission of water underground; often acting as a barrier for groundwater.
Avifauna	Birds of a particular region, habitat or geological period.
Backfilling	The process of refilling and stabilising an excavated hole.
Biodiversity Offsets Scheme (BOS)	The NSW framework for offsetting unavoidable impacts on biodiversity from development with biodiversity gains through landholder stewardship agreements (DPE 2023).
Biodiversity Stewardship Agreement (BSA)	An agreement registered on title whereby landowners can sell biodiversity credits to developers that need to offset impacts, the government, or other buyers seeking to secure conservation (DPE 2023). BSA's are registered on the title of land in perpetuity.
Blasting	The deliberate fragmentation and displacement of rock with the use of explosives; usually to create access to underground resources.
Category 1 land	Land that is exempt from offset requirements under the *Biodiversity Conservation Act 2016* (BC Act).
Category 2 land	Land that is subject to offset requirements under the *Biodiversity Conservation Act 2016* (BC Act).
Colluvial	Relating to or derived from colluvium. Colluvium refers to loose, unconsolidated sediments deposited at the base of a slope, predominantly by gravity (e.g. rainwash, sheetwash, slow continuous downslope creep).
Construction	Activities that are related to the establishment phase of the Project and that will occur on a site for only a limited period of time.
Cutback	Lateral extension of an open pit.
Derived Native Grassland (DNG)	A native grassland remaining after the removal of previous woody species (e.g. trees and and/or shrubs).
Dewatering	The removal of water from a construction area.
Drawdown	The lowering of water levels in a surface water or groundwater storage resulting from the loss or take of water from the storage.
Earthworks	All works involving the loosening, excavating, placing, shaping and compacting of soil or rock.
Ecological community	A naturally occurring group of native plants, animals and other organisms that are interacting in a unique habitat. It's structure, composition and distribution are determined by environmental factors such as soil type, position in the landscape, altitude, climate and water availability (DCCEEW 2021a).
Ecosystem	A dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit.
Ecosystem credit species	Threatened species considered likely to occur within an area based on the presence of certain Plant Community Types (PCTs).
Ecotone	An area where two or more biological/ecological communities meet and integrate.

Term	Definition
Elution	The process of extracting one material from another with the use of a solvent.
Ephemeral waterbody	A waterbody that remains flooded for short periods of time typically in response to seasonal rainfall.
Frugivore	An animal that survives mainly on raw fruits, roots, shoots, nuts and seeds.
Gilgai	Small, repeated mounds and depressions that form on shrink swell and cracking clay soils (DES 2013). Typically form ephemeral wetlands after seasonal rains.
Groundwater dependent ecosystem	Natural ecosystems that require access to groundwater to meet all or some of their water requirements on a permanent or intermittent basis, so as to maintain their communities of plants and animals, ecosystem processes and ecosystem services.
High Threat Weed (HTW)	Exotic plant species considered resistant to management actions.
Integrated Waste Landform (IWL)	A large facility present at CGO which stores and manages mine waste and the by-products of mining processes, including tailings.
Internal Catchment Drainage System (ICDS)	A drainage system to be constructed within CGO to collect potentially contaminated surface water generated on site, thereby preventing discharge of contaminated water into Lake Cowal.
Lake Protection Bund (LPB)	A large structure skirting the eastern perimeter of the CGO that provides mutual, hydrological separation between Lake Cowal and the mine.
Loamy	Relating to fertile soil composed of sand, silt and clay.
Leaching	The extraction of a substance from a solid material with the use of a solvent.
Nectarivore	An animal deriving its energy primarily from nectar.
Non-metric Multidimensional Scaling (nMDS)	A statistical ordination method that enables the visualisation of similarity between objects in complex multivariate datasets.
Open cut/pit	Mining method which involves digging up material from the surface and/or open-air pit.
Operation	Activities that are related to operation phase of the Project and that will occur on the site until mine completion.
Orebody	A mass or concentration of ore.
Paleochannel aquifer	An aquifer formed in a remnant river or stream channel that has been buried by younger sediment.
Plant Community Type (PCT)	The finest level in the NSW vegetation classification hierarchy. PCTs identify recurring patterns of native plant species assemblages in relation to environmental conditions (soil, temperature, moisture and other factors, DPE 2022a).
Ramsar Wetland	Wetlands designated as internationally important by the Ramsar convention on Wetlands of International Importance Especially as Waterfowl Habitat.
Reagent	A substance or compound added to a system in order to facilitate a chemical reaction, e.g. the use of cyanide to extract gold from ore by way of leaching.
Remnant Vegetation	Patches of trees, shrubs and grasses which have not been cleared.
Riparian	An area or zone within or along the banks of a stream or adjacent to a watercourse or wetland; relating to a riverbank and its environment, particularly to the vegetation.
Sedimentation	The deposition of particles into nearby waterways as a result of construction activities.

Term	Definition
Silt fence/curtain	A continuous structure erected around the construction zone to trap sediment and other suspended material and prevent it from entering the nearby environment.
Species credit species	Threatened species that cannot reliably be predicted to occur within an area based on the presence of certain Plant Community types (PCTs).
Sporocarp	A specialised structure in aquatic ferns which function to produce and release spores.
State Significant Development (SSD)	Developments deemed to have state significance by the Department of Planning and Environment (DPE) due to their size, economic value or potential impacts. SSDs are assessed under the Rapid Assessment Framework.
Strip ratio	The amount of unwanted material that must be removed in order to release a given quantity of ore.
Surface water	Water that flows over or is stored on the surface of the earth that includes: (a) water in a watercourse, lake or wetland and (b) any water flowing over or lying on land: (i) after having precipitated naturally or (ii) after having risen to the surface naturally from underground.
Tailings	Waste materials left over from the processing of mined ore.
Tailings storage facility	A facility designed to safely contain and process mine tailings.
Upper Catchment Diversion System (UCDS)	A catchment diversion system located upstream of the CGO which prevents normal surface water mixing with runoff from water derived from areas of Project construction and operation.
Waste Rock Emplacement (WRE)	Storage locations for waste rock unearthed during mining operations.

Acronyms

Acronym	Definition
AOO	Area of Occupancy
ARI	Annual Rainfall Interval
ASL	Above Sea Level
AQMP	Air Quality Management Plan
BACI	Before-After Control-Impact
BAM	Biodiversity Assessment Method
BAM-C	Biodiversity Assessment Method Calculator
BC Act	*Biodiversity Conservation Act 2016*
BC Regulation	Biodiversity Conservation Regulation 2017
BCD	Biodiversity and Conservation Division
BDAR	Biodiversity Development Assessment Report
BMP	Blast Management Plan
BOAMS	Biodiversity Offset and Agreement Management System
BOM	Bureau of Meteorology
BOS	Biodiversity Offsets Scheme
BoS	Biodiversity Offset Strategy
BSA	Biodiversity Stewardship Agreement
CAMBA	China-Australia Migratory Bird Agreement
CEEC	Critically Endangered Ecological Community
CEMP	Construction Environment Management Plan
CGM	Cowal Gold Mine
CGO	Cowal Gold Operations
CMP	Cyanide Management Plan
DAWE	Department of Agriculture, Water and Environment
DBH	Diameter at Breast Height
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DEC	Department of the Environment and Conservation
DECC	Department of Environment and Climate Change
DEMs	Digital Elevation Models
DEWHA	Department of Environment, Water, Heritage and the Arts
DFSI	Department of Finance, Services and Innovation

Acronym	Definition
DIWA	Directory of Important Wetlands in Australia
DMP	Dust Management Plan
DNG	Derived Native Grassland
DoEE	Department of Energy and Environment
DP	Deposited Plans
DPE	Department of Planning and Environment
DPI	Department of Primary Industry
DPIE	NSW Department of Planning, Industry and Environment
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities.
DTM	Digital Terrain Model
EAAF	East Asian – Australasian Flyway
EEC	Endangered ecological community
EIS	Environmental Impact Statement
EMM	EMM Consulting Pty Ltd
ENSO	El Niño-Southern Oscillation
EOO	Extent of Occupancy
EPA	Environmental Protection Authority
EPA&A Act	*Environmental Planning and Assessment Act 1979*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPIs	Environmental Planning Instruments
ESCMP	Erosion and Sediment Control Management Plan
FFMP	Flora and Fauna Management Plan
FM Act	*Fisheries Management Act 1994*
GDE	Groundwater dependent ecosystem
GIS	Geographic Information System
ha	Hectares
HBT	Hollow Bearing Tree
HMMP	Hazardous Materials Management Plan
HTW	High Threat Weed
IBRA	Interim Biogeographic Regionalisation for Australia
ICDS	Internal Catchment Drainage System
ICMI	International Cyanide Management Institute
IWL	Integrated Waste Landform

Acronym	Definition
JAMBA	Japan-Australia Migratory Bird Agreement
KBA	Key Biodiversity Area
KFH	Key Fish Habitat
km	Kilometre
KTPs	Key Threatening Processes
LGA	Local Government Area
LLS	Local Land Services
LMP	Land Management Plan
LPB	Lake Protection Bund
m	Metre
mAHD	metres Australian height datum
mbgl	metres below ground level
MIC	Maximum Instantaneous Charge
ML	Mining lease
mm	Millimetres
MNES	Matters of National Environmental Significance
MOD 11	Cowal Gold Operations Processing Rate Modification 11
MOD 14	Cowal Gold Operations Processing Rate Modification 14
Mt	Megatonne
nMDS	Non-metric Multidimensional Scaling
NMP	Noise Management Plan
NSW	New South Wales
NVR	Native Vegetation Regulatory Map
OEH	Office of Environment and Heritage
OPC	Open Pit Continuation
PCT	Plant Community Type
PIRMP	Pollution Incident Response Management Plan
PMST	Protected matter search tool
ROKAMBA	Republic of Korea-Australia Migratory Bird Agreement
RMP	Rehabilitation Management Plan
RVA	Rapid Vegetation Assessment
RVEP	Remnant Vegetation Enhancement Program
SAII	Serious and Irreversible Impact

Acronym	Definition
SEARs	Secretary's Environmental Assessment Requirements
SEED	Sharing and Enabling Environmental Data
SEPP	State Environmental Planning Policy
SRD SEPP	State Environmental Planning Policy (State and Regional Development) 2011
SSD	State Significant Development
SSMP	Soil Stripping Management Plan
SWGMBMP	Surface Water, Groundwater, Meteorological and Biological Monitoring Programme
TBDC	Threatened Biodiversity Database Collection
TEC	Threatened Ecological Community
TSF	Tailings Storage Facility
TSMP	Threatened Species Management Protocol
TSSC	Threatened Species Scientific Committee
UCDS	Internal Upper Catchment Diversion System
UNSW	University of New South Wales
VCP	Vegetation Clearance Protocol
VIS	BioNet Vegetation Information System
WAD	Weak-Acid Dissociable
WM Act	*NSW Water Management Act 2000*
WMP	Water Management Plan
WRE	Waste Rock Emplacement

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1 Introduction

1.1 The Project

1.1.1 Background

Evolution Mining (Cowal) Pty Limited (Evolution) is the owner and operator of Cowal Gold Operations (CGO), an existing open pit and underground gold mine approximately 38 kilometres (km) north-east of West Wyalong, in the central west region of New South Wales (NSW).

CGO is located on the traditional lands of the Wiradjuri People and is immediately adjacent to the western foreshore of Lake Cowal, which is an ephemeral waterbody. The existing CGO mine is shown at a regional scale in Figure 1.1.

CGO was first approved in 1999, and open pit mining operations commenced in 2005. Underground mining operations were approved in 2021 and development works to enable underground mining are underway. Evolution is now seeking approval for further open pit mining operations at CGO through the Open Pit Continuation Project (hereafter the Project).

This Biodiversity Development Assessment Report (BDAR) forms part of the Environmental Impact Statement (EIS) for the Project. It documents the assessment methods, results, the initiatives built into the Project design to avoid and minimise biodiversity impacts, and the biodiversity credit obligation for residual impacts which cannot be avoided.

1.1.2 Project overview

The Project primarily seeks to continue the open pit operations by approximately 10 years to 2036 and extend the total mine life by approximately two years to 2042.

This will involve further development of the existing E42 Pit and the development of open pit mining in three new and adjacent orebodies, known as the 'E46', 'GR' and 'E41' pits. It is noted that the three new and adjacent ore bodies are within the existing mining lease (ML 1535) (Figure 1.2). No change to the approved ore processing rate of 9.8 Mt per annum is proposed.

Other than the changes to existing approved activities as set out above, all activities that are currently approved under the existing Ministerial development consents are intended to continue. The existing activities approved under the consents are described in Chapter 3 of the EIS.

A detailed description of the Project is contained in Chapter 4 of EIS. The Project comprises the following key components:

- The continued operation of activities as approved under DA14/98 and SSD 10367.
- Development of three new open pits (the 'E46', 'GR' and 'E41' pits) to the north and south of the existing open pit (E42), within the current approved mining lease.
- Extending the existing open pit to the east and south via a 'cutback' within the current approved mine lease.
- Extending open pit mining operations by approximately 10 years to 2036 and total mine life by approximately 2 years to 2042.
- Expansion of the integrated waste landform (IWL) to accommodate life of mine tailings.

- Extension of the lake protection bund (LPB) system to provide continued separation and mutual protection between Lake Cowal and the mine.
- Backfilling of one of the new open pits (E46) with waste rock and establishment of a new waste rock emplacement on the backfilled pit to minimise the additional area required for waste rock disposal.
- Expansion of the footprint of the existing Waste Rock Emplacement (WRE) areas to accommodate additional waste rock.
- Development of additional topsoil and subsoil stockpiles to accommodate materials from pre-stripping, with materials to be reused during progressive mine rehabilitation.
- Upgrades to the existing surface water drainage system, to assist with on-site water management and maximise on-site water conservation.
- Modification of internal site access and haul roads.
- Development of new water storages and relocation of some components of the surface water drainage system.
- Modification and relocation of some existing auxiliary mining infrastructure.

A conceptual Project layout is shown in Figure 1.2. The Project will not change existing ore processing rates or methods, tailings disposal methods, main site access, water supply sources or hours of operation. The Project will also retain the existing open pit mining workforce.

The Project will be constructed in stages as shown in Figure 1.3. Construction will occur across five stages divided annually between Year 1, 2, 5, 6 and 7. Commencing with construction of the northern portion of the LPB (Year 1), followed by the southern portion of the LPB in the following year (Year 2).

1.1.3 Site description and definitions

The study area, subject of extensive vegetation and targeted threatened species surveys to meet the requirements of the BDAR, is 1,745.81 hectares (ha). Of this, 1,030.68 ha will be directly disturbed by the Project (hereafter Additional disturbance area). The Project will also involve use of 1,713.64 ha of an existing and approved disturbance area (hereafter referred to as existing and approved disturbance area). Project elements referred to in this BDAR are described in Table 1.1 and displayed in Figure 1.4.

EMM also undertook surveys of biodiversity values outside the study area to inform the BDAR assessment and Biodiversity Offset Strategy (Chapter 10). These include vegetation mapping and plots across Evolution's broader land-holdings, a spatially extensive targeted survey for the Austral Pillwort (*Pilularia novae-hollandiae*), a threatened plant found within the Additional disturbance area. The potential for impacts to groundwater dependent ecosystems (GDE) was also assessed here, which involved groundwater modelling that extended outside of the study area. These additional areas considered within this BDAR, which extend outside of the study area, are displayed in Figure 1.5.

Table 1.1 Project elements referred to in this BDAR

Project elements	Definition
Existing and approved disturbance area	Areas that are disturbed and/or approved to be disturbed under the current development consents that apply to CGO. This area includes CGOs existing operations including open pit mine, underground mine, processing facility, IWL, waste rock emplacement areas, ore stockpiles and ancillary infrastructure.
Additional disturbance area	Areas that will be directly disturbed by the Project that are outside of the existing and approved disturbance area. This is the same as Subject Land, as defined by BAM (2020).
Indirect impact area	Areas subject to anticipated indirect impacts. Extent depends on the nature of indirect impact, such as noise, light and dust (see Section 8.4).
Study area[1]	Area which was surveyed for to consider ecological values within the Additional disturbance area and indirect impact area. This is the same as EIS Study area, as referred to by the EIS.
Broader Austral Pillwort survey area	Land outside of the Additional disturbance area surveyed for Austral Pillwort (*Pilularia novae-hollandiae*) to assist in the Serious and Irreversible Impact assessment.
Broader Evolution land-holding vegetation survey area	Land outside of the Additional disturbance area subject to vegetation mapping surveys undertaken by EMM as part of the Biodiversity Offset Strategy (see Chapter 10).
Groundwater study area	Groundwater model domain defined in the groundwater assessment (EMM 2023b).
Potential groundwater drawdown extent	Area where drawdown of groundwater is expected due to the Project, as determined by the groundwater assessment (EMM 2023b).
Buffer area	1,500 m buffer of the Additional disturbance area (for landscape assessment).

1. Equates to study area as defined in the EIS.

The study area is located partially within Lake Cowal, which is a large ephemeral inland wetland system in the Lachlan Catchment. Water levels in Lake Cowal are highly dynamic, fluxing from fully dry to fully inundated, with a maximum depth of approximately 4.2 m. Once fully inundated, it can take approximately 3 years to dry. Across the study period for this BDAR, the lake conditions extended across a filling cycle, with the lake being dry at the start of the study in 2020 and filling from 2021 to early 2022. Further information regarding the wetting and drying cycle of Lake Cowal and influence on survey efforts for this BDAR are provided in Section 3.1.2.

The Additional disturbance area includes land that will be directly disturbed by the Project and includes a 30 m buffer off the LPB (into Lake Cowal) to account for indirect impacts to vegetation during construction. Following construction, a new lake foreshore will be constructed within this 30 m buffer, which will extend from the toe of the LPB and improve habitat quality and connectivity for woodland and waterbirds, arboreal mammals, fishes and invertebrates. Details on the foreshore can be found in the rehabilitation management plan (EMM 2023d).

Most of the Additional disturbance area has been previously heavily disturbed due to historical agricultural activities. Limited cattle grazing occurred within the study area during the present study. Recent cropping of grain had occurred toward the south-east. Other land-uses include farm dams, sealed and un-sealed access tracks, stock fencing and farm sheds/infrastructure. When dry, cattle grazing and cropping also occurs within Lake Cowal.

Small naturally occurring ephemeral depressions, known as gilgais, are also dispersed across the floodplains adjacent to Lake Cowal. In the study area, gilgais typically range from 2 to 10 m in diameter. Further details regarding these ephemeral depressions, including microhabitats they may provide, are detailed in Section 3.1.2.

Existing upper catchment diversion channels, located to the north and south of the Existing and approved disturbance area, drain clean surface water east into Lake Cowal.

Groundcover across the study area is primarily native, with exotic vegetation interspersed as a matrix of varying densities, with exotic grasses representing the greatest weed cover. High Threat Weeds present are African Boxthorn (*Lycium ferocissimum*) and Bathurst Burr (*Xanthium spinosum*). Vegetation within Lake Cowal is typically a grassland/sedgeland wetland, with a patch of Lignum to the northeast of the Additional disturbance area. A narrow strip of woodland flanks the Lake Cowal foreshore to the north and south of the existing disturbance area. Dispersed small patches of remnant open woodland also occur from Lake Cowal heading west across the alluvial plain and floodplain toward low rises. The Additional disturbance area also includes areas where trees have been previously planted by Evolution.

Lot numbers that apply to the study area, their respective areas and zoning are shown in Table 1.2. Locations of these land parcels are displayed in Figure 3.2.

Table 1.2 Lots within Study area and Additional disturbance area

Lot	DP	Total lot area (ha)	Area of lot within study area (ha)	Area of lot within additional disturbance area (ha)	Zoning under the Bland Local Environmental Plan
7001	DP1029713	59.08	59.08	-	RU1 Primary Production
100	DP1059150	192.27	190.26	61.24	RU1 Primary Production
101	DP1059150	207.66	207.66	28.69	RU1 Primary Production
102	DP1059150	580.75	507.67	120.33	RU1 Primary Production
103	DP1059150	59.68	59.68	-	RU1 Primary Production
104	DP1059150	102.69	102.69	4.04	RU1 Primary Production
105	DP1059150	261.44	261.44	21.35	RU1 Primary Production
106	DP1059150	12.40	12.40	1.53	RU1 Primary Production
107	DP1059150	206.47	205.22	81.69	RU1 Primary Production
1	DP1060709	12.41	12.41	0.65	RU1 Primary Production
2	DP1060709	5.25	5.25	-	RU1 Primary Production
1	DP1060907	12.96	12.96	1.81	RU1 Primary Production
2	DP1060907	24.25	24.25	10.07	RU1 Primary Production
7303	DP1143731	95.74	95.74	49.58	RU1 Primary Production
7323	DP1157291	220.11	100.87	16.67	RU1 Primary Production
36	DP39733	565.01	48.56	19.95	RU1 Primary Production
37	DP39733	20.60	7.91	0.12	RU1 Primary Production
38	DP39733	400.00	174.38	93.68	RU1 Primary Production
1	DP530299	630.97	0.23	-	RU1 Primary Production

Table 1.2 Lots within Study area and Additional disturbance area

Lot	DP	Total lot area (ha)	Area of lot within study area (ha)	Area of lot within additional disturbance area (ha)	Zoning under the Bland Local Environmental Plan
2	DP530299	688.21	278.65	167.73	RU1 Primary Production
2	DP549106	198.05	84.93	31.20	RU1 Primary Production
2	DP753083	77.99	0.17	-	RU1 Primary Production
7	DP753083	257.95	257.95	11.73	RU1 Primary Production
22	DP753083	248.59	8.16	7.52	RU1 Primary Production
45	DP753083	66.69	66.69	-	RU1 Primary Production
64	DP753083	312.04	136.06	87.07	RU1 Primary Production
23	DP753097	495.43	137.88	19.02	RU1 Primary Production
24	DP753097	414.16	180.58	63.82	RU1 Primary Production
25	DP753097	411.43	163.41	118.52	RU1 Primary Production
56	DP753124	157.64	0.01	-	RU1 Primary Production

1.2 Consideration of BOS triggers

The Project was declared as a State Significant Development/State Significant Infrastructure Project under Part 4 Division 4.7/Part 5, Division 5.2 of the *Environmental Planning and Assessment Act 1979.* Assessment in accordance with the Biodiversity Offset Scheme (BOS) and Biodiversity Assessment Method is mandatory. Accordingly, this BDAR has been prepared.

1.3 Assessment requirements

The Department of Planning and Environment (DPE) Secretary's Environmental Assessment Requirements (SEARs) for the Project State Significant Development (SSD) 42917792 were issued on 10 June 2022. Input into the SEARs for the Project were issued by Biodiversity and Conservation Division (BCD) on 30 May 2022.

On 28 June 2022, the Project was determined to be a 'controlled action' under Section 75 of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as it is likely to have a significant impact on Matters of National Environmental Significance (MNES). As the Project will be assessed in accordance with the Amending agreement No. 1 to the Bilateral Agreement under Section 45 of the EPBC Act relating to environmental assessment between the Commonwealth and the NSW governments, BCD requires additional information relating to MNES to be included in the Project's EIS to appropriately undertake the assessment under this Agreement. These additional requirements were provided as Attachment 3 on letter provided by BCD on 11 July 2022.

Table 1.3 lists the biodiversity assessment requirements relevant to the Project, as required by DPE, BCD and DCCEEW, and describes where these are addressed in the BDAR.

Table 1.3 Environmental Assessment Requirements

Requirement	Section addressed
DPE: Secretary's Environmental Assessment Requirements (SEARs)	
An assessment of the likely biodiversity impacts of the development in accordance with the Biodiversity Assessment Method (BAM) and documented in a Biodiversity Development Assessment Report (BDAR).	Addressed within this BDAR.
A strategy to offset any residual impacts of the development in accordance with the offset rules under the Biodiversity Offsets Scheme, including details of any potential biodiversity stewardship sites for retiring biodiversity credits, including consideration of inter-relationship between aquatic biodiversity offsets for loss of Key Fish Habitat and offsets required under the BAM.	Addressed within the Project Biodiversity Offset Strategy (Chapter 10).
An aquatic ecological assessment that addresses all direct and indirect impacts of the development on Key Fish Habitat and associated flora and fauna including threatened species, populations, and communities during construction and operation.	Addressed within the Cowal Gold OPC Project Aquatic Ecology Assessment (EMM 2023a).
BCD: Recommendations for SEARs	
The EIS should fully describe the proposal, the existing environment, including threatened species habitat not associated with vegetation communities such as paddock trees, and impacts of the development including the location and extent of all proposed works that may impact on flooding and biodiversity.	The proposal is described in Section 1.1. The existing environment, including vegetation communities and paddock trees, is provided in Chapters 3 and 4. Impacts associated with the Project are detailed in Chapter 8.
The Scoping Report indicates that remnant vegetation will be impacted to the north and south of the current development with the expansion of the footprint of the existing waste rock expansion areas. In addition, it appears that past rehabilitation areas will be cleared to make way for this expansion. Consideration of how this can be compensated for may be appropriate.	Planted vegetation zones to be impacted in the Additional disturbance area will be offset in accordance with the BOS. These zones have been assessed as native vegetation in accordance with BAM. The landform will be rehabilitated with native vegetation following closure of the mine. This will include re-construction of the lake foreshore in front of the LPB. This foreshore will be constructed when Lake Cowal is dry, when such work is appropriate. Further details are provided in the rehabilitation strategy (EMM 2023d). Consideration of how the impacts can be compensated for is addressed within the Biodiversity Offset Strategy (Chapter 10).
The proposed additional topsoil and subsoil stockpile areas to the north west of the current approval will also likely impact native vegetation. This vegetation impact needs to be assessed and calculated.	Impacts to native vegetation associated with stockpiling have been firstly avoided and minimised where possible (see Section 8.2.1). Residual impacts to native vegetation are assessed in accordance with BAM and offset liability calculated in Section 8.10.
The expansion of the pit areas into the lake itself will require great care. In addition to direct and indirect impacts, the assessment of potential risks and mitigation measures that will be applied will be critical.	Direct and indirect impacts associated with expansion of the pit areas into Lake Cowal are assessed in Chapter 8. Mitigation measure recommended to reduce risks of direct, indirect and prescribed impacts are provided in Section 8.3. Adaptive management plans for uncertain impacts are provided in Section 8.3.2.

Table 1.3 Environmental Assessment Requirements

Requirement	Section addressed
Minimum requirements for the biodiversity assessment are listed in Appendix K of the Biodiversity Assessment Method (BAM). The Accredited Assessor preparing the Biodiversity Development Assessment Report (BDAR) is advised to follow the BDAR template. When the BDAR is submitted, we request that the BAM accredited assessor provides spatial data directly to BCD. While other digital data can be uploaded into the Biodiversity Offset and Agreement Management System (BOAMS), there is currently no function to upload zip or spatial files.	Minimum requirements as per Appendix K of the BAM were met, with the BDAR template structure followed as suggested. Spatial data to be provided directly as a package to BCD upon lodgement of the BDAR.
Given the proportion of land that has already been cleared in the surrounding region, the proponents must set out how impacts to biodiversity will be avoided and minimised.	Measures to avoid and minimise impacts of the Project on native vegetation through location and design are provided in Section 8.2.2. The Biodiversity Offset Strategy (Chapter 10) identifies lands proposed to be established as Stewardship sites. These sites would over time provide large areas of native vegetation, where possible consolidated into larger patches.
Regarding the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, the EIS should identify any relevant Matters of National Environmental Significance, and whether the proposal has been referred to the Australian Government or whether it is already determined to be a controlled action.	Relevant MNES are identified in Section 9.1. The Project has been designed as a controlled action as detailed in Section 2.1.1.
Attachment A.1. Biodiversity impacts related to the proposed development are to be assessed in accordance with Section 7.9 of the *Biodiversity Conservation Act 2016* using the Biodiversity Assessment Method (BAM) 2020 and documented in a Biodiversity Development Assessment Report (BDAR). The BDAR must include information in the form detailed in the *Biodiversity Conservation Act 2016* (s6.12), Biodiversity Conservation Regulation 2017 (s6.8) and the BAM, unless DPE determines that the proposed development is not likely to have any significant impact on biodiversity values.	This document satisfies the requirement of a BDAR.
Attachment A.2. The BDAR must document the application of the avoid, minimise and offset framework including assessing all direct, indirect, uncertain and prescribed impacts in accordance with the BAM.	Measures to avoid and minimise direct, indirect and prescribed impacts are provided in Section 8.2.1 and 8.2.2. Assessment of residual direct, indirect, uncertain and prescribed impacts is provided in Chapter 8. Section 8.3 also provides details of management and mitigation measures for indirect and prescribed impacts, whilst adaptive management plans for uncertain impacts are provided in Section 8.3.2.

Table 1.3 Environmental Assessment Requirements

Requirement	Section addressed
Attachment A 3. The BDAR must include details of the measures proposed to address the offset obligation as follows: a) The total number and classes of biodiversity credits required to be retired for the development/Project. b) The number and classes of like-for-like biodiversity credits proposed to be retired. c) The number and classes of biodiversity credits proposed to be retired in accordance with the variation rules. d) Any proposal to fund a biodiversity conservation action. e) Any proposal to make a payment to the Biodiversity Conservation Fund. If seeking approval to use the variation rules, the BDAR must contain details of the reasonable steps that have been taken to obtain requisite like-for-like biodiversity credits.	Measures 3a. and 3b. are provided in Section 8.10. The Biodiversity Offset Strategy (Chapter 10) provides a pathway for satisfying the offset requirements, including 3c. and 3e. At this stage, 3d. will not considered be pursued to satisfy any of the offset liability. Use of the variation rules may be sought, depending on the status of landholder negotiations prior to commencement of construction.
Attachment A4. The BDAR must be submitted with all digital spatial data associated with the survey and assessment as per Appendix K of the BAM.	Spatial data as per Appendix K of the BAM to be provided directly as a package to BCD upon lodgement of the BDAR.
Attachment A5. The BDAR must be prepared by a person accredited in accordance with the Accreditation Scheme for the Application of the Biodiversity Assessment Method Order 2017 under s6.10 of the Biodiversity Conservation Act 2016.	The BDAR was prepared by a BAM accredited assessor.
DCCEEW: Assessment requirements	
15. The EIS must address the matters outlined in Schedule 4 of the Environment Protection and Biodiversity Conservation Regulations 2000 and the matters outlined below in relation to the controlling provisions.	Information in Schedule 4 of Environment Protection and Biodiversity Conservation Regulations 2000 is provided in the overarching EIS document.
2. For each of the EPBC Act controlling provisions impacted by the proposed action, the EIS must provide: i. Survey results, including details of the scope, timing and methodology for studies or surveys used and how they are consistent with (or justification for divergence from) published Commonwealth guidelines and policy statements. For ecological communities, this includes any condition thresholds provided in the listing advice or approved conservation advice. ii. A description and quantification of habitat in the study area (including suitable breeding habitat, suitable foraging habitat, important populations and habitat critical for survival), with consideration of, and reference to, any relevant Commonwealth guidelines and policy statements including listing advices, conservation advices and recovery plans, threat abatement plans.	16i. See Sections 4.3.3, 5.3.3 and 5.3.4. Additional information regarding vegetation condition thresholds is provided in Section 9.1.2. 16ii. See Section 9.1.2.

Table 1.3 Environmental Assessment Requirements

Requirement	Section addressed
iii. Maps displaying the above information (specific to EPBC matters) overlaid with the proposed action. It is acceptable, where possible, to use the mapping and assessment of Plant Community Types (PCTs) and the species surveys prescribed by the BAM as the basis for identifying EPBC Act-listed species and communities. The EIS must clearly identify which PCTs are considered to align with habitat for the relevant EPBC Act-listed species or community, and provide individual maps for each species or community. iv. Description of the nature, geographic extent, magnitude, timing and duration of any likely direct, indirect and consequential impacts on any relevant EPBC Act-listed species and communities. It must clearly identify the location and quantify the extent of all impact areas to each relevant EPBC Act-listed species or community. v. Information on proposed avoidance and mitigation measures to deal with the impacts of the action, and a description of the predicted effectiveness and outcomes that the avoidance and mitigation measures will achieve. vi. Quantification of the offset liability for each species and community significantly impacted, and information on the proposed offset strategy, including discussion of the conservation benefit for each species and community, how offsets will be secured, and the timing of protection. It is a requirement that offsets directly contribute to the ongoing viability of the specific protected matter impacted by a proposed action i.e. 'like-for-like'. vii. Like-for-like includes protection of native vegetation that is the same ecological community or habitat being impacted (preferably in the same region where the impact occurs), or funding to provide a direct benefit to the matter being impacted e.g. threat abatement, breeding and propagation programs or other relevant conservation measures.	16iii. See Figure 4.3, Figure 9.1 and Figure 9.2. Table 4.17 details PCTs associated with threatened ecological communities. Table 9.4 details PCTs composing potential habitat of EPBC Act listed threatened and migratory species to be impacted. 16iv. See Chapter 8 and Section 9.1.2. 16v. See Sections 8.2 and 8.3. 16 vi. Offset liability for EPBC Act listed threatened species and community significantly impacted in Section 8.10. See Biodiversity Offset strategy (Chapter 10) for approach to offsetting impacts to EPBC Act listed migratory species not captured by the BAM. 16 vii. Like-for-like offset requirements for EPBC Act listed entities that are significantly impacted are applied within the Offset strategy provided in EMM (2023b).

1.4 Purpose of this report

The specific objectives of this assessment report (BDAR) are to:

- Describe biodiversity values of the study area.
- Assess the likelihood that threatened species and communities (threatened biodiversity) listed under relevant the *NSW Biodiversity Conservation Act 2016* (BC Act) and *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) could occur in the study area.
- Document the strategies implemented to avoid and/or minimise impacts of the Project on threatened biodiversity.
- Assess residual threatened biodiversity impacts, after avoidance and minimisation strategies have been implemented.

- Provide environmental safeguards to mitigate threatened biodiversity impacts during construction and operation.

1.5 Information sources

1.5.1 Publications and databases

To provide context for the Project, information about flora and fauna species, populations, communities and habitats from the locality (generally within 10 km) was obtained from the following databases:

- BioNet Atlas of NSW Wildlife for previous threatened species records (hereafter DPE BioNet 2023).
- BioNet Threatened Biodiversity Database Collection (hereafter DPE TBDC 2023).
- DCCEEW Protected Matters Search Tool (PMST) for Matters of National Environmental Significance (MNES) likely to occur within the study areas (DCCEEW 2023a).
- NSW Plant Community Types (PCTs), as held within the BioNet Vegetation Classification database (hereafter DPE BioNet Vis 2023).

1.5.2 Other relevant reports

This BDAR has been prepared with reference to other technical reports that were prepared as part of the Project. The other relevant reports referenced in this biodiversity assessment are listed below.

- Aquatic ecology assessment (EMM 2023a)
- Groundwater assessment (EMM 2023b)
- Noise impact assessment (EMM 2023c)
- Rehabilitation strategy (EMM 2023d)
- Surface water assessment (ATC Williams 2023)
- Traffic impact assessment (EMM 2023e)
- Visual impact assessment (EMM 2023f)
- Air quality and greenhouse gas assessment (EMM 2023g).

1.5.3 Spatial data

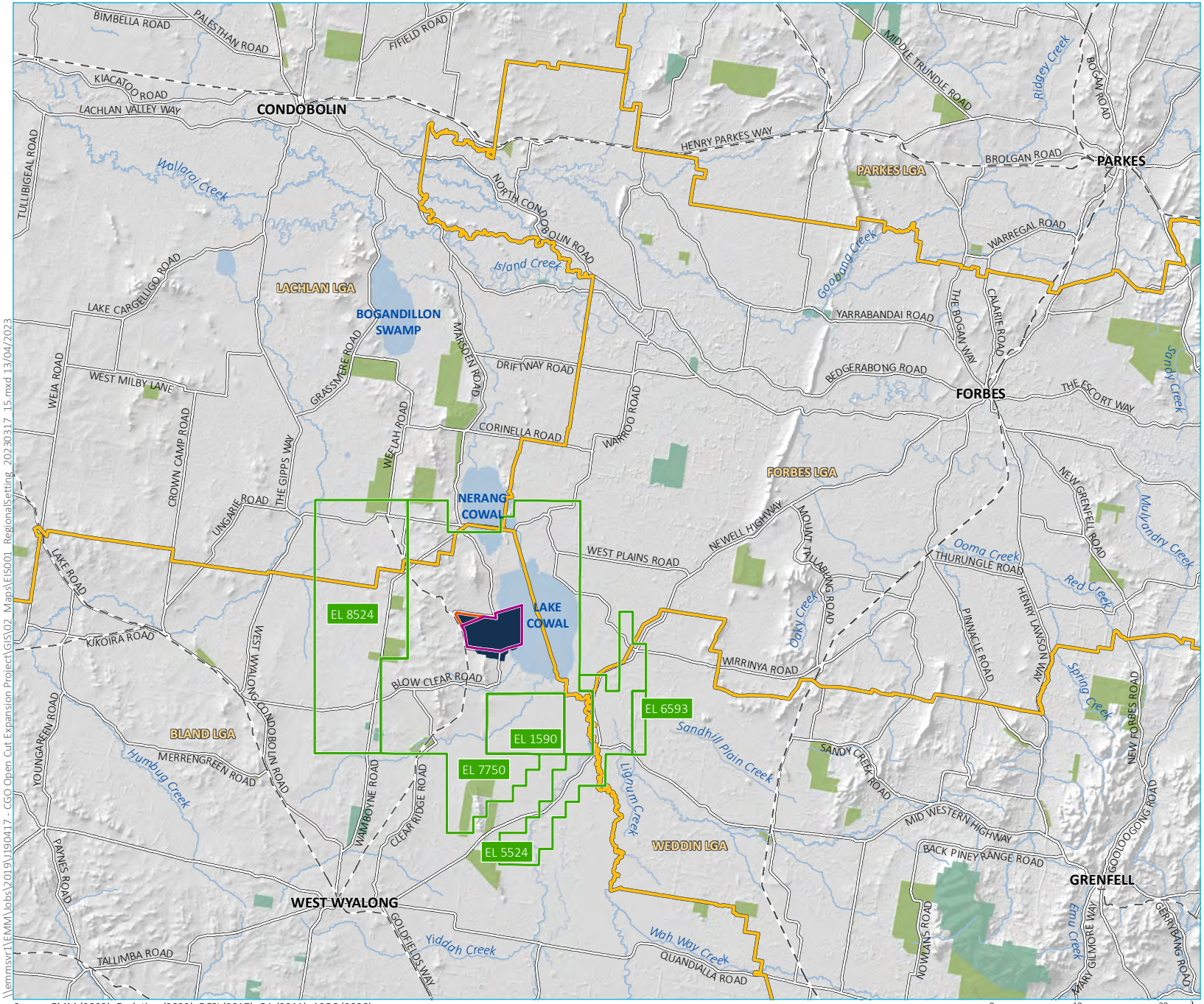
Spatial data encompassing the study area, including the Additional disturbance area, was obtained from Evolution. Base map data was obtained from Department of Finance, Services and Innovation (DFSI) NSW databases, with cadastral data obtained from DFSI digital cadastral database. Mapping for stream orders was obtained from DPI.

The following spatial datasets were utilised during the development of this report:

- Vegetation mapping undertaken by AMBS Ecology & Heritage (2018) for Cowal Gold Operations Processing Rate Modification (MOD 14).
- NSW State Vegetation Type Map (DPE 2022a).
- Mitchell Landscapes Version V3.1 (DPE 2016a).
- Interim Biogeographic Regionalisation of Australia (IBRA) Version 7 (DoEE 2017a).
- Directory of important wetlands (DCCEEW 2023b).
- NSW Wetlands (DPE 2022c).

Mapping undertaken during the site assessment was conducted using a hand-held GPS unit, mobile tablet computers running Collector for ArcGIS™ and Survey123 for ArcGIS™ and aerial photo interpretation. Accuracy is subject to accuracy of GPS devices, generally ± 5 m. Mapping has been produced using a Geographic Information System (GIS; ArcGIS 10.5).

Spatial data relevant to this BDAR was provided to the DPIE following lodgement of the BDAR.





KEY

- Project area
- Mining lease (ML1535)
- Mining lease (ML1791)
- Exploration licence (EL)
- Rail line
- Main road
- Named watercourse
- Named waterbody
- Local government area
- NPWS reserve
- State forest

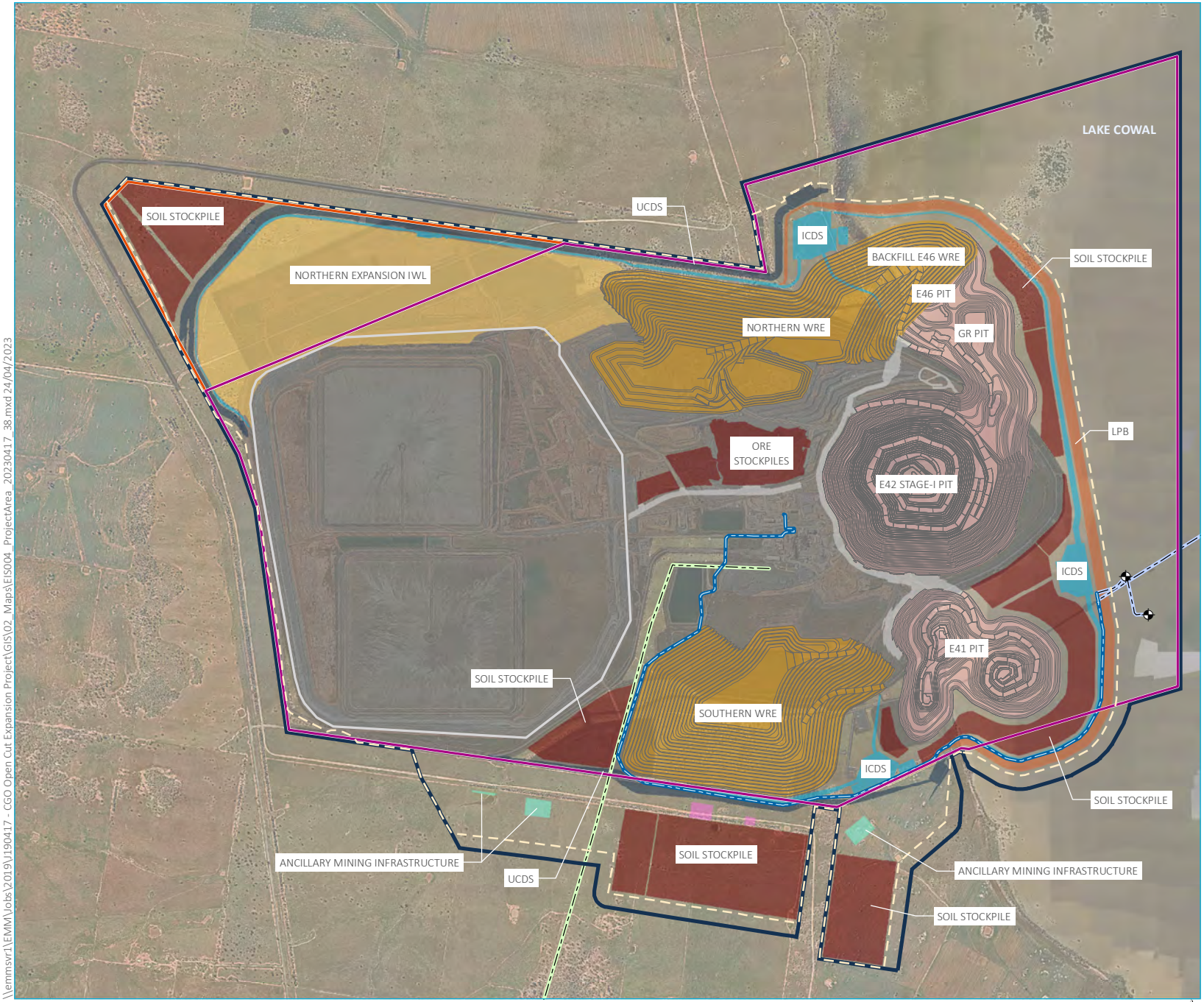
Source: EMM (2023); Evolution (2023); DFSI (2017); GA (2011); ASGC (2006)

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Regional context

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Biodiversity Development Assessment Report
Figure 1.1

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KEY

- Project area
- Additional disturbance area
- Approved disturbance area
- Approved IWL footprint
- Mining lease (ML1535) (offset for clarity)
- Mining lease (ML1791) (offset for clarity)
- Saline groundwater supply bore
- Water supply pipeline
- Electricity transmission line

Conceptual project infrastructure

- Open cut pit footprint
- Northern expansion IWL
- Waste rock emplacement (WRE)
- Lake protection bund (LPB)
- Stockpile
- Up catchment diversion system (UCDS)
- Internal Catchment Drainage System (ICDS)
- Ancillary mining infrastructure
- Magazine
- Road
- Water supply pipeline realignment

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Source: EMM (2023); Evolution (2023); DFSI (2017); Nearmap (2021)

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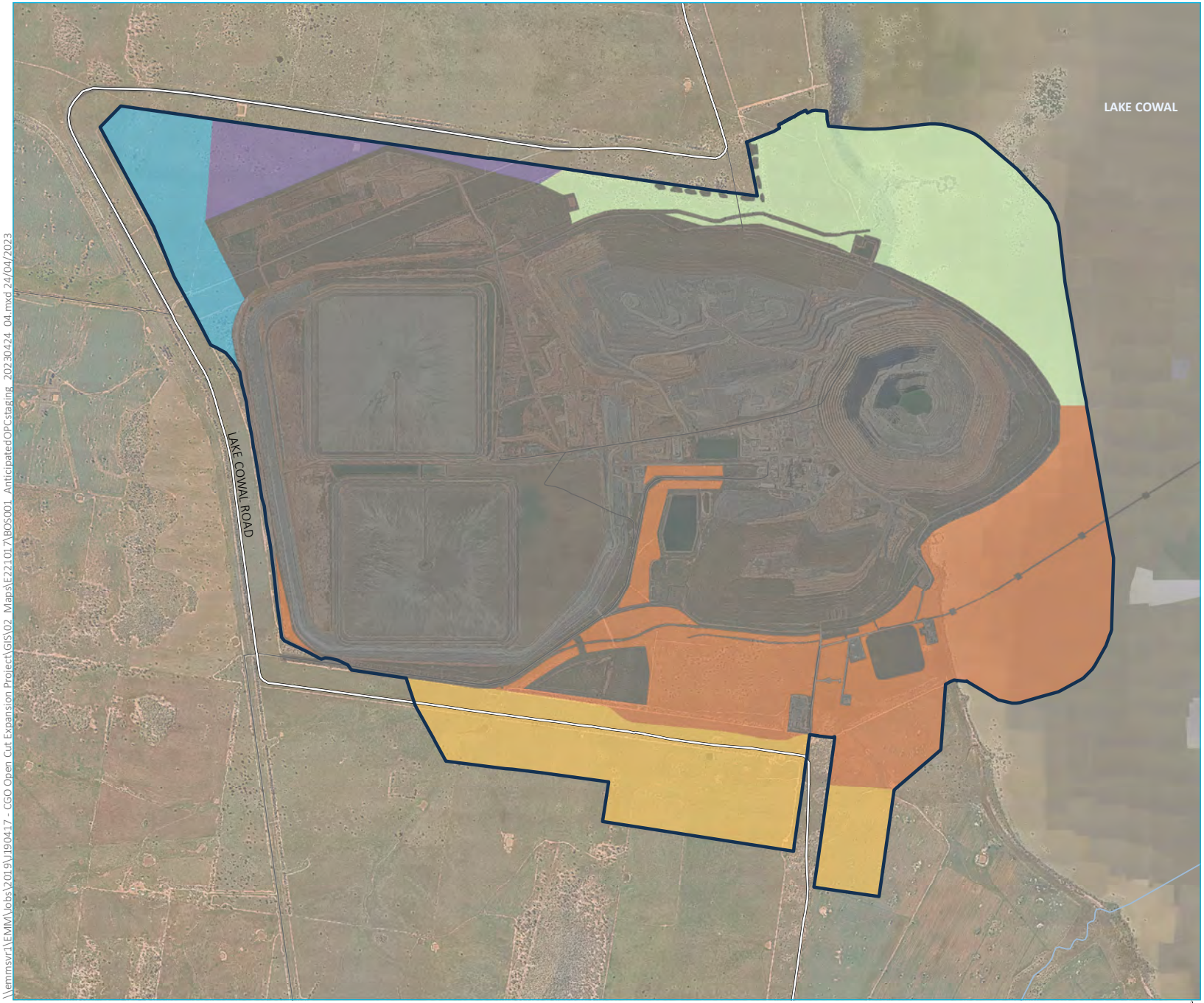
GDA 1994 MGA Zone 55

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Project overview

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Biodiversity Development Assessment Report
Figure 1.2

EMM creating opportunities



KEY

- Additional disturbance area
- Existing and approved disturbance area
- Major road
- Minor road
- Named watercourse

OPC staging

- July 2024
- July 2025
- July 2028
- July 2029
- July 2030

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Source: EMM (2023); Evolution (2023); Nearmap (2021); DFSI (2017)

0 1 2 km

GDA 1994 MGA Zone 55

N

Staging of the project

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Biodiversity Development Assessment Report
Figure 1.3

EMM creating opportunities



KEY

- Study area
- Additional disturbance area
- Existing and approved disturbance area
- Major road

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Source: EMM (2023); Evolution (2023); DFSI (2017); Nearmap (2021)

0 1 2 km

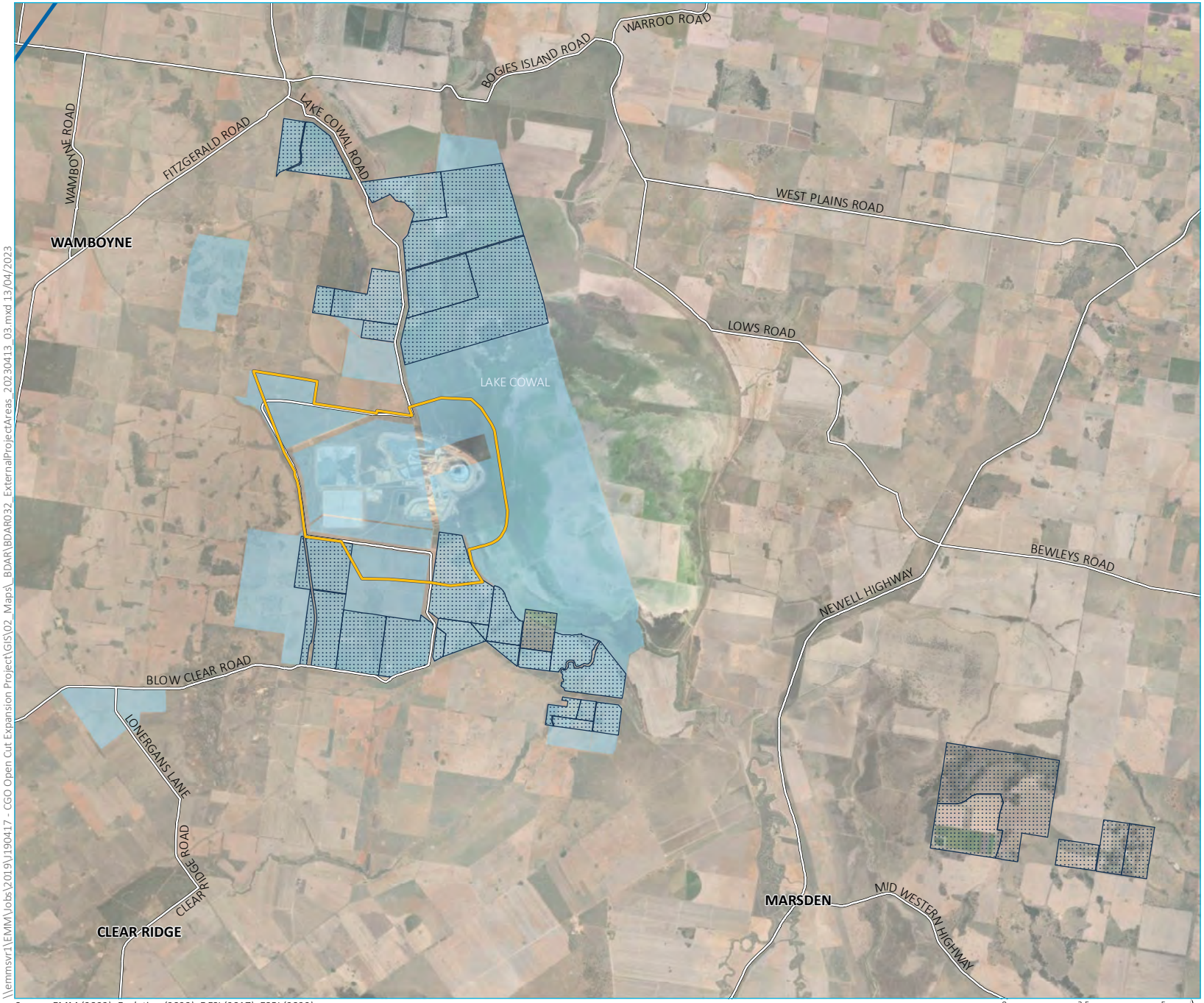
GDA 1994 MGA Zone 55

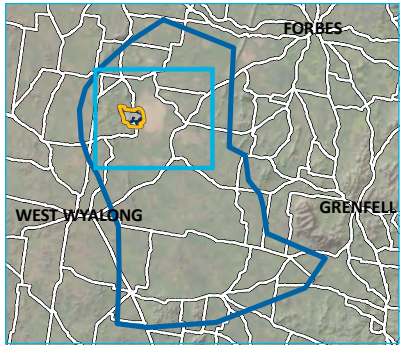
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Areas referred to in BDAR within mining lease

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Biodiversity Development Assessment Report
Figure 1.4

EMM creating opportunities





KEY

- Study area
- Groundwater study area
- Broader Austral Pillwort survey area
- Broader Evolution land-holding vegetation survey area
- Major Road

Areas referred to in BDAR outside mining lease

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Biodiversity Development Assessment Report
Figure 1.5

Source: EMM (2023); Evolution (2023); DFSI (2017); ESRI (2022)

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creating opportunities

2 Legislative context

This chapter provides a brief outline of the key biodiversity legislation and government policy considered in this assessment.

2.1 Commonwealth

2.1.1 Environmental Protection and Biodiversity Conservation Act 1999

The *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities, heritage places and water resources which are defined as Matters of National Environmental Significance (MNES) under the EPBC Act. These are:

- world heritage properties
- places listed on the National Heritage Register
- Ramsar wetlands of international significance
- threatened flora and fauna species and ecological communities
- migratory species
- Commonwealth marine areas
- the Great Barrier Reef Marine Park
- nuclear actions (including uranium mining)
- water resources, in relation to coal seam gas or large coal mining development.

Under the EPBC Act, an action that may have a significant impact on a MNES is deemed to be a 'controlled action' and can only proceed with the approval of the Commonwealth Minister for the Environment. An action that may potentially have a significant impact on a MNES is to be referred to DAWE for determination as to whether or not it is a controlled action. If deemed a controlled action the Project is assessed under the EPBC Act, and a decision made as to whether or not to grant approval.

The Project was referred to the Commonwealth Minister for the Environment and determined to be a controlled action on 11 July 2022 (EPBC 2022/9223). The Project will be assessed in accordance with the Amending agreement No. 1 to the Bilateral Agreement under Section 45 of the EPBC Act relating to environmental assessment between the Commonwealth and the NSW governments. The Secretary determined that the following controlling provisions apply:

- listed threatened species and communities (Sections 18 and 18A of the EPBC Act)
- listed migratory species (Sections 20 and 20A of the EPBC Act).

An assessment of the Project against the EPBC Act is provided in Section 9.1.

2.2 State

2.2.1 Environmental Planning and Assessment Act 1979

The NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) was enacted to encourage the consideration and management of impacts of proposed development or land-use changes on the environment and the community. The EP&A Act is administered by the NSW Department of Planning, Industry and Environment (DPIE).

The EP&A Act provides the overarching structure for planning in NSW; however, is supported by other statutory environmental planning instruments (EPIs) including State Environmental Planning Policies (SEPPs). EPIs relevant to the natural environment are outlined further below.

i State Environmental Planning Policy (State and Regional Development) 2011

On 10 June 2022, the Project was declared to be State Significant Development (SSD 42917792) by the NSW Minister for Planning under the provisions of the EP&A Act and is defined in clause 5 of Schedule 1 of the SRD SEPP.

ii State Environmental Planning Policy (Biodiversity and Conservation) 2021

State Environmental Planning Policy (Biodiversity and Conservation) 2021 (hereafter referred to as the Biodiversity and Conservation SEPP) aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for Koalas to ensure a permanent free-living population over their present range and reverse the current trend of Koala population decline. The Biodiversity and Conservation SEPP adopts two Chapters of relevance to Koala management, with Chapter 3 – *Koala Habitat Protection 2020*, and Chapter 4 – *Koala Habitat Protection 2021*.

In nine metropolitan Sydney local government areas (Blue Mountains, Campbelltown, Hawkesbury, Ku-Ring-Gai, Liverpool, Northern Beaches, Hornsby, Wollondilly) and the Central Coast LGA Chapter 4 of the Biodiversity and Conservation SEPP applies to all land use zones. Outside of these areas Chapter 3 continues to apply to all land zoned RU1, RU2, and RU3.

The Project is not a development application and does not require approval from Council, and thus consideration of the Biodiversity and Conservation SEPP is not triggered. Nonetheless, consideration has been given to the potential occurrence and impacts upon the koala within this report.

2.3 Biodiversity Conservation Act 2016

The Biodiversity Conservation Act 2016 (BC Act) is the legislation responsible for the conservation of biodiversity in NSW through the protection of threatened flora and fauna species, populations and ecological communities. The BC Act, together with the Biodiversity Conservation Regulation 2017 (BC Regulation), established the Biodiversity Offsets Scheme (BOS).

The BOS includes establishment of the Biodiversity Assessment Method (the BAM, DPIE 2020a) for use by accredited persons in biodiversity assessment under the scheme. The purpose of the BAM is to assess the impact of actions on threatened species and threatened ecological communities, and their habitats and determine offset requirements. For major Projects, use of the BAM is mandatory, unless a BDAR waiver is granted.

The BAM sets out the requirements for a repeatable and transparent assessment of terrestrial biodiversity values on land in order to:

- Identify the biodiversity values on land subject to proposed development area.

- Determine the impacts of a proposed development, following all measures to avoid, minimise and mitigate impacts.
- Quantify and describe the biodiversity credits required to offset the residual impacts of proposed development on biodiversity values.

As an SSD, assessment of the likely biodiversity impact of the development needs to be in accordance with Section 7.9 of the BC Act and the BAM. Section 7.9 of the BC Act requires that all SSD applications are to be accompanied by a BDAR, unless the Planning Agency Head and the Environment Agency Head determine that the proposed development is not likely to have any significant impact on biodiversity values. No such determination has been made for the Project and, accordingly, a BDAR is required for the Project.

This BDAR has been undertaken in accordance with the requirements of the BAM (2020).

2.4 Fisheries Management Act 1994

The *Fisheries Management Act 1994* (FM Act) contains provisions for the conservation of fish stocks, key fish habitat, biodiversity, threatened species, populations and ecological communities. It regulates the conservation of fish, vegetation and some aquatic macroinvertebrates and the development and sharing of the fishery resources of NSW for present and future generations. The FM Act lists threatened species, populations and ecological communities, key threatening processes (KTPs) and declared critical habitat. Assessment guidelines to determine whether a significant impact is expected are detailed in Sections 220ZZ and 220ZZA of the FM Act.

Another objective of the FM Act is to conserve key fish habitat (KFH). These are defined as aquatic habitats that are important to the sustainability of recreational and commercial fishing industries, the maintenance of fish populations generally and the survival and recovery of threatened aquatic species. KFH is defined in Sections 3.2.1 and 3.2.2 of the *Policy and Guidelines for Fish Conservation and Management* (DPI 2013).

The impact of the Project on threatened aquatic species, populations, communities, habitats and KFH have been assessed separately and are presented in the aquatic ecology assessment (EMM 2023a).

2.5 Biosecurity Act 2015

The NSW *Biosecurity Act 2015* has superseded *the Noxious Weeds Act 1993*, which has now been repealed.

The primary objective of the Biosecurity Act is to provide a framework for the prevention, elimination and minimisation of biosecurity risks posed by biosecurity matter, dealing with biosecurity matter, carriers and potential carriers, and other activities that involve biosecurity matter, carriers or potential carriers.

The Biosecurity Act stipulates management arrangements for weed biosecurity risks in NSW, with the aim to prevent, eliminate and minimise risks. Management arrangements include:

- any land managers and users of land have a responsibility for managing weed biosecurity risks that they know about or could reasonably be expected to know about
- applies to all land within NSW and all waters within the limits of the State
- local strategic weed management plans will provide guidance on the outcomes expected to discharge duty for the weeds in that plan.

The Riverina Regional Strategic Weed Management Plan 2017–2022 (LLS 2017) applies to the study area. A list of priority weeds for Riverina Local Land Services Region is provided in Appendix 1 of that plan.

The provisions of the Biosecurity Act are discussed further in Section 9.3.

2.6 Water Management Act 2000

Division 6 of the *Water Management Act 2000* (WM Act) requires consideration of controlled activities (i.e. activities within 40 m of riparian land) and aquifer interference activities. The NSW Aquifer Interference Policy (DPIE 2012) requires an assessment of potential impacts on groundwater users, including groundwater dependent ecosystems. Impacts on riparian land are considered in Section 9.4 of this report.

Part A

Stage 1 – Biodiversity assessment

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3 Landscape features

3.1 Landscape features

The landscape features described in the following sections are shown on Figure 3.1 and Figure 3.2.

3.1.1 Bioregions and landscapes

The Project occurs across one IBRA region and one subregion (Figure 3.1):

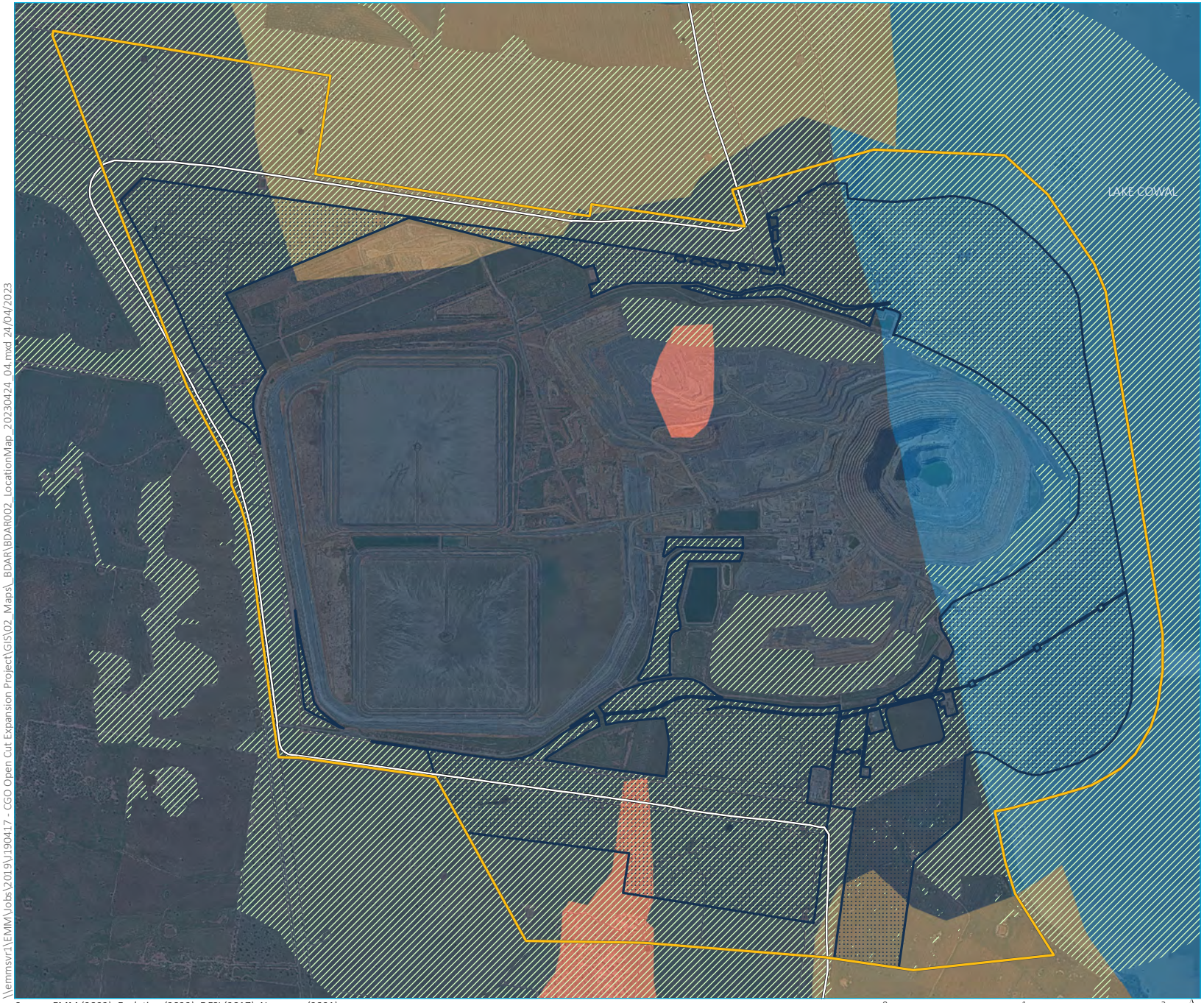
- NSW South Western Slopes IBRA region and Lower Slopes IBRA subregion.

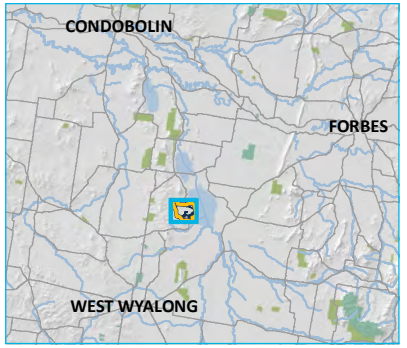
As the entire buffer area is located in the NSW South Western Slopes IBRA region and Lower Slopes subregion, these were the region and subregion used in this current assessment.

The buffer area occurs across four BioNet NSW Landscapes (formerly Mitchell Landscapes, Figure 3.1):

- Cowal Lakes, Swamps and Lunettes (713.93 ha)
- Ardletham Hills (2,438.45 ha)
- Bimbi Plains (217.90 ha)
- Manna Hills and Footslopes (71.62 ha).

As the majority of the Additional disturbance is located in the Ardletham Hills BioNet NSW Landscape, this was the landscape used in this assessment.





KEY

- Study area
- Additional disturbance area
- Native vegetation cover
- Major road

BioNet NSW landscapes
(formerly Mitchell landscapes)

- Ardlethan hills
- Bimbi plains
- Cowal lakes, swamps and lunettes
- Manna hills and footslopes

INSET KEY

- Major road
- Named watercourse
- Named waterbody
- NPWS reserve
- State forest

The entirety of the map extent is located within the NSW South Western Slopes IBRA region and Lower Slopes IBRA subregion

Source: EMM (2023); Evolution (2023); DFSI (2017); Nearmap (2021)

0 1 2 km

GDA 1994 MGA Zone 55

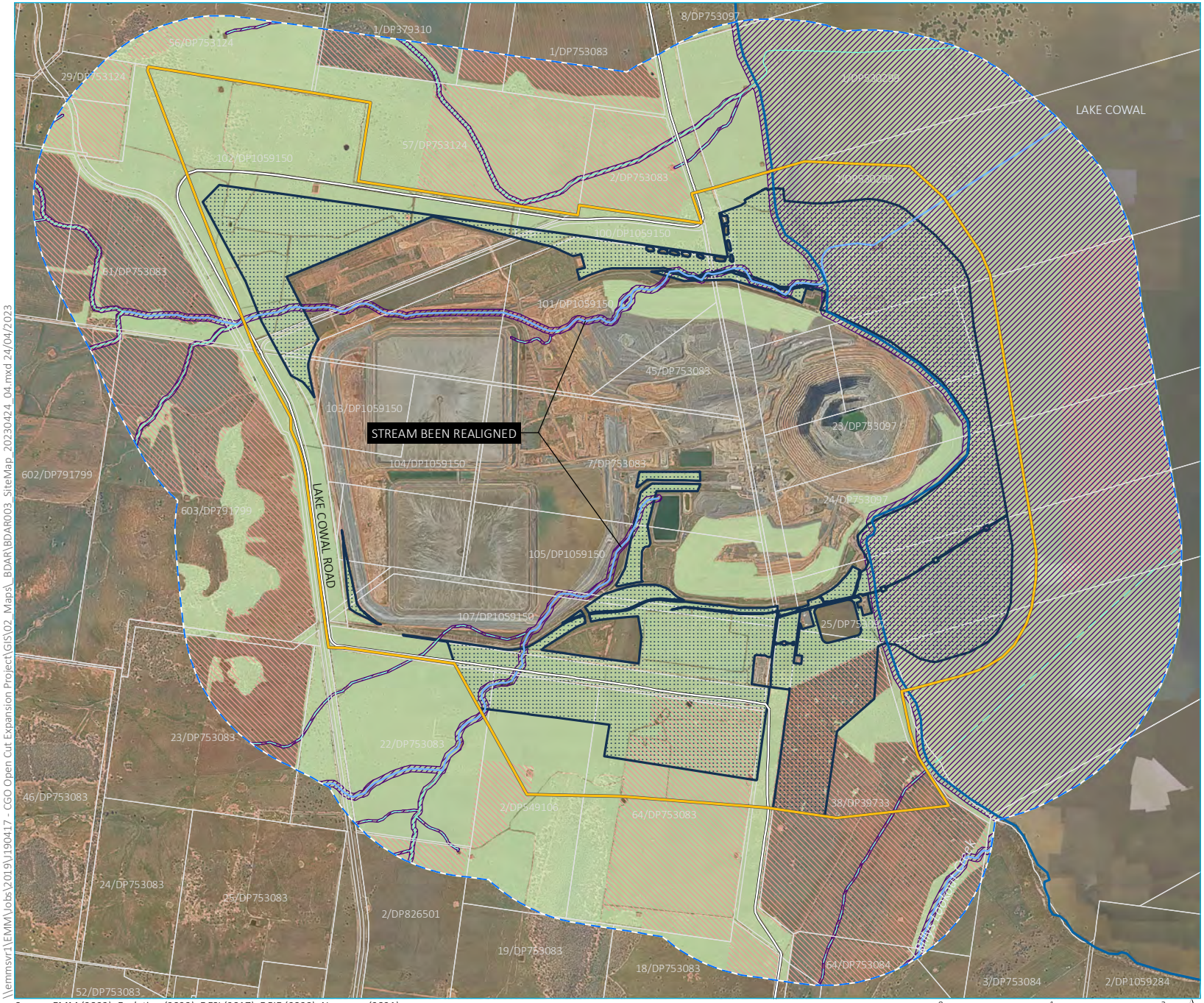
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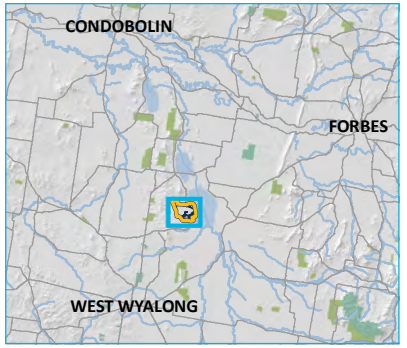
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Location map

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Biodiversity Development Assessment Report
Figure 3.1

EMM
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KEY

- Study area
- Additional disturbance area
- Impact area 1500 m buffer
- Native vegetation cover
- Cropping land (ALUM 2023)
- Riparian buffer
- Wetland (Lake Cowal)
- Major road
- Cadastral boundary

Strahler stream order

- 1st
- 2nd
- 3rd

INSET KEY

- Major road
- Named watercourse
- Named waterbody
- NPWS reserve
- State forest

The entirety of the map extent is located within the NSW South Western Slopes IBRA region and Lower Slopes IBRA subregion

Site map

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Biodiversity Development Assessment Report
Figure 3.2

Source: EMM (2023); Evolution (2023); DFSI (2017); DPIE (2023); Nearmap (2021)

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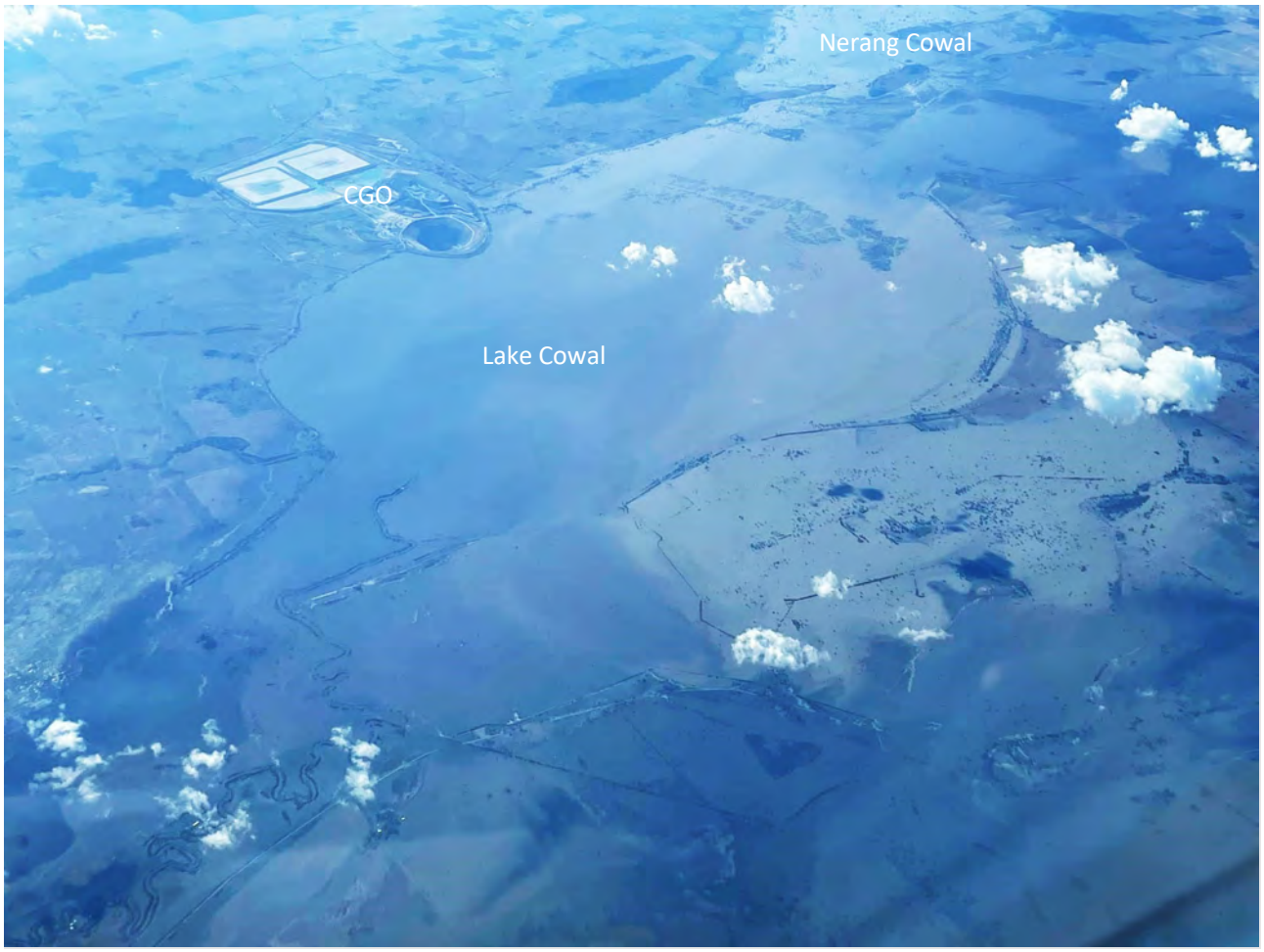
creating opportunities

3.1.2 Rivers, streams, estuaries and wetlands

The study area is located within the Lachlan River catchment. The Lachlan River catchment covers approximately 90,000 square kilometres of southern NSW. It begins in the Great Dividing Range near Gunning and flows 1,400 km across western NSW to its junction with the Murrumbidgee River near Oxley (Green et al. 2011).

The most significant interaction of the Project with a waterway occurs at Lake Cowal. This lake is the largest natural inland lake in New South Wales. It is an ephemeral lake with water levels rising and falling depending on rainfall and flows received. There can be long periods where Lake Cowal does not contain water (Figure 3.3).

Wetlands associated with Lake Cowal are included in the Directory of Important Wetlands in Australia (DIWA; DCCEEW 2023b). Lake Cowal fills naturally from the Lachlan River in times of high flows. When full, it can cover over approximately 16,150 ha, and have a maximum depth of 4.2 m (DECCEEW 2023b). When fully flooded, Lake Cowal can connect with nearby floodplain wetland Nerang Cowal (to the north of Lake Cowal), leading to an overall sized wetland of approximately 20,500 ha (DCCEEW 2023b; Photograph 3.1). Based on a reconstruction of historic water levels at Lake Cowal, Lake Cowal has been fully inundated on approximately 17 occasions since 1883, with flooding occurring approximately every eight years on average (Figure 3.3). DCCEEW (2023b) states that Lake Cowal is flooded approximately 50% of the time. Once flooded fully, it retains water for up to three years (Green et al. 2011). When dry, the lakebed is primarily used for cropping and grazing by local landowners. A description of the water levels in Lake Cowal across the surveys undertaken for this BDAR are provided below. Lake Cowal was fully inundated in 2022 (see Section 3.1.2i).



Photograph 3.1 Lake Cowal fully inundated with connection to Lake Nerang during November 2022

Note: the existing CGO site in the top left corner.

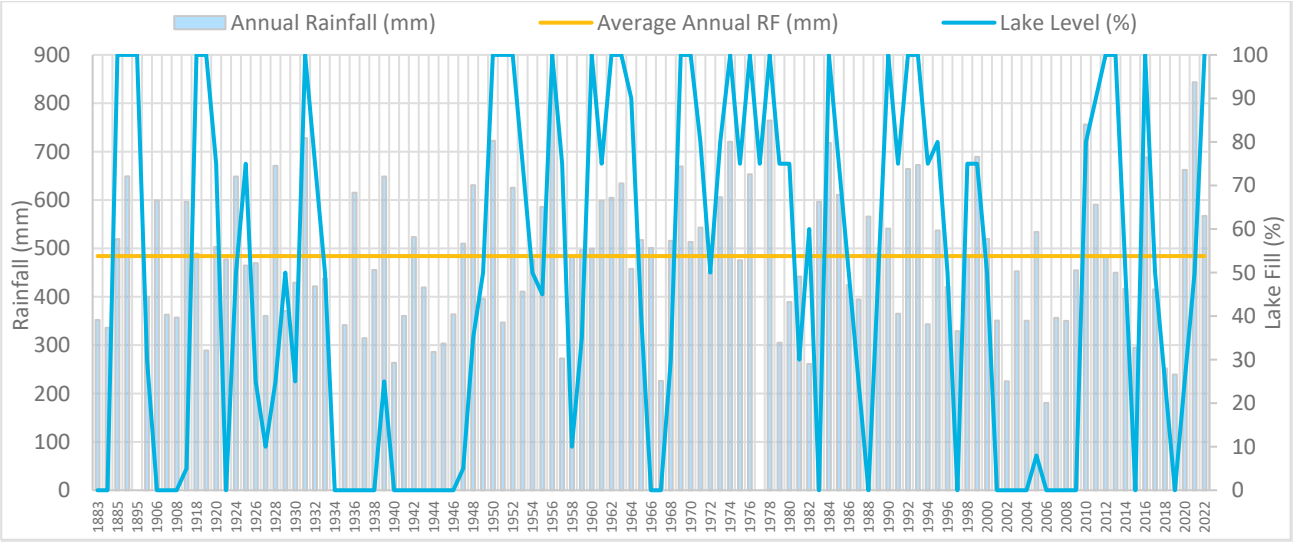


Figure 3.3 Reconstruction of long-term water levels in Lake Cowal

Source: pers. comm. Evolution 2023

Named tributaries that drain into Lake Cowal within the buffer area are Billys Lookout Creek (1st to 3rd order) and Sandy Creek (1st to 3rd order) (Figure 3.1). Several unnamed 1st to 3rd order tributaries within the buffer area also flow into Lake Cowal. Locations of water bodies and their associated riparian buffers (as per BAM 2020) are displayed in Figure 3.1.

Other notable nearby waterbodies include the nationally important Bogandillon wetland, located approximately 30 km northwest of Lake Cowal. Additional floodplain wetlands within 30 km of Lake Cowal, as recognised by the NSW Wetlands layer, include Gum Swamp (~5 km southeast of Lake Cowal), Round Swamp (~20 km northwest of Lake Cowal), Bundaburrah Cowal (~24 km northeast of Lake Cowal), Ooma Creek (~27 km east of Lake Cowal), Thurumbidgee Lagoon (~22 km northeast of Lake Cowal) and several other floodplain wetlands (DPE 2022c).

Within the study area, micro-relief afforded by gilgai depressions capture water periodically to produce small ephemeral wetland habitats. These gilgai are formed over time through the expansion of clay soils. These are not a river, stream, estuary or wetland, but are noted due to providing microhabitat relevant to some biodiversity.

In the study area, gilgai typically range from 2 to 10 m in diameter, but some gilgais were observed up to approximately 30 m in diameter. When full, these gilgai can range from shallow (i.e. <10 cm) to relatively deep (e.g. 1–2 m). Following heavy rains, the rate of drying out depends upon the size of the water body and evapotranspiration. For instance, once rains subsided in late 2022, shallow gilgais dried within 1–2 weeks, with deeper gilgais holding water for several months. These gilgais occur in Belah and Weeping Myall woodland areas within the study area, across the alluvial plain inland from the foreshore Lake Cowal. Examples of gilgais functioning as small wetlands following rainfall over 2021–2022 of varying depths within the study area are provided in Photograph 3.2 to Photograph 3.4. The potential habitat provided by these microhabitats is explored further in Chapter 5.



Photograph 3.2 Shallow gilgai (i.e. <10 cm) following heavy rains (November 2022)



Photograph 3.3 Medium depth gilgai (i.e.<50 cm) following heavy rains (November 2022)



Photograph 3.4 Deep gilgai (i.e.>50 cm) following heavy rains (November 2022)

i Lake Cowal water levels across study period

Over the past decade, Lake Cowal has filled and emptied on three occasions. Typically, the drying period occurs over approximately a 3 year period. Across the survey period for the BDAR, Lake Cowal was mostly dry from commencement of surveys in November 2019 through 2020. Following consistent rainfall associated with a La Nina El Niño–Southern Oscillation (ENSO) event, Lake Cowal filled into 2021 through to late 2022. Surveys undertaken for the BDAR concluded in February 2023. Lake levels in early 2023 were the greatest over the past decade (and potentially longer).

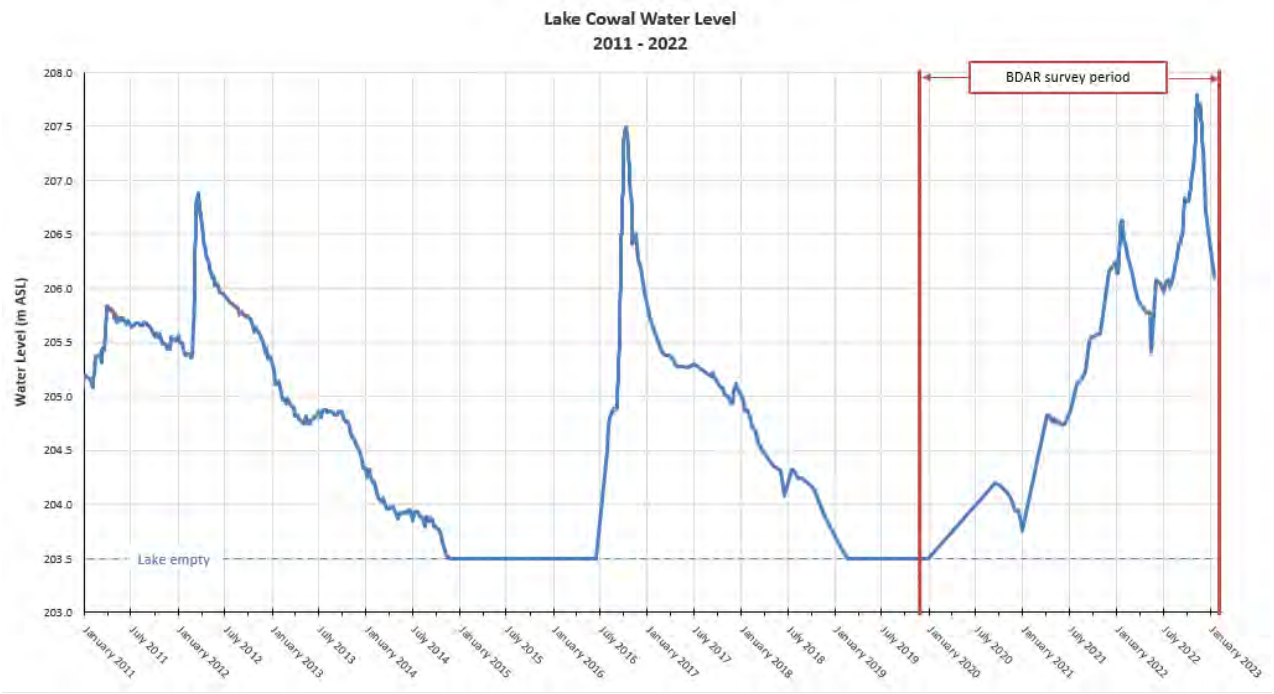


Figure 3.4 Lake Cowal water level BDAR survey period

Source: pers. comm. Evolution 2023

3.1.3 Connectivity

Woodland vegetation within the study area is highly fragmented, owing to extensive clearing by past agricultural activities. Consequently, remnant woodland often occurs in small, isolated patches, surrounded by a matrix of scattered trees and derived native grassland disturbed by past and ongoing agriculture. Such fractured habitat is likely to limit movements of many arboreal mammals, with limited vegetated extending through the study area to support their movement. The only apparent connective habitat for arboreal mammals is located along the Lake Cowal foreshore, where a narrow and fragmented strip of remnant vegetation that extends south from the study area to other narrow extents of riparian vegetation associated with the southern shoreline of Lake Cowal, Sandy and Bland Creek (Figure 3.2). Nevertheless, although there are varying distances between treed nodes throughout the study area, the distances between patches are not so great that they should create barriers to movement of woodland birds.

Native vegetation derived grasslands, which dominate the vegetation at the site, are largely connected throughout the study area, which may support the movement of ground-dwelling mammals, birds, reptiles and frogs across the site. Gilgai depressions which are common across the alluvial plains within the study area, also provide ephemeral aquatic habitats that may assist movement of frogs. However, for movements of larger ground-dwelling fauna including macropods and emus, stock fencing provides a hard barrier along the mining lease boundary. Lake Cowal Road also extends toward the perimeter of the study area but does not provide a significant barrier to movement of ground-dwelling fauna as it is narrow (i.e. road corridor width is typically 5–10 m with no associated fencing) and infrequently used by vehicles.

Although Lake Cowal is not considered a flyway network site within the East Asian – Australasian Flyway (EAAF) for migratory shorebirds (DoEE 2017b), Lake Cowal is regularly visited by several migratory shorebird species (see Section 1.1.1). As such, Lake Cowal may, at least during wetter years, provide a node to aid movement of some migratory bird species heading to and from shorebird habitat within the EAAF. Figure 3.5 shows proximity of Lake Cowal to the 25 important EAAF sites within Australia (EAAFP 2023).

3.1.4 Areas of geological significance

There are no karst, caves, crevices, cliffs, rocks or other features of geological within the buffer area.

3.1.5 Areas of outstanding biodiversity value

There are no areas of outstanding biodiversity within the buffer area.

3.2 Assessment of site context

Vegetation mapping across the Project application area and locality identified a range of vegetation communities. Sources of data used to inform this assessment included the State Vegetation Type Mapping (DPE 2022b), Nearmap™ Imagery and vegetation mapping undertaken by EMM within Evolution's landholdings. The extent of native vegetation cover based on these data sources is shown in Figure 3.2.

A 1,500 m buffer was placed around the Additional disturbance area, consistent with the requirements of the BAM (DPIE 2020a). The area of native vegetation within the buffer and the percent native vegetation was then calculated. Land mapped in Australian Land Use and Management Classification (ALUM; DPIE 2017) as cropping land was removed from the calculation of the native vegetation buffer.

Vegetation proximal to the study area is highly fragmented, with native vegetation often occurring in isolated patches surrounded by a matrix of agricultural land. Native vegetation cover for the buffer area is provided in Table 3.1.

Table 3.1 Percentage of native vegetation cover by IBRA subregion

IBRA subregion	Native vegetation in buffer area (ha)	Buffer area (ha)	Approximate percentage of native vegetation in buffer area
Lower Slopes	4,296.04	6,814.93	63.04%

1. As per BAM (2020), native vegetation includes native woody and non-woody vegetation, including DNG.

2. Rehabilitation in the existing and approved footprint was included in mapping of native vegetation in the buffer area.





KEY

- Australian EAAFP site
- Lake Cowal
- East Asian - Australasian Flyway (inset)

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Source: EMM (2023); EAAFP (2023); ESRI (2023)

GCS WGS 1984

N

East Asian – Australasian Flyway network sites within Australia

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Biodiversity Development Assessment Report
Figure 3.5

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4 Native vegetation

4.1 Background review

Prior to and during vegetation mapping, EMM consulted the following datasets, including several vegetation mapping reports for Cowal Gold Operations (CGO). Information sources used to inform vegetation mapping included Resource Strategies (1998); Resource Strategies (2013), AMBS Ecology and Heritage (2018), Resource Strategies (2018), DPE (2022b) and DPE BioNet Vis (2023).

To inform vegetation mapping, EMM also drew upon vegetation mapping across Evolution's broader land-holdings (Figure 1.5). Vegetation community type and extent within these land-holdings was undertaken to inform the Project Biodiversity Offset Strategy (Chapter 10). This broader survey effort also included vegetation mapping and BAM plots undertaken outside of the mining-lease to establish Biodiversity Stewardship Areas to partially satisfy the Evolution's MOD 14 offset liability.

4.2 Methods

4.2.1 Detailed vegetation mapping and habitat assessment

The type, extent and condition of vegetation communities were mapped on foot and by vehicle across the study area on 4 to 8 November 2019; 19 to 28 May 2020; 7 to 12 August 2020; 26 to 28 April 2021; and 19 to 25 April 2022. This assessment included detailed vegetation mapping and habitat assessments. PCTs were identified and stratified into vegetation zones based on broad condition state using the definitions in Table 4.1.

Where there was some uncertainty about correct PCT alignment, or to justify PCT alignment, a series of rapid vegetation assessments (RVAs) were undertaken, with the three dominant species in the overstorey, midstorey and groundcover recorded. In total, 23 RVAs were undertaken. Vegetation was mapped in the field using GPS-enabled tablet computers using Collector for ArcGIS™.

Areas of derived native grassland (DNG) were difficult to assign to PCTs and are discussed below.

Table 4.1 Definitions used in delineation of vegetation zones

Condition class	Description
High	Largely intact with all strata present and minimal disturbance.
Medium	Some elements or stratum missing or immature, but minimal disturbance.
Regenerating	Regeneration of woody vegetation (i.e. shrubs and/or trees) is occurring following disturbance by human activities, such as past clearing for agriculture.
Planted	Vegetation planted by Evolution. This planted vegetation was firstly assessed against the Streamlined assessment module – Planted native vegetation (Appendix D of BAM; DPIE 2020; see Section 4.3.3). Since the planted vegetation occurs within an area that contains a mosaic of planted and remnant native vegetation and which can be reasonably assigned to a PCT known to occur in the same IBRA subregion as the Project, the planted native vegetation was allocated to the best-fit PCT and the BAM (2020) was applied here.
Derived native grassland (DNG)	Tree stratum and shrub stratum missing. Native vegetation restricted to groundcover.
Poor	Tree stratum present, but understorey vegetation degraded due to weeds or other major disturbance.
Cropped land	Land that has been historically cleared (i.e. pre-1990) and regularly used for cycles of planting, cultivation and harvesting of grains and/or lucerne hay.

Table 4.1 Definitions used in delineation of vegetation zones

Condition class	Description
Cleared	Cleared of native vegetation by human activities, including existing roads and unsealed access tracks, cleared and highly disturbed land, particularly associated with past mining and agricultural activities.
Exotic grassland	A small patch of grass at residence to south of the Additional disturbance area. This grass was primarily exotic, with little native groundcover.
Dam	Constructed farm dams. Stored water is used for agricultural purposes.

i Assigning PCTs to derived native grassland areas

To assist with allocation of these areas to PCTs, landscape position, topography, soils, drainage elements, proximity of remnant woodland and indications of past canopy using scattered trees and regenerating canopy species were also noted.

Due to the challenge of allocating DNG to PCTs across such a naturally complex mosaic of woodlands across the alluvial plain at Lake Cowal, which has been largely cleared/disturbed by agriculture, EMM recently worked with BCD to provide a model of the vegetation community types for re-allocating areas of DNG to their original PCTs for MOD 14. The iterative process of remapping derived native vegetation to PCTs, as approved by BCD for MOD 14, is provided in Appendix C. This approach to mapping derived vegetation is summarised below.

As with remapping of derived vegetation for MOD 14 undertaken with approval of BCD, key datasets used to allocate DNG to PCTs applied for the Project were:

1. landscape position/topography
2. soils
3. proximity to intact woodland (where present)
4. remnant and regenerating canopy species scattered trees
5. land use.

The application of the above factors to mapping DNG areas, as approved by BCD for re-mapping of derived grassland vegetation for MOD 14, are summarised in Table 4.2 below.

Table 4.2 Summary of features used to allocate PCTs to DNG areas

Feature	Application
Landscape position/topography/ drainage	• Contour mapping, Digital Elevation Models (DEMs) and drainage patterns were used to inform landscape landform elements. • PCT 82 was mapped on a broad range of landform elements, including hillslopes, foot slopes, floodplains and areas of the alluvial plain associated with better drainage in areas surrounding MOD 14. Typically, PCT 82 was located at a slightly higher elevation than PCTs 55 and 26. • PCT 55 and 26 were mapped in flat and undulating areas across the alluvial plain. PCT 26 was associated with small rises where apparent and PCT 55 with poorer drainage areas, however, this was not a limiting factor to extent. • Gilgais were associated with both PCT 55 and 26. Not associated with PCT 82. • PCT 185 was mapped on hillslopes and hillcrests as it is restricted to these landscape positions locally.
Soils	• Soils of PCT 82 were typically red brown clay loams, sometimes containing gravel. • PCTs 55 and 26 were identified as having brown to red clay and loamy clay soils. • Some areas of PCT 55 had predominately grey clays.
Proximity to intact woodland (where present)	• Proximity to woodland patches of PCT 26, 55 and 82 indicated the presence of the relevant PCT in adjacent DNG areas if associated landform elements and soils also occurred. • Remnant woodlands of these PCTs were readily distinguished where landform elements and soils align. • PCT 82 was identified by dominance or codominance of Western Grey Box (*Eucalyptus microcarpa*). • PCT 26 was identified by the dominance or codominance of Weeping Myall (*Acacia pendula*). • PCT 55 may have Weeping Myall present, however, the canopy is clearly dominated by Belah (*Casuarina cristata*). • Across the alluvial plain, woodland patches of PCT 55 and PCT 26 were noted to frequently form a mosaic of small patches of both woodlands with ecotones between. • PCT 55 and 26 displayed a similarity of soils and landform elements, a mosaic occurrence pattern and lack of discernible difference in floristics of ground cover. • Where soil colour differences and landform elements (small rises and poorer drainage areas) were not readily apparent, scattered trees and proximity to woodland patches were considered viable, but limited, indicators of PCTs. • DNG areas adjacent to remnant woodlands were considered part of the same PCT unless other factors, primarily landscape position or soils, strongly indicated a different PCT.
Scattered trees	• Scattered trees commonly associated with PCT 82 were Western Grey Box, Poplar Box (*Eucalyptus populnea*), Kurrajong (*Brachychiton populneus*) and White Cypress Pine (*Callitris glaucophylla*). • Belah was found to be more commonly associated with PCT 55, so areas adjacent scattered Belah (where the landscape position was considered consistent) were indicative of PCT 55 DNG. • Wilga (*Geijera parviflora*) and Western Rosewood (*Alectryon oleifolius*) were identified to occur very infrequently in PCT 26 woodland and were much more common in PCT 55. So, PCT 55 was considered as potentially occurring where scattered Wilga and Western Rosewood were dominant. • The occurrence of Weeping Myall as scattered trees or very small patches was considered to indicate the presence of PCT 26. • Weeping Myall was found to less likely to regenerate in isolated areas. On this basis, PCT 26 was not discounted where there was a lack of Weeping Myall scattered trees.
Land use	• Past land use was considered in PCT determination mostly on high hillslopes and hillcrests, which were not cleared for agriculture. However, the footslopes and floodplains have broadly experienced intensive agriculture, so land use was a less useful diagnostic for PCTs allocated in these areas.

ii Multivariate analysis

Determining PCT associated with DNG areas was a difficult task due to the naturally complex mosaic of woodlands that result from small differences in landform elements, particularly across the alluvial plain, where a number of PCTs naturally occur. In the absence of an overstory and/or shrub layer in, or nearby, the vegetation patch, due to the highly cleared landscape, allocation of PCTs was difficult. Compounding this was the ubiquity of ground cover species due to past and current land use (i.e. ground cover species had a high degree of similarity between different PCTs). Assigning vegetation communities to DNGs was also found to be challenging within the previous biodiversity assessment for Modification 14 (AMBS Ecology & Heritage 2018).

In attempt to resolve PCTs allocated to DNG areas, a multivariate analysis was undertaken on the 148 BAM plots EMM has undertaken across Evolution's land-holdings, including those within the study area. This dataset included plots undertaken to inform the Biodiversity Offset Strategy (Chapter 10). This analysis involved firstly establishing a species dissimilarity matrix in PRIMER^{TM} based on species presence/absence data from BAM plots. A Cluster Analysis was then performed and visualised on a Non-metric Multidimensional Scaling (nMDS) plot grouping plots with 20 and 40% similarity (note that higher similarity values failed to distinguish any further grouping, so were not included here).

4.2.2 Vegetation integrity assessment

Following the stratification of vegetation zones within the study area, native vegetation integrity was assessed using data obtained via a series of plots, as per the methodology outlined in Section 4.2.1, 4.3.3 and 4.3.4 of the BAM (DPIE 2020a). Plot data was collected from the study area between 16 to 25 March 2020; 30 March to 8 April 2020; 19 to 28 May 2020; 26 to 28 April 2021 and 19 to 25 April 2022. At each plot location the following was undertaken:

- one 20 x 20 m plot, for assessment of composition and structure
- one 20 x 50 m plot for assessment of function, including a series of five 1 x 1 m plots to assess average leaf litter cover.

The assessment of composition and structure, based on a 20 x 20 m plot, recorded species name, stratum, growth form, cover and abundance rating for each species present within the plot. Cover (foliage cover) was estimated for all species rooted in or overhanging the plot, and recorded using decimals (if less than 1%, rounded to whole number (1–5%) or estimated to the nearest 5% (5–100%). Abundance was counted (up to 20) and estimated above 20, and recorded using the following intervals: 1, 2, 3, 4, 5, 10, 20, 50, 100, 500, 1,000, 1,500, 2,000 etc.

The assessment of function recorded the number of large trees, the presence of tree stem size class, tree regeneration, number of trees with hollows and length of fallen logs, as well as leaf litter cover within the 20 x 50 m plot and five 1 x 1 m subplots. The minimum number of plots and transects per vegetation zone was determined using Table 3 of the BAM (DPIE 2020a). A total of 111 plots were undertaken within or near the study area. All plots for Zone 19 (PCT 185 High) were not entered in the BAM Calculator (BAM-C) because this zone is not inside the Additional disturbance area and so will not be cleared. Nevertheless, an initial BAM-C was run with Zone 19 included to determine the vegetation integrity score. Note that all plots were undertaken within an overarching study area, which allowed for ongoing design changes. Plot datasheets are provided in Appendix A, while compiled plot data is provided in Appendix B.

Surveys for flora and vegetation communities were completed under the authority of Scientific License (SL100409). A list of flora species was compiled for each plot and PCT. Records of all flora species were (for past records) or will be (for recent records) submitted to the Atlas of NSW Wildlife.

4.2.3 Management zones

Section 8.2 of BAM (DPIE 2020a) requires the assessment of indirect impacts on native vegetation, threatened ecological communities and threatened species habitats and Section 8.6 states that biodiversity credits can be used to compensate for indirect biodiversity impacts.

Delineation of a proposed development into different management zones allows for direct impacts (i.e. total loss of native vegetation and fauna habitat in a given area) and indirect impacts (e.g. decreasing condition in retained native vegetation and fauna habitats adjacent to direct impacts) to be quantified and, where necessary, offset.

To provide flexibility to the Project, all areas within the Additional disturbance area have been assumed to be 100% loss. It is, however, noted that in practice not all biodiversity values within the Additional disturbance area will be completely removed. For example, the Additional disturbance area allows for installation of a silt curtain and associated construction activity to construct the LPB, extending 30 m off the toe of the constructed LPB. All of this area has been included in the Additional disturbance area and assumed to have 100% loss within this BDAR. When conditions are suitable, the lake foreshore will be rehabilitated within this 30 m buffer (EMM 2023d). For this reason, and due to the highly degraded condition of the vegetation present due to historical agricultural activities, no management zones have been established for assessment of indirect impacts.

4.3 Results

4.3.1 Vegetation description

The area surrounding the study area is a mosaic of cleared agricultural land used for cropping and grazing, vegetation associated with Lake Cowal and corridors and patches of remnant woodland. A large proportion of agricultural grazing land consists of derived native grasslands. Remnant and regenerating woodlands persist primarily on hilltops, hillslopes, road verges and riparian corridors.

Lake Cowal forms the eastern boundary of the Additional disturbance area. Moving west, the landscape transitions from a thin strip of fringing sandy and loamy clays, grading into a flat to slightly undulating alluvial plain of loamy clays and clay, often with gilgais. These alluvial plains are also typified by interspersed ephemeral drainage channels and associated floodplains of alluvial loams and loamy clays that sometimes have a gravely or silty texture. Further west, the alluvial plain rises into broad foot slopes of loam, clay and some gravels forming into low hillslopes and ridges of shallow gravel and loamy soils.

Prior to European colonisation, remnant vegetation within the study area suggested the landscape outside of Lake Cowal would have comprised a mosaic of woodland communities across the alluvial plain and foot slopes. Complex patterns of vegetation communities would have been associated with subtle variance in elevation, soil differentiation and drainage across these landscape elements, with frequent transitions between these communities.

Past and current land use comprising agriculture and mining have significantly altered native vegetation condition and extent, and in some cases modified landform elements. Large scale clearing of woodlands across the alluvial plain, floodplains, foot slopes and hill slopes for cropping and grazing has resulted in large areas of derived native grassland (DNG) both with and without scattered trees. Scattered trees were separated out from areas mapped as DNG, and put into a higher condition vegetation zone for the PCT.

As a reflection of their unsuitability for agricultural use, some hillslope and hillcrest woodland communities are typically in higher condition than those on the alluvial and floodplains.

A total of 264 species (175 native and 89 exotic) were recorded across the 111 BAM plots carried out throughout the EIS Study Area.

4.3.2 Plant community types

A broad summary of all PCTs in the study area, within the direct impact areas is provided in Table 4.3.

Table 4.3 Plant community types mapping within the study area

Plant community type	Vegetation formation	Vegetation class	Percentage cleared[1]	Study area (ha)	Direct impacts (ha)
PCT 17 Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Freshwater Wetlands	Inland Floodplain Shrublands	63.00%	21.71	12.04
PCT 26 Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	Semi-arid Woodlands	Riverine Plain Woodlands	90.00%	254.20	200.82
PCT 53 Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains	Freshwater Wetlands	Inland Floodplain Shrublands	67.00%	449.37	311.08
PCT 55 Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.	Semi-arid Woodlands (Grassy sub-formation)	North-west Floodplain Woodlands	83.00%	372.44	215.18
PCT 82 Western Grey Box – Poplar Box – White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	Grassy Woodlands	Floodplain Transition Woodlands	75.00%	313.70	120.17
PCT 185 Dwyer's Red Gum – White Cypress Pine – Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion	Semi-arid Woodlands (Shrubby sub-formation)	Inlands Rocky Hill Woodland	20.00%	73.94	5.06
PCT 244 Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).	Grassy Woodlands	Floodplain Transition Woodlands	73.00%	12.28	12.28
PCT 249 River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	50.00%	65.31	51.97

1. % cleared is from DPE BioNet Vis (2023) for estimated area % cleared since 1750 within NSW.

4.3.3 Vegetation zones

The eight PCTs in the study area were categorised into 26 vegetation zones. At a broad spatial scale, vegetation zones were delineated by the presence of a canopy (high, medium and poor condition classes) and absence of a canopy (DNG condition classes). Zones were also delineated for PCTs where natural regeneration was evident (i.e. regenerating condition class) or active restoration has been applied by tree planting (i.e. planted condition class). A list of vegetation zones in the study area, including the area of direct impacts, is provided in Table 4.4.

Note that there was a small extent (0.06 ha) of PCT 249 Poor originally mapped out, consisting of sparse paddock trees with a disturbed understorey. As there was no ability to undertake a plot in such small and scattered patches, the area of PCT 249 Poor was subsequently merged with the higher condition vegetation zone PCT 249 Medium for the purposes of vegetation integrity and offset calculations.

i Application of the planted native vegetation Decision-making key

The decision-making key in Appendix D of the BAM (DPIE 2020a) provides a framework for the assessment of planted native vegetation using the BAM. This key was applied to Zones 4, 10 and 14 as they consist of vegetation that was planted by Evolution. It was found that the BAM must be applied to zones 4, 10 and 14, since they occur within an area that contains a mosaic of planted and remnant native vegetation and which can be reasonably assigned to a PCT known to occur in the same IBRA subregion as the proposal.

Table 4.4 Vegetation zones identified along with broad condition states as identified by EMM

Zone	PCT ID	PCT name	Condition	Vegetation Zone name	Study area (ha)	Direct impacts (ha)	Plots performed
1	17	Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Medium	17_Medium	21.71	12.04	None (Benchmark assumed except no trees are in this zone; see Table 4.5)
2	26	Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	DNG	26_DNG	217.88	179.14	7 (Co012, 1, 19, 20, 23, 25 and 44)
3			Poor	26_Poor	4.31	4.04	2 (Co001 and 33)
4			Planted	26_Planted	12.31	10.57	3 (30, 31 and 32)
5			Medium	26_Medium	3.98	2.58	2 (Plot 017 and C6)
6			High	26_High	15.72	4.49	6 (Plot 008, Co013, 26, 27, 28 and 29)

Table 4.4 Vegetation zones identified along with broad condition states as identified by EMM

Zone	PCT ID	PCT name	Condition	Vegetation Zone name	Study area (ha)	Direct impacts (ha)	Plots performed
7	53	Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains	Medium	53_Medium	449.37	311.08	7 (34, 35, 36, 37, 38, 39 and 40)
8	55	Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions	DNG	55_DNG	290.94	166.34	10 (Plot 009, 41, 42, 43, 45, 46, 48, 49, 50 and 51)
9			Poor	55_Poor	11.66	6.14	6 (Plot 015, Plot 016, Plot 021, 47, 57 and 58)
10			Planted	55_Planted	11.64	8.83	4 (24, 55, 56 and 66)
11			Medium	55_Medium	58.68	33.87	6 (Plot 018, 14, 17, 52, 53 and 54)
12	82	Western Grey Box – Poplar Box – White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	DNG	82_DNG	294.88	113.02	18 (Plot 003, Plot 007, Plot 012, Plot 022, Co002, Co003, Co005, Co008, Co009, Co010, Co011, 2, 3, 4, 5, 59, 61 and 65)
13			Poor	82_Poor	5.90	0.94	2 (C7 and C8)
14			Planted	82_Planted	1.64	0.37	1 (64)
15			Regenerating	82_Regen	7.81	5.23	4 (Plot 001, Plot 002, Plot 004 and Co004
16			Medium	82_Medium	3.46	0.62	1 (67)

Table 4.4 Vegetation zones identified along with broad condition states as identified by EMM

Zone	PCT ID	PCT name	Condition	Vegetation Zone name	Study area (ha)	Direct impacts (ha)	Plots performed
17	185	Dwyer's Red Gum – White Cypress Pine – Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion	DNG	185_DNG	42.91	3.56	2 (Plot 006 and Plot 019)
18			Medium	185_Medium	7.95	1.50	3 (Plot 005, Co006 and Co007)
19			High	185_High	23.08	0	4 (Plot 010, Plot 011, Plot 013 and Plot 020)
20	244	Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)	DNG	244_DNG	10.33	10.33	3 (C9, 21 and 62)
21			Poor	244_Poor	0.21	0.21	1 (60)
22			Medium	244_Medium	1.75	1.75	2 (22 and 63)
23	249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	DNG	249_DNG	8.28	6.85	3 (6, 7 and 8)
24			Regenerating	249_Regen	20.69	16.53	4 (13, 15, 16 and 18)
25			Medium	249_Medium	36.33	28.58	5 (Co014, 9, 10, 11 and 12)
26	Cropped	Cropped land	Non-native	-	128.79	71.17	5 C1, C2, C3, C4 and C5 Zone is classified as Category 1 land (see Appendix E)
-	Dam	-	-	-	4.94	2.71	-
-	Cleared	-	-	-	47.80	27.44	-
-	Exotic grassland	-	-	-	0.38	0.38	-

Justification and description of the eight PCTs within the study area and their respective zones is provided in Table 4.5 to Table 4.13 below. Where applicable, the presence and extent of these Threatened Ecological Communities (TECs) is identified by applying relevant State and Commonwealth TEC identification criteria.

a Multivariate analysis

The multivariate analysis revealed >20% similarity amongst most plots for PCT 26, 55 and 82, regardless of vegetation zone condition (e.g. DNG, low and medium condition). Hence, groundcover floristic composition was not found to be useful for allocating PCTs to areas with a derived condition state. This was supported by AMBS Ecology & Heritage (2018), who also could not clarify distinctions between plant communities or any historic pre-clearing information within multivariate analysis of flora with plots undertaken for MOD 14 (immediately adjacent to the Additional disturbance area), with a suite of native species found to be ubiquitous across the landscape.

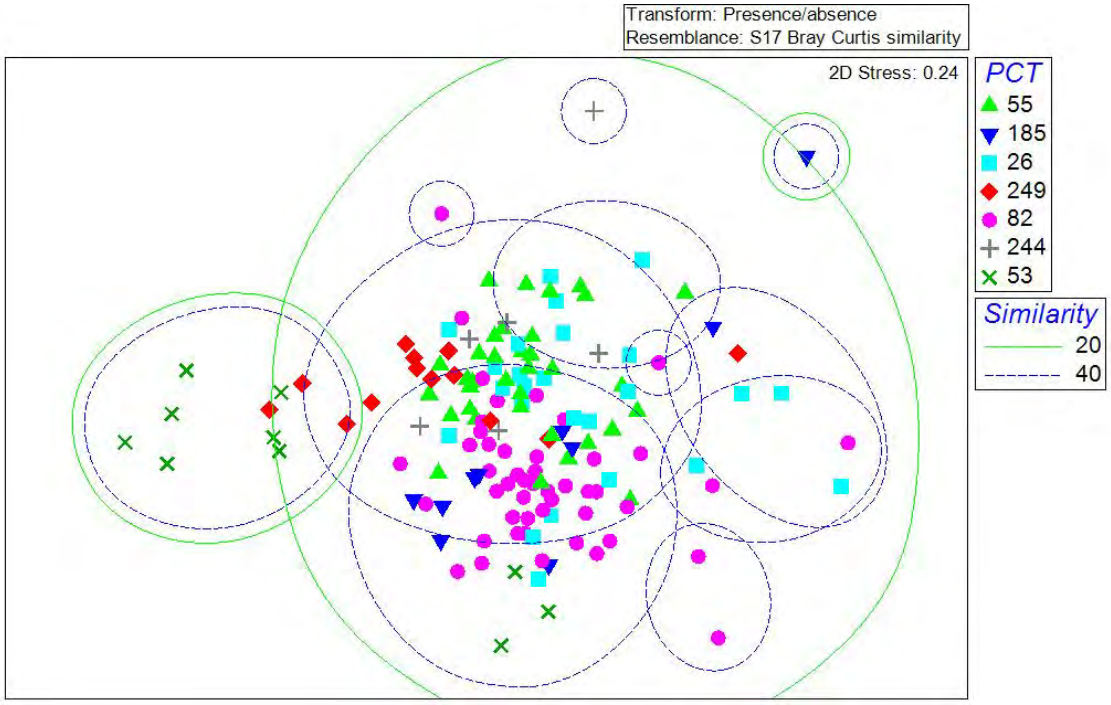


Figure 4.1 nMDS plot of BAM plot data collected within Evolution's land-holdings, including those study area



KEY

- Study area
- Additional disturbance area
- Existing and approved disturbance area
- Major road
- BAM plot

Vegetation communities

PCT 17 - Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)
- Medium

PCT 26 | Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
- DNG
- Planted
- Poor
- Medium
- High

PCT 53 | Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains
- Medium

PCT 55 | Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions
- DNG
- Planted
- Poor
- Medium

PCT 82 | Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion
- DNG
- Planted
- Regenerating
- Poor
- Medium

PCT 185 | Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
- DNG
- Medium
- High

PCT 244 | Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate climate zone of central NSW
- DNG
- Poor
- Medium

PCT 249 | River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW
- DNG
- Regenerating
- Medium

Other
- Cleared
- Cropped
- Dam
- Exotic Grassland

Plant community types and BAM plot locations in the subject land

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Biodiversity Development Assessment Report
Figure 4.2

EMM creating opportunities

\\emmsvr1\EMM\Jobs\2019\J190417 - CGO Open Cut Expansion Project\GIS\02_Maps_BDAR\BDAR004_PCTmappingAndBAMplots_20230421_04.mxd 24/04/2023

Source: EMM (2023); Evolution (2023); DFSI (2017); Nearmap (2021)

0 1 2 km

GDA 1994 MGA Zone 55

N

ii PCT 17 – Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)

Table 4.5 Vegetation zone 1 description

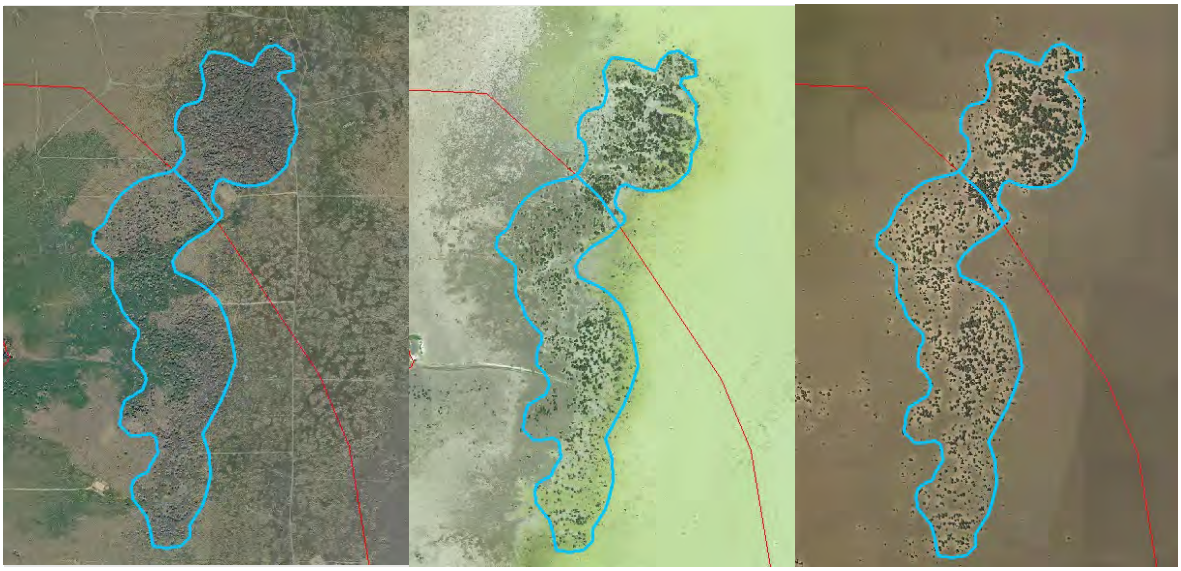
Vegetation Zone 1 – PCT 17 Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	
PCT ID	17
Common name	Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)
Condition class	Vegetation zone 1 – Medium
Extent within additional disturbance area	12.04 ha 12.04 ha (Medium)
General description	PCT 17 is described within DPE BioNet VIS (2023) as an inland floodplain shrubland that occurs in river channels and depressions on floodplains subject to regular flooding (DPE BioNet Vis 2023). This vegetation community occurs in Lake Cowal and extends into the Additional disturbance area by a narrow strip of Lignum (*Duma florulenta*) dominated shrubland extending southwest from much larger ~31.73 ha patch. The vegetation is periodically inundated as Lake Cowal fills (see Photograph 4.1).
Zone description	**Zone 1 – Medium** The area currently mapped as PCT 17 was originally mapped as PCT 53 by EMM, and the two communities have multiple similarities. EMM believes that this vegetation is transitional zone between PCT 17 and PCT 53. EMM considered leaving this vegetation classified as PCT 53 but eventually remapped to PCT 17 as the observed Lignum (*Duma florulenta*) density appeared to be a slightly better fit for PCT 17.
Survey effort	No plots were undertaken due to inundation of Lake Cowal after the PCT 17 was mapped as a new vegetation zone. Although no BAM plots were undertaken prior to inundation, this area was inspected on foot when the lake was dry. That area had had a higher density of Lignum than the adjacent PCT 53, which was the distinguishing feature to distinguish PCT 17. However, due to the subsequent inundation of the lake, BAM plots could not be undertaken in this vegetation patch. DPE BCD was consulted on this matter on 31 August 2022 and 28 November 2022, seeking a pathway forward to assessing the vegetation integrity of this patch of vegetation (Appendix D; 31 August 2022 and 28 November 2022). The agreed approach with BCD was to identify the boundary of PCT 17 by the extent of Lignum in aerial photographs (see Photograph 4.1). In absence of survey, PCT 17 was represented with vegetation integrity assessment generally as benchmark condition within the BDAR except for overstorey benchmarks (as discussed below). To determine whether any Eucalypt overstorey is present EMM has reviewed recent Nearmap™ August 2016, November 2018, and October 2021 aerial imagery. From this inspection, eucalypts can be clearly discerned within PCT 249 vegetation mapped to the west. But no eucalypts were observed within the PCT 17 vegetation within the study area. EMM proposed to BCD that a value of zero is entered for tree species richness and tree cover, and benchmark values are used for all other attributes. The approach to assign tree species richness and cover to zero for the benchmark data being used for VI plots in PCT 17 was agreed with by BCD (Appendix D; 14 December 2022; Ref: DOC22/717039). Note that as a shrubland community, no function condition scores are utilised.

Table 4.5 Vegetation zone 1 description

Vegetation Zone 1 – PCT 17 Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	
Condition description	**Zone 1 – Medium** A review of aerial photography of this patch of Lignum (*Duma florulenta*) between 2018, 2019 and 2020 revealed the patch is in medium condition and lacks trees. However, this patch has a moderate density of shrubs, primarily due to a dominance of Lignum. The Lignum shrub layer is the distinguishing floristic difference to the adjacent PCT 53. Both areas of PCT 17 and PCT 53 within Lake Cowal have a similar management practice history, with both patches grazed by livestock when the lake is dry. As an ephemeral system, the Lignum (*Duma florulenta*) is likely to express different flora community composition and structure over time, due to variation in rainfall. That is, vegetation composition and structure are expected to be higher after floodwaters recede, and lower in drier years.
Characteristic species used for identification of PCT	The primary distinguishing feature of this vegetation zone was the higher density of Lignum (*Duma florulenta*) than other floodplain vegetation within Lake Cowal. That is, despite having the same landscape position (~205 m ASL), geology (Lake Cowal Soil Landscape) and land-use history (same pressures of past grazing), Lignum (*Duma florulenta*) was in far greater density in this patch that the adjacent PCT 53. However, an assessment of aerial photography revealed that this patch of Lignum was a transitional zone between PCT 53, where Lignum (*Duma florulenta*) is still a diagnostic species but far less density. This is clear when comparing the Lignum patch in the Additional disturbance area to a true patch of PCT 17 to the northeast, where Lignum (*Duma florulenta*) is very dense and quite obviously a true representation of PCT 17. Although plot data is not available from that patch due to inundation shortly after the decision to treat this vegetation patch as a separate PCT, it is logical to assume that understory vegetation diversity and density would be comparable to the adjacent PCT 53. However, a precautionary approach has been utilised with all attributes treated as being over benchmark, except Eucalypt species richness and cover due to a lack of emergent eucalypts observed in aerial imagery.
Justification of evidence used to identify the PCT	PCT 17 is listed as occurring within the NSW South Western Slopes, Lower Slopes, IBRA subregion, in which the study area occurs. The PCT can occur in river channels and depressions on floodplains subject to regular flooding, with landform elements including stream beds, drainage depressions, swamps and back plains. Within the study area, the PCT is associated with Lake Cowal, which is an ephemeral wetland prone to flooding when rainfall is sufficient. The PCT is associated typically with a clay lithology; dominant soils in Lake Cowal are very deep (>150 cm), very poorly drained Grey Clays. Species across this patch of PCT 17 are likely to be similar to PCT 53, which occurs immediately adjacent to this patch, due to a similar geology, landscape position and land-use history. However, the Lignum (*Duma florulenta*) thicket is a distinguishing feature. Black Box (*Eucalyptus largiflorens*), which is a diagnostic canopy species for PCT 17, is lacking from this patch.
Status	PCT 17 is not associated with any listed TECs under the BC Act or EPBC Act.
Estimate of percent cleared value of PCT across its distribution	63%
Patch size	Vegetation zone 1 – Medium: 101 ha
Hollow-bearing trees	Vegetation zone 1 – Medium: Absent

Table 4.5 Vegetation zone 1 description

Vegetation Zone 1 – PCT 17 Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)



Photograph 4.1 **Zone 1: PCT 17 (aerial photos during 2018, 2019 and 2021). Blue line = PCT 17 patch; Red line = EIS Study area boundary. Source: Nearmaps™**

iii PCT 26 – Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion

Table 4.6 Vegetation zones 2-6 description

Vegetation Zones 2-6 – PCT 26 Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	
PCT ID	26
Common name	Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
Condition class	Vegetation zone 2 – DNG Vegetation zone 3 – Poor Vegetation zone 4 – Planted Vegetation zone 5 – Medium Vegetation zone 6 – High
Extent within additional disturbance area	**200.82 ha** 179.14 ha (DNG) 4.04 ha (Poor) 10.57 ha (Planted) 2.58 ha (Medium) 4.49 ha (High)

Table 4.6 Vegetation zones 2-6 description

Vegetation Zones 2-6 – PCT 26 Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	
General description	PCT 26 is described as semi-arid, open grassy woodland dominated by Weeping Myall (DPE BioNet VIS 2023). Woodland areas occupy a small extent across the study area, with large areas of this PCT occurring as DNG. This community is located primarily within the northern and southern extent of the study area, adjacent Lake Cowal and just inland from the PCT 249 River Red Gum (*Eucalyptus camaldulensis*) zone. It occurs in low-lying extents of the study area adjacent to PCT 55, where clay soils dominate and gilgai are present.
Zone description	**Zone 2 – DNG** This zone lacks any upper stratum. Some sparse native, low stature shrubs occur, with native grasses and forms relatively common. Weeds are typically in low densities; mean of 8.58% weed cover across BAM plots. **Zone 3 – Poor** An open grassy woodland with sparse Weeping Myall and largely disturbed but native middle and ground stratum. Weeds are typically in high densities; mean of 46.7% weed cover across BAM plots. **Zone 4 – Planted** An open grassy woodland with planted Weeping Myall community. This vegetation was allocated to PCT 26 primarily due to landscape position, rather than vegetation composition. That is, there were elements of both PCT 26 and 55, particularly since Belah were relatively common planting species. However, this planted zone was allocated to PCT since it was immediately adjacent, and in cases surrounded by PCT 26. Weeds are typically in low densities; mean of 0.53% weed cover across BAM plots. **Zone 5 – Medium** An open grassy woodland with remnant Weeping Myall canopy and greater understory richness and diversity than Zone 3. Weeping Myall cover had a mean of 13.33% cover across plots undertaken in this zone. Weeds are typically in low densities; mean of 0.1% weed cover across BAM plots. **Zone 6 – High** An open grassy woodland with more mature and greater density remnant Weeping Myall canopy than Zone 5. Canopy cover by Weeping Myall here is 20.17%, as estimated by BAM plots. Weeds are typically in low densities; mean of 4.4% weed cover across BAM plots. **Diagnostic species** Diagnostic canopy species used to identify Zones 3 to 6 was primarily *Acacia pendula* (Weeping Myall). Zone 4 also had planted Belah (*Casuarina cristata*) and Yellow Box (*Eucalyptus melliodora*), which are also diagnostic of PCT 26. Common middle stratum species diagnostic of PCT 26 across all zones were Thorny Saltbush (*Rhagodia spinescens*) and Cotton Bush (*Maireana aphylla*). The diagnostic shrub *Acacia stenophylla* (River Cooba) also occurred in Zone 5, whilst Black Cotton Bush (*Maireana decalvans*) occurred in Zones 2 and 6. Diagnostic groundcover species common all zones were Climbing Saltbush (*Einadia nutans*) and Ruby Saltbush (*Enchylaena tomentosa*). Diagnostic groundcover species common to at least two of the five zones included Creeping Saltbush (*Atriplex semibaccata*), Lesser Joyweed (*Alternanthera denticulata*), Fairy Grass (*Sporobolus caroli*) and Speargrass (*Austrostipa scabra*). **Exotic species** Many exotic species were cosmopolitan and patchily distributed across zones 2 to 6. Weed cover is greatest in Zone 2 (67%) and least in Zone 5 (0.1%). Exotic species found in two or more zones included Rape (*Brassica* x *napus*), Paddy Melon (*Cucumis myriocarpus* subsp*. leptodermis*), Patterson's Curse (*Echium plantagineum*), Potato Weed (*Heliotropium europaeum*), Smooth Catsear (*Hypochaeris glabra*), Common Peppercress (*Lepidium africanum*), Perennial Ryegrass (*Lolium perenne*), White Horehound (*Marrubium vulgare*), Spotted Burr Medic (*Medicago arabica*), Black-berry Nightshade (*Solanum nigrum*) and Common Sowthistle (*Sonchus oleraceus*). The only High Threat Weed (HTW) detected was Bathurst Burr (Xanthium spinosum), with this weed only recorded in Zone 3.

Table 4.6 Vegetation zones 2-6 description

Vegetation Zones 2-6 – PCT 26 Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	
Survey effort	20 plots/transects within the study area: • Zone 2 – 7 plots • Zone 3 – 2 plots • Zone 4 – 3 plots • Zone 5 – 2 plots • Zone 6 – 6 plots.
Condition description	**Zone 2 – DNG** The derived native grasslands have been subject to historical grazing and clearing. These areas typically support a relatively largely extent of native groundcover (primarily grasses) with moderate species richness. **Zone 3 – Poor** These areas are composed of scattered and remnant patches of Weeping Myall, Belah and River Cooba, with a highly modified understory. The shrub layer is largely absent, with regeneration of Weeping Myall lacking. The native groundcover composition and structure is similar to the adjacent DNG, owing to common current and past land-uses. DNG typically intersperses these patches of remnant vegetation. **Zone 4 – Planted** Planted vegetation consistent with PCT 26 (owing to landscape position, geology and flora community that are consist with this vegetation community) flanks access roads to the south of the study area. Varying levels of regeneration are present, with sparse remnant Weeping Myall present. **Zone 5 – Medium** The canopy is reasonably intact with limited evidence of historical clearing of canopy species. The midstory is largely absent, likely due to removal of palatable saltbush species by grazers (macropods and livestock). Ground cover is predominately native with moderate species richness and relatively few exotic species present. Woody debris and fallen timber are present in several areas in low abundance. Surrounding land use (historical clearing, grazing and adjacent track) and associated edge impacts contribute to the condition of this zone. Edge effects are exacerbated by the small areas of remnants composing this zone. **Zone 6 – High** This zone has a higher density Weeping Myall, with regenerating and mature individuals present. Similar to Zone 5 (Medium), there is still disturbance to middle and understory by grazing of macropod and livestock. As these patches are typically larger than other zones, there is less influence of edge effects moving into the middle of these patches of vegetation.
Characteristic species used for identification of PCT	Across the vegetation zones, 14 diagnostic flora species were detected within plots, consisting of: • upper stratum: three diagnostic species • middle stratum: five diagnostic species • ground stratum: six diagnostic species. A list of these species is provided above. For the high, medium, poor and planted zones, the presence of Weeping Myall was a key determinant of this PCT. Nevertheless, DNG areas largely lacked Weeping Myall, six diagnostic ground cover species for PCT were present, giving supporting evidence of the presence of PCT, along with factors such as landscape position, soils and hydrology as discussed below.

Table 4.6 Vegetation zones 2-6 description

Vegetation Zones 2-6 – PCT 26 Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	
Justification of evidence used to identify the PCT	PCT 26 is listed as occurring within the NSW South Western Slopes, Lower Slopes, IBRA subregion, in which the study area occurs. Remnant canopy trees were a key diagnostic to identifying PCT 26. Areas of PCT 26 in high, medium condition and planted were distinguished by the presence of Weeping Myall, with the dominance of Weeping Myall being a key diagnostic used to identify this community. The adjacent PCT 55 was typically denoted by dominant Belah. Wilga (*Geijera parviflora*), a diagnostic shrub associated with PCT 55, was also less common in PCT 26. Poor condition patches of PCT 26 also had highly scattered Weeping Myall present. PCT 26 and PCT 55 were found to frequently intergrade on slightly undulating flats associated with gilgai, making identification difficult of PCT where canopy trees were absent. Areas of DNG lacking a tree canopy due to past clearing for livestock grazing and cropping were identified as being consistent with PCT 26 primarily by landscape position and geology. PCT 26 was typically found on slight rises and flats, on red-brown and grey clay loam soils with moderate to good drainage, often above active drainage channels and wetlands (i.e. PCT 249 and 53). PCT 26 was also typically located slightly above PCT 55 in the landscape. Note that attempts to resolve PCT associations of DNG areas based on floristics was unsuccessful given a relatively homogenous understory across the study area (see multivariate assessment in Section 4.3.3ia). Part of the area this community once occupied by PCT 26 has been cleared for cropping, with wheat, rye and barley dominant as well as high weed cover (primarily *Sonchus oleraceus*) common. The area with active cropping present has been identified as Category 1 land (see Appendix E), and not requiring consideration within this assessment. Nevertheless, most paddock trees present within these cropped lands, identified as Category 2 land and so subject to the BAM, were primarily Belah, Western Rosewood, and Wilga. Based on these trees best grouping with PCT 55, as all three trees are diagnostic of PCT 55, they were consequently mapped as the poor condition PCT 55 zone. Where Weeping Myall was present as paddock trees across the study area, these areas were mapped as PCT 26 poor.
Status	**BC Act** The listing advice for *Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions*, listed as an Endangered Ecological Community (EEC) under the BC Act (NSW Scientific Committee 2011) states that a woodland patch must meet the following criteria to be included in the listing: • A low open woodland or DNG on red-brown clay loams of an alluvial plain within the NSW South Western Slopes bioregion. • Dominated by Weeping Myall, invariably one of or the only dominant canopy species for the EEC or in disturbed DNG areas would respond to management actions and assisted regeneration. • Have an understorey predominately comprising native grasses, chenopods and herbs associated with the EEC. All vegetation zones are considered to be aligned with the BC Act listed EEC. All five zones (i.e. Zones 2 to 6) are located on red-brown clay loams of an alluvial plain within the NSW South Western Slopes bioregion. Zones 3, 4 and 6 are dominated by Weeping Myall, whilst all zones would likely respond to management actions and assisted regeneration in time. In total, 16 diagnostic understory species associated with this PCT were detected in plots. Even zone 2 (DNG), the most disturbed of the five zones, had 15 diagnostic understory species recorded in plots. The most common diagnostic ground cover of relevant growth forms were: • Curly Windmill Grass (*Enteropogon acicularis*) – most common grass with a mean cover of 12.04%. • Climbing Saltbush (*Einadia nutans*) – most common forb with a mean cover of 1.19%.

Table 4.6 Vegetation zones 2-6 description

Vegetation Zones 2-6 – PCT 26 Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	
	EPBC Act The listing advice for EPBC Act *Weeping Myall Woodlands* Endangered community (TSSC 2009) determines that a woodland patch must meet the following criteria to be included in the listing: • the tree canopy is dominated (at least 50% of trees present) by living, dead or defoliated Weeping Myall trees • the overstorey must have at least 5% tree canopy cover or at least 25 dead or defoliated mature Weeping Myall trees/ha • the area is at least 0.5 ha in size • the patch has either: – more than two layers of regeneration of Weeping Myall present, or – the tallest layer of living, dead or defoliated Weeping Myall trees is at least 4 m tall and of the vegetative cover present, 50% is comprised of native species. Applying the above criteria, vegetation zones 5 (Medium) and 6 (High) meet all the criteria for Weeping Myall Woodlands as listed under the EPBC Act. Taking a precautionary approach Zone 3 (Poor) was also considered commensurate with this EEC. That is, Zone 3 Poor lacks more than two layers of regenerating Weeping Myall due to historic clearing of understory by agriculture. However, over 50% of vegetation cover is composed of native species (~70% native in plot 33), whilst the tree canopy is dominated by Weeping Myall >5% in this zone. Weeping Myall planted in Zone 4 were too sparse and immature to meet the EPBC Act criteria of at least 5% tree canopy cover or 25 Weeping Myall per ha. Zone 2 (DNG) lacks mature Weeping Myall, so fails to meet the above criteria due to a lack of tree canopy and Weeping Myall over 4 m tall.
Estimate of percent cleared value of PCT across its distribution	90%
Patch size	Vegetation zone 2 – DNG: 101 ha Vegetation zone 3 – Poor: 101 ha Vegetation zone 4 – Planted: 101 ha Vegetation zone 5 – Medium: 101 ha Vegetation zone 6 – High: 101 ha
Hollow-bearing trees	Vegetation zone 2 – DNG: Absent Vegetation zone 3 – Poor: Present Vegetation zone 4 – Planted: Absent Vegetation zone 5 – Medium: Absent Vegetation zone 6 – High: Absent

Table 4.6 Vegetation zones 2-6 description

Vegetation Zones 2-6 – PCT 26 Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion


Photograph 4.2 Zone 2: PCT 26 DNG



Photograph 4.3 Zone 3: PCT 26 Poor

Table 4.6 Vegetation zones 2-6 description

Vegetation Zones 2-6 – PCT 26 Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion


Photograph 4.4 Zone 4: PCT 26 Planted



Photograph 4.5 Zone 5: PCT 26 Medium

Table 4.6 Vegetation zones 2-6 description

Vegetation Zones 2-6 – PCT 26 Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion



Photograph 4.6 Zone 6: PCT 26 High (note plot undertaken during dry conditions)

iv PCT 53 – Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains

Table 4.7 Vegetation zone 7 description

Vegetation Zone 7 – PCT 53 Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains	
PCT ID	53
Common name	Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains
Condition class	Vegetation zone 7 – Medium
Extent within additional disturbance area	311.08 ha (Medium)
General description	PCT 53 is described as a low to mid-high sedgeland/grassland dominated by spike rushes, with the species composition varying across wide distribution of this community and levels of or time since inundation (DPE BioNet Vis 2023). This vegetation community comprises most of the vegetation within Lake Cowal, transitioning into PCT 249, which occurs along the Lake Cowal shoreline. Elements of PCT 249, including River Red Gum (*Eucalyptus camaldulensis*) become more sparse heading away from the shoreline, giving way to this wetland that is dominated by semi-aquatic and aquatic forbs, sedges and rushes. To the northeast of the study area, the density of Lignum (*Duma florulenta*) increases as the vegetation community transitions from PCT 53 to PCT 17, including the area assigned to Zone 1. The vegetation has all been mapped as occurring in one vegetation zone, which has been disturbed previously by agricultural practices when Lake Cowal is dry, including grazing and cropping. Note that this vegetation zone was surveyed prior to inundation of Lake Cowal.

Table 4.7 Vegetation zone 7 description

Vegetation Zone 7 – PCT 53 Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains	
Zone description	**Zone 7 – Medium** This zone has a very sparse diagnostic canopy of River Red Gum (*Eucalyptus camaldulensis*) that increases toward the shoreline, where it transitions into PCT 249. The primary diagnostic shrub found in this zone was Lignum (*Duma florulenta*), however the density was far less than the patch mapped as PCT 17 (Zone 1). Groundcover species diagnostic of PCT 53 are (Lesser Joyweed (*Alternanthera denticulata*), Warrego Grass (*Paspalidium jubiflorum*), Hairy Panic (*Panicum effusum*), Rat's Tail Couch (*Sporobolus mitchellii*), Tarvine (*Boerhavia dominii*), Pigweed (*Portulaca oleracea*) and Yellow Twin-heads (*Eclipta platyglossa*). Weed cover was patchy, ranging from 0.4% to 90.1%. Exotic species include *Abutilon grandifolium*, *Chenopodium album* (Fat Hen), *Cirsium vulgare* (Spear Thistle), *Conyza bonariensis* (Flaxleaf Fleabane), *Lactuca serriola* (Prickly Lettuce), *Malva parviflora* (Small-flowered Mallow), *Medicago polymorpha* (Burr Medic), *Onopordum acanthium* subsp. *acanthium* (Scotch Thistle), *Poaceae indeterminate* (Grasses, reeds and bamboos), *Solanum nigrum* (Black-berry Nightshade) and *Sonchus oleraceus* (Common Sowthistle).
Survey effort	Seven plots/transects within the study area: • Zone 7 – 7 plots.
Condition description	**Zone 7 – Medium** Historical clearing, grazing and establishment of tracks and associated agriculture infrastructure has disturbed this patch. This zone is characterised by sparse River Red Gum (*Eucalyptus camaldulensis*), which are more common toward the shoreline of Lake Cowal. The shrub layer is also largely lacking, except where Lignum (*Duma florulenta*) was dense. The groundcover was the most abundant with high levels of native grasses and graminoids (mean of 81.06% across all seven plots). Weed cover was patchy, ranging from low to high cover. No HTW were recorded in this zone.
Characteristic species used for identification of PCT	Across the vegetation zone nine diagnostic flora species were detected within plots consisting of: • upper stratum: one diagnostic species • middle stratum: one diagnostic species • ground stratum: seven diagnostic species. A list of these species is provided above.

Table 4.7 Vegetation zone 7 description

Vegetation Zone 7 – PCT 53 Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains	
Justification of evidence used to identify the PCT	PCT 53 is listed as occurring within the NSW South Western Slopes, Lower Slopes, IBRA subregion, in which the study area occurs. This PCT occurs on low lying flats or depressions on floodplains that regularly flood after rain. Within the study area, this PCT is located within Lake Cowal, which is a low lying flat ephemeral wetland that floods after sufficient rainfall. Hence, the landscape position fits PCT 53. The PCT is associated typically with a clay lithology; dominant soils in Lake Cowal are very deep (>150 cm), very poorly drained grey clays. Species across PCT 17 within the study area are similar to PCT 53, which occurs immediately adjacent to PCT 53, due to a similar geology, landscape position and land-use history. However, the Lignum (*Duma florulenta*) thicket is a distinguishing feature of the area mapped as PCT 17. The floristic composition of the mapped PCT 53 also matches the description of PCT 53, with nine diagnostic species present, including at least one diagnostic species from each stratum. Another potential PCT that was considered within Lake Cowal was PCT 24 Canegrass swamp tall grassland wetland of drainage depressions, lakes and pans of the inland plains. An analysis of vegetation data from BAM plots collected across the OPC area and within Lake Cowal identified varying cover of Canegrass (*Eragrostis australiasica*), at the time of floristic surveys (i.e. June 2020). Of the plot data available, most areas had a low cover of Canegrass (i.e. 0–10%). But there was a notably higher density of Canegrass recorded toward the south of the LPB area. Specifically, two of the eight BAM plots at the southern extent of the LPB area (plots 39 and 40) had a 55–65% cover of Canegrass (see Appendix D; EMM Memorandum, 28 November 2022). Assessment of the photographs of these plots revealed a mosaic with a grassland/sedgeland formation appearance (see Photographs 1 and 2 of Appendix D; EMM Memorandum, 28 November 2022). Apart from Canegrass, no other flora species diagnostic of PCT 24 were located at either Plot 39 or 40. Further, Rat's Tail Couch (*Sporobolus mitchellii*), Lesser Joyweed (*Alternanthera denticulata*) and Swamp Dock (*Rumex brownii*) were recorded at these plots, which are diagnostic species of PCT 53 (Appendix A provides plot data). Hence, there were floristic elements of both PCT 53 and 24 in these plots. In support of our vegetation mapping, the State Vegetation mapping allocates PCT 53 across the study area, whilst mapping PCT24 toward the centre of the lake, outside of the study area (see Appendix D; EMM Memorandum, 28 November 2022. There was no alternative accurate and recent mapping that can be used to complement our mapping dataset. Other vegetation mapping to guide allocation of vegetation communities is now outdated and appears to be inaccurate. One map dataset available is EES (1999), who undertook vegetation mapping as part of their water bird assessment. This mapping focused on identifying the broad bird nesting habitat types Canegrass, Lignum (*Duma florulenta*) and River Red Gum (*Eucalyptus camaldulensis*), rather than vegetation communities per se. This mapping indicated presence of Canegrass in the southern LPB area. But the accuracy of this mapping is questionable since it was produced over 20 years ago, and this mapping focused on fauna habitat attributes. There are also notable inaccuracies given large stands of mature Red River Gum (which have evidently not changed in extent over 20 years) are not displayed at all along the Lake Cowal foreshore, despite large areas mapped in this vicinity by EMM as part of the BDAR. Hence, EMM has no reliable historic dataset at hand to guide vegetation community allocation and their extent. The other issue with allocating vegetation communities in Lake Cowal is it is highly ephemeral, so the vegetation composition is likely to change through time. That is, in such a hydraulically dynamic ecosystem, vegetation will typically succeed between sedgeland and grassland across wetting and drying cycles, respectively. Accordingly, and weighing all the factors above, PCT 53 was considered a more representative vegetation community since it is a grassland/sedgeland community rather than purely a grassland, which applies to PCT24.

Table 4.7 Vegetation zone 7 description

Vegetation Zone 7 – PCT 53 Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains	
	Allocating vegetation to PCT 53, rather than questionably allocating areas to PCT 24, was also considered a more conservative approach since: • PCT 53 is a higher offset trading group (Inland Floodplain Swamps greater than or equal to 50% and less than 70%) than PCT 24 (Inland Floodplain Shrublands less than 50%). • PCT 53 has more threatened species associated than PCT 24. The potential presence of PCT 360 was also considered following feedback from BCD (Appendix D; Correspondence ref: DOC22/717039, 4 October 2022). However, at least within the study area, Lake Cowal appears to generally lack gilgais. This is demonstrated by a Digital Terrain Model (DTM), which shows high uniformity of elevation throughout the Lake Cowal when assessed using a 10 cm elevation differential (see Appendix D; EMM Memorandum 28 November 2022), as opposed to an area with known gilgais which shows a 'stippled' appearance due to the presence of gilgais (see Appendix D; EMM Memorandum 28 November 2022). None of the diagnostic species for PCT 360 were detected in any of the seven BAM plots undertaken by EMM within Lake Cowal (as per DPE BioNet Vis 2023). Similarly, no diagnostic species were detected in any of the seven plots undertaken in Lake Cowal as part of annual monitoring of wetland condition with Evolution's mining lease (DnA Environmental 2022a). The presence of PCT 360 is also geographically unlikely at Lake Cowal as it is well north of the known distribution of PCT 360. That is, PCT 360 has been located at Holbrook, Albury and Jindera, in the southern-most part of the NSW South-western Slopes Bioregion (i.e. >230 km south; DPE 2022b). It is therefore considered that there is currently no evidence to support the occurrence of PCT 360 at Lake Cowal. Further details on the consideration of PCT 24 and PCT 360 is provided in correspondence with BCD (Appendix D; Correspondence ref: DOC22/717039, 14 December 2022).
Status	PCT 53 is associated with the *Artesian Springs Ecological Community in the Great Artesian Basin*, a Critically Endangered Ecological Community listed under the BC Act, and *The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin*, listed as Endangered under the EPBC Act. The study area is not within the Great Artesian Basin, and as such PCT 53, is not considered a threatened ecological community under either the BC Act or the EPBC Act within the study area.
Estimate of percent cleared value of PCT across its distribution	67%
Patch size	Vegetation zone 7 – Medium: 101 ha
Hollow-bearing trees	Vegetation zone 7 – Medium: Absent

Table 4.7 Vegetation zone 7 description

Vegetation Zone 7 – PCT 53 Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains



Photograph 4.7 Zone 7: PCT 53 Medium

v PCT 55 – Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions

Table 4.8 Vegetation zones 8-11 description

Vegetation Zones 8-12 – PCT 55 Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions	
PCT ID	55
Common name	Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions
Condition class	Vegetation zone 8 – DNG Vegetation zone 9 – Poor Vegetation zone 10 – Planted Vegetation zone 11 – Medium
Extent within additional disturbance area	**215.18 ha** 166.34 ha (DNG) 6.14 ha (Poor) 8.83 ha (Planted) 33.87 ha (Medium)
General description	PCT 55 is a tall grassy woodland dominated by Belah, occurring on floodplains and alluvial plains (DPE BioNet Vis 2023). PCT 55 typically occurs slightly downslope from PCT 82, and gilgai were common. Soils in this community were mostly red-brown and some grey clay soils, which is consistent with the PCT description. However, there were some areas where more red clay loam soils were present, yet the floristic assemblage matched PCT 55 due to an abundance of Belah (and not Grey Box or Weeping Myall which may suggest another PCT). PCT 55 in the study area is mostly represented by DNG, often lacking a canopy or midstory, due to a history of intensive grazing from cattle and sheep.

Table 4.8 Vegetation zones 8-11 description

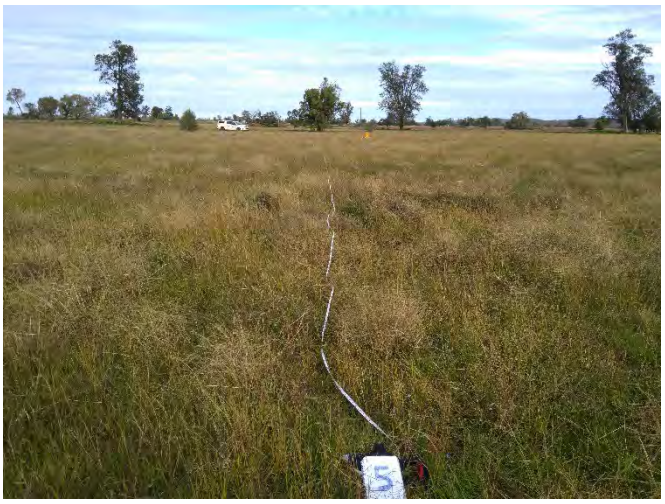
Vegetation Zones 8-12 – PCT 55 Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions	
Zone description	**Zone 8 – DNG** This zone lacks any canopy trees or shrubs. This zone was heavily impacted by clearing from agricultural land use, which led to loss of a canopy/shrub layers and an abundance of common paddock weeds. **Zone 9 – Poor** This zone is typified by sparsely distributed Belah (*Casuarina cristata*) and diagnostic shrubs Wilga (*Geijera parviflora*) and Western Rosewood (*Alectryon oleifolius*); all of which are diagnostic of PCT 55. This zone was heavily impacted by clearing and heavy grazing associated with past agricultural land uses, which has led to loss of much of the Belah canopy, a reduced middle stratum, and an abundance of common paddock weeds. **Zone 10 – Planted** Trees planted by Evolution. Most of these canopy trees are immature and of a similar age, due to being planted at a similar time. This planted vegetation was allocated to PCT 55 largely based on landscape position, with this zone located being adjacent to or surrounded by PCT 55. **Zone 11 – Medium** This zone is dominated by the mature Belah (*Casuarina cristata*), with a more intact and a more diverse native mid-story than Zones 9 and 10. Similarly, there is a denser and more diverse native understory than the other zones, however, impacts of grazing by cattle and macropods were still evident. **Diagnostic species** The primary diagnostic canopy species was Belah, which occurred across all zones except DNG. Zone 10 also had the diagnostic canopy species Western Grey Box (*Eucalyptus microcarpa*), and Weeping Myall (*Acacia pendula*). Wilga (*Geijera parviflora*) was the most common diagnostic middle stratum species, occurring in Zone 9 Poor, Zone 10 Planted and Zone 11 Medium zones. Diagnostic groundcover species occurring in all four zones included Climbing Saltbush (*Einadia nutans*), Ruby Saltbush (*Enchylaena tomentosa*), Curly Windmill Grass (*Enteropogon acicularis*), Tarvine (*Boerhavia dominii*), Corrugated Sida (*Sida corrugata*), *Walwhalleya proluta* and Pink Bindweed (*Convolvulus erubescens*). Other diagnostic species occurring in two or more zones included Galvinized Burr (*Sclerolaena birchii*), Black Rolypoly (*Sclerolaena muricata*), Queensland Bluegrass (*Dichanthium sericeum*), A Fuzzweed (*Vittadinia cuneata*), Creeping Saltbush (*Atriplex semibaccata*), Fairy Grass (*Sporobolus caroli*), and Lesser Joyweed (*Alternanthera denticulata*). **Exotic species** Many exotic species were cosmopolitan and patchily distributed across zones 8 to 11. Weed cover is greatest in Zone 9 (37.63%) and least in Zone 10 (2.98%). Exotic species found within all zones were Common Sowthistle (*Sonchus oleraceus*). The HTW, Bathurst Burr (*Xanthium spinosum*a) was also observed in all four zones. Other exotic species observed in two or more zones included Turnip (*Brassica rapa* subsp*. campestris*), Paddy Melon (*Cucumis myriocarpus* subsp*. leptodermis*), Patterson's Curse (*Echium plantagineum*), Viper's Bugloss (*Echium vulgare*), Potato Weed (*Heliotropium europaeum*), Smooth Catsear (*Hypochaeris glabra*), Common Peppercress (*Lepidium africanum*), Perennial Ryegrass (*Lolium perenne*), Small-flowered Mallow (*Malva parviflora*), Cut-leaved Medic (*Medicago laciniata*), Burr Medic (*Medicago polymorpha*), Black-berry Nightshade (*Solanum nigrum*) and Wheat (*Triticum aestivum*).
Survey effort	26 plots/transects within the study area: • Zone 8 – 10 plots. • Zone 9 – 6 plots. • Zone 10 – 4 plots. • Zone 11 – 6 plots.

Table 4.8 Vegetation zones 8-11 description

Vegetation Zones 8-12 – PCT 55 Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions	
Condition description	**Zone 8 – DNG** The derived native grasslands have been subject to historical grazing and clearing. These areas typically support a relatively large proportion of native groundcover (primarily grasses) with a moderate species richness. **Zone 9 – Poor** These areas are composed of scattered and remnant patches of Belah, with a highly modified understory. The native groundcover composition and structure is similar to the adjacent DNG, owing to similar current and past land-uses. **Zone 10 – Planted** Planted vegetation consistent with PCT 55 (owing to landscape position, geology and flora that are consist with this vegetation community). Planted vegetation forms narrow strips as part of active management by Evolution. Much of the canopy and shrub species are immature and appears to be of a similar age structure, owing to a similar time of planting. **Zone 11 – Medium** The Belah canopy is reasonably intact with some thinning out apparent due to historical clearing (and lack of other diagnostic canopy species). The midstory is sparse, likely due to removal of palatable species (or new recruits) by grazers (i.e. macropods and livestock). Ground cover is predominately native with moderate species richness and relatively few exotic species present. Woody debris and fallen timber are present in several areas in patchy but low to moderate abundance. Surrounding land use (historical clearing, grazing and adjacent tracks) and associated edge impacts have degraded the condition of this zone. Edge effects are exacerbated by the small areas of remnants composing this zone.
Characteristic species used for identification of PCT	Across the vegetation zones, 20 diagnostic flora species for PCT 55 were detected within plots, consisting of: • Upper stratum: three diagnostic species • Middle stratum: three diagnostic species • Ground stratum: fourteen diagnostic species. A list of these species is provided above.
Justification of evidence used to identify the PCT	PCT 55 is listed as occurring within the NSW South Western Slopes, Lower Slopes, IBRA subregion, within which the study area occurs. Within the study area, PCT 55 is associated with alluvial plains including depressions, flats, foot slopes and drainage lines, which is consistent with the PCT description. It was typically located adjacent and slightly downslope of PCT 82. The PCT description also states that this community occurs on alluvial brown or grey clay soils. Within this vegetation zone, soils are mostly red-brown clay soils, with gilgais very common, so the geology and hydrology of the zone also matches the PCT description. When determining the extent of PCT 55, the location of remnant Belah were helpful in distinguishing this vegetation community. Typically, PCT 55 had a higher abundance of Belah, whilst Weeping Myall was rare or absent. In the cropped area (see Appendix E), remnant paddock trees were primarily Belah (*Casuarina cristata*), Wilga (*Geijera parviflora*) and Western Rosewood (*Alectryon oleifolius*). These remanent trees were best aligned as diagnostic of PCT 55, despite there likely to be an intergrade into PCT 26 at some point in that cropped paddock. In contrast, the occurrence of Weeping Myall allowed PCT 26 to be more readily identifiable from PCT 55. PCT 55 also intergraded into PCT 82 heading upslope but was differentiated from PCT 82 based on a dominance of Belah, a lower landscape position and abundant gilgai. PCT 82 also had the diagnostic trees Kurrajong (*Brachychiton populneus*) and White Cypress (*Callitris glaucophylla*), which do not occur in PCT 55.

Table 4.8 Vegetation zones 8-11 description

Vegetation Zones 8-12 – PCT 55 Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions	
	Where such canopy trees were missing, it was more difficult to distinguish between PCT 26 and 55 since both intergrade on slightly undulating flats and have gilgai. In DNG areas that lacked canopy trees, PCT 55 was identified by being positioned in lower relief areas with higher clay content in soils, poorer drainage, and proximity to remnant patches of Belah woodland. Ground cover and midstory species assemblages were not considered as a useful diagnostic of PCT 55, as indicated in in the multivariate analysis above (see Section 4.3.3ia).
Status	PCT 55 can be associated with the BC Act listed Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions EEC. However, to be considered for this EEC, the tree layer should include Weeping Myall (*Acacia pendula*) as one of the dominant species or the only tree species present. Across the zones classified as PCT 55, Weeping Myall is not a dominant species, and is sparsely distributed, only occurring in plots in the planted zone. Moreover, disturbed DNG areas assigned to PCT 55 align with adjacent vegetation where Weeping Myall (*Acacia pendula*) is not one of the dominant species, so that although these areas would respond to management actions, so it is expected that the vegetation community native to these areas would not be consistent with this EEC. As such, zones associated with PCT 55 within the study area are not considered to be consistent with the BC Act Weeping Myall EEC. Similarly, as the tree canopy is not dominated (at least 50% of trees present) by living, dead or defoliated Weeping Myall trees, PCT 55 within the study area is not consistent with the EPBC Act Weeping Myall Woodlands EEC.
Estimate of percent cleared value of PCT across its distribution	83%
Patch size	Vegetation zone 8 – DNG: 101 ha Vegetation zone 9 – Poor: 101 ha Vegetation zone 10 – Planted: 101 ha Vegetation zone 11 – Medium: 101 ha
Hollow-bearing trees	Vegetation zone 8 – DNG: Absent Vegetation zone 9 – Poor: Present Vegetation zone 10 – Planted: Absent Vegetation zone 11 – Medium: Present



Photograph 4.8 Zone 8: PCT 55 DNG

Table 4.8 Vegetation zones 8-11 description

Vegetation Zones 8-12 – PCT 55 Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions

Photograph 4.9 Zone 9: PCT 55 Poor

Photograph 4.10 Zone 10: PCT 55 Planted

Table 4.8 Vegetation zones 8-11 description

Vegetation Zones 8-12 – PCT 55 Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions



Photograph 4.11 Zone 11: PCT 55 Medium

vi PCT 82 – Western Grey Box – Poplar Box – White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion

Table 4.9 Vegetation zones 12-16 description

Vegetation Zones 12-16 – PCT 82 Western Grey Box – Poplar Box – White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	
PCT ID	82
Common name	Western Grey Box – Poplar Box – White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion
Condition class	Vegetation zone 12 – DNG Vegetation zone 13 – Poor Vegetation zone 14 – Planted Vegetation zone 15 – Regenerating Vegetation zone 16 – Medium
Extent within additional disturbance area	**120.17** ha 113.02 ha (DNG) 0.94 ha (Poor) 0.37 ha (Planted) 5.23 ha (Regenerating) 0.62 ha (Medium)
General description	PCT 82 is a tall woodland dominated by Western Grey Box (*Eucalyptus microcarpa*), Poplar Box (*Eucalyptus populnea* subsp. *bimbil*) and White Cypress Pine (*Callitris glaucophylla*), occurring on old alluvial plains and terraces (DPE BioNet Vis 2023). As within the study area, Kurrajong (*Brachychiton populneus*) and Bulloak (*Allocasuarina luehmannii*) were also common within this community. Within the study area, PCT 82 is located on hillslopes, footslopes, flats and drainage lines on red-brown clay and brown loamy clay soils. Typically, within the study area it is located just upslope from PCT 55, and downslope of PCT 185.

Table 4.9 Vegetation zones 12-16 description

Vegetation Zones 12-16 – PCT 82 Western Grey Box – Poplar Box – White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	
Zone description	**Zone 12 – DNG** This zone lacks any canopy trees or shrubs. This zone has been heavily impacted by clearing associated with agricultural land uses, which have led to loss of a canopy/shrub layers and infestation by common paddock weeds. Nevertheless, native species still dominate the groundcover. This zone also lacks fallen logs. Weeds are typically in low densities; mean of 5.2% weed cover across BAM plots. **Zone 13 – Poor** This zone consists of sparse canopy trees and shrubs. These scattered trees/shrubs are interspersed by zone 12 (DNG). Apart from scattered canopy trees and shrubs, the groundcover is like Zone 12 (DNG). Weeds are typically in low densities; mean of 3.1% weed cover across BAM plots. **Zone 14 – Planted** Trees planted by Evolution. Most of these canopy trees are immature and of a similar age, due to being planted at a similar time. This planted vegetation was allocated to PCT 82 largely based on landscape position and tree species, with this zone located being adjacent to or surrounded by PCT 82. Trees planted here are most consistent with PCT 82, with far more Western Grey Box planted then planted vegetation associated with PCT 26 and 55. Weeds are typically in moderate to high densities; mean of 25.9% weed cover across BAM plots. **Zone 15 – Regenerating** This zone was previously DNG; however, shrubs and trees are naturally regenerating. Most prevalent shrubs regenerating in this zone are immature White Cypress Pine (*Callitris glaucophylla*) and Green Wattle (*Acacia deanei*). Although not diagnostic of this zone, Western Silver Wattle (*Acacia decora*) also occurred on some occasions. Weeds are typically in low densities; mean of 2.2% weed cover across BAM plots. **Zone 16 – Medium** This zone is located primarily in two small patches at north-western and south-western extent of the study area. Woodland in medium condition is identified by a fragmented Western Grey Box (*Eucalyptus macrocarpa*), White Cypress (*Callitris glaucophylla*), Bulloak (*Allocasuarina luehmannii*) and Kurrajong (*Brachychiton populneus* subsp*. populneus*) canopy with a sparse or absent midstory. Within this vegetation zone, the middle and understory are largely disturbed due to grazing and clearing for agriculture. However, some sparse middle stratum species are still found here. Weeds are typically in low densities; mean of 0.7% weed cover across BAM plots. **Diagnostic species** The primary diagnostic canopy species was Western Grey Box, which occurred across all zones except DNG. Poor condition patches consisted of sparse mature Wilga and Western Rosewood, with Western Grey Box, Bulloak and Kurrajong rare. Other diagnostic species within Zones 13 to 16 observed outside of plots due to their sparse nature were Broad-leaf Hopbush (*Dodonaea viscosa* subsp*. spatulata*), Wilga (*Geijera parviflora*), Green Wattle (*Acacia deanei*), Budda (*Eremophila mitchellii*) and Senna from taxon 'zygophylla'. Groundcover species diagnostic of PCT 82 present within two or more zones included Speargrass (*Austrostipa scabra*), Climbing Saltbush (*Einadia nutans*), Curly Windmill Grass (*Enteropogon acicularis*), Galvinized Burr (*Sclerolaena birchii*), Rock Fern (*Cheilanthes sieberi*), *Oxalis perennans* and Corrugated Sida (*Sida corrugata*). **Exotic species** Many exotic species were cosmopolitan and patchily distributed across zones 12 to 16. Weed cover is greatest in Zone 12 (78%) and least in Zone 16 Medium (0.7%). Exotic species found within two or more zones were Wild Oats (*Avena fatua*), Skeleton Weed (*Chondrilla juncea*), Flaxleaf Fleabane (*Conyza bonariensis*), Patterson's Curse (*Echium plantagineum*), Common Peppercress (*Lepidium africanum*), Perennial Ryegrass (*Lolium perenne*), Burr Medic (*Medicago polymorpha*), Vervain (*Salvia verbenaca*), Common Sowthistle (*Sonchus oleraceus*). The HTW, Bathurst Burr (*Xanthium spinosum*a), was also observed in Zone 12 DNG.

Table 4.9 Vegetation zones 12-16 description

Vegetation Zones 12-16 – PCT 82 Western Grey Box – Poplar Box – White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	
Survey effort	26 plots/transects within the study area: • Zone 12 – 18 plots. • Zone 13 – 2 plots. • Zone 14 – 1 plot. • Zone 15 – 4 plots. • Zone 16 – 1 plot.
Condition description	**Zone 12 – DNG** The derived native grasslands have been subject to historical clearing and have been intensively grazed by stock and macropods. Midstory and canopy species are lacking, with paddock trees grouped with Zone 13. DNG areas typically have a relatively high proportion of perennial native grasses and forbs. However, paddock weeds and exotic grasses (including barley, oats and rye) are common. Fallen timber is entirely absent. **Zone 13 – Poor** Zone consists of remanent trees and shrubs (including paddock trees), which have been historically cleared understory. Trees constituting this zone are mostly mature Wilga and Western Rosewood, with some Western Grey Box, Bulloak and Kurrajong. This zone typically lacks a native understory, with scarring from livestock trampling common at the base of any remnant mature shrubs and trees (apparently due to livestock seeking shade). The ground cover is predominately native, dominated by perennial grasses. Paddock weeds and exotic grasses (including barley, oats and rye) are also common. Fallen timber is low or absent. Exotic species occur in low abundances (typically <5%). **Zone 14 – Planted** The planted area has low canopy and midstratum diversity and cover is sparse. Western Grey Box is the dominant species planted here. All individuals are established juveniles of the same age. Groundcover is sparse and moderate in species richness. There are moderate extents of exotic species within the ground cover for this zone (up to 25%). Fallen timber and litter cover are low or absent. **Zone 15 – Regenerating** The regenerating zone has low canopy and midstratum diversity and cover is sparse. All individuals were typically established juveniles of the same age. In many cases these patches were White Cypress seedlings sourced from a nearby mature tree. Groundcover is sparse and moderate in species richness. Few exotic species occur and only make up a small portion of the ground cover (typically <5%). Fallen timber and litter cover are low or absent. **Zone 16 – Medium** The canopy is partially cleared and the midstory is largely absent in the medium condition zone. Age structure of canopy species is highly variable. Hollows occur but are in low abundances. Stock grazing has also occurred across the zone. Ground cover is predominately native with moderate species richness and few exotic species present in most areas. Exotic species occur in low abundance (typically <5%). Woody debris and fallen timber occurrences are moderate in most woodland areas.
Characteristic species used for identification of PCT	Across the vegetation zones, 21 diagnostic flora species for PCT 82 were detected within and outside plots, consisting of: • Upper stratum: four diagnostic species (three located outside plots, noting that these species were in low density so not captured by plots). • Middle stratum: six diagnostic species (five located outside plots). • Ground stratum: 11 diagnostic species. A list of these species is provided above.

Table 4.9 Vegetation zones 12-16 description

Vegetation Zones 12-16 – PCT 82 Western Grey Box – Poplar Box – White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	
Justification of evidence used to identify the PCT	**BC Act** Zones 12–16 are considered to be aligned with *Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions*, listed as an EEC under the BC Act. Disturbed remnants are considered to form part of the community, including where the vegetation would respond to assisted natural regeneration. Allocation to this EEC was based on the following factors listed in the final determination (NSW TSSC 2011): • *Eucalyptus microcarpa* (Inland Grey Box) is the most characteristic species where remnants remain or within patches lacking Grey Box, but these trees occur in nearby, adjacent remanent patches. • Occurs where average rainfall is 375–800 mm pa. • Mean maximum annual temperature is 22–26°C. • Occurs within South West Slopes Bioregion. • Site is in Bland Local Government Area (LGA). • TEC description includes areas where overstorey may be absent as a result of past clearing or thinning, leaving only an understorey, which applies to Zones 12 and 15. • Occurrence of 24 of 74 species that characterise this EEC (observed in and outside of plots). • Soils in this PCT are red-brown clay and brown loamy clays with gravel more common in upper hillslope transitional areas, which is consistent with the description of red brown earths alluvial soils that commonly occur with this TEC. • Despite extent of disturbance to all PCT 82 zones, it would be expected that understorey and overstorey, or both, would, under appropriate management, likely respond to assisted natural regeneration from the soil seed bank. **EPBC Act** The EPBC Act Policy Statement for *Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-Eastern Australia* EEC (DSEWPaC 2012) determines that a woodland or DNG patch must meet the following criteria to be included in the listing: • The area is within the known distribution for the TEC. • At least 50% of the plant cover in the ground layer is made up of perennial native species OR at least 10% of plant cover in ground layer is made up of perennial native grass species. • Western Grey Box is or was the dominant canopy species. • Patch is at least 0.5 ha. • Non-grass weeds do not make up more than 30% of the ground cover. • Canopy species cover at least 10% of the patch OR evidence that Western Grey Box was once common in the patch. • In DNG, Shrubland or Woodland patches less than 2 ha, at least 12 perennial native species in mid and ground layers AND at least 50% of ground cover is perennial native species. • In woodland patches less than 2 ha there are at least 8 perennial native species in mid and ground layers AND at least 50% of ground cover is perennial native species. All zones are consistent with this TEC according to the above criteria. That is, medium condition patches are considered consistent since, although sparse, the canopy layer contains Grey Box (*E. microcarpa*) as the dominant or co-dominant tree species, whilst the vegetative cover of non-grass weed species in the ground layer is less than 30%. For patches less than 2 ha and/or where canopy is less developed (including DNG, poor, regenerating and planted vegetation), at least 50% of the vegetative cover in the ground layer is made up of perennial native species and there are 12 or more native species are present in the ground layer.
Estimate of percent cleared value of PCT across its distribution	70%

Table 4.9 Vegetation zones 12-16 description

Vegetation Zones 12-16 – PCT 82 Western Grey Box – Poplar Box – White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	
Patch size	Vegetation zone 12 – DNG: 101 ha Vegetation zone 13 – Poor: 101 ha Vegetation zone 14 – Planted: 101 ha Vegetation zone 15 – Regenerating: 101 ha Vegetation zone 16 – Medium: 101 ha
Hollow-bearing trees	Vegetation zone 12 – DNG: Absent Vegetation zone 13 – Poor: Absent Vegetation zone 14 – Planted: Absent Vegetation zone 15 – Regenerating: Absent Vegetation zone 16 – Medium: Absent



Photograph 4.12 Zone 12: PCT 82 DNG



Photograph 4.13 Zone 13: PCT 82 Poor

Table 4.9 Vegetation zones 12-16 description

Vegetation Zones 12-16 – PCT 82 Western Grey Box – Poplar Box – White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion

Photograph 4.14 Zone 14: PCT 82 Planted

Photograph 4.15 Zone 15: PCT 82 Regenerating

Table 4.9 Vegetation zones 12-16 description

Vegetation Zones 12-16 – PCT 82 Western Grey Box – Poplar Box – White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion



Photograph 4.16 Zone 16: PCT 82 Medium

vii PCT 185 – Dwyer's Red Gum – White Cypress Pine – Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion

Table 4.10 Vegetation zone 17-19 description

Vegetation Zones 17 to 19 – PCT 185 Dwyer's Red Gum – White Cypress Pine – Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion	
PCT ID	185
Common name	Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
Condition class	Vegetation zone 17 – DNG Vegetation zone 18 – Medium Vegetation zone 19 – High
Extent within additional disturbance footprint	**5.06 ha** 3.56 ha (DNG) 1.50 ha (Medium) 0 ha (High)
General description	PCT 185 is a tall mallee open woodland dominated by Dwyer's Red Gum (*Eucalyptus dwyeri*), White Cypress Pine and/or Currawang (*Acacia doratoxylon*), occurring on rocky ridges and hillcrests (DPE BioNet Vis 2023). Within the study area, this community occurs as DNG, poor, medium and high condition classes. This vegetation community is restricted to rocky hills within the north-west and southern extents of the study area.

Table 4.10 Vegetation zone 17-19 description

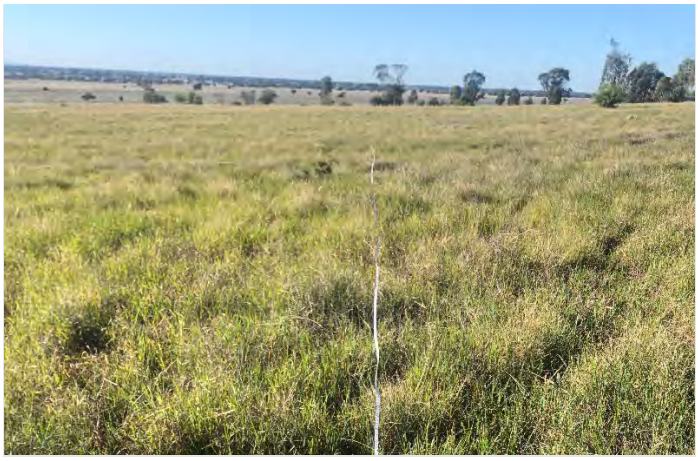
Vegetation Zones 17 to 19 – PCT 185 Dwyer's Red Gum – White Cypress Pine – Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion	
Zone Description	**Zone 17 – DNG** This zone lacks any canopy trees or shrubs throughout this zone. This zone was heavily impacted by clearing associated with agricultural land uses, which has led to loss of a canopy/shrub layers. Weeds are typically in low densities; mean of 0.3% weed cover across BAM plots. **Zone 18 – Medium** This zone consists of woodland in medium condition with sparse Dwyers Run Gum (*Eucalyptus dwyeri*) and sparse to absent mid-story. Medium condition areas are typically located downslope of higher condition areas, likely due to edge effects from agriculture as land becomes more arable heading downslope. Weeds are typically in low densities; mean of 0.18% weed cover across BAM plots. **Zone 19 – High** Woodland in high condition is identified by largely intact canopy of Dwyers Run Gum (*Eucalyptus dwyeri*) and Mugga Ironbark (*Eucalyptus sideroxylon*), with scattered Kurrajong (*Brachychiton populneus*). Canopy cover is ~25%. The midstory is largely sparse or absent. Weeds are typically in low densities; mean of 0.3% weed cover across BAM plots. **Diagnostic species** Diagnostic canopy species Dwyers Run Gum (*Eucalyptus dwyeri*) was common within Zone 18 Medium and Zone 19 High. The high condition zone also had the diagnostic canopy species Mugga Ironbark (*Eucalyptus sideroxylon*) and Kurrajong (*Brachychiton populneus*). The diagnostic shrub Berry Saltbush (*Einadia hastata*) occurred in both medium and high condition zones. Diagnostic ground cover species in those two zones were A Raspwort (*Gonocarpus elatus*), Purple Burr-Daisy (*Calotis cuneifolia*), *Oxalis perennans* and Rock Fern (*Cheilanthes sieberi*). The DNG lacked any diagnostic canopy trees or shrubs, with the only diagnostic understory species being *Oxalis perennans* and Rock Fern (*Cheilanthes sieberi*). **Exotic species** Many exotic species were cosmopolitan and patchily distributed across zones 17 to 19. Weed cover were generally low in all three zones (≤0.3%). Exotic species found within two or more zones were Skeleton Weed (*Chondrilla juncea*), Flaxleaf Fleabane (*Conyza bonariensis*), Common Peppercress (*Lepidium africanum*) and Black-berry Nightshade (*Solanum nigrum*).
Survey effort	9 plots/transects within the study area: • Zone 17 – 2 plots. • Zone 18 – 4 plots. • Zone 19 – 3 plots.

Table 4.10 Vegetation zone 17-19 description

Vegetation Zones 17 to 19 – PCT 185 Dwyer's Red Gum – White Cypress Pine – Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion	
Condition description	**Zone 17 – DNG** The derived native grasslands have been subject to historical grazing and clearing. These areas typically support a relatively large extent of native groundcover (primarily grasses) with moderate species richness. Canopy trees and shrubs are lacking. There is little to no fallen logs present in this zone. **Zone 18 – Medium** The canopy is primarily Dwyers Red Gum and is patchy, with some thinning out apparent due to historical clearing. The midstory is sparse, likely due to removal of palatable species (or new recruits) by grazers (i.e. macropods and livestock). Ground cover is predominately native with moderate species richness and relatively few exotic species present. Woody debris and fallen timber are present in several areas in patchy but moderate abundance. Some hollows also occur within this zone. Surrounding land use (historical clearing, grazing and adjacent tracks) and associated edge impacts contribute to the condition of this zone. Edge effects are exacerbated by the small areas of remnants composing this zone. **Zone 19 – High** The canopy is largely intact with Dwyers Red Gum and Mugga Ironbark most common. However, the midstory is sparse, likely due to removal of palatable species (or new recruits) by grazers (i.e. macropods and livestock). Ground cover is predominately native with moderate species richness and relatively few exotic species present. Woody debris and fallen timber are considerably high in several areas. Many of the mature Dwyer Red Gum and Mugga Ironbark have hollows present.
Characteristic species used for identification of PCT	Across the vegetation zones, eight diagnostic flora species for PCT 185 were detected within plots, consisting of: • upper stratum: three diagnostic species • middle stratum: one diagnostic species • ground stratum: four diagnostic species. A list of these species is provided above.
Justification of evidence used to identify the PCT	PCT 185 is listed as occurring within the NSW South Western Slopes, Lower Slopes, IBRA subregion, within which the study area occurs. This PCT was identified primarily on an abundance of diagnostic canopy species Dwyers Red Gum and Mugga Ironbark. The location within the landscape was also consistent, with PCT 185 occurring on shallow gravelly, sandy or loamy soils on rocky ridges, hillslopes and hillcrests. Within the study area, the PCT is associated with a rocky hillcrest on shallow gravelly, red-brown loam soil. PCT 186 Dwyer's Red Gum – Black Cypress Pine – Currawang shrubby low woodland on rocky hills mainly in the NSW South Western Slopes Bioregion was the next best fit, however, several of the diagnostic species that would be expected to be present in this setting were absent, including Black Cypress, Tumbledown Red Gum, Bundy and Red Stringybark. Patches of DNG consistent with this PCT were identified by nearby diagnostic canopy species (primarily Dwyers Red Gum and Mugga Ironbark), location on the rocky hillcrest and soils that were consistent with higher condition zones that were attributed to this PCT.
Status	PCT 185 is not associated with any listed TECs under the BC Act or EPBC Act.
Estimate of % cleared value of PCT across its distribution	20%
Patch size	Vegetation zone 17 – DNG: 101 ha Vegetation zone 18 – Medium: 101 ha Vegetation zone 19 – High: 101 ha

Table 4.10 Vegetation zone 17-19 description

Vegetation Zones 17 to 19 – PCT 185 Dwyer's Red Gum – White Cypress Pine – Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion	
Hollow-bearing trees	Vegetation zone 17 – DNG: Absent Vegetation zone 18 – Medium: Present Vegetation zone 19 – High: Present



Photograph 4.17 Zone 17: PCT 185 DNG



Photograph 4.18 Zone 18: PCT 82 Medium

Table 4.10 Vegetation zone 17-19 description

Vegetation Zones 17 to 19 – PCT 185 Dwyer's Red Gum – White Cypress Pine – Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion



Photograph 4.19 Zone 19: PCT 82 High

viii PCT 244 – Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)

Table 4.11 Vegetation zone 20-22 description

Vegetation Zones 20 to 22 – Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)	
PCT ID	244
Common name	Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)
Condition class	Vegetation zone 20 – DNG Vegetation zone 21 – Poor Vegetation zone 22 – Medium
Extent within Additional disturbance area	**12.28 ha** 10.33 ha (DNG) 0.21 ha (Poor) 1.75 ha (Medium)
General description	PCT 244 is a mid-high to tall woodland or open woodland, dominated by Poplar Box (*Eucalyptus populnea* subsp. *bimbil*). The small trees Belah (*Casuarina cristata*) or Western Rosewood (*Alectryon oleifolius* subsp. *canescens*) may be present but not co-dominant. The shrub layer is absent or sparse with some thickets in places. All zones associated within this PCT in the study area have been substantially impacted by past grazing or cropping. This zone is located immediately to the north of the Additional disturbance area, adjacent the western shoreline of Lake Cowal. It is located in a slightly lower position in the landscape than PCT 26 and PCT 55, and along the drainage diversion channel that flows east into Lake Cowal. PCT 244 is also located just inland than PCT 249, which typically extends along the shoreline of Lake Cowal.

Table 4.11 Vegetation zone 20-22 description

Vegetation Zones 20 to 22 – Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)	
Zone description	**Zone 20 – DNG** This zone lacks any canopy trees, with sparse shrubs throughout this zone. This zone was heavily impacted by clearing associated with past agricultural land uses, which has led to loss of a canopy/shrub layers. This zone intersperses patches of medium condition PCT 244, located along the riparian area associated with the drainage channel that flows east into Lake Cowal. Weeds are typically in low densities; mean of 3.45% weed cover across BAM plots. **Zone 21 – Poor** Poor condition areas are located on the outside of medium condition zone. Sparsely distributed, juvenile Poplar Box (*Eucalyptus populnea* subsp*. bimbil*) are present here, which likely recruited from mature vegetation in the nearby medium condition zone. Weeds are typically in low densities; mean of 1.3% weed cover across BAM plots. **Zone 22 – Medium** Medium condition areas consist of remnant patches of Poplar Box (*Eucalyptus populnea* subsp*. bimbil*) and Belah (*Casuarina cristata*). The mid-story is largely sparse, but there are scattered Wilga (*Geijera parviflora*). Several mature Belah (*Casuarina cristata*) have hollows in this zone. Fallen logs are moderately common. Weeds are typically in very high densities; mean of 75.9% weed cover across BAM plots. **Diagnostic species** Poplar Box (*Eucalyptus populnea* subsp*. bimbil*) is the primary diagnostic canopy species in Zones 21 and 22, with more mature individuals occurring in the later zone. The primary diagnostic shrub species present in all three zones was Black Cotton Bush (*Maireana decalvans*). Diagnostic shrubs Wilga (*Geijera parviflora*), Thorny Saltbush (*Rhagodia spinescens*) also occurred in the Zone 22. Diagnostic groundcover species in all three zones were Corrugated Sida (*Sida corrugata*), *Walwhalleya proluta*, Warrego Grass (*Paspalidium jubiflorum*) and *Oxalis perennans.* The diagnostic groundcover species Pigweed (*Portulaca oleracea*), Quena (*Solanum esuriale*) and Tarvine (*Boerhavia dominii*) also occurred within two of the three zones. **Exotic species** Many exotic species were cosmopolitan and patchily distributed across zones 20 to 22. Weed cover was greatest in Zone 22 Medium (75.9%) and lowest in Zone 21 Poor (1.3%). High infestations of Perennial Ryegrass (*Lolium perenne*) and Patterson's Curse (*Echium plantagineum*) occur in Zone 22. Weeds found in two or more zones of PCT 244 included Turnip (*Brassica rapa* subsp*. campestris*), Patterson's Curse (*Echium plantagineum*) Viper's Bugloss (*Echium vulgare*), Small-flowered Mallow (*Malva parviflora*), Black-berry Nightshade (*Solanum nigrum*) and Common Sowthistle (*Sonchus oleraceus*). Three HTWs were detected in PCT 244, which were Bathurst Burr (*Xanthium spinosum*; Zones 21 and 22), Paspalum (*Paspalum dilatatum*; Zone 22) and Lippia (*Phyla canescens*; Zone 20).
Survey effort	6 plots/transects within the study area: • Zone 20 – 3 plots. • Zone 21 – 2 plots. • Zone 22 – 1 plot.

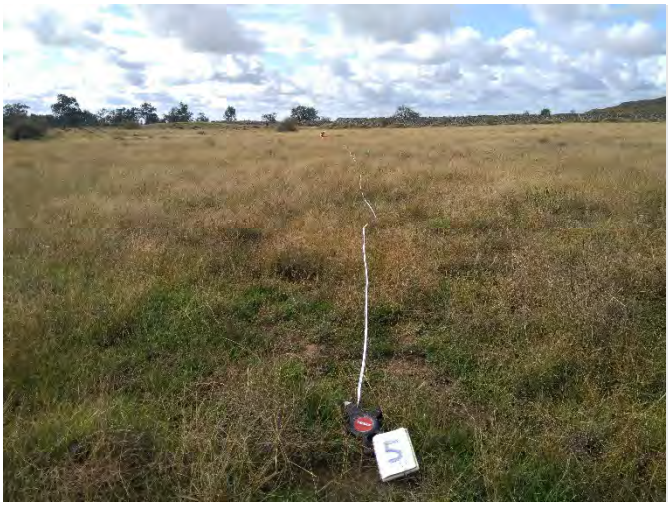
Table 4.11 Vegetation zone 20-22 description

Vegetation Zones 20 to 22 – Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)	
Condition description	**Zone 20 – DNG** The derived native grasslands have been subject to grazing and clearing. This zone supports a relatively high proportion of native groundcover (primarily grasses) with a moderate species richness. Canopy trees and shrubs are lacking. There is a moderate extent of weed infestation present, with some pockets of high weed density. There is little to no fallen logs present in this zone. **Zone 21 – Poor** Highly disturbed vegetation zone surrounding better quality mature vegetation in Zone 22. Zone is an intergrade between DNG and medium condition zones. Trees are sparse and typically juveniles, with the odd paddock tree. Weed cover is typically low, but there are some pockets of high weed density. There is little to no fallen logs present in this zone. **Zone 22 – Medium** The canopy is primarily scattered Poplar Box and Belah, with a much lower density than would have naturally once occurred. The canopy and midstory of this zone have been thinned out due to historical clearing for grazing and cropping. The midstory is sparse, likely due to removal of palatable species (or new recruits) by grazers (i.e. macropods and livestock). There is a moderate to high extent of weed infestation present. Woody debris and fallen timber are present in several areas in patchy but moderate abundance. Surrounding land use (e.g. historical clearing, grazing and adjacent tracks) and associated edge impacts contribute to the condition of this zone. Edge effects are exacerbated by the small remnants composing this zone.
Characteristic species used for identification of PCT	Across the vegetation zones, 18 diagnostic flora species for PCT 244 were detected within plots, consisting of: • upper stratum: two diagnostic species (one outside plots) • middle stratum: three diagnostic species • ground stratum: 13 diagnostic species. A list of these species is provided above.
Justification of evidence used to identify the PCT	PCT 244 is listed as occurring within the NSW South Western Slopes, Lower Slopes, IBRA subregion, within which the study area occurs. This PCT was identified primarily on an abundance of diagnostic canopy species Poplar Box and Belah since the understory was considerably impacted by agriculture. The location within the landscape was also consistent with PCT 244, with the patch associating with a drainage depression within a riparian area on an alluvial plain. The soil geology is also consistent with PCT 244 with alluvial loams and clays present. Patches of DNG consistent with this PCT were identified by nearby diagnostic canopy species (primarily Poplar Box and Belah) and a similar elevation/proximity to the riparian area associated with Zone 22.

Table 4.11 Vegetation zone 20-22 description

Vegetation Zones 20 to 22 – Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)	
Status	PCT 244 is not associated with any listed TECs under the BC Act. However, only Zone 22 is consistent with the EPBC Act listed *Poplar Box Grassy Woodland on Alluvial Plains* EEC. To be considered consistent with this EPBC Act listed EEC, the patch must meet the following thresholds based on the key diagnostic characteristics; along with the description of the ecological community and the area it inhabits. Zones 20 to 22 were assessed against these criteria below. **Key diagnostic characteristics** Location and physical environment: Zones 20 to 22 are consistent with this criterion since consistent they occur in the NSW South Western Slopes IBRA region. All three zones also occur on a depositional alluvial plain with clay, clay-loam, loam and sandy loam, as part of a defined floodplain. Structure: Only Zone 22 meets the requirement of being a grassy woodland to grassy open woodland with a tree crown cover of 10% or more at patch scale; a tree canopy is present where canopy tree species are capable of reaching 10 m or more in height; *Eucalyptus populnea* (Poplar Box) is present in the canopy and is the dominant tree species; Mid layer (1–10 m) crown cover of shrubs to small trees is low (<30%). The patch also has a ground layer (<1 m) mostly dominated by native grasses, other herbs and occasionally chenopods (during extended dry periods), ranging from sparse to thick (i.e. in some places >50% of groundcover is native). Zone 22 Medium also has 23 diagnostic species for this TEC, as listed in Appendix A of the Conservation Advice (TSSC 2019a). Zones 20 and 21 do not have a tree crown cover of 10%, nor is a tree canopy present, and so do not qualify for this EEC. Despite meeting the criteria to qualify for the Poplar Box woodland EEC, Zone 22 fails to meet the criteria required to be referred under national environmental law. That is, it fails to meet the criteria for Category A1, which allows for patches ≥1 ha, since perennial weed cover is too high and native understorey is not diverse enough. To be considered Category A1, 90% or more of the perennial vegetation cover needs to be native species and 30 or more native plant species are required within in the ground layer per ha. However, weed cover in this zone can be very high, ranging from 10.6 to 141.2% exotic groundcover. Natives made up 57.69% and 79.41% of species richness of the groundcover, which is also below the 90% threshold to be considered Category A1. Note, however, that the diversity threshold is reached with >30 native species is present in the ground layer (when plot data were pooled). Further, Zone 22 fails to meet the >5 ha patch size threshold to consider for the other referral criteria. Despite failing to meet the condition or patch size thresholds for referral, following the precautionary principle, the impact the patch of Poplar Box Grassy Woodland on Alluvial Plains EEC was referred under the EPBC Act (EPBC 2022/09223). Upon review by DCCEEW, it was not considered that the proposed action would have not a significant impact to this EEC (date of decision 28 June 2022).
Estimate of percent cleared value of PCT across its distribution	73%
Patch size	Vegetation zone 21 – DNG: 101 ha Vegetation zone 22 – Poor: 101 ha Vegetation zone 23 – Medium: 101 ha
Hollow-bearing trees	Vegetation zone 21 – DNG: Absent Vegetation zone 22 – Poor: Absent Vegetation zone 23 – Medium: Present

Table 4.11 Vegetation zone 20-22 description

Vegetation Zones 20 to 22 – Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)

Photograph 4.20 Zone 21: PCT 244 DNG

Photograph 4.21 Zone 21: PCT 244 Poor

Table 4.11 Vegetation zone 20-22 description

Vegetation Zones 20 to 22 – Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)



Photograph 4.22 Zone 22: PCT 244 Medium

ix PCT 249 – River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW

Table 4.12 Vegetation zone 23-25 description

Vegetation Zones 23 to 25 – PCT 249 River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	
PCT ID	249
Common name	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW
Condition class	Vegetation zone 23 – DNG Vegetation zone 24 – Regenerating Vegetation zone 25 – Medium
Extent within additional disturbance footprint	**51.97 ha** 6.85 ha (DNG) 16.53 ha (Regenerating) 28.58 ha (Medium)
General description	PCT 249 is a tall woodland with trees averaging about 20 m high dominated by River Red Gum (*Eucalyptus camaldulensis* subsp. *camaldulensis*). Shrubs are absent or rare. The ground cover is dense and often contains a number of grasses, which is altered with soil wetness and flooding regimes and from north to south. This community occurs in closed (e.g. cowals) and open depressions on floodplains and alluvial plains mainly from central west NSW to Victoria. Within the study area this PCT occurs within the riparian area flanking Lake Cowal. This area is periodically inundated with the filling and emptying of Lake Cowal. The width of this PCT is greater in the north of the study area (up to ~0.5 km wide) and narrow (<100 m wide) to the south.
Zone description	**Zone 23 – DNG**

Table 4.12 Vegetation zone 23-25 description

Vegetation Zones 23 to 25 – PCT 249 River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	
	This zone lacks any canopy trees, with sparse shrubs throughout this zone. This zone was heavily impacted by clearing associated with past agricultural land uses, which has led to loss of a canopy and shrub layers. This zone typically sits more landward than other PCT 249 zones and has a slightly higher elevation. As this zone is likely to be less frequently inundated than the other PCT 249 zones, it is likely to have been prone to more intensive grazing. Weeds are typically in low densities; mean of 2.6% weed cover across BAM plots. **Zone 24 – Regenerating** This zone was located along the inner riparian area of Lake Cowal and typified by recruiting River Red Gums. This zone was heavily impacted by clearing associated with past agricultural land uses within Lake Cowal, which has led to loss of a most canopy/shrub layers. This zone typically sits on the inner extent of the riparian area, toward the middle of Lake Cowal from the medium condition zone PCT 249. This vegetation is located in a subtly lower landscape position than Zone 23, so that more sparse tree cover and impacts associated with inundation are likely to be more prevalent and contribute to a more simplified structure. Here, as inundation extent increases, tree cover becomes sparser, giving way to more wetland communities moving into Lake Cowal (i.e. PCTs 17 and 53). Past grazing may have also contributed to a loss of canopy trees and shrubs in this area. Weeds are typically in high densities; mean of 46.4% weed cover across BAM plots. Hollow-bearing trees and fallen logs are absent. **Zone 25 – Medium** Medium condition areas consist of moderate density (~20%) River Red Gum. The canopy of this zone is largely retained, with less impacts from past agriculture than the other two PCT 249 zones. This zone is prone to inundation when Lake Cowal is full. The mid-story is largely sparse, which is not unusual for this community. Scattered diagnostic shrubs present in this zone are Lignum, *Sclerolaena muricata* (Black Rolypoly) and *Glycyrrhiza acanthocarpa* (Native Liquorice). Weeds are typically in high densities; mean of 58.8% weed cover across BAM plots. Hollow-bearing trees are and fallen logs are common. **Diagnostic species** River Red Gum is the primary diagnostic species for Zones 24 and 25, but trees are lacking in Zone 23 due to past clearing for agriculture. Diagnostic shrubs present in all three zones were Lignum (*Duma florulenta*) and Native Liquorice (*Glycyrrhiza acanthocarpa*). Diagnostic shrubs in two zones were Black Rolypoly (*Sclerolaena muricata*). The diagnostic groundcover species Lesser Joyweed (*Alternanthera denticulata*) was common across all three zones, whilst Caustic Weed (*Chamaesyce drummondii*) occurred in two of the three zones. Other groundcover diagnostic species in at least one zone were Shiny Dock (*Rumex tenax*), Common Couch (*Cynodon dactylon*) Common Sneezeweed (*Centipeda cunninghamii*) and *Marsilea costulifera*. **Exotic species** Many exotic species were cosmopolitan and patchily distributed across zones 23 to 25. Weed cover ranged from low densities in Zone 23 (2.6%) to high densities in Zone 25 (58.8%). Weed species common to all three zones for PCT 249 were Paddy Melon (*Cucumis myriocarpus* subsp*. leptodermis*), Viper's Bugloss (*Echium vulgare*), Burr Medic (*Medicago polymorpha*) and Common Sowthistle (*Sonchus oleraceus*). Weeds recorded in two zones for PCT 249 were *Abutilon grandifolium*, *Chenopodium album* (Fat Hen), *Cirsium vulgare* (Spear Thistle), *Hypochaeris glabra* (Smooth Catsear), *Lactuca serriola* (Prickly Lettuce), *Malva parviflora* (Small-flowered Mallow). The HTW, *Xanthium spinosum* (Bathurst Burr), also occurred in zones 23 and 25.
Survey effort	12 plots/transects within the study area: • Zone 23 – 3 plots. • Zone 24 – 4 plots. • Zone 25 – 5 plots.

Table 4.12 Vegetation zone 23-25 description

Vegetation Zones 23 to 25 – PCT 249 River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	
Condition description	**Zone 23 – DNG** The derived native grasslands have been subject to historical grazing and clearing, as well as periodic inundation associated with filling of Lake Cowal. These areas typically support a relatively high proportion of native groundcover (primarily grasses) with a moderate species richness. Canopy trees and shrubs are lacking. There is a low to moderate extent of weed infestation present. There is little to no fallen logs present in this zone. **Zone 24 – Regenerating** The regenerating areas are in a poor to moderate condition, with a low and sparse canopy and midstratum diversity. Most tree cover consists of juvenile River Red Gum. These areas were once cleared and grazed by livestock but are naturally regenerating with trees starting to establish. This zone also more regularly inundates than the other zones of PCT 249, as it is located more into Lake Cowal. Groundcover is moderate with sedges and grasses common, with a moderate in species richness. There typically a high weed cover here. Hollow-bearing trees and fallen logs are absent. **Zone 25 – Medium** The canopy is primarily mature River Red Gum, with a patchier cover than would have naturally once occurred. The canopy and midstory of this zone were likely thinned out due to historical clearing for grazing and cropping; however, this is not uncommon for this community. There is a high extent of weed infestation present here. Woody debris and fallen timber are present in several areas in patchy but moderate abundance. Mature River Red Gum in this zone also have abundant hollows. Surrounding land use (historical clearing, grazing and adjacent tracks) and associated edge impacts contribute to the degraded condition of the understory of this zone. Edge effects are exacerbated by the small areas of tree remnants composing this zone.
Characteristic species used for identification of PCT	Across the vegetation zones, 11 diagnostic flora species for PCT 249 were detected within plots, consisting of: • upper stratum: one diagnostic species • middle stratum: four diagnostic species • ground stratum: six diagnostic species. A list of these species is provided above.
Justification of evidence used to identify the PCT	PCT 249 is listed as occurring within the NSW South Western Slopes, Lower Slopes, IBRA subregion, within which the study area occurs. This PCT was identified primarily on an abundance of diagnostic canopy species River Red Gum since the understory was considerably impacted by agriculture. Mature River Red Gum were used to delineate the medium condition zone 25, whilst regenerating River Red Gum allowed the regenerating zone 24 to be identified. The location within the landscape was also consistent with PCT 249, with the patch associating with the edges of Lake Cowal, an ephemeral cowal wetland. PCT 249 in the study area also occurs on grey sandy clay to heavy cracking clay soils on the edges of or across the bed of Lake Cowal, which is consistent with the description of this PCT. Disturbance from cropping and grazing within this PCT is also consistent with the description of the typical impacts from agricultural land-use within such cowals. Patches of DNG consistent with this PCT were identified by nearby diagnostic canopy species (River Red Gum) and locations within the riparian area that were consistent with the medium condition zone for this PCT 249, where remanent mature River Red Gum still occur. The diagnostic shrub species Lignum, Black Rolypoly (*Sclerolaena muricata*) and Native Liquorice (*Glycyrrhiza acanthocarpa*) also assisted delineating PCT 249 where River Red Gum were cleared.
Status	PCT 249 is associated with the *Artesian Springs Ecological Community in the Great Artesian Basin* EEC, which listed as Critically Endangered under the BC Act. However, as the study area is not with the Great Artesian Basin and PCT 249 in the study area is not considered this TEC under either the BC Act. PCT 249 does not correspond with any EPBC Act listed EEC.

Table 4.12 Vegetation zone 23-25 description

Vegetation Zones 23 to 25 – PCT 249 River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	
Estimate of percent cleared value of PCT across its distribution	50%
Patch size	Vegetation zone 23 – DNG: 101 ha Vegetation zone 24 – Regenerating: 101 ha Vegetation zone 25 – Medium: 101 ha
Hollow-bearing trees	Vegetation zone 23 – DNG: Absent Vegetation zone 24 – Regenerating: Absent Vegetation zone 25 – Medium: Present



Photograph 4.23 Zone 23: PCT 249 DNG



Photograph 4.24 Zone 24: PCT 249 Regenerating

Table 4.12 Vegetation zone 23-25 description

Vegetation Zones 23 to 25 – PCT 249 River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW



Photograph 4.25 Zone 25: PCT 249 Medium

x Category 1 land – Cropped land

Table 4.13 Vegetation zone 26 description

Vegetation Zone 26 – Cropped land	
PCT ID	Cannot be reasonably assigned due to degraded nature. Paddock trees were separated out and were assigned to zone PCT 55_Poor.
Common name	N/A
Condition class	Vegetation zone 26 – Cropped land
Extent within additional disturbance area	71.52 ha
General description	This zone occurs wholly within Lot 38 DP39733. This lot has historically been used for cropping and cattle grazing. These agricultural practices occurred prior 1973, when the first aerial photos reveal the extent of vegetation clearing was comparable to present day. The current land use of this property is a 3-year crop/rest rotation. The land was last cropped in 2021, with harvest stretched out to early 2022, thereafter has not been cropped (Evolution 2023; Pers. comms. Tammy Rawson, Senior Advisor – Environment).

Table 4.13 Vegetation zone 26 description

Vegetation Zone 26 – Cropped land	
Zone description	A historically cropped and grazed area. This zone was subject to a Category 1 and 2 land assessment (see Appendix E). Land within the site was firstly assessed against the LLS Act criteria to determine where Category 2 land is present. The assessment concluded that Category 2 land is present in areas where there was woody native vegetation before 1990. These were mature paddock trees consisting of Wilga, Western Rosewood and Belah. These paddock trees that aligned with Category 2 land were captured within Zone 9 PCT 55 Poor. This was the only extent considered as Category 2 land since none of the area mapped as cropped is considered category 2 land as per the criteria in the LLS Act (Section 60(I)). Moreover, no "category 2-vulnerable regulated land", "category 2-sensitive regulated land" and "excluded land" was identified on the transitional NVR Map. The remainder of the site was considered consistent with the criteria for Category 1 land as it can be demonstrated that there has been a long and consistent use of the site for agriculture, including cropping, pasture improvement and stock grazing.
Survey effort	Although it was determined that the pastural extent of Category 1, five plots were undertaken in December 2022 to ascertain the composition of vegetation in this zone. • Zone 26 – 5 plots.
Condition description	Land is highly disturbed by past and recent stock grazing and cropping. Groundcover is dominated by weeds, with common weeds including *Lolium rigidum*, *Panicum capillare*, *Juncus bufonius* and *Avena fatua*. That is, within the five plots undertaken across this cropped area, there was approximately 25% weed cover and 21% native cover (~18% of was native grasses). This is likely to be toward greatest expression of native species cover given the extremely high rainfall in the months prior to survey and time since cropping (the pasture was resting after being last harvested for grain). The land was last cropped in 2021, with harvest stretch out to early 2022. Hence, the flora plots were approximately one year after harvest.
Characteristic species used for identification of PCT	This zone is not consistent with any PCT owing to a high level of disturbance. However, remnant trees have been assigned to PCT55 Poor, since Wilga, Western Rosewood and Belah best fit that PCT. Moreover, this zone is in a similar landscape position on the floodplain adjacent to Lake Cowal to nearby remnant patches of PCT 55. This vegetation would have transitioned to PCT 26 at some point, however a lack of Weeping Myall in this zone makes distinguishing this limit difficult. Native groundcover as surveyed within plots following rest and high rainfall revealed the three most common groundcover species were *Lachnagrostis filiformis*, *Echinochloa colona* and *Eriochloa pseudoacrotricha*, which are widespread and cosmopolitan grasses, not specifically aligned with a PCT.
Justification of evidence used to identify the PCT	N/A
Status	This zone is not associated with any listed TECs under the BC Act or EPBC Act.
Estimate of % cleared value of PCT across its distribution	N/A
Patch size	101 ha
Hollow-bearing trees	N/A

Table 4.13 Vegetation zone 26 description

Vegetation Zone 26 – Cropped land

Photograph 4.26 Zone 26: Cropped; North-eastern extent (looking south-west)

Photograph 4.27 Zone 26: Cropped; Central northern extent (looking west)

Table 4.13 Vegetation zone 26 description

Vegetation Zone 26 – Cropped land


Photograph 4.28 Zone 26: Cropped; North-western extent (looking east)

Table 4.13 Vegetation zone 26 description

Vegetation Zone 26 – Cropped land

Photograph 4.29 Zone 26: Cropped; Middle extent (looking east)

Photograph 4.30 Zone 26: Cropped; Middle extent (looking south)

Table 4.13 Vegetation zone 26 description

Vegetation Zone 26 – Cropped land


Photograph 4.31 Zone 26: Cropped; Middle extent (looking south)



Photograph 4.32 Zone 26: Cropped; southeastern extent (looking north-west)

4.3.4 Vegetation integrity scores

Eight PCTs occur in the study area. Twenty-four vegetation zones were mapped and entered into the credit calculator to determine vegetation integrity scores.

i Benchmarks utilised

Plots to assess vegetation integrity were undertaken from 2020 to 2022, which spans El niño and La niña ENSO events, were characterised by below and above average rainfall, respectively. Since all eight PCTs identified within the OPC footprint have 'dry', 'average' and 'wet' benchmark values applicable to the South West Slopes IBRA region within NSW DPE BioNet Vis (2023), the most appropriate benchmark was adopted in the BAM-C. To clarify the approach, EMM consulted with BCD on the matter (Appendix D; Letter dated 28 November 2022).

The query raised was that the DPIE (2020a) *Guidance for assessors and decision-makers in applying modified benchmarks to assessments of vegetation integrity* speaks to applying rainfall calibrated benchmarks, it does not provide guidance where plot data has been collected across multiple months or years, and thus the approach to be used where plots have been collected within varying rainfall conditions. Moreover, only one benchmark condition can be inserted for each vegetation zone in the BAM-C and does not allow entry of adjusted benchmark values to individual plots.

A decision was made that a reasonable and appropriate overall benchmark value to be applied to the plot data would be determined. As agreed with BCD (Appendix D; correspondence ref; DOC22/717039, 14 December 2022), our approach involved the following:

1. Sum all rainfall data (collected at West Wyalong; nearest BoM weather station) 365 days prior to each day BAM plots were undertaken.

2. Assign each plot undertaken to either 'dry', 'average' or 'wet', based on rainfall thresholds for the 12 months prior to each plot surveyed, based on PCT specific benchmarks in NSW DPE BioNet Vis (2023). We note that each PCT has its own rainfall thresholds that are specific to the South West Slopes IBRA region (it is noted that these remain unchanged following the introduction of V1.2 benchmarks as verified 10 February 2023).

3. Determine the most common rainfall condition ('dry', 'average' and 'wet'; as per the DPE BioNet Vis 2023) when BAM plots were undertaken within each PCT. This will be considered the highest number of plots undertaken during 'dry', 'average' or 'wet' conditions.

4. For each PCT, the benchmark data to be applied in the BAM-C will then be based on the rainfall condition associated with when the most plots were undertaken.

Criteria for defining 'dry', 'average' or 'wet' conditions are detailed in Table 4.14. A summary of the benchmarks applied is provided in Table 4.15.

Table 4.14 Rainfall benchmark thresholds over 12 month period as per DPE BioNet Vis (2023)

PCT	Dry (mm)	Average (mm)	Wet (mm)
17	<334	334-573	> 573
26	<313	313-544	> 544
53	<382	382-615	> 615
55	<335	335-573	> 573
82	<312	361-593	> 593
185	<368	368 - 608	> 608
244	<361	361-593	> 593
249	<379	379-617	> 617

Table 4.15 Frequency of BAM plots undertaken during different rainfall conditions and benchmark data applied[1]

Rainfall benchmark[2]	PCT 26	PCT 53	PCT 55	PCT 82	PCT 185	PCT 244	PCT 249
Plot rainfall condition state							
Dry	0	14%	30%	20%	0	33%	42%
Average	70%	86%	50%	20%	22%	50%	50%
Wet	30%	0	20%	60%	78%	17%	8%
Most common rainfall condition	Average	Average	Average	Wet	Wet	Average	Average
Benchmark data utilised							
Tree richness	2	1	3	3	4	3	2
Shrub richness	6	1	5	5	8	4	2
Grass and Grass-like richness	7	7	5	7	6	6	6
Forb richness	10	8	11	11	10	10	8
Fern richness	0	1	1	1	1	1	1
Other richness	1	0	1	1	2	1	1
Tree cover	7	0	20	38	52	31	55
Shrub cover	8	0	5	2	11	2	0
Grass and Grass-like cover	9	75	11	35	18	23	36
Forb cover	4	7	4	6	7	5	6
Fern cover	0	1	0	0	1	0	0
Other cover	0	0	0	0	0	0	0
Number of large trees	4	2	5	3	5	3	4
Stem size class	3	3	3	4	3	4	4
Total length fallen logs	10	60	28	49	45	49	62
Generation stems	Present	Present	Present	Present	Present	Present	Present
Litter cover	45	25	35	65	70	65	44

Notes: 1. Benchmark data applied according to plots that will be inserted in BAM-C only.

2. PCT specific rainfall benchmarks were applied as per the DPE BioNet Vis (2023) as at 26-5-2023 for the NSW South Western Slopes IBRA region.

ii Vegetation integrity scores

A summary of the vegetation integrity score for each vegetation zone is provided in Table 4.16. The vegetation integrity score is based on the transect data which is compared with the most appropriate rainfall benchmark values for each vegetation type, as per Table 4.15.

Table 4.16 Vegetation zone summary

Zone	PCT ID	PCT name	Condition	Study area (ha)	Direct impacts (ha)	Vegetation integrity score
1	17	Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Medium	21.71	12.04	97.2
2	26	Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	DNG	217.88	179.14	18.0
3			Poor	4.31	4.04	70.1
4			Planted	12.31	10.57	79.8
5			Medium	3.98	2.58	72.0
6			High	15.72	4.49	91.6
7	53	Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains	Medium	449.37	311.08	70.6
8	55	Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions	DNG	290.94	166.34	20.4
9			Poor	11.66	6.14	52.1
10			Planted	11.64	8.83	74.7
11			Medium	58.68	33.87	83.8
12	82	Western Grey Box – Poplar Box – White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	DNG	294.88	113.02	35.8
13			Poor	5.90	0.94	49.7
14			Planted	1.64	0.37	24.7
15			Regenerating	7.81	5.23	50.4
16			Medium	3.46	0.62	75.3
17	185	Dwyer's Red Gum – White Cypress Pine – Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion	DNG	42.91	3.56	11.9
18			Medium	7.95	1.50	68.5
19			High	23.08	0	79.8
20	244	Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)	DNG	10.33	10.33	21.0
21			Poor	0.21	0.21	31.7
22			Medium	1.75	1.75	89.5

Table 4.16 Vegetation zone summary

Zone	PCT ID	PCT name	Condition	Study area (ha)	Direct impacts (ha)	Vegetation integrity score
23	249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	DNG	8.28	6.85	40.1
24			Regenerating	20.69	16.53	48.2
25			Medium	36.33	28.58	75.1
26	Cropped	Cropped land	Non-native	128.79	71.17	N/A
-	Dam	-	-	4.94	2.71	-
-	Cleared	-	-	47.80	27.44	-
-	Exotic grassland	-	-	0.38	0.38	-

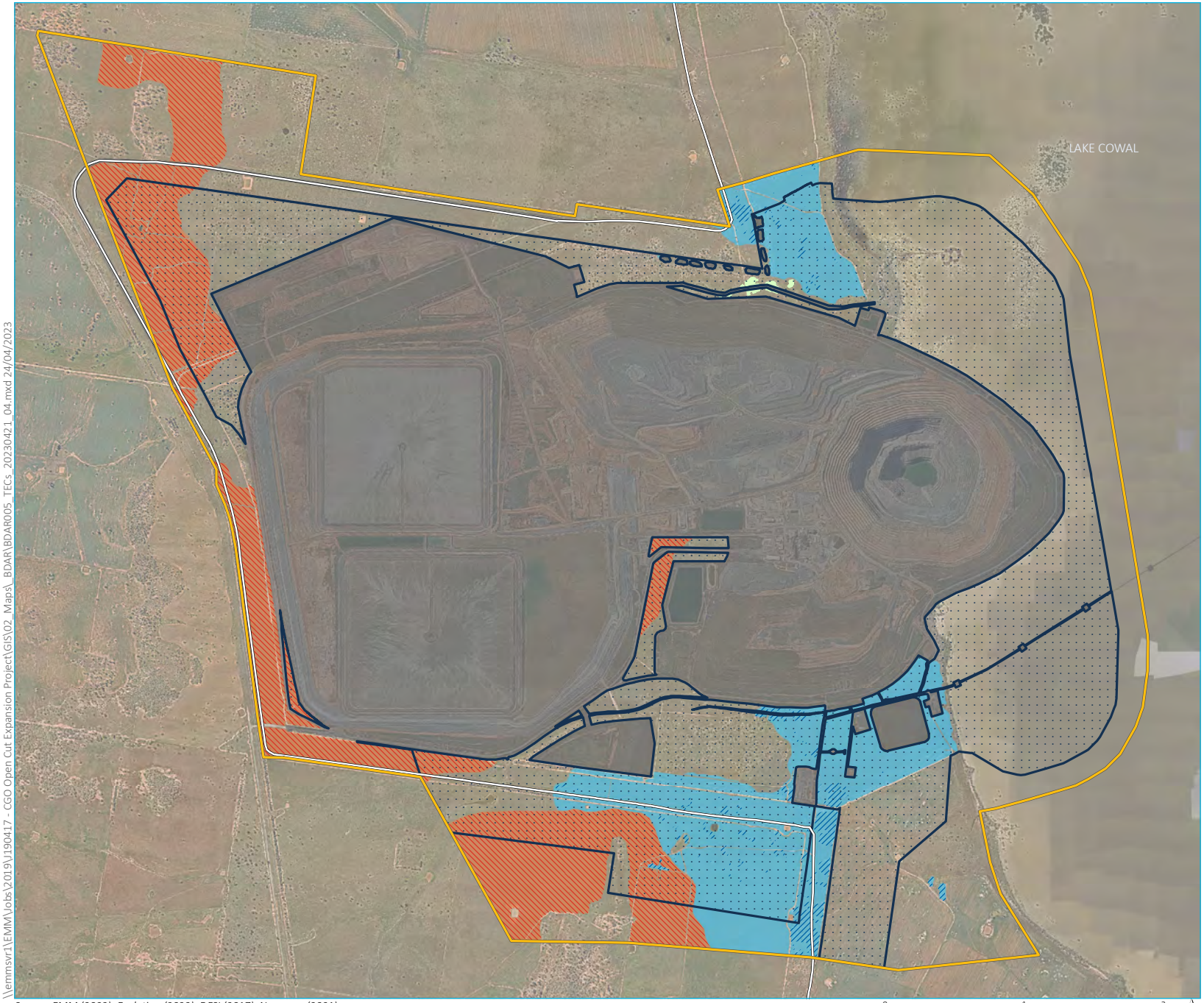
Vegetation integrity scores for naturally occurring wooded vegetation varied between 31.7 and 91.6. Planted wooded vegetation varied from 24.7 to 79.8. Note that plot data from PCT 185 DNG had a very low vegetation integrity score of 11.9, which is below the benchmark for offsetting.

4.3.5 Threatened ecological communities

Based on the information outlined above, four threatened ecological communities have been recorded within the study area. A summary is provided in Table 4.17 and locations of these Threatened Ecological Communities (TEC) is shown in Figure 4.3.

Table 4.17 Threatened ecological communities recorded in the Additional disturbance area

Threatened Ecological Community	EPBC Act	BC Act	Associated PCTs and vegetation zones	Study area (ha)	Direct impact (ha)
Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions	-	E	PCT 26: DNG; Poor; Planted; Medium; High	254.20	200.82
Weeping Myall Woodlands	E	-	PCT 26: Poor; Medium; High	24.00	11.11
Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions	-	E	PCT 82: DNG; Poor, Planted; Regenerating; Medium	313.70	120.17
Grey Box (Eucalyptus macrocarpa) Grassy Woodlands and Derived Native Grasslands of South-Eastern Australia	E	-	PCT 82: DNG; Poor, Planted; Regenerating; Medium	313.70	120.17
Poplar Box Grassy Woodland on Alluvial Plains	-	E	PCT 244: Medium	1.75	1.75



KEY

- Study area
- Additional disturbance area
- Existing and approved disturbance area
- Major road

Threatened ecological communities

EPBC Act

- Weeping Myall Woodlands
- Grey Box (Eucalyptus macrocarpa) Grassy Woodlands and Derived Native Grasslands of South-Eastern Australia
- Poplar Box Grassy Woodland on Alluvial Plains

BC Act

- Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions
- Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions

Threa

\\emmsvr1\EMM\Jobs\2019\I190417 - CGO Open Cut Expansion Project\GIS\02_Maps_BDAR\BDAR005_TECs_20230421_04.mxd 24/04/2023

Source: EMM (2023); Evolution (2023); DFSI (2017); Nearmap (2021)

0 1 2 km

GDA 1994 MGA Zone 55

N

Threatened ecological communities listed under BC Act and EPBC Act in the subject land

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Biodiversity Development Assessment Report
Figure 4.3

EMM creating opportunities

5 Threatened species

5.1 Threatened species habitat description

5.1.1 Lake Cowal

The study area primarily consists of derived native grasslands with some remnant and regenerating woodlands, shrublands and wetlands associated with gilgais and Lake Cowal. Due to an extensive history of grazing and cropping agricultural use throughout the study area, many habitat features for threatened species are degraded and thus provides suitable limited habitat for threatened species.

For many threatened and or migratory bird species, the ephemeral wetland within Lake Cowal provides suitable habitat. Historically, the condition of wetland habitat in Lake Cowal has declined due to extensive vegetation clearing by historic grazing and agriculture within Lake Cowal, as well as ongoing degradation by erosion, ploughing, herbicide spraying, weeds, feral predators and competitors, fishing, hunting and agricultural activities within surrounding catchments.

During dry conditions, habitat available within Lake Cowal is typically grassland/sedgeland, with little to no free water, and hence Lake Cowal offers little habitat value for wetland bird species. Terrestrial fauna may occur during dry periods, with several species of amphibians, reptiles and mammals all having potential to occur. However, during wetting-drying cycles, the inundation and retreat of the shoreline presents suitable habitat for various freshwater wetland associated species, notably waterbirds. The long term history of wetting and drying cycles within Lake Cowal are reconstructed in Figure 3.3, with those across the BDAR study period shown in Figure 3.4.

Typically, greater numbers and diversity of waterbirds occur within Lake Cowal when aquatic habitat is available, with the community composition largely influenced by availability of suitable foraging opportunities and or breeding habitat for non-migrant birds. For instance, fish-eating waterbirds are typically recorded in Lake Cowal when water levels are sufficient to support adequate fish stocks within Lake Cowal. In contrast, availability of shallow water habitat and mudflats typically influences use by waders. An analysis of waterbird assemblages at Lake Cowal from 1989 to 2012 revealed the greatest diversity and abundance of waterbirds (including breeding non-migrant birds) occurred when the lake is at an intermediate water level (Australian Museum Business Services 2013).

5.1.2 Gilgai

Additional potential wetland habitat is presented by gilgais, which are small clay ephemeral depressions. When free water is available in these depressions, they may support threatened frogs and waterbirds. Typically, within the study area, these gilgais occurred within PCTs 26 and 55. The hydrology of these microhabitats is dynamic, with wetting-drying cycles closely associated with rainfall and evapotranspiration, as well as the volume and depth of the depression. During dry conditions, free water is typically lacking, with the depressions typically dominated by native tussock grasses, forbs, sedges, occasionally rushes and bare clay. Many gilgais were also often encroached by exotic grasses. However, during wet conditions, gilgais fill with water, promoting the succession of more aquatic vegetation, including native sedges and rushes that can fringe the depressions.

Gilgais most frequently occurred in DNG areas, but also occur in remnant woodland patches. An example of a gilgai in both an inundated and dried state is shown in Photograph 5.1 and Photograph 5.2.



Photograph 5.1 Inundated gilgai located in south of study area – November 2022



Photograph 5.2 Same gilgai as above after drying out – January 2023

5.1.3 Woodland habitat

Remnant woodland with the study area is typically patchy, providing limited connectivity for arboreal fauna. The greatest connectivity occurs along the foreshore of Lake Cowal to the south of CGO, with a narrow band of River Red Gums connecting to relatively small and patchy areas of woodland areas adjacent the southwestern shoreline of Lake Cowal. Nevertheless, apart from the CGO site, there are no hard barriers that prevent movement of mobile ground-dwelling fauna or birds.

The highest value habitat for ground-dwelling woodland fauna are remnant patches in high condition, which typically provide a moderate to high level of fallen timber and litter cover. In contrast, medium and poor condition remnants typically support sparse to moderate level of fallen timber and litter cover.

For hollow-dependent fauna, hollow bearing trees are relatively abundant across remnant zones supporting a mature remnant canopy. The greatest abundance of hollows was recorded in the riparian woodland areas of Lake Cowal containing mature River Red Gums.

Across all remnant woodland areas, the midstory is typically sparse with some areas of moderate cover and some larger midstory species, which were primarily Wilga and Western Rosewood. Ground cover was moderately dense across all woodland zones (including DNG), comprising native grasses, prominently perennial tussock grasses, and forbs.

5.2 Ecosystem credit species

Ecosystem credits species are threatened species that can be reliably predicted to use an area of land based on habitat surrogates. For the purposes of the BAM (DPIE 2020a), ecosystem credit species are deemed to be offset through the habitat surrogates (PCTs) in which they occur.

A list of ecosystem credit species predicted to occur within the study area, based on the PCTs present and generated by the calculator associated within the BAM (DPIE 2020a) is provided in Table 5.1. The potential for these species to occur within the disturbance footprint was assessed in accordance with Section 5.2.2 of the BAM (DPIE 2020a).

Table 5.1 Assessment of ecosystem credit species within the Additional disturbance area

Scientific name	Common name	Biodiversity Risk Weighting	Justification for exclusion
Anseranas semipalmata	Magpie Goose	1.5	Not excluded.
Artamus cyanopterus cyanopterus	Dusky Woodswallow	1.5	Not excluded.
Botaurus poiciloptilus	Australasian Bittern	2	Not excluded.
Calidris ferruginea	Curlew Sandpiper	2	Not excluded.
Calyptorhynchus lathami	Glossy Black-Cockatoo	2	Exclude zones lacking *Allocasuarina* spp. or casuarina species, for PCT 244. Also condition class Derived grassland for PCTs 55, 82 and 185.
Certhionyx variegatus	Pied Honeyeater	1.5	Excluded from DNG.
Chalinolobus picatus	Little Pied Bat	2	Not excluded.
Chthonicola sagittata	Speckled Warbler	2	Excluded from DNG.
Circus assimilis	Spotted Harrier	2	Not excluded.
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	2	Excluded since the study area is west of the Newell Highway (Geographic limitation).
Daphoenositta chrysoptera	Varied Sittella	1.5	Excluded from DNG.
Dasyurus maculatus	Spotted-tailed Quoll	2	Not excluded.
Epthianura albifrons	White-fronted Chat	1.5	Not excluded.
Falco hypoleucos	Grey Falcon	2.0	Not excluded.
Falco subniger	Black Falcon	1.5	Not excluded.
Glossopsitta porphyrocephala	Purple-crowned Lorikeet	2	Excluded from DNG.
Grantiella picta	Painted Honeyeater	1.5	Excluded from DNG.
Grus rubicunda	Brolga	1.5	Not excluded.
Haliaeetus leucogaster	White-bellied Sea-Eagle (Foraging)	2	Not excluded.
Hamirostra melanosternon	Black-breasted Buzzard (Foraging)	1.5	Not excluded.

Table 5.1 Assessment of ecosystem credit species within the Additional disturbance area

Scientific name	Common name	Biodiversity Risk Weighting	Justification for exclusion
Hieraaetus morphnoides	Little Eagle (Foraging)	1.5	Not excluded.
Hirundapus caudacutus	White-throated Needletail	2	Not excluded.
Hylacola cautus	Shy Heathwren	2	Excluded since the study area is east of Wyalong (Geographic limitation).
Lathamus discolor	Swift Parrot (Foraging)	3	Excluded from DNG.
Leipoa ocellata	Malleefowl	2	Excluded from DNG.
Limosa limosa	Black-tailed Godwit (Foraging)	2	Not excluded.
Lophochroa leadbeateri	Major Mitchell's Cockatoo (Foraging)	2	Not excluded.
Lophoictinia isura	Square-tailed Kite (Foraging)	1.5	Not excluded.
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	1.5	Excluded from DNG.
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	1.5	Excluded from DNG.
Neophema pulchella	Turquoise Parrot	2	Not excluded.
Ninox connivens	Barking Owl (Foraging)	2	Not excluded.
Nyctophilus corbeni	Corben's Long-eared Bat	2	Not excluded.
Oxyura australis	Blue-billed Duck	1.5	Not excluded.
Pachycephala inornata	Gilbert's Whistler	1.5	Excluded from DNG.
Petroica boodang	Scarlet Robin	1.5	Not excluded.
Petroica phoenicea	Flame Robin	1.5	Not excluded.
Polytelis swainsonii	Superb Parrot (Foraging)	2	Excluded from DNG.
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	1.5	Not excluded.
Pteropus poliocephalus	Grey-headed Flying-fox	2	Excluded from DNG.
Rostratula australis	Australian Painted Snipe	2	Not excluded.
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	2	Not excluded.
Sminthopsis macroura	Stripe-faced Dunnart	2	Not excluded.
Stagonopleura guttata	Diamond Firetail	1.5	Not excluded.
Stictonetta naevosa	Freckled Duck	1.5	Not excluded.
Tyto novaehollandiae	Masked Owl (Foraging)	2	Not excluded.

5.3 Species credit species

5.3.1 Candidate species assessment

In accordance with Step 3 (Section 5.2.3 of BAM (DPIE 2020a)), a field assessment of habitat constraints and microhabitats was undertaken in the field to determine the suitability of habitat within the study area for:

- predicted species (ecosystem credit species associated with recorded PCTs, predicted by the Biodiversity Assessment Method Calculator (BAMC))
- candidate species (species credit species associated with specific geographic and landscape feature constraints)
- species predicted to occur by the EPBC Act Protected Matters Search Tool.

Candidate species predicted by the BAMC are shown in Table 5.2. An assessment of the geographic and landscape constraints has been provided for each species, with a justification provided where species have been excluded, in accordance with Steps 1 to 3 (Section 5.2.1 to 5.2.3) of the BAM.

Table 5.2 Candidate threatened species assessment

Step 1 – Identify threatened species for assessment		Step 2 – Assessment of habitat constraints and vagrant species			Step 3 – Identify candidate species for further assessment
Scientific name	**Common name**	**Habitat/geographic constraints**	**Constraint present within the study area?**	**Vagrant species?**	**Candidate species (yes/no) and rationale**
Amphibromus fluitans	Floating Swamp Wallaby-grass	• Semi-permanent/ephemeral wet areas. • Periodically inundated sites (including table drains and farm dams), notably wetlands on riverine floodplain).	Yes	No	Yes. Included since suitable habitat is available, species is not a vagrant and no geographic constraints. Further assessment required.
Austrostipa metatoris	A spear-grass	• N/A	N/A	No	Yes. Included since suitable habitat is available, species is not a vagrant and no geographic constraints. Further assessment required.
Austrostipa wakoolica	A spear-grass	• Alluvial plains and plains. • South of Narranderra.	No	No	Yes. Included since suitable habitat is available and species is not a vagrant. Subject site is north of Narranderra, which is considered north of the geographic constraint for the species. However, there are several herbarium-backed records within 10 km of the subject site, so has been retained as a candidate species. Further assessment required. Note that the geographic constrain was unchecked in the BAM-C but species was manually added as a confirmed candidate species.
Burhinus grallarius	Bush Stone-curlew	• Fallen/standing dead timber including logs.	Yes	No	Yes. Included since suitable habitat is available, species is not a vagrant and no geographic constraints. Further assessment required.
Calidris ferruginea	Curlew Sandpiper	• N/A	N/A	No	No. Excluded since study area is not mapped as important habitat for this species. Further assessment as a Species Credit Species is not required.
Calyptorhynchus lathami	Glossy Black-Cockatoo	• Hollow bearing trees. • Living or dead tree with hollows greater than 15 cm diameter and greater than 8 m above ground.	Yes	No	Yes. Included since suitable habitat is available, species is not a vagrant and no geographic constraints. Further assessment required.
Calyptorhynchus lathami – endangered population	Glossy Black-Cockatoo	• Carrathool, Griffith, Leeton and Narrandera LGAs.	No	No	No. Excluded subject site is outside Carrathool, Griffith, Leeton and Narrandera LGAs. Further assessment not required.
Cercartetus nanus	Eastern Pygmy-possum	• N/A	N/A	Yes	No. Excluded since there are no records of Eastern Pygmy Possum within the Lower Slopes IBRA subregion, and the closest records are approximately 100 km away to the east of Parkes and just north of Cootamundra. Hence, the species is considered a vagrant. Further assessment not required.
Climacteris affinis – endangered population	White-browed Treecreeper	• Carrathool local government area south of the Lachlan River and Griffith local government area.	No	No	No. Excluded since subject site is outside Carrathool local government area south of the Lachlan River and Griffith local government area. Further assessment not required. Note that the BAM-C does not have a geographic limitation for this endangered population. As the study area is outside the LGA where this population occurs, the vagrant box has been checked in the BAM-C to discount as a confirmed candidate species.
Crinia sloanei	Sloane's Froglet	• Semi-permanent/ephemeral wet areas. • Containing relatively shallow sections with submergent and emergent vegetation, or within 500 m of wet area. • Within 500 m of swamps. • Within 500 m of waterbody.	Yes	No	Yes. Included since suitable habitat is available, species is not a vagrant and no geographic constraints. Further assessment required.
Cullen parvum	Small Scurf-pea	• N/A	N/A	No	Yes. Included since suitable habitat is available, species is not a vagrant and no geographic constraints. Further assessment required.

Table 5.2 Candidate threatened species assessment

Step 1 – Identify threatened species for assessment		Step 2 – Assessment of habitat constraints and vagrant species			Step 3 – Identify candidate species for further assessment
Scientific name	**Common name**	**Habitat/geographic constraints**	**Constraint present within the study area?**	**Vagrant species?**	**Candidate species (yes/no) and rationale**
Diuris tricolor	Pine Donkey Orchid	• N/A	N/A	No	Yes. Included since suitable habitat is available, species is not a vagrant and no geographic constraints. Further assessment required.
Eleocharis obicis	Spike-Rush	• Semi-permanent/ephemeral wet areas. • Periodically waterlogged sites (including table drains and farm dams).	Yes	No	Yes. Included since suitable habitat is available, species is not a vagrant and no geographic constraints. Further assessment required.
Haliaeetus leucogaster	White-bellied Sea-Eagle	• Living or dead mature trees within suitable vegetation within 1 km of a rivers, lakes, large dams or creeks, wetlands and coastlines.	Yes	No	Yes. Included since suitable habitat is available, species is not a vagrant and no geographic constraints. Further assessment required.
Hamirostra melanosternon	Black-breasted Buzzard	• Waterbodies. • Land within 40 m of riparian woodland on inland watercourses/waterholes containing dead or dying eucalypts.	Yes	No	Yes. Included since suitable habitat is available, species is not a vagrant and no geographic constraints. Further assessment required.
Hieraaetus morphnoides	Little Eagle	• Nest trees – live (occasionally dead) large old trees within vegetation).	Yes	No	Yes. Included since suitable habitat is available, species is not a vagrant and no geographic constraints. Further assessment required.
Lathamus discolor	Swift Parrot	• As per Important Habitat Map.	No	No	No. Excluded since study area is not mapped as important habitat for this species. Further assessment as a Species Credit Species is not required.
Lepidium aschersonii	Spiny Peppercress	• N/A	N/A	No	Yes. Included since suitable habitat is available, species is not a vagrant and no geographic constraints. Further assessment required.
Lepidium monoplocoides	Winged Peppercress	• N/A	N/A	No	Yes. Included since suitable habitat is available, species is not a vagrant and no geographic constraints. Further assessment required.
Leptorhynchos orientalis	Lanky Buttons	• West of Narrandera/Lockhart Road and North of Urana/Lockhart Road.	No	No	No. Excluded since subject site is located east of Narrandera/Lockhart Road. Further assessment not required.
Limosa limosa	Black-tailed Godwit	• As per Important Habitat Map.	N/A	No	No. Excluded since study area is not mapped as important habitat for this species. Further assessment as a Species Credit Species is not required.
Litoria raniformis	Southern Bell Frog	• N/A	N/A	No	Yes. Included since suitable habitat is available, species is not a vagrant and no geographic constraints. Further assessment required.
Lophochroa leadbeateri	Major Mitchell's Cockatoo	• Hollow bearing trees; Living or dead tree with hollows greater than 10 cm diameter.	Yes	No	Yes. Included since suitable habitat is available, species is not a vagrant and no geographic constraints. Further assessment required.
Lophoictinia isura	Square-tailed Kite (Breeding)	• Nest trees.	Yes	No	Yes. Included since suitable habitat is available, species is not a vagrant and no geographic constraints. Further assessment required.
Myotis macropus	Southern Myotis	• Waterbodies. • Waterbodies with permanent pools/stretches 3 m or wider, including rivers, large creeks, billabongs, lagoons, estuaries, dams and other, on or within 200 m of the site.	Yes	No	Yes. Included since suitable habitat is available, species is not a vagrant and no geographic constraints. Further assessment required.

Table 5.2 Candidate threatened species assessment

Step 1 – Identify threatened species for assessment		Step 2 – Assessment of habitat constraints and vagrant species			Step 3 – Identify candidate species for further assessment
Scientific name	**Common name**	**Habitat/geographic constraints**	**Constraint present within the study area?**	**Vagrant species?**	**Candidate species (yes/no) and rationale**
Ninox connivens	Barking Owl (Breeding)	• Hollow bearing trees. • Living or dead trees with hollows greater than 20 cm diameter and greater than 4 m above the ground.	Yes	No	Yes. Included since suitable habitat is available, species is not a vagrant and no geographic constraints. Further assessment required.
Petaurus norfolcensis	Squirrel Glider	• N/A	Yes	No	Yes. Included since suitable habitat is available, species is not a vagrant and no geographic constraints. Further assessment required.
Petaurus norfolcensis - endangered population	Squirrel Glider	• Wagga Wagga Local Government Area.	No	No	No. Excluded since the subject site is not in the Wagga Wagga LGA. Further assessment not required. Note that the BAM-C does not have a geographic limitation for this endangered population. As the study area is outside the LGA where this population occurs, the vagrant box has been checked in the BAM-C to discount as a confirmed candidate species.
Phascolarctos cinereus	Koala	• Presence of koala use trees – refer to Survey Comments field in DPE TBDC (2023a).	Yes	No	Yes. Included since suitable habitat is available, species is not a vagrant and no geographic constraints. Further assessment required.
Pilularia novae-hollandiae	Austral Pillwort	• N/A	N/A	No	Yes. Included since suitable habitat is available, species is not a vagrant and no geographic constraints. Further assessment required.
Polytelis swainsonii	Superb Parrot (Breeding)	• Hollow bearing trees. • Living or dead *E. blakelyi, E. melliodora, E. albens, E. camaldulensis, E. microcarpa, E. polyanthemos, E. mannifera, E. intertexta* with hollows greater than 5 cm diameter. • Greater than 4 m above ground or trees with a DBH of greater than 30 cm.	Yes	No	Yes. Included since suitable habitat is available, species is not a vagrant and no geographic constraints. Further assessment required.
Pteropus poliocephalus	Grey-headed Flying-fox (Breeding)	• Breeding camps.	No	No	No. Excluded since there are no breeding camps within the study area. The closest known Grey-headed Flying-fox camps are located at Grenfell approximately 74 km to the southeast of the site, and Parkes approximately 90 km to the northeast of the site (DCCEEW 2021b).
Senecio garlandii	Woolly Ragwort	• N/A	N/A	No	Yes. From a precautionary perspective this species was included as a candidate species, though it noted that the site does not contain any sheltered slopes of rocky outcrops, which this species associates with (DPE 2018a). Species is not a vagrant and no geographic constraints.
Swainsona murrayana	Slender Darling Pea	• N/A	N/A	No	Yes. Included since suitable habitat is available, species is not a vagrant and no geographic constraints. Further assessment required.
Swainsona sericea	Silky Swainson-pea	• N/A	N/A	No	Yes. Included since suitable habitat is available, species is not a vagrant and no geographic constraints. Further assessment required.
Tyto novaehollandiae	Masked Owl (Breeding)	• Hollow bearing trees. • Living or dead trees with hollows greater than 20 cm diameter.	Yes	Yes	Yes. Included since suitable habitat is available, species is not a vagrant and no geographic constraints. Further assessment required.

5.3.2 Candidate species credit species requiring further assessment

Candidate species for further assessment were identified in accordance with Step 1 to 2 (Section 5.2.1 to 5.2.2) of BAM (DPIE 2020a). A list of species requiring further assessment is provided in Table 5.3.

Table 5.3 Candidate species credit species requiring further assessment

Scientific name	Common name	EPBC Act	BC Act	Flora or fauna
Amphibromus fluitans	Floating Swamp Wallaby-grass	Vulnerable	Vulnerable	Flora
Austrostipa metatoris	-	Vulnerable	Vulnerable	Flora
Austrostipa wakoolica	A spear-grass	Endangered	Endangered	Flora
Burhinus grallarius	Bush Stone-curlew	Endangered	Endangered	Fauna
Calyptorhynchus lathami (Breeding)	Glossy Black-Cockatoo	Vulnerable	Not Listed	Fauna
Crinia sloanei	Sloane's Froglet	Vulnerable	Endangered	Fauna
Cullen parvum	Small Scurf-pea	Endangered	Not Listed	Flora
Diuris tricolor	Pine Donkey Orchid	Vulnerable	Not Listed	Flora
Eleocharis obicis	Spike-Rush	Vulnerable	Vulnerable	Flora
Haliaeetus leucogaster	White-bellied Sea-Eagle	Vulnerable	Not Listed	Fauna
Hieraaetus morphnoides (Breeding)	Little Eagle	Vulnerable	Not Listed	Fauna
Lepidium aschersonii	Spiny Peppercress	Vulnerable	Vulnerable	Flora
Lepidium monoplocoides	Winged Peppercress	Endangered	Endangered	Flora
Litoria raniformis	Southern Bell Frog	Endangered	Vulnerable	Fauna
Lophochroa leadbeateri	Major Mitchell's Cockatoo	Vulnerable	Endangered	Fauna
Lophoictinia isura	Square-tailed Kite	Vulnerable	Not Listed	Fauna
Ninox connivens	Barking Owl	Vulnerable	Not Listed	Fauna
Petaurus norfolcensis	Squirrel Glider	Vulnerable	Not Listed	Fauna
Phascolarctos cinereus	Koala	Endangered	Endangered	Fauna
Pilularia novae-hollandiae	Austral Pillwort	Endangered	Not Listed	Flora
Polytelis swainsonii	Superb Parrot	Vulnerable	Vulnerable	Fauna
Senecio garlandii	Woolly Ragwort	Vulnerable	Not Listed	Flora
Swainsona murrayana	Slender Darling Pea	Vulnerable	Vulnerable	Flora
Swainsona sericea	Silky Swainson-pea	Vulnerable	Not Listed	Flora
Tyto novaehollandiae (Breeding)	Masked Owl	Vulnerable	Not Listed	Fauna

5.3.3 Targeted survey methods

i Previous targeted flora surveys

Previous threatened flora surveys undertaken in or nearby Evolution's mining lease that are applicable to the Project are detailed in Table 5.4.

Table 5.4 Previous threatened flora surveys within and nearby the study area

Surveys	Period	Method	Reference
Flora surveys within ML 1565 and surrounds prior to operation.	1969 and 2003	Quadrat sampling, random meander search and targeted searches within aquatic/semi-aquatic habitat.	Vestjens (1977); Anne Clements and Associates (1995); Charles Sturt University (1997); Bower (1997; 1998a–b; 2003a–b).
Flora surveys for the Cowal Gold Mine E42 Modification Environmental Assessment.	2008	Quadrat sampling and random meander search.	FloraSearch (2008).
Austral Pillwort annual monitoring.	2006 to present	Annual monitoring for the Austral Pillwort within ML 1535 and surrounds.	DnA Environmental (2012c–2022c).
Opportunistic threatened flora surveys undertaken during annual monitoring for Remnant Vegetation Enhancement Program, Compensatory Wetland, rehabilitation areas and Biodiversity offsets.	2008 to present	Quadrat sampling and random meander search.	DnA Environmental (2008, 2010, 2011c, 2011a–2022a, 2011b–2022b, 2012d–2021d, 2018e–2022e)
Targeted threatened flora surveys within and surrounding ML 1535 within Evolution-owned lands.	2011 to 2012	Targeted searches for threatened flora at floristic survey sites and incidental searches.	Australian Museum Business Services (2012); FloraSearch (2013); Resource Strategies Pty Ltd (2013)
Targeted threatened flora surveys for MOD 14.	August, September and November 2017	Targeted searches for threatened flora.	AMBS Ecology & Heritage (2018)

ii Targeted flora surveys for BDAR

Targeted flora surveys were undertaken over 68 days (202 person days) between September 2020 and January 2023. Surveys were undertaken in accordance with NSW (DPIE 2020b) guidelines. Methods applied depended on the extent and type of habitat the species associates with.

For terrestrial threatened flora, most surveys were undertaken adopting a parallel field transect approach, as per DPIE (2020b). However, due to the size of the site (and potential habitat > 50 ha), surveys for terrestrial species from 2022 onwards adopted a two-phase grid-based systematic survey approach, as per DPIE (2020b).

For aquatic threatened flora, surveys for these species focused on aquatic habitat as per DPIE (2020b), including gilgais, drainage lines and on the foreshore and within Lake Cowal. A summary of the survey effort applied to relevant candidate species is provided in Table 5.5. Targeted flora survey effort, organised by month of survey, is illustrated in Figure 5.1 to Figure 5.13.

Table 5.5 Threatened flora survey effort

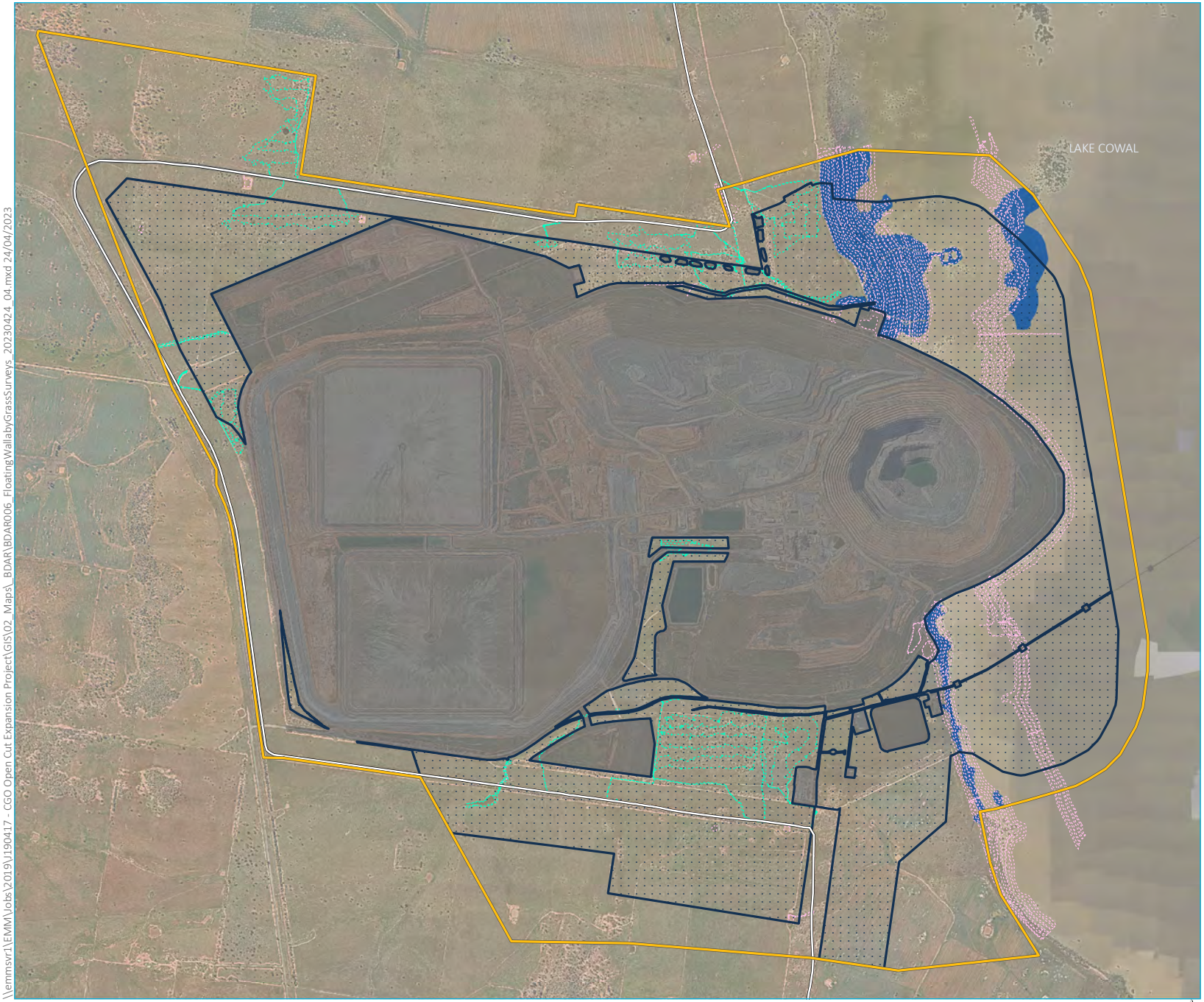
Dates	Target Species	People	Survey days	Method
16–28 September 2020	• *Diuris tricolor* • *Swainsona murrayana* • *Swainsona sericea* • *Lepidium monoplocoides.*	Four	12 (48 person days)	10 m wide transects, as required for herbs/forbs in open vegetation DPIE (2020b).
10–17 November 2020	• *Eleocharis obicis* • *Pilularia novae-hollandiae.* Additional species surveyed for amongst aquatic habitats: • *Swainsona sericea* • *Austrostipa metatoris* • *Lepidium aschersonii* • *Austrostipa wakoolica* • *Lepidium monoplocoides.*	Three	7 (21 person days)	Searched appropriate parts of the waterbody as per survey guide for aquatic plants (DPIE 2020b). Survey focused on ephemeral aquatic habitat including gilgais and wetland habitat associated with Lake Cowal where wet habitat occurred at the time of survey. Note that within Lake Cowal, this survey effort focused on the shoreline area at the time of survey, where potential aquatic habitat for *E. obicis* and Austral Pillwort was present. That is, surveys were conducted along the water line of Lake Cowal at the time of survey, and 50 m past and up to 100 m back from the water line. The depth of the water restricted survey further into the lake, however as *E. obicis* is only up to 30 cm high and Austral Pillwort expresses in drying mud, this survey effort was considered representative of potential habitat in Lake Cowal at the time of survey. Survey for *Pilularia novae-hollandiae* followed the methodology established by Bower (1998a). Groups of plants suspected of being *P. novae-hollandiae* were sampled by digging 3 cm or 4 cm into substrate containing them. The soil or mud was washed from the roots to reveal the sporocarps which were used to confirm the identity of *P. novae-hollandiae*. Where located, estimates of plant numbers were made adopting the definition by Bower (1998a), with an individual plant considered as the node on the rhizome with its associated 2 or 3 fronds and sporocarp.
24 November – 2 December 2020	• *Austrostipa metatoris* • *Lepidium aschersonii* • *Austrostipa wakoolica* • *Lepidium monoplocoides* • *Swainsona sericea.* Additional species surveyed for amongst within aquatic habitats encountered: • *Eleocharis obicis* • *Pilularia novae-hollandiae.*	Three	7 (27 person days)	10 m wide transects, as required for herbs/forbs in open vegetation DPIE (2020b).

Table 5.5 Threatened flora survey effort

Dates	Target Species	People	Survey days	Method
8–13 December 2020	• *Amphibromus fluitans* • *Pilularia novae-hollandiae* • *Cullen parvum.* Additional species surveyed for amongst aquatic habitats: • *Lepidium aschersonii* • *Austrostipa wakoolica* • *Lepidium monoplocoides.*	Three	6 (18 person days)	Survey for *Amphibromus fluitans* included searches of appropriate parts of waterbodies as per survey guide for aquatic plants (DPIE 2020b). Survey focused on ephemeral aquatic habitat including gilgais and wetland habitat associated with Lake Cowal where wet habitat occurred at the time of survey. Survey for *Cullen parvum* undertaken were 10 m wide transects, as required for herbs/forbs in open vegetation (DPIE 2020b). Survey for *Pilularia novae-hollandiae* followed the methodology established by Bower (1998a). Further detail regarding the survey of this species is provided above under November – December 2020 survey.
19–25 April 2022	• *Lepidium aschersonii*	Four	7 (28 person days)	Two-phased grid-based systematic survey, as per DPIE (2020b).
19–20 September 2022; 22 September 2022	• *Diuris tricolor* • *Lepidium monoplocoides* • *Senecio garlandii* • *Swainsona murrayana* • *Swainsona sericea*	Two	3 (6 person days)	Two-phased grid-based systematic survey, as per DPIE (2020b).
15–18 November 2022	• *Eleocharis obicis* • *Pilularia novae-hollandiae*	Two	4 (8 person days)	Searched appropriate parts of the waterbody as per survey guide for aquatic plants (DPIE 2020b). Survey focused on ephemeral aquatic habitat including gilgais and wetland habitat associated with Lake Cowal where wet habitat occurred at the time of survey. Survey for *Pilularia novae-hollandiae* followed the methodology established by Bower (1998a). Further detail regarding the survey of this species is provided above under November – December 2020 survey.
16–22 November 2022	• *Austrostipa metatoris* • *Lepidium aschersonii* • *Austrostipa wakoolica* • *Lepidium monoplocoides* • *Swainsona sericea*	Two	7 (14 person days)	Two-phased grid-based systematic survey, as per DPIE (2020b).

Table 5.5 Threatened flora survey effort

Dates	Target Species	People	Survey days	Method
6–9 December 2022	• *Pilularia novae-hollandiae* • *Amphibromus fluitans*	Two	4 (8 person days)	Searched appropriate parts of the waterbody as per survey guide for aquatic plants (DPIE 2020b). Survey focused on ephemeral aquatic habitat including gilgais and wetland habitat associated with Lake Cowal where wet habitat occurred at the time of survey. Survey for *Pilularia novae-hollandiae* followed the methodology established by Bower (1998a). Further detail regarding the survey of this species is provided above under November – December 2020 survey.
10 – 17 January	• *Pilularia novae-hollandiae* • *Amphibromus fluitans*.	Five	11 (24 person days)	Surveys for *Pilularia novae-hollandiae* and *Amphibromus fluitans* using the approach above under November – December 2020 survey. Repeated sampling within the study area undertaken to target the progressive drying of gilgais, when Austral Pillwort expresses. Surveys were also extended into cropped land (Zone 25) to survey potential habitat within surface depressions in low-lying extents. Surveys were also undertaken outside of the study area, across the Broader Austral Pillwort survey area during this period. The aim of these broader surveys, outside the study area, were to inform the local distribution of this species within SAII assessment. Note that BCD confirmed that January 2022 was a suitable period for surveying Austral Pillwort due to recent high rainfalls associated with La nina (Appendix D; correspondence ref; DOC22/717039, 14 December 2022), despite being outside the survey months prescribed by the DPE TBDC (2023b).



KEY

- Study area
- Additional disturbance area
- Existing and approved disturbance area
- Major road
- Associated vegetation communities

Survey tracks

- 2020 - Parallel field transect (DPIE 2020b)
- 2022 - Two-phase grid-based systematic survey (DPIE 2020b)

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Source: EMM (2023); Evolution (2023); DFSI (2017); Nearmap (2021)

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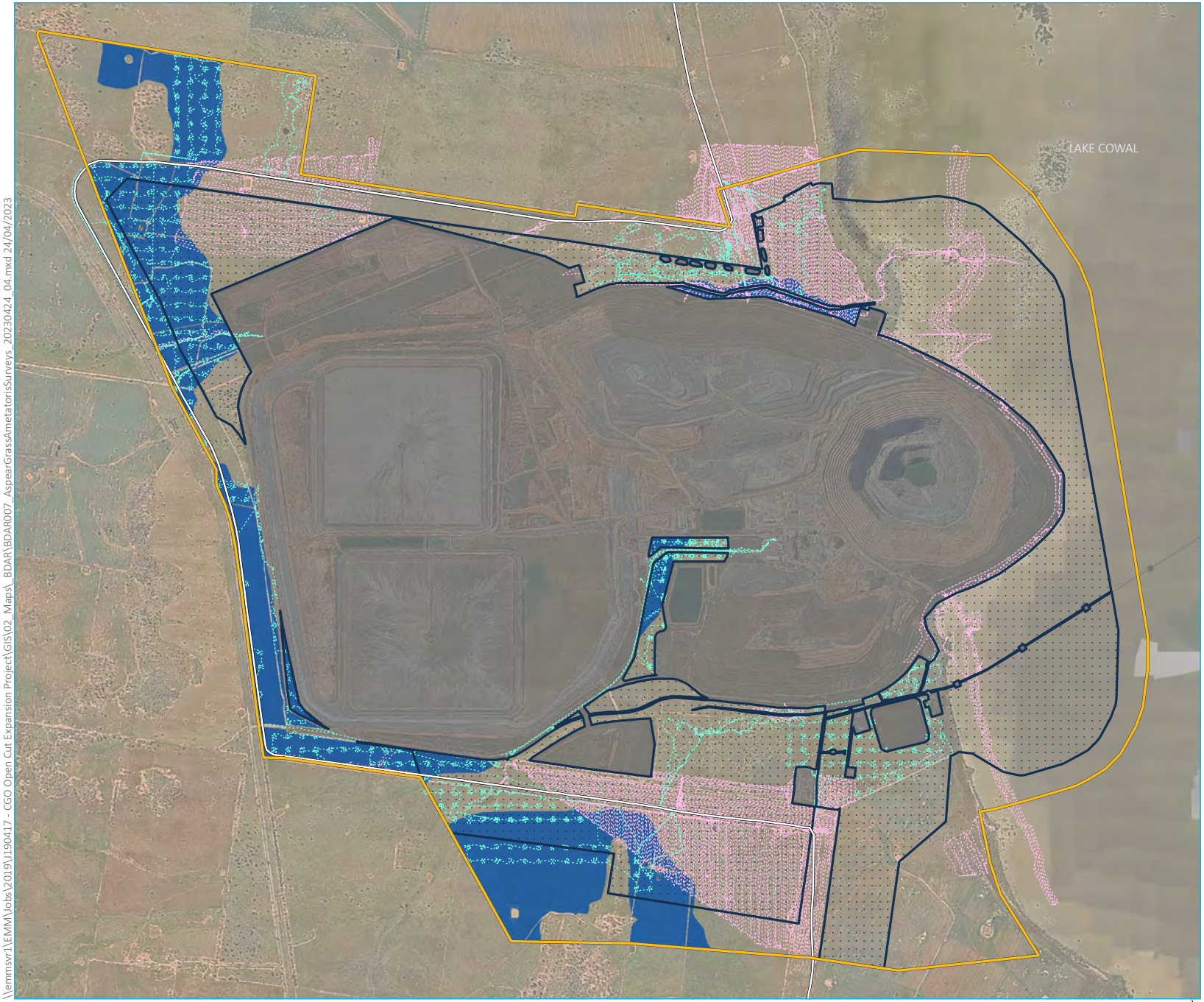
GDA 1994 MGA Zone 55

N

Threatened flora surveys within study area: Floating Wallaby Grass (*Amphibromus fluitans*)

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Biodiversity Development Assessment Report
Figure 5.1

EMM creating opportunities



KEY

- Study area
- Additional disturbance area
- Existing and approved disturbance area
- Major road
- Associated vegetation communities

Survey tracks

- 2020 - Parallel field transect (DPIE 2020b)
- 2022 - Two-phase grid-based systematic survey (DPIE 2020b)

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Source: EMM (2023); Evolution (2023); DFSI (2017); Nearmap (2021)

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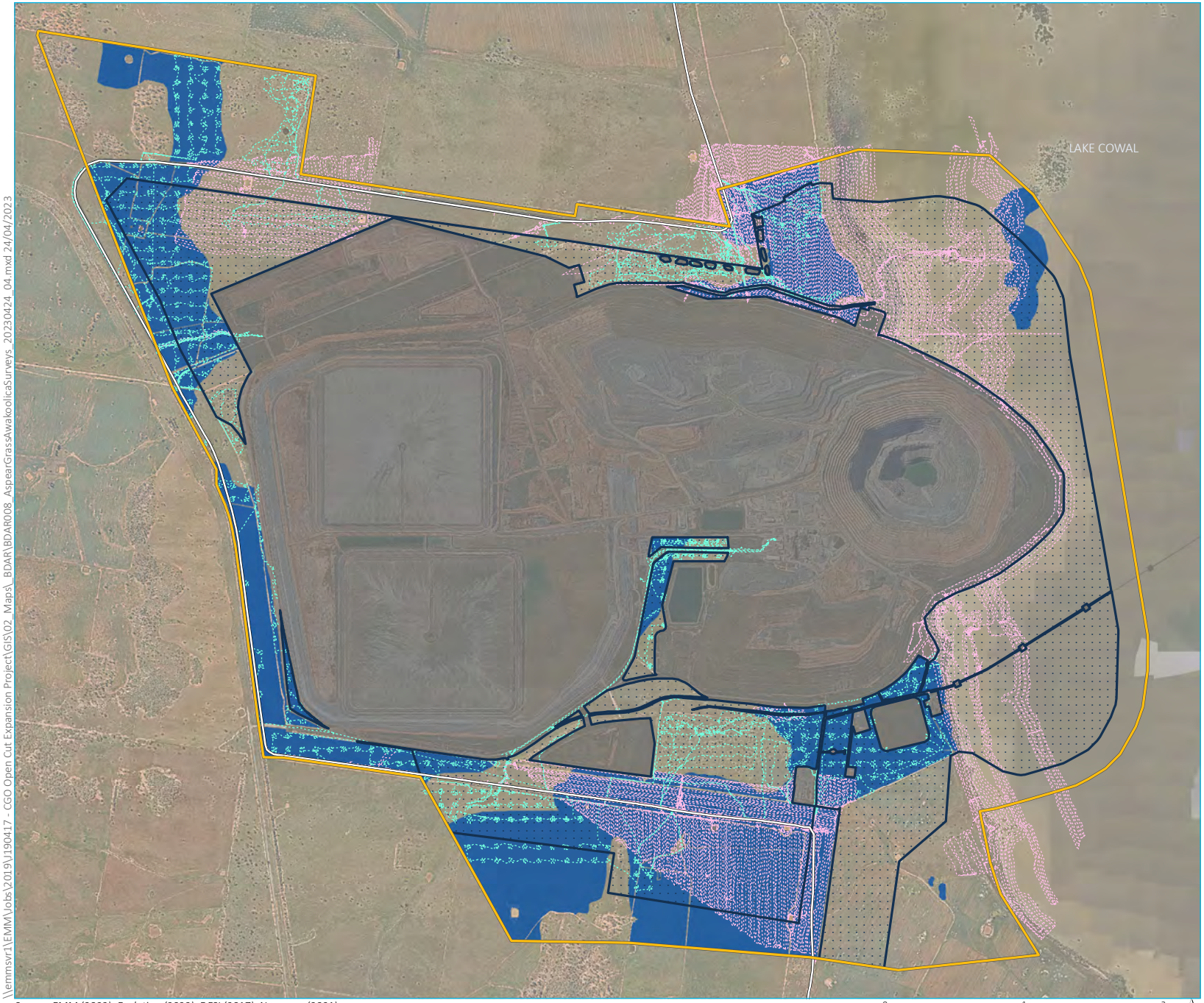
GDA 1994 MGA Zone 55

N

Threatened flora surveys within study area: A spear-grass (*Austrostipa metatoris*)

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Biodiversity Development Assessment Report
Figure 5.2

EMM creating opportunities



KEY

- Study area
- Additional disturbance area
- Existing and approved disturbance area
- Major road
- Associated vegetation communities

Survey tracks

- 2020 - Parallel field transect (DPIE 2020b)
- 2022 - Two-phase grid-based systematic survey (DPIE 2020b)

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Source: EMM (2023); Evolution (2023); DFSI (2017); Nearmap (2021)

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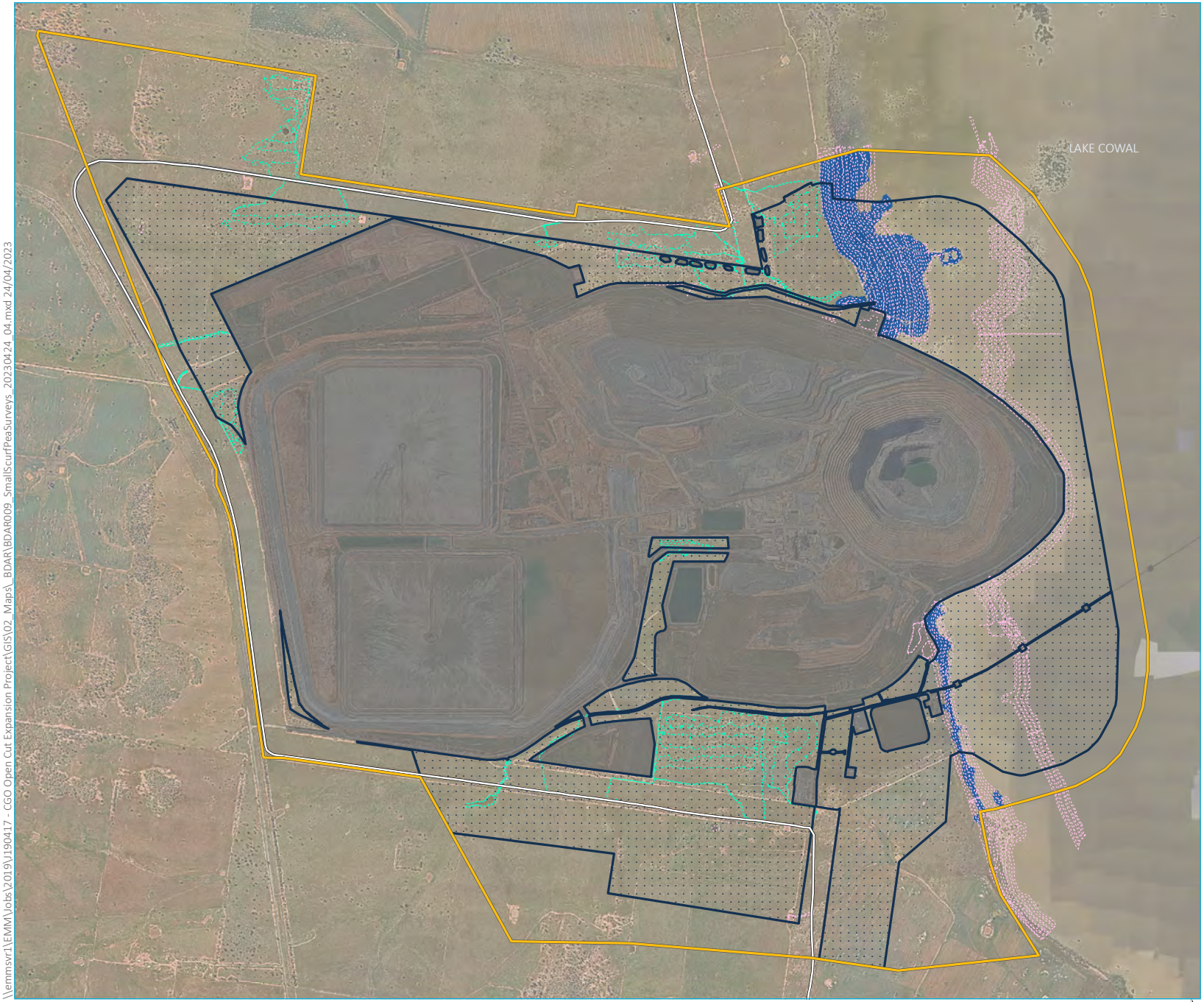
GDA 1994 MGA Zone 55

N

Threatened flora surveys within study area: A spear-grass (*Austrostipa wakoolica*)

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
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Figure 5.3

EMM creating opportunities



KEY

- Study area
- Additional disturbance area
- Existing and approved disturbance area
- Lake Cowal Road
- Associated vegetation communities

Survey tracks

- 2020 - Parallel field transect (DPIE 2020b)
- 2022 - Two-phase grid-based systematic survey (DPIE 2020b)

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Source: EMM (2023); Evolution (2023); DFSI (2017); Nearmap (2021)

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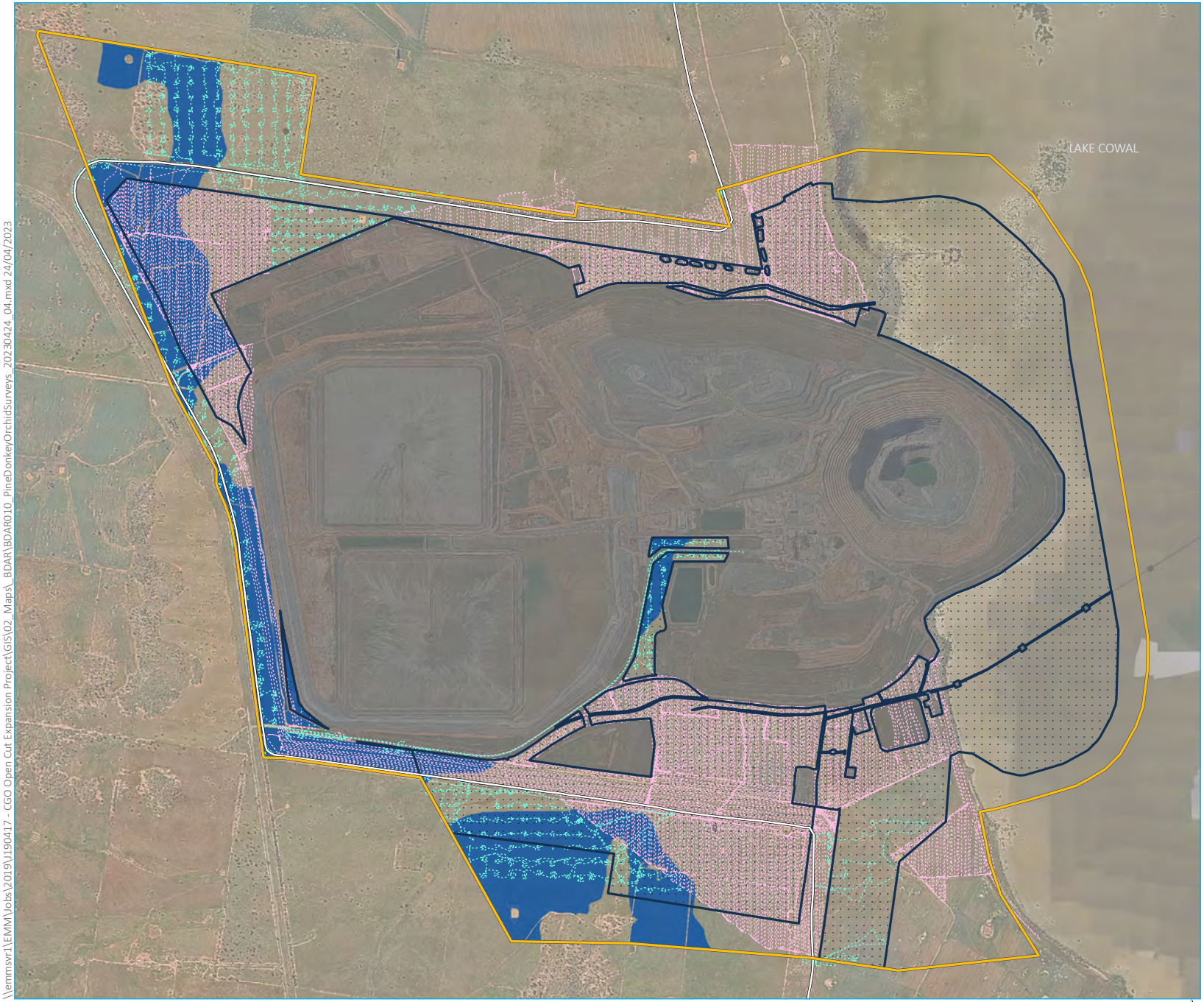
GDA 1994 MGA Zone 55

N

Threatened flora surveys within study area: Small Scurf-pea (*Cullen parvum*)

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Biodiversity Development Assessment Report
Figure 5.4

EMM creating opportunities



KEY

- Study area
- Additional disturbance area
- Existing and approved disturbance area
- Major road
- Associated vegetation communities

Survey tracks

- 2020 - Parallel field transect (DPIE 2020b)
- 2022 - Two-phase grid-based systematic survey (DPIE 2020b)

\\emmsvr1\EMM\Jobs\2019\I190417 - CGO Open Cut Expansion Project\GIS\02_Maps_BDAR\BDAR010_PineDonkeyOrchidSurveys_20230424_04.mxd 24/04/2023

Source: EMM (2023); Evolution (2023); DFSI (2017); Nearmap (2021)

0 1 2 km

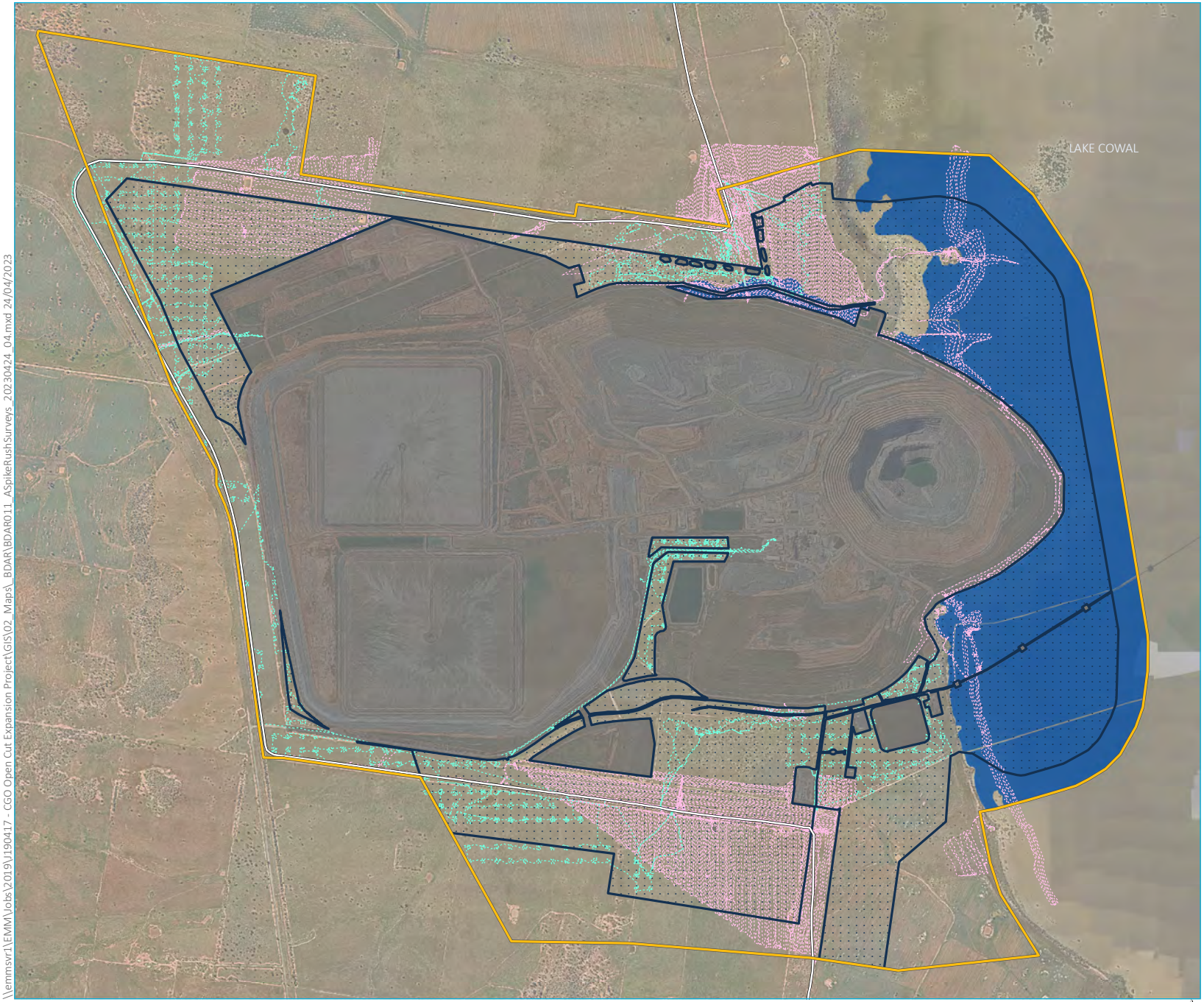
GDA 1994 MGA Zone 55

N

Threatened flora surveys within study area: Pine Donkey Orchid (*Diuris tricolor*)

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Biodiversity Development Assessment Report
Figure 5.5

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KEY

- Study area
- Additional disturbance area
- Existing and approved disturbance area
- Major road
- Associated vegetation communities

Survey tracks

- 2020 - Parallel field transect (DPIE 2020b)
- 2022 - Two-phase grid-based systematic survey (DPIE 2020b)

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Source: EMM (2023); Evolution (2023); DFSI (2017); Nearmap (2021)

0 1 2 km

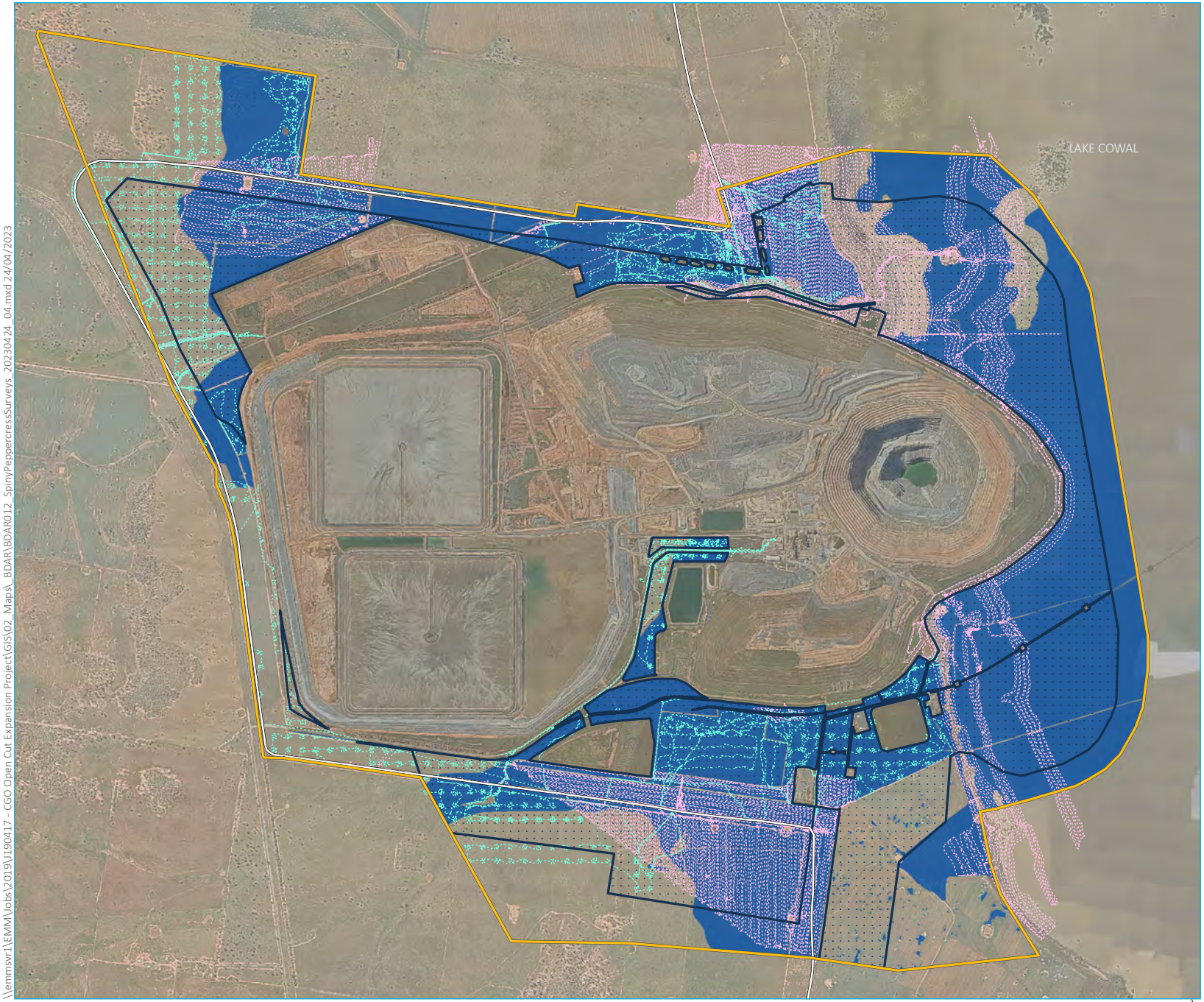
GDA 1994 MGA Zone 55

N

Threatened flora surveys within study area: A Spike-Rush (*Eleocharis obicis*)

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Biodiversity Development Assessment Report
Figure 5.6

EMM creating opportunities



KEY

- Study area
- Additional disturbance area
- Existing and approved disturbance area
- Major road
- Associated vegetation communities

Survey tracks

- 2020 - Parallel field transect (DPIE 2020b)
- 2022 - Two-phase grid-based systematic survey (DPIE 2020b)

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Source: EMM (2023); Evolution (2023); DFSI (2017); Nearmap (2021)

0 1 2 km

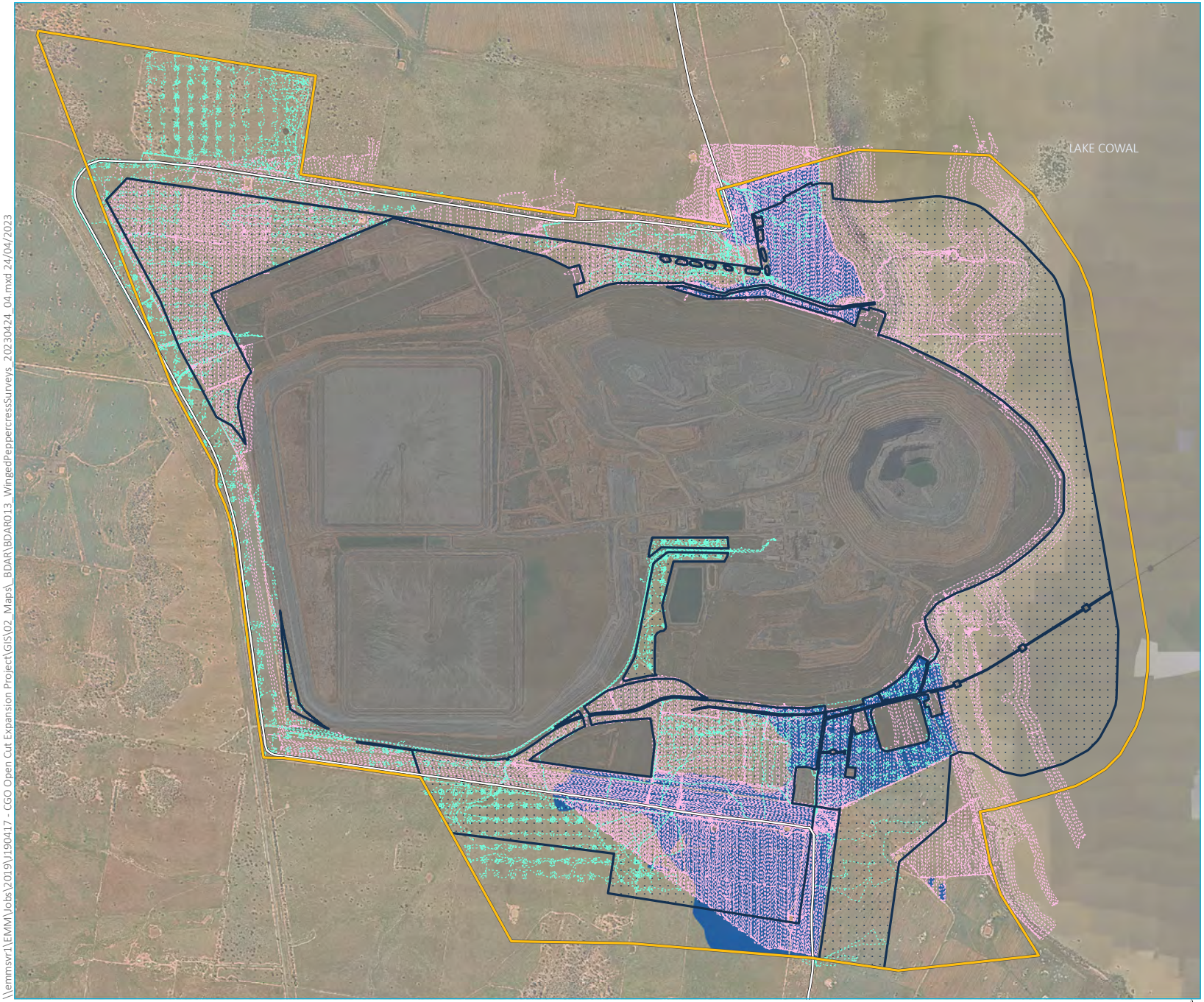
GDA 1994 MGA Zone 55

N

Threatened flora surveys within study area: Spiny Peppercress (*Lepidium aschersonii*)

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Biodiversity Development Assessment Report
Figure 5.7

EMM creating opportunities



KEY

- Study area
- Additional disturbance area
- Existing and approved disturbance area
- Major road
- Associated vegetation communities

Survey tracks

- 2020 - Parallel field transect (DPIE 2020b)
- 2022 - Two-phase grid-based systematic survey (DPIE 2020b)

\\emmsvr1\EMM\Jobs\2019\J190417 - CGO Open Cut Expansion Project\GIS\02_Maps_BDAR\BDAR013_WingedPeppercressSurveys_20230424_04.mxd 24/04/2023

Source: EMM (2023); Evolution (2023); DFSI (2017); Nearmap (2021)

0 1 2 km

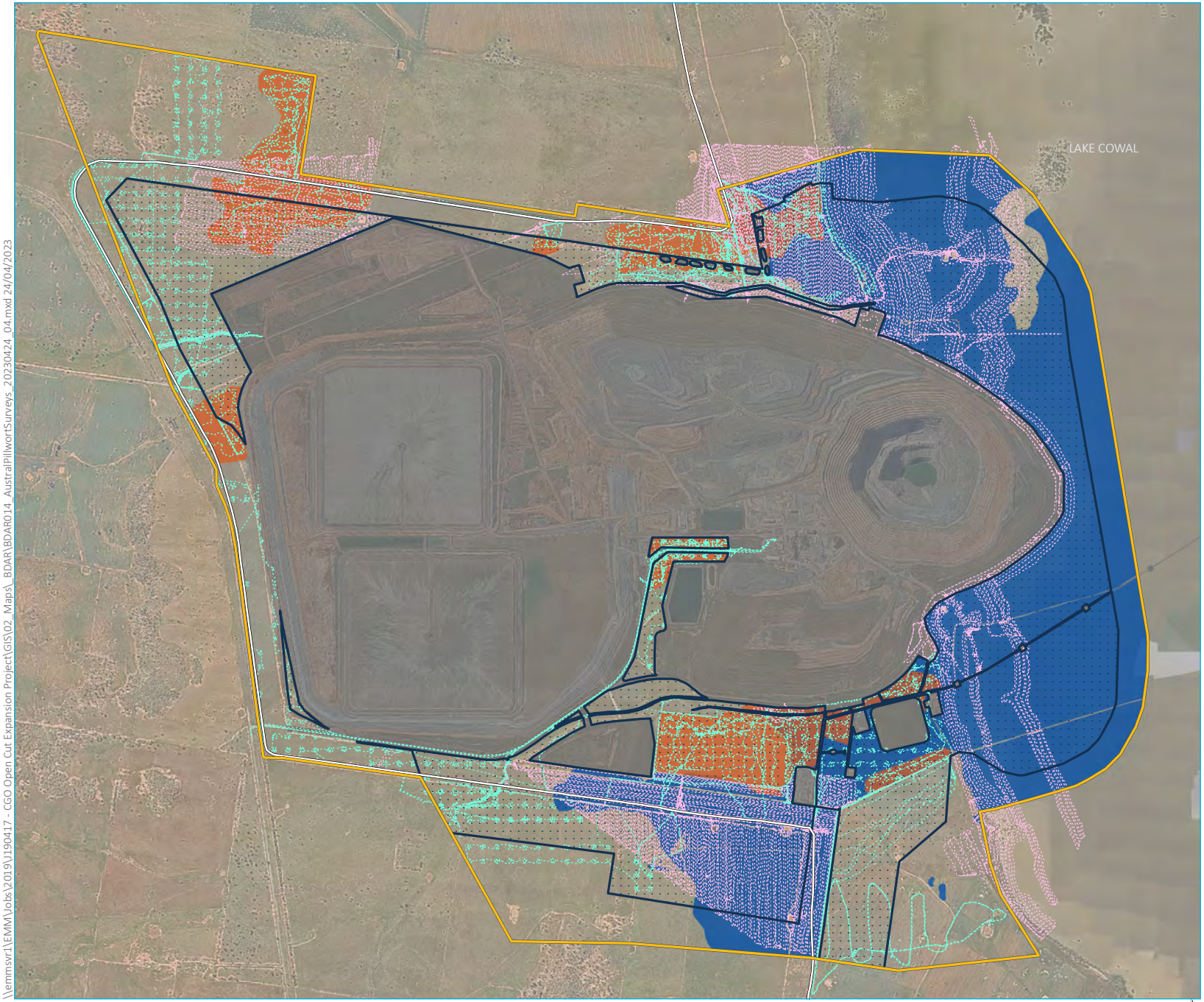
GDA 1994 MGA Zone 55

N

Threatened flora surveys within study area: Winged Peppercress (*Lepidium monoplocoides*)

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Biodiversity Development Assessment Report
Figure 5.8

EMM
creating opportunities



KEY

- Study area
- Additional disturbance area
- Existing and approved disturbance area
- Major road
- Associated vegetation communities
- Broad gilgai area

Survey tracks

- 2020 - Parallel field transect (DPIE 2020b)
- 2022 - Two-phase grid-based systematic survey (DPIE 2020b)

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Source: EMM (2023); Evolution (2023); DFSI (2017); Nearmap (2021)

0 1 2 km

GDA 1994 MGA Zone 55

N

Threatened flora surveys within study area: Austral Pillwort (*Pilularia novae-hollandiae*)

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Biodiversity Development Assessment Report
Figure 5.9

EMM creating opportunities



KEY

- Study area
- Additional disturbance area
- Existing and approved disturbance area
- Lake Cowal Road
- Broad gilgai area
- Austral Pillwort survey tracks

\\emnsvr1\EMM\Jobs\2019\1190417 - CGO Open Cut Expansion Project\GIS\02_Maps_BDAR\BDAR015_BroaderLakeCowalAustralPillwortSurveys_20230424_04.mxd 24/04/2023

Source: EMM (2023); Evolution (2023); DFSI (2017)

0 2.5 5 km

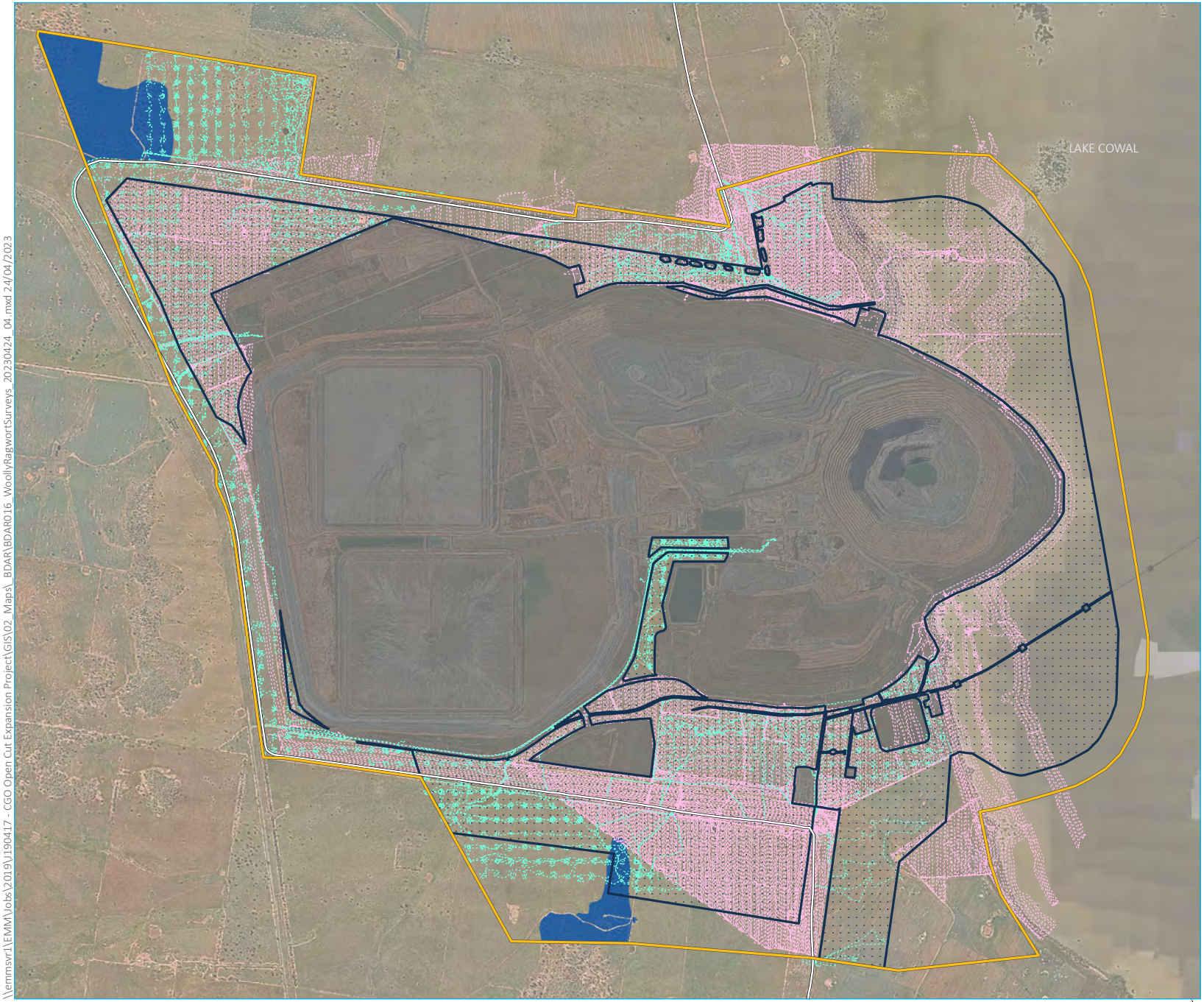
GDA 1994 MGA Zone 55

N

Threatened flora surveys within Broader Lake Cowal survey area: Austral Pillwort (*Pilularia novae-hollandiae*)

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Biodiversity Development Assessment Report
Figure 5.10

EMM
creating opportunities



KEY

- Study area
- Additional disturbance area
- Existing and approved disturbance area
- Major road
- Associated vegetation communities

Survey tracks

- 2020 - Parallel field transect (DPIE 2020b)
- 2022 - Two-phase grid-based systematic survey (DPIE 2020b)

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Source: EMM (2023); Evolution (2023); DFSI (2017); Nearmap (2021)

0 1 2 km

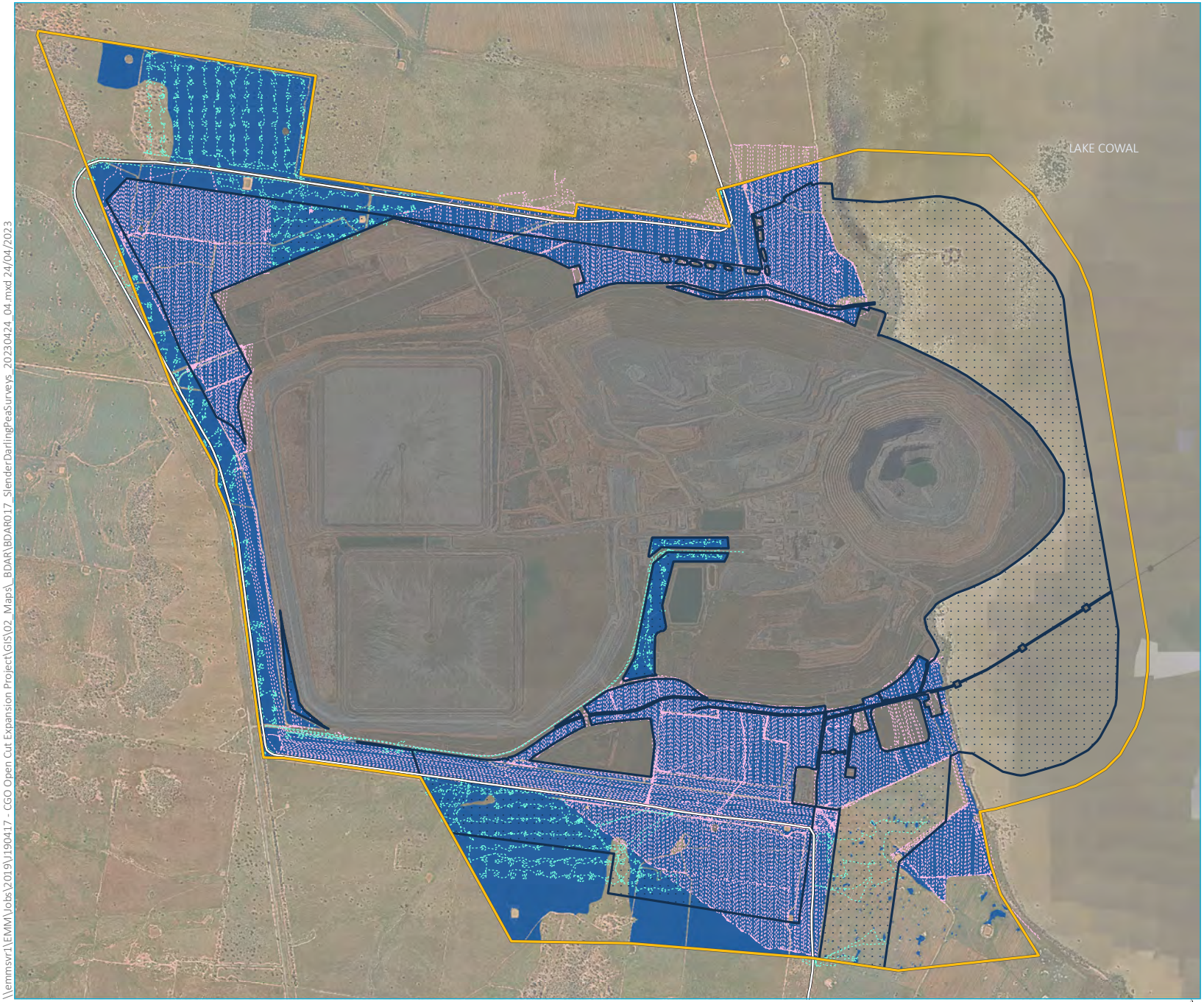
GDA 1994 MGA Zone 55

N

Threatened flora surveys within study area: Woolly Ragwort (*Senecio garlandii*)

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Biodiversity Development Assessment Report
Figure 5.11

EMM
creating opportunities



KEY

- Study area
- Additional disturbance area
- Existing and approved disturbance area
- Major road
- Associated vegetation communities

Survey tracks

- 2020 - Parallel field transect (DPIE 2020b)
- 2022 - Two-phase grid-based systematic survey (DPIE 2020b)

\\emmsvr1\EMM\Jobs\2019\I190417 - CGO Open Cut Expansion Project\GIS\02_Maps_BDAR\BDAR017_SlenderDarlingPeaSurveys_20230424_04.mxd 24/04/2023

Source: EMM (2023); Evolution (2023); DFSI (2017); Nearmap (2021)

0 1 2 km

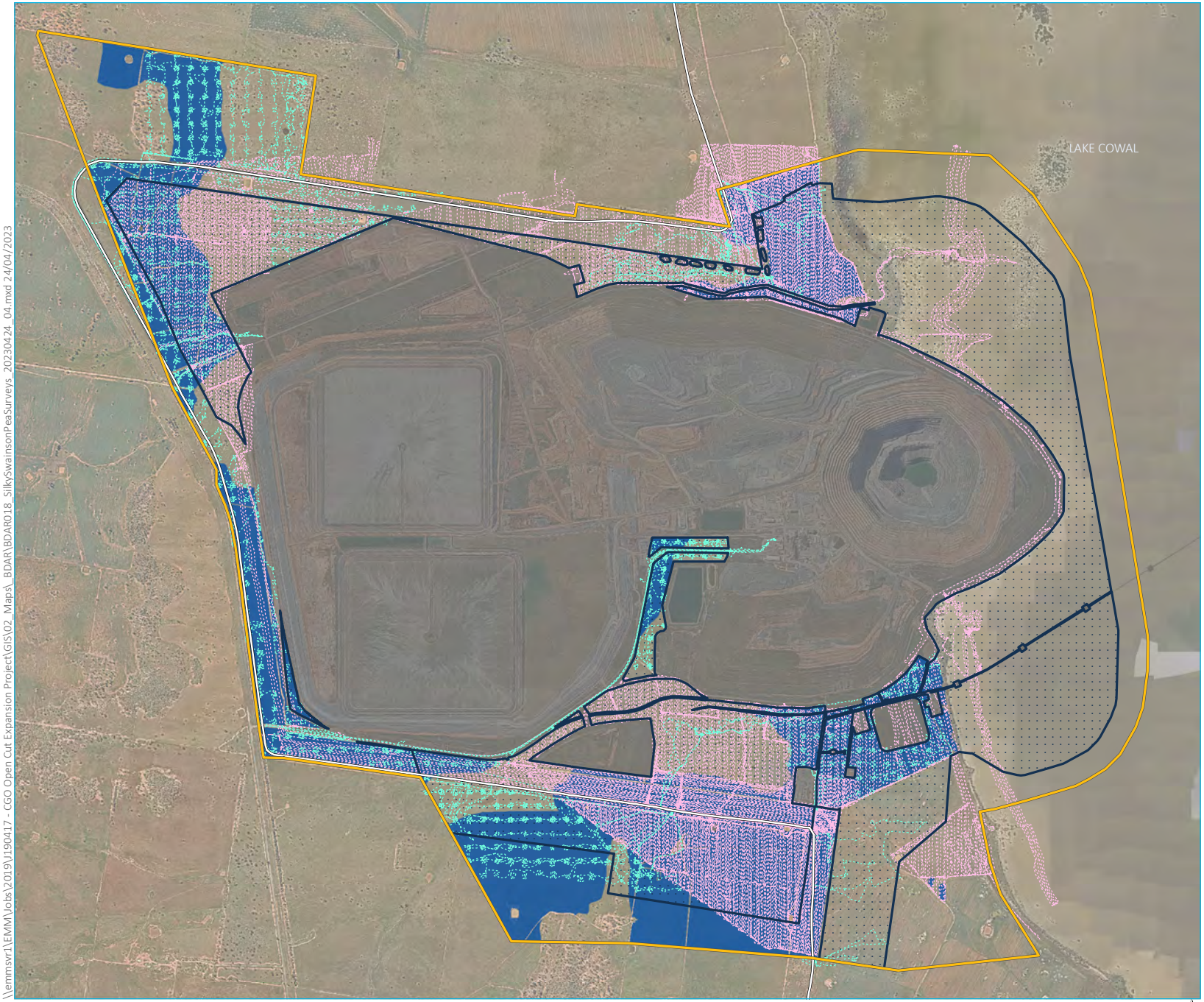
GDA 1994 MGA Zone 55

N

Threatened flora surveys within study area: Slender Darling Pea (*Swainsona murrayana*)

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Biodiversity Development Assessment Report
Figure 5.12

EMM creating opportunities



KEY

- Study area
- Additional disturbance area
- Existing and approved disturbance area
- Major road
- Associated vegetation communities

Survey tracks

- 2020 - Parallel field transect (DPIE 2020b)
- 2022 - Two-phase grid-based systematic survey (DPIE 2020b)

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Source: EMM (2023); Evolution (2023); DFSI (2017); Nearmap (2021)

0 1 2 km

GDA 1994 MGA Zone 55

N

Threatened flora surveys within study area: Silky Swainson Pea (*Swainsona sericea*)

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Open Pit Continuation Project
Biodiversity Development Assessment Report
Figure 5.13

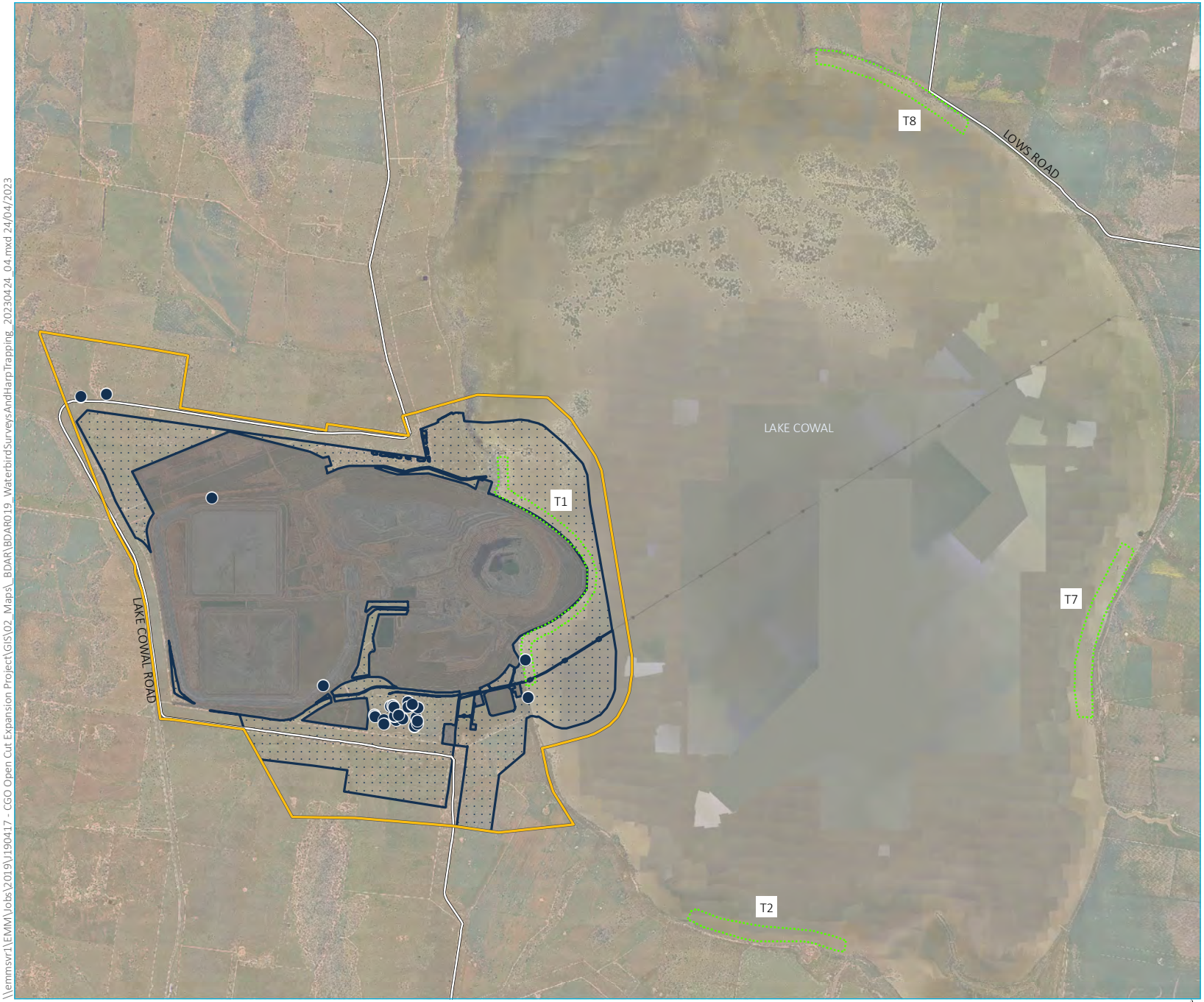
EMM creating opportunities

iii Previous targeted fauna surveys

Previous threatened fauna surveys undertaken in or nearby Evolution's mining lease that are applicable to the Project are detailed in Table 5.6. Locations of surveys adopted within this BDAR for microbats from AMBS Ecology & Heritage (2018) and Evolution's waterbird monitoring locations are shown in Figure 5.14.

Table 5.6 Previous threatened fauna surveys within and nearby study area

Surveys	Period	Method	Reference
Fauna species recorded within ML 1535 and surrounds before operations: amphibians, reptiles, birds and mammals (including bats) and waterbirds.	1995	'A size' Elliot traps, pitfall traps, spotlighting, Anabat™ detecting, amphibian call recording, habitat searches and waterbird counts.	Vestjens (1977), Gunninah Consultants (1995), Mount King Ecological Surveys (1997), Greg Richards and Associates (1997a–b).
Waterbird Monitoring for Evolution Lake Cowal.	1989 to present (95 monitoring efforts to date)	Monitoring of wetland bird species diversity and abundance and their breeding success has been conducted three times a year at Lake Cowal since 1989.	Australian Museum Business Services (2013); Gell and Peake (2011–2014; three reports per year); Gell (2015–2022; three reports per year)
Targeted surveys for threatened amphibians, reptiles, birds and mammals (including bats) were conducted within ML 1535 for the Threatened Species Management Protocol.	2003	Targeted amphibians, reptiles, birds and mammals, and involved, herpetological searches, bird census surveys, call broadcasting, spotlighting, targeted searches, Anabat™ detecting and harp trapping.	Barrick (2003a–b), Country Energy (2004)
Regular monitoring within ML 1535 of tailings storage facilities, pre-clearance surveys, records of fauna deaths.	2005-present	Pre-clearance surveys, monitoring of the tailings storage facilities, annual records of fauna deaths within the Annual Environment Management Report (AEMR, note: identification of fauna deaths to species not provided in the AEMR from 2016).	Donato Environmental Services (2010–2016, 2019–2022), Barrick (Cowal) Limited (2005–2015).
Targeted surveys for the Cowal Gold Mine E42 Modification Environmental Assessment.	2008	Spotlighting on foot, spotlighting by vehicle, herpetological searches, bird surveys, call playback, opportunistic observations and interpreting tracks and traces of fauna. A habitat assessment was also conducted.	Western Research Institute (2008)
Waterbird Monitoring.	2010 -2020 (13 survey events)	Aerial surveys undertaken from high-wing aircraft. Surveys undertaken in October annually.	UNSW (2022)
Amphibian survey.	2011	Spotlighting on foot, spotlighting by vehicle, call playback, opportunistic observations, listening for and interpreting frog calls, searching for egg masses and dip netting for tadpoles. A habitat assessment of all survey sites was also conducted.	Cenwest Environmental Services (2011)
Targeted surveys for Superb Parrot within and surrounding ML 1535.	2012	Targeted surveys and habitat assessment.	Kerle (2013a–b)
Targeted threatened fauna surveys for Cowal Gold Mine Processing Rate Modification: amphibians, reptiles, diurnal and nocturnal birds, arboreal and ground-dwelling mammals (including bats).	2016–2017	Nocturnal habitat search and call playback for amphibians, habitat search for reptiles, area searches for diurnal birds (including wetlands), motion cameras and hair tubes for ground-dwelling mammals, spotlighting for nocturnal mammals and birds, call playback for barking owl, koala and bush stone-curlew, habitat searches for Grey-headed flying foxes, harp trapping and Anabat™ detectors for microbats.	AMBS Ecology & Heritage (2018)



KEY

- Study area
- Additional disturbance area
- Existing and approved disturbance area
- Major road
- Harp-trapping locations undertaken by AMBS (2018)
- Waterbird survey transect (Evolution monitoring)

Locations of Evolution's waterbird survey and AMBS (2018) harp-trapping surveys adopted in this BDAR

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Biodiversity Development Assessment Report
Figure 5.14

Source: EMM (2023); Evolution (2023); AMBS (2018): DFSI (2017); Nearmap (2021)

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GDA 1994 MGA Zone 55

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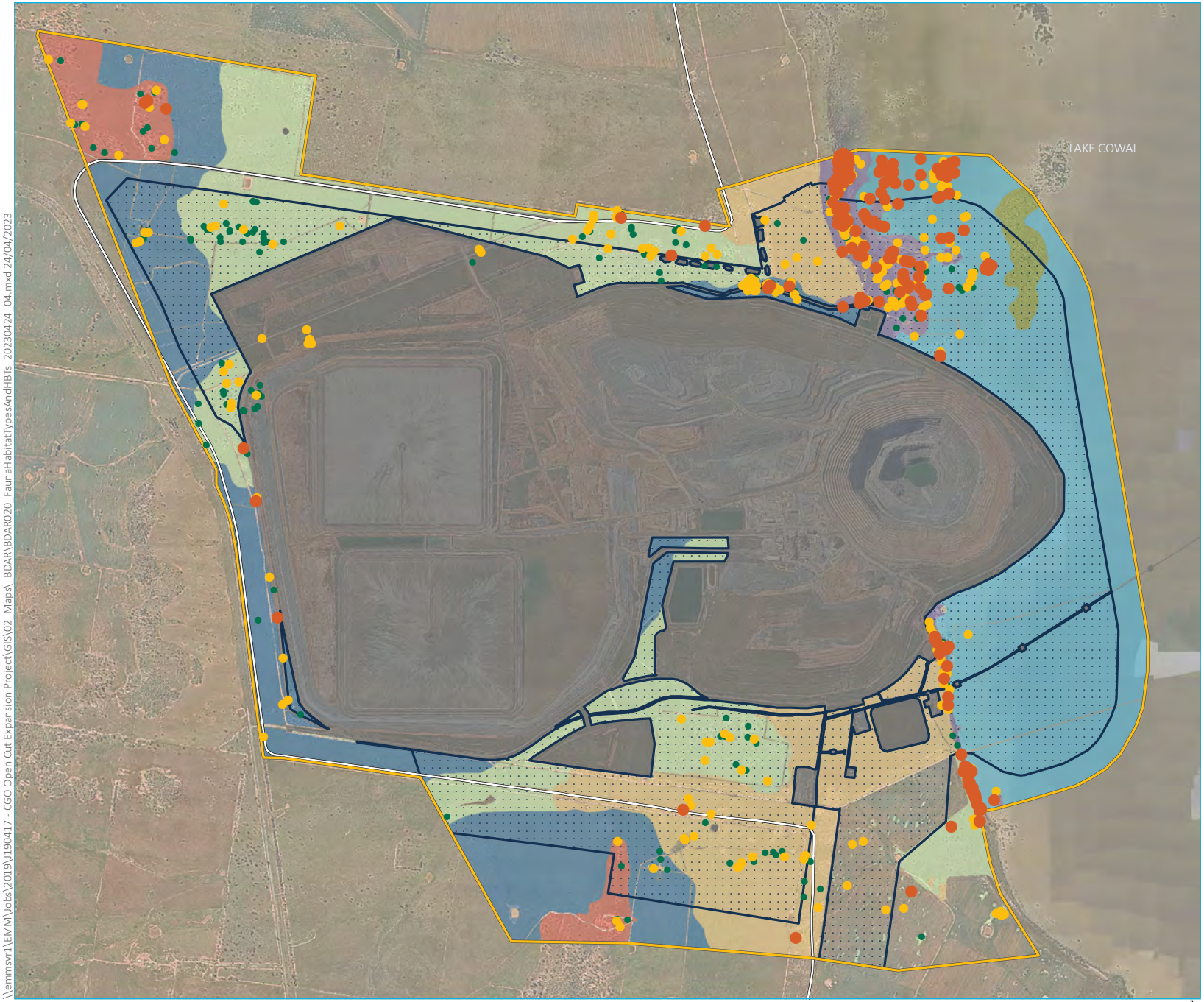
iv Targeted fauna surveys for BDAR

Targeted threatened fauna surveys were undertaken between August 2020 and January 2023. Surveys were designed in consultation with NSW (DEC 2004, DEC 2009, OEH 2018, DPIE 2020b, DPE 2022d) and Commonwealth (DSEWPaC 2010a, DSEWPaC 2010b and DSEWPaC 2011) guidelines. Species-specific survey information, as provided within the DPE TBDC (2023c), was also used to guide surveys where available at the time of survey.

Survey effort was firstly guided by stratifying the study area into broad habitat types. Finer-scale habitat characteristics were also noted across initial surveys of the study area, including noting of hollow-bearing trees for hollow-associated threatened birds and mammals (recording tree species, diameter at breast height, hollow number grouped into <5 cm, 5–20 cm and >20 cm entry diameters), search for rocky outcrops/bushrock for reptiles, and locations of waterbodies for waterbirds and amphibians. Survey stratification units, representing the broad habitat types for fauna in the survey area, are detailed in Table 5.7. A map indicating locations of these stratification units, as well as hollow-bearing trees, is provided in Figure 5.15.

Table 5.7 Stratification survey units and survey area

PCT	Stratification unit	Total area (ha)	Wooded area (ha)
53	1. Inland Floodplain Swamps	449.37	0
17	2. Inland Floodplain Shrublands	21.71	0
249	3. Inland Riverine Forests	65.31	57.03
26	4. Riverine Plain Woodlands	254.19	36.32
82, 244	5. Floodplain Transition Woodlands	325.98	1.96
55	6. North-west Floodplain shrublands	372.92	81.98
185	7. Inland Rocky Hill Woodlands	73.94	31.02



KEY

- Study area
- Additional disturbance area
- Existing and approved disturbance area
- Major road

Hollow-bearing tree (largest hollow present)

- < 5 cm
- 5 - 20 cm
- > 20 cm

Broad habitat type

- Inland floodplain swamps
- Inland floodplain shrublands
- Inland riverine forests
- Riverine plain woodlands
- North west floodplain shrublands
- Floodplain transition woodlands
- Inland rocky hill woodlands

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Source: EMM (2023); Evolution (2023); DFSI (2017); Nearmap (2021)

0 1 2 km

GDA 1994 MGA Zone 55

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Threatened/migratory survey fauna stratification units and hollow-bearing-trees

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Figure 5.15

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a Diurnal birds

Diurnal bird surveys were undertaken for the following species:

- Glossy Black Cockatoo (*Calyptorhynchus lathami*)
- Major Mitchell's Cockatoo (*Lophochroa leadbeateri*)
- Superb Parrot (*Polytelis swainsonii*)
- White-bellied Sea Eagle (*Haliaeetus leucogaster*)
- Little Eagle (*Hieraaetus morphnoides*)
- Square-tailed Kite (*Lophoictinia isura*)
- Black-breasted Buzzard (*Hamirostra melanosternon*).

Bird survey methods were developed with reference to DEC (2004) and DSEWPaC (2010a). Transects, area-based searches and habitat-targeted searches were undertaken for all six bird species. Surveys were firstly aimed at detecting species presence, then identifying signs of breeding. Surveys primarily focused on mature, remnant woodland (i.e. stratification units 3 to 7), which may support breeding of these six birds. Survey effort was also applied to cover small, isolated patches and paddock trees, where suitable habitat was identified.

For the hollow-associated birds Glossy Black Cockatoo, Superb Parrot and Major Mitchell's Cockatoo, surveys focused on woodland where suitable hollows were available for nesting. This was guided by a hollow-bearing tree survey, which involved traversing the study area on foot and recording trees with hollows, including the species, diameter at breast height (DBH), and number/ size class of hollows (grouped into <5 cm, 5–20 cm and >20 cm entry size). In total, 651 hollow-bearing trees were recorded (as shown in Figure 5.15), with the application of these size classes for each of these hollow-associated bird species outlined in Table 5.8. Details of hollow-bearing trees are provided in Appendix F.

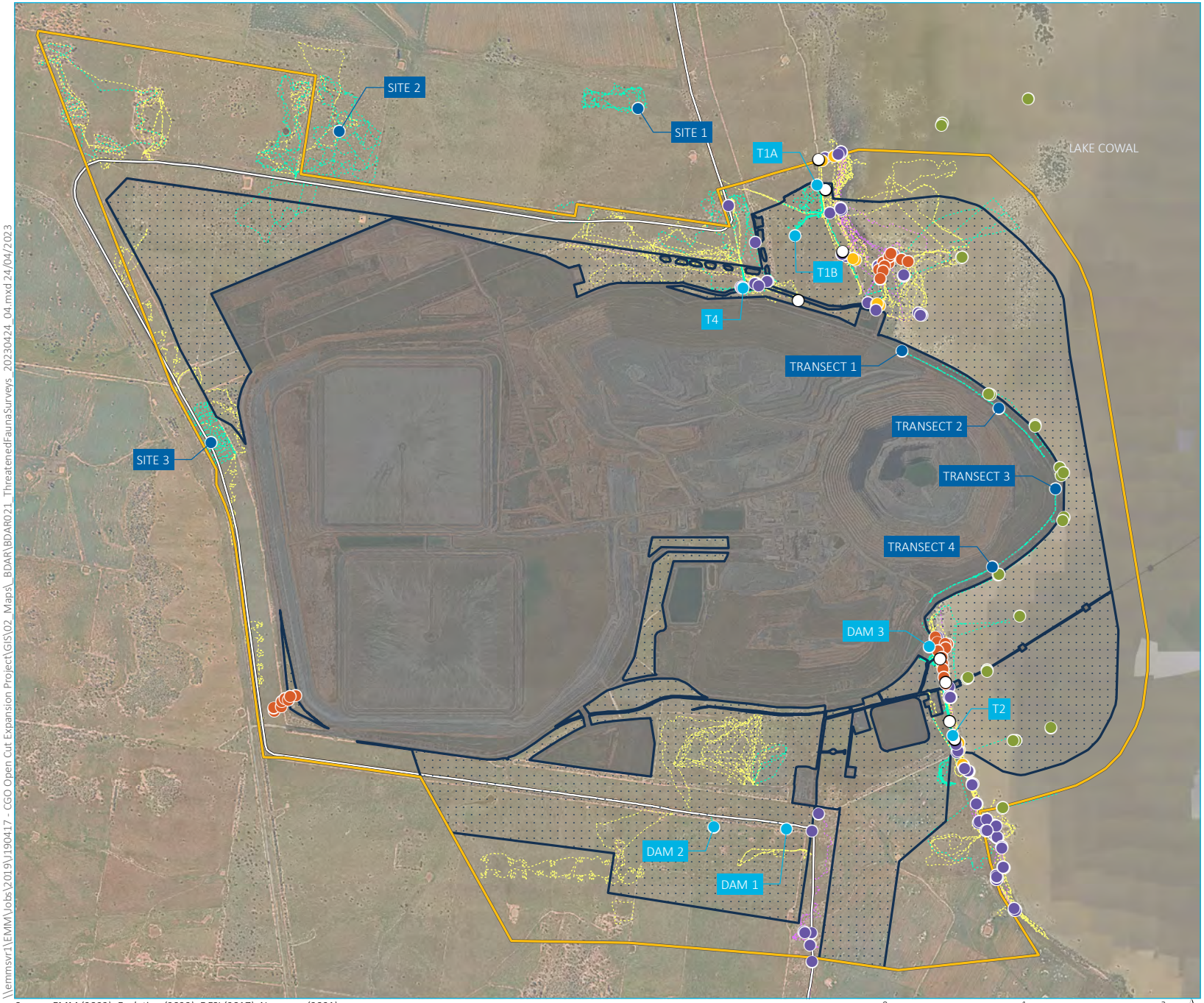
For the raptor species, Little Eagle, White-bellied Sea Eagle, Square-tailed Kite and Black-breasted Buzzard, surveys focused on mature *Eucalyptus* sp., where their nesting is typically supported. Due to inundation of Lake Cowal at the time of surveys, additional survey effort was undertaken using a thermal-imaging drone. Occupied nests were identified by drone at night as indicated by body heat. Methods and survey effort are outlined in Table 5.8. Locations of diurnal bird surveys are shown in Figure 5.16.

Table 5.8 Methods and survey effort – diurnal birds

Species	Definition of breeding activity (DPE TBDC 2023c)	Survey description	Survey effort
Hollow-associated bird: Glossy Black-Cockatoo	Breeding was presumed present if: 1. begging birds of any age or sex have been identified at the site. 2. lone adult males have been identified at the site during the breeding season (April to August), or 3. an occupied nest has been found (DPE TBDC 2023d).	Transect and area-based searches: • Surveys were conducted in the early morning and late afternoon, along transects or through pre-defined areas. • Observers travelled on foot, seeking out the species, including suitable hollows that may support breeding (i.e. >15 cm entry and >8 m above ground as per DPE TBDC 2023d; as marked up in HBT surveys). • All birds detected (by call or sight) were identified where possible and recorded. Targeted searches: • Targeted surveys were undertaken in the early morning or late afternoon where the most suitable hollow breeding habitat were located (i.e. >20 cm entry and >8 m above ground, as per DPE TBDC 2023d).	In total, 36 hours of targeted surveys were undertaken for this species across the January to September survey period (DPE TBDC 2023d). This included: • Sixteen hours of transect surveys over four days between 14–18 August 2020. • Eight hours of area-based searches over four days between 1–4 August 2021. • Twelve hours of targeted searches over four days between 25–20 August 2021. A further 33 days of opportunistic searches were undertaken in conjunction with threatened flora surveys. There was no BAM survey guideline for diurnal birds available at the time of surveys. While DEC (2004) and DSEWPaC (2010a) do not specify survey effort for the Glossy-black Cockatoo, the survey effort exceeded that recommended for the Kangaroo Island Glossy Black Cockatoo (DSEWPaC 2010a).
Hollow-associated bird: Major Mitchell's Cockatoo	Breeding was presumed present if: 1. begging birds of any age or sex have been identified at the site 2. lone individuals of the species have been identified during the breeding season (August to November), or 3. an occupied nest has been found (DPE TBDC 2022e).	Transect and area-based searches: • Surveys were conducted in the early morning and late afternoon, along transects or through pre-defined areas. • Observers travelled on foot, seeking out the species, including suitable hollows that may support breeding (i.e. live or dead trees with >10 cm hollow) as marked up in HBT surveys). • All birds detected (by call or sight) were identified where possible and recorded. Targeted searches: • Targeted surveys were undertaken in the early morning or late afternoon where suitable tree hollows that may support breeding were located (i.e. live or dead trees with >10 cm hollow; DPE TBDC 2022e).	In total, 30 hours of surveys were undertaken for this species across the September to December survey period (DPE TBDC 2022e). This included: • Sixteen hours of area-based searches over four days between 20–24 October 2020. • Fourteen hours of transect, area-based and targeted searches over four days between 17–20 October 2022. A further 50 days of opportunistic searches were undertaken in conjunction with threatened flora surveys. There are no BAM survey guidelines for diurnal birds available at the time of surveys. DEC (2004) and DEC (2010) do not provide guidance on survey effort for the Major Mitchell cockatoo.
Hollow-associated bird: Superb Parrot	Breeding habitat was presumed present if: 1. presence of habitat features and observed nest, or 2. two or more birds seen on site (DPE TBDC 2023f). Due to the need to identify a nest tree to establish a species polygon (as per DPE TBDC 2023f), a breeding site was only considered present if a nest tree was located.	Transect and area-based searches: • Surveys were conducted in the early morning and late afternoon, along transects or through pre-defined areas. • Observers travelled on foot, seeking out the species, including suitable hollows that may support breeding (i.e. live or dead *E. camaldulensis* or *E. microcarpa* with >5 cm entry >4 m above ground with DBH >30 cm; DPE TBDC 2023f). Note that *E. blakelyi*, *E. melliodora*, *E. albens*, *E. polyanthemos*, *E. mannifera* and *E. intertexta*, which may support Superb Parrot nesting, were not present. • All birds detected (by call or sight) were identified where possible and recorded. Targeted searches: • Targeted surveys were undertaken in the early morning or late afternoon where suitable tree hollows that may support breeding were located (i.e. *E. camaldulensis* or *E. microcarpa* with >5 cm entry >4 m above ground with DBH >30 cm; DPE TBDC 2023f).	In total, 30 hours of surveys were undertaken across the September to November survey period (DPE TBDC 2023f). This included: • Sixteen hours of area-based searches over four days between 20–24 October 2020. • Fourteen hours of transect, area-based and targeted searches over four days between 17–20 October 2022. A further 40 days of opportunistic searches were undertaken in conjunction with threatened flora surveys. There are no BAM survey guidelines for diurnal birds available at the time of surveys. The minimum survey effort for Superb Parrot as recommended by DEC (2010; 12 hours per 50 ha of habitat) was exceeded.

Table 5.8 Methods and survey effort – diurnal birds

Species	Definition of breeding activity (DPE TBDC 2023c)	Survey description	Survey effort
Raptor: White-bellied Sea-eagle	Breeding habitat for White-bellied Sea-eagle was presumed if: 1. large old trees present within 1 km of a river, lake, large dam, large creek, wetland or coastline 2. the presence of a large stick nest within tree canopy, or 3. an adult with nesting material, or 4. adults observed duetting within breeding period.	Transect and area-based searches: • Surveys conducted in the early morning or late afternoon, along transects or through pre-defined areas. • Observers travel on foot, seeking out the species and habitat features including raptor nests. • All birds detected (by call or sight) were identified where possible and recorded. Nest surveys were undertaken by drone survey in inundated areas of Lake Cowal. Two survey efforts were undertaken, in attempt to identify nesting of raptors through the day and night. Drone surveys were undertaken using a Maverick 2 Enterprise Advanced (M2EA) drone attached with a longwave thermal camera with a 9 mm sensor and visual (RGB) camera. The follow approach was adopted for raptor surveys: • Surveys carried out in the day used the visual (RGB) to inspect treetops for raptor nests. Closer inspection was undertaken to identify bird species where occupancy was detected. • All woodland habitat across the inundated area was surveyed whilst maintaining >30% side overlap between flight paths. • Flight altitude was maintained around 30–40 m above the canopy, with a maximum speed of 8 m/s. • Drone was operated by an experienced pilot with prior experience in fauna drone surveys. • Surveys were carried out with the assistance of a spotter, who was on hand to investigate and confirm identification of any thermal signatures. Incidental surveys for nesting raptors were also carried out in conjunction with Koala surveys. These drone surveys were undertaken in the dark, allowing nesting raptors to be detected based on body temperature (see Appendix G; koala drone survey report by Dr Chad Beranek).	In total, over 34 hours of transect/area-based searches were carried out for these species between 20–24 October 2020 and 17–20 October 2022. These survey efforts occurred within the prescribed survey timeframe for the four threatened raptors. 227.16 ha of woodland and paddock trees were surveyed for raptor nesting by drone between 4–6 October 2022 and 17-20 October 22 A further 47 days of opportunistic searches were undertaken in conjunction with threatened flora surveys. There are no BAM survey guidelines for diurnal birds available at the time of surveys. Moreover, DEC (2004) does not provide guidance on survey effort for these species.
Raptor: Little Eagle Raptor: Square-tailed Kite	Breeding habitat for Little Eagle and Square-tailed Kite was presumed if: • a male and female pair in an area with large old trees in suitable vegetation, or • a female with nesting material, or • an individual or pair on a large stick nest in the top half of the tree canopy.		
Raptor: Black-breasted Buzzard	Potential nesting habitat was considered land within 40 m of riparian woodland on inland watercourses/waterholes containing dead or dying eucalypts, as per DPE TBDC (2023g). However, there is no definition of breeding habitat for this species. So, principals regarding identification of breeding habitat were applied from the Little Eagle and Square-tailed Kite due to similarity in nesting behaviour.		



KEY

- Study area
- Additional disturbance area
- Existing and approved disturbance area
- Major road

Threatened fauna surveys

- Diurnal bird survey
- Nocturnal bird survey
- Arboreal elliot trapping
- Migratory and wetland bird survey
- Anabat survey
- Sloane's Froglet survey
- Southern Bell Frog survey
- Diurnal bird survey transect
- Nocturnal bird survey transect
- Frog survey transect

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Source: EMM (2023); Evolution (2023); DFSI (2017); Nearmap (2021)

0 1 2 km

GDA 1994 MGA Zone 55

N

Threatened fauna surveys: Frogs, diurnal birds, nocturnal birds, arboreal elliot trapping, waterbird survey and anabat survey

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Figure 5.16

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b Waterbird surveys

Surveys were undertaken to target migratory shorebird/wetland birds listed under the EPBC Act. Although the Candidate wetland bird species Curlew Sandpiper (*Calidris ferruginea*) and Black-tailed Godwit (*Limosa limosa*) were ruled out as species credit entities due to a lack of important habitat (i.e. Lake Cowal is not indicated as important habitat on the Important Habitat Map for these species in BOAMS), survey efforts were nonetheless extended to detect these species (including record of any observed breeding). Methods and effort supplied in Table 5.14. Locations of threatened and migratory bird surveys are shown in Figure 5.16.

Table 5.9 Methods and survey effort – threatened and migratory waterbird surveys

Survey Method	Survey Effort
Migratory and wetland bird surveys were completed following the inundation of Lake Cowal in the winter of 2020 in accordance with the Survey guidelines for Australia's threatened birds (DEWHA 2010) and Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species (DoEE 2017b).	Five locations[1] were selected along the shoreline, approximately 1 km apart. A total of 20 minutes was spent at each location with two observers identifying and counting all species, using binoculars and spotting scopes. The initial survey was undertaken between 11–12 November 2020. The survey was repeated twice on 17–18 February 2021 and once on 3 March 2021. The spread of surveys was carried out to gain understanding of any seasonal variation and capture a range of habitat as the lake was inundated and receded, providing deeper water to shallow foraging habitat for waders. Estimates of individuals sighted, as well any nesting, was also recorded.

[1]Exact survey locations changed slightly as the lake shoreline shifted throughout the survey period.

c Nocturnal birds

Nocturnal bird surveys were undertaken for the following species:

- Masked Owl (*Tyto novaehollandiae*)
- Barking Owl (*Ninox connivens*)
- Bush-stone Curlew (*Burhinus grallarius*).

Surveys for these species were developed with reference to DEC (2004). A combination of call playback and spotlighting was undertaken to survey for all nocturnal birds. For owl species, additional watches of suitable hollows were carried out at dusk, whilst spotlighting transects were conducted throughout suitable habitat for the Bush-stone Curlew. All methods and associated survey effort are outlined in Table 5.10. Locations of nocturnal bird surveys are shown in Figure 5.16.

Table 5.10 Methods and survey effort – nocturnal birds

Species	Survey description	Survey effort
Owls – Masked Owl and Barking Owl	Call playback and spotlighting was undertaken for Owl species as recommended by DEC (2004). Surveys were carried out as follows: • Surveys commenced with a 10–15 minute listening period. This was used to listen for passively calling birds as well as to target the male and female calling back and forth to one another. This can be useful in identifying nest trees. • Listening period was followed by spotlighting for 10 minutes in the immediate vicinity. • Call playback was then undertaken with the call of each target species played intermittently for a 5 minute period followed by a 10 minute listening period. • Following call playback a further 10 minutes of spotlighting was undertaken. • Survey sites were separated by at least 0.8–1 km, as per the suggestions of DEC (2004). To complement call-playback and spotlighting, dusk watches of suitable hollows were also undertaken. Hollows were selected if they showed signs of use (e.g. whitewash) and/or were suitable for breeding (i.e. living or dead trees with >20 cm entry >4 m above ground; DPE TBDC 2023h-i).	Spotlighting and call-playback surveys were repeated four times at three different locations between 14–18 August 2020. While DEC (2004) suggests five and eight visits for the Barking Owl and Masked Owl respectively, survey effort was supplemented by the inclusion of dusk-watches of suitable hollows. In total, 28 hollow-bearing trees were watched four times over four nights between 14–18 August 2020.
Bush-stone Curlew	Call playback and spotlighting was undertaken for the Bush-stone Curlew concurrently with surveys for the Masked Owl and Barking Owl. Spotlighting transects for Bush-stone Curlew were also carried out as per the recommendations of DEC (2004). Surveys were conducted as follows: • Observers searched for the species at night along replicate 500 m–1 km transects. • Along each transect, a torch (>1,000 lumens) was used to actively locate and 'flush' individuals. • Surveys targeted woodland patches in stratification units 3 and 5 with suitable falling/standing dead timber, including logs, as per DPE TBDC (2023j).	Spotlighting and call-playback surveys were repeated four times at five different locations between 14–18 August 2020, 4–7 October and 22–25 November 2022. Five replicate 500 m – 1 km spotlighting transects were also surveyed four times during the above survey events. DEC (2004) has not resolved bird survey requirements and does not provide guidance on survey effort for the Bush-stone Curlew.

d Arboreal mammals

Arboreal mammal surveys were undertaken for the following species:

- Squirrel Glider (*Petaurus norfolcensis*)
- Koala (*Phascolarctos cinereus*).

Surveys for the Squirrel Glider were developed in consultation with DEC (2004) and DSEWPaC (2011) guidelines. For the Koala, surveys were undertaken in accordance with DPE (2022d), which requires the use of a scat-based detection technique and one additional method. Given the large scale of the site, Koala Detection Dogs and Drone surveys were considered the methods utilised in this study. Detailed information regarding survey methods and weather conditions are presented in Table 5.11 and Table 5.12 respectively. Squirrel Glider survey locations are shown in Figure 5.16, whilst koala survey effort is shown in Figure 5.17.

Table 5.11 Methods and survey effort – arboreal mammals

Method	Survey description	Survey effort
Arboreal trapping – Squirrel Glider	Trapping for the Squirrel Glider was undertaken throughout woodland areas in stratification units 3 and 5. Poor and regenerating areas were excluded due to the absence of mature trees necessary to support the species (DPE TBDC 2023k). Surveys were designed with reference to DEC (2004) and involved the following: • Elliot B traps were placed in suitable habitat at 2–4 m above the ground, 50 m apart in two parallel lines separated by 50 m. • Traps were baited with a mixture of peanut butter, rolled oats and honey. • A mixture of water and honey was sprayed on each tree trunk. • Traps were checked early in the morning and closed for the day. • Traps were re-opened and rebaited in the late afternoon.	A total of 120 trap nights were expended surveying for this species. Trapping took place over four nights between 20–24 October 2020. DEC (2004) suggests 24 trap nights over 3–4 consecutive days per 50 ha of stratification unit, with replication for every additional 100 ha. Based on the amount of wooded area associated with the species provided in Table 5.7, a minimum of 100 trap nights would be required by DEC (2004). The minimum survey effort was thus exceeded.
Drones – Koala	Drone surveys for the Koala were undertaken in accordance with DPE (2022d), including: • Use of a Maverick 2 Enterprise Advanced (M2EA) drone attached with a longwave thermal camera with a 9 mm sensor and visual (RGB) camera. • Flight altitude was maintained around 60–65 m above the canopy, with a maximum speed of 8 m/s. • Full extent of suitable habitat across the site was surveyed whilst maintaining >30% side overlap between flight paths. • Drone was operated by an experienced pilot with prior experience in koala surveys (note: surveys undertaken by C. Berenak, the primary author of a paper the drone surveys in DPE (2022d) are based upon – see Beranek et al. 2020). • Surveys were carried out with the assistance of a spotter, who was on hand to investigate and confirm identification of any thermal signatures. • Potential Koala detections were validated via drone with the use of an auxiliary light and RGB camera. • Survey sites were repeated twice on separate nights.	227.16 ha of woodland habitat and paddock trees were surveyed over five nights between the 4–6 October and the 18–19 October. Survey sites were repeated twice as per the requirements of DPE (2022d). The total length of flight paths was 234.34 km. A more detailed report on methods and survey effort is provided in Appendix G (koala drone survey report by Dr Chad Beranek).
Detection Dogs – Koala	Detection dog surveys were carried out in accordance with the requirements of DPE (2022d): • Three 200 m transects were placed for every 5 ha of suitable habitat, spaced ≥ 100 m apart. • Transects located evenly throughout suitable habitat, ensuring representative coverage of PCTs and avoiding edges, where possible. • Detection dog handlers walked the central transect twice; first in one direction and then the opposite. • Detection dogs were then permitted to roam freely within the 25 m to the side of the transect. • Detection dog handlers walked the transect at an average speed of 10 m/min.	108, 200 m transects were surveyed from 10–11 January 2023 and 30 January – 2 February 2023. A more detailed report on methods and survey effort is provided in Appendix G (TATE Animal Enterprises, 3 February 2023). Note that the detection dog surveys were undertaken across three events. This included, an initial attempt on 1 November 2022, which was cancelled due to unexpected flooding, and conditions on site were deemed too wet to permit positive detection of Koala scat. Surveys 11 January 2023 were cancelled due to unforeseen extreme heat.

Table 5.12 Weather conditions for Koala Surveys

Date	Method	Start	Finish	Rainfall <24 hours (mm)	Rainfall <72 hours (mm)	Min Temp (°C)	Max Temp (°C)	Relative Humidity (%)[1]	Mean wind (km/h)[1]	Max wind gust (km/h)
All data sourced from West Wyalong Airport (BoM 2023a, station number 050017)										
4/10/2022	Drone	19:45	23:07	1.6	1.6	7.6	23	48	11	26
5/10/2022	Drone	21:01	23:28	37	38.6	12	14.2	89	28	41
6/10/2022	Drone	18:57	20:11	0	38.6	11.8	20	80	20	33
18/10/2022	Drone	18:50	19:21	0	0	9.6	23.8	58	19	35
19/10/2022	Drone	19:14	19:37	0	0	12.3	26.6	52	22	39
10/01/2023	Detection Dogs	6:30	13:00	0	0	20.4	34.9	73	17	31
31/01/2023	Detection Dogs	6:30	17:00	10.6	24.6	18.4	33.4	87	13	39
1/02/2023	Detection Dogs	6:30	17:00	0	23	12.1	31.7	57	4	48
2/02/2023	Detection Dogs	6:30	16:00	0	10.6	13	29.3	59	6	57

Notes: 1. Data closest to survey times provided (9:00 am provided for detection dog Surveys, 3:00 pm for drone surveys).



KEY

- Study area
- Additional disturbance area
- Existing and approved disturbance area
- Major road
- Koala detection dog transect
- Koala detection dog survey track
- Koala drone flight path
- Suitable Koala habitat

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Source: EMM (2023); Evolution (2023); DFSI (2017); Nearmap (2021)

0 1 2 km

GDA 1994 MGA Zone 55

N

Threatened fauna surveys: Koala

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Figure 5.17

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e Microchiropteran bats

Microbat surveys were undertaken to target the Southern Myotis (*Myotis macropus*) and Corben's Long Eared Bat (*Nyctophilus corbenii*). Call analyses were also extended to any other threatened bats distinguishable by this method.

Surveys for this species were developed in accordance with OEH (2018). Acoustic detection methods were chosen due to the large extent of suitable riparian habitat present along the edges of Lake Cowal. Survey effort and methods are outlined in Table 5.13. Weather conditions for surveys carried out by EMM are displayed in Table 5.14. Locations of Anabat™ and harp trapping efforts are shown in Figure 5.16.

Table 5.13 Methods and survey effort – Microchiropteran bats

Method	Survey description	Survey effort
Acoustic detection	Acoustic detectors were deployed in mature River Red Gum and Poplar Box woodland within stratification unit 3, within the Riparian area of Lake Cowal. This riparian area was identified as the primary suitable habitat for Southern Myotis, which is known to associate with waterbodies with permanent pools/stretches 3 m or wider, including rivers, large creeks, billabongs, lagoons, estuaries, dams and other waterbodies. Surveys were carried out in accordance with OEH (2018) and involved the following: • Acoustic detectors were placed along the margins of Lake Cowal in patches of mature, inundated River Red Gum and Poplar box, where potential hollow-roosts were identified. • Detectors were set to record from dusk until dawn and were placed a minimum of 50 m apart. • Acoustic detectors deployed included the Anabat™ Express and the Wildlife Acoustics SM4BAT FS mounted with an SMM-U2 microphone. • Calls were analysed in the program Anabat™ insight by a suitably experienced ecologist (see Appendix G, bat call analysis results and email correspondence 19 December 2022).	Thirty-nine detection nights were recorded across eight locations between 15–25 November 2022. Sites were surveyed for 2 to 10 nights each. OEH (2018) guidelines specify a minimum survey effort of four sites surveyed for four nights (16 detector nights) for sites with less than 50 ha or habitat/riparian stream lengths less than 2.5 km. Approximately 2.5 km of suitable riparian habitat is present on the study area. The minimum survey effort of 16 detection nights was thus exceeded. AMBS Ecology & Heritage (2018) also undertook a total of 22 Anabat™ detector nights in 2017 and 8 detector nights in 2016 within the Additional disturbance area.
Harp-trapping	Harp-trapping was undertaken within the Subject-land by AMBS Ecology & Heritage (2018) targeting Corben's Long-eared Bat, which is difficult to distinguish from other *Nyctophilus* spp. based on call alone. See AMBS Ecology & Heritage (2018) for further details on the methods applied. Harp-trapping effort was focused on Riverine Plain Woodland and Floodplain Transition Woodland habitats that could potentially support Corben's Long-eared Bat.	Twenty-two harp trap nights were undertaken in late October 2017. Four harp trap nights were also undertaken in 2016.

Table 5.14 Weather Conditions for EMM Anabat™ Surveys[1]

Survey night	Rainfall <24 hours (mm)	Rainfall <72 hours (mm)	Min temp (°C)	Max temp (°C)
All data sourced from West Wyalong Airport (BoM 2023a, station number 050017)				
15/11/2022	4	45.4	11.1	17.2
16/11/2022	0	37.4	7.8	18.3
17/11/2022	0	4	4.9	19.7
18/11/2022	0	0	5.9	23
19/11/2022	0	0	10.7	25.9
20/11/2022	5.2	5.2	14	22.2
21/11/2022	0	5.2	11.1	17.5
22/11/2022	1.8	7	5.8	18.7
23/11/2022	0	1.8	9	22.7
24/11/2022	0	1.8	8	25.9

Notes: 1. Survey dates were not provided in AMBS Ecology & Heritage (2018). Accordingly, relevant weather data could not be supplied.

f Frogs

Frog surveys were undertaken for the following species:

- Sloane's Froglet (*Crinia sloanei*)
- Southern Bell Frog (*Litoria raniformis*).

Surveys for frogs were stratified by vegetation zone and the presence of suitable breeding waterbodies, as identified for each species in the DPE TBDC (2023c) and DPIE (2020c). For the Sloane's Froglet, which is associated with various permanent and ephemeral waterbodies (DPE TBDC 2023m), gilgais, drainage lines and shallow, inundated areas across the study area were considered suitable habitat. For the Southern Bell Frog, potential breeding habitat was considered all areas of the lake foreshore in associated vegetation zones with emergent aquatic vegetation, as per DPIE (2020c). Stratification units used to inform frog surveys are outlined in Table 5.15.

Table 5.15 Habitat areas for frogs

Target species	Waterway/habitat	Approximate length (km)/area (ha)
Sloane's Froglet	Gilgai[1] areas	220.54 ha
	Drainage lines[1]	4 km
Southern Bell Frog	Lake Cowal foreshore	6 km

Notes: 1. Precise mapping of gilgai areas and drainage lines was not undertaken; values presented here are rough estimates used to inform survey efforts. Gilgai areas refers to broad areas in which gilgais may occur, not independent gilgai.

Methods and survey effort for frogs were developed in consultation with both DECC (2009), DSEWPaC (2010b) and DPIE (2020c). Given the release of DPIE (2020c) guidelines in late 2020, all surveys carried out in 2020 were designed in reference to DECC (2009). To bridge the gap in survey effort recommendations between these guidelines, further survey was undertaken for the Sloane's Froglet in 2021 and the Southern Bell Frog in 2022.

For the Sloane's Froglet, survey methods were modified to accommodate the extensive areas of gilgais. After consulting with a DPIE species officer for the Sloane's Froglet (Appendix D, email from David Hunter on 16 July 2021), a meandering transect approach was agreed to be more appropriate than the linear method suggested in DPIE (2020c).

Due to the inundation of Lake Cowal during the 2022 survey period, suitable habitat in stratification units 1–3 could not be re-surveyed for the Southern Bell Frog. Subsequently, surveys were conducted along accessible shoreline, which consisted of flooded grassland and submerged paddocks with limited emergent aquatic vegetation. Given this marginal habitat, additional survey was directed towards nearby waterbodies (<2 km from foreshore) with more suitable microhabitat features. These included clusters of Gilgai, dams, and streams fringed with aquatic vegetation (predominantly *Eleocharis* spp.). Survey of areas outside stratification units was considered appropriate given the species is known to widely disperse from permanent waterbodies in response to seasonal flooding (Wassens et al. 2008).

Methods and survey effort for frogs are outlined in Table 5.16. Locations of frog survey efforts are shown in Figure 5.16. Weather conditions and frog species encountered during BAM frog surveys in 2021 and 2022 are detailed in Table 5.17 and Appendix G (EMM Targeted Frog Surveys – species detected table) respectively.

Table 5.16 Methods and survey effort – frogs

Species	Survey Method	Survey effort
Nocturnal surveys – Sloane's Froglet (Aug 2020)	Nocturnal surveys were informed by DECC (2009) and involved nocturnal aural-visual transect surveys and call playback along drainage lines and gilgais.	Sixteen hours of survey were expended over four nights between 10–14 August 2020. A total of 13 transects of varying lengths were surveyed, with three transects repeated on separate nights as per DECC (2009). Overall, 24 km of habitat was walked by two surveyors.
Nocturnal Surveys – Sloane's Froglet (Aug 2021)	Nocturnal surveys were conducted according to DPIE (2020c) and involved the following for every 50 m of transect: • An initial 5 minute listening period to listen for calling males. • If suitable breeding habitat was present, 5 minutes of intermittent playback of the species call was carried out to elicit a response. • Using a spotlight and head torch, searches were completed within surrounding vegetation, rocks, and other microhabitats. • All frogs observed or heard were recorded. • Hygiene protocols were followed to prevent the spread of chytrid fungus, with full wash down between streams. When surveying gilgais, a modified approach involving longer, meandering transects was undertaken as per communication with the BCD (Appendix D, email from David Hunter 16 July 2021).	Thirty-eight hours of survey was completed for this species over eight nights between 1–4 August 2021 and 26–29 August 2021. Where linear habitat existed, 500 m transects were established as per DPIE (2020c). Four linear transects were surveyed twice over four nights, equating to 16 hours survey effort. Where habitat consisted of gilgais, three meandering transects were repeated four times over four nights, equating to 22 hours survey effort. Eight km of habitat was surveyed during this time. While DPIE (2020c) methods were modified in this case, total survey effort (38 hours) approximated the maximum 40 hours recommended for sites with >5 km suitable habitat.

Table 5.16 Methods and survey effort – frogs

Species	Survey Method	Survey effort
Nocturnal surveys – Southern Bell Frog (November 2020)	A combination of aural-visual transect surveys and tadpole dip netting was undertaken for this species as per the recommendations of DECC (2009).	Sixteen hours of survey was completed for this species over four nights between 11–15 November 2020. Eight transects of varying lengths were surveyed twice on separate nights, as per DECC (2009). Over 5 km of wetland and adjacent terrestrial habitat was surveyed for the species.
Nocturnal Surveys – Southern Bell Frog (November 2022)	Nocturnal surveys were conducted according to DPIE (2020c) and involved the following for every 50 m of transect: • An initial 5 minute listening period to listen for calling males. • If suitable breeding habitat was present, 5 minutes of intermittent playback of the species call was carried out to elicit a response. • Using a spotlight and head torch, searches were completed within surrounding vegetation, rocks, and other microhabitats. • All frogs observed or heard were recorded. • Hygiene protocols were followed to prevent the spread of chytrid fungus, with full wash down between streams. Transect lengths were modified according to the presence of suitable breeding habitat. When gilgais were surveyed, a meandering transect approach was adopted as implemented for the Sloane's froglet.	Twenty-three hours of survey was carried out over four nights between 21–26 November 2022. Five transects of varying lengths and three dams were surveyed at a pro-rata rate per DPIE (2020c). While DPIE (2020c) methods were again modified here, combined survey effort during 2020 and 2022 (39 hours) approximated the maximum 40 hours recommended for sites with >5 km suitable habitat.

Table 5.17 Weather Conditions for targeted frog surveys in 2021 and 2022

Site	Date	Start time	End time	Start temperature (°C)	End temperature (°C)	Rainfall <24 hours (mm)	Rainfall <7 days (mm)	Rainfall <month (mm)	Humidity (%)	Barometric pressure	Cloud cover (eights of sky)	Wind speed	Moon phase
All data sourced from West Wyalong Airport (BoM 2023a, station number 050017)													
Sloane's Froglet													
Site 1	1/08/2021	-	-	6.4	4.8	0	2.5	57.5	-	-	0/8	Calm	Waning crescent
	2/08/2021	-	-	5	4.4	0	2.5	57.5	-	-	4/8	Light	Waning crescent
	3/08/2021	-	-	2.3	1.7	4	6.5	53.5	-	-	3/8	Moderate	Waning crescent
	4/08/2021	-	-	5	4.3	1	7.5	54.5	-	-	3/8	Moderate	Waning crescent
Site 2	1/08/2021	-	-	6.8	4.2	0	2.5	57.5	-	-	0/8	Calm	Waning crescent
	2/08/2021	-	-	11	5.5	0	2.5	57.5	-	-	0/8	Calm	Waning crescent
	3/08/2021	-	-	3.3	2.8	4	6.5	53.5	-	-	0/8	Moderate	Waning crescent
	4/08/2021	-	-	4.5	3.8	1	7.5	54.5	-	-	0/8	Light	Waning crescent
Site 3	1/08/2021	-	-	4.2	3.2	0	2.5	57.5	-	-	0/8	Calm	Waning crescent
	2/08/2021	-	-	4.2	4	0	2.5	57.5	-	-	4/8	Light	Waning crescent
	3/08/2021	-	-	3.5	3.1	4	6.5	53.5	-	-	3/8	Moderate	Waning crescent
	4/08/2021	-	-	4.9	4.7	1	7.5	54.5	-	-	0/8	Moderate	Waning crescent
Transect 1	27/08/2021	-	-	10.6	8.6	1	15.5	25	-	-	0/8	Light	Waning Gibbous
	29/08/2021	-	-	9	6.7	0	15.5	25	-	-	1/8	Moderate	Waning Gibbous
Transect 2	26/08/2021	-	-	9.1	5.8	0	14.5	24	-	-	7/8	Light	Waning Gibbous
	28/08/2021	-	-	6.4	4.6	0	15.5	25	-	-	0/8	Moderate	Waning Gibbous
Transect 3	26/08/2021	-	-	5.7	3.9	0	14.5	24	-	-	7/8	Calm	Waning Gibbous
	28/08/2021	-	-	4.5	3.2	0	15.5	25	-	-	0/8	Light	Waning Gibbous
Transect 4	27/08/2021	-	-	8.5	6.9	1	15.5	25	-	-	0/8	Light	Waning Gibbous
	29/08/2021	-	-	6.5	4.3	0	15.5	25	-	-	0/8	Light	Waning Gibbous
Southern Bell Frog													
T1A+B	5/10/2022	19:25:00	21:25:00	-	-	37	38.6	130	-	-	-	-	Waxing Gibbous
T1A	23/11/2022	0:25:00	1:25:00	11.3	-	0	7	174.2	65	1016.9	8/8	7.4 km/h	Waning Crescent
	23/11/2022	20:00:00	21:05:00	17.1	-	0	7	174.2	53	1016.9	0/8	14.8 km/h	Waning Crescent
	24/11/2022	22:55:00	23:55:00	13.9	-	0	7	166.8	59	1018.9	0/8	9.3 km/h	Waxing Crescent
T1B	23/11/2022	0:25:00	1:25:00	11.3	-	0	7	174.2	65	1016.9	8/8	7.4 km/h	Waning Crescent
	23/11/2022	20:00:00	21:05:00	17.1	-	0	7	174.2	53	1016.9	0/8	14.8 km/h	Waning Crescent
	24/11/2022	22:55:00	23:55:00	13.9	-	0	7	166.8	59	1018.9	0/8	9.3 km/h	Waxing Crescent

Table 5.17 Weather Conditions for targeted frog surveys in 2021 and 2022

Site	Date	Start time	End time	Start temperature (°C)	End temperature (°C)	Rainfall <24 hours (mm)	Rainfall <7 days (mm)	Rainfall <month (mm)	Humidity (%)	Barometric pressure	Cloud cover (eights of sky)	Wind speed	Moon phase
T2	22/11/2022	20:00:00	22:00:00	14.4	-	1.8	7	188.6	54	1016.7	8/8	16.7 km/h	Waning Crescent
	23/11/2022	22:30:00	0:15:00	13.4	-	0	7	174.2	69	1018.8	0/8	13 km/h	Waning Crescent
	24/11/2022	20:05:00	21:55:00	18.7	-	0	7	166.8	40	1017.6	0/8	13 km/h	Waxing Crescent
	25/11/2022	21:20:00	23:00:00	17	-	0	7	165.8	41	1015.5	0/8	7.4 km/h	Waxing Crescent
T3	22/11/2022	21:53:00	22:53:00	13.6	-	1.8	7	188.6	59	1017	8/8	11.1 km/h	Waning Crescent
	23/11/2022	22:30:00	23:05:00	13	-	0	7	174.2	69	1018.8	0/8	13 km/h	Waning Crescent
	24/11/2022	20:05:00	20:45:00	18.7	-	0	7	166.8	40	1017.6	0/8	13 km/h	Waxing Crescent
	25/11/2022	21:20:00	22:00:00	17	-	0	7	165.8	41	1015.5	0/8	7.4 km/h	Waxing Crescent
T4	22/11/2022	23:25:00	0:10:00	11.3	-	1.8	7	188.6	65	1016.9	8/8	17.4 km/h	Waning Crescent
	23/11/2022	21:10:00	21:55:00	13.4	-	0	7	174.2	64	1018.2	0/8	13 km/h	Waning Crescent
	24/11/2022	0:00:00	0:45:00	18.7	-	0	7	166.8	40	1017.6	0/8	13 km/h	Waxing Crescent
	25/11/2022	20:15:00	21:00:00	18.7	-	0	7	165.8	34	1015.5	0/8	9.3 km/h	Waxing Crescent
DAM 1	24/11/2022	0:32:00	0:42:00	-	-	0	7	166.8	-	-	0/8	-	Waxing Crescent
	24/11/2022	20:00:00	20:10:00	13.8	-	0	7	166.8	54	1018.8	0/8	7.4 km/h	Waxing Crescent
	25/11/2022	22:00:00	22:10:00	17	-	0	7	165.8	41	1015.5	0/8	7.4 km/h	Waxing Crescent
DAM 2	24/11/2022	0:42:00	0:52:00	-	-	0	7	166.8	-	-	-	-	Waxing Crescent
	24/11/2022	20:12:00	20:22:00	13.8	-	0	7	166.8	54	1018.8	0/8	7.4 km/h	Waxing Crescent
	25/11/2022	23:12:00	23:22:00	14.8	-	0	7	165.8	49	1015.4	0/8	11.1 km/h	Waxing Crescent
DAM 3	23/11/2022	23:00:00	23:15:00	14.4	-	0	7	174.2	54	1016.7	8/8	16.7 km/h	Waning Crescent
	24/11/2022	20:50:00	21:05:00	13.4	-	0	7	166.8	69	1018.8	0/8	13 km/h	Waxing Crescent
	25/11/2022	23:24:00	23:34:00	14.8	-	0	7	165.8	49	1015.4	0/8	11.1 km/h	Waxing Crescent

5.3.4 Targeted survey results

i Targeted flora

a Previous targeted flora surveys

The Austral Pillwort is the only threatened flora species to have been previously recorded within ML 1535. Within ML 1535, Bower (1998a) found Austral Pillwort in 52 gilgais out of the 95 surveyed (or 54.7%). Bower (1998a) also located Austral Pillwort commonly in gilgais north and south of ML 1535, as well as 12 km south of Condobolin. Clements and Rodd (1995) also found Austral Pillwort in a gilgai 13 km southwest of the study area, near Bland Creek.

Other threatened species found within 10 km of the Project Footprint include Pine Donkey Orchid (*Diuris tricolor*), *Tylophora linearis*, Silky Swainson-pea (*Swainsona sericea)* and *Austrostipa wakoolica* (AMBS Ecology & Heritage 2018).

Round-Leaf Wilsonia (*Wilsonia rotundifolia*) was recorded by DnA Environmental at Lake Cowal within a monitoring site for the RVEP, however has since been confirmed to be *Cressa australis* (Rosinweed), a species that is not listed as threatened.

b Targeted flora surveys by EMM

The only threatened plant EMM found within the Additional disturbance area was the Austral Pillwort. The number of Austral Pillwort recorded are presented in Table 5.18. The identification of this species was confirmed by positive identifications of five voucher specimens by the Royal Botanic Gardens Mt Annan (Appendix H; 30 November 2022).

Table 5.18 Austral Pillwort recorded

Area	Locations recorded	Estimated individuals
Additional disturbance footprint	7	2,810
Study area	16	3,861
Broader Austral Pillwort survey area	44	117,436

Locations of Austral Pillwort recorded are shown in Figure 5.18. Locations of Austral Pillwort found in the Broader Austral Pillwort survey area are shown in Figure 5.19. Photos of this species are provided in Photograph 5.3, Photograph 5.4 and Photograph 5.5 below. A more detailed assessment of the microhabitat occupied by this species, which was used to inform the species polygon for Austral Pillwort, is provided in the expert report attached in Appendix J.

The Austral Pillwort was found associating with grey cracking-clays in PCTs 26 and 55, within shallow depressions with a low grass/sedge cover, typically adjacent to Belah and Weeping Myall. Individuals were found both submerged and emerging from shallow, pooled water, with a grey clay substrate. In such a setting, it appeared that the nearby canopy reduced the competition of grasses and sedges in these areas, potentially by shading. Conversely, this species was usually not found within gilgais in the open, which were often populated by dense grasses and sedges. Deeper gilgais were also usually full of decaying grasses, and so did not appear to present suitable habitat, even as water levels declined with ongoing evapotranspiration. The only location this species was found away from tree cover was in shallow depressions where grass and sedge competitors were largely lacking. This included two sites; one within the Additional disturbance area within the cropped area (Zone 26) where grass/sedge cover was low in a shallow depression, and the second in a low-lying paddock 12 km south of Lake Cowal where grass/sedge was low.



Photograph 5.3 **Austral Pillwort emerging from shallow depression**



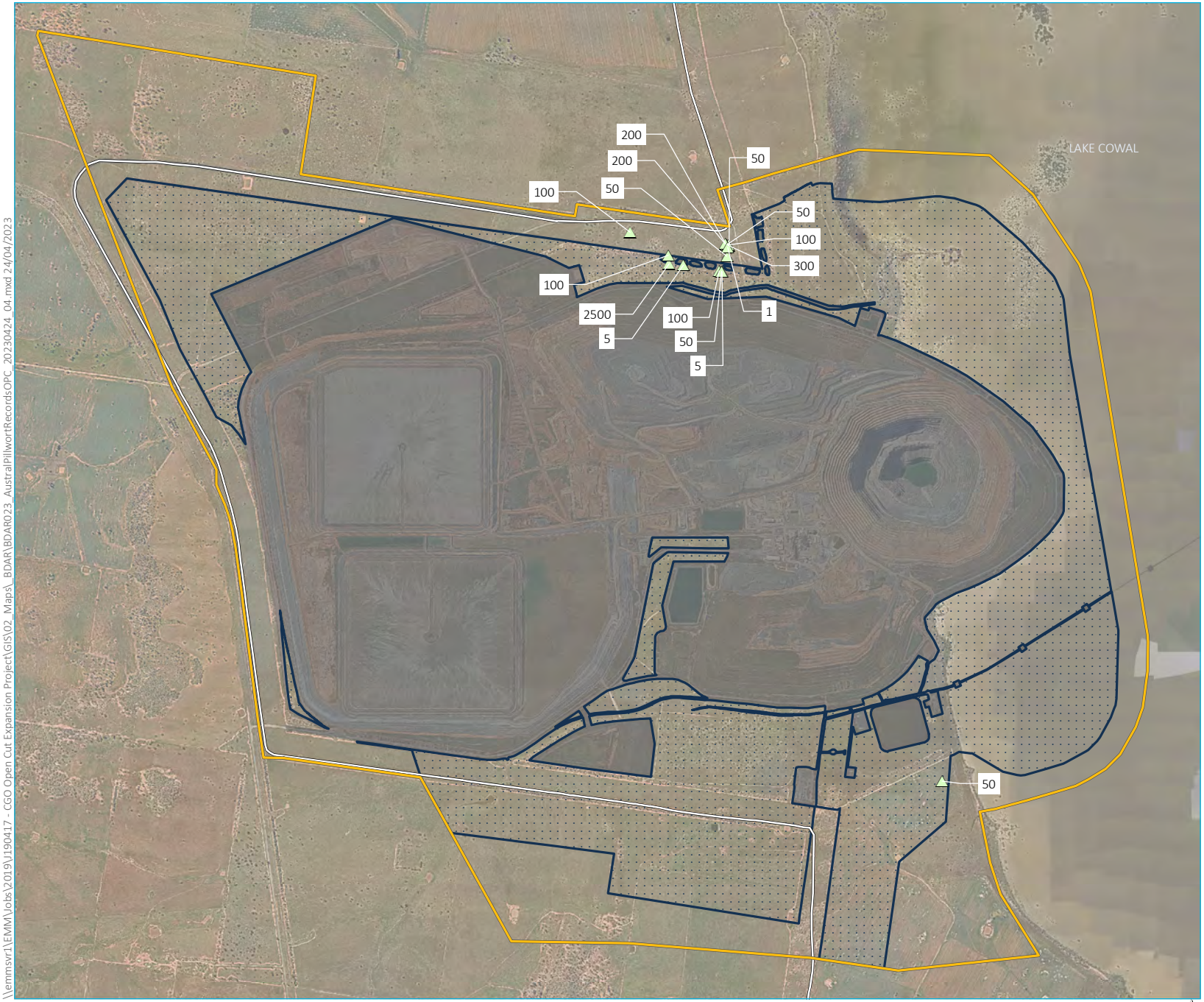
Photograph 5.4 **Austral Pillwort growing submerged**



Photograph 5.5 **Austral Pillwort with sporocarps and rhizomes**



Photograph 5.6 **Austral Pillwort with sporocarps (showing scale)**



KEY

- Study area
- Additional disturbance area
- Existing and approved disturbance area
- Major road
- Austral Pillwort record

Austral Pillwort recorded in and nearby additional disturbance footprint

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Biodiversity Development Assessment Report
Figure 5.18

Source: EMM (2023); Evolution (2023); DFSI (2017); Nearmap (2021)

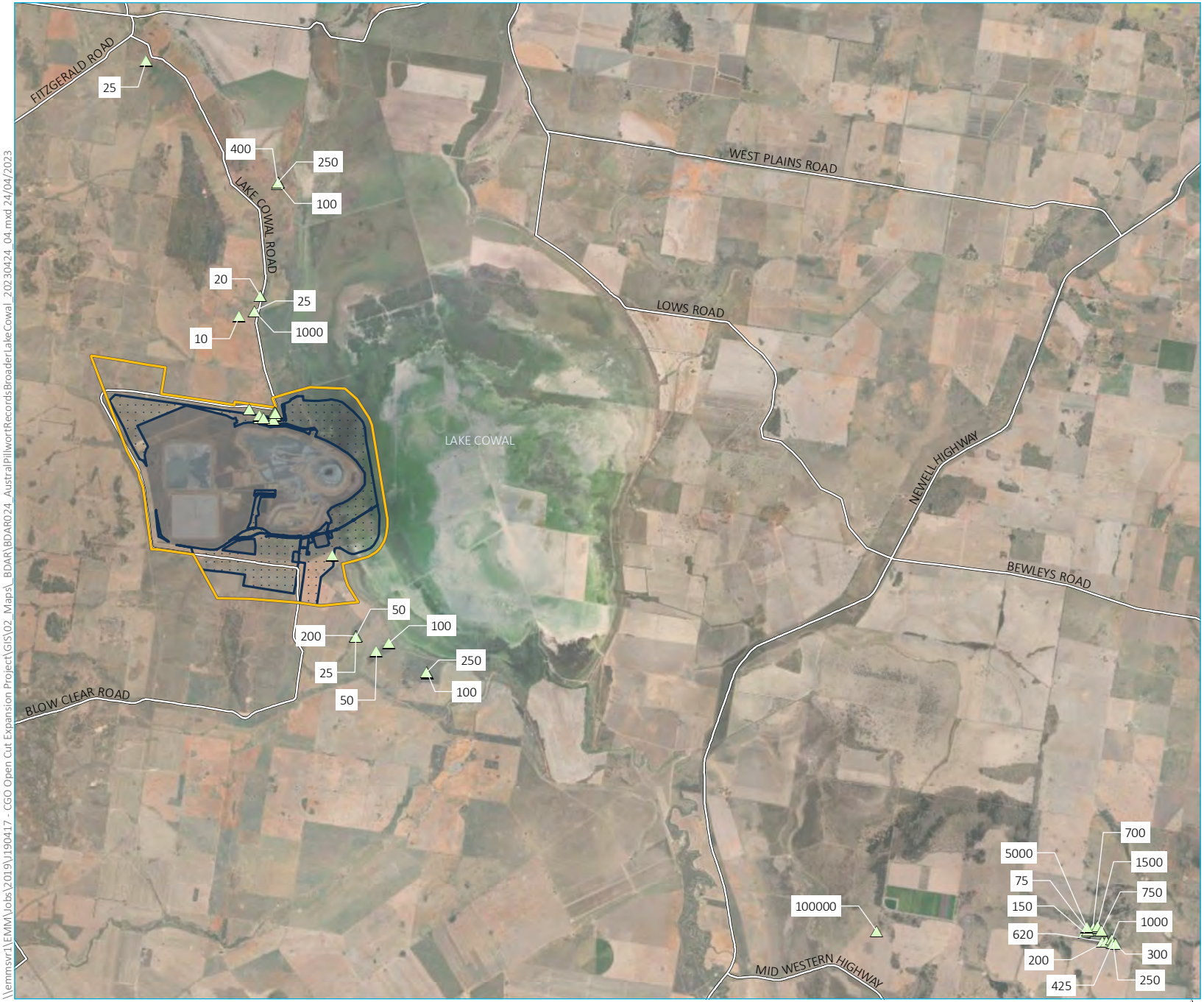
0 1 2 km

GDA 1994 MGA Zone 55

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creating opportunities



KEY

- Study area
- Additional disturbance area
- Existing and approved disturbance area
- Major road
- Austral Pillwort record

Austral Pillwort recorded in the broader Lake Cowal area

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Biodiversity Development Assessment Report
Figure 5.19

Source: EMM (2023); Evolution (2023); DFSI (2017)

0 2.5 5 km

GDA 1994 MGA Zone 55

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EMM creating opportunities

ii Targeted fauna surveys

a Previous targeted fauna surveys

In total, 58 BC Act and/or EPBC Act listed fauna species have been previously detected on or nearby the study area. All threatened species records within a 5 km radius of the site have been collated and presented by fauna group below, including from DPE BioNet (2023).

Diurnal Birds

Records of diurnal birds are displayed in Table 5.19. In total, 29 threatened diurnal bird species have been detected within the locality. Of these species, only 11 have been recorded in the last five years, whilst the remaining 18 have not been recorded in the area since 1997. Given many of these species are represented by a single DPE BioNet (2023) record, some of these detections are likely to be unreliable.

Table 5.19 Diurnal bird species recorded during previous surveys

Species	Common name	BC Act	EPBC Act	BAM Ecosystem/ Species Credit Species	Last Recorded (<5 km of study area)	Data source
Recent records (since 2017)						
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V	-	Ecosystem	2018	BioNet Atlas (2023)
Epthianura albifrons	White-fronted Chat	V	-	Ecosystem	2021[1]	AMBS Ecology & Heritage (2018), DPE BioNet (2023)
Falco subniger	Black Falcon	V	-	Ecosystem	2017	AMBS Ecology & Heritage (2018), DPE BioNet (2023)
Grantiella picta	Painted Honeyeater	V	V	Ecosystem	2017	Vestjens (1977), DPE BioNet (2023)
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	-	Species/ Ecosystem	2021[1]	AMBS (2018), DPE BioNet (2023)
Hieraaetus morphnoides	Little Eagle	V	-	Species/ Ecosystem	2018	Vestjens (1977), Barrick (Cowal) Limited (2005l, 2005s, 2005r, 2005w, 2005y, 2006a, 2007c, 2009a), AMBS (2018), DPE BioNet (2023)
Lophochroa leadbeateri	Major Mitchell's Cockatoo	V	-	Species/ Ecosystem	2018	Barrick (2012b), AMBS (2018), DPE BioNet (2023)
Lophoictinia isura	Square-tailed Kite	V	-	Species/ Ecosystem	2020[1]	Barrick (2007g, 2010b), DPE BioNet (2023)
Polytelis swainsonii	Superb Parrot	V	V	Species/ Ecosystem	2022[1]	Barrick (2005m, 2008b, 2015), Kerle (2013a), AMBS Ecology & Heritage (2018), DPE BioNet (2023)

Table 5.19 Diurnal bird species recorded during previous surveys

Species	Common name	BC Act	EPBC Act	BAM Ecosystem/ Species Credit Species	Last Recorded (<5 km of study area)	Data source
Pomatostomus temporalis temporalis	Grey-crowned Babbler	V	-	Ecosystem	2022[1]	Vestjens (1977), Gunninah Consultants (1995), Barrick (2005b–g, 2005i -k, 2005n, 2005o, 2005r, 2005s, 2005u, 2005v-x, 2005zii–ziii, 2006a–b, 2007b–c, 2007f–g, 2008a, 2009a, 2010b, 2013), Western Research Institute (2008), Kerle (2013a), AMBS Ecology & Heritage (2018), DPE BioNet (2023)
Stagonopleura guttata	Diamond Firetail	V	-	Ecosystem	2021[1]	DPE BioNet (2023)
Not recent (before 2017)						
Anthochaera phrygia	Regent Honeyeater	CE	CE	Species/ Ecosystem	1997[2]	DPE BioNet (2023)
Chthonicola sagittata	Speckled Warbler	V	-	Ecosystem	1997	DPE BioNet (2023)
Circus assimilis	Spotted Harrier	V	-	Ecosystem	1997	Vestjens (1977), DPE BioNet (2023)
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V	-	Ecosystem	1995	DPE BioNet (2023)
Daphoenositta chrysoptera	Varied sitella	V	-	Ecosystem	1997	Gunninah Consultants (1995), DPE BioNet (2023)
Drymodes brunneopygia	Southern Scrub-robin	V	-	Ecosystem	1997[2]	DPE BioNet (2023)
Falco hypoleucos	Grey Falcon	V	V	Ecosystem	1997	DPE BioNet (2023)
Glossopsitta pusilla	Little Lorikeet	V	-	Ecosystem	1997[2]	DPE BioNet (2023)
Hamirostra melanosternon	Black-breasted Buzzard	V	-	Species/ Ecosystem	1989	DPE BioNet (2023)
Hylacola cautus	Shy Heathwren	V	-	Ecosystem	1997[2]	DPE BioNet (2023)
Lathami discolor	Swift Parrot	E	CE	Species/ Ecosystem	1997[2]	DPE BioNet (2023)
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V	-	Ecosystem	1997[2]	DPE BioNet (2023)

Table 5.19 Diurnal bird species recorded during previous surveys

Species	Common name	BC Act	EPBC Act	BAM Ecosystem/ Species Credit Species	Last Recorded (<5 km of study area)	Data source
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V	-	Ecosystem	1997[2]	DPE BioNet (2023)
Neophema pulchella	Turquoise Parrot	V	-	Ecosystem	1997[2]	DPE BioNet (2023)
Pachycephala inornata	Gilbert's Whistler	V	-	Ecosystem	1997	Gunninah Consultants (1995), DPE BioNet (2023)
Pandion cristatus	Eastern Osprey	V	-	Species/ Ecosystem	1989	DPE BioNet (2023)
Petroica boodang	Scarlet Robin	V	-	Ecosystem	1997[2]	DPE BioNet (2023)
Petroica phoenicea	Flame Robin	V	-	Ecosystem	1997[2]	DPE BioNet (2023)

Notes: 1. Recorded by EMM during present studies. [2]Single DPE BioNet (2023) record

Waterbirds

Waterbirds detected by previous targeted surveys undertaken across Lake Cowal are detailed in Table 5.19. In total, 21 species of BC Act and/or EPBC Act listed waterbirds have been detected across Evolution and University of NSW monitoring programs, which extend from 1989 to 2022 and 2008 to 2022, respectively.

Of waterbirds recorded under these monitoring programs, 14 species are listed as migratory under the EPBC Act. Of the six BC Act listed threatened waterbirds recorded, only the Curlew Sandpiper is considered a dual credit species. However, Lake Cowal is not considered important habitat (as per Important Habitat Mapping in BOAMS) for Curlew Sandpiper, so it is not considered a species credit species in this BDAR.

For reference, Evolution's monitoring data is provided in Appendix J.

Table 5.20 Waterbirds recorded at Lake Cowal during previous surveys

Species	Common name	BC Act	EPBC Act	BAM Ecosystem/Species Credit Species	Maximum no. recorded	Data source/s
Threatened Species						
Anseranas semipalmata	Magpie Goose	V	-	Ecosystem	77	Gell (2016c, 2017a, 2018a, 2021b), UNSW (2022; recorded in 2016, 2017, 2020).
Botaurus poiciloptilus	Australasian Bittern	E	E	Ecosystem	1	Australian Museum Business Services (2013; recorded in 1993).
Calidris ferruginea	Curlew Sandpiper	E	CE, Mi, Ma	Species/ Ecosystem	12	Australian Museum Business Services (2013; recorded 2001).
Grus rubicunda	Brolga	V	-	Ecosystem	3	Australian Museum Business Services (2013; recorded 1990, 1995), Gell (2019a), UNSW (2022; recorded in 2015).
Oxyura australis	Blue-billed Duck	V	-	Ecosystem	13	Australian Museum Business Services (2013; recorded 1990), Gell (2021b, 2022a–b).
Stictonetta naevosa	Freckled Duck	V	-	Ecosystem	23	Australian Museum Business Services (2013; recorded 1989, 1990, 1995, 1996, 1999, 2000, 2013), Gell (2016b–c, 2017a, 2021c, 2022a–b), Evolution (species observed October 2022 and January 2023, personal communication, 26 February 2023).
Migratory Species						
Calidris acuminata	Sharp-tailed Sandpiper	-	Mi, Ma	-	1,445	Australian Museum Business Services (2013; recorded in 1991, 1992, 1997, 2000, 2001), Gell and Peake (2014a, 2014c), Gell (2017b, 2018c, 2019a).
Calidris ferruginea	Curlew Sandpiper	E	CE, Mi, Ma	Species/ Ecosystem	12	Australian Museum Business Services (2013; recorded 2001).
Calidris melanotos	Pectoral Sandpiper		Mi, Ma	-	2	Australian Museum Business Services (2013; recorded in 1992).
Calidris ruficollis	Red-necked Stint	-	Mi, Ma	-	20	Australian Museum Business Services (2013; recorded in 1992, 2001), Gell and Peake (2014c).
Charadrius bicinctus	Double-banded Plover	-	Mi, Ma	-	8	Australian Museum Business Services (2013; recorded in 1997, 2001).
Chlidonias leucopterus	White-winged Black Tern	-	Mi, Ma	-	4	Australian Museum Business Services (2013; recorded in 1997, 1999, 2000, 2001).

Table 5.20 Waterbirds recorded at Lake Cowal during previous surveys

Species	Common name	BC Act	EPBC Act	BAM Ecosystem/Species Credit Species	Maximum no. recorded	Data source/s
Gallinago hardwickii	Latham's Snipe		Mi, Ma	-	14	Australian Museum Business Services (2013, recorded in 1993, 1995, 1996, 1997, 1999, 2000, 2001, 2011), Gell and Peake (2014b), Gell (2016c, 2017a, 2017c, 2022a).
Gelochelidon macrotarsa	Gull-billed Tern	-	Mi, Ma	-	16	Australian Museum Business Services (2013; recorded in 1989, 1991, 1992, 2011, 2012), Gell and Peake (2014a, 2014c), Gell (2017b–c, 2019a), UNSW (2022; recorded in 2011, 2013, 2015, 2017, 2020).
Hydroprogne caspia	Caspian Tern	-	Mi, Ma	-	2	Australian Museum Business Services (2013; recorded in 1992, 1993, 1995, 1996, 2010), Gell (2018a, 2022c), UNSW (2022; recorded in 2011, 2018).
Numenius minutus	Little Curlew	-	Mi, Ma	-	2	Australian Museum Business Services (2013; recorded in 1997).
Plegadis falcinellus	Glossy Ibis	-	Mi, Ma	-	556	Australian Museum Business Services (2013; recorded in 1991, 1992, 1994, 1995, 1996, 1997, 1999, 2000, 2001, 2010, 2011, 2012), Gell and Peake (2013a-b, 2014a, 2014c), Gell (2014c, 2016c, 2017a, 2017c, 2018a, 2018c, 2019a, 2019c, 2022a), UNSW (2022; recorded in 2011, 2013, 2014, 2015, 2017, 2018, 2020).
Pluvialis fulva	Pacific Golden Plover	-	Mi, Ma	-	1	Australian Museum Business Services (2013; recorded 1997).
Tringa nebularia	Common Greenshank	-	Mi, Ma	-	82	Australian Museum Business Services (2013; recorded 1992, 1993, 1995, 1996, 1997, 1999, 2000, 2001).
Tringa stagnatilis	Marsh Sandpiper	-	Mi, Ma	-	82	Australian Museum Business Services (2013; recorded in 1992, 1993, 1995, 1996, 1997, 2001).

Notes: V = Vulnerable; E = Endangered; CE = Critically Endangered; Mi = Migratory; Ma = Marine

iii Waterbird Breeding Locations

An analysis of Evolution waterbird monitoring reports from 1989 to 2012 was conducted by Australian Museum Business Services in 2013 (Australian Museum Business Services 2013). In their review they undertook detailed mapping of breeding locations, which have been adapted and presented in Figure 5.20. According to their analysis, the highest levels of breeding activity occurred in the northern section of Lake Cowal, with area B2 supporting the greatest number of colonial nests and area B5 hosting the highest number of breeding birds.

Due to the widespread inundation of colonial nests by floodwaters in 2022 (Evolution, personal communication, 27 February 2023), waterbird breeding observations for 2022–23 were not considered representative of normal breeding activity in Lake Cowal. Accordingly, comparison with AMBS (2013) was made using Evolution monitoring data from 2021–22, when conditions were highly conducive to breeding activity across the lake (Gell 2022c).

Review of waterbird breeding data from 2021-2022 revealed a similar spatial distribution of breeding activity with AMBS (2013), suggesting some temporal stability in waterbird breeding areas. That is, during that period, areas B2 and B5 were also found to host the highest proportion of breeding activity within Lake Cowal. In those B2 and B5 areas, breeding for 11 and 14 waterbird species was observed during the 2021–22 summer, respectively. Notably, the Glossy Ibis (*Plegadis falcinellus*; EPBC Act: migratory), was also observed breeding in area B5 during this period, with 300 pairs recorded. This northern area of Lake Cowal also supported breeding of the Magpie Goose (*Anseranas semipalmata*; BC Act listed: vulnerable), with nesting of this species observed in Areas B2, B4 and B5.

Other areas where bird breeding was recorded in 2021–22, albeit to a lesser extent than B2 and B5, was area B8. Ten species were observed to breed here throughout 2021–22, but in much lesser numbers than B2 and B5. Furthermore, area B4 experienced a large breeding event of the Little Black Cormorant (*Phalacrocorax sulcirostris*), but only hosting breeding for three waterbird species.

Evolution waterbird breeding monitoring data is presented below in Table 5.21. Data was compiled from three surveys undertaken in August 2021, October 2021 and January 2022.

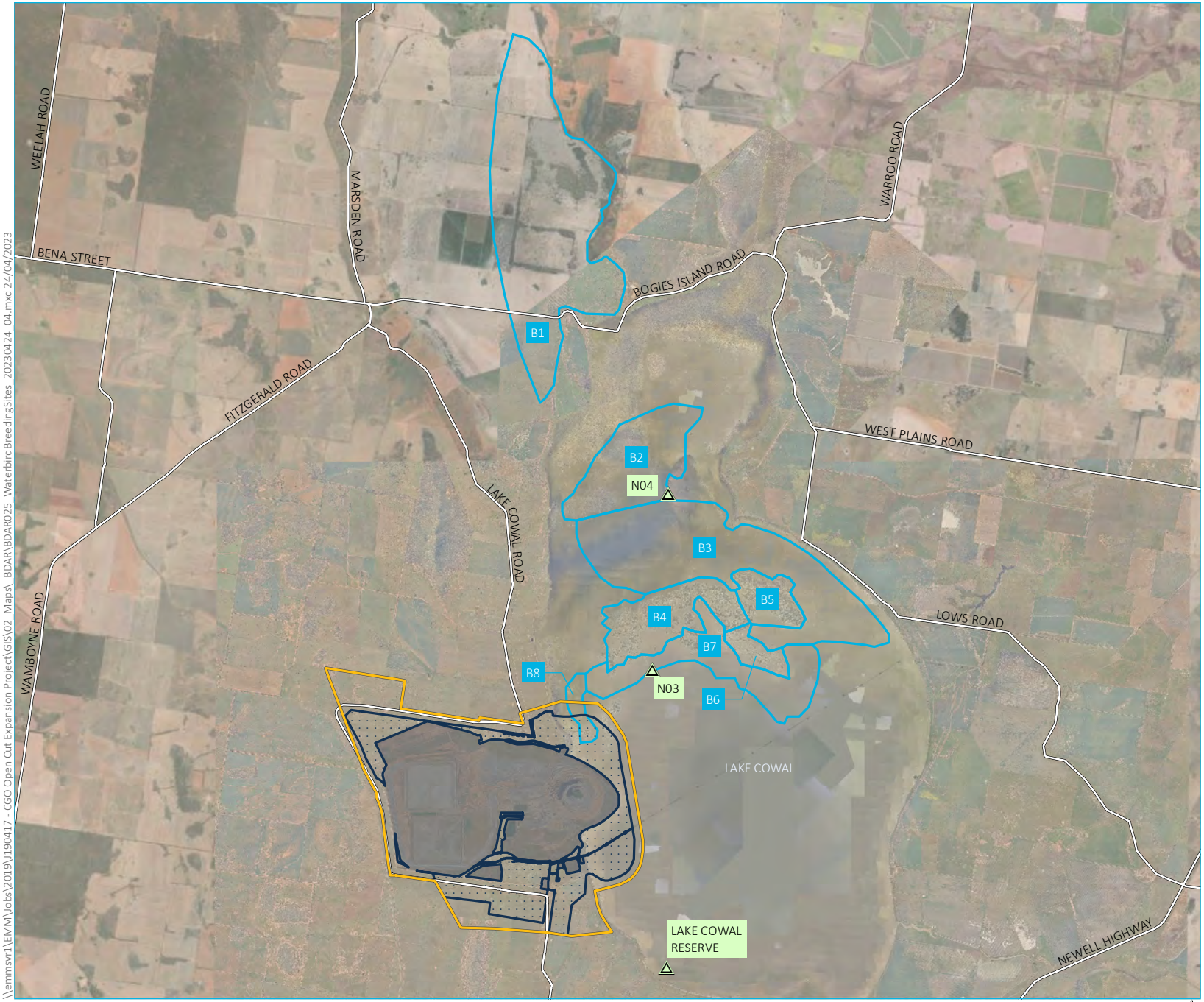
Table 5.21 Waterbird Breeding Data 2021-22 (Gell 2022)

Species	Common Name	BC Act	EPBC Act	Breeding Locations[1]			
				B2	B4	B5	B8
Anhinga novaehollandiae	Australasian Darter	-	-	21P/34N/71J	-	26A/31N/53J	6P/16N/24J
Tachybaptus novaehollandiae	Australasian Grebe	-	-	-	-	2A/2J	-
Threskiornis molucca	Australian White Ibis	-	-	2P/14N	-	500P/515N	-
Cygnus atratus	Black Swan	-	-	2P/8J	-	-	-
Bubulcus ibis	Cattle Egret	-	M	-	-	3P/4N/3J	-
Ardea alba modesta	Eastern Great Egret	-	M	6P/6N/11J	-	9P/11N/7J	-
Plegadis falcinellus	Glossy Ibis	-	Mi	-	-	300P/450N	-
Phalacrocorax carbo	Great Cormorant	-	-	-	-	7A/6N/11J	1P/4N/8J
Podiceps cristatus	Great Crested Grebe	-	-	8A/14J	-	-	6A/9J
Anas gracilis	Grey Teal	-	-	120P/120N	-	5N	3P/18N/12J
Ardea intermedia	Intermediate Egret	-	M	-	-	12A/7N/9J	-
Phalacrocorax sulcirostris	Little Black Cormorant	-	-	-	600P/618N/1200J	4A/26J	3P/13N/37J

Table 5.21 Waterbird Breeding Data 2021-22 (Gell 2022)

Species	Common Name	BC Act	EPBC Act	Breeding Locations[1]			
				B2	B4	B5	B8
Anseranas semipalmata	Magpie Goose	V	-	4N	3N	5N	-
Nycticorax caledonicus	Nankeen Night Heron	-	M	11P/9N/8J	-	150P/150N/120J	3N
Phalacrocorax varius	Pied Cormorant	-	-	-	-	-	6P/16N/24J
Platalea regia	Royal Spoonbill	-	-	2P/7N	17P/28N	200P/320N	-
Threskiornis spinicollis	Straw-necked Ibis	-	-	-	-	12500P/13700N	-
Egretta novaehollandiae	White-faced Heron	-	-	-	-	-	1N
Ardea pacifica	White-necked Heron	-	-	6P/6N/15J	-	-	2P/5N/9J
Platalea flavipes	Yellow-billed Spoonbill	-	-	2N	-	-	6P/9N/7J

Notes: 1. Key: P = pairs, N = nest, J = juveniles, A = breeding adults. M = Marine; Mi = Migratory; V = Vulnerable.



KEY

- Study area
- Additional disturbance area
- Existing and approved disturbance area
- Major road
- Non-residential noise assessment location
- Colonial waterbird breeding site

Colonial waterbird breeding sites recorded during Evolution's waterbird monitoring program

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Biodiversity Development Assessment Report
Figure 5.20

Source: EMM (2023); Evolution (2023); DFSI (2017); Nearmap (2021)

0 2.5 5 km

GDA 1994 MGA Zone 55

N

EMM creating opportunities

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a Nocturnal Birds

Two threatened nocturnal birds have previously been recorded at Lake Cowal according to historic DPE BioNet records; the Bush-stone Curlew and the Barking Owl. The Bush-stone Curlew is represented by a single record from 1997. Records for these species are summarised in Table 5.22.

Table 5.22 Nocturnal birds species recorded during previous surveys

Species	Common name	BC Act	EPBC Act	BAM Ecosystem/ Species Credit Species	Last Recorded (<5 km of study area)	Data source
Burhinus Grallarius	Bush-stone Curlew	E	-	Species	1997[1]	DPE BioNet (2023)
Ninox connivens	Barking Owl	V	-	Species/ Ecosystem	2005	DPE BioNet (2023), Barrick (2005ziv)

Notes: 1. Single DPE BioNet (2023) record from 1997.

b Arboreal Mammals

No reliable records of threatened arboreal mammals could be identified during desktop surveys for this Project. While one record of a Squirrel Glider from 1997 is hosted on the DPE BioNet (2023), this observation was made based on a tree scratching, and is thus considered unsubstantiated.

c Bats

No Grey-headed flying fox camps have been reported on or nearby the study area.

Four threatened microbat species have been previously recorded on or nearby the study area. There is also one record of the Corben's Long-eared Bat from Lake Cowal in 1989 (DPE BioNet 2023). A summary of records is presented in Table 5.23.

Table 5.23 Microbat species recorded during previous surveys

Species	Common name	BC Act	EPBC Act	BAM Ecosystem/ Species Credit Species	Last Recorded (<5 km of study area)	Data source
Chalinolobus picatus	Little Pied Bat	V	-	Ecosystem	2012	Gunninah consultants (1995), Donato Environmental Services (2010a, 2010b, 2011a, 2012a, 2012b)
Nyctophilus corbeni	Corben's Long-eared Bat	V	V	Ecosystem	1989[1]	DPE BioNet (2023)
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Species/ Ecosystem	1997	DPE BioNet (2023)
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	Ecosystem	2022[2]	Greg Richards and Associates (1997a), Donato Environmental Services (2010b, 2011a, 2011b, 2020b), AMBS Ecology & Heritage (2018).
Vespadelus baverstocki	Inland Forest Bat	V	-	Ecosystem	2012	Barrick (Cowal) Limited (2009a), Donato Environmental Services (2010a, 2010b, 2011a, 2012a, 2012b).

Notes: 1. Single record from 1989 as per DPE BioNet (2023).
2. Recorded by EMM during present studies.

d Frogs

Two threatened frog species have historically been observed in the area: the Sloane's Froglet and the Southern Bell Frog. Only a single, DPE BioNet (2023) record from 1997 exists for the Southern Bell Frog. Records are summarised in Table 5.24.

Table 5.24 Frog species recorded during previous surveys

Species	Common name	BC Act	EPBC Act	BAM Ecosystem/ Species Credit Species	Last Recorded (<5 km of study area)	Data source
Crinia sloanei	Sloane's Froglet	V	E	Species	1995	Vestjens (1977), Gunninah Consultants (1995)
Litoria raniformis	Southern Bell Frog	E	V	Species	1997[1]	DPE BioNet (2023)

Notes: 1. Single DPE BioNet (1997) record

iv Targeted fauna surveys for BDAR

In total, 14 BC Act and/or EBPC Act listed fauna species were detected by EMM during targeted surveys for this Project. These included seven threatened diurnal bird species, five waterbird species and two bat species. Locations of threatened fauna recorded during surveys for the BDAR are shown in Figure 5.21.

No threatened nocturnal bird, arboreal or ground-dwelling mammal or frog species were detected.

a Diurnal Birds

The seven diurnal bird species observed during surveys by EMM in or near the study area were:

- Diamond Firetail
- Glossy Black-Cockatoo
- Grey-crowned Babbler
- Superb Parrot
- Square-tailed Kite
- White-bellied Sea-Eagle
- White-fronted Chat.

All species were detected in the study area except the Glossy Black-Cockatoo, which was observed approximately 10 km north of the study area. EMM also recorded evidence of this species foraging (i.e. chewed orts) ~3 km north of the study area. This species is listed as dual species/ecosystem credit species under the BC Act, however no signs of breeding for this species were observed.

The Superb Parrot was the only hollow-associated bird species detected within the study area. It is a dual species/ecosystem credit species under the BC Act and is listed as vulnerable under the EPBC Act. One individual was detected amongst Weeping Myall vegetation (PCT 26) to the south of the mine. Two more observations of single individuals were made within PCT 185 towards the northwest corner of the study area. No signs of breeding were observed for this species.

Other dual-credit species under the BC Act included the Square-tailed Kite and White-bellied Sea-Eagle, neither of which were observed breeding within the study area. The remaining species (Grey-crowned Babbler, Diamond Firetail, White-fronted Chat) are all Ecosystem Credit Species listed under the BC Act.

b Waterbirds

EMM detected five BC Act and/or EPBC Act listed waterbird species within the study area. Waterbird Species recorded were:

- Australasian Bittern (*Botaurus poiciloptilus*)
- Latham's Snipe (*Gallinago hardwickii*)
- Caspian Tern (*Hydroprogne caspia*)
- Blue-billed Duck (*Oxyura australis*)
- Glossy Ibis.

All BC Act listed species recorded (Australasian Bittern and Blue-billed Duck) are Ecosystem Credit Species. The remaining species listed above are listed as migratory under the EPBC Act.

c Bats

No Grey-headed flying fox camps were reported on or nearby the study area.

One BC Act listed Ecosystem Credit species, the Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris)*, was detected during acoustic recorder surveys on the study area. A probable detection was also made of the Little Pied Bat (*Chalinolobus picatus)*, which is also an Ecosystem Credit species listed under the BC Act.

Numerous acoustic detections were made of bat(s) within the *Nyctophilus*/*Myotis* genus, which can be difficult to identified to species-level with currently available technologies. However, of the calls recorded, only two calls could not be distinguished between *Nyctophilus* and *Myotis*. A. Rowles (Appendix G; email correspondence on 19/12/2022) stated that:

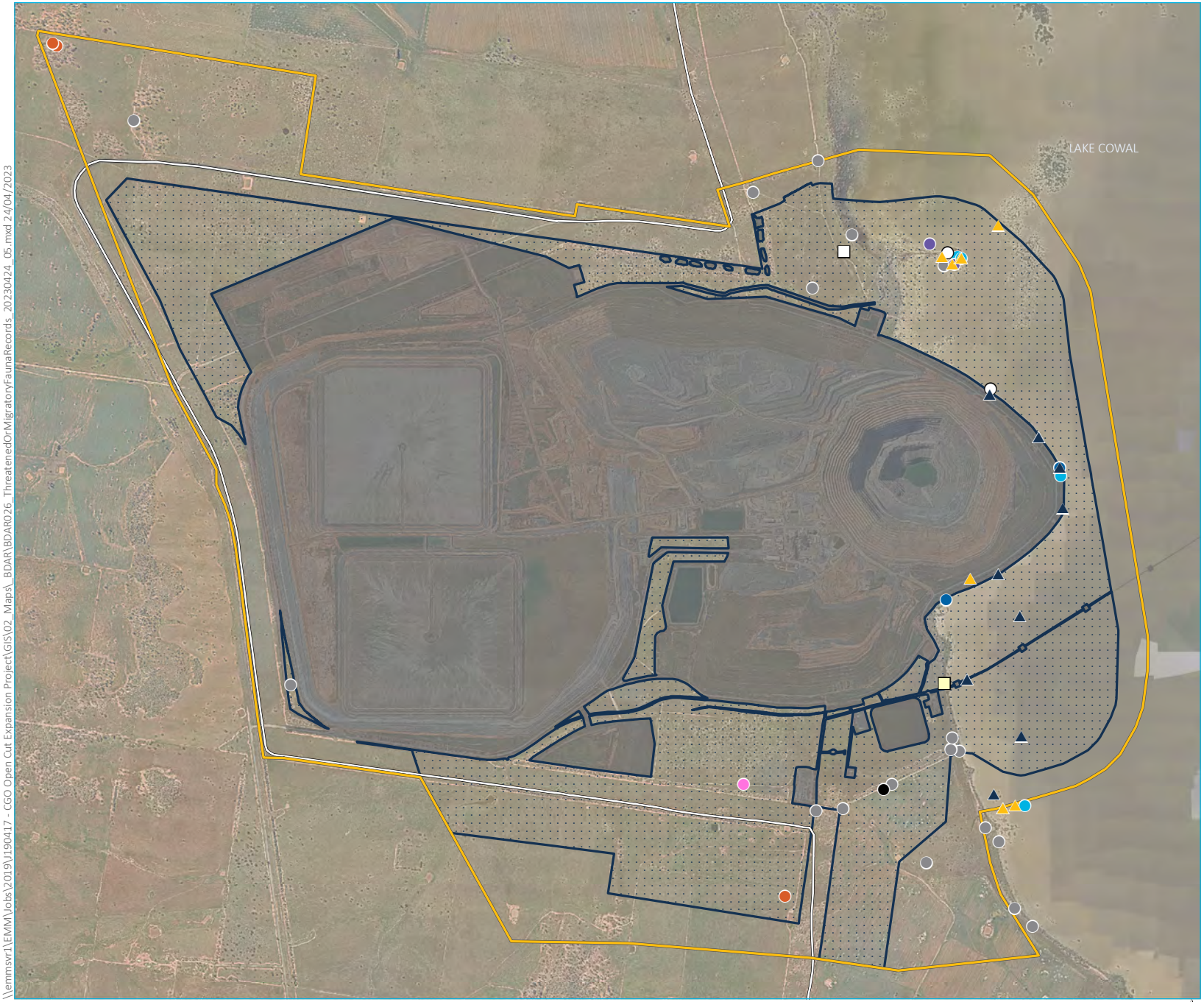
> There were two passes which I could not distinguish between Nyctophilus and Myotis. When you get a good Myotis foraging area, you tend to get quite a few passes and get some characteristic features amongst them, so it is likely that if these passes were Myotis activity level is low or passing individual/s. I would rate this as only a possible Myotis.

Hence, even if Southern Myotis is assumed to be present, low activity levels suggested no important roosting habitat was within the study area.

Moreover, harp trapping surveys undertaken by AMBS Ecology & Heritage (2018), undertaken in 2016 and 2017, failed to capture Corben's Long-eared Bat and Southern Myotis. These surveys were designed to target Corben's Long-eared Bat, as the analysis of echolocation call commonly detected *Nyctophilus spp*. However, out of the 26 nights of harp trapping all *Nyctophilus* spp. captured were Lesser Long-eared Bat (*Nyctophilus geoffroyi*).

d Frogs

No BC Act or EPBC Act listed frog species was detected in the study area. Across all targeted frog surveys, six relatively common frog species were detected, which were Spotted Marsh Frog (*Limnodynastes tasmaniensis*), Giant Banjo Frog (*Limnodynastes interioris*), Broad-palmed Rocket Frog (*Litoria latopalmata*), Eastern sign-bearing Froglet (*Crinea parinsignifera*), Peron's Tree Frog (*Litoria peronii*) and Sudell's Frog (*Neobatrachus sudellae*).



KEY

- Study area
- Additional disturbance area
- Existing and approved disturbance area
- Major road

Threatened fauna recorded

Birds

- Australasian Bittern
- Blue-billed Duck
- Diamond Firetail
- Grey-crowned Babbler (eastern subspecies)
- Square-tailed Kite
- Superb Parrot
- White-bellied Sea-Eagle
- White-fronted Chat

Mammals

- Little Pied Bat
- Yellow-bellied Sheathtail-bat

Migratory species recorded

- Caspian Tern
- Glossy Ibis
- Latham's Snipe

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Source: EMM (2023); Evolution (2023); DFSI (2017); Nearmap (2021)

0 1 2 km

GDA 1994 MGA Zone 55

N

Threatened/migratory fauna recorded during surveys for BDAR

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Biodiversity Development Assessment Report
Figure 5.21

EMM creating opportunities

v Candidate species presence, extent and habitat quality

Table 5.24 defines the presence (or absence) of candidate species in the study area and habitat quality. The number of individuals impacted by the Project is provided for count-based species, while the area of habitat impacted is provided for area-based species. The area of habitat has been used to define the species polygon for area-based species, in accordance with Step 4 to 6 of the BAM (DPIE 202a; Section 5.2.4 to 5.2.6).

The only species credit species found present through survey within the Additional disturbance area was Austral Pillwort. As such, species credits for the Austral Pillwort are required due to direct impact on this species.

Due to inundation of Lake Cowal at the time of surveys, the following species were not surveyed for within the Additional disturbance area in its entirety:

- Austral Pillwort
- Spiny Peppercress
- A Spike-rush (*Eleocharis obicis*).

To assess the potential occurrence of Austral Pillwort and Spiny Peppercress occurring within the unsurveyed extent of the Additional disturbance area, separate species expert reports were prepared for Austral Pillwort and Spiny Peppercress by Dr Colin Bower (see Appendix K). Dr Bower was approved by the DPE as a species expert for these two species in accordance with Section 5.3 (Box 3) of the Biodiversity Assessment Method. This recognition applies exclusively to the Lake Cowal Open Cut Continuation Project within the Bland Local Government Area. Colin's approval letter is appended to these Expert Repots in Appendix K. Those species expert reports concluded the following:

- The species polygon for Austral Pillwort within the Additional disturbance area was determined to be 1.15 ha (see Figure 5.22). The area of the species polygons for Austral Pillwort was determined to be 2.64 ha across the study area and 7.01 ha across the Broader Austral Pillwort survey area. Lacustrine habitat in Lake Cowal was not considered to provide suitable habitat, so no species polygon was assigned to the unsurveyed extent of Lake Cowal.
- No species polygon was assigned to the Spiny Peppercress since Lake Cowal was considered to not be suitable habitat for the species.

To assess the potential occurrence of A Spike-rush (*Eleocharis obicis*) occurring within the unsurveyed extent of the Additional disturbance area, a species expert report was prepared by Neville Walsh (see Appendix K). Mr Walsh was approved by the DPE as a species expert for A Spike-rush (*Eleocharis obicis*) in accordance with Section 5.3 (Box 3) of the Biodiversity Assessment Method. This recognition applies exclusively to the Lake Cowal Open Cut Continuation Project within the Bland Local Government Area. Neville's approval letter is appended to the Expert Report in Appendix K. That species expert report concluded:

- No species polygon was assigned to A Spike-rush (*Eleocharis obicis*) since Lake Cowal was considered to not be suitable habitat for the species.

Table 5.25 Candidate species presence, extent and habitat quality

Scientific name	Common name	Step 4 – Determine candidate species presence/absence	Step 5 – Determine the area or count, and location of suitable habitat for a species credit species		Step 6 – Determine the habitat condition within the species polygon for species assessed by area	
			Individuals impacted (count-based species)	Area impacted (area-based species)	Associated vegetation zone/s	Vegetation integrity scores
Pilularia novea-hollandiae	Austral Pillwort	Recorded during targeted survey	N/A	1.15 ha (noting 0.32 ha is in category 1/cleared land)	• PCT 55_DNG (0.25 ha); PCT 55 Poor (0.004 ha); PCT 55 Planted (0.27 ha); PCT 55_Medium (0.30 ha). • 0.32 ha is in category 1/cropped land. 0.83 ha is in vegetation zones requiring offset.	PCT 55_DNG = 20.4; PCT 55 Poor = 52.1; PCT 55 Planted = 74.7; PCT 55_Medium = 83.8



KEY

- Study area
- Additional disturbance area
- Existing and approved disturbance area
- Major road
- Austral Pillwort species polygon

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Source: EMM (2023); Evolution (2023); DFSI (2017); Nearmap (2021)

0 1 2 km

GDA 1994 MGA Zone 55

N

Austral Pillwort species polygon

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Biodiversity Development Assessment Report
Figure 5.22

EMM creating opportunities

6 Groundwater dependent ecosystems

An assessment of the incremental impact of the project was undertaken by comparing modelled groundwater levels under the currently approved scenario against the levels expected following project commencement.

Three post closure cases for groundwater levels were simulated to encapsulate the range of expected conditions following the end of mining, which are:

5. Dry case: This is the worst-case scenario for groundwater drawdown. It considers that open voids are maintained at their final mining level, i.e. they remain dry. This is highly conservative from a drawdown perspective as it assumes that groundwater will continue to flow into a pit void, which in reality will not occur.

6. Proposed recovery case: This is the most likely scenario. It considers recovery of groundwater based on modelled water balance within extracted pits undertaken for the project by ATC Williams (2023). The surface water assessment included final void water balance modelling, incorporating simulated pit inflows as a function of water level alongside surficial fluxes (rainfall, runoff and evaporation). Two pit voids were simulated; E42/GR and E41. Water balance modelling was undertaken for a post-mining period of 1,000 years, estimating long-term fill levels of approximately 104 metres Australian height datum (mAHD) for E42/GR and 126 mAHD for E41. Pit lake levels were simulated in the groundwater model using data from the surface water assessment, creating a semi-coupled groundwater-surface water pit lake recovery model. This is the best estimate groundwater model based on available data.

7. Wet case: This is the best-case scenario for groundwater drawdown. It deactivates the open pits at the end of mining and water levels are allowed to recover within these pits with either backfill or open void properties applied. However, no recharge or evaporation is applied, and therefore groundwater levels respond more quickly moving higher than would be expected in reality.

The potential for groundwater dependent ecosystems (GDE) was firstly explored through undertaking a groundwater interaction assessment (Section 6.2). Based on the current depth to groundwater, the potential risk of impacts associated with drawdown of groundwater was then considered through GDE characterisation and risk assessment (Section 6.2). An assessment of spatial and physical changes to groundwater availability was then undertaken for PCTs identified as having a potential dependence on groundwater (Section 6.3). The potential impacts of the project on groundwater quality are assessed in Section 6.3.3.

6.1 Methods

6.1.1 Groundwater availability

This chapter assesses impacts of groundwater drawdown on terrestrial GDEs, comprising terrestrial native vegetation and groundwater-dependent wetlands and near shore ecosystems.

The study area for the GDE assessment is the groundwater model domain defined in the groundwater impact assessment (EMM 2023b; hereafter groundwater study area).

Literature and spatial data reviewed to support the assessment included:

- Upper Lachlan Alluvial Groundwater Source Water Sharing Plan
- NSW Murray-Darling Basin Fractured Rock Groundwater Sources Water Sharing Plan
- Bureau of Meteorology's Atlas of Groundwater Dependent Ecosystems (BoM 2023b)

- Biodiversity Assessment Report and Biodiversity Offset Strategy for MOD 14 Processing Rate Modification (AMBS Ecology & Heritage 2018)
- BDAR for Underground Development (EMM 2020)
- State Vegetation Type Map (SVTM; DPE 2022a)
- High Ecological Value Aquatic Ecosystems (HEVAE) mapping (DPE 2018b).

Depth to groundwater was based on data collected primarily in 2021 with some datapoints extrapolated/assumed from earlier measurements (EMM 2023b).

i Geological interactions assessment

Prior to undertaking the modelling exercise, EMM's hydrogeologists reviewed the spatial extent of PCTs with potential to access shallow groundwater to determine if they occurred on surface geological units where drawdown would not occur as the groundwater is a perched system. Areas with perched groundwater systems were excluded from the assessment given the lack of groundwater connectivity to underlying regional aquifers and therefore negligible risk of impact.

ii Groundwater interaction assessment

Depth to groundwater was modelled across the groundwater study area to identify potential GDEs. PCTs aligning with high priority GDEs within BoM (2023b) and DPE (2018) were also identified across the groundwater study area.

Within the groundwater study area, depth to groundwater surfaces were created for existing conditions [Digital Elevation Model (DEM) minus pre-mining water table elevation]. Resultant depth to groundwater surfaces were then reclassified into the following categories, following Serov *et al* (2012):

- high potential for groundwater interaction (depth to groundwater ranges from 0 to 2 mbgl)
- moderate potential for groundwater interaction (2 to 5 mbgl)
- low potential for interaction (5 to 10 mbgl).

Modelled depth to groundwater with current project approvals was overlaid with PCTs to assess the potential dependence of these communities on groundwater. PCT mapping across the groundwater study area was informed by vegetation mapping undertaken by EMM within the OPC study area, as well as Evolution's broader landholdings (Section 10.1). For areas outside of Evolution's landholdings across the groundwater study area, the STVM (DPE 2022a) was adopted. Derived native grassland and cropped land mapped in Evolution's landholdings was not included in the assessment since current groundwater levels are >5 mbgl at these locations, whilst the root zone in these areas is unlikely to extend >3-4 mbgl. Modelled assessment surfaces across the groundwater study area were 100 to 1,500 m cell size.

iii GDE characterisation and risk assessment

Following the *Risk Assessment Guidelines for Groundwater Dependent Ecosystems* (Serov et al, 2012), combined with the results of the spatial analysis, field assessment, groundwater and geological interactions assessments, potential GDEs were categorised, based on their degree of dependence on groundwater, using the criteria in Table 6.1.

Table 6.1 Groundwater dependence categories

Groundwater dependence	Criteria	Risk of impact
Entirely/obligate	More than 50% of the PCT is mapped in areas with groundwater at 0.5 mbgl or less, or more than 75% of the PCT is mapped in areas with groundwater at 2 mbgl or less.	High
Facultative – high	More than 50% of the PCT is mapped in areas with groundwater at 2 mbgl or less, and more than 75% of the PCT is mapped in areas with groundwater at 5 mbgl or less.	Moderate
Facultative – proportional	More than 75% of the PCT is mapped in areas with groundwater at 5 mbgl or less, but less than 50% of the PCT is mapped in areas with groundwater at 2 mbgl or less.	Low
Facultative – opportunistic	More than 50% of the PCT is mapped in areas with groundwater at 5 mbgl or less, but less than 75% of the PCT is mapped in areas with groundwater at 2 mbgl.	Low
Non-dependent	Evenly distributed across groundwater levels, with the majority (greater than 50% of the PCT) mapped in areas with groundwater at 5 mbgl or more.	Negligible

iv Drawdown impacts – spatial and physical

Impacts were firstly assessed by comparing modelled groundwater levels between those at present (i.e. current groundwater levels under the current and approved operations) against the dry-case scenario (i.e. worst-case scenario) once pits are extracted by the project. This dry-case scenario considers the final voids will remain dry, except for E46 pit, which will be backfilled. Modelled changes to groundwater level assumed that the extracted pits would remain dry and not fill with water, which is highly unlikely since water balance modelling indicates the pits will fill over time (ATC Williams 2023). Hence, the assessment of impacts to GDEs presented here is highly conservative.

Impacts to PCTs with potential groundwater association were considered to be negligible if the difference in drawdown between the approved operations and the project was identified as being 0-2 m only. These PCTs were not considered further. Vegetation within the Additional disturbance area was also excluded from the assessment as it will be cleared.

Groundwater drawdown was assessed for PCTs identified as having a more than negligible risk of impact from drawdown. Due to the small extent of PCTs where this may occur, except PCT 249, a single hydrograph was produced to conduct the sensitivity analysis at the centre of each respective polygon closest to the mine. This approach was used since drawdown will be typically greatest toward the mine and reduce with distance moving away from the mine. Due to the large expanse of PCT 249, a hydrograph was produced in each groundwater dependence category, e.g. where 0–2, 2–5, 5–10, 10–20, 20 m+ drawdown is predicted. Locations for these hydrographs for PCT 249 were selected in the centre of the polygon closest to the mine for each of these drawdown extent categories. The time series for the hydrographs extends from current groundwater levels to year 3000.

6.1.2 Groundwater quality

The potential for contamination of groundwater by the project was explored by advective particle tracking. This tracking was simulated from groundwater recharged at the IWL and WRE. For more information see the groundwater assessment (EMM 2023b).

6.2 Results

6.2.1 Geological interactions assessment

Within Lake Cowal, PCTs 17, 24, 53 and 249 were excluded from the impact assessment since the lake is hydraulically separate from groundwater. Evidence to support the hydrological separation of Lake Cowal with groundwater is:

- There is a low permeability lacustrine clay layer beneath the lake. The next geological layer down (the Upper Cowra) has a phreatic surface of 1–2 m below ground surface.
- Groundwater quality multivariate statistics have shown no evidence of the distinct lake water quality signature appearing in either the open cut or underground. This would suggest that there is little to no hydraulic connection between the lake and the underlying groundwater system, given mining commenced in 2005 and we have water quality data spanning over a decade.
- Water quality trends shown in graphical output in annual monitoring reports shows stability in key water quality analytes that again highlights compartmentalisation between lake water quality and what is observed in pits and monitoring bores surrounding the site.
- The groundwater level hydrograph analysis also suggests that there is no direct connection between the lake and the bores around the pit.

Note that risk of impacts to PCT 17, 24, 53 and 249 and were still considered across the groundwater study area outside of Lake Cowal.

6.2.2 Groundwater interaction assessment

Fifty PCTs were mapped within the groundwater study area. Based on current depth to groundwater levels, the following conclusions with regards to groundwater dependence of the PCTs were identified (note that Table 6.2 identifies the PCTs):

- PCTs 10, 15, 17, 182 and 249 identified as entirely/obligate dependence on groundwater
- PCTs 75, 105, 184 and 279 identified as facultative – proportional
- PCT 24 identified as facultative – opportunistic
- All other PCTs were identified as non-dependent on groundwater.

Figure 6.1 shows the spatial extent of current groundwater levels and the PCTs which were identified as having potential groundwater dependence, overlaid with 2 m interval contours of the modelled current depth to groundwater.

6.2.3 GDE characterisation and risk assessment

The groundwater dependence, ecological values and risks are assessed for each GDE in Table 6.2.

Based on an entirely/obligate dependence on groundwater, the risk of impact by the project was considered high on PCTs 10, 15, 17, 182 and 249. Risk of impact for vegetation communities with a facultative – proportional and Facultative – opportunistic dependence on groundwater, which were PCTs 24, 75, 105, 184 and 279, were considered low.

Of the ten communities considered to have more than negligible risk of impact from groundwater drawdown, PCTs 10, 182 and 249 were considered to be high probability GDEs by BoM (2023b), whilst PCTs 10 and 249 align with high priority GDEs according to HEVAE mapping (DPE 2018b).

An impact assessment was undertaken for the ten communities with a more than negligible risk of impact, as detailed in Section 6.3.

Table 6.2 Groundwater dependence of PCTs and risk of impact

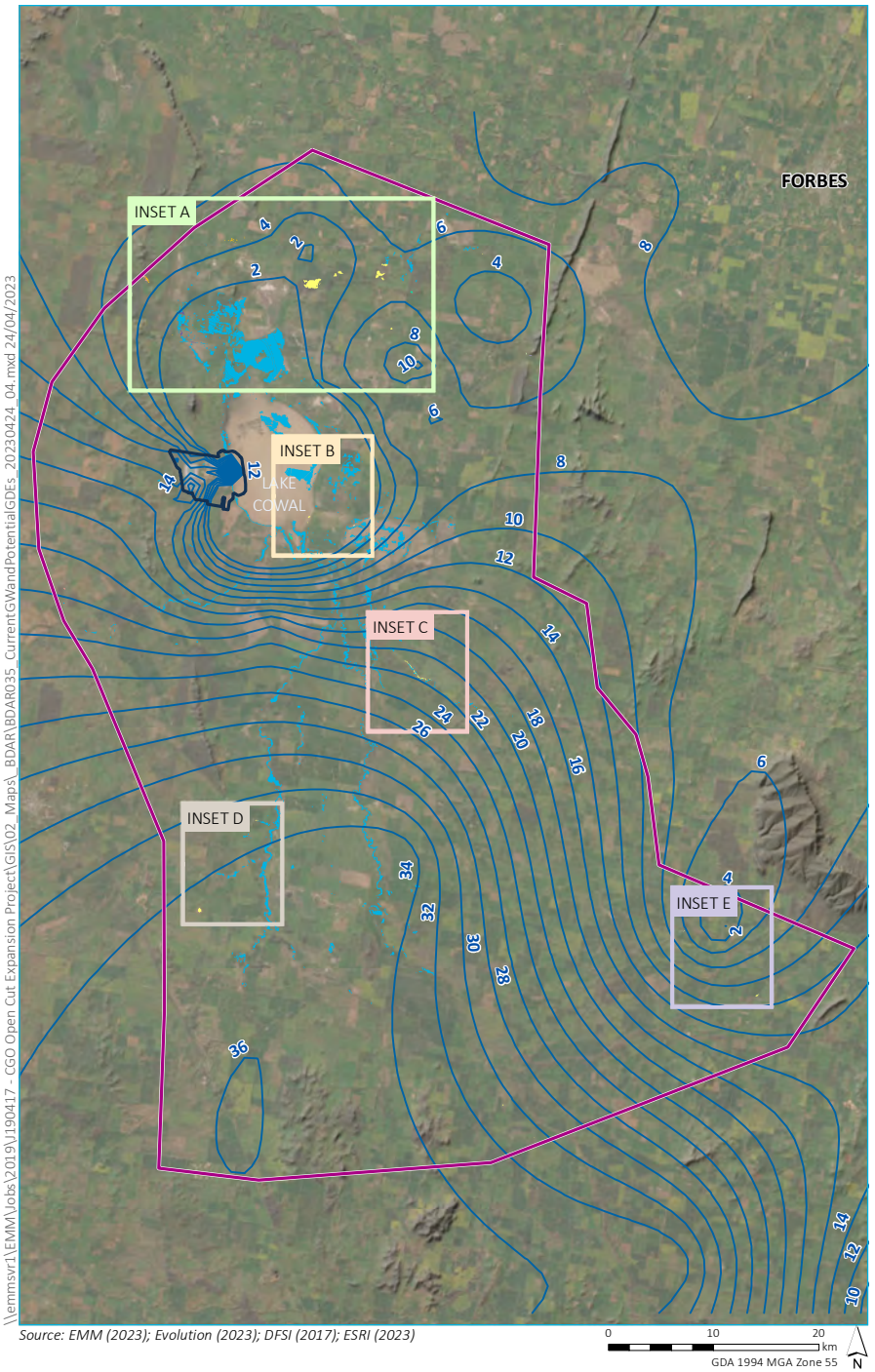
Plant community type	Groundwater dependence	Risk of impact	Impact assessment required
2 River Red Gum-sedge dominated very tall open forest in frequently flooded forest wetland along major rivers and floodplains in south-western NSW	Non-dependent	Negligible	No
5 River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the eastern Riverina Bioregion.	Non-dependent	Negligible	No
9 River Red Gum – wallaby grass tall woodland wetland on the outer River Red Gum zone mainly in the Riverina Bioregion	Non-dependent	Negligible	No
10 River Red Gum – Black Box woodland wetland of the semi-arid (warm) climatic zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Entirely/obligate	High	Yes
11 River Red Gum – Lignum very tall open forest or woodland wetland on floodplains of semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Non-dependent	Negligible	No
13 Black Box – Lignum woodland wetland of the inner floodplains in the semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Non-dependent	Negligible	No
15 Black Box open woodland wetland with chenopod understorey mainly on the outer floodplains in south-western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Entirely/obligate	High	Yes
17 Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Entirely/obligate	High	Yes
24 Canegrass swamp tall grassland wetland of drainage depressions, lakes and pans of the inland plains	Facultative – opportunistic	Low	No
26 Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	Non-dependent	Negligible	No
27 Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	Non-dependent	Negligible	No
45 Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion	Non-dependent	Negligible	No
53 Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains	Non-dependent	Negligible	No
54 Buloke – White Cypress Pine woodland in the NSW South Western Slopes Bioregion	Non-dependent	Negligible	No
55 Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.	Non-dependent	Negligible	No

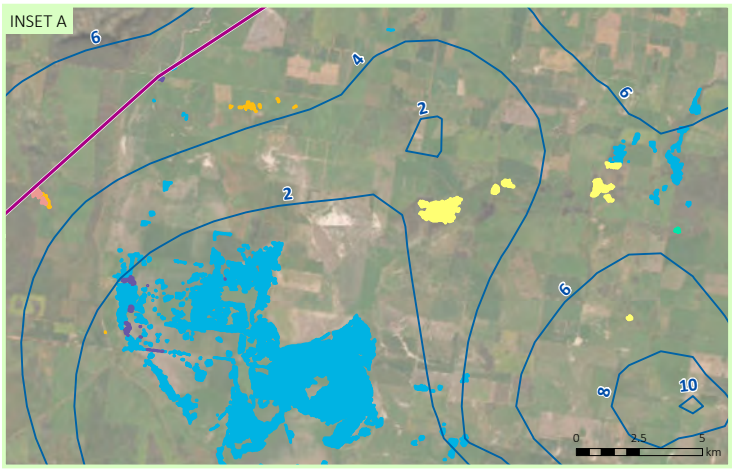
Table 6.2 Groundwater dependence of PCTs and risk of impact

Plant community type	Groundwater dependence	Risk of impact	Impact assessment required
56 Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW	Non-dependent	Negligible	No
70 White Cypress Pine woodland on sandy loams in central NSW wheatbelt	Non-dependent	Negligible	No
72 White Cypress Pine – Poplar Box woodland on footslopes and peneplains mainly in the Cobar Peneplain Bioregion	Non-dependent	Negligible	No
74 Yellow Box – River Red Gum tall grassy riverine woodland of NSW South Western Slopes Bioregion and Riverina Bioregion	Non-dependent	Negligible	No
75 Yellow Box – White Cypress Pine grassy woodland on deep sandy-loam alluvial soils of the eastern Riverina Bioregion and western NSW South Western Slopes Bioregion	Facultative – proportional	Low	Yes
76 Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions	Non-dependent	Negligible	No
77 Yarran shrubland of the NSW central to northern slopes and plains	Non-dependent	Negligible	No
80 Western Grey Box – White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion	Non-dependent	Negligible	No
81 Western Grey Box – cypress pine shrub grass shrub tall woodland in the Brigalow Belt South Bioregion	Non-dependent	Negligible	No
82 Western Grey Box – Poplar Box – White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	Non-dependent	Negligible	No
104 Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion	Non-dependent	Negligible	No
105 Poplar Box grassy woodland on flats mainly in the Cobar Peneplain Bioregion and Murray Darling Depression Bioregion	Facultative – proportional	Low	Yes
110 Western Grey Box – Cypress Pine shrubby woodland on stony footslopes in the NSW South Western Slopes Bioregion and Riverina Bioregion	Non-dependent	Negligible	No
173 Sandplain mallee of central NSW	Non-dependent	Negligible	No
176 Green Mallee – White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion	Non-dependent	Negligible	No
177 Blue Mallee – Bull Mallee – Green Mallee very tall mallee shrubland of the West Wyalong region, NSW South Western Slopes Bioregion	Non-dependent	Negligible	No
182 Cumbungi rushland wetland of shallow semi-permanent water bodies and inland watercourses	Entirely/obligate	High	Yes
184 Dwyers Red Gum – White Cypress Pine – Currawang low shrub-grass woodland of the Cobar Peneplain Bioregion	Facultative – proportional	Low	Yes
185 Dwyers Red Gum – White Cypress Pine – Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion	Non-dependent	Negligible	No

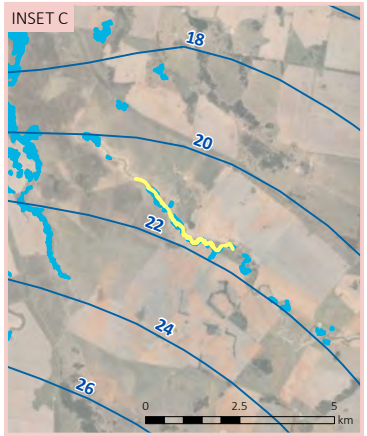
Table 6.2 Groundwater dependence of PCTs and risk of impact

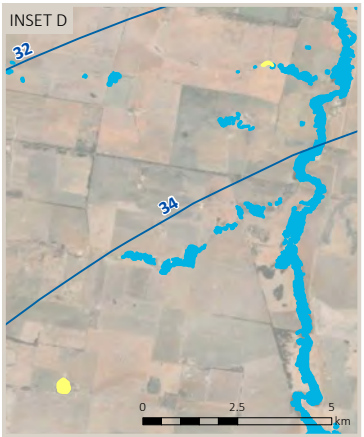
Plant community type	Groundwater dependence	Risk of impact	Impact assessment required
186 Dwyers Red Gum – Black Cypress Pine – Currawang shrubby low woodland on rocky hills mainly in the NSW South Western Slopes Bioregion	Non-dependent	Negligible	No
201 Fuzzy Box Woodland on alluvial brown loam soils mainly in the NSW South Western Slopes Bioregion	Non-dependent	Negligible	No
217 Mugga Ironbark – Western Grey Box – cypress pine tall woodland on footslopes of low hills in the NSW South Western Slopes Bioregion	Non-dependent	Negligible	No
244 Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).	Non-dependent	Negligible	No
248 Mixed box eucalypt woodland on low sandy-loam rises on alluvial plains in central western NSW	Non-dependent	Negligible	No
249 River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Entirely/obligate	High	Yes
251 Mixed Eucalypt woodlands of floodplains in the southern-eastern Cobar Peneplain Bioregion	Non-dependent	Negligible	No
257 Dwyers Red Gum – Currawang grassy low woodland of the central western plains of NSW	Non-dependent	Negligible	No
267 White Box – White Cypress Pine – Western Grey Box shrub/grass/forb woodland in the NSW South Western Slopes Bioregion	Non-dependent	Negligible	No
276 Yellow Box grassy tall woodland on alluvium or parna loams and clays on flats in NSW South Western Slopes Bioregion	Non-dependent	Negligible	No
277 Blakelys Red Gum – Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion	Non-dependent	Negligible	No
278 Riparian Blakelys Red Gum – box – shrub – sedge – grass tall open forest of the central NSW South Western Slopes Bioregion	Non-dependent	Negligible	Yes
279 Blakelys Red Gum – White Cypress Pine woodland on footslopes of hills in central part of the NSW South Western Slopes Bioregion	Facultative – proportional	Low	No
292 She oak – Fringe Myrtle heathland on rocky ranges in the NSW South Western Slopes Bioregion	Non-dependent	Negligible	Yes
332 Tumbledown Red Gum – Black Cypress Pine – Red Stringybark woodland on rocky hills in the NSW central western slopes	Non-dependent	Negligible	No
356 Blakelys Red Gum x Dirty Gum – White Cypress Pine tall riparian woodland, NSW South Western Slopes Bioregion	Non-dependent	Negligible	No

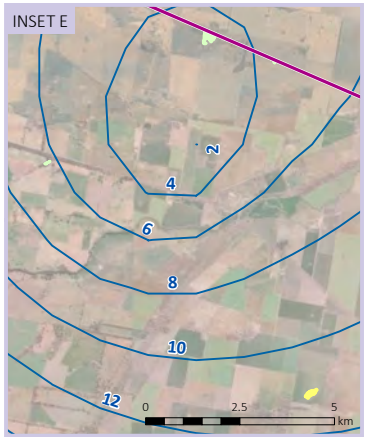












KEY

- Groundwater study area
- Additional disturbance area
- Groundwater level contour (m BGL)

PCT ID (potential groundwater dependence)

- PCT 10 (entirely/obligate)
- PCT 15 (entirely/obligate)
- PCT 17 (entirely/obligate)
- PCT 24 (facultative - opportunistic)
- PCT 75 (facultative - proportional)
- PCT 105 (facultative - proportional)
- PCT 182 (entirely/obligate)
- PCT 184 (facultative - proportional)
- PCT 249 (entirely/obligate)
- PCT 279 (facultative - proportional)

Current groundwater levels and PCTs with potential groundwater dependence

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Biodiversity Development Assessment Report
Figure 6.1

Source: EMM (2023); Evolution (2023); DFSI (2017); ESRI (2023)

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6.3 Impact assessment

6.3.1 Modelled drawdown impacts – spatial and physical

Contours showing the difference in drawdown between the approved operations and the project, as well as the ten PCTs which had potential dependence on groundwater from Section 6.2.3 are shown on Figure 6.2.

Negligible to minor difference in drawdown of 0-2 m was predominately predicted for PCTs 15, 17, 24, 75, 105, 182, 184 and 279, so further assessment for those communities was considered unnecessary. The supporting data is supplied in Appendix I, with Appendix Table I.1 showing the current depth to groundwater and Appendix Table I.2 the modelled difference in drawdown between the approved operations and the project. These PCTs are also shown on Figure 6.2. These PCTs were not considered further in terms of impact assessment.

Potential incremental impacts due to difference in drawdown between the approved operations and the project were predicted for PCTs 10 and 249 only.

Potential impacts were predicted for:

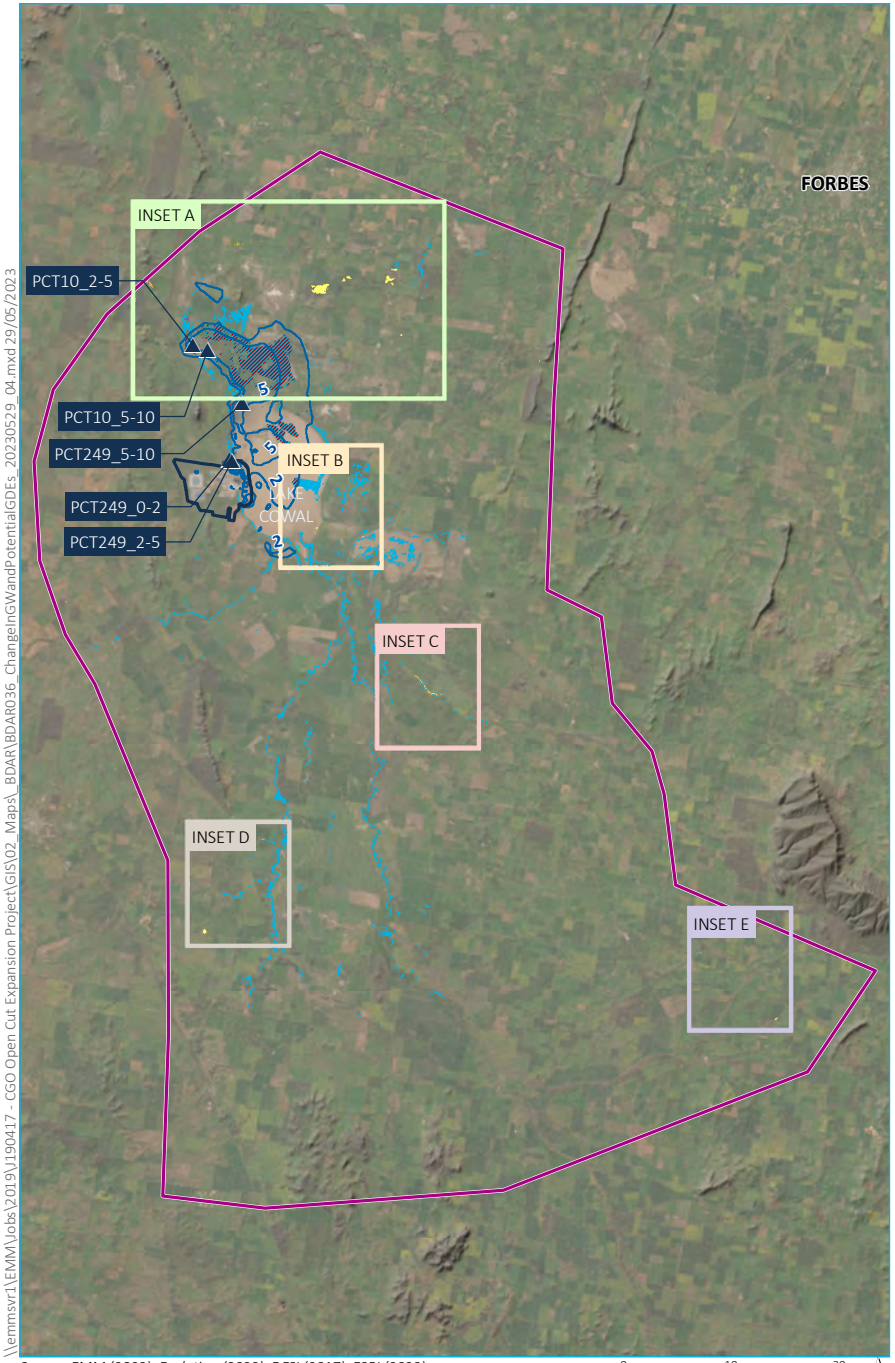
- **PCT 10** – *River Red Gum – Black Box woodland wetland of the semi-arid (warm) climatic zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion).*

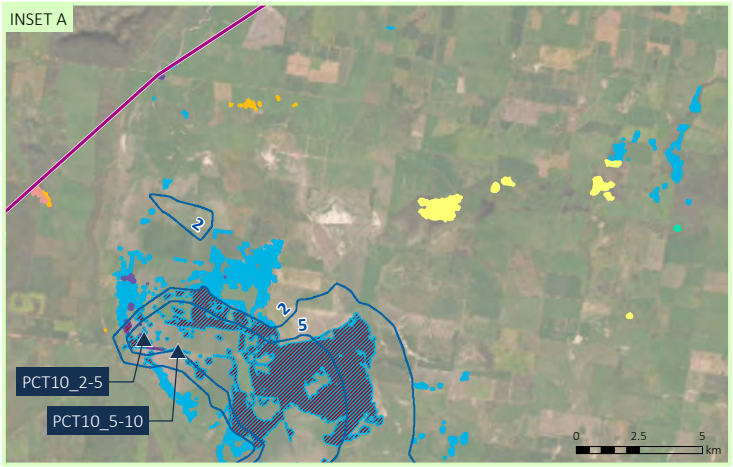
  The change in groundwater depth was modelled to increase by 2–5 m over 4.69 ha and 5–10 m over 1.50 ha. Groundwater may become more difficult to draw to the root zone in this area, with some water stress occurring across the impacted area. Further sensitivity analysis is undertaken on this PCT in Section 6.3.2.

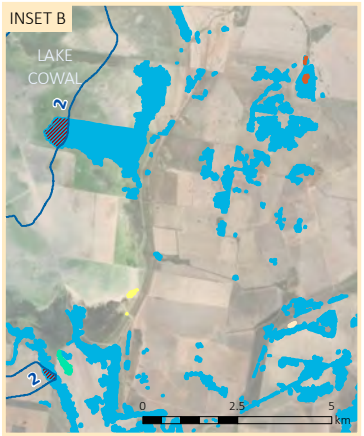
- **PCT 249** – *River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW*

  The change in groundwater depth was modelled to increase by 2–5 m over 1,106.59 ha and 5–10 m over 1,263.45 ha; noting that this includes patches mapped as occurring within Lake Cowal which will not be affected due to the hydrological separation of Lake Cowal with regards to groundwater (Section 6.2.1). Thus, these are overly conservative estimates of areas potentially affected. Groundwater may become more difficult to draw to the root zone in this area, with some water stress occurring across the impacted area.

  Further sensitivity analysis is undertaken on this PCT for the 2-5 and 5-10 m incremental groundwater drawdown areas in Section 6.3.2.













KEY

- Groundwater study area
- Additional disturbance area
- Hydrograph location
- Incremental groundwater drawdown level contour (m BGL)
- Potential impacts with incremental drawdown of > 2 m

PCT ID (potential groundwater dependence)

- PCT 10 (entirely/obligate)
- PCT 15 (entirely/obligate)
- PCT 17 (entirely/obligate)
- PCT 24 (facultative - opportunistic)
- PCT 75 (facultative - proportional)
- PCT 105 (facultative - proportional)
- PCT 182 (entirely/obligate)
- PCT 184 (facultative - proportional)
- PCT 249 (entirely/obligate)
- PCT 279 (facultative - proportional)

Difference in drawdown between the approved operations and the project Incremental change in groundwater with PCTs with potential groundwater dependence

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Biodiversity Development Assessment Report
Figure 6.2

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6.3.2 Impact sensitivity analysis – spatial, physical and temporal

For each GDE where a modelled drawdown impact was identified in Section 6.3 (PCT 10 and PCT 249), a hydrograph was generated at representative locations to identify the temporal nature of impacts under the most conservative 'dry-case', the most likely 'proposed recovery' and least conservative 'wet-case' scenarios. The spatial extent of difference in drawdown between the approved operations and the project under the most conservative 'dry-case' is shown in Figure 6.2. An analysis is provided in Table 6.3.

Drawdown impacts are predicted to be long-term in nature for PCTs 10 and 249. A change in drawdown due to the project for both communities is not expected (outside of the OPC footprint) to exceed deepening greater than 20 m from that currently approved. Nevertheless, based on the most likely 'proposed recovery' scenario, the absolute change in water level may result in water stress for some Eucalypts within those woodland communities. River Red Gum, the dominant tree species in both PCTs 10 and 249, can develop an extensive and deep taproot system with the literature reporting depths of 12–22.6 mbgl (Jones et al. 2020). Hence, based on such root system depths, it may be expected that groundwater level changes in some areas for PCTs 10 and 249 may make it more difficult for these trees to access groundwater.

The potential impact of groundwater drawdown on River Red Gum at Lake Cowal will ultimately depend on the depth of the tap root system. River Red Gum have a dimorphic root system where there is a high root density in the upper soil profile, and immediately above the water table (Orellana et al. 2012). Although root depths of 12-22.6 mbgl have been reported for River Red Gum, the development of a tap root system can be largely hindered by a thick clay horizon. For instance, Jones et al. (2020) found clay to present an extreme physical barrier to root penetration of River Red Gum adjacent to Lake Broadwater, QLD, with occasional tree roots recorded in clay to a depth of 4 mbgl. In that study, a maximum rooting depth of 7.6 mbgl was found across four sites within Australia's Great Artesian Basin with geological settings that are comparable to Lake Cowal and surrounds, which was consistently shallower than that reported in the literature. Similarly, the rooting depth of River Red Gums, and hence dependence on groundwater may be obscured by a thick clay horizon adjacent to Lake Cowal since PCTs 10 and 249 occur on thick massive clays associated with the Cowra formation. It is possible that these communities utilise shallow sources of soil moisture above the regional water-table aquifer.

The potential separation of River Red Gum communities to deeper regional groundwater is supported by results from ongoing monitoring of River Red Gum communities adjacent to the approved and extracted CGO pits by DnA Environmental. That monitoring program has yet to detect any degraded condition that could be attributable to groundwater drawdown associated with extraction of approved pits. Changes in vegetation condition of woodland adjacent to CGO were attributed to natural causes (combined with grazing where permitted) and not mining processes (Donna Johnston; DnA Environmental; pers. comms. 21 January 2023). Nevertheless, adaptive management measures for uncertain impact associated with groundwater drawdown are provided in Section 8.3. See Figure 6.2 for hydrograph locations.

Table 6.3 Impact sensitivity analysis - drawdown

PCT	Predicted incremental dry-case drawdown (mbgl)	Hydrograph number	Sensitivity analysis
10	2–5	Plate 6.1	An increase in drawdown between the approved operations and the project under the dry-case (worst-case scenario) is expected of up to approximately 1.57 m. As regional groundwater is expected to drawdown to 17.07 mbgl within the proposed – recovery case (best-estimate scenario), if Eucalyptus spp. depend on that water source rather than shallow sources of soil moisture, they should still access groundwater within the root zone, but this may become more difficult. Adaptive management for the uncertain impact associated with groundwater drawdown is provided in Section 8.3.
10	5–10	Plate 6.2	An increase in drawdown between the approved operations and the project under the dry-case (worst-case scenario) is expected of up to approximately 7.5 m. As regional groundwater is expected to drawdown to 17.93 mbgl within the proposed – recovery case (best-estimate scenario), if Eucalyptus spp. depend on that water source rather than shallow sources of soil moisture, they should still access groundwater within the root zone, but this may become more difficult. Adaptive management for the uncertain impact associated with groundwater drawdown is provided in Section 8.3.
249	0–2	Plate **6.3**	An increase in drawdown between the approved operations and the project under the dry-case is expected of up to approximately 2.1 m. As regional groundwater is expected to drawdown to 27.03 mbgl within the proposed – recovery case (best-estimate scenario), if Eucalyptus spp. depend on that water source rather than shallow sources of soil moisture, they may still possibly access groundwater within the root zone, but this will likely become more difficult. It is noted that as stated in the methods (Section 6.1.1iv), the hydrograph was generated for the PCT polygon with the predicted incremental dry-case drawdown closest to the mine. The closest polygon is immediately adjacent to the mine (Figure 6.2), and, as such, the hydrograph shows a high level of total groundwater drawdown. Adaptive management for the uncertain impact associated with groundwater drawdown is provided in Section 8.3.
	2–5	Plate 6.4	An increase in drawdown between the approved operations and the project under the dry-case is expected of up to approximately 2.6 m. As regional groundwater is expected to drawdown to 25.78 mbgl within the proposed – recovery case (best-estimate scenario), if Eucalyptus spp. depend on that water source rather than shallow sources of soil moisture, they may still possibly access groundwater within the root zone, but this will likely become more difficult. It is noted that as stated in the methods (Section 6.1.1iv), the hydrograph was generated for the PCT polygon with the predicted incremental dry-case drawdown closest to the mine. The closest polygon is immediately adjacent to the mine (Figure 6.2), and, as such, the hydrograph shows a high level of total groundwater drawdown. Adaptive management for the uncertain impact associated with groundwater drawdown is provided in Section 8.3.

Table 6.3 Impact sensitivity analysis - drawdown

PCT	Predicted incremental dry-case drawdown (mbgl)	Hydrograph number	Sensitivity analysis
	5–10	Plate **6.5**	An increase in drawdown between the approved operations and the project under the dry-case is expected of up to approximately 8.6 m. As regional groundwater is expected to drawdown to 7.38 mbgl within the proposed – recovery case (best-estimate scenario), if Eucalyptus spp. depend on that water source rather than shallow sources of soil moisture, they should still access groundwater within the root zone. It is noted that as stated in the methods (Section 6.1.1iv), the hydrograph was generated for the PCT polygon with the predicted incremental dry-case drawdown closest to the mine. The closest polygon is some distance from the mine (Figure 6.2), and located further away than the 0-2 and 2-5 incremental dry-case drawdown polygons which are adjacent to the mine, as such, although the predicted incremental drawdown is higher, the hydrograph shows a lower level of total groundwater drawdown than other two scenarios.

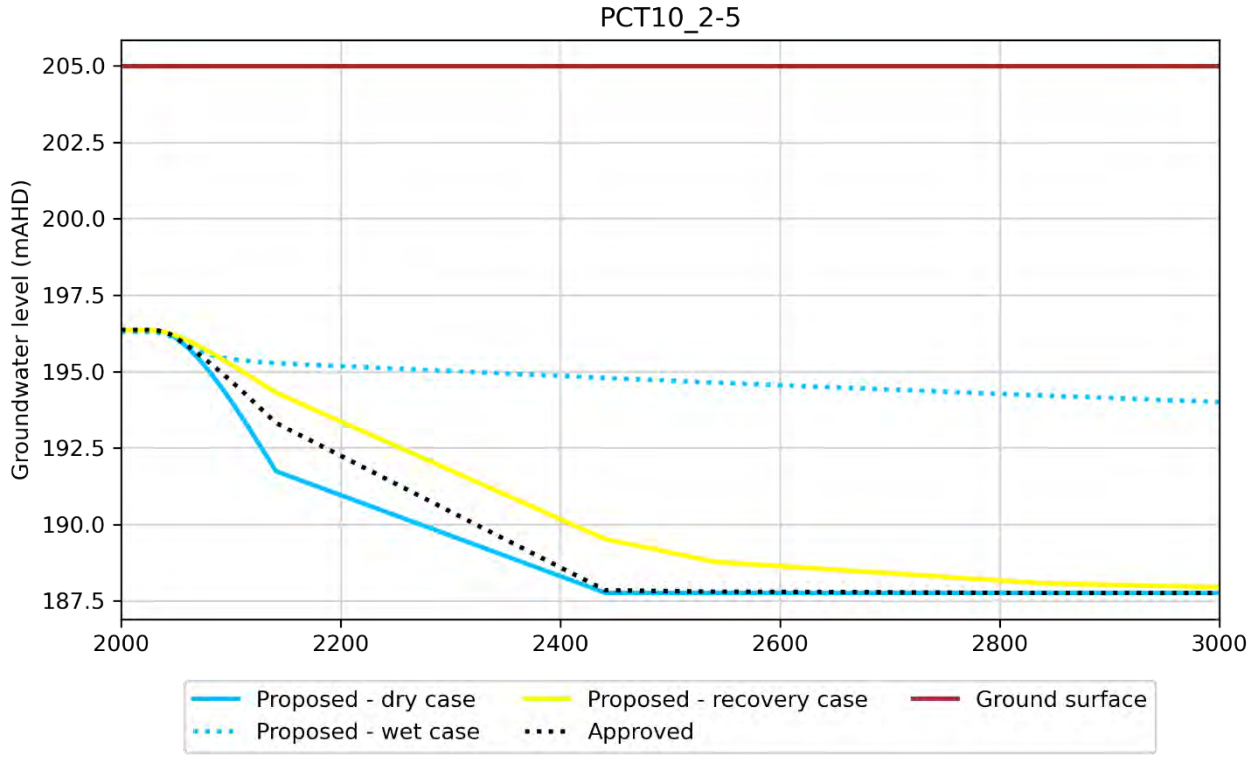


Plate 6.1 Absolute groundwater level hydrograph for PCT 10, 2-5 m incremental groundwater drawdown location

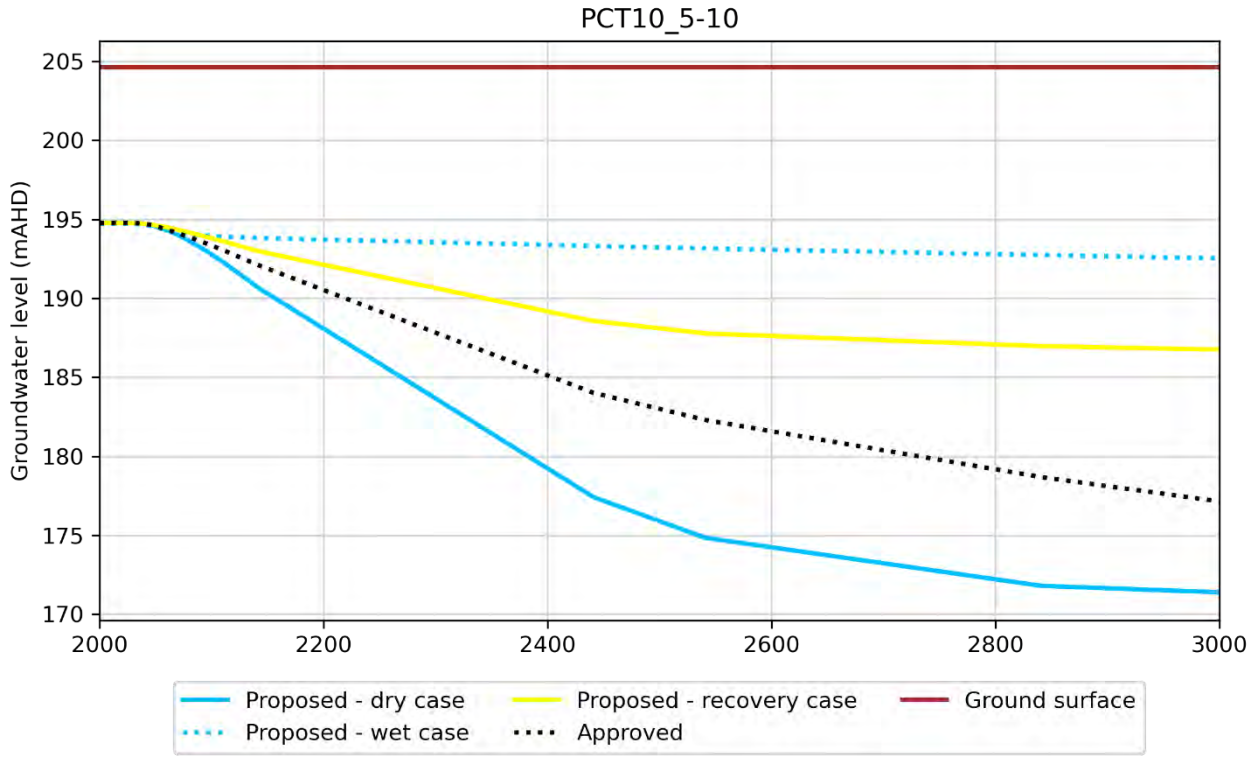


Plate 6.2 **Absolute groundwater level hydrograph for PCT 10, 5-10 m incremental groundwater drawdown location**

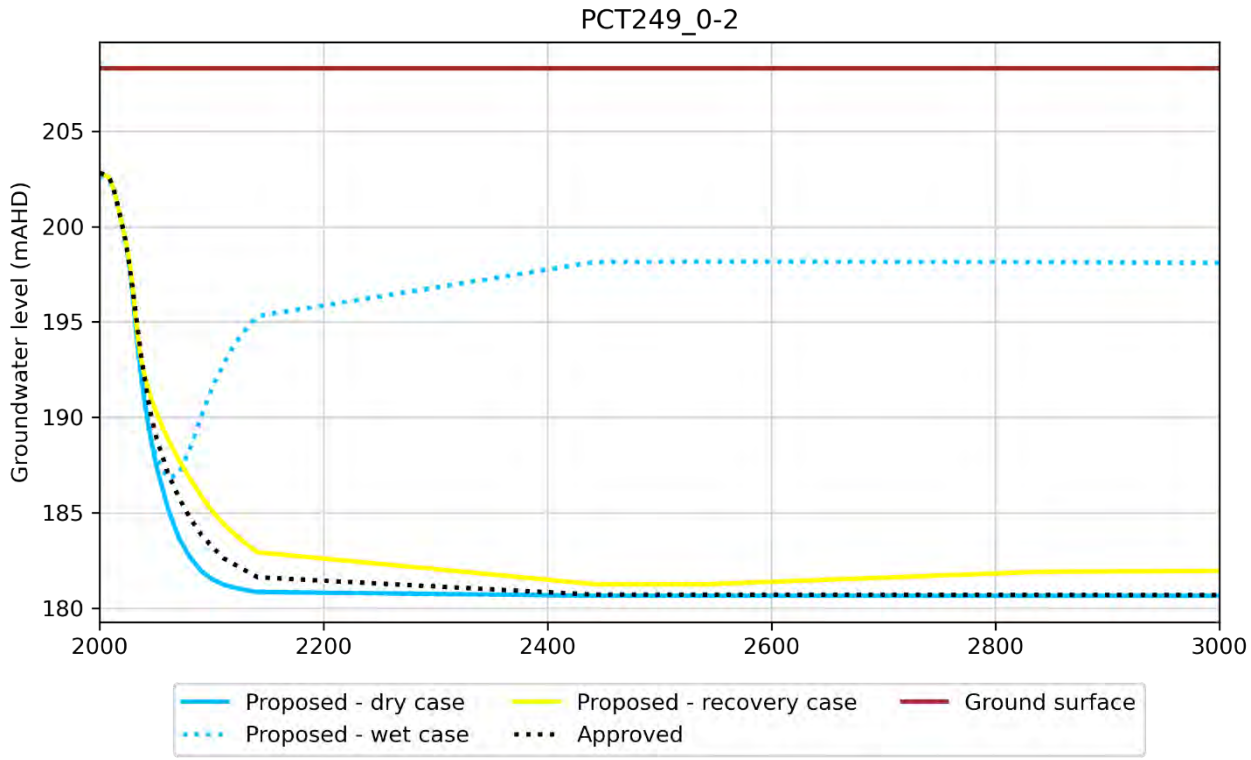


Plate 6.3 **Absolute groundwater level hydrograph for PCT 249, 0-2 m incremental groundwater drawdown location**

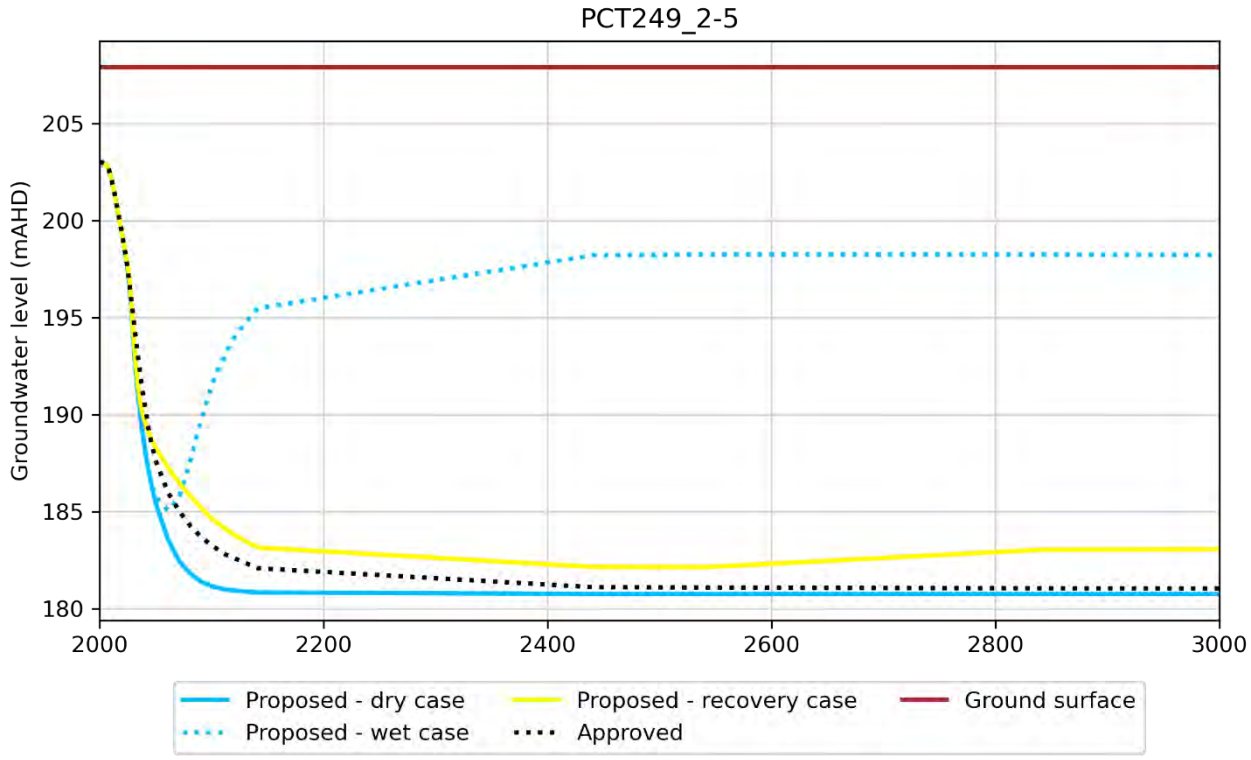


Plate 6.4 **Absolute groundwater level hydrograph for PCT 249, 2-5 m incremental groundwater drawdown location**

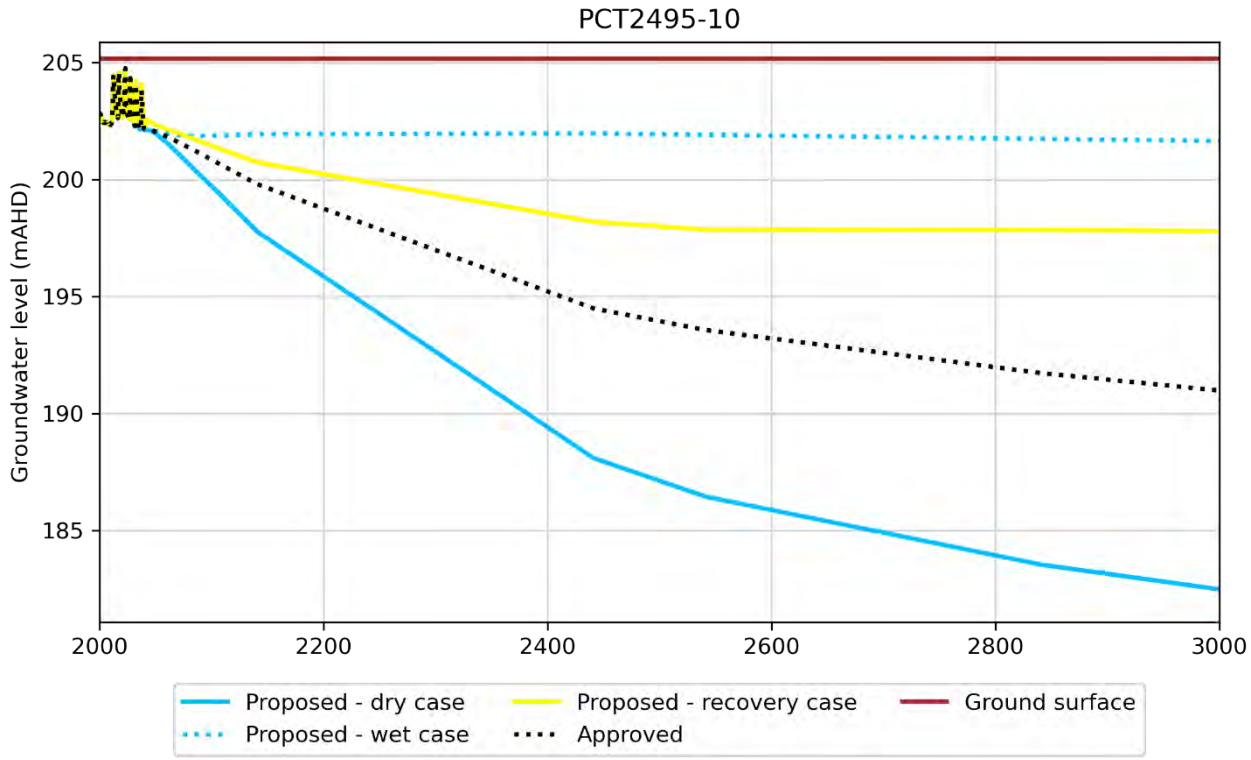


Plate 6.5 **Absolute groundwater level hydrograph for PCT 249, 5-10 m incremental groundwater drawdown location**

6.3.3 Groundwater quality

Advective particle tracking was simulated from groundwater recharged at the IWL and WRE. A groundwater mound develops around these seepage locations, and as a result groundwater flows to the north and west away from the mine area. Long-term drawdown from open cut mining is expected to exceed the magnitude of mounding, and modelled groundwater flow paths reverse direction towards the mine within 100 years. Groundwater quality is therefore not anticipated to be an issue, as contaminants from seepage are predicted to be captured within the long-term groundwater sink of the residual open cut pits.

7 Prescribed impacts

All potential prescribed impacts are identified in Table 7.1.

Table 7.1 Potential prescribed impacts

Feature	Present	Description and location	Threatened species or community dependent on feature
Karst, caves, crevices, cliffs, rocks or other geological features of significance	☒Yes / ☐No	There are crevices and cliffs within extracted mine pits within the Approved footprint. The E46 pit will be back-filled as part of the Project. Although these areas are already approved for disturbance under a previous modification, this backfilling is not expected to impact any of any rock-dependent threatened species. That is, the site is highly active and isolated from access by ground-dwelling fauna by fencing and ongoing mine operations. There have also been no cave-associated microbats detected either by previous studies or those undertaken for the BDAR (see Section 1.1.1).	N/A
Human-made structures	☐Yes / ☒No	No human-made structures that offer potential habitat to threatened species will be removed as part of the Project.	N/A
Non-native vegetation	☒Yes / ☐No	One small patch of Austral Pillwort (~50 individuals) was found within the cropped area inside the Additional disturbance area. This area was a small ephemeral depression with sparse sedges, and more intensive surveys in the area failed to find it elsewhere in this zone. This cropped area was assessed as Category 1 land (see Appendix E). Another small patch of Austral Pillwort (~100 individuals) was also found adjacent to a cleared track, so that part of the species polygon occurs in that cleared area. This potential prescribed impact is assessed in Section 8.5.	Austral Pillwort (*P. novae-hollandiae*)
Habitat connectivity	☒Yes / ☐No	The Project will add to an incremental increase to the existing CGO footprint. However, given that threatened woodland and waterbirds are highly mobile due to their flying abilities, the Additional disturbance footprint is not expected to interrupt connectivity for these entities. Hence, it is not expected that the Project would disconnect habitat for threatened species, including that may associate with woodland habitats and/or within the ephemeral wetland of Lake Cowal. Moreover, in the long term, rehabilitation of the foreshore in front of the LPB, including planting of trees, will improve connectivity of riparian habitat north and south of CGO. As the Austral Pillwort disperses its spores by water, it is possible that the Additional disturbance may interfere with the dispersal of this species. However, it is considered unlikely that the Project would notably change overland flows, and hence this potential dispersal mechanism for Austral Pillwort, from that at present. Moreover, waterfowl are likely to disperse sporocarps of this species, given this has been shown as a dispersal method other species of Marsileaceae in Australia, including isolated habitats such as gilgai. The assessment of this potential prescribed impact is explored in Section 8.5.	Austral Pillwort (*P. novae-hollandiae*) Threatened shorebirds/waterbirds: • Magpie Goose, Australasian Bittern, Curlew Sandpiper, Brolga, White-bellied Sea Eagle, Blue-billed Duck, Australian Painted Snipe and Freckled Duck. Migratory shorebirds/waterbirds: • Sharp-tailed Sandpiper, Pectoral Sandpiper, Red-necked Stint, Double-banded Plover, White-winged Black Tern, Latham's Snipe, Gull-billed Tern, Caspian Tern, Little Curlew, Glossy Ibis, Pacific Golden Plover, Common Greenshank, Common Sandpiper, Marsh Sandpiper, Bar-tailed Godwit, Black-tailed Godwit, Whimbrel; and Wood Sandpiper.
Waterbodies, water quality and hydrological processes	☒Yes / ☐No	If not managed effectively, the Project has the potential to impact upon threatened flora and fauna within the Lake Cowal catchment through: • sedimentation of surface water, including Lake Cowal • cyanide contamination of surface water, including Lake Cowal • direct exposure of threatened fauna to cyanide within treatment ponds. Based on the nature of the Project, potential prescribed impacts on hydrological process may arise due to: • potential drawdown and contamination of groundwater • potential change to the water balance of Lake Cowal. However, surface and groundwater modelling of scenarios prior to and after the Project reveal negligible change in these parameters. The outputs of these models, and the justification for a negligible prescribed impacts on biodiversity, are discussed immediately below. After construction of the LPB, there is expected to be a negligible change in lake levels. That is, under a 1%, 0.1% and Probable Maximum Flood (PMF) flood events, the variance between the proposed and current flood depth was approximately 15 mm (ATC Williams 2023). This equates to a maximum of approximately 5 m horizontal change to the shoreline, or approximately 0.2% increase in flood area. Given the highly dynamic movement of the Lake Cowal during its wetting and drying cycles, which often extends well beyond its associated riparian area and into adjacent floodplains, combined with the highly irregular chance of this minor incremental increase in flood area, it is not expected that the Project will impact threatened ecological communities or threatened/migratory species habitat through changing the level or horizontal extent of surface water in Lake Cowal. The potential prescribed impact of surface water contamination and exposure of fauna to cyanide is assessed in Section 8.5. The potential impact of the Project on GDEs was considered in Chapter 6. In summary, PCTs 10 and 249 may potentially have some impact, though the current incremental groundwater drawdown modelling is based on a highly conservative 'dry' case for the mine pits.	Threatened shorebirds/ waterbirds: • Magpie Goose, Australasian Bittern, Curlew Sandpiper, Brolga, White-bellied Sea Eagle, Blue-billed Duck, Australian Painted Snipe and Freckled Duck. Migratory shorebirds/ waterbirds: Sharp-tailed Sandpiper, Pectoral Sandpiper, Red-necked Stint, Double-banded Plover, White-winged Black Tern, Latham's Snipe, Gull-billed Tern, Caspian Tern, Little Curlew, Glossy Ibis, Pacific Golden Plover, Common Greenshank, Common Sandpiper, Marsh Sandpiper, Bar-tailed Godwit, Black-tailed Godwit, Whimbrel; and Wood Sandpiper.
Wind farm development	☐Yes / ☒No	No wind farm is proposed as part of the Project.	N/A

Table 7.1 Potential prescribed impacts

Feature	Present	Description and location	Threatened species or community dependent on feature
Vehicle strikes	☒Yes / ☐No	During construction, there will be an increase in vehicle movements associated with construction activities that may increase the risk of vehicle strike to threatened fauna during this period. If construction occurs when Lake Cowal is full, there may be an increased risk of vessel strike for threatened shorebirds/waterbirds due to increased boating activities required to support construction of the LPB. Increased risks of vessel strike to these birds are expected to occur during construction only. Increased vehicle movements within CGO and the Additional disturbance area will also be required to facilitate movements of personnel and equipment during construction. During operation, the Project will not change staff personnel numbers or operational activities to the point that the risk of vehicle/vessel strike to threatened fauna is expected to increase notably beyond that at present.	Threatened shorebirds/waterbirds: • Magpie Goose, Australasian Bittern, Curlew Sandpiper, Brolga, White-bellied Sea Eagle, Blue-billed Duck, Australian Painted Snipe and Freckled Duck. Migratory shorebirds/waterbirds: • Sharp-tailed Sandpiper, Pectoral Sandpiper, Red-necked Stint, Double-banded Plover, White-winged Black Tern, Latham's Snipe, Gull-billed Tern, Caspian Tern, Little Curlew, Glossy Ibis, Pacific Golden Plover, Common Greenshank, Common Sandpiper, Marsh Sandpiper, Bar-tailed Godwit, Black-tailed Godwit, Whimbrel; and Wood Sandpiper. Threatened woodland birds: • Dusky Woodswallow, Glossy Black-Cockatoo, Pied Honeyeater, Speckled Warbler, Spotted Harrier, Brown Treecreeper (eastern subspecies), Varied Sittella, White-fronted Chat, Black Falcon, Purple-crowned Lorikeet, Painted Honeyeater, Black-breasted Buzzard, Little Eagle, Shy Heathwren, Swift Parrot, Malleefowl, Major Mitchell's Cockatoo, Square-tailed Kite, Hooded Robin (south-eastern form), Black-chinned Honeyeater (eastern subspecies), Turquoise Parrot, Barking Owl, Gilbert's Whistler, Scarlet Robin, Flame Robin, Superb Parrot, Grey-crowned Babbler (eastern subspecies), Diamond Firetail and Masked Owl. Threatened microbats: • Little Pied Bat and Yellow-bellied Sheathtail-bat. • Threatened ground-dwelling fauna: • Spotted-tailed Quoll and Stripe-faced Dunnart.

Part B

Impact Assessment

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8 Impact assessment

This chapter identifies the potential impacts of the Project on biodiversity values. The chapter firstly introduces impacts that may occur if measures were not employed to avoid, minimise or mitigate impacts (Section 8.1). Section 8.2 details the measures taken to date to avoid and minimise impacts, including direct, indirect and prescribed impacts. Section 8.3 outlines adaptive management for impacts that are uncertain and measures to mitigate residual impacts. Sections 8.4, 8.5, 8.7 and 8.8 identify the residual impacts of the Project, whilst Section 8.6 provides an assessment for entities considered as a potential Serious and Irreversible Impact.

8.1 Potential impacts without measures to avoid, minimise or mitigate impacts

Without any measures to avoid, minimise or mitigate impacts, the mine development associated with the amended Project would potentially result in the following impacts on biodiversity:

- direct impacts:
  - loss of native vegetation
  - loss and degradation of native fauna habitats
  - removal of hollow-bearing trees
  - removal of habitat resources for threatened fauna
- potential indirect impacts outside of the Additional disturbance area:
  - increased noise, vibration and dust levels resulting in disturbance of fauna species, and potential for consequent abandonment of habitat and/ or changes in behaviour (including breeding behaviour)
  - lighting for night works, resulting in disturbance to fauna species and changes in occupancy or behaviour
  - fire
  - weed introduction and spread
  - vertebrate pest invasion
  - chemical and oil spills
  - erosion and sedimentation
  - potential inadvertent disturbance of retained habitats
- prescribed impacts:
  - non-native vegetation
  - waterbodies, water quality and hydrological processes
  - vehicle strike.

8.2 Avoid and minimise impacts

8.2.1 Avoid and minimise direct and indirect impacts

The original EIS design issued in March 2022 impacted an estimated area of 1,495 ha of native vegetation. Although most of the vegetation to be impacted in that original footprint is considerably degraded by historical agricultural activities, this translated to significant native vegetation impacts due to the large footprint of this original design. Considering the NSW Government's Biodiversity Offsets Scheme (BOS), Evolution followed the hierarchy below when revising the Project footprint:

1. first consider whether the development can avoid a negative impact on the environment
2. next consider whether the development can minimise any negative impacts that cannot be avoided
3. once all reasonable steps to avoid or minimise environmental impacts have been exhausted, offset any remaining impacts.

Noting this hierarchy, the Project design was progressively optimised to avoid impacts to native vegetation where possible by minimising the overall disturbance footprint. The design evolution is documented below. In total, the design revision process undertaken since March 2022 reduced the disturbance footprint by 364.7 ha.

Measures to avoid and minimise impacts on direct and indirect impacts through Project location and design are detailed below.

i Project location

The CGO site is an existing open pit mining operation with an established disturbance footprint and substantial existing surface infrastructure, including processing plant, water management infrastructure, access roads, internal roads and haul roads, electricity transmission lines, waste storage and transfer facility, workshop facilities, and administration and bathhouse buildings. Much of the existing surface infrastructure will be utilised or modified to support the Project.

ii Project design

Given the identified orebody widths, depths, strip ratios and other properties, conventional open pit mining methods (versus underground) have been determined to be the only economical means of extraction.

Whilst the design of the additional disturbance area has been predominantly revised due to constraints such as land tenure and topography, all design iterations were considered alongside the potential direct and indirect impacts on biodiversity values. Noting that over half of the impacts to native vegetation result from encroachment into Lake Cowal, where there are minimal opportunities to alter the footprint due to the location of the target orebodies, opportunities to reduce impacts on biodiversity values have been largely focused on terrestrial areas, particularly with the design and location of soil stockpiles and the Lake Protection Bund (LPB).

Table 8.1 summarises the avoidance and minimisation measures already incorporated into the mine development's design and the additional measures to minimise the potential for unacceptable impacts on biodiversity associated with the mine development. The final Project footprint, following the implementation of avoidance and minimisation measures, is shown in Figure 8.1.

Table 8.1 Direct and indirect impact avoidance and minimisation design strategy

Action	Design element	Impact minimisation/avoidance	Intended biodiversity outcome	Timing	Responsibility
Direct impacts					
E46 Backfill design and Southern WRE	Backfill of E46 footprint to avoid the need to expand WRE south (see note 1 in Figure 8.1).	Containment of waste dumps within ML allowing for optimisation of ancillary infrastructure and topsoil stockpiles outside mine lease.	Minimise impact on Weeping Myall and Inland Grey Box TECs. The alternative, of using this area as a waste dump rock, would have compromised the long-term ecosystem function of woodland/DNG in that location.	Design	Client
Lot 102 topsoil stockpile	Stockpile zone reallocated to primarily cropped vegetation zone (i.e. primarily Category 1 land; see note 3 in Figure 8.1).	Avoidance of impacts to vegetation community good condition PCT 185 and patches of moderate condition PCT 55 and 82 (see Note 2 in Figure 8.1).	Reduce impact to Superb Parrot foraging habitat. This parrot was regularly sighted within PCT 185 in this area (Section 1.1.1). This action avoided some impacts on remnant patches of Inland Grey Box TEC. Scattered patches of mature Belah, Wilga and Kurrajong within this vegetation community, also provide additional important habitat for threatened woodland birds, including the Superb Parrot. Avoidance of PCT 55 in this area also avoids impacts to a network of gilgais that are in relatively good condition, which may provide habitat to migratory/threatened waterbirds and/or non-threatened frogs.	Design	Client
Southern topsoil stockpiles	Change to Southern Waste Rock Emplacement (WRE) footprint has allowed stockpiles to be pushed north. Area in SE corner of Project mostly absent of vegetation has been prioritised for use (see note 4 in Figure 8.1).	50% reduction in disturbance footprint to south of Mining Lease (ML).	Reduce impacts on remnant patches of Inland Grey Box TEC. Scattered patches of mature Inland Grey Box and White Cypress Pine within this vegetation community, as well as the patch of good condition PCT 185 on the hillcrest to the south of the Additional disturbance area, also provide additional avoidance of habitat for threatened woodland birds, including the Superb Parrot. Focusing topsoil stockpiling within the cropped land zone, which has historically been used for grain cropping, reduces corresponding impacts to biodiversity values on Lot 102, as described above (see note 3 in Figure 8.1).	Design	Client
Lake Protection Bund (LPB)	Design optimisation to minimise footprint within Lake Cowal (see note 5 in Figure 8.1).	Reduce direct impact of the Project on lake vegetation (i.e. PCTs 17, 53 and 249) and associated habitat for waterbirds.	Reduce direct impact to shrubland PCT 17, grassland/sedgeland PCT 53 and mature River Redgum woodland PCT 249. This LPB design change led to a reduction of impact to threatened/migratory waterbird habitat, including potential roosting/breeding habitat associated with PCTs 17 and 249.	Design	Client
Use of existing LPB	Use of existing LPB to provide a hydrological separation with Lake Cowal.	Avoid the need to construct a temporary lake protection bund (in front of the LPB). This reduces direct impact of the Project on lake vegetation (i.e. PCTs 17, 53 and 249) and associated habitat for waterbirds.	Avoid additional direct impact to shrubland PCT 17, grassland/sedgeland PCT 53 and mature River Redgum woodland PCT 249. This LPB design change led to a reduction of impact to threatened/migratory waterbird habitat, including potential roosting/breeding habitat associated with PCTs 17 and 249.	Design	Client
No upgrades to access roads to mine required.	Use of existing mine access roads.	The Project will not modify the access roads, so that upgrades, such as road widening or construction of new access points, are not required.	No impacts to sensitive terrestrial entities (e.g. Inland Grey Box EEC) due to road construction activities.	Design	Evolution
Indirect impacts					
Design of site lighting	Design standards like AS 4282 Control of obtrusive effects of outdoor lighting, National Light Pollution Guidelines for Wildlife (DoEE 2020), and the Dark Sky Planning Guideline (DPE 2016b) will be applied during the design of Project elements. More detail on the implementation of relevant and practicable measures to reduce impacts of light on wildlife are provided in the Visual Impact Assessment for the Project (EMM 2023f).	Design guidelines adapted from the guidelines include: • eliminating upward spill light • directing light downwards, not upwards • use of shielded fittings • avoiding 'over' lighting • use of energy efficient bulbs • use of asymmetric beams, where floodlights are used • ensuring lights are not directed towards reflective surfaces • use of warm white colours.	Reduce impact of light spillage on threatened and/or migratory waterbirds within Lake Cowal, including potential disruption of foraging, disorientation, disturbance of rest and predation.	Design, construction, operation	Client
Reconstruct lake foreshore in front of the LPB. This will occur within the 30 m buffer from the LPB toe, which has been assessed here as part of the Additional disturbance area, and hence will be offset accordingly.	Building of foreshore berm and channels, adding habitat elements including placement of rocks/logs and planting of suitable trees. Details are provided in the Rehabilitation Plan (EMM 2023d).	Removal of the existing foreshore rehabilitation effort as part of the Project may remove habitat for fish and waterbirds. Although this impact is within an area where such disturbance approved, this proposed rehabilitation work would re-establish this riparian environment.	Provide a connective riparian habitat along the western shoreline of Lake Cowal, to connect habitat north and south of CGO for mobile fauna, including woodland birds and arboreal mammals. This rehabilitation work would also provide valuable habitat for waterbirds and fish within Lake Cowal.	Design	Client



KEY

- Proposed disturbance footprint (current)
- Proposed disturbance footprint (March 2022)
- Existing and approved disturbance area
- Major road
- Cadastral boundary

Change in disturbance footprint since March 2022

- Increase (28.1 ha)
- Reduction (391.8 ha)

avoidance/minimisation measures at design stage

1. Backfill of E46 footprint to avoid the need to expand WRE south.
2. Avoidance of impacts to vegetation community good condition PCT 185 and patches of moderate condition PCT 55 and 82.
3. Stockpile zone reallocated to primarily cropped vegetation zone (i.e. primarily Category 1 land).
4. Change to Southern Waste Rock Emplacement (WRE) footprint has allowed stockpiles to be pushed north. Area in SE corner of project mostly absent of vegetation has been prioritised for use.
5. Design optimisation to minimise footprint within Lake Cowal.

\\emmsvr1\EMM\Jobs\2019\I190417 - CGO Open Cut Expansion Project\GIS\02_Maps_BDAR\BDAR029_ProjectDesignEvolution_20230413_03.mxd 13/04/2023

Source: EMM (2023); Evolution (2023); DFSI (2017); Nearmap (2021)

0 1 2 km

GDA 1994 MGA Zone 55

N

Project design evolution to avoid and minimise impacts to biodiversity values

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Biodiversity Development Assessment Report
Figure 8.1

EMM creating opportunities

8.2.2 Avoid and minimise prescribed impacts

Measures to avoid and minimise impacts on prescribed impacts through Project location and design are detailed below.

i Project location

The Project is located in a geologically suitable position to avoid impacts to Lake Cowal associated with potential water draw down. That is, the Project is in an area where underlying aquifers, which may be intersected by mining of the additional pits as part of the Project, are hydrologically separated surface water features, including Lake Cowal. This was demonstrated in the hydrogeological assessment by Coffey (2020) and EMM (2023b), which showed that Lake Cowal is isolated from underlying aquifers. That is, there are very low permeability lake-bed sediments (thick clay) in Lake Cowal, which act as an impeding layer (aquitard) to vertical leakage from the lake. This is known because the open cut pit, which lies on the edge of the lake separated by two bunds, has received a minor, stable and consistent flow of groundwater from August 2005 through to the current day, despite Lake Cowal becoming inundated three times over the past 10 years (i.e. 2010, 2016 and 2022; see Figure 3.4). Connectivity between the lake and underlying aquifers would have seen steep rises in groundwater inflows during these inundation events. Studies and monitoring have also shown that the groundwater in areas around the open cut pit have generally been dewatered. Recent monitoring results from the exploration decline beneath Lake Cowal show that groundwater pressures within 10 m from the exploration decline are generally dry or in an unsaturated condition. Coffey (2020) who has been studying the hydrogeological conditions around CGO since 1995, concluded that "*Groundwater impacts to Lake Cowal are predicted to be negligible*".

Further evidence to support the poor connectivity between Lake Cowal and the fractured rock groundwater system beneath Lake Cowal was the rate of recession after filling events. That is, after analysing eight recession events, Coffey (2021) found that average fall in lake water level (accounting for rainfall) from the events was equal to 80% of pan evaporation, which was similar to recorded rates of water level fall for large shallow lakes that contain suspended and dissolved solids in a semi-arid climate. Coffey (2021) concluded that the results of their assessment indicate that transfer of groundwater to or from Lake Cowal is low.

Given the operational knowledge and data from CGO regarding groundwater, and data from the exploration decline there is a high degree of certainty over these conclusions.

Table 8.2 Prescribed impact avoidance and minimisation design strategy

Action	Design consideration	Impact minimisation/avoidance	Intended biodiversity outcome	Timing	Responsibility
Waterbodies, water quality and hydrological processes					
Design of lake isolation system, including: • LPB • Perimeter waste rock emplacement.	A new lake isolation system designed to hydrologically separate the new open pits during development, mining and post-closure of the CGO. The LPB will be designed to have a low permeability embankment designed to prevent water inflow (during periods of high lake water level) from Lake Cowal into the mine pits over the life of the mine and over the long term.	Prevent the exchange of water to and from Lake Cowal into the open pit development area during periods of high-water levels.	Avoid impacts of water quality within Lake Cowal that may arise from sedimentation and/or other water quality contamination if mining operations are inundated. Hydrological separation should avoid water quality impacts on threatened and/or migratory waterbirds in Lake Cowal.	Design	Evolution
Use of existing Lake Protection Bund and not construct a temporary bund wall.	No need to construct a temporary lake protection bund (in front of the LPB).	Avoid impacts to water quality that may arise from construction of a temporary bund wall.	Avoid impacts of water quality within Lake Cowal that may arise from sedimentation and/or other water quality contamination associated with construction of a temporary bund wall. This action will avoid additional risks to water quality for threatened and/or migratory waterbirds in Lake Cowal.	Design	Evolution
Construction of LPB in two stages; north and south. Northern section will tie-in with existing LPB.	Approach to constructing the LPB.	Stage impacts of pumping of lake water.	Staging impacts of water drainage (if required) and construction activities associated with the LPB will reduce potential impacts on threatened and/or migratory waterbirds in Lake Cowal.	Design	Evolution
Using clean rock and fill within the LPB.	Avoid potential contamination of Lake Cowal by selecting suitable rock and fill material, away from mineralized zone.	Extensive testing during the design phase has been undertaken to source rock and fill that is suitable for the construction of the LPB. This is to avoid potential issues associated with water contamination in Lake Cowal, particularly in the case if construction is to occur when Lake Cowal is inundated. It is likely that testing will also be required during the construction process; the testing regime will probably need to be agreed with the EPA.	Avoid potential impacts of construction of the LPB on water quality within Lake Cowal that may arise if clean fill and rock is used.	Design	Evolution
Update of internal catchment drainage system (ICDS). The ICDS captures and treats surface water within the CGO site. Treated water is used within the CGO site so that no water is discharged outside of the CGO site.	Design the permanent water management to accommodate the Project requirements and operate during the life of mine through to after mine rehabilitation and closure. Storages have been suitably designed according to the needs of the Project and will be installed and maintained to ensure no discharge of mine water or sediment-laden water outside the ICDS.	Avoid overflow of cyanide contaminated water into adjacent waterways, including Lake Cowal. Surface water collected within the limits of the ICDS are directed to the process water storage dam for use as process water, dust suppression and conditioning of construction materials.	Avoid discharge of surface contaminated water into Lake Cowal, avoiding impacts to threatened and/or migratory waterbirds in Lake Cowal.	Design	Evolution
Update of internal upper catchment diversion system (UCDS). The UCDS diverts surface water upstream of CGO operations to ensure no interaction with mining operations.	Relocation of the upstream catchment diversion system to ensure water draining into Lake Cowal is isolated from CGO operations.	Avoid contamination of surface waters by mixing of runoff with water within areas of Project construction/operation.	Avoid discharge of surface contaminated water into Lake Cowal, avoiding impacts to threatened and/or migratory waterbirds in Lake Cowal.	Design	Evolution
Update of the Integrated Waste Landform (IWL) which holds the tailings.	Expansion of the IWL to accommodate tailings from the new open pits, which will operate during the life of mine through to after mine rehabilitation and closure. The IWL has been designed to ensure sufficient capacity for a 1 in 1,000 Annual Rainfall Interval (ARI) event of 48 hour duration. Also, the storage facility is designed to ensure any unforeseen overflows are directed to contained water storages or open pit.	Avoid overflow of cyanide contaminated water into adjacent waterways, including Lake Cowal.	Avoid discharge of cyanide contaminated tailings into Lake Cowal, avoiding impacts to threatened and/or migratory waterbirds in Lake Cowal.	Design	Evolution
Design of final landform	Final open pit designed to ensure an equilibrium surface water level such that there will be no release of pit lake water into Lake Cowal. Nevertheless, even in the unlikely of an extreme weather event that leads to overtopping, the LBP would prevent any water from the pit overflowing to Lake Cowal.	Avoid overflow of potentially more saline lake pit water into adjacent waterways, including Lake Cowal.	Avoid discharge of surface contaminated water into Lake Cowal, avoiding impacts to threatened and/or migratory waterbirds in Lake Cowal.	Design	Evolution
Design of final landform	Backfill option also employed to reduce the extent of pit lake water, and hence reduce potential chance of water release of pit lake water.				
Vehicle strikes					
Development-related operational and construction traffic will use the preferred approved road transport routes describe.	No construction of new access roads or change of established transport routes.	Avoid impacts of vehicle strike along new transport routes.	Reduce frequency of vehicle strikes on threatened shorebirds/waterbirds, threatened woodland birds, threatened microbats and ground-dwelling fauna.	Design	Evolution

8.2.3 Other measures considered

The Project design sought to optimise the Project by taking an on-balance approach when considering physical, environmental, social, cultural heritage and economic considerations. In reaching this point, various alternative approaches were considered early in the Project design phase, which included the following options that may have increased the Additional disturbance area (and associated impacts on biodiversity values) or compromised the potential effectiveness of environmental protective measures:

- waste rock emplacement on freehold land to the north of (and external to) ML 1535; alternate configurations of tailings storage i.e. upstream (vertical) versus downstream (lateral)
- various WRE configurations for the Southern WRE in consideration of Superb Parrot habitat
- relocation of several water storage dams (D3 and D5) and the creation of new dams and cut-off drains
- alternate tenement strategies.

8.3 Mitigation and management measures

8.3.1 Mitigating residual impacts – management measures and implementation

Several management plans have been prepared and applied by CGO to meet several requirements to reduce indirect impacts on biodiversity. The environmental performance of CGO has been subject to independent environmental audits, with the annual environmental performance of CGO publicly released within annual reviews. Based on ongoing assessment of environmental performance, and adopting feedback from independent audits, an independent monitoring panel and relevant regulators, these management plans have evolved since commencement in 2005. These mitigation and management practices will also be applied to the Project, with these plans updated to meet the revised conditions following approval, to the satisfaction of regulators.

Plans relevant to biodiversity include:

- Air Quality management plan (AQMP, Evolution Mining Cowal Pty Limited 2015a)
- Blast management plan (BMP, Evolution Mining Cowal Pty Limited 2015b)
- Biodiversity Offset Management Plan (BOMP, Evolution Mining Cowal Pty Limited 2015d)
- Cyanide management plan (CMP, Evolution Mining Cowal Pty Limited 2020a)
- Environmental management strategy (EMS, Evolution Mining Cowal Pty Limited 2021)
- Erosion and sediment control management plan (ESCMP, Evolution Mining Cowal Pty Limited 2022a)
- Flora and fauna management plan (FFMP, Evolution Mining Cowal Pty Limited 2015c)
- Hazardous materials management plan (HMMP, Evolution Mining Cowal Pty Limited 2020b)
- Land management plan (LMP, Evolution Mining Cowal Pty Limited 2015d)
- Noise management plan (NMP, Evolution Mining Cowal Pty Limited 2022b)
- Mine operations – surface water, groundwater, meteorological and biological monitoring program (SWGMBMP, Evolution Mining Cowal Pty Limited 2018)

- Pollution incident response management plan (PIRM, Evolution Mining Cowal Pty Limited 2022c)
- Rehabilitation management plan (RMP, Evolution Mining Cowal Pty Limited 2022d)
- Soil stripping management plan (SSMP, Evolution Mining Cowal Pty Limited 2022e)
- Transport management plan (TMP, Evolution Mining Cowal Pty Limited 2022f)
- Water management plan (WMP, Evolution Mining Cowal Pty Limited 2022g).

These plans are publicly available here: https://evolutionmining.com.au/compliance/#cowalpart.

Table 8.3 provides an overview of proposed mitigation and management measures to mitigate residual indirect and prescribed impacts.

Table 8.3 Mitigating residual impacts – management measures and implementation

Mitigation measure	Method/technique	Timing	Frequency	Responsibility	Likely efficacy	MNES
Direct impacts on fauna from construction and operation activities						
Delineation of Disturbance Areas	The boundary of the disturbance area will be clearly marked or fenced to prevent accidental damage to adjoining remnant native vegetation during vegetation clearance activities or construction works. The importance of respecting clearing and operation boundaries to be included in site inductions for all personnel. Areas of habitat containing retained Austral Pillwort (i.e. within the study area but outside the additional disturbance footprint) are to be identified and marked out as a no go zone.	Prior to and during construction and operations	As required.	Evolution, contractors, suitably qualified ecologist	High. An established and effective method to establish boundaries of disturbance.	Weeping Myall and Inland Grey Box TECs, Austral Pillwort, threatened and migratory waterbirds as per Section 9.1.
Pre-clearance surveys	Vegetation clearance will follow the established Vegetation Clearance Protocol (VCP) as per the FFMP. This involves a two-stage assessment by a suitably qualified ecologist to determine their usage by birds, bats and/or arboreal mammals. This protocol will be extended to aquatic species, including frogs, depending on water levels at the time of construction. Where the secondary habitat assessment determines that a habitat tree is being utilised as a roosting and/or nesting resource by non-threatened fauna, the fauna management strategies phase of the VCP will be initiated. Where the secondary habitat assessment determines that a habitat tree is being utilised as a roosting and/or nesting resource by threatened fauna, the Threatened Species Management Strategy stage of the Threatened Species Management Protocol (TSMP) will be initiated.	Prior to and during construction	As required.	Evolution, contractors, suitably qualified ecologist	Medium. An established and effective to reduce impacts to fauna during clearing.	Migratory waterbirds and threatened woodland birds as per Section 9.1.
Salvage logs for use in BSA(s)	Logs of removed trees are to be retained for installation in BSA(s) to provide fauna habitat where practicable.	During construction	As required.	Evolution, contractor	High. Logs will be used to increase habitat values within BSA(s) to be stablished as per the Biodiversity Offset Strategy (Section 10).	Migratory waterbirds and threatened woodland birds as per Section 9.1.
Rescue and rehabilitation of wildlife	Established approaches to rescue and rehabilitate wildlife that may become bogged/sick/trapped in the tailings dams or elsewhere within ML 1535 will be employed as per the FFMP.	Ongoing	Infrequent. As required.	Evolution, contractor, suitably qualified ecologist	Medium. Proven to be effective in management of sick and injured wildlife encountered at CGO.	Migratory waterbirds and threatened woodland birds as per Section 9.1.
CGO staff training	Constructions crew are to undertake training prior to commencement of work to inform them of sensitive biological areas, including threatened and migratory species and ecological communities. They are to be informed of the areas bound to work in, delineated no go areas and the TSMP in the case of an unexpected threatened species find.	Prior to and during construction and operation	Infrequent. As required.	Evolution	High. Proven to be effective in management of biodiversity issues encountered at CGO whilst undertaking construction and operation activities.	
Integrated Waste Landform (IWL) staff training	Staff working in IWL are to undertake a wildlife observation training course, including bird identification.	Prior to and during operation	Infrequent. As required.	Evolution	Medium. Staff are familiar with assessing and responding to interactions. Training outcomes, including carcass simulations, has historically demonstrated competency.	
Indirect impact: Noise						
Where feasible, noisy construction activities will be scheduled to occur away from the northern side of the LPB construction area (i.e. area closest to known waterbird breeding areas) during October to March period, when waterbird breeding and migratory shorebird visitation mostly occurs.	Schedule construction and operation activities where feasible to avoid impacts of noise on waterbirds.	During construction and operation October to March	Infrequent. As required.	Evolution, contractor	High. Avoiding noisy activities will likely reduce potential impacts on waterbirds associated with construction and operation noise.	Migratory waterbirds as per Section 9.1.
See Section 8.3.2 for additional contingency measures to reduce noise associated with construction/operation noise and blasting on waterbirds.						

Table 8.3 Mitigating residual impacts – management measures and implementation

Mitigation measure	Method/technique	Timing	Frequency	Responsibility	Likely efficacy	MNES
Indirect impact: Erosion and sedimentation						
Erection of continuous silt curtain around construction zone.	A continuous silt curtain will be erected around the construction zone of the LPB, both inside and outside the LPB. The silt curtain is to be installed prior to trap fine sediment and prevent suspended material migrating into the main body of the lake.	Prior to construction. Only required if Lake Cowal is inundated at time of construction.	Once. Performance monitored in accordance with the CEMP.	Evolution, contractor	High. A continuous silt curtain was used previously during the construction of the existing LPB and temporary LPB, demonstrating the effectiveness of managing water quality issues in Lake Cowal during such activities.	Migratory waterbirds as per Section 9.1.
Treating surface water captured during construction of the LPB to an ecologically suitable quality prior to discharge into Lake Cowal.	If the LPB is to be constructed in the wet, dewatering will be required. In this case, water will be pumped from the mine side of the LPB into Lake Cowal. This water will undergo routine water quality testing as part of the CEMP and treatment (where required) prior to discharge into Lake Cowal. Water shall only be discharged if it meets relevant ANZECC (2000) water quality guidelines aimed at protecting freshwater aquatic environments. Multiple water treatment units will be used along the LPB as it is constructed.	During construction. Only required if Lake Cowal is inundated at time of construction.	Construction only. Performance monitored in accordance with the CEMP.	Evolution, contractor	High. Treatment of sediment latent water during construction is a common approach, prior to disposal. Water testing (to be included in the CEMP) should ensure that only water of a suitable quality will be discharged into Lake Cowal.	Migratory waterbirds as per Section 9.1.
Settlement storages for runoff control	Temporary sediment basins for the provision of settlement storages are to be designed and constructed where runoff could concentrate during construction (as determined by the ESR Manager or delegate) in accordance with the *Urban Erosion and Sediment Control Handbook* (CALM 1992), *Managing Urban Stormwater – Soils and Construction* (DECC 2008) and *Best Practice Erosion and Sediment Control* (IECA 2008). Sediment basins are to be designed to temporarily contain runoff from disturbance areas to facilitate the settlement of suspended solids. Flocculants are to be used as required when the rate in which the suspended solids settle is slowed by the suspension of dispersive soils. Post construction, sediment basins will be either retained as permanent erosion and sediment control structures or backfilled, topsoiled and revegetated once no longer required for erosion and sediment control.	Prior to and during construction	As required. Performance monitored in accordance with the CEMP.	Evolution, contractor	High. Sediment and erosion controls at CGO within ESCMP are well established and proven to be effective. Any issues with sediment and erosion management are further mitigated through the ICDS, which ensures any sediment or erosion latent runoff is captured and treated onsite. Moreover, once constructed, the LPB will provide a hydrological separation between CGO activities and Lake Cowal.	Weeping Myall and Inland Grey Box TECs, and migratory waterbirds as per Section 9.1.
Provision of clean diversion (through update of UCDS)	Temporary diversion banks are to be designed and constructed in accordance with details provided in the Urban Erosion and Sediment Control Handbook (CALM 1992). Any future works would apply similar methods as defined in Volume 1 of *Managing Urban Stormwater – Soils and Construction* (Landcom 2004), *Managing Urban Stormwater – Soils and Construction Volume 2E Mines and Quarries* (DECC 2008) and *Best Practice Erosion and Sediment Control* (IECA 2008). Once complete, permanent water diversion will be afforded by an update to the existing UCDS (see Section 8.2.2ii).	Prior to and during construction	Once. Performance monitored in accordance with the CEMP.	Evolution, contractor		
Contingencies to apply during construction of the LPB	Construction of temporary erosion and sediment control measures that may include silt fences, hay bales, cut-off drains and dams, coir rope logs, additional planting of vegetation or inflatable weirs. Scheduling the construction of the bund in sections to avoid wetter parts of the year.	Construction	Once. Performance monitored in accordance with the CEMP.	Evolution, contractor		
Contingencies to apply during operation	The following contingencies will be employed during the operational phase of the CGO, and will be applied to the Project: • Regular scheduled monitoring for signs of erosion or water flows from the surface of, through or under the LPB. • Remedial revegetation, rock armouring, revegetation or earthworks as necessary (e.g. to address sodic soils with gypsum or lime). • Where necessary and feasible to do so, a cut-off drain and sump could be constructed to intercept flows and sediment and allow its capture and return to the CGO for disposal in the IWL or reuse in the process water circuit.	Operations	As required. Performance monitored in accordance with the CEMP.	Evolution, contractor		
Stabilisation and revegetation to occur in parallel with construction	As described in the ESCMP, batters of the LPB are to be revegetated in accordance with details provided in Section 3.3.6 of the *Urban Erosion and Sediment Control Handbook (*CALM, 1992).	During construction and operations	As required according to the rehabilitation plan. Performance monitored in accordance with the CEMP.	Evolution, contractor, suitably qualified rehabilitation specialist		

Table 8.3 Mitigating residual impacts – management measures and implementation

Mitigation measure	Method/technique	Timing	Frequency	Responsibility	Likely efficacy	MNES
Indirect impact: Accidental spills						
Accidental spills of processing water, oils, fuels or reagents during construction and operations, including cyanide	As described in the Pollution Incident Response Management Plan, any incident is to be reported immediately to relevant authorities. Containment and clean-up are to be undertaken in accordance with CGO's HMMP. Note that the ICMI Code for Cyanide Management requires signatories (which includes CGO) to ensure that any spillage outside a bunded area above 0.5 mg/L Weak Acid Dissociable (WAD) cyanide is recorded as an incident and treated as an emergency requiring immediate surface clean up.	During construction and operations	Immediately when there is a pollution incident.	Evolution, contractor	High. The Internal Catchment Drainage System (ICDS) will collect potentially contaminated surface water generated on-site, avoiding discharge to Lake Cowal. CGO has a strong environmental performance, demonstrated by no reportable incidents or complaints regarding surface water quality between 2011 and 2021.	Migratory waterbirds as per Section 9.1.
Indirect impact: Light spill						
Reduce impacts of night lighting on waterbird habitat in Lake Cowal	Measures to mitigate impacts of night-lighting include: • Use unidirectional lighting fixtures. • Vegetation and earth mound screens to block direct views of lights from Lake Cowal. • Use of light shields to limit spill of lighting. • Switching lights off when not required. • Waste rock dumping will be scheduled such that elevated bunds of waste rock are placed between primary work areas and waterbird nesting areas, where practicable, to mitigate potential impacts from night-lighting.	During construction and operations	Daily during night.	Evolution, contractor	Medium. Light spill is likely to be greatest during construction but subside once the LPB and earth mounds provide a hard barrier for light into Lake Cowal.	Migratory waterbirds as per Section 9.1.
Indirect impact: Dust						
Reduce dust and particulate matter	Established approaches to reducing dust and particulate matter will be employed as per the Dust Management Plan (DMP). Equipment to be used includes water trucks, water sprats, dust collection systems and hoods/covers. The DMP identifies specific management measures for each dust source, including haul road, minor roads, materials handling, soil stripping, drilling, blasting and equipment maintenance that are applicable to the construction and operation of the Project. Suitable rates of application of dust suppression water (or other material) will be determined on an ongoing basis through on-site experience and will be largely related to soil types, variability in mine traffic volumes and meteorological conditions. Timing of activities can also be selected to reduce dust and particulate matter, such as stripping and placement of soil stockpiles at appropriate moisture conditions whenever possible.	During construction and operations	Daily as required.	Evolution, contractor	Medium. Depends upon activities (including traffic volumes, their location, soil type and meteorological conditions). For instance, hot, dry, windy days when large numbers of vehicles are trafficking massive-structured soil types will be more difficult to management than on wet days.	Weeping Myall and Inland Grey Box TECs, migratory waterbirds, threatened woodland birds as per Section 9.1.
See Section 8.3.2 for additional contingency measures to reduce noise associated with dust generated by construction/operation on waterbirds.						
Indirect impact: Weeds and edge effects						
Weed control	Weeds will continue to be managed in accordance with measures in the existing LMP. This involves: • annual inspections of weeds • mechanical and/or application of approved herbicides • follow-up inspections to assess effectiveness. • minimising seed transport by using vehicle wash bays. Use of herbicides in wetland areas (including Lake Cowal) will be strictly controlled. Within these areas, physical removal methods will be employed, where practicable. Where physical control methods are not suitable, a herbicide registered for use in aquatic situations by the National Registration Authority may be used. Good hygiene practices are to be used to reduce the risk of spreading weeds and pathogens, including ensuring that all machinery, materials and personnel are clean of any weed seed to entering the site Priority Weeds listed under *Biosecurity Act 2015* to be actively managed on site to limit the spread of weeds into the adjacent areas. Weeds removed from the subject site are to be disposed of appropriately at an approved waste facility.	Ongoing	Annual inspections. Weed control guided by inspection results.	Evolution, contractor	Medium. Targeted weed reduction for high threat weeds should notably reduce infestations to a manageable load. Eradication is not possible given the connectiveness of the site and large extents of weeds in the region.	Migratory waterbirds, threatened woodland birds and threatened ground-dwelling fauna as per Section 9.1.

Table 8.3 Mitigating residual impacts – management measures and implementation

Mitigation measure	Method/technique	Timing	Frequency	Responsibility	Likely efficacy	MNES
Indirect impact: Fire						
Fire response measures	Fire extinguishers accessible on site. CGO's fire truck is to be used in the case of a grass fire.	During construction and operations	Infrequent. As required.	Evolution, contractor	Low. Outbreak of fire has not occurred at CGO to date.	Weeping Myall and Inland Grey Box TECs, migratory shorebirds, threatened woodland birds as per Section 9.1.
Indirect impact: Vertebrate pest invasion into retained habitats						
Vertebrate pest control	Feral animals will be continued to be management in accordance with measures in the LMP. This involves: • Regular inspections to assess pest populations on Evolution land; • Pest control for declared pests (including rabbits, pigs, wild dogs, foxes and wild cats); and • Follow-up inspections to assess effectiveness. Pest control measures to be employed include (but not limited to): poisoning (e.g. 1080 and curiosity baiting), trapping, shooting, destruction of warrens (rabbits).	Ongoing	Annual inspections. Pest control guided by inspection results.	Evolution, suitably qualified vertebrate pest controller	Medium. Targeted vertebrate pest reduction should notably reduce local populations to a manageable load. Eradication is not possible given the connectiveness of the site and large extents of population of vertebrate pests in the region.	Migratory waterbirds, threatened woodland birds as per Section 9.1.
Prescribed impact: Waterbodies, water quality and hydrological processes						
Fully enclosed fencing around IWL	A two metres high fence built around the perimeter of the IWL with a mesh gauge no greater than 50 mm diameter in the top metre and no greater than 20 mm diameter in the bottom metre. Fence mesh buried 500 mm below ground level to deny access to burrowing animals. The fence contains a half hat design which curves away from the tailings storage area.	Prior to construction of the IWL expansion	Once. With fencing integrity routinely checked.	Evolution	High for ground-dwelling fauna. Low for flying fauna, including birds and microbats.	Threatened ground-dwelling fauna as per Section 9.1.
Making the IWL non-conducive to establishment of wildlife	Rehabilitation of the tailings storage area during operations will be such that the tailings storage facility batters are stabilised whilst providing minimal habitat value for bird life (i.e. revegetated with pasture cover only). The batters will be maintained so that other vegetation (such as trees and shrubs) does not become established in the vicinity of the tailings storages until the facility has been de-commissioned and capped.	Operations	Ongoing as required.	Evolution	Medium: Removing habitat for waterbirds will likely reduce visitation by some species. This would be less effective for insectivorous microbats.	Migratory waterbirds, Threatened ground-dwelling fauna as per Section 9.1.
Broadcast of audio and visual stimuli to scare/repel birds within IWL	Hazing may be used deter birds from landing or utilising an area. Depending on the species, techniques that may be employed include: • radar systems that detect avifauna presence at the tailings facilities • bird deterrent stations, activated remotely by either the radar or timer mode which broadcast bird distress calls, barking dogs, gun shots etc • gas cannons linked to the radar or timer-mode control station/s • car horns • solar powered scattered laser light tripod station (held in safe storage to be used if required) • bird scaring kite • human presence.	Ongoing	Infrequent. As required.	Evolution	Medium. Proven to be effective in management of birds with existing IWL and TSF.	

Table 8.3 Mitigating residual impacts – management measures and implementation

Mitigation measure	Method/technique	Timing	Frequency	Responsibility	Likely efficacy	MNES
Prescribed impact: Vehicle and vessel strike						
Reduce risk of fauna strike by boats through speed limits and working within defined operating limits	Speed limits will be imposed on vessels used in constructing the LPB, if Lake Cowal is inundated at the time of construction. Vessels will operate within safe speed limits and adhere to designed operating limits, to reduce interactions with waterbirds in Lake Cowal. Vessel operating areas should be defined prior to construction to avoid waterbird breeding areas, as far as practicable. Extra mitigation measures, including further reduction of vessel speed, should be considered during October to January, when waterbirds are breeding and migratory shorebirds are visiting Lake Cowal.	Prior to construction, during construction and operation	Daily.	Evolution, contractor	High. Reducing vessel speeds and restricting vessel movements to defined working areas should considerably reduce risk of waterbird strike.	Migratory waterbirds as per Section 9.1.
Reduce risk of fauna strike by vehicles/equipment through notification and speed limits	Speed limits will be imposed on vehicles. Signposting will be installed to remind personnel of the danger of vehicles to wildlife.	Ongoing	Daily.	Evolution, contractor	High. Reducing vehicle traffic to and from site by busing staff considerably reduces risk of fauna strike.	Migratory waterbirds, threatened woodland birds as per Section 9.1.
CGO staff training	Education to staff during induction about abiding by above driving rules to reduce fauna strike, including periods when vehicle strikes are more likely based on fauna behaviour (e.g. sunrise and sunset).	Ongoing	As required.	Evolution	Medium. Increasing staff awareness about risks of fauna vehicle strikes, including periods when this is more likely to occur, should contribute to reduce risk of fauna strikes.	
Reduce traffic to and from site	Private vehicle travel to and from the CGO is undertaken in accordance with Evolution's *Private Vehicle Travel to and from Site Policy* and related policies. Company-provided transport to and from the CGO is to be used where possible, and private vehicles are not permitted to travel to and from the CGO unless an Essential Driver Authority or temporary exemption is provided by Evolution.	Ongoing	Multiple times daily.	Evolution, contractor	High. Reducing vehicle traffic to and from site by busing staff considerably reduces risk of fauna strike.	

8.3.2 Adaptive management strategy for indirect, prescribed and uncertain impacts

An adaptive management strategy has been developed for the Project to monitor and respond to uncertain indirect and prescribed biodiversity impacts (see Table 8.4).

Table 8.4 Adaptive management strategy

Uncertain biodiversity impact	Baseline data required	Proposed monitoring approach	Trigger for management	Risk of failure	Response
Potential noise impacts to threatened/ migratory waterbirds in Lake Cowal during construction and operation (excluding blasting)	• Confirm locations of breeding colonies of waterbirds. • Establish new transects adjacent to the proposed LPB, including nearest bird breeding areas to the Additional disturbance area, and comparable reference areas within Lake Cowal. • The following parameters should be recorded during baseline, as well as replicate monitoring efforts: – meteorological conditions present at the time of monitoring – lake characteristics (e.g. lake depth, percent water coverage of lake and filling phase status) – vegetation survey data of the transects – waterbird species and counts (abundance and diversity estimates) – breeding activity (species, nesting and breeding pair counts) – nesting habitat type and locations – opportunistic observations of behaviour responses to mine activities. • Evolution's waterbird monitoring undertaken across Lake Cowal since 1989 will form the baseline dataset to test for changes in waterbird communities [i.e. a before-after control-impact (BACI) assessment].	Three monitoring events to be undertaken annually by a suitably qualified ornithologist, including main bird breeding/migratory shorebird visitation period (September to January). Monitoring during each survey effort is to occur adjacent to LPB and established monitoring locations across Lake Cowal. A statistical assessment of the change in waterbird communities should be undertaken annually across the first three years of construction; and the first three years of operations. The analysis should consider a BACI approach. Outcomes of the assessment will be the identification of a trigger for management and informing the need of an appropriate response.	An adverse reaction observed to noise and/or light associated with construction and/or operations includes (but not limited to): • abrupt negative changes in bird behaviour corresponding with commencement of construction and operations • significant reductions in the number and/or species richness of waterbirds, or • movement of waterbirds foraging, roosting and/or nesting away from the Additional disturbance area. For impacts to be attributed to construction and/or operations, it would be expected to see these negative responses of waterbirds to be greatest closest to mine compared to baseline levels and reference areas away from mine activities.	Medium: Waterbird usage of Lake Cowal naturally is highly variable in space and time. This includes periods when there is little/no water in Lake Cowal, so waterbird communities are typically reduced or absent. Hence, the ability to detect responses of waterbirds to indirect impacts of the Project may be masked by this variance in the composition waterbird communities and locations of habitat usage in Lake Cowal.	Contingency measures that can be employed if response is triggered are detailed below. Contingency measures to minimise noise may include: • Restricting movement of trucks on ridgelines and exposed haul routes where their noise can propagate over a wide area, especially at night. • Scheduling the use of noisy equipment during the daytime. • Siting noisy equipment behind structures that act as barriers, or at the greatest distance from the noise sensitive area. • Orienting equipment so that noise emissions are directed away from any sensitive areas, to achieve maximum attenuation of noise. • Scheduling operations so that noisy equipment items are used separately rather than concurrently. • Keeping equipment well maintained. • Employing 'quiet' practices when operating equipment (e.g. positioning idling trucks in appropriate areas). • Adjusting reversing alarms on heavy equipment to make them 'smarter', limiting acoustic range to the immediate danger area. • Using equipment with efficient mufflers and using quieter engines (such as electric instead of internal combustion). • Using high-pressure hydraulic systems to split rock instead of hydraulic or pneumatic hammers. • Damping or lining metal trays. • An evaluation of the design and mitigation of night lighting (see Section 8.2.1) should also be reviewed since the effects of noise and light are difficult to differentiate if waterbird communities change following commencement of construction or operation. If negative changes in waterbird behaviour and/or distribution occur following commencement of operations, contingencies to minimise blasting emissions should be explored since construction and operation have similar noise generating activities. Monitoring results from the CGM's noise and blasting monitoring programmes (as detailed in the NMP and BMP will also be used to monitor and respond to noise and blasting impacts.

Table 8.4 Adaptive management strategy

Uncertain biodiversity impact	Baseline data required	Proposed monitoring approach	Trigger for management	Risk of failure	Response
Potential noise impacts to threatened/ migratory waterbirds in Lake Cowal during blasting	• Confirm locations of breeding colonies of waterbirds. • Within main bird breeding areas, and during the main breeding period from bird hide and/ or boat, monitor the following parameters: – meteorological conditions present at the time of monitoring – lake characteristics (e.g. lake depth, percent water coverage of lake and filling phase status) – vegetation survey data of the transects – abrupt changes of bird behaviour as a result of noise (e.g. bird taking flight as a result of a noise stimulus) – differences in behaviour between different species of birds – the number and proportion of birds that take flight if considered to be in response to noise (relative to the total resident population at the time of monitoring) – the proportion of birds that return if they take flight in response to noise – the length of time birds are away if they take flight and the likely impact this would have to hatching and fledging of offspring – the degree to which birds develop tolerance to noise levels over time – changes in foraging and breeding patterns in terms of the extent and/or location of foraging – any changes in breeding areas.	Attended monitoring is to occur immediately before, during and after the first ten blasts. Observations during the initial blast are to be overseen by four suitably qualified ornithologists. Construction: Three monitoring events annually by a suitably qualified ornithologist, including main bird breeding/migratory shorebird visitation period (September to January). Operations: Three monitoring events annually by a suitably qualified ornithologist, including main bird breeding/migratory shorebird visitation period (September to January).	An adverse reaction observed to blasting emission, including (but not limited to): • abrupt negative changes in bird behaviour corresponding with the noise • significant number and/or proportion of birds take flight compared to total resident population corresponding with the noise stimulus • a significantly less proportion of birds return if they take flight in response to noise; and/or • A length of time birds that away if they take flight and that likely to have a more than negligible impact.	Medium: Changes in blast output and location, as well as spatiotemporal variance in waterbird occupancy/nesting may change response of waterbirds to blasting over time (i.e. subsequent to initially observed blasts). However, initial blasts are likely to be the most acute and inform of any changes required to appropriately manage blasting emissions.	Contingency measures that can be employed if response is triggered: • reduce the MIC or charge mass per delay, to the lowest possible level • keep face heights to a practical minimum • ensure stemming type and length is adequate • eliminate exposed detonating cord. Investigate alternative initiation methods • eliminate secondary blasting (instead of popping, use rock breaker or drop hammer) • reduce the need for toe shots (e.g. better control of drill patterns) • orientate faces where possible so that they do not face directly towards waterbird breeding colonies • ensure that all delays are designed to eliminate wave front reinforcement • vary the direction of initiation • exercise strict control over the burden, spacing and orientation of all blast drill holes • take particular care where the face is already broken or where it is strongly jointed, sheared, or faulted • consider deck loading where appropriate to avoid broken ground or cavities in the face (e.g. from back break). • Monitoring results from the CGM's noise and blasting monitoring programmes (as detailed in the NMP and BMP will also be used to monitor and respond to noise and blasting impacts.

Table 8.4 Adaptive management strategy

Uncertain biodiversity impact	Baseline data required	Proposed monitoring approach	Trigger for management	Risk of failure	Response
Potential impacts on fauna associated with IWL during operation, including cyanide	Existing fauna monitoring data collected at CGO's existing TSF and IWL, which commenced in 2006, will form the baseline dataset to identify any increases in fauna mortality or illness associated with the Project. Established control locations will be continued to be monitored to allow mining related impacts to be differentiated from natural variation.	Monitoring to be undertake includes (but not limited to): • Permanent establishment of Anabat™ microbat call detectors at TSF and IWL, as well as analogous control locations, recording for four hours from dusk. Bat species to be identified to the species level (if possible) and activity levels to be compared through time by a suitably experienced ecologist. Evolution should explore the potential for real-time, automated bat call identification to improve ability to detect and respond to a trigger. • Observations of wildlife (primarily avifauna) visitations and interactions twice daily by CGO staff, once in morning and just before sunset. Data to be recorded includes (but not limited to): – date and time of inspection – type of wildlife guild observed – number of individuals of each wildlife guild present – habitat (for example, supernatant, beach, embankment etc) – wildlife behaviour and IWL habitats that individuals interacted with (for example, flying over the tailings dam, wading in the supernatant pond, etc) – fauna effects (as defined in the CGO FFMP) – fauna incidents (as defined in the CGO FFMP) – fauna deaths – supernatant surface area. Efficacy of this wildlife monitoring to be tested by carcass replication trials at least every eight weeks, such as use of coloured balloons across TSF and IWL to represent carcasses. All carcasses are to be collected and examined to determine the cause of mortality, particularly if it can be attributed to cyanide toxicosis. The process to be followed for fauna autopsies is provided in Section 6.3 of the FFMP. CGO observations to be supplemented by quarterly observations by a suitably qualified ecology.	Biannually an assessment of impacts to fauna is to be undertaken, with findings included as part of a submission to CGO regulators. This report is to compile and assess the following data: • IWL quarterly site visits to conduct intensive wildlife observations, IWL perimeter fence inspections, provide on-site training to wildlife observers • desktop review of existing electronic data collected by Anabat™ Swift devices • desktop review of existing wildlife visitation data recorded at the IWL and control site. Results to be compiled and performance to be assessed: • an evaluation of the accuracy of wildlife and chemistry monitoring data • an assessment of seasonal patterns in wildlife visitations • a review of monitoring protocols and identification of any deficiencies • the provision of appropriate remedial management options.	Moderate: CGO has designed and improved its control strategies for Cyanide management through its established CMP, which was approved by Department of Planning in 2006. Since commencement, an independent audit of the environmental performance of CGO, including performance on the CMP, has occurred in annually since 2004 (except 2020 and 2021). Management of cyanide at CGO has been certified by the International Cyanide Management Institute's (ICMI) Code for Cyanide Management. This code is a voluntary, performance driven, certification program of best practices for gold and silver mining companies and the companies producing and transporting cyanide used in gold and silver mining. The Cyanide Code provides a management system for the safe management of cyanide throughout its use cycle. Environmental performance indicators demonstrate the effectiveness of the CMP. Key results of annual reports from 2010 to 2021 period are: • no cyanide-related wildlife mortality or effect were recorded • CN_{WAD} concentrations have remained low and within licence conditions for the TSF. That is, the maximum CN_{WAD} of water sampled twice daily from the tailings slurry has never exceeded the 50 mg/L limit.	Reducing cyanide levels in the tailings dams in the event it is established that fauna deaths are occurring from cyanide in tailings dam water. Contingency measures for reducing cyanide levels in the tailings dams in the event it is established that fauna deaths are occurring from cyanide in tailings dam water are presented in Section 8 of the FFMP. Measures include: • adding cyanide destruction chemical(s) to tailings dam waters to reduce existing cyanide levels, or • increasing the dosage rate of cyanide destruction chemical(s) in the cyanide destruction circuit to achieve new cyanide level in tailings discharge to the dam. In the event of wildlife deaths occurring due to cyanide, Evolution will consult with the relevant government agencies to agree on an appropriate course of action. Other measures to supplement wildlife management beyond minimising use of cyanide and cyanide destruction beyond be considered to scare away birds and animals include: • floating balls • remote-control airborne devices • use of netting.

Table 8.4 Adaptive management strategy

Uncertain biodiversity impact	Baseline data required	Proposed monitoring approach	Trigger for management	Risk of failure	Response
Monitoring cyanide concentrations within the IWL and other relevant water bodies.	Cyanide in the existing IWL is currently managed as part of the CMP. Within the new TSF and IWL, this established approach will be adopted. As such, acceptable limits of cyanide concentrations are to be assessed against relevant water quality criteria. Currently, the aqueous component of the tailings slurry stream are to be maintained below a maximum concentration of 20 mg/L weak-acid dissociable (WAD) cyanide in solutions (CN_{WAD}) (90 percentile over six months) and 30 mg/L CN_{WAD} maximum permissible limit at any time at the process plant. Note that these limits are below those suggested by Leading Practice Sustainable Development Program for the Mining Industry handbook for Cyanide Management (IISA 2008), who state that "it is now recognised that wildlife at freshwater TSFs are protected by the accepted safe no discharge WAD cyanide level of 50 mg/L." Note that Weak acid dissociable cyanide is the recognised cyanide form to measure with respect to monitoring and potential adverse effects.	Cyanide concentration is to be recorded twice daily from water at an active spigot in the TSF, IWL and any other relevant water body. Frequency of water monitoring is to be revised in correspondence with relevant regulators following approval and prior to commencement of operations. CN_{WAD} monitoring results are continued to be reported monthly on the company website. A review of cyanide chemistry data associated with the TSF, IWL and other relevant water bodies is to be compiled biannually, with findings included as part of a submission to CGO regulators.	Cyanide levels of the aqueous component of the tailings slurry stream do not exceed: 20 mg CNWAD/L (90 percentile over six months), and a maximum permissible limit at any time of 30 mg CNWAD/L at the process plant.		Contingency measures for reducing cyanide levels in the tailings dams in the event it is established that fauna deaths are occurring from cyanide in tailings dam water are presented in Section 8 of the FFMP. These measures include: • adding cyanide destruction chemical(s) to tailings dam waters to reduce existing cyanide levels, or • increasing the dosage rate of cyanide destruction chemical(s) in the cyanide destruction circuit to achieve new cyanide level in tailings discharge to the dam. In the event of cyanide concentrations exceeding the trigger, Evolution will consult with the relevant government agencies to agree on an appropriate course of action.
Potential contamination of groundwater	An existing groundwater monitoring programme is undertaken at CGO as per the WMP. This program monitors water level and quality within aquifers beneath the ML area and regionally within the Bland Creek Palaeochannel aquifer. Additional monitoring sites are to be established considering the Project, with baseline monitoring at these locations to be undertaken.	Monthly measurements of groundwater chemistry, including cyanide concentrations.	Measured concentrations of analyte in groundwater exceeds ANZECC (2000) guidelines and elevated beyond baseline concentrations.	Low. There is a low chance of connection between Lake Cowal and groundwater within the underlying aquifers due to the depth of the relatively impermeable clay that separates the Lake Cowal bed from the underlying aquifer system. Environmental performance indicators that demonstrate the effectiveness of the groundwater within annual reports from 2010 to 2021 are: • Cyanide within groundwater has been below the laboratory detection limit from 2014 to 2021. There have been readings above the laboratory detection limit in 2010, 2011, 2012 and 2013. However, subsequent retesting showed reductions in concentrations. • There has been no observed die-off of vegetation in areas adjacent to CGO that has been attributed to drawdown of groundwater, including in Lake Cowal.	In the event of serious impacts to groundwater by way of recharge or contamination, Evolution will consult with the relevant government agencies to agree on an appropriate course of action.
Potential drawdown of groundwater		Monthly measurements of groundwater levels	Trigger levels for groundwater are provided in the WMP.		

Table 8.4 Adaptive management strategy

Uncertain biodiversity impact	Baseline data required	Proposed monitoring approach	Trigger for management	Risk of failure	Response
	Potential GDEs located outside CGO should be firstly ground-truthed. Note that PCTs 10 and 249 were identified as those with a high risk of drawdown impacts in Chapter 6.If required, representative vegetation plots (e.g. BAM plots combined with vegetation health measurements designed to detect water stress impacts over time) established prior to project commencement in PCT 10 and 249 where drawdown impacts may occur. Established control locations will continue to be monitored to allow mining related impacts to be differentiated from natural variation. Vegetation monitoring should also be coupled with piezometers measuring groundwater levels (see above) to discern potential impacts associated with drawdown from other factors, such as climate.	Seasonal monitoring of vegetation condition and health within areas that may experience drawdown as well as control locations. Vegetation surveys should be coupled with measurement of groundwater levels.	Significant changes decline in vegetation condition and/or health within PCTs 10 and 249 where drawdown is expected due to the project, but not at control locations. Declines in condition should be seen corresponding to reduced groundwater levels.	Environmental performance indicators that demonstrate the effectiveness of the groundwater within annual reports from 2010 to 2021 are: • There has been no observed die-off of vegetation in areas adjacent to CGO that has been attributed to drawdown of groundwater, including in Lake Cowal.	Evolution will consult with the relevant government agencies to agree on an appropriate course of action.
Potential contamination of surface water or sediments in including Lake Cowal during construction and operation.	Water and sediment quality sampling is currently undertaken within Lake Cowal as part of the Surface Water, Groundwater, Meteorological and Biological Monitoring Programme (SWGMBMP). Baseline water quality values for Lake Cowal are provided in the Water Management Plan, which are used to indicate any connections between the closed catchment of the Project and Lake Cowal. Australian New Zealand Environmental Conservation Council (ANZECC 2000) water quality guidelines will continue to be used to identify any pollution of Lake Cowal that may have arisen. Baseline values should be reviewed considering results from the ongoing monitoring by Evolution, which commenced in 2010. New monitoring locations should also be established where needed that are nearby and representative of areas that may be sensitive to construction and operation impacts on water quality, including water bird breeding areas. If construction is to be undertaken when Lake Cowal is full, additional water sampling should occur prior to and during the construction of the LPB, to inform the application of additional or change of mitigation/management measures.	Parameters to be continued to be measured within water samples include (but not limited to): • pH and electrical conductivity • turbidity and suspended solids • dissolved oxygen • heavy metals • hydrocarbons. Parameters to be continued to be measured within sediment samples include (but not limited to): • Arsenic • Cadmium • Lead • Zinc • Antimony.	Where monitoring results indicate values in excess of the ANZECC and ARMCANZ (2000) default 99% protection level triggers.	Low. Risk of failure is likely to be greatest during construction, especially if Lake Cowal is inundated at the time. However, monitoring of sediment across the 2010 to 2021 period have identified no connections between the closed catchment of CGO operations and Lake Cowal. Although surface water monitoring during some years when Lake Cowal was full found some elevated metal concentrations, this was within the expected variance of this waterbody and not attributed to activities at CGO. Hence, risk of water contamination should notably reduce once the LPB is constructed, providing a hydrological separation between construction and operation activities and Lake Cowal. After this, any potential contaminants within surface waters can be internally captured and treated within the ICDS.	A review and investigation procedure will be conducted to validate the data and to assess the need to implement additional management measures to those already in place. The review procedure will involve validation of data, management of data, analysis and investigation, and where necessary development of ameliorative measures. Ameliorative measures will be developed in consultation with the relevant authorities based on the results of the review and investigative process.

Table 8.4 Adaptive management strategy

Uncertain biodiversity impact	Baseline data required	Proposed monitoring approach	Trigger for management	Risk of failure	Response
Potential impact of dust and particulate matter on threatened/migratory waterbirds in Lake Cowal	The Dust Management Plan (DMP) outlines an air quality monitoring programme that includes a network of 15 dust gauges to monitor dust deposition in the vicinity of the Project during construction and operation. Three of these dust gauges (i.e. DG2, DG3 and DG4) are located proximal to bird breeding areas and will be analysed monthly. The DMP provides further details of the air quality monitoring programme. Additional dust gauges should be established in accordance with any changes in bird breeding locations and to account for the Additional disturbance area. Surface water and sediment quality monitoring will also be undertaken in Lake Cowal to assess potential impacts of deposition of dust and particulate matters (see adaptive management for surface water and sediments in Lake Cowal above).	Parameters to be continued to be measured within sediment samples include (but not limited to): • Total suspended particulate matter (i.e. all suspended particles in the air). • PM_{10} (i.e. all particles with equivalent aerodynamic diameters of less than 10 µm). • Dust deposition (i.e. any particulate matter that falls out from suspension in the atmosphere).	Assessment of the dust deposition monitoring programme results against EPA criteria.	Medium. Despite all management efforts, transport of dust and particulate matter is difficult to control offsite. Nevertheless, based on the development of effective responses to feedback from regulators and an independent monitoring panel, Evolution has an effective and adaptable approach to dust management that is applicable to the Project, which can be tailored to the meteorological conditions and potential sources of dust/particulate matter.	In the event the EPA amenity criteria for dust deposition is exceeded within bird breeding areas, an assessment will be conducted to determine: • the timing of elevated dust levels • the general location of the elevated dust levels • the climatic conditions at the time of the elevated dust levels • potential contributing factors to the elevated dust levels • whether the elevated dust levels are attributable to Project activities. Additional dust control, management and modification measures to be adopted will be selected with consideration of: • mine activities scheduled for the next phase of construction/operation • possible reasons for previous elevated dust levels • additional modifications in the form of control methods or operational changes which could be adopted • control equipment that will be utilised • the location of current and future dust generating activities. Potential measures include: • increased watering of exposed surfaces via water trucks or other methods as required • activating or increasing rates of water application at fixed water sprays on stockpiles and/or transfer points • the temporary cessation of ancillary or non-essential on-site dust generating activities (e.g. soil stripping).
Impacts of construction/ operations on retained Austral Pillwort adjacent to Additional disturbance area	Records of Austral Pillwort gathered for surveys in the current BDAR will be used as a baseline dataset. Areas where Austral Pillwort was recorded in the Broader Austral Pillwort survey area (i.e. away from the Additional disturbance area) will be used as a control.	Protective fencing (e.g. parawebbing) will be placed around retained Austral Pillwort individuals for their protection during construction, where required. The condition of the fencing will be monitored during construction. Monitoring of Austral Pillwort adjacent to construction areas will be built into the existing annual Austral Pillwort monitoring program by Evolution. This will allow the persistence and health of retained Austral Pillwort will be assessed following construction to determine if an indirect impact has occurred. Surveys should be timed during October to December after rainfalls, in drying mud after inundation. Where possible, concurrent monitoring of reference populations will inform if decline is due to natural or construction/operation related impacts.	Protective fencing is breached (where installed). A decline in numbers or absence of Austral Pillwort from areas adjacent to Additional disturbance area, but not control locations. Note that factors other than mining construction and operations including rainfall (i.e. species only expresses following significant winter/spring rainfall) and incursion by grasses and weeds and agricultural activities (including stock grazing) may also explain changes in Austral Pillwort populations, so such factors should also be recorded.	Medium. The ephemeral nature of Austral Pillwort makes it hard to survey for. Suitable rainfall is required prior to summer for this species to express. If absent in monitoring, control locations should be inspected closely to ensure the low count/absence is due to climatic factors other than mining.	If fencing is breached, reinstall fencing to protect retained Austral Pillwort. If a loss of Austral Pillwort is associated with construction or operations, consider offsetting this impact via the NSW BOS, or propagation and translocation into the adjoining habitat utilising the propagated plants or retained topsoil for excavated Austral Pillwort gilgai habitat (approval for this translocation would be required).

8.4 Residual indirect impacts

As identified in Section 8.1, there is the potential for the Project to have residual indirect impacts on biodiversity values outside of the Additional disturbance area. Background context to the nature of these residual impacts, relevant guidelines/standards, current management of these impacts and environmental performance given existing operations are discussed in the subsections 8.4.1 to 8.4.6 below. The potentially impacted entities, extent, frequency, duration, Project phase, likelihood and consequence of these residual indirect impacts associated with the Project are then assessed in Table 8.5.

8.4.1 Noise, vibration and dust

Noise, vibration and dust have potential to indirectly impact fauna outside of the Additional disturbance footprint. For example, noise, vibration and dust generated during construction and/or operation of the Project have potential to impact migratory and nesting waterbirds in Lake Cowal well outside of the additional disturbance footprint. These potential indirect impacts are discussed further below.

i Noise and vibration

Noise from construction and/or operations may disturb fauna through damaging their auditory system, by evoking a startling response and/or masking of sounds that are important to their survival, including those required to mate, forage and detect predators (Cross et al. 2021). Impacts of disturbance from vibration has attracted little research focus, but the impacts to fauna are believed to be similar to those observed for noise since vibrations can create airborne noise (e.g. Caorsi et al. 2019). Nevertheless, there are currently no formal NSW or commonwealth guidelines available with criteria provided to assess potential impacts of noise or vibration on fauna, including waterbirds.

Currently, there are a limited number of studies that identify thresholds of noise tolerance for shorebirds. For instance, Brown (1990) demonstrated that seabird colonies on the Great Barrier Reef respond adversely to pre-recorded aeroplane noise, with birds preparing to fly or flying off noise of these recordings exceeded 85 dB(A). Moreover, Smit & Visser (1993) documented inter-specific differences in roosting activity of wading shorebirds to noise generated from aircraft and military shooting activities in Dutch Wadden Sea. That study documented disturbance of shorebirds to shooting when noise impacts were 84–100 dB (A), especially if the noise occurs when the birds are still arriving from the feeding areas. However, disturbance to shorebirds in the region was typically not detected when sound levels of shooting were 43–87 dB (A). Studies of impacts of road traffic on wetland bird communities by Hirvonen (2001) found that the abundance of breeding wader birds declined in areas up to 800 m from a newly constructed road. This study suggested that where traffic noise was >56 dB, numbers of breeding waders declined, however the effect of both visual and noise on waterbirds is difficult to distinguish in that study since both sources of disturbance increased when the road was built.

Thresholds of noise effects have been devised within a waterbird disturbance toolkit by Cutts et al. (2013). Through a combination of literature review (including the above cited studies) and field observations, which included migratory species that may occur at Lake Cowal, Cutts et al. (2013) made the following definitions for impacts of noise on waterbirds: high noise level effects (sudden noise over 60 dB or a more prolonged noise over 72 dB); moderate noise level effects (occasional noise events above 55 dB, a more regular noise 60–72 dB or long-term regular noise above 72 dB); and low noise level effects (noises less than 55 dB or a more regular noise 55–72 dB in some highly disturbed areas). However, it was noted by Cutts et al. (2013) that birds are liable to habituation as they usually become more tolerant to both aural and visual disturbance stimuli with increased exposure time to regular activities. They also found that waterbirds often respond to visual disturbance before noise, whilst responses to noise impacts are usually greater when a source of visual disturbance is also present.

The predicted noise impacts of construction and operation noise at waterbird breeding areas (N03 and N04) are expected to be a maximum of 54 $LA_{eq,15min}$. Maximum instantaneous LAmax levels for construction and operation are predicted to be lower than the maximum $LA_{eq,15min}$ (i.e. <54 dB). As a per Cutts et al. (2013), such noise levels of less than 55dB are classed as likely to have a low noise level effect on waterbirds. However, impulsive noise due to infrequent loud noises and vibration, including those from blasting, may have a greater potential to cause negative responses of shorebirds (e.g. Wright et al. 2010). Impacts of impulsive noise may be greatest prior to the construction of the LPB, when noise and visual disturbance are most likely to have an interactive impact on waterbird response. However, as the LPB and WRE begin providing a visual barrier between mining activities and waterbird breeding habitat, the potential impact of at least the visual disturbance should reduce. Moreover, impacts of impulsive noise from operations, including blasting, should be greatest early in the operation phase, with the potential for waterbirds to habituate in the long term. The potential impacts of noise and vibration impacts associated with blasting on waterbirds should also reduce as these proposed mine pits deepen, and hence provide a hard barrier to dampen the transmission of noise and vibration.

To date, there is no evidence that construction or operation noise associated with the existing mining operations has disturbed waterbird communities in Lake Cowal, despite the potential for noise and vibration to impact waterbirds in Lake Cowal. The use of adaptive management to monitor and respond to potentially negative responses to waterbirds has been undertaken since mining commenced in 2005. Through attended monitoring during commencement of operations (including blasting) combined with monitoring of waterbirds three-times annually since 1989, efforts have been made to detect mining-related changes in waterbird usage and nesting within Lake Cowal. Analysis from the results for this monitoring by AMBS (2013) concluded that "there does not appear to be any difference in the number of birds, the number of species, or the diversity of birds recorded along the transect closest to the mine site, compared with those present prior to the development of Cowal Gold Mine". Moreover, previous monitoring of blasts conducted before and after initial blasting at CGO identified no significant noise impact on waterbirds. That is, as cited in CGO's Flora and Fauna management plan:

> the Cowal Gold Project 2005 Annual Environmental Management Report (Barrick 2006) includes a summary of bird observation results during the first 10 blasts at the CGM. The blast observations included four fauna specialists and were overseen by Dr Peter Gell of the University of Adelaide. Dr Peter Gell has been involved in monitoring and reporting on waterbird populations and breeding activities at Lake Cowal since 1992. The four fauna specialists found that there was no abrupt change in the behaviour of any bird species to any blast and no evidence that any bird perceived any blast (Gell 2005). Further observations by Dr Gell in 2011 during a blast event identified no discernible reaction to the noise (or other effects) associated with the blast (Gell & Peake 2011).

The currently employed NMP and BMP were developed in consultation with relevant state regulators as part of the previous modifications will be employed to reduce noise impacts to meet Impact Assessment Criteria established in the development conditions (Evolution Mining Cowal Pty Limited 2015b, 2022b). The environmental performance of the operation of CGO is monitored and assessed against established noise criteria routinely and reported annually to relevant regulators within their annual environmental report.

ii Dust

Dust generated by mining activities may impact flora species or the physiological performance and elicited a stress of fauna, particularly if heavy metals within deposited dust contaminate soil and water (Cross et al. 2021). Nevertheless, there are currently no formal NSW or commonwealth guidelines available with criteria provided to assess potential impacts of dust on flora or fauna, including waterbirds.

To managed potential for air quality issues arising from construction and operation including dust, Evolution has an established Air Quality Management plan (including dust management plan) that was developed in consultation with relevant state regulators as part of the previous modification will be employed to reduce air quality impacts to meet Impact Assessment Criteria established in the development conditions (Evolution 2015a). This plan involves ongoing dust deposition in environments surrounding the mine using high-volume air samplers, which measure long-term trends in Particulate Matter M 10µm (PM_{10}), Total Suspended Particulates (TSP) and Dust Deposition. Active management measures are also applied on a day-to-day basis in effort to operate within established environmental performance criteria. Safeguards and control strategies to minimise dust generation are also reviewed when conditions become are hot and windy.

8.4.2 Lighting for night works

Artificial light generated by human activities such as mining may disrupt activity periods, foraging behaviour, reproduction and predation risk for fauna. Within NSW, potential impacts of light pollution on fauna are managed through the *Dark Sky Planning Guideline* (DPE 2016b), which was developed to provide design guidelines that maintain the dark sky, and to improve lighting practices. Nationally, the Australian Standard *AS/NZS 4282:2019 Control of the obtrusive effects of outdoor lighting* recognises the impact of artificial light on biota. Moreover, with relevance to management of light impacts on migratory shorebirds that visit Lake Cowal, the *National Light Pollution Guidelines for Wildlife* (DoEE 2020) provides technical guidance for managing light pollution to avoid disruption of important habitat and critical behaviours such as foraging, reproduction and dispersal for marine turtles, seabirds and migratory shorebirds.

Despite the potential for light generated by mining activities at CGO on waterbirds within Lake Cowal, analysis of waterbird community trends from monitoring undertaken since 1989 has yet to detect any such impact. That is, a comparison of waterbird communities adjacent to the existing CGO before and after operations by AMBS (2013) concluded that "there does not appear to be any difference in the number of birds, the number of species, or the diversity of birds recorded along the transect closest to the mine site, compared with those present prior to the development of Cowal Gold Mine". This result suggests that following construction and operation commencement of the mine, lighting (as well as other potential sources of disturbance), did not impact the waterbird community.

CGO currently manages light emission through an established Flora and Fauna Management Plan (FFMP), which was developed in consultation with relevant state regulators as part of the previous modifications (Evolution Mining Cowal Pty Limited 2015c). This plan involves ensuring all external lighting complies with relevant Australian Standards including Australian Standard AS4282, with performance monitored and assessed annually. This plan will be updated to meet revised conditions following approval, in consultation with relevant regulators, including the proposed measures to mitigate light in accordance with AS4282, *Dark Sky Planning Guideline* (DPE 2016b) and the *National Light Pollution Guidelines for wildlife* (DoEE 2020). Additional measures proposed to mitigate light impacts associated with the Project are provided in Section 8.3.

8.4.3 Weed introduction and spread

Plant infestations can alter ecosystem function, often resulting in the reduction of the diversity of native flora and fauna communities (Groves & Willis 2013), although some weeds may also provide habitat for some fauna (Carlos et al. 2014). If construction and operation activities are inappropriately managed, weeds may be introduced to or increased in areas adjacent to the Additional disturbance footprint, including Lake Cowal. In NSW, LLS coordinates weed management on a regional basis in accordance with the *Biosecurity Act* 2015, with the *Riverina Regional Strategic Weed Management Plan 2017-2022* (LLS 2017) relevant to the Project.

Evolution currently manages priority weeds identified by LLS (2017) by an established weed management plan (Section 6 of the LMP). This plan was developed in consultation with relevant state regulators as part of the previous modifications and will be employed to reduce weed impacts as established in the development conditions (Evolution Mining Cowal Pty Limited 2015d). It involves ongoing identification of weeds during annual site inspections, mechanical removal and/or use of appropriate herbicides in authorised areas (with strict control in wetland areas), follow-up site inspections to determine effectiveness of weed control measures.

8.4.4 Vertebrate pest invasion

Vertebrate pests are well documented to impact native fauna by predation and competition for resources. Pest animals can also impact native flora through herbivory and disturbance, such as trampling. The Project has potential to encourage vertebrate pests, including rabbits, foxes, pigs and wild dogs, through disturbance that benefits these species. In NSW, LLS coordinates pest animal management on a regional basis in accordance with the *Biosecurity Act* 2015, with the *Riverina Regional Strategic Pest Animal Management Plan 2018–2023* (LLS 2018) relevant to the Project.

Currently, Evolution controls pests within ML 1535, ML 1791 and existing offset areas in accordance with their LMP, FFMP and BOMP. This involves regular inspections to assess the status of pest populations, mandatory pest control for declared pests (i.e. rabbits, foxes, pigs and wild dogs). This pest eradication program currently employs collapsible traps, 1080 Fox baits and Talon mouse bait blocks and traps.

Inspections are undertaken to assess the effectiveness of control measures implemented and review these if necessary. This pest control plan was developed in consultation with relevant state regulators as part of the previous modifications and will be employed to reduce impacts of vertebrate pests as established in the development conditions (Evolution Mining Cowal Pty Limited 2015c–e). The LMP, FFMP and the BOMP management plans will be updated to meet revised conditions following approval, in consultation with relevant regulators. Additional mitigation measures to be employed during construction and operation to reduce vertebrate pests are recommended in Section 8.3.

8.4.5 Chemical and oil spills

Chemical and oil spills have the potential to impact fauna in surrounding environments by toxicosis or contaminating soil and water an organism inhabits. If construction and operation activities are inappropriately managed, chemicals and oil may be introduced into areas adjacent to the Additional disturbance footprint, including Lake Cowal.

Currently, any spill at CGO is responded to in accordance with the Pollution Incident Response Management Plan (PIRMP) and contained/disposed of in accordance with CGO's Hazardous Materials Management Plan (HMMP). The effectiveness of these management plans has been demonstrated by no reportable incidents or complaints regarding surface water quality as reported within annual reports between 2011 and 2021. These PIRMP and HMMP plans were developed in consultation with relevant state regulators as part of the previous modifications will be employed to reduce impacts of chemical and oil spills as established in the development conditions (Evolution Mining Cowal Pty Limited 2020b, 2022c). In addition to management plans, CGO has an ICDS and UCDS, which are designed to contain any spillage at the CGO site and preventing it from entering the surrounding environment, including Lake Cowal. That is, the site water management system is designed to contain all potentially contaminated water generated within the closed catchment of the ML 1535 area while diverting all other water around the perimeter of the CGO site. Evolution monitors the performance of the water management system through routine surface water monitoring and comparing against relevant ANZECC water quality guidelines and historic water quality data. All water quality monitoring data are compared against established environmental performance criteria within their annual reviews.

8.4.6 Erosion and sedimentation

Erosion and sedimentation have potential to impact fauna in surrounding environments by degrading habitat condition in aquatic and terrestrial ecosystems. If surface water generated during construction and operation activities are inappropriately managed, export of sediment and erosion (including any bound contaminants) may degrade retained habitat adjacent to the Additional disturbance footprint, including Lake Cowal.

Currently, sediment and erosion are managed by an Erosion and Sediment Control Management Plan (ESCMP). The effectiveness of these management plans has been demonstrated by no reportable incidents or complaints regarding surface water quality as reported within annual reports between 2011 and 2021. This ESCMP was developed in consultation with relevant state regulators as part of the previous modifications will be employed to reduce impacts of chemical and oil spills as established in the development conditions (Evolution Mining Cowal Pty Limited 2022a). In addition to management plans, CGO has a site water management system (as described further in Section 8.4.5) that is designed to contain all potentially contaminated runoff and prevent it from entering the surrounding environment, including Lake Cowal. Potential impacts of erosion and sedimentation on surrounding environments, including Lake Cowal, are monitored through surface water monitoring and annual review (described further in Section 8.4.5).

Table 8.5 Residual indirect impacts associated with the Project

Indirect impact	Potentially impacted entities	Extent	Frequency	Duration	Project phase	Likelihood and Consequence
Increased noise and vibration: construction and operation without blasting	Threatened and/or migratory waterbirds in Lake Cowal.	For the waterbird breeding areas (assessment locations N03 and N04), construction noise is predicted to be between 51 dB and 54 dB $LA_{eq,15min}$, whilst operational noise is predicted to be between 35 dB and 52 dB $LA_{eq,15min}$. Maximum instantaneous LAmax levels for construction and operation are predicted to be lower than the $LA_{eq,15min}$ detailed above (i.e. <54 dB $LA_{eq,15min}$). Potential impacts of noise reduce with increasing distance from the mine (see EMM 2023c).	Day and night	Short-term for construction: Greatest potential for impacts of construction noise and vibration would be when the LPB is built. Construction noise and vibration impacts will reduce once the LPB and UCDS are constructed. Noise and vibration impacts associated with construction will end once construction phase is complete. Long-term for operation: Operation noise and vibration will commence once construction is finished and cease at the end of mine life.	Construction and Operation	Likelihood: Certain; Consequence: Uncertain Activities contributing to the worst-case scenario for noise and vibration emissions during construction are those used during the LPB construction and UCDS construction. Equipment that may generate noise during these construction activities include excavators, dozers, scrapers, water carts, dump trucks, compactors, smooth drums, pulveriser, graders, drill rigs, backhoes and cranes. Activities contributing to the worst-case scenario for noise and vibration emissions during operation (without blasting) are those generated by the processing area and mining fleet, IWL development support fleet and underground mine. Equipment that may generate noise during these operation activities include process plant, primary crusher, secondary crushing plant, mobile crusher, stockpile conveyors, excavators, haul trucks, loaders, dozers, water trucks, graders, drill rigs, rollers, dump trucks, underground mine trucks, pastefill plant and ventilation fan. Note that since most of the plant to process gold exists already and currently operating, the major change in operational noise as part of the Project will arise undertaking existing earthmoving activities in the new pit, stockpile, and waste rock locations. To minimise the potential impacts of noise and vibration, NMP and BMP will be updated to meet revised conditions following approval of the Project, in consultation with relevant regulators. Proposed measures to mitigate potential noise and vibration impacts associated with are provided Section 8.3. Nevertheless, as construction and operation of the Project will be undertaken closer to known waterbird nesting habitat than currently approved activities, a precautionary approach will be applied by considering impacts of noise and vibration arising from construction and operational as an uncertain impact. As such, adaptive management will be undertaken to identify and respond to any changes in waterbird habitat usage or behaviour associated with mining construction and/ or operation (see Section 8.3.2).
Increased noise and vibration: Blasting only	Threatened and/or migratory waterbirds in Lake Cowal.	The nearest waterbird breeding area is approximately 2 km from the blast source. Noise impacts would be greatest at the northern pits E46 and GR, reducing for E41 as it is located further from waterbird nesting sites. Note that for all pits, blast noise should reduce with ongoing depth. Potential impacts of noise reduce with increasing distance from the mine (see EMM 2023c).	Day only (between 9:00 am and 5:00 pm). Maximum of two blasts per day in the open pits.	Long term: Blasting will commence once construction is complete and cease at the end of mine life.	Operation	Likelihood: Certain; Consequence: Uncertain Compared to the previous initial blasting for CGO, the proposed new pits are located further into Lake Cowal, and thus closer to potential waterbird habitat. This may lead to greater disturbance to waterbirds than previous blasting. However, the potential impact of noise and vibration on waterbirds depends upon the timing of blasting in relation to water levels in Lake Cowal, and hence availability of suitable waterbird habitat, and timing of both visitation of migratory species and nesting. Greatest risk of impacts of blasting is expected to occur during periods when most migratory bird species visiting and breeding activity occurs in Lake Cowal (i.e. September to January), especially when sufficient water is in the lake [note that intermediate water depths support the greatest numbers and diversity of waterbirds in Lake Cowal (AMBS 2013). Impacts are also expected to be greatest associated with early mining of pits, as well as the more northern E46 and GR pits, positioned nearest to colonial waterbird nesting locations. However, the potential impacts of noise and vibration impacts associated with blasting on waterbirds should reduce as these proposed mine pits deepen, and hence provide a harder barrier to dampen the transmission of noise and vibration. To minimise the potential impacts of noise and vibration associated with blasting, the NMP and BMP will be updated to meet revised conditions following approval of the Project, in consultation with relevant regulators. Proposed measures to mitigate potential noise and vibration impacts associated with are provided Section 8.3. Due to the uncertain impact of blasting noise and vibration associated on waterbirds in Lake Cowal, an adaptive management will be undertaken to identify and respond to any changes in waterbird habitat usage or behaviour associated with mining construction and/ or operation, including initial blasting (see Section 8.3.2).

Table 8.5 Residual indirect impacts associated with the Project

Indirect impact	Potentially impacted entities	Extent	Frequency	Duration	Project phase	Likelihood and Consequence
Increased dust	Weeping Myall and Inland Grey Box TECs; Threatened and/or migratory waterbirds in Lake Cowal.	With appropriate management, air quality will be managed to meet air quality assessment criteria and operating conditions within the Development Consent. If inappropriately managed, dust and particulate matter can be carried several km during hot, dry conditions. Extent of deposition would depend on wind speed and direct. Potential impacts of dust/particulate matter reduce with increasing distance from the mine (see EMM 2023g).	Day and night	Short-term for construction: Potential air quality impacts associated with construction will cease when construction complete. Potential for dust impacts associated with construction will end once construction phase is complete. Long-term for operation: Potential air quality impacts will cease at the end of mine life.	Construction and Operation	**Likelihood: High; Impact: Uncertain (likely to be higher during hot, windy conditions)** Risk of impact from dust and particular matter is greatest during dry and windy conditions. Activities that could potentially emit dust during both phases include waste emplacement areas and other portions of the mine site exposed to wind, waste rock handling and stockpiling activities (including loading and unloading, spreading and shaping of waste), movement of vehicles on unsealed roads for general mining activities, topsoil stripping and stockpiling; drilling and blasting (operations only); and crushing, screening, transport and preparation of ore. Note that plant activities involved with gold processing that may emit dust/particulate matter are already approved and operating. To minimise potential impacts of dust on surrounding environments, the AQMP will be updated to meet revised conditions following approval, in consultation with relevant regulators. Proposed measures to mitigate dust impacts associated with the Project are provided in Section 8.3. Nevertheless, as construction and operations will be undertaken closer to known nesting habitat than previously at CGO, a precautionary approach will be applied by considering dust impacts arising from construction and operation as an uncertain impact. As such, adaptive management will be undertaken to identify and respond to dust and particulate matter emitted to surrounding environments (including Lake Cowal) associated with mining construction and/ or operation (see Section 8.3.2). Impacts of long-term deposition of dust and particulate matter will also be assessed through surface water and sediment monitoring in Lake Cowal, with adaptive management applied if needed (see Section 8.3.2).
Light spill from night works	Threatened and/or migratory waterbirds in Lake Cowal.	With appropriate management, light emission from construction and operation activities can be substantially reduced. If inappropriately managed, light spillage on threatened and/or migratory waterbirds within Lake Cowal can disrupt foraging, orientation, disturb rest and increase risk of predation. Greatest light impacts would occur over the first year of construction, when the LPB is built.	Night	Short-term for construction: Impacts of light spill from construction will likely reduce following the construction of the LPB, which should shield at least some light from night work from spilling into Lake Cowal. Potential light impacts associated with construction will cease when construction complete. Long-term for operation: Potential light impacts from operation will cease at the end of mine life.	Construction and Operation	**Likelihood Medium; Impact: Uncertain** Activities contributing to light emissions during construction would consist of the use of mobile equipment, including earthmoving equipment (diggers, loaders and trucks), pumping equipment and vessels/barges (if lake is inundated at the time of LPB construction). Potential light impacts for waterbirds would be greatest during construction of the LPB and reduce after its completion as construction activities move away from the lake and the LPB provides a barrier to light emitted from subsequent construction and operation activities. Construction and operations would adopt relevant mitigation measures to reduce potential light spill onto adjacent environments, including Lake Cowal. As outlined in the VIA (EMM 2023f), measures to be included would apply relevant guidelines and standards including AS4282, *Dark Sky Planning Guideline* (DPE 2016b) and the *National Light Pollution Guidelines for wildlife* (DoEE 2020) (see Section 8.4.2). Nevertheless, construction and operations will be undertaken closer to known nesting habitat than previously at CGO, whilst the influence of noise and visual disturbance can interact to increase the potential for waterbird disturbance (DoE 2015), a precautionary approach will be applied by considering impacts of construction and operation lighting as an uncertain impact. These uncertain impacts are primarily associated with the construction phase, before the LPB shields subsequent construction and operations. Due to the uncertain impact of light spill on waterbirds in Lake Cowal, adaptive management will be undertaken to identify and respond to any changes in waterbird habitat usage or behaviour associated with mining construction and/ or operation (see Section 8.3.2).
Weed introduction and spread	Weeping Myall and Inland Grey Box TECs; Threatened and/or migratory waterbird habitat in Lake Cowal.	With appropriate management, weeds spread and/or introduced from construction activities can be substantially reduced. If inappropriately managed, weeds may degrade condition of TECs and threatened and/or migratory waterbird habitat within Lake Cowal. Nevertheless, due to the already degraded nature and weeds present in adjacent areas, it is considered unlikely that the Project will introduce new weeds and/or enhance existing weed infestation.	Day and night	Short term: if weeds are appropriately managed.	Construction and operation	**Likelihood: Low; Impact: Low** Given the highly degraded condition of much of groundcover adjacent to the Additional disturbance area, owing to a long history of agricultural activities, it is not expected that the Project will introduce new weeds or enhance existing infestations. Nevertheless, the Weed Management Plan will be updated to meet revised conditions following approval, in consultation with relevant regulators. Additional mitigation measures to be employed during construction and operation to reduce weeds are recommended in Section 8.3.

Table 8.5 Residual indirect impacts associated with the Project

Indirect impact	Potentially impacted entities	Extent	Frequency	Duration	Project phase	Likelihood and Consequence
Chemical and oil spills (note: potential impacts associated with cyanide management within operations is addressed in Section 8.5)	Threatened and/or migratory waterbirds in Lake Cowal.	With appropriate management, risk of chemical spills from construction and operation activities can be substantially reduced. If inappropriately managed, chemical spillage may impact upon downstream threatened and/or migratory waterbird habitat within Lake Cowal.	Day and Night	Medium: Potential impacts associated with risks of chemical spill will be greatest prior to construction of the LPB. Potential risks of chemical spill will still continue until the end of mine life.	Construction and Operation	**Likelihood: Low; Impact: High (only before the LPB and ICDS are complete)** The potential for impacts associated with chemical and oil spills on the adjacent Lake Cowal would be greatest if construction is to occur when Lake Cowal is full. At this time, if chemical and oil spills are not adequately contained and disposed of, they may enter Lake Cowal through surface water. During construction and operations, any spills would be managed by Evolution's established PIRMP and HMMP, which would be updated to meet relevant regulatory requirements following approval. Moreover, during dewatering of the LPB, any water discharged to Lake Cowal would need to meet relevant ANZECC (2000) water quality guidelines. Once construction of LPB is complete, the updated ICDS will then collect any potentially contaminated surface water generated on-site, including chemical and oil spills, avoiding discharge to Lake Cowal. Once updated, UCDS will also ensure that surface water originating upstream of the Project do not intercept potentially contaminated runoff from construction and operation areas, and hence risk export and deposition in Lake Cowal. Potential impacts of chemical and oil spills associated with the Project would be managed through existing PIRMP and HMMP plans, which will be updated to meet revised conditions following approval, in consultation with relevant regulators. Additional mitigation measures to be employed during construction and operation to reduce potential impacts associated with chemical and oil spills are recommended in Section 8.3. Adaptive management will also be applied to any uncertain impacts associated with water quality, as provided Section 8.3.2.
Erosion and sedimentation	Threatened and/or migratory waterbirds in Lake Cowal.	With appropriate management, risk of sediment and erosion from construction and operation activities can be substantially reduced. If inappropriately managed, sediments and erosion may impact upon downstream threatened and/or migratory waterbird habitat within Lake Cowal.	Day and Night	Medium: Potential impacts associated with risks of sediment and erosion will be greatest prior to construction of the LPB. Potential risks of sedimentation and erosion will still continue until the end of mine life.	Construction and Operation	**Likelihood: Medium; Impact: High (only before the LPB and ICDS are complete)** The potential for sediment and erosion impacts on the adjacent Lake Cowal would be greatest if construction is to occur when Lake Cowal is full. At this time, sources of potential contamination to Lake Cowal include mobilisation of sediments by construction activities, leaching of minerals from rock materials and dewatering during the construction of the LPB presents potential to impact waterbird habitat in Lake Cowal, if not appropriately managed. Risk of sediment and erosion occurring outside of the Additional disturbance footprint will be reduced through: • Construction of a silt curtain on the inner and outer extent of the LPB during construction, encapsulating earthworks (performance of the proposed silt curtain is documented in the Surface Water Assessment for the Project (EMM 2023e). • Using geological suitable rock material to construct the LPB, including not using rock from mineralised zone. • Treating of water to meet relevant ANZECC (2000) water quality guidelines prior to discharge into Lake Cowal. Once construction of LPB is complete, the updated ICDS will then collect potentially contaminated surface water generated on-site, avoiding discharge to Lake Cowal. Once updated, UCDS will also ensure that surface water originating upstream of the Project do not intercept potentially sediment latent runoff from construction and operation areas, and hence risk export and deposition in Lake Cowal. The ESCMP plans will be updated to meet revised conditions following approval, in consultation with relevant regulators. The ICDS and UCDS will also be updated to accommodate the Project (see Section 8.2). Additional mitigation measures to be employed during construction and operation to reduce potential impacts associated with chemical and oil spills are recommended in Section 8.3. Adaptive management to be applied to uncertain impacts associated with water quality is provided Section 8.3.2.

8.5 Residual prescribed impacts

Prescribed impacts associated with the Project are presented in Chapter 7. The nature, extent, duration and consequence of residual prescribed impacts associated with the Project are detailed in Table 8.6.

Table 8.6 Residual prescribed impacts associated with the Project

Consideration	Assessment
Habitat connectivity	
Nature	Relevant threatened entity: Austral Pillwort. It is understood that spores of ferns from the Marsileaceae family, which includes Austral Pillwort, are dispersed in water rather than air, where they are transported by water flow until they land on and adhere to a substrate (Schneider & Pryer 2002). Thus, spores of the Austral Pillwort likely disperse across the floodplain through overland flow, following high rainfall. The additional disturbance footprint is not expected to considerably alter the hydrological connectivity of the floodplain adjacent to the Project, so the Project is not expected to significantly alter the potential for Austral Pillwort to disperse through overland flow. Other than passive transport of spores in surface water, waterfowl have long been a proposed as a mechanism for dispersal of aquatic ferns in the Marsileaceae family. Avian ingestion of sporocarps (spore bearing bodies) is believed to explain how various aquatic ferns from the Marsileaceae family reach isolated habitats since they may pass undamaged through their digestive tract (Malone & Proctor 1965, Jones 1998). It is also believed that Marsileaceae family ferns might also disperse though spores adhering to external surfaces of birds. At Lake Cowal, abundant waterfowl were observed to visit gilgais following sufficient rainfall, and spores from Austral Pillwort are also likely to be released from the sporocarp at this time. Hence, there is potential that waterfowl aid the dispersal of Austral Pillwort. The dispersal potential for Austral Pillwort by waterfowl is not expected to be impacted by the Project given the high mobility of these birds.
Extent	Population of Austral Pillwort at Lake Cowal.
Duration	Potentially permanent.
Consequence	Although the dispersal mechanism for Austral Pillwort has not been resolved, there is strong evidence that overland flow and ingestion and spread of sporocarps by waterfowl are a likely dispersal mechanism for aquatic ferns in the Marsileaceae family. The Project is not expected to modify overland flows in the alluvial plains adjacent to the Project, so the ability for the species to disperse by surface water is not expected to change from the existing and approved disturbance area at the CGO site. Due to the high mobility of waterfowl around Lake Cowal, it is considered unlikely that the Project will interfere with avian dispersal of the Austral Pillwort.
Non-native vegetation	
Nature	Relevant threatened entity: Austral Pillwort. There is a parcel of cropped land within the Additional disturbance area where a threatened plant, the Austral Pillwort, has been located. This area has been identified as Category 1 land due to a long history of agricultural disturbance, including grazing and more recent cropping (see assessment in Appendix E). Although this land is generally unsuitable habitat for threatened plants, owing to the long history of disturbance, the Austral Pillwort was detected at one location. Other areas of this Category 1 land were more elevated, and largely lacked ephemeral depressions that offer suitable habitat. There was also one record of Austral Pillwort located at the edge of an existing, unsealed access track. As such, some of the species polygon at this location overlapped with this cleared area.
Extent	Based on the surveys and counts performed the Project would remove approximately 50 individuals from the areas of non-native vegetation. Within the cropped land, 50 Austral Pillwort individuals were recorded, with a species polygon in this area considered to be 0.32 ha (see Appendix K for method for determining species polygon). The Austral Pillwort recorded adjacent to the area cleared for an access track was estimated to be 100 individuals. These individuals will be impacted but are included within the vegetated area impacts. However, due to the 30 m buffer applied to generate the species polygon, 0.04 ha of the species polygon for these individuals is within this cleared area.

Table 8.6 Residual prescribed impacts associated with the Project

Consideration	Assessment
Duration	Permanent.
Consequence	Permanent loss of 0.32 ha of Austral Pillwort habitat within areas of non-native vegetation. This species is data deficient, so the full extent of the population in NSW is not understood. Surveys for the Project were conducted within the OPC study area and the broader Austral Pillwort survey area. These surveys found this species in 44 locations and an estimated 117,436 individuals across this area alone. The overall species polygon associated individuals outside of the Additional disturbance area was determined to be 8.5 ha. As such, the removal of 50 individuals within this area of non-native vegetation represents 0.04% of the recorded population at Lake Cowal.
Waterbodies, water quality and hydrological processes	
Nature	Relevant threatened/migratory entities: threatened and migratory waterbirds, bats, fish, and other aquatic fauna. Note that the potential impact of the Project on GDEs was assessed in Section 6. Groundwater was modelled to incrementally deepen and to potentially have more than a negligible change (i.e. >2 m decrease in groundwater depth) for PCTs 10 and 249. For PCT 10, incremental drawdown is predicted to be 2–5 m over 4.69 ha and 5–10 m over 1.50 ha. For PCT 249, groundwater was modelled to incrementally deepen by 2–5 m over 1,106.59 ha and 5–10 m over 1,263.45 ha. This impact is being treated as an uncertain impact with Adaptive Management applied in Section 8.3.2. Moreover, potential impact of the Project on surface water balance in Lake Cowal associated with the Project is expected to be negligible, as addressed in Section 7. Potential impacts of sediment and erosion are considered indirect impacts, as addressed in Section 8.4. The remaining potential prescribed impact of the Project associated with waterbodies, water quality and hydrological processes (if not appropriately managed) can be separated into: • Chemical contamination of surface water, including cyanide. • Direct exposure of threatened fauna to cyanide within treatment ponds. The nature, extent, duration and potential consequence are different for the above potential impacts, so have been addressed separately in the sections below. **Chemical contamination of surface water, including cyanide** CGO has approval for the processing, treatment and storage of mine tailings, including the handling and disposal of cyanide. The potential prescribed impact was considered here since the Project will involve an extension to the IWL, rather than any change in the existing and approved processing rate or method. Through implementing established management approaches, Evolution has effectively minimised the potential hazard that cyanide may pose to fauna, including threatened/migratory birds. CGO has designed and improved its control strategies for Cyanide management through its established Cyanide Management Plan, which was approved by Department of Planning in 2006. Since commencement, an independent audit of the environmental performance of CGO, including performance on the Cyanide Management Plan, has occurred in annually since 2004 (except 2020 and 2021). The approach to management of cyanide at CGO has also been certified by the International Cyanide Management Institute's (ICMI) Code for Cyanide Management. This code is a voluntary, performance driven, certification program of best practices for gold and silver mining companies and the companies producing and transporting cyanide used in gold and silver mining. The Cyanide Code provides a management system for the safe management of cyanide throughout its use cycle. Operations associated with the Project will continue to adopt the established approach to the management and control of chemicals used in operations, including Cyanide. Details regarding adaptive management of chemicals, including mitigation and adaptive management, are detailed in Sections 8.3.1 and 0. Note that after more than 100 years of operational use and research into alternative technologies, cyanide remains the preferred reagent for extracting gold where leaching is required. **Direct exposure of threatened fauna to cyanide within treatment ponds** CGO has approval for the processing, treatment and storage of mine tailings, including the handling and disposal of tailings within treatment ponds. The potential prescribed impact was considered here since the Project will involve an extension to the IWL, rather than any change in the existing and approved processing rate or method.

Table 8.6 Residual prescribed impacts associated with the Project

Consideration	Assessment
	In accordance with the existing approval, the tailings slurry will pass through a cyanide destruction process before being discharged to the upgraded IWL. Here, cyanide concentrations are to be maintained at a suitably low level, in effort to reduce the potential for direct exposure of mobile fauna that may visit the IWL that may be harmed or poisoned through ingesting cyanide. Currently, the aqueous component of the tailings slurry stream is to be maintained below a maximum concentration of 25 mg/L weak-acid dissociable (WAD) cyanide in solutions (CNWAD) (90 percentile over six months) and 30 mg/L CNWAD maximum permissible limit at any time is considered an interim benchmark at the process plant. Note that this is below the limit suggested by Leading Practice Sustainable Development Program for the Mining Industry handbook for Cyanide Management (IISA 2008), who state that "it is now recognised that wildlife at freshwater TSFs are protected by the accepted safe no discharge WAD cyanide level of 50 mg/L". Provided fencing is effective in precluding ground-dwelling threatened fauna (as recommended in Section 8.3.1), threatened bats and threatened/migratory birds present the highest risks of interaction with the IWL. These interactions would be minimised through adapting established approaches to monitoring and responding to fauna activity and mortalities at the IWL and maintaining cyanide at acceptably low levels. The effectiveness of these management approaches is demonstrated from environmental performance of CGO from 2010 to 2021, with annual reports indicating that no cyanide-related wildlife mortality or effect was recorded, whilst the maximum CN_{WAD} of water sampled twice daily from the tailings slurry never exceeded the 50 mg/L limit over that period. Operations associated with the Project will continue to adopt the established approach to the management of interactions of fauna with the upgraded IWL. Details regarding adaptive management of fauna at the upgraded IWL, including mitigation/management and adaptive management, are detailed in Sections 8.3.1 and 0.
Extent	**Chemical contamination of surface water, including cyanide** Potential interaction of fauna with processing, treatment and storage of mine tailings would likely be greater during periods when Lake Cowal holds water since most waterbird species are more common in Lake Cowal when inundated. However, the chance of a release of any chemical used during operations is highly unlikely since CGO is hydrologically separated from Lake Cowal by an ICDS that collects potentially contaminated surface water generated on-site and avoid discharge into to Lake Cowal. The UCDS will also be diverted to avoid surface water generated upstream from CGO mixing with any contamination, if this event occurs. This ICDS and UCDS will be redesigned to accommodate the new landform and any changes in processing resulting from the Project. Details regarding the upgraded ICDS and UCDS are provided in Section 8.2. The success of this ICDS and UCDS in preventing contamination of Lake Cowal is demonstrated through monitoring of surface waters and sediments within Lake Cowal. To date, there is no evidence of sediment or water contamination in Lake Cowal associated with mining operations. Moreover, there have been no reportable incidents or complaints regarding surface water quality between 2011 and 2021. If there is a pollution event, CGO has a Pollution Incident Response Plan and Hazardous Materials Management Plan developed to notify relevant parties, rapidly contain any incident and effectively respond. These plans were developed to the satisfaction of relevant regulators. All management plans pertaining to chemicals used in operations, including Cyanide, will be updated in accordance with revised development consent conditions, to meet the satisfaction of relevant regulators. **Direct exposure of threatened fauna to cyanide within treatment ponds** The potential extent of impact from fauna exposed to cyanide that the IWL extent to the fauna directly exposed to cyanide if concentrations are above the established limits of wildlife safety. However, to date, concentrations of cyanide have not exceeded limits of wildlife safety, so the potential of tailings to cause direct harm or poisoning of the animal is considered low. Specifically, there has been no sign of cyanide poisoning of fauna carcasses collected in or near the IWL, as reported in annual reports from 2010 to 2021. There has however been some mortality of fauna stuck in the tailings slurry, but this was highly infrequent. Where this occurred the incident was reported, subsequent investigations revealed that the cause of death was not cyanide toxicosis.

Table 8.6 Residual prescribed impacts associated with the Project

Consideration	Assessment
Duration	**Chemical contamination of surface water, including cyanide** Risks of chemical contamination of surface waters should remain largely unchanged since the method of processing and storage of tailings will remain unchanged from that applied since commencement in 2005 and pertain primarily to the operation phase of the Project. Since Cyanide has a short half-life, particularly when exposed to sunlight as in the case of the IWL, the primary risk of cyanide poisoning for fauna, including threatened/migratory birds, will cease shortly after gold processing concludes. Risks of legacy cyanide contamination within the IWL at the closure of the mine would be reduced through rehabilitation of this land (see Rehabilitation management plan, EMM2023e). **Direct exposure of threatened/migratory fauna to cyanide within treatment ponds** Risks of exposure of threatened/migratory fauna to cyanide will remain largely unchanged since the method of processing and storage of tailings will be consistent with that applied since commencement in 2005, varying only in a change in the extent of the IWL. Once gold production concludes, the risk of exposure of fauna to cyanide should reduce as there would be no more wet tailings produced. Risks of legacy cyanide contamination within the IWL at the closure of the mine will be reduced through rehabilitation of this land (see Rehabilitation management plan, EMM2023e).
Consequence	**Chemical contamination of surface water, including cyanide** In the case of a pollution event, the ICDS and UCDS should ensure that any contaminated water should be contained on site and not move into Lake Cowal. Moreover, based on CGO's well-established management plans, and ongoing environmental performance, it is considered highly unlikely that a spill will occur. It is also considered highly unlikely that cyanide would be released into surface waters outside CGO, given there is no evidence of this during extensive surface water monitoring. In the unlikely case that this occurs however, cyanide as well as other chemicals used in gold processing have potential to be toxic to aquatic fauna, including fish and waterbirds. The extent of the impact, in terms of timeframe and spatial extent, would depend on the amount of chemical released and water levels in Lake Cowal at the time of the spill. A pollution event during dry conditions would be easier to manage than in the wet. Periods when the lake holds water may also present a greater risk of chemical exposure in this case, as the chance of intermixing of mine and lake water would be greater and waterbird communities in Lake Cowal re typically more diverse and abundant. Nevertheless, although the consequence could be acute and short term for aquatic fauna if chemicals spill into surface waters of Lake Cowal, the design of the CGO site combined with best-practice control measures, should ensure this risk is minimised and controlled effectively in the unlikely case a pollution event occurs. **Direct exposure of threatened fauna to cyanide within treatment ponds** The potential for cyanide toxicosis for fauna is considered very low since concentrations of cyanide at the IWL are to be continued to be maintained below limits that are considered safe for wildlife. Moreover, if in the unlikely case that a mortality occurs due to cyanide poisoning, adaptive management (as detailed in Section 8.3.2) and including subsequent investigations will ensure that factors that led to this mortality event are rapidly ameliorated, to ensure that further mortalities do not occur. However, infrequent, incidental death of threatened/migratory birds and threatened bats may also occur at the IWL, most likely by individuals getting stuck in the slurry.

Table 8.6 Residual prescribed impacts associated with the Project

Consideration	Assessment
Vehicle strike	
Nature	Relevant threatened/migratory species: threatened and migratory waterbirds, threatened woodland birds, threatened microbats and ground-dwelling fauna. Increases in vehicle traffic associated with the Project construction/operations may increase risk of fauna strike, causing injury or mortality. Risk of fauna strike is likely to be more acute in new construction/operating areas, where fauna have yet to encounter this threat. Some vessel movements may occur in Lake Cowal to assist construction of the LPB, if this occurs in the wet, however vessel movements are expected to be infrequent and slow moving (i.e. barges) so are not expected to pose a threat of fauna strike. Time of day can also influence the risk of fauna strike, with early in the morning and late in the evening typically being higher times of activity for fauna and hence, a greater risk of strike. For waterbirds, the time of year will also influence risk of collision and/ or disturbance. The most sensitive time for waterbirds in Lake Cowal is from October to January. This is the period when breeding occurs, as well as visitations by migratory shorebirds. Risk of vehicle strike for waterbirds will also depend upon water level, with intermediate water levels typically accommodating the most and species rich waterbird communities (Australian Museum Business Services 2013). The lowest risk period is when Lake Cowal is dry, and so waterbird occupancy and breeding occurrence is low or absent. With appropriate training and management/mitigation measures, the frequency of fauna strike can be substantially reduced, as recommended in Section 8.3.
Extent	There would be an additional 15 light vehicle and 17 heavy vehicle trips for a combined 32 vehicle trips per day during peak construction months. That equates to an increase of up to 15% of vehicle traffic due to the construction of the Project, with traffic volumes returning to levels comparable to those at present associated with approved CGO operations. However, there will be no changes to workforce numbers, shift times and extraction or processing rates. So, there will be a minor addition of 5 trucks per day to the operations traffic. These vehicle movements to and from site from West Wyalong will follow fully sealed and commonly used public roads (e.g. Ungarie Road, Wamboyne Road, Blow Clear Road and Bonehams Lane), where additional traffic associated primarily associated with construction should not notably increase fauna collisions along this route. An increase in traffic within the existing CGO operations footprint as a result of the Project is unlikely to increase the risk of fauna collisions since fauna access is highly restricted in this area due to fencing, whilst busy mining activities at CGO prevent residence or visitation by most mobile fauna. The Project may also increase risk of vehicle collision primarily within Lake Cowal, where vehicle traffic was previously low. However, there will be speed controls in place for any vehicle/vessel access to Lake Cowal.
Duration	The risk of vehicle strike will be greatest during construction, when additional vehicle movements will be required by construction activities. For road traffic, there is expected to be an increase of up to 15% of vehicle traffic to and from CGO during construction only. However, risk of vehicle strike should reduce during the operations phase since the Project will largely return to that already approved (i.e. workforce numbers, shift times and extraction or processing rates will remain unchanged). An additional five trucks per day is expected to occur during operations only. See Traffic Impact Assessment for further information (EMM 2023e).
Consequence	There could be a short-term increase in vehicle strikes due to increased traffic associated during the construction phase only, primarily due to traffic within new areas of Lake Cowal previously less frequented by vehicles. This may lead to a low chance of mortality or injury of threatened shorebirds/waterbirds, migratory shorebirds/ waterbirds, threatened woodland birds, threatened microbats and threatened ground-dwelling fauna during the construction phase. If construction occurs in the wet, and vessels are used, there is not expected to be any notable risk to fauna since vessels used are expected to be infrequent and slow moving (i.e. mostly barges). It is not expected that Project would increase the risk of vehicle strike during operations since vehicle movements should not be substantially different to that currently present at CGO. Nevertheless, since commencement in 2005, CGO has well established management and mitigation measures for reducing risk of fauna strike, achieved through notifications and speed limits, CGO staff training and reducing traffic to and from site by providing bus services for employees, thereby restricting private travel to site. Likewise, if construction is to occur when Lake Cowal is inundated, and so vessels are required, vessel speed and areas of operation can be managed to reduce interactions with waterbirds. Any impacts of vehicle strike should notably reduce once mining operations finish, with a substantial reduction in vehicle movements during the rehabilitation phase.

8.6 Serious and Irreversible Impacts

An impact is to be regarded as serious and irreversible (SAII) if it is likely to contribute significantly to the risk of a threatened species (including endangered populations) or an ecological community becoming extinct based on the following four principles:

- Principle 1: The impact will cause a further decline of a species or ecological community that is currently observed, estimated, inferred or reasonably suspected to be in a rapid rate of decline.
- Principle 2: The impact will further reduce the population size of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very small population size.
- Principle 3: The impact is made on the habitat of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very limited geographic distribution.
- Principle 4: The impacted species or ecological community is unlikely to respond to measures to improve its habitat and vegetation integrity, and therefore its members are not replaceable.

Candidate SAII entities with regards to the Project are listed in Table 8.7, along with the relevant principles for the listing of the SAII entity, based on information from the BioNet Threatened Biodiversity Data Collection (BioNet TBDC 2023c). No assessment of any other threatened entities at risk of an SAII has been requested by the decision-maker. SAII assessments are provided in Section 8.6.2. Avoidance and mitigation measures for the Project are set out in Section 8.2.

Table 8.7 Candidate SAII entities for the Project

Threatened community or species	Principle			
	1	2	3	4
Austral Pillwort	No	No	Yes[1]	No

Notes: 1. Species is identified as an SAII entity in the BioNet TBDC (2023b) based on principle 3 (geographic constraints). However, a recent review of the geographic extent of the species by DPE suggests that principle 3 is no longer relevant, as discussed below.

Despite the Austral Pillwort not being considered an SAII species based on this recent review of geographic data for the species by DPE, an assessment as an SAII species is provided below in Section 8.6.1 as the species has not yet been formally delisted as an SAII entity.

8.6.1 Threatened ecological communities

Section 9.1.1 of BAM (DPIE 2020a) requires additional impact assessment for threatened ecological communities that are also listed as candidate entities for Serious and Irreversible Impacts (SAII). However, none of the TECs to be impacted by the Project are listed as an SAII entity, so an assessment of these TECs against the SAII criteria is not required.

8.6.2 Threatened species

Section 9.1.2 of BAM (DPIE 2020a) requires additional impact assessment for threatened species that are also listed as an SAII entity. The Austral Pillwort is the only SAII to be considered for an additional assessment.

In accordance with BAM 9.1.2, the assessor may also provide new information that can be used to demonstrate that the principle identifying the species as at risk of an SAII, is inaccurate. Based on updated geographic data for the Austral Pillwort, it is considered that the principle 3 that identifies this species as an SAII within the DPE BioNet TBDC (2023b) is inaccurate. Within the BioNet TBDC (2023b), Austral Pillwort is identified as a SAII species due to Principle 3 only, due to it being known from ≤ 3 locations and/ or an area of occupancy (AOO) or extent of occurrence (EOO) of < 100 km^2.

Spatial extent of the species from DPE (see email correspondence on 21 December 2021 in Appendix D) indicated that, following a review of BioNet, the Australian Virtual Herbarium (AVH) and Species profile, recent data on the distribution of the Austral Pillwort suggests that this species does not qualify for Principle 3. This correspondence was provided by DPE, informing us that based on this recent review of data, the Austral Pillwort is known to:

- Known from 4 or more locations (i.e. exceeding the ≤ 3 locations criteria for principal 3).
- Estimated area of occupancy (AOO) = 88 km^2 (i.e. exceeding the AOO of < 100 km^2 criteria for principal 3).
- Estimated extent of occurrence (EOO) = 120,013 km^2 (i.e. exceeding the EOO of < 100 km^2 criteria for principal 3).

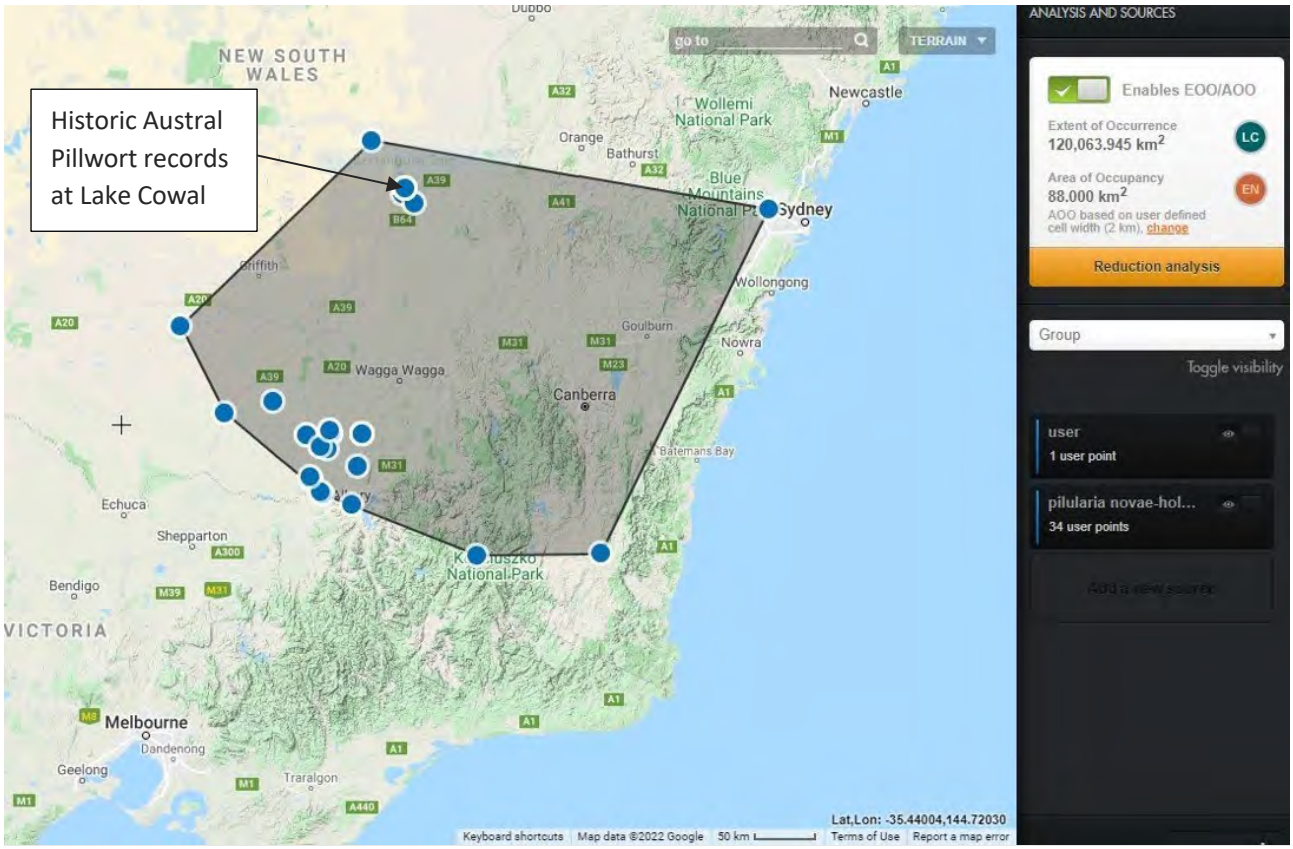


Figure 8.2 **Area of occupancy (AOO) and extent of occurrence (EOO) of Austral Pillwort (as provided by DPE 2022 in email correspondence on 21 December 2022; Appendix D)**

Although this recent review of the geographic constraints of this species by DPE (see Appendix D) suggests that the extent of occurrence and number of known locations of Austral Pillwort now exceeds thresholds for principle 3 (see details above), the species has yet to be formally delisted as an SAII. As such, the data to be used in this assessment, as provided by DPE (3 March 2023; Appendix D), is the following:

- Number of locations = 2 (i.e. meeting the ≤ 3 locations criteria for principal 3).
- Estimated AOO = 8–124 km^2 (i.e. meeting the AOO of < 100 km^2 criteria for principal 3).
- Estimated extent of occurrence (EOO) = 142,147 km^2 (i.e. exceeding the EOO of < 100 km^2 criteria for principal 3).

Nevertheless, in this most recent advice, DPE recognise the need to review the listing of Austral Pillwort as an SAII, stating that "A review of the data in 2022 suggests that Pilularia novae-hollandiae should be considered for removal from being listed as at risk of SAII for Principle 3."

Note that the timing for nominations to reconsider the SAII status of this species occurred following lodgement (i.e. May). As such Table 8.8 and Table 8.9 provide an assessment of the Austral Pillwort against the assessment criteria provided in Section 9.1.2 of BAM (DPIE 2020a).

Table 8.8 SAII assessment for Austral Pillwort – status

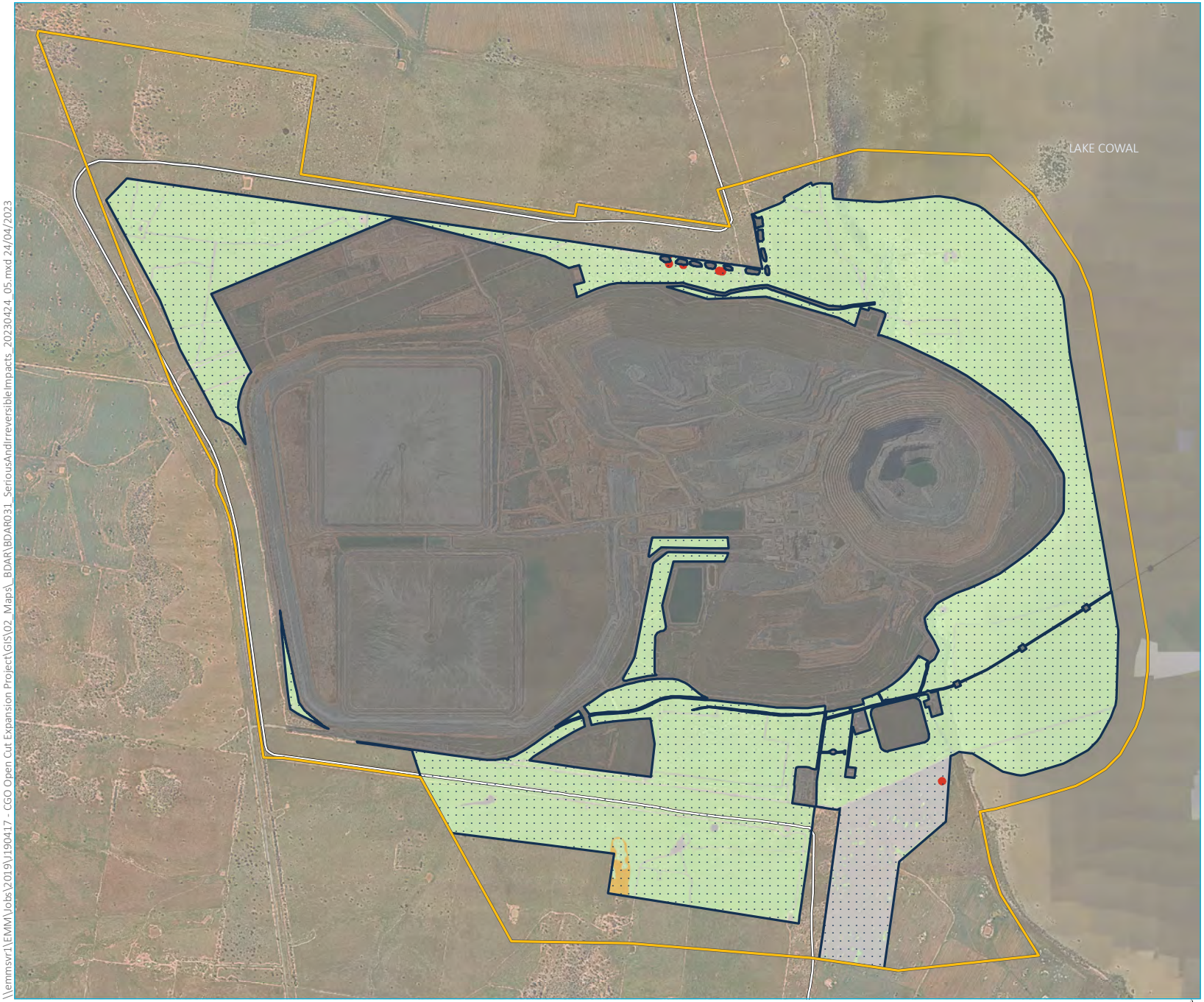
Criteria	Data/information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information (e.g. TBDC indicates data is unknown or deficient)
Evidence of rapid decline (Principle 1)			
Change in population size in NSW in the past 10 years or 3 generations (indicate whether as a direct estimate of the population or if indicated by an index or surrogate).	The species was listed prior to 1996, so no determination is available that estimated population size at that time. Moreover, data provided by DPE states that a population estimate is data deficient. DPE (2022e) states that there are two known extant populations in NSW; Lake Cowal and Oolambeyan NP. However, the species is difficult to detect as this species is ephemeral, and so likely to be only detectable in drying mud after rainfall. It is therefore likely that this species is more widespread than currently understood. For instance, Bower (1998a) suggests that Austral Pillwort is likely to be widespread across Central NSW. Nevertheless, Lake Cowal is identified as a known extant population, or at least part of an extant population. This species was first detected at Lake Cowal in 1993 (one record), followed by 1998 (four records) (BioNet Atlas 2023). As such, the 44 detected locations for this species during surveys for this BDAR indicates that the population, at least at Lake Cowal, has persisted. Although ongoing monitoring of this population by DnA Environmental failed to detect this species during annual surveys since 2001, it is likely that timing of those surveys and corresponding climatic conditions may have hampered the ability to monitor this population. In conclusion, it is difficult to appraise whether the Lake Cowal population has declined due to insufficient population data. The number of individuals observed by EMM during survey across all survey efforts (including the additional disturbance area, study area and broader Austral Pillwort survey area was estimated to be 117,436 individuals.	• DPE (2022e) • BioNet Atlas (2023) • BioNet TBDC (2023b) • AVH (2023a) • Bower (1998a) • DPE correspondence (21 December 2022 and 3 March 2023); Appendix D) • EMM survey data	The BioNet TBDC indicates that population size data is deficient. This species is easily overlooked during surveys since it is cryptic and only expresses in drying mud, so an accurate estimate of population size is difficult. As such, it is believed to be more widespread than appreciated. The difficulty in detecting this species is exemplified by EMM commonly detecting this species at Lake Cowal in 2022 and 2023, despite ongoing annual monitoring for this species by DNA Environmental since 2006.
Evidence of small population size (Principle 2)			
Current population size in NSW	There is no current population estimate in NSW. DPE (2022e) states that there are only two known extant population locations recorded for this species (Lake Cowal and Oolambeyan NP), but likely to be more common and widespread. There are also more contemporary records for the species in Urangeline East and Jerilderie in 2000 (BioNet Atlas 2023). There has not been a determination of population size by the TSSC as this species was listed prior to 1996.	• DPE (2022e) • BioNet Atlas (2023) • BioNet TBDC (2023b) • AVH (2023a) • DPE correspondence (21 December 2022 and 3 March 2023); Appendix D)	As this species is easily overlooked and difficult to survey because of seasonal constraints (i.e. needs drying mud to express), there is considerable uncertainty surrounding the size and extent of the potential Austral Pillwort population in NSW. Populations may exist more extensively than currently understood but remain undetected. Hence, a lack of reliable demographic data for the species inhibits the ability to assess population size and temporal trends.
Decline in species' population size in 3 years or one generation	The overall population of Austral Pillwort is unknown. However, at the known population at Lake Cowal, there is no evidence of a decline in the species' population. Although monitoring of the Lake Cowal population annually since 2001 failed to detect this species, it is likely that this was due to unsuitable conditions during sampling, rather than representing population decline. That is, the species was found to be widespread within surveys by EMM in 2022 and 2023 along the western shoreline of Lake Cowal, near where the species was originally detected in 1998. Note however that the exact locations of the 1998 records are not available, so repeated sampling was not possible. Furthermore, the species was also located to the south of Lake Cowal in new locations. Across the entire range of the population, which extends across Australian Capital Territory, Victoria, Tasmania, South Australia and Western Australia and New Zealand, there is no evidence available suggesting a decline in the species' population size in 3 years or one generation. This species is not listed under the EPBC Act, and nationally, and is regularly recorded across the southern extent of Australia with 254 records of Austral Pillwort made across Australia and New Zealand (AVH 2023a).	• DPE (2022e) • BioNet Atlas (2023) • BioNet TBDC (2023b) • AVH (2023a) • DnA Environmental (2001-2021) • DPE correspondence (21 December 2022 and 3 March 2023; Appendix D)	
Number or percentage of mature individuals in each subpopulation or whether the species is likely to undergo extreme fluctuations	As the population extent and size of the Austral Pillwort is currently unknown, there is no data available relating to the number or percentage of mature individuals in any of the known populations. Although the temporal variance in detections (i.e. species last detected at Lake Cowal in 1998) may suggest extreme fluctuations in population numbers, the infrequency of detections during that monitoring likely to represent the ephemeral nature of the species. That is, the species lies dormant for extended periods, expressing only after sufficient rainfall and during the drying cycle within certain gilgais, making it difficult to reliably census. Despite this, the full extent of the overall population of Austral Pillwort is likely to be widespread, as demonstrated by the vast extent of records of this species across Australia, including Australian Capital Territory, Victoria, Tasmania, South Australia and Western Australia (AVH 2023a).		

Table 8.8 SAII assessment for Austral Pillwort – status

Criteria	Data/information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information (e.g. TBDC indicates data is unknown or deficient)
Evidence of limited geographic range (Principle 3)			
Extent of occurrence (ha)	Although DPE (2022e) identified that the species occurs at 4 or more locations, this revised data has yet to be finalised, so the number of locations to be considered in this assessment is 2 (3 March 2023; Appendix D). Since 2000, locations this species has been found in NSW include Lake Cowal, Oolambeyan NP), Urangeline East and Jerilderie in 2000 (BioNet Atlas 2023; AVH 2023a). The EOO is estimated by DPE (3 March 2023; Appendix D) to be 142,147 km^2 (Figure 8.2).	• DPE (2022e) • BioNet Atlas (2023) • BioNet TBDC (2023b) • AVH (2023a) • DnA Environmental (2001-2021) • DPE correspondence (21 December 2022 and 3 March 2023; Appendix D)	As this species is easily overlooked and difficult to survey because of seasonal constraints (i.e. needs drying mud to express), there is considerable uncertainty surrounding the geographic distribution of Austral Pillwort population in NSW. Populations are likely to be more geographically extensively than currently understood but remain undetected. Hence, a reliable distribution data for the species inhibits the ability to accurately assess the EOO and AOO. Recent records for Austral Pillwort have not been factored into the assessment of Principle 3 provided here. Based on a contemporary review of data in 2022, DPE stated that "*A review of the data in 2022 suggests that Pilularia novae-hollandiae should be considered for removal from being listed as at risk of SAII for Principle 3. However, until the data is finalised and reviewed by Conservation Science the SAII listing stands and the above data should be used in a Biodiversity Assessment Report for assessment under the Biodiversity Offset Scheme.*"
Area of occupancy (ha)	The AOO is estimated by DPE (3 March 2023; Appendix D) to be 8–124 km^2 (Figure 8.2).		
Number of threat-defined locations	The two extant populations at Lake Cowal and Oolambeyan NP are identified as a priority management sites, with DPE (2022e) noting that species likely to be more common and widespread. Threats to the species include: • Drainage of swamps. • Roadside populations may be threatened by roadworks. • Easily overlooked and difficult to survey for because of seasonal constraints - survey for this species would need to be done when soils are moist but not inundated. • Rye grass and other grasses outcompeting the species. • Stock is a possible threat to the Gilgai habitat, particularly in wet periods.		Not all suitable habitat areas for the species have been surveyed representatively due to the ephemeral nature of the species. As such, it is possible that the species is widespread in Central NSW (Bower 1998a). Hence, the extent of the species, and associated threat-defined locations, is likely to be inaccurately understood.
Whether the species' population is likely to undergo extreme fluctuations	As the population of the Austral Pillwort and this species' ecology is not well understood, it is unknown if the species undergoes extreme fluctuations.		Although the expression of vegetative material is sporadic and a known response to rainfall, and may appear to undergo extreme fluctuations, there is currently no scientific research on the phenology of the species nor population demography. Hence, the flux of the population is uncertain.

Table 8.9 SAII assessment for Austral Pillwort – impact assessment

Impact	Data/information	Data sources	Details of data deficiency, assumptions or reasons for low confidence in information (e.g. TBDC indicates data is unknown or deficient)
Number of individuals (mature and immature) present in the subpopulation on the study area.	It is estimated that 3,861 individuals are located within the study area.	• Surveys as part of BDAR by EMM	TBDC indicates data is unknown or deficient.
Number of individuals (mature and immature) present as a percentage of total NSW population (%).	The total NSW population is unknown. Although known from limited locations in western NSW, it is likely to be widely distributed since it is easily overlooked. Across Lake Cowal, ~117,436 individuals were recorded during the 2022/2023 summer survey (see Figure 5.10). The number of individuals within the study area represents 3.29% of the known population at Lake Cowal, as established by surveys by EMM. The number present within NSW is likely to be at least an order of magnitude higher. The number within the Lake Cowal area is considered to be a significant underestimate, with surveys limited by access to lands and time available within the survey window for the species.	• Surveys as part of BDAR by EMM	As above.
Number of individuals (mature and immature) to be impacted by the proposal.	It is estimated that 2,810 individuals will be impacted within the Additional disturbance area. This was spread across seven records.	As above	As above.
Individuals (mature and immature) to be impacted by the proposal as a percentage of total NSW population (%).	Since the total NSW population is unknown, the proportion to be impacted by the proposal is unknown. Nevertheless, 114,626 Austral Pillwort individuals were recorded across the Lake Cowal outside of the Additional disturbance footprint. Based on only on those records, the number of individuals to be impacted is 2.45% of the known Lake Cowal population. The percentage of total NSW population would be much lower, likely <0.24%.	As above	As above.
Area of habitat to be impacted (ha) (for species measured by area only).	1.15 ha of Austral Pillwort habitat will be impacted by the Project.	Detailed in the species polygon in Figure 5.9.	Species polygon consists of PCT 55_DNG (0.25 ha); PCT 55 Poor (0.004 ha); PCT 55 Planted (0.27 ha); and PCT 55_Medium (0.30 ha). 0.32 ha is in category 1/cleared land. 0.83 ha is in vegetation zones requiring offset.
Area of the species' geographic range to be impacted by the proposal (ha).	As a data deficient species, the full extent of the species' geographic range is not understood. However, based on the records collected at Lake Cowal alone by EMM for this BDAR, the estimated total species polygon outside the Additional disturbance area is 8.5 ha. As such, removal of 1.15 ha of habitat by the Project would remove 12% of the currently known extent by EMM at Lake Cowal. The amount of loss is likely to be much less given EMM only surveyed accessible land parcels (Evolution-owned, publicly accessible land including road easements and crown land and a nearby BSA where access was approved), so the extent recorded is likely to be far less than that present. Moreover, one record made from the edge of a road reserve where an estimated >100,000 individuals were observed. Here, the full extent of this patch was likely to extend far over a large, inundated paddock, but this could not be confirmed due to property access constraints.	As above	As above.
Area of the species' geographic range to be impacted as a percentage of the total area or extent of occupancy (%).	Loss of 1.15 ha of habitat translates to <0.0000001% of the 142,147 km^2 EOO for the Austral Pillwort.	As above	EOO provided by DPE correspondence (21 December 2022; Appendix D).
Individuals impacted.	Some individuals of subpopulation and habitat will be impacted	As above	Species polygon and extent of impact described above.
Viability of a fragmented population.	The Project will only disturb 1.15 ha of potential habitat. As the Project will only have an incremental increase in footprint of the existing CGO site, it is considered unlikely that the Project would fragment the population to the extent of impacting the viability of the Lake Cowal population. That is, despite clearance of suitable habitat as part of the initial Project, the Lake Cowal population appears to be still highly viable given the records of Austral Pillwort both north and south of the CGO site. Given the fine size and numerous spores released from sporocarps, which may be readily transported by both wind and water, it is considered unlikely that the removal of potential habitat for the Project would fragment the population at Lake Cowal.	As above	Species polygon and extent of impact described above. Full extent of the existing population at Lake Cowal, as recorded by EMM in 2023, is shown in Figure 5.10).



KEY

- Study area
- Additional disturbance area
- Existing and approved disturbance area
- Major road
- Austral Pillwort polygon (SAII)
- Impacts requiring offsets
- Impacts not requiring offsets
- Areas not requiring assessment

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Source: EMM (2023); Evolution (2023); DFSI (2017); Nearmap (2021)

0 1 2 km

GDA 1994 MGA Zone 55

N

Serious and irreversible impacts, impacts requiring offsets, impacts not requiring offsets and areas not requiring assessment

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Biodiversity Development Assessment Report
Figure 8.3

EMM
creating opportunities

8.7 Impact summary

8.7.1 Residual direct impacts

Table 8.10 summarises the direct impacts to BC Act listed PCTs/TECs and species credit species associated with the Project. Also listed are species that are Commonwealth listed only, which are considered to be at risk of a significant impact from the Project (as per Section 9.1).

As discussed in Section 1.1.2 the OPC Project is proposed to be developed in stages, and thus for biodiversity credit obligations to also occur in a staged manner. Table 8.10 summarises the staged and total direct impacts.

Table 8.10 also identifies entities which are listed as serious and irreversible impact (SAII) entities, which are addressed in Section 8.6.

Changes in vegetation integrity scores associated with direct impacts are provided in Section 8.10.

8.7.2 Residual indirect impacts

There are no residual indirect impacts expected to result in changes in vegetation integrity scores outside of the Additional disturbance footprint.

Table 8.10 Summary of residual direct impacts

Entity	BC Act[1]	EPBC Act[1]	SAII entity	Project phase (ha impacted)					
				Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Overall
PCT 17 Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	-	-	No	12.04	-	-	-	-	12.04 ha
PCT 26 Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	E	E	No	35.90	79.54	85.37	-	-	200.82 ha
PCT 53 Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains	-	-	No	132.12	178.96	-	-	-	311.08 ha
PCT 55 Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.	-	-	No	27.47	82.39	28.51	54.24	22.57	215.18 ha
PCT 82 Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	E	E	No	-	11.90	53.07	-	55.20	120.17 ha
PCT 185 Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion	-	-	No	-	-	5.06	-	-	5.06 ha
PCT 244 Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).	-	E	No	12.28	-	-	-	-	12.28 ha
PCT 249 River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	-	-	No	45.80	6.17	-	-	-	51.97 ha
Austral Pillwort	E	-	Yes	0.87	0.28	-	-	-	1.15 ha
Australasian Bittern[2]	E	E	No	189.96	185.13	-	-	-	375.09 ha
Latham's Snipe[2]	-	M	No	189.96	185.13	-	-	-	375.09 ha
Sharp-tailed Sandpiper[2]	-	M	No	189.96	185.13	-	-	-	375.09 ha
Glossy Ibis[2]	-	M	No	189.96	185.13	-	-	-	375.09 ha
Migratory shorebird habitat[2]	-	M	No	189.96	185.13	-	-	-	375.09 ha

Notes: 1. M = migratory, E = Endangered.

2. Potential waterbird habitat was considered to be the total of PCT 17, PCT 53 and PCT 249. This covers all vegetation in the Additional disturbance area inside or within the riparian area of Lake Cowal.

8.8 Impacts requiring offset

This section provides an assessment of the impacts requiring offsetting in accordance with Section 9.2 of BAM (DPIE 2020a). The location of impacts requiring offset is shown in Figure 8.3.

i Impacts on native vegetation

Impacts to native vegetation requiring offsets include:

- direct impacts on 12.04 ha of PCT 17 – Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)
- direct impacts on 200.82 ha of PCT 26 – Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
- direct impacts on 311.08 ha of PCT 53 – Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains
- direct impacts on 215.18 ha of PCT 55 – Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions
- direct impacts on 120.17 ha of PCT 82 – Western Grey Box – Poplar Box – White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion
- direct impacts on 5.06 ha of PCT 185 - Dwyer's Red Gum – White Cypress Pine – Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
- direct impacts on 12.28 ha of PCT 244 – Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)
- direct impacts on 51.97 ha of PCT 249 – River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW.

A summary of the ecosystem credits required for all vegetation zones, including changes in vegetation integrity score, are provided in Table 8.12. A total of 20,046 ecosystem credits are required to offset the residual impacts of the Project. A credit report is provided in Appendix L.

8.9 Impacts not requiring offsets

In accordance with Section 9.2.1 of BAM (DPIE 2020a), impacts on vegetation zones and threatened species habitat do not require offsets where:

- Category 1 land as per the LLS Act.
- A vegetation zone representative of a critically endangered or endangered ecological community has a vegetation integrity score less than 15.
- A vegetation zone representative of a vulnerable ecological community and/or threatened species habitat has a vegetation integrity score less than 17.
- A vegetation zone that is not listed has a vegetation integrity score less than 20.

Table 8.11 provides a summary of the vegetation zones that do not trigger the above thresholds.

Table 8.11 Summary of impacts not requiring offsets – native vegetation

Vegetation zone	PCT	Name	Area	Vegetation integrity score	Future vegetation integrity score	Change in vegetation integrity score	Credits required
17	185-Dwyer's Red Gum – White Cypress Pine – Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion	185_DNG	3.56	11.9	0.0	-11.9	0

Areas not requiring assessment in accordance with Section 9.3 of BAM (DPIE 2020a) include:

- Category 1 land (Zone 26; as assessed in Appendix E).
- Cleared areas, including existing roads and unsealed access tracks, cleared and highly disturbed land, particularly associated with past mining activities.
- Watercourses/ farm dams.

The locations of impacts not requiring offset and not requiring assessment are shown in Figure 8.3.

8.10 Biodiversity Credit Report

The Ecosystem and Species credit liability for the Project is provided in Sections 8.10.1 and 8.10.2 below. As the Project will be undertaken in stages, the breakdown of credit liability is also presented in those sections. A credit report is provided in Appendix L.

Offsets will be provided through implementation of the biodiversity offset scheme. A Biodiversity Offset Strategy for satisfying these offset requirements is provided in Chapter 10.

8.10.1 Ecosystem credits

A total of 20,046 ecosystem credits are required to offset the residual impacts of the Project. The credits required per vegetation zone is detailed in Table 8.12.

Table 8.12 Summary of ecosystem credits required

Vegetation zone number	PCT	Vegetation zone name	Area	Vegetation integrity score	Future vegetation integrity score	Change in vegetation integrity score	Credits required
1	Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	17_Medium	12.0	97.2	0.0	-97.2	512
2	Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	26_DNG	179.1	18.0	0.0	-18.0	1,614
3		26_Poor	4.0	70.1	0.0	-70.1	142
4		26_Planted	10.6	79.8	0.0	-79.8	422
5		26_Medium	2.6	72.0	0.0	-72	93
6		26_High	4.5	91.6	0.0	-91.6	206
7	Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains	53_Medium	311.1	70.6	0.0	-70.6	9,609
8	Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions	55_DNG	166.3	20.4	0.0	-20.4	1,695
9		55_Poor	6.1	52.1	0.0	-52.1	160
10		55_Planted	8.8	74.7	0.0	-74.7	330
11		55_Medium	33.9	83.8	0.0	-83.8	1,419
12	Western Grey Box – Poplar Box – White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	82_DNG	113.0	35.8	0.0	-35.8	2,024
13		82_Poor	0.94	49.7	0.0	-49.7	23
14		82_Planted	0.37	24.7	0.0	-24.7	5
15		82_Regen	5.2	50.4	0.0	-50.4	132
16		82_Medium	0.62	75.3	0.0	-75.3	23
17	Dwyer's Red Gum – White Cypress Pine – Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion	185_DNG	3.6	11.9	0.0	-11.9	0
18		185_Medium	1.5	68.5	0.0	-68.5	39

Table 8.12 Summary of ecosystem credits required

Vegetation zone number	PCT	Vegetation zone name	Area	Vegetation integrity score	Future vegetation integrity score	Change in vegetation integrity score	Credits required
19	Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)	244_DNG	10.3	21.0	0.0	-21.0	109
20		244_Poor	0.21	31.7	0.0	-31.7	3
21		244_Medium	1.8	89.5	0.0	-89.5	78
22	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	249_DNG	6.9	40.1	0.0	-40.1	120
23		249_Regen	16.5	48.2	0.0	-48.2	349
24		249_Medium	28.6	75.1	0.0	-75.1	939

Notes: Zone 19 (PCT 185_High) does not occur within the Additional disturbance area. So, these zones are not entered into the BAM-C.

As the Project will be constructed in five stages (Figure 1.3), a breakdown of the ecosystem credit liability is provided in Table 8.12. The stages are as follows:

- Stage 1 - July 2024 anticipated construction commencement
- Stage 2 - July 2025 anticipated construction commencement
- Stage 3 - July 2028 anticipated construction commencement
- Stage 4 - July 2029 anticipated construction commencement
- Stage 5 - July 2030 anticipated construction commencement.

Table 8.13 Summary of ecosystem credits required by stage

Vegetation zone number	PCT	Vegetation zone name	Stage 1 Credit liability	Stage 2 Credit liability	Stage 3 Credit liability	Stage 4 Credit liability	Stage 5 Credit liability	Total
1	Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	17_Medium	512	0	0	0	0	512
2	Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	26_DNG	296	619	699	0	0	1,614
3		26_Poor	8	28	106	0	0	142
4		26_Planted	56	224	142	0	0	422
5		26_Medium	52	10	31	0	0	93
6		26_High	0	190	16	0	0	206
7	Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains	53_Medium	4,081	5,528	0	0	0	9,609
8	Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions	55_DNG	158	592	260	505	180	1,695
9		55_Poor	5	56	39	23	37	160
10		55_Planted	103	143	56	8	20	330
11		55_Medium	378	768	0	149	124	1,419
12	Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	82_DNG	0	200	924	0	900	2,024
13		82_Poor	0	3	7	0	13	23
14		82_Planted	0	5	0	0	0	5
15		82_Regen	0	0	30	0	102	132
16		82_Medium	0	10	0	0	13	23
17	Dwyer's Red Gum – White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion	185_DNG	0	0	0	0	0	0
18		185_Medium	0	0	39	0	0	39

Table 8.13 Summary of ecosystem credits required by stage

Vegetation zone number	PCT	Vegetation zone name	Stage 1 Credit liability	Stage 2 Credit liability	Stage 3 Credit liability	Stage 4 Credit liability	Stage 5 Credit liability	Total
20	Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)	244_DNG	109	0	0	0	0	109
21		244_Poor	3	0	0	0	0	3
22		244_Medium	78	0	0	0	0	78
23	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	249_DNG	120	0	0	0	0	120
24		249_Regen	349	0	0	0	0	349
25		249_Medium	736	203	0	0	0	939
TOTAL			**7044**	**8579**	**2349**	**685**	**1389**	**20046**

Notes: ecosystem credits were allocated by the proportion of each zone to be impacted by the respective stages. Where rounding was required, normal rounding protocols were followed. If a credit requirement for a stage was exactly on 0.5, then it was rounded up for the earlier stage, and down for the later stage (if needed for the later stage).

8.10.2 Species credits

Impacts to threatened species habitat requiring offsets include:

- direct impacts on 1.15 ha of habitat for the Austral Pillwort (noting 0.32 ha is in Category 1 and cleared land, so has been assessed as a prescribed impact).

A summary of the species credits required for all vegetation zones occupied by the threatened species, including changes in vegetation integrity score, are provided in Table 8.14.

Table 8.14 Summary of species credits required

Species	Vegetation zone name	Area (ha)	Habitat condition	Future habitat condition	Loss of habitat condition	Candidate SAII	Species credits
Austral Pillwort[1]	55_DNG	0.25	20.4	0.0	-20.4	Yes	4
	55_Planted	0.27	74.7	0.0	-74.7	Yes	15
	55_Poor	0.01	52.1	0.0	-52.1	Yes	1
	55_Medium	0.30	83.8	0.0	-83.8	Yes	19
	TOTAL						**39**

Notes: 1. No credits are required for the Austral Pillwort in cleared land and Zone 26 (Cropped land) as it is Category 1 land (see Section 8.5); the total area of the species polygon in these areas is 0.32 ha. Impacts to Austral Pillwort in cleared land and Zone 26 have been assessed as a Prescribed Impact associated with clearing non-native vegetation (see Section 7).

2. 0.004 ha of Austral Pillwort habitat was in Zone 55_Poor. It was rounded up to 0.01 in BAM-C.

As the Project will be constructed in five stages, a breakdown of the ecosystem credit liability is provided in Table 8.15.

Table 8.15 Summary of species credits required by stage

Species	Vegetation zone name	Stage 1 Credit liability	Stage 2 Credit liability	Stage 3 Credit liability	Stage 4 Credit liability	Stage 5 Credit liability	Total
Austral Pillwort[1]	55_DNG	4	0	0	0	0	4
	55_Planted	15	0	0	0	0	15
	55_Poor	1	0	0	0	0	1
	55_Medium	19	0	0	0	0	19
Total		**39**	**0**	**0**	**0**	**0**	**39**

9 Assessment of other relevant biodiversity legislation

9.1 Environment Protection and Biodiversity Conservation Act 1999

This chapter provides an assessment of the Project's impacts specific to species and communities listed under the EPBC Act. A likelihood of occurrence assessment for protected matters is presented in Section 9.1.1.

9.1.1 Likelihood of occurrence assessment

i Threatened ecological communities

Four EPBC listed TECs were predicted to occur within the study area by the Protected Matters Search Tool (PMST; Appendix M):

- Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia
- Poplar Box Grassy Woodland on Alluvial Plains
- Weeping Myall Woodlands
- White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

Table 9.1 assesses the likelihood of these TECs occurring in the study area. Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia EEC, Poplar Box Grassy Woodland on Alluvial Plains EEC and Weeping Myall Woodlands EEC were recorded in the study area. Impacts to these TECs are discussed further in Section 9.1.2.

None of the PCTs recorded across either site are consistent with White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC, so this TEC is not considered further.

Table 9.1 Likelihood of occurrence for listed ecological communities

Ecological community	EPBC Act Status	Habitat requirements	Likelihood of occurrence
Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	E	Grassy Woodland is the most common form of the ecological community that comprises a tree layer and a native understorey with a varying proportion of shrubs, grasses and herbs. This grassy woodland form has a tree canopy that is dominated or co-dominated by Grey Box (*Eucalyptus microcarpa*). The shrub or mid layer is variable. It ranges from absent, where it has been removed, to moderately dense cover. Shrub composition also can be variable. The ground layer also varies in composition, with mostly grasses or a combination of grasses and grass-like plants, herbaceous flowering plants and the smaller chenopods (salt bushes). The nature of the ground layer is influenced by the density of the shrub layer at a site, because where the shrub layer is denser, the ground layer is usually sparser due to competition for light and moisture. Patches of derived native grassland can occur where the tree canopy and mid layer has been almost entirely removed but the native ground layer remains largely intact.	**Recorded.** Up to 120.17 ha consistent with EPBC Act criteria will be directly impacted. Further assessment provided in Section 9.1.2.
Poplar Box Grassy Woodland on Alluvial Plains	E	Drought tolerant grassy, eucalypt woodlands where poplar/bimble box is the main tree canopy species present. Other tree species may occasionally occur depending on the characteristics of the site. The mostly grassy understorey can vary in composition depending on local hydrological conditions, rainfall, landscape position, soil type and season. Occurs on fertile clay or loamy soils on alluvial plains, lower slopes, creek flats and drainage lines.	**Recorded.** Up to 1.75 ha consistent with EPBC Act criteria will be directly impacted. Further assessment provided in Section 9.1.2.
Weeping Myall Woodlands	E	Weeping Myall Woodlands occur in a range of forms from open woodlands to woodlands, in which weeping myall (*Acacia pendula*) trees are the sole or dominant overstorey species. Although weeping myall trees are often the only tree species in these woodlands, other trees can occur in the overstorey of the ecological community. The understorey often includes an open layer of shrubs above an open ground layer of grasses and herbs, though the ecological community can exist naturally as either a shrubby, or grassy woodland.	**Recorded.** Up to 11.11 ha consistent with EPBC Act criteria will be directly impacted. Further assessment provided in Section 9.1.2.
White Box Yellow Box Blakely's Red Gum Woodland and Derived Native Grasslands	CE	Characterised by a species-rich understorey of native tussock grasses, herbs and scattered shrubs, and the dominance, or prior dominance, of White Box, Yellow Box or Blakely's Red Gum trees. Tree-cover is generally discontinuous and consists of widely spaced trees of medium height in which the canopies are clearly separated.	**Negligible.** Does not occur – this community is not consistent with any of the PCTs identified during the field surveys.

ii Threatened species

The PMST and/or BAM-C predicted that 29 species listed under the EPBC Act could occur within the study area, respectively. The likelihood of occurrence for these species is assessed in Table 9.2.

Of EPBC Act listed threatened species with potential to occur, Australasian Bittern was recorded at three locations along the foreshore of Lake Cowal, whilst Superb Parrot was recorded twice in the north-east of the study area and once to the south. In total, eight EPBC Act listed threatened species are considered likely to occur in the study area, which are:

- Australasian Bittern (*Botaurus poiciloptilus*)
- Australian Painted Snipe (*Rostratula australis*)
- Curlew Sandpiper (*Calidris ferruginea*)
- Glossy Black Cockatoo (*Calyptorhynchus lathami*)
- Major Mitchell Cockatoo (*Lophochroa leadbeateri leadbeateri*)
- Painted Honeyeater (*Grantiella picta*)
- Superb Parrot (*Polytelis swainsonii*)
- White-throated Needletail (*Hirundapus caudacutus*).

Potential impacts to these species associated with the Project are assessed in Section 9.1.2.

Table 9.2 Likelihood of occurrence for threatened species

Scientific Name	Common Name	EPBC Status	Source	Likelihood of occurrence
Plants				
Amphibromus fluitans	Floating Swamp Wallaby-grass	Vulnerable	BAM-C	Low. Not predicted by PMST but is a predicted candidate species under the BAM. Associates with permanent swamps, with potential habitat in gilgais and drainage lines. However, targeted surveys in accordance with NSW Guide to surveying threatened Plants and their habitats (DPIE 2020b) did not record the species (See Section 5.3.4ib). Samples of *Amphibromus* spp. were collected during these surveys and identified by National Herbarium of New South Wales and Australian National Herbarium as *Amphibromus nervosus* (see Plant identification Appendix H; correspondence on 25 November 2022). Moreover, targeted threatened plant surveys undertaken within and around the study area have historically failed to detect this species (Section 5.3.3i).
Austrostipa metatoris	A spear-grass	Vulnerable	BAM-C, PMST	Low. Herbarium backed records are restricted to Murray River Valley (AVH 2023b), where it typically associates with sandhills, sandridges, undulating plains and flat open mallee country with red to red-brown clay-loam to sandy-loam soils. Undulating plains with suitable soils do occur within the study area. However, targeted surveys in accordance with NSW Guide to surveying threatened Plants and their habitats (DPIE 2020b) did not record the species (See Section 5.3.4ib). Samples of *Austrostipa* spp. were collected during these surveys and identified by Australian National Herbarium as *Austrostipa setacea*, *Austrostipa blackii, Austrostipa blackii, Austrostipa setacea and Austrostipa puberula.* Moreover, targeted threatened plant surveys undertaken within and around the study area have historically failed to detect this species (Section 5.3.3i).
Austrostipa wakoolica	A spear-grass	Vulnerable	BioNet, BAM-C, PMST	Low. Herbarium backed records are located within 10 km of study area in last 5 year (AVH 2023c). Associates with floodplains of the Murray River tributaries, in open woodland on grey, silty clay or sandy loam soils. Potential habitat throughout the study area within grassy woodland and derived native grasslands on floodplains. However, targeted surveys in accordance with NSW Guide to surveying threatened Plants and their habitats (DPIE 2020b) did not record the species (See Section 5.3.4ib). Samples of *Austrostipa* spp. were collected during these surveys and identified by Australian National Herbarium as *Austrostipa setacea*, *Austrostipa blackii, Austrostipa blackii, Austrostipa setacea and Austrostipa puberula.* Moreover, targeted threatened plant surveys undertaken within and around the study area have historically failed to detect this species (Section 5.3.3i).
Eleocharis obicis	Spike-Rush	Vulnerable	BAM-C	Low. Grows in ephemerally wet situations such as roadside mitre drains and depressions, usually in low-lying grasslands. Potential habitat throughout the Study area within drainage lines, gilgais and Lake Cowal. However, targeted surveys in accordance with NSW Guide to surveying threatened Plants and their habitats (DPIE 2020b) did not record the species (See Section 5.3.4ib). Moreover, an expert report was undertaken (see Appendix K) to consider potential habitat for this species occurring in Lake Cowal, where survey was not possible due to inundation, which ruled out Lake Cowal as potential habitat for the species. Moreover, targeted threatened plant surveys undertaken within and around the study area have historically failed to detect this species (Section 5.3.3i). Further assessment is provided in Section 9.1.2.
Lepidium aschersonii	Spiny Peppercress	Vulnerable	BioNet, BAM-C, PMST	Low. Found on ridges of gilgai clays dominated by Belah (*Casuarina cristata*), Bulloak (*Allocasuarina luehmanii*) and Grey Box (*Eucalyptus microcarpa*), which occurs across the study area. However, targeted surveys in accordance with NSW Guide to surveying threatened Plants and their habitats (DPIE 2020b) did not record the species (See Section 5.3.4ib). Moreover, an expert report was undertaken (see Appendix K) to consider potential habitat for this species occurring in Lake Cowal, where survey was not possible due to inundation, which ruled out Lake Cowal as potential habitat for the species. Moreover, targeted threatened plant surveys undertaken within and around the study area have historically failed to detect this species (Section 5.3.3i).
Lepidium monoplocoides	Winged Peppercress	Endangered	BAM-C, PMST	Low. Occurs on seasonally moist to waterlogged sites, on heavy fertile soils, with suitable habitat available within the study area. Nearest herbarium backed records near Lake Cargelligo/Condobolin (>50 km away). However, targeted surveys in accordance with NSW Guide to surveying threatened Plants and their habitats (DPIE 2020b) did not record the species (See Section 5.3.4ib). Moreover, targeted threatened plant surveys undertaken within and around the study area have historically failed to detect this species (Section 5.3.3i).
Swainsona murrayana	Slender Darling Pea	Vulnerable	BAM-C, PMST	Low. Species collected from clay-based soils, ranging from grey, red and brown cracking clays to red-brown earths and loams, which occur in the study area. However, targeted surveys in accordance with NSW Guide to surveying threatened Plants and their habitats (DPIE 2020b) did not record the species (See Section 5.3.4ib). Moreover, targeted threatened plant surveys undertaken within and around the study area have historically failed to detect this species (Section 5.3.3i).
Tylophora linearis	-	Endangered	BioNet, PMST	Low. Grows in dry scrub and open forest but is not associated with any PCTs within the subject site. EMM located this species within 10 km of the study area, but within mallee vegetation (PCT 176). This vegetation community is not present on the study area. However, targeted surveys in accordance with NSW Guide to surveying threatened Plants and their habitats (DPIE 2020b) did not record the species (See Section 5.3.4ib). Moreover, targeted threatened plant surveys undertaken within and around the study area have historically failed to detect this species (Section 5.3.3i).
Amphibians				
Crinia sloanei	Sloane's Froglet	Endangered	BAM-C, PMST	Low. Species associated with periodically inundated areas in grassland, woodland and disturbed habitats, which occur in the study area. Species last recorded in or nearby Lake Cowal in 1994. However, targeted surveys accordance with NSW Survey Guide for Threatened Frogs (DPIE 2020c; or in accordance with guidance from species expert) did not record the species (see Section 5.3.3ivf).
Litoria raniformis	Southern Bell Frog	Vulnerable	BioNet, PMST	Low. Species associated with permanent or ephemeral Lignum swamps and River Red Gum swamps or billabongs along floodplains, which occur in the study area. Species last recorded in or nearby Lake Cowal in 1997. However, targeted surveys undertaken with reference to NSW Survey Guide for Threatened Frogs (DPIE 2020c) did not record the species (see Section 5.3.3ivf).
Birds				
Anthochaera phrygia	Regent Honeyeater	Critically Endangered	BioNet, PMST	Low. Species has a sporadic distribution and scarce local records. As the study area is not located on the important habitat map, it is unlikely that this species would regularly forage at the site or breed here. Nevertheless, targeted bird surveys have been undertaken and did not record the species (Section 5.3.3iva). Moreover, targeted bird surveys undertaken within and around the study area have historically failed to detect this species (Section 5.3.3iii).
Botaurus poiciloptilus	Australasian Bittern	Endangered	BAM-C, BioNet, PMST	Known. Species was detected by Evolution's water bird monitoring program (in 1993) and recorded during targeted surveys at three locations in PCT53 in the current study. Potential habitat occurs within Lake Cowal and its associated riparian area, consisting of PCTs 17, 53 and 249. Further assessment is provided in Section 9.1.2.
Calidris ferruginea	Curlew Sandpiper	Critically Endangered	PMST, Evolution	High. Species has been recorded at Lake Cowal as part of Evolution monitoring, last recorded in 2001. Potential habitat occurs within Lake Cowal and its associated riparian area, consisting of PCTs 17, 53 and 249. Further assessment is provided in Section 9.1.2.

Table 9.2 Likelihood of occurrence for threatened species

Scientific Name	Common Name	EPBC Status	Source	Likelihood of occurrence
Calyptorhynchus lathami	Glossy Black-Cockatoo	Vulnerable	BioNet, BAM-C.	Moderate. Species primarily associated with open forests and woodlands along the coast and Great Dividing Range. However, EMM recorded this species foraging ~10 km north of the study area, with evidence of foraging (i.e. chewed orts) ~3 km north of the study area. Vegetation communities in the study area that this species may associate are PCTs 55, 82, 185 and 244, with potential feed trees being Belah (*Casuarina cristata*) and Bulloak (*Allocasuarina luehmannii*). Nevertheless, targeted bird surveys (including mapping and surveying hollows that could support nesting) were undertaken and did not record the species nesting within or near the study area (Section 5.3.3iva). Moreover, targeted bird surveys undertaken within and around the study area have historically failed to detect this species (Section 1.1.1).
Falco hypoleucos	Grey Falcon	Vulnerable	BioNet, BAM-C., PMST	Low. Species usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions. However, there are two records of this species within 10 km of Lake Cowal, with the most recent made in 1999 (BioNet Atlas 2023). The nearest eBird (2022a) records located this species in Weddin, >50 km to the south-east of the OPC. Vegetation communities in the study area that this species may associate are PCTs 17, 26, 53, 55, 82, 244 and 249, and offer opportunistic foraging habitat. Nevertheless, targeted bird surveys (including surveys for nesting raptors) have been undertaken and did not record the species (Section 5.3.3iva). Moreover, targeted bird surveys undertaken within and around the study area have historically failed to detect this species (Section 1.1.1).
Grantiella picta	Painted Honeyeater	Vulnerable	BioNet, BAM-C., PMST	High. Inhabits Boree/ Weeping Myall (*Acacia pendula*), Brigalow (*A. harpophylla*) and Box-Gum Woodlands and Box-Ironbark Forests, where it feeds on the fruits of mistletoes growing on woodland eucalypts and acacias. However, there are records of this species within 10 km of Lake Cowal, with the most recent made in 2021 (BioNet Atlas 2023). Vegetation communities in the study area that this species may associate are PCTs 26, 55, 82, 244 and 249. Nevertheless, targeted bird surveys (including survey of woodlands supporting mistletoes, including preferential genus *Amyema* spp.) have been undertaken and did not record the species (Section 5.3.3iva). Moreover, targeted bird surveys undertaken within and around the study area have historically failed to detect this species (Section 1.1.1). Further assessment is provided in Section 9.1.2.
Hirundapus caudacutus	White-throated Needletail	Vulnerable	BAM-C, PMST	Moderate. Species is an aerial feeder and breeds in Asia. Records of this species within 10 km of Lake Cowal are scarce (only one record), with the most recent made in 2021 (BioNet Atlas 2023). Species may forage above all PCTs within the study area. Nevertheless, targeted bird surveys (including survey of woodlands supporting mistletoes, including preferential genus *Amyema* spp.) have been undertaken and did not record the species (Section 5.3.3iva). Moreover, targeted bird surveys undertaken within and around the study area have historically failed to detect this species (Section 1.1.1). Further assessment is provided in Section 9.1.2.
Lathamus discolor	Swift Parrot	Critically Endangered	BioNet, BAM-C, PMST	Low. Species has a sporadic distribution and scarce local records. As the study area is not located on the important habitat map, it is unlikely that this species would regularly forage at the site, breed whilst breeding occurs in Tasmania. there are records of this species within 10 km of Lake Cowal, with the most recent made in 1997 (BioNet Atlas 2023). Vegetation communities in the study area that this species may associate are PCTs 82 and 249. Nevertheless, targeted bird surveys have been undertaken and did not record the species (Section 5.3.3iva). Moreover, targeted bird surveys undertaken within and around the study area have historically failed to detect this species (Section 1.1.1).
Leipoa ocellata	Malleefowl	Vulnerable	BioNet, BAM-C, PMST	Low. Species predominantly inhabits mallee communities, preferring the tall, dense and floristically-rich mallee. Species not recorded from within 10 km of Lake Cowal since 1997 (BioNet Atlas 2023). The only vegetation community in the study area that this species may associate is PCT 185, which will not be impacted. Nevertheless, targeted bird surveys have been undertaken and did not record the species (Section 5.3.3iva). Moreover, targeted bird surveys undertaken within and around the study area have historically failed to detect this species (Section 1.1.1).
Limosa lapponica baueri	Bar-tailed Godwit (baueri)	Vulnerable	PMST	Low. Species is typically coastal, and associates with large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. Less frequently it occurs in salt lakes and brackish wetlands, sandy ocean beaches and rock platforms. Species has been not recorded from within 10 km of Lake Cowal (BioNet Atlas 2023). Nevertheless, targeted bird surveys have been undertaken and did not record the species (Section 5.3.3iva). Moreover, targeted bird surveys undertaken within and around the study area have historically failed to detect this species (Section 1.1.1).
Lophochroa leadbeateri leadbeateri	Major Mitchell Cockatoo	Endangered	PMST	Moderate. Species lives in arid and semi-arid woodlands dominated by Mulga (*Acacia aneura*), mallee and box eucalypts, Slender Cypress Pine (*Callitris gracilis*) or Belah (*Casuarina cristata*). Vegetation communities in the study area that this species may associate are woodland extents of PCTs 55, 82, 185 and 244. There are multiple records of the species within 10 km of Lake Cowal, with the most recent in 2020 (BioNet Atlas 2023). Nevertheless, targeted bird surveys (including mapping and surveying hollows that could support nesting) were undertaken and did not record the species, nor was nesting observed within or near the study area (Section 5.3.3iva).
Numenius madagascariensis	Eastern Curlew	Critically Endangered	PMST	Low. Species is typically coastal, and in NSW is mainly found in intertidal mudflats and sometimes saltmarsh of sheltered coasts. Species has been not recorded from within 10 km of Lake Cowal. Moreover, the study area is not located on the important habitat map. Nevertheless, targeted bird surveys have been undertaken and did not record the species (Section 5.3.3iva). Moreover, targeted bird surveys undertaken within and around the study area have historically failed to detect this species (Section 1.1.1).
Pezoporus occidentalis	Night Parrot	Endangered	PMST	Negligible. Species is considered extinct in NSW. Nevertheless, targeted bird surveys have been undertaken and did not record the species (Section 5.3.3iva). Moreover, targeted bird surveys undertaken within and around the study area have historically failed to detect this species (Section 1.1.1).
Polytelis swainsonii	Superb Parrot	Vulnerable	BioNet, BAM-C, PMST	Known. Species associates with Box-Gum, Box-Cypress-pine and Boree Woodlands and River Red Gum Forest. Species was recorded in the current study in PCT 185 in the far north-west of the EIS study area, but outside the study area. Species has also been regularly recorded from within 10 km of Lake Cowal since 1995 (BioNet Atlas 2023). Moreover, targeted bird surveys undertaken within and around the study area have historically detected this species (Section 5.3.4ii). Further assessment is provided in Section 9.1.2.
Rostratula australis	Australian Painted Snipe	Endangered	BioNet, BAM-C, PMST	Moderate. Species usually found in shallow inland wetlands including farm dams, lakes, rice crops, swamps and waterlogged grasslands. Species not recorded from within 10 km of Lake Cowal since 1997 (BioNet Atlas 2023). Vegetation communities in the study area that this species may associate are PCTs 17, 53 and 249. Nevertheless, targeted bird surveys have been undertaken and did not record the species (Section 5.3.3iva). Moreover, targeted bird surveys undertaken within and around the study area have historically failed to detect this species (Section 1.1.1). Further assessment is provided in Section 9.1.2.
Mammals				
Dasyurus maculatus	Spotted-tailed Quoll	Endangered	BAM-C, PMST	Low. Species recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Species not recorded from within 10 km of Lake Cowal (BioNet Atlas 2023). The only vegetation community in the study area that this species may associate is PCT 249 according to BAM-C.
Phascolarctos cinereus	Koala	Endangered	BAM-C, PMST	Low. Species feeds almost exclusively on eucalypt foliage, and their preferences vary regionally, with koala feed trees present within the study area including River red gum (*E. camaldulensis*), Bimble box (*E. populnea*), Western grey box (*E. macrocarpa*) and Dwyer's red gum (*E. dwyeri*). Species not recorded from within 10 km of Lake Cowal (BioNet Atlas 2023). Species may associate with any vegetation communities within the study area according to BAM-C. Nevertheless, targeted koala surveys via drone and detection dogs have been undertaken and did not record the species (Section 5.3.3ivd). Moreover, targeted surveys undertaken within and around the study area have historically failed to detect this species (Section 1.1.1).

Table 9.2 Likelihood of occurrence for threatened species

Scientific Name	Common Name	EPBC Status	Source	Likelihood of occurrence
Bats				
Nyctophilus corbeni	Corben's Long-eared Bat	Vulnerable	BioNet, BAM-C, PMST	Low. As *Nyctophilus* sp./spp. are indistinguishable by call characteristics only, trapping is required to confidently identify this species. As such, although *Nyctophilus* sp./spp. are commonly detected within the tailings storage facilities (recorded in 14 out of 50 monitoring periods between 2019 and 2022, Donato Environmental Services 2018-2022) and *Nyctophilus* spp. were recorded at 5 of the 6 sites that Anabats were deployed by EMM, the presence of *N. corbeni* within or nearby the OPC cannot be discounted based on this method. However, intensive harp trapping, specifically targeting *N. corbeni*, was undertaken by AMBS Ecology & Heritage (2018) within Riverine Plain Woodland and Floodplain Transition Woodland habitats within and adjacent to the Additional disturbance area. That survey effort extended over 22 trapping nights, with no N. corbeni captured. However, 15 *N. geoffroyi* individuals were captured. This is supported by a general lack of capture data for the species locally, with two captures of this species in 1989 displayed on BioNet, noting that these records having 100 km accuracy (BioNet Atlas 2023). Besides a lack of captures to confirm presence of this species in the Additional disturbance area, vegetation on the site is considered low value based on the vegetation it more commonly associates with. That is, *N. corbeni* is more abundant in extensive stands of vegetation in comparison to smaller woodland patches, and in habitats that have a distinct tree canopy and a dense, cluttered understorey layer. However, remnant woodland present within the Additional disturbance area is typically small, have a patchy tree canopy generally lack a midstory.
Pteropus poliocephalus	Grey-headed Flying-fox	Vulnerable	BioNet, BAM-C, PMST	Low. Species occurs along the NSW coast, extending further inland in the north. This species is a canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, melaleuca swamps and banksia woodlands. Roosts in large colonies, commonly in dense riparian vegetation. Species last recorded from within 10 km of Lake Cowal in 1997 (BioNet Atlas 2023). Species may associate with PCT 55 and PCT 244 within the study area according to BAM-C. Nevertheless, targeted surveys have been undertaken and did not record the species (Section 5.3.4ii). Moreover, targeted surveys undertaken within and around the study area have historically failed to detect this species (Section 1.1.1).
Reptiles				
Aprasia parapulchella	Pink-tailed Legless Lizard	Vulnerable	PMST	Low. Species typically associates with well-drained sites, with rocky outcrops or scattered, partially-buried rocks. Species has not been recorded from within 10 km of Lake Cowal (BioNet Atlas 2023). Species is not associate with any vegetation communities within the study area according to BAM-C, whilst rocky outcrops/scattered rocks are largely lacking. Moreover, targeted surveys undertaken within and around the study area have historically failed to detect this species (Section 1.1.1).
Hemiaspis damelii	Grey Snake	Endangered	PMST	Low. Species typically associates with floodplains and ephemeral wetlands which provide breeding habitat for frog species that are its main prey. This species uses cracks within heavy clay soils for shelter and hunting. Such habitat is located within the study area; however this species is not known to occur in or near Lake Cowal. That is, within the Lachlan River catchment, this species is known from the lower Lachlan catchment areas, whilst Lake Cowal is located in the mid to upper Lachlan River catchment. The nearest record of this species is located ~65 km to the southeast (single record made in 1992; BioNet Atlas 2023). However, the documented Lachlan River subpopulation is located west of Maude, ~310 km southwest of the study area. Moreover, targeted surveys undertaken within and around the study area have historically failed to detect this species (Section 1.1.1).

iii Migratory species

In total, 26 migratory species listed under the EPBC Act were predicted to occur in the study area based on a EPBC PMST search, records from the BioNet Atlas (2023) and review of Evolution waterbird monitoring reports. Table 9.3 provides an assessment of the likelihood of these species utilising habitat within the study area.

Of the 20 EPBC Act listed migratory species with a moderate or greater likelihood to occur, Caspian Tern (*Hydroprogne caspia*), Glossy Ibis (*Plegadis falcinellus*) and Latham's Snipe (*Gallinago hardwickii*) were detected in the study area by the present study.

Fifteen migratory shorebird species under the EPBC Act were considered as having a moderate or greater chance of occurring, which were:

- Bar-tailed Godwit (*Limosa lapponica*)
- Black-tailed Godwit (*Limosa limosa*)
- Common Greenshank (*Tringa nebularia*)
- Common Sandpiper (*Actitis hypoleucos*)
- Curlew Sandpiper (*Calidris ferruginea*)
- Double-banded Plover (*Charadrius bicinctus*)
- Latham's Snipe (*Gallinago hardwickii*)
- Little Curlew (*Numenius minutus*)
- Marsh Sandpiper (*Tringa stagnatilis*)
- Pacific Golden Plover (*Pluvialis fulva*)
- Pectoral Sandpiper (*Calidris melanotos*)
- Red-necked Stint (*Calidris ruficollis*)
- Sharp-tailed Sandpiper (*Calidris acuminata*)
- Whimbrel (*Numenius phaeopus*)
- Wood Sandpiper (*Tringa glareola*).

Four EPBC Act listed migratory wetland-associated bird species (i.e. not listed as migratory shorebirds) are considered as having a moderate or greater chance of occurring:

- Caspian Tern (*Hydroprogne caspia*)
- Glossy Ibis (*Plegadis falcinellus*)
- Australian Gull-billed Tern (*Gelochelidon macrotarsa*)
- White-winged Black Tern (*Chlidonias leucopterus*).

One EPBC Act listed migratory woodland bird species is considered as having a moderate or greater chance of occurring:

- White-throated Needletail (*Hirundapus caudacutus*).

Impact assessments for these migratory species are provided in Section 9.1.2, following EPBC Act listed threatened entities. Note that for migratory species also listed as a threatened species under the EPBC Act, the criteria for listed threatened species was applied, as per DoE (2013).

Table 9.3 Likelihood of occurrence for migratory species

Scientific name	EPBC Status	Source	Likelihood of occurrence
Bar-tailed Godwit (*Limosa lapponica*)	Mi[1], Mar	PMST	**Moderate**. Species has been recorded within 10 km of Lake Cowal, most recently in 1997 (BioNet Atlas 2023). Targeted bird surveys as part of this study and previous bird surveys within and around the study area have failed to detect this species (Section 1.1.1). Suitable habitat within study area includes wetland habitat provided by Lake Cowal, when inundated.
Black-tailed Godwit (*Limosa limosa*)	Mi[1], Mar	BioNet	**Moderate**. Species has been recorded within 10 km of Lake Cowal, most recently in 1997 (BioNet Atlas 2023). Targeted bird surveys as part of this study and previous bird surveys within and around the study area have failed to detect this species (Section 1.1.1). Suitable habitat within study area includes wetland habitat provided by Lake Cowal, when inundated.
Caspian Tern (*Hydroprogne caspia*)	Mi, Mar	Evolution, EMM	**Known**. Species recorded by EMM in study area, and more broadly across Lake Cowal by Evolution monitoring. Suitable habitat within study area includes wetland habitat provided by Lake Cowal, when inundated.
Common Greenshank (*Tringa nebularia*)	Mi[1], Mar	PMST, Evolution	**Moderate**. Species has been recorded as part of Evolution monitoring, most recently in 2001. Suitable habitat within study area includes wetland habitat provided by Lake Cowal, when inundated.
Common Sandpiper (*Actitis hypoleucos*)	Mi[1], Mar	PMST, BioNet	**High**. Species has been recorded within 10 km of Lake Cowal, with most recent record in 2016 (BioNet Atlas 2023). Targeted bird surveys as part of this study and previous bird surveys within and around the study area have failed to detect this species (Section 1.1.1). Suitable habitat within study area includes wetland habitat provided by Lake Cowal, when inundated.
Curlew Sandpiper (*Calidris ferruginea*)	CE, Mi[1], Mar	PMST, Evolution	**High**. See Table 9.2.
Double-banded Plover (*Charadrius bicinctus*)	Mi[1], Mar	Evolution	**High**. Species recorded at Lake Cowal by Evolution monitoring, most recently in 2001. Suitable habitat within study area includes wetland habitat provided by Lake Cowal, when inundated.
Eastern Curlew (*Numenius madagascariensis*)	Mi, Mar	PMST	Low. Species has not been recorded within 10 km of Lake Cowal (BioNet Atlas 2023). Unlikely to occur given the absence of required foraging habitat types (i.e. mudflats, mangroves, coastal lakes).
Fork-tailed Swift (*Apus pacificus*)	Mi, Mar	PMST	Low. Records at Lake Cowal are scarce, with the last recorded in 1997 (BioNet Atlas 2023). Targeted bird surveys as part of this study and previous bird surveys within and around the study area have failed to detect this species (Section 1.1.1). Aerial feeder with no suitable nesting habitat in study area.
Glossy Ibis (*Plegadis falcinellus*)	Mi, Mar	Evolution, EMM	**Known**. Species recorded by EMM in study area, and more broadly across Lake Cowal by Evolution monitoring. Suitable habitat within study area includes wetland habitat provided by Lake Cowal, when inundated.

Table 9.3 Likelihood of occurrence for migratory species

Scientific name	EPBC Status	Source	Likelihood of occurrence
Australian Gull-billed Tern (*Gelochelidon macrotarsa*)	Mi, Mar	Evolution	**High**. Species recorded at Lake Cowal by Evolution monitoring, most recently in 2019. Suitable habitat within study area includes wetland habitat provided by Lake Cowal, when inundated.
Latham's Snipe (*Gallinago hardwickii*)	Mi[1], Mar	PMST, EMM	**Known**. Species has been recorded at Lake Cowal by EMM as part of the current study. Suitable habitat within study area includes wetland habitat provided by Lake Cowal but may also use crop/pasture land.
Little Curlew (*Numenius minutus*)	Mi[1], Mar	Evolution	**Moderate**. Species recorded at Lake Cowal by Evolution monitoring in 1997. Suitable habitat within study area includes wetland habitat provided by Lake Cowal, when inundated.
Marsh Sandpiper (*Tringa stagnatilis*)	Mi[1], Mar	Evolution	**High**. Species recorded at Lake Cowal by Evolution monitoring, most recently in 2001. Suitable habitat within study area includes wetland habitat provided by Lake Cowal, when inundated.
Pacific Golden Plover (*Pluvialis fulva*)	Mi[1], Mar	Evolution, BioNet	**Moderate**. Species recorded at Lake Cowal by Evolution monitoring in 1992, with most recent record within 10 km of Lake Cowal in 1997 (BioNet Atlas 2023). Suitable habitat within study area includes wetland habitat provided by Lake Cowal, when inundated.
Pectoral Sandpiper (*Calidris melanotos*)	Mi[1], Mar	PMST, Evolution	**High**. Species has been recorded at Lake Cowal as part of Evolution monitoring, last recorded in 1992. Suitable habitat within study area includes wetland habitat provided by Lake Cowal, when inundated.
Red-necked Stint (*Calidris ruficollis*)	Mi[1], Mar	Evolution	**Moderate**. Species recorded at Lake Cowal by Evolution monitoring, most recently in 2014. Suitable habitat within study area includes wetland habitat provided by Lake Cowal, when inundated.
Rufous Fantail (*Rhipidura rufifrons*)	Mi, Mar	PMST	Low. Species not been recorded within 10 km of Lake Cowal since 1995 (BioNet Atlas 2023). Unlikely to occur as moist, dense forests are absent from the study area.
Satin Flycatcher (*Myiagra cyanoleuca*)	Mi, Mar	PMST	Low. Species not been recorded within 10 km of Lake Cowal since 1976 (BioNet Atlas 2023). Targeted bird surveys as part of this study and previous bird surveys within and around the study area have failed to detect this species (Section 5.3.3v).
Sharp-tailed Sandpiper (*Calidris acuminata*)	Mi[1], Mar	PMST, Evolution	**High**. Species has been recorded at Lake Cowal as part of Evolution monitoring, last recorded in 2019. Suitable habitat within study area includes wetland habitat provided by Lake Cowal, when inundated.
Swift Parrot (*Lathamus discolor*)	Mi, Mar	PMST	Low. See Table 9.2.
Whimbrel (*Numenius phaeopus*)	Mi[1]	BioNet	**Moderate**. Species recorded within 10 km of Lake Cowal in 1997 (BioNet Atlas 2023). Suitable habitat within study area includes wetland habitat provided by Lake Cowal, when inundated.
White-throated Needletail (*Hirundapus caudacutus*)	Mi, Mar	PMST	**Moderate**. See Table 9.2.
White-winged Black Tern (*Chlidonias leucopterus*)	Mi, Mar	Evolution	**High**. Species recorded at Lake Cowal by Evolution monitoring in 2001. Suitable habitat within study area includes wetland habitat provided by Lake Cowal, when inundated.

Table 9.3 Likelihood of occurrence for migratory species

Scientific name	EPBC Status	Source	Likelihood of occurrence
Wood Sandpiper (*Tringa glareola*)	Mi[1]	BioNet	**Moderate**. Species recorded within 10 km of Lake Cowal in 1997 (BioNet Atlas 2023). Suitable habitat within study area includes wetland habitat provided by Lake Cowal, when inundated.
Yellow Wagtail (*Motacilla flava*)	Mi, Mar	PMST	Low. Species has not been recorded within 10 km of Lake Cowal (BioNet Atlas 2023). Species is a vagrant to NSW, being a more common visitor to northern Australia. Targeted bird surveys as part of this study and previous bird surveys within and around the study area have failed to detect this species (Section 5.3.3v).

1. Migratory shorebird species listed under the EPBC Act.

9.1.2 Significant impact assessments

As identified in likelihood assessments of EPBC Act listed entities Section 9.1.1, three TECs, six threatened species and 26 migratory/marine species were found or were considered likely to occur within the study area. Impacts to these commonwealth-listed entities are assessed below. Note that impact assessments for EPBC Act listed species are provided firstly for threatened species then migratory species.

Potential impacts of the Project on EPBC Act listed entities is summarised in Table 9.4. A map of impacts to EPBC Act TEC is provided in Figure 4.3. Potential direct impact for EPBC Act listed threatened species is provided in Figure 9.1, whilst those to EPBC Act listed migratory species are displayed in Figure 9.2.

Table 9.4 Potential impact of the Project on EPBC Act listed entities

Entity	EPBC Act	Habitat extent	Potential direct impact (ha)
Threatened Ecological Communities			
Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	E	PCT 82: DNG; Poor, Planted; Regenerating; Medium	120.17
Poplar Box Grassy Woodland on Alluvial Plains	E	PCT 244: Medium	1.75
Weeping Myall Woodlands	E	PCT 26: Poor; Medium; High	11.11
Threatened species[1]			
Australasian Bittern (*Botaurus poiciloptilus*)	E	PCT 17: Medium; PCT 53: Medium; PCT 249 DNG; Regenerating, Medium	375.09
Australian Painted Snipe (*Rostratula australis*)	E	PCT 17: Medium; PCT 53: Medium; PCT 249 DNG; Regenerating; Medium	375.09
Curlew Sandpiper (*Calidris ferruginea*)	CE, Mi[4], Mar	PCT 17: Medium; PCT 53: Medium; PCT 249: DNG, Regenerating, Medium	375.09
Glossy Black Cockatoo (*Calyptorhynchus lathami*)	V	PCT 55: Poor, Planted, Medium; PCT 82: Poor, Regenerating, Planted, Medium. Note that PCT 185 and PCT 244 were not included since feed trees are largely lacking from these vegetation communities.	55.99

Table 9.4 Potential impact of the Project on EPBC Act listed entities

Entity	EPBC Act	Habitat extent	Potential direct impact (ha)
Major Mitchell Cockatoo (*Lophochroa leadbeateri leadbeateri*)	E	PCT 55: Poor, Planted, Medium; PCT 82: Poor, Regenerating, Medium; PCT 185: Medium; PCT 244: Poor, Medium Note: Excluded from cleared vegetation zones (condition class Derived grassland). Known to associate with Belah and Box Gum woodland.	59.45
Painted Honeyeater (*Grantiella picta*)	V	PCT 26: Poor; Planted; Medium, High; PCT 55 Poor, Planted, Medium; PCT 82: Poor, Regenerating, Medium; PCT 185 Medium; PCT 244 Poor, Medium; PCT 249 Regenerating, Medium. Note: Excluded from cleared vegetation zones (condition class Derived grassland).	126.24
Superb Parrot (*Polytelis swainsonii*)[2]	V	PCT 26: Poor, Planted, Medium, High; PCT 55 Poor, Planted, Medium; PCT 82: Poor, Regenerating, Medium; PCT 185 Medium[3]; PCT 244 Poor, Medium; PCT 249 Regenerating, Medium. Note: Excluded from cleared vegetation zones (condition class Derived grassland).	126.24
White-throated Needletail (*Hirundapus caudacutus*)	V	All vegetation zones (including Category 1 land)	999.77
Migratory species[3]			
Bar-tailed Godwit (*Limosa lapponica*)	Mi[4], Mar	PCT 17: Medium; PCT 53: Medium; PCT 249 DNG; Regenerating; Medium	375.09
Black-tailed Godwit (*Limosa limosa*)	Mi[4], Mar	PCT 17: Medium; PCT 53: Medium; PCT 249 DNG; Regenerating; Medium	375.09
Caspian Tern (*Hydroprogne caspia*)	Mi, Mar	PCT 17: Medium; PCT 53: Medium; PCT 249 DNG; Regenerating; Medium	375.09
Common Greenshank (*Tringa nebularia*)	Mi[4], Mar	PCT 17: Medium; PCT 53: Medium; PCT 249 DNG; Regenerating; Medium	375.09
Common Sandpiper (*Actitis hypoleucos*)	Mi[4], Mar	PCT 17: Medium; PCT 53: Medium; PCT 249 DNG; Regenerating; Medium	375.09
Curlew Sandpiper (*Calidris ferruginea*)	CE, Mi[4], Mar	See above	375.09
Double-banded Plover (*Charadrius bicinctus*)	Mi[4], Mar	PCT 17: Medium; PCT 53: Medium; PCT 249 DNG; Regenerating; Medium	375.09
Glossy Ibis (*Plegadis falcinellus*)	Mi, Mar	PCT 17: Medium; PCT 53: Medium; PCT 249 DNG; Regenerating; Medium	375.09
Australian Gull-billed Tern (*Gelochelidon macrotarsa*)	Mi, Mar	PCT 17: Medium; PCT 53: Medium; PCT 249 DNG; Regenerating; Medium	375.09
Latham's Snipe (*Gallinago hardwickii*)	Mi[4], Mar	PCT 17: Medium; PCT 53: Medium; PCT 249 DNG; Regenerating; Medium	375.09

Table 9.4 Potential impact of the Project on EPBC Act listed entities

Entity	EPBC Act	Habitat extent	Potential direct impact (ha)
Little Curlew (*Numenius minutus*)	Mi[4], Mar	PCT 17: Medium; PCT 53: Medium; PCT 249 DNG; Regenerating; Medium	375.09
Marsh Sandpiper (Tringa stagnatilis)	Mi[4], Mar	PCT 17: Medium; PCT 53: Medium; PCT 249 DNG; Regenerating; Medium	375.09
Pacific Golden Plover (*Pluvialis fulva*)	Mi[4], Mar	PCT 17: Medium; PCT 53: Medium; PCT 249 DNG; Regenerating; Medium	375.09
Pectoral Sandpiper (*Calidris melanotos*)	Mi[4], Mar	PCT 17: Medium; PCT 53: Medium; PCT 249 DNG; Regenerating; Medium	375.09
Red-necked Stint (*Calidris ruficollis*)	Mi[4], Mar	PCT 17: Medium; PCT 53: Medium; PCT 249 DNG; Regenerating; Medium	375.09
Sharp-tailed Sandpiper (*Calidris acuminata*)	Mi[4], Mar	PCT 17: Medium; PCT 53: Medium; PCT 249 DNG; Regenerating; Medium	375.09
Whimbrel (*Numenius phaeopus*)	Mi[4]	PCT 17: Medium; PCT 53: Medium; PCT 249 DNG; Regenerating; Medium	375.09
White-throated Needletail (*Hirundapus caudacutus*)	V, Mi, Mar	See above	See above
White-winged Black Tern (*Chlidonias leucopterus*)	Mi, Mar	PCT 17: Medium; PCT 53: Medium; PCT 249 DNG; Regenerating; Medium	375.09
Wood Sandpiper (*Tringa glareola*)	Mi[4]	PCT 17: Medium; PCT 53: Medium; PCT 249 DNG; Regenerating; Medium	375.09

Notes: 1. Habitat extent for threatened species was determined by PCTs associated with the species as per the BioNet TBDC (2023c).

2. PCT 185 was added as Superb Parrot habitat since this species was observed in PCT 185 on several occasions.

3. Since many migratory waterbirds use a range of habitats to forage and shelter, all riparian and lacustrine habitat associated with Lake Cowal were considered potential habitat. 4. Migratory shorebird species listed under the EPBC Act.



KEY

- Additional disturbance area
- Existing and approved disturbance area
- Major road

Potentially impacted threatened species habitat

- Painted Honeyeater and Superb Parrot
- White-throated Needletail
- Major Mitchell Cockatoo
- Glossy Black Cockatoo
- Australasian Bittern, Australian Painted Snipe and Curlew Sandpiper

Source: EMM (2023); Evolution (2023); DFSI (2017); Nearmap (2021)

0 1 2 km

GDA 1994 MGA Zone 55

N

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Potential direct impact to EPBC Act listed threatened species

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Biodiversity Development Assessment Report
Figure 9.1

EMM creating opportunities



KEY

- Additional disturbance area
- Existing and approved disturbance area
- Major road

Potentially impacted Migratory species habitat

- White-throated Needletail
- Bar-tailed Godwit, Black-tailed Godwit, Caspian Tern, Common Greenshank, Common Sandpiper, Curlew Sandpiper, Double-banded Plover, Glossy Ibis, Australian Gull-billed Tern, Latham's Snipe, Little Curlew, Marsh Sandpiper, Pacific Golden Plover, Pectoral Sandpiper, Red-necked Stint, Sharp-tailed Sandpiper, Whimbrel, White-winged Black Tern and Wood Sandpiper

\\emmsvr1\EMM\Jobs\2019\I190417 - CGO Open Cut Expansion Project\GIS\02_Maps_BDAR\BDAR034_MigratorySpeciesHabitatImpacted_20230421_04.mxd 24/04/2023

Source: EMM (2023); Evolution (2023); DFSI (2017); Nearmap (2021)

0 1 2 km

GDA 1994 MGA Zone 55

N

Potential direct impact to
EPBC Act listed migratory species

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Biodiversity Development Assessment Report
Figure 9.2

EMM
creating opportunities

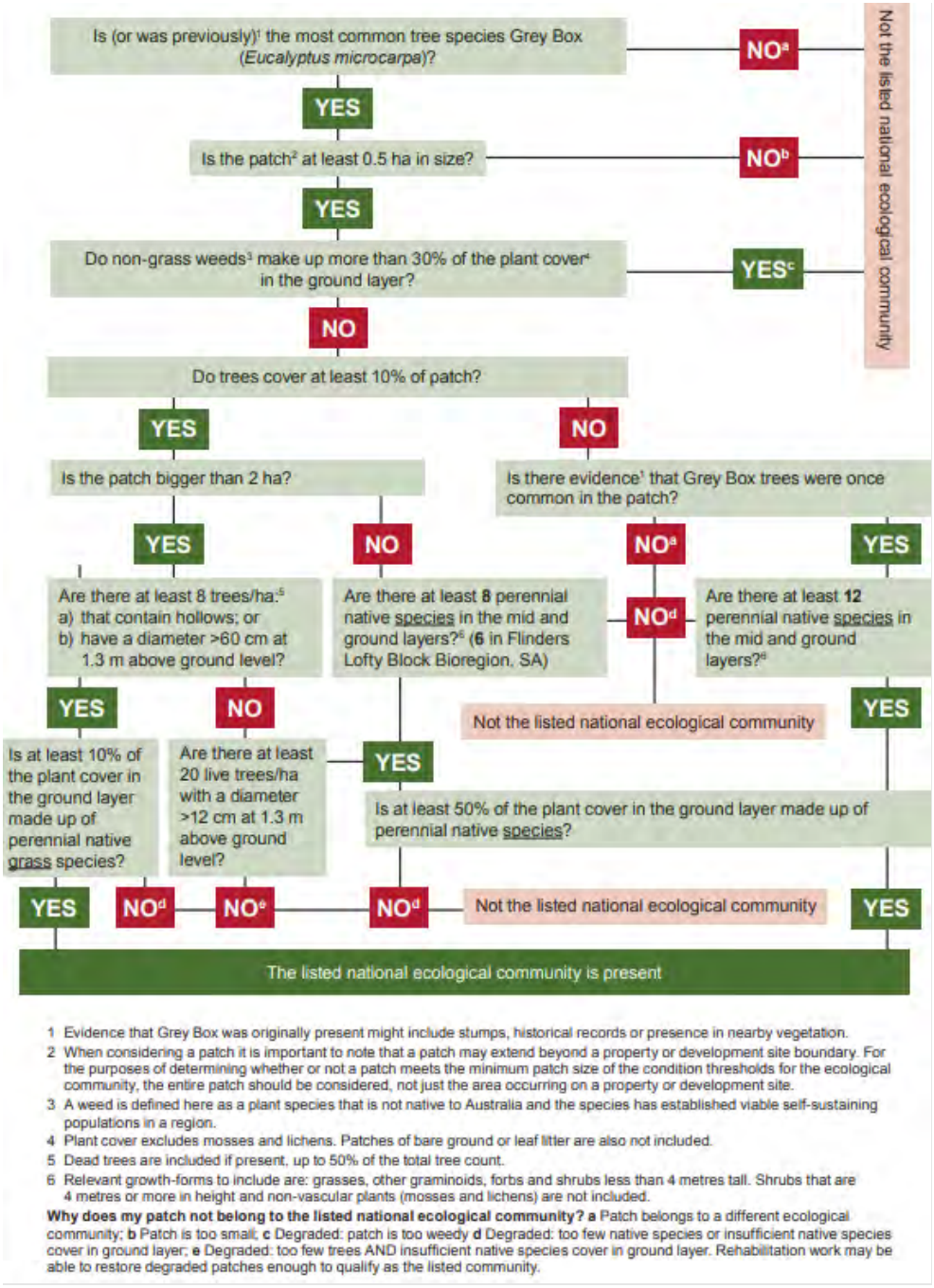
a Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia

The Commonwealth Listing Advice for the endangered Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia (TSSC 2010) provides a general description of the community and describes its status. This EEC occupies a position in the landscape that is transitional between the temperate woodlands and forests of the lower slopes and tablelands of south-eastern Australia, and the semi-arid communities further inland. The ecological community typically occurs in landscapes of low-relief on productive soils derived from alluvial or colluvial materials but may occur on a range of substrates. The ecological community tends to occupy drier sites of the belt of grassy woodlands in south-eastern Australia, within a rainfall zone of 375–700 mm/year. The ecological community has suffered extensive clearing in the past, mostly for agricultural and pastoral purposes.

This community typically has a tree canopy dominated by Grey Box (*E. microcarpa*). A range of other associated tree species may be present but do not dominate the ecological community. The understorey comprises a sparse shrub layer and a species-rich ground layer of grasses and herbs. Chenopods are often present, particularly in drier parts of the range. The ecological community includes patches of derived grassland where a tree canopy of Grey Box was known to have been present but has been removed, and the native ground layer remains largely intact.

The listing advice for the community (TSSC 2010) lists threatening processes for this EEC as vegetation clearing primarily for agricultural purposes; consequent fragmentation of native vegetation remnants; inappropriate land use regimes (grazing, fire, herbicides, fertilizer addition); weed invasion; the low level of protection in reserves; and climate change. Threat abatement actions are presented in the approved Conservation Advice for this ecological community (TSSC 2010).

The EPBC Act Policy Statement for Grey Box (*E. microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-Eastern Australia (DSEWPaC 2012) provides a flowchart to assist in determining if patches are included in the listed community (Plate 9.1). The structure and diversity of the native plant community types (PCTs) in the Project application area have been compared with the flowchart (Plate 9.1) to determine if they represent the listed community. An assessment of vegetation zones against these criteria was made in Table 4.9, with all zones of PCT 82 found to be consistent with this TEC.



1 Evidence that Grey Box was originally present might include stumps, historical records or presence in nearby vegetation.
2 When considering a patch it is important to note that a patch may extend beyond a property or development site boundary. For the purposes of determining whether or not a patch meets the minimum patch size of the condition thresholds for the ecological community, the entire patch should be considered, not just the area occurring on a property or development site.
3 A weed is defined here as a plant species that is not native to Australia and the species has established viable self-sustaining populations in a region.
4 Plant cover excludes mosses and lichens. Patches of bare ground or leaf litter are also not included.
5 Dead trees are included if present, up to 50% of the total tree count.
6 Relevant growth-forms to include are: grasses, other graminoids, forbs and shrubs less than 4 metres tall. Shrubs that are 4 metres or more in height and non-vascular plants (mosses and lichens) are not included.

Why does my patch not belong to the listed national ecological community? a Patch belongs to a different ecological community; **b** Patch is too small; **c** Degraded: patch is too weedy **d** Degraded: too few native species or insufficient native species cover in ground layer; **e** Degraded: too few trees AND insufficient native species cover in ground layer. Rehabilitation work may be able to restore degraded patches enough to qualify as the listed community.

Plate 9.1 Flowchart to determine presence of the Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia (DSEWPaC 2012)

Approximately 120.17 ha of the EPBC Act listed Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia will be impacted by the Project. Table 9.5 provides an Assessment of Significance under the EPBC Act for the removal of this TEC by the Project, in accordance with the assessment criteria for endangered ecological communities (DoE 2013a). This impact to Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia was referred under the EPBC Act (EPBC 2022/09223). Upon review by DCEEEW, it was considered that the proposed action would have a significant impact to this EEC (date of decision 28 June 2022).

Table 9.5 Assessment of significance for Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia

Criteria	Discussion
Conservation status	**Endangered**
1. Reduce the extent of an ecological community	**Likely**. 120.17 ha of the listed community will be removed by the Project. EMM recorded 313.70 ha within Evolution's nearby and adjoining land-holdings. Approximately 511 ha of Grey Box (*E. microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia has also been mapped within 5 km of the study area, as per the State Vegetation Type Mapping (SVTM; DPE 2022a). This comprises 98 ha of PCT 76 Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions, 339 ha of PCT 80 Western Grey Box - White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion, 4 ha of PCT 82 Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion, 3 ha of PCT 110 Western Grey Box - Cypress Pine shrubby woodland on stony footslopes in the NSW South Western Slopes Bioregion and Riverina Bioregion and 67 ha of PCT 248 Mixed box eucalypt woodland on low sandy-loam rises on alluvial plains in central western NSW. Note that this does not account for the condition of vegetation mapped, and areas of these PCTs in poor condition may not meet the criteria for the EPBC Act listed community. However, much of the DNG mapped within the study area has not been classified in the SVTM, likely due to its derived state, so the extent of DNG consistent with this TEC is likely to be underestimated at least locally in that mapping. All zones of PCT 82 within the Additional disturbance area were identified as Grey Box (*E. microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia in the study area (as per Plate 9.1 and applied in Table 4.9). Accordingly, the Project would result in a reduction of 23.51% in extent of the EEC within a 5 km radius of the Project (based on all areas of the PCTs above meeting the EPBC Act condition requirement). The Commonwealth listing advice (TSSC 2010) estimates that 332,000 ha of the community is extant in NSW and 534,500 ha on a national scale. Accordingly, the Project will result in a reduction of 0.04% in the community's NSW extent and 0.02% on a national scale, respectively. Note that the actual decline may be greater than estimated since The Commonwealth listing advice states that the above estimates do not consider the condition of the remaining extent of this EEC, so the actual decline of this EEC in good condition may be greater than estimated. Based on the extent of loss of the community both locally, within NSW and national scale, the Project is expected to reduce the extent of this ecological community.
2. Fragment or increase fragmentation	**Likely**. The listed community is highly fragmented within and surrounding the study area, with much of the area cleared by past agricultural practices. Accordingly, the Project would increase the degree of fragmentation of the community.
3. Adversely affect critical habitat	**Unlikely**. A Conservation Advice has been developed (DEWHA 2010) for this community, but it does not identify critical habitat for this TEC. Management priorities are allocated toward remnants currently within the Travelling Stock Route estate, which are not within the study area. As such, it is not expected that the Project would adversely affect critical habitat.
4. Modify or destroy abiotic factors necessary for survival	**Unlikely**. Abiotic factors including soil and surface hydrology will be modified in the study area, and therefore represents a permanent impact. The listed community occurs directly west and south of the Additional disturbance area, within the study area. An assessment of changes to groundwater availability and quality that these retained patches would use opportunistically was conducted. The assessment concluded that retained patches of the community would not be adversely affected by the Project.
5. Cause a substantial change in species composition	**Unlikely**. The Project will remove 120.17 ha of habitat for the listed community within the Additional disturbance area. Retained areas of the listed community outside the mine disturbance footprint will be designated as no-go zones (with the exception of entry for environmental management). Weed management measures will also be developed and implemented in retained areas of the community outside the Additional disturbance area, but within the study area. The condition of these areas is likely to improve in quality with this management.

Table 9.5 Assessment of significance for Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia

Criteria	Discussion
6. Cause a substantial reduction in quality or integrity	**Unlikely**. The Project will remove all areas of this community within the Additional disturbance area; consequently, there will be no residual risk within the study area. Areas of this TEC to be retained within study area have historically been impacted directly and indirectly by agriculture for a long period. That is, the majority of weed species within the TEC are exotic pasture species associated with previous agricultural land uses. Weed management measures will be developed and implemented in retained areas of the community within the study area.
7. Interfere with recovery	**Unlikely**. Currently, there is no recovery plan for this TEC. Instead, a Conservation Advice document for this TEC was developed to guide the implementation of priority management actions, mitigate key threats, and support the recovery of this TEC (TSSC 2010). Priority Actions fall under the following: • Habitat Loss, Disturbance and Modification; • Invasive Species; • Trampling, Browsing or Grazing; • Fire; and • Conservation Information. Of the priority actions that address the above threated, the clearance of this TEC has potential to contravene Point 1, by reducing the extent of the listed community. However, the Conservation Advice focuses on protection of remnants of particularly high quality (e.g. within Travelling Stock Route estate) or important in a landscape context (e.g. as wildlife corridors or linkages). As vegetation consistent with this TEC within the Additional disturbance area are not of high quality (medium condition at best), whilst this vegetation is highly fragmented and not an important wildlife corridor or linkage, it is not expected that the Project would interfere with recovery of this TEC. Nevertheless, to offset impacts to this TEC, extensive biodiversity steward areas (BSAs) containing this TEC will be locally managed within Stewardship sites. These BSAs will include active management measures that aim to increase the condition, extent and connectivity of this TEC within the vicinity of Lake Cowal. These measures are consistent with Points 1 to 4 of the above threat abatement actions.
Conclusion	**Likely significant impact**. The Project is likely to result in a significant impact on the listed community as it will remove 120.17 ha of habitat, which is likely to reduce the extent of the TEC and fragment or increase fragmentation. Impacts to the 120.17 ha of the community removed by the Project are known, predictable and irreversible.

b Poplar Box Grassy Woodland on Alluvial Plains

The Commonwealth Listing Advice for the endangered Poplar Box Grassy Woodland on Alluvial Plains (TSSC 2019a) provides a general description of the community and describes its status. It occurs in eastern Australia, intergrading with but ranging further west and north than other grassy woodlands that extend through NSW and southern Queensland. Located west of the Great Dividing Range, this TEC is typically at less than 300 m above sea level (ASL) and between latitudes 20°S to 34°S. It occurs on palaeo and recent depositional soils in flat terrain and occasionally along watercourses in undulating country. The soils in these watercourses are considered alluvial and the regularity of flow after heavy rain curtails shrub growth. The vegetation of the ecological community varies from a grassy woodland to grassy open woodland structure but may occasionally exhibit an open forest structure with an overstorey dominated by Poplar Box (*Eucalyptus populnea*) and an understorey predominantly composed of perennial forbs and C4 grasses. Generally, this TEC lacks a substantial mid layer (tall shrub). Vegetative ground cover can be very sparse during dry periods but become mid-dense after rain particularly if fire has been absent for a long time. Where the Poplar Box Grassy Woodland occurs near creek lines and low-lying areas, species adapted to occasional inundation, such as sedges and rushes, may dominate during these wetter periods.

The listing advice for the community (TSSC 2019a) lists threatening processes for this TEC as clearance and fragmentation, weed invasion, inappropriate fire and grazing, dieback, chemical impact and spraydrift,

hydrological changes, salinization, nutrient enrichment, invasive fauna and climate change. Threat abatement actions are presented in the approved Conservation Advice for this ecological community (TSSC 2019a).

The EPBC Act Policy Statement for Poplar Box Grassy Woodland on Alluvial Plains (DoEE 2019c) provides a table to assist in determining if vegetation patches meet condition thresholds for national legal protection. To be considered consistent with this TEC, the patch must meet the following thresholds based on the key diagnostic characteristics; along with the description of the ecological community and the area it inhabits.

Category and rationale	Native cover and diversity thresholds	Minimum patch size thresholds*
CLASS A HIGHEST QUALITY		
Category A1. Little to no perennial weeds and diverse native understorey	The crown cover of canopy trees in the patch is ≥10% **AND** ≥ 90% of perennial vegetation cover in the ground layer** is native **AND** ≥ 30 native plant species per patch in the ground layer	≥ 1 ha
Category A2. A large patch with low perennial weeds and diverse native understorey	The crown cover of canopy trees in the patch is ≥10% **AND** ≥70% of perennial vegetation cover in the ground layer** is native **AND** ≥ 30 native plant spp. per patch in the ground layer	≥ 5 ha
CLASS B GOOD QUALITY		
Category B. A large patch with good quality native understorey or with mature trees	The crown cover of canopy trees in the patch is ≥10% **AND** ≥ 50% of perennial vegetation cover in ground layer** is native **AND EITHER** ≥ 20 perennial native plant species per patch in the ground layer **OR** ≥ 10 mature trees+ per ha with ≥ 30cm dbh*** (and/or hollows)	≥ 5 ha
CLASS C MODERATE QUALITY		
Category C A large patch with low native cover but retains good native understorey diversity and habitat features of mature trees	The crown cover of canopy trees in the patch is ≥10% **AND** **If** < 50% of perennial vegetation cover in ground layer** is native, then the patch **must** have: ≥ 20 native plant spp. per patch in the ground layer **AND** ≥ 10 mature trees+ per ha with ≥ 30cm dbh*** (and/or hollows) **AND** smaller trees+, saplings or seedlings suggestive of periodic recruitment	≥ 5 ha

Plate 9.2 Condition categories and thresholds for the Poplar Box Grassy Woodland on Alluvial Plains ecological community (TSSC 2012)

Within the Additional disturbance area, Zone 20 DNG and Zone 21 Poor fail to meet the Structure criteria due to a lack of a *Eucalyptus populnea* (Poplar Box) canopy (i.e. no crown cover of canopy trees in the patch ≥10%). Zone 22 Medium meets the native cover and diversity thresholds for Class B Good Quality (i.e. crown cover ≥10%, ≥50% perennial vegetation cover and ≥20 perennial native plant species) but not Class A Highest Quality. However, Zone 22 fails to meet the minimum patch size threshold of ≥5 ha Class B Good Quality; the total patch size associated with Zone 22 is <3 ha. As such, this patch of TEC is below the minimum for a patch to be considered for a referral, environment assessment and compliance provisions of the EPBC Act. As such, an Assessment of Significance under the EPBC Act has not been undertaken here. Nevertheless, following the precautionary principle, this patch of Poplar Box Grassy Woodland on Alluvial Plains EEC was referred under the EPBC Act (EPBC 2022/09223). Upon review by DCEEEW, it was not considered that the proposed action would have a significant impact to this EEC (date of decision 28 June 2022).

c Weeping Myall Woodlands

The Commonwealth Listing Advice for the endangered Weeping Myall Woodlands (TSSC 2008a) provides a general description of the community and describes its status. This TEC occurs on the inland alluvial plains west of the Great Dividing Range in NSW and Queensland. It occurs in the Riverina, NSW South Western Slopes, Darling Riverine Plains, Brigalow Belt South, Brigalow Belt North, Murray-Darling Depression, Nandewar and Cobar Peneplain IBRA Bioregions. The ecological community currently occurs in small pockets throughout this range.

Weeping Myall Woodlands occur in a range of forms from open woodlands to woodlands, in which weeping myall (*Acacia pendula*) trees are the sole or dominant overstorey species (DEWHA 2009). The understorey of Weeping Myall Woodlands often includes an open layer of shrubs above an open ground layer of grasses and herbs, though the ecological community can exist naturally as either a shrubby, or grassy woodland. The ecological community generally occurs on flat areas, shallow depressions or gilgais on raised alluvial plains. These areas are not associated with active drainage channels and are rarely, if ever, flooded. The ecological community occurs on black, brown, red-brown or grey clay or clay loam soils.

The listing advice identified the main threats to the ecological community as clearing and ongoing degradation (TSSC 2008a). As Weeping Myall occurs on highly fertile and arable soils where there is significant pressure to clear for cropping. Other threats include overgrazing, weed invasion and herbivory by caterpillars of the Bag-shelter Moth. Threat abatement actions are presented in the approved Conservation Advice for this ecological community (TSSC 2008a).

The EPBC Act Policy Statement for Weeping Myall Woodlands (DEWHA 2009) provides a flowchart to assist in determining if patches are included in the listed community (Plate 9.3). The structure and diversity of the native plant community types (PCTs) in the Project application area have been compared with that flowchart, with an assessment of vegetation zones against these criteria was made in Table 4.6. That assessment found vegetation zones 3 (Poor), 5 (Medium) and 6 (High) meet all the criteria for Weeping Myall Woodlands as listed under the EPBC Act.

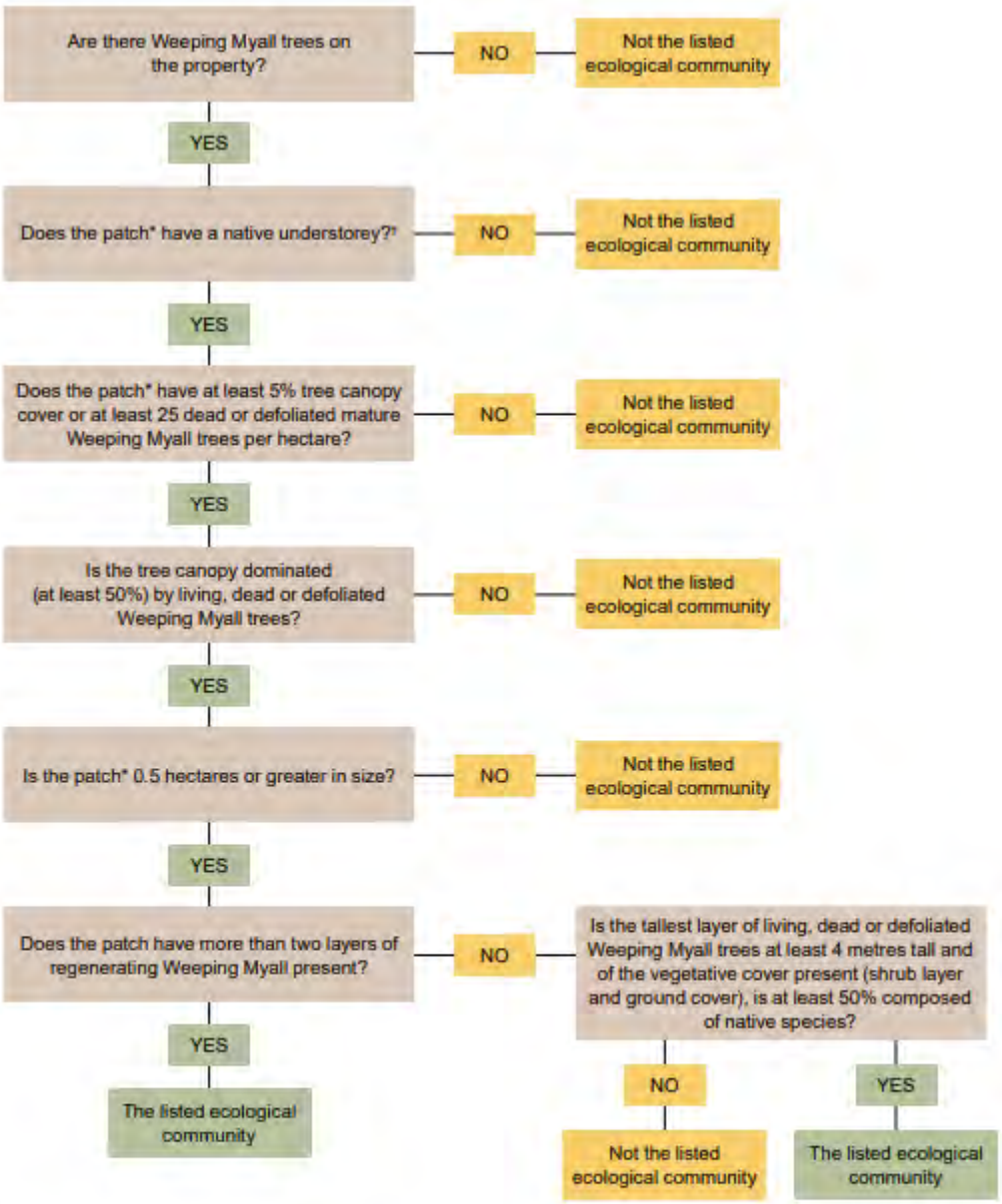


Plate 9.3 Weeping Myall Woodlands – Decision Flowchart (DEWHA 2009)

Approximately 11.11 ha of the EPBC Act listed Weeping Myall Woodlands will be impacted by the Project. Table 9.6 provides an Assessment of Significance under the EPBC Act for the removal of this TEC by the Project, in accordance with the assessment criteria for endangered ecological communities (DoE 2013a). This impact on Weeping Myall Woodlands was referred under the EPBC Act (EPBC 2022/09223). Upon review by DCEEEW, it was considered that the proposed action would have a significant impact to this EEC (date of decision 28 June 2022).

Table 9.6 Assessment of significance for Weeping Myall Woodlands

Criteria	Discussion
Conservation status	**Endangered**
1. Reduce the extent of an ecological community	**Likely**. Approximately 11.11 ha of the listed community will be removed by the Project. EMM recorded 24.00 ha within Evolution's nearby and adjoining land-holdings. Approximately 55 ha of Weeping Myall Woodlands has also been mapped within 5 km of the study area, as per the SVTM (DPIE 2022a). This comprises entirely of PCT 26 Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion. Note that this does not account for the condition of vegetation mapped, and areas of these PCTs in poor condition may not meet the criteria for the EPBC Act listed community. However, much of the DNG mapped within the study area has not been classified in the SVTM, likely due to its derived state, so the extent of DNG consistent with this TEC is likely to be underestimated at least locally in that mapping. Vegetation zones 3 (Poor), 5 (Medium) and 6 (High) within the Additional disturbance area meet all the criteria for Weeping Myall Woodlands as listed under the EPBC Act (as per Plate 9.3 and applied in Table 4.6). Accordingly, the Project would result in a reduction of 20% in extent of the EEC within a 5 km radius of the Project (based on all areas of the PCTs above meeting the EPBC Act condition requirement). The Commonwealth listing advice (TSSC 2010) estimates that 190,000 to 330,000 ha of the community is extant in NSW and 220,000 to 361,000 ha on a national scale. Accordingly, the Project will result in a reduction of 0.006% in the community's NSW extent and 0.005% on a national scale, respectively. The Commonwealth listing advice states that the above estimates do not consider the amount that remains in good condition, so the actual decline may be greater than estimated. Based on the extent of loss of the community both locally, within NSW and national scale, the Project is expected to reduce the extent of this ecological community.
2. Fragment or increase fragmentation	**Likely**. The listed community is highly fragmented within and surrounding the study area, with much of the area cleared by past agricultural practices. Accordingly, the Project would increase the degree of fragmentation of the community.
3. Adversely affect critical habitat	**Unlikely**. A Conservation Advice has been developed (TSSC 2008a) for this community, but it does not identify critical habitat for this TEC. Management priorities are allocated toward highest quality remnants, which are currently within the Travelling Stock Route estate and reserves, which do not occur within the study area. As such, it is not expected that the Project would adversely affect critical habitat.
4. Modify or destroy abiotic factors necessary for survival	**Unlikely**. Abiotic factors including soil and surface hydrology will be modified in the study area, and therefore represents a permanent impact. The listed community occurs directly west and south of the Additional disturbance area, within the study area. An assessment of changes to groundwater availability and quality that retained patches would use opportunistically was conducted. The assessment concluded that retained patches of the community would not be adversely affected by the Project.
5. Cause a substantial change in species composition	**Unlikely**. The Project will remove 11.11 ha of habitat for the listed community within the Additional disturbance area. Retained areas of the listed community outside the Additional disturbance area will be designated as no-go zones (with the exception of entry for environmental management). Weed management measures will also be developed and implemented in retained areas of the community outside the Additional disturbance area, but within the study area. The condition of these areas is likely to improve in quality with this management.
6. Cause a substantial reduction in quality or integrity	**Unlikely**. The Project will remove all areas of this community within the Additional disturbance area; consequently, there will be no residual risk within the study area. Areas of this TEC to be retained within study area have historically been impacted directly and indirectly by agriculture for a long period. That is, the majority of weed species within the TEC are exotic pasture species associated with previous agricultural land uses. Weed management measures will be developed and implemented in retained areas of the community within the study area.

Table 9.6 Assessment of significance for Weeping Myall Woodlands

Criteria	Discussion
7. Interfere with recovery	**Unlikely**. Currently, there is no recovery plan for this TEC. Instead, a Conservation Advice document for this TEC was developed to guide the implementation of priority management actions, mitigate key threats, and support the recovery of this TEC (TSSC 2008a). Priority Actions fall under the following: • protecting remnants of the listed ecological community through the development of conservation agreements and covenants; • the use of strategic grazing that allows regeneration; • replanting of understorey species where they have been depleted; • use of lopping methods that do not result in the death of the dominant tree species; • avoiding the application of fertilisers and herbicides in or near remnants; • protecting remnants from weeds including the speedy eradication of any new invasions; and • raising awareness of the ecological community within the community. Of the priority actions that address the above threated, the clearance of this TEC has potential to contravene Point 1, by reducing the extent of the listed community. However, the Conservation Advice focuses on protection of remnants of particularly high quality (e.g. within Travelling Stock Route estate). As vegetation consistent with this TEC within the Additional disturbance area are not of high quality (medium condition at best), it is not expected that the Project would interfere with recovery of this TEC. Nevertheless, to offset impacts to this TEC, extensive BSAs containing this TEC will be locally established. These BSAs will include active management measures which aim to increase the condition, extent and connectivity of this TEC within the vicinity of Lake Cowal. These measures are consistent with Points 1, 3 and 5 of the above threat abatement actions.
Conclusion	**Likely significant impact**. The Project is likely to result in a significant impact on the listed community as it will remove 11.11 ha of habitat, which is likely to reduce the extent of the TEC and fragment or increase fragmentation. Impacts to the 11.11 ha of the community removed by the Project are known, predictable and irreversible.

d Australasian Bittern

The Commonwealth Conservation Advice for the Australasian Bittern (EPBC Act: Endangered) (TSSC 2019b) describes the conservation status, distribution, biology/ecology and threats to the survival of the Australasian Bittern. The Australasian Bittern occurs from south-east Queensland to south-east South Australia as far as the Adelaide Region, southern Eyre Peninsula, Tasmania and in the southwest of Western Australia. In New South Wales, it occurs along the coast and is also frequently recorded in the Murray Darling Basin, notably in floodplain wetlands of the Murray, Murrumbidgee, Lachlan, Macquarie and Gwydir Rivers. Garnett et al. (2011) estimated that there were 1,000 mature Australasian Bitterns within the Australian population, with the population likely declining. BirdLife International (2022) estimated in 2009-2010 there to be 82-162 in New South Wales. Key threats can be broadly grouped as habitat loss, transitions from ponded rice farming to other farming systems, habitat degradation, climate change, infrastructure and introduced animals.

The draft National Recovery Plan for the Australasian Bittern (DoEE 2019a) details the species biology, ecology, distribution, populations, habitat and threats. The draft recovery plan describes the species as occurring mainly in freshwater wetlands in the temperate southeast and southwest of Australia and, exceptionally, in estuaries or tidal wetlands. The preferred habitat is described as wetlands with dense vegetation, especially where there is a mosaic of cover, 0.5–3.5 m in height, where they forage in still, shallow water (<0.3 m deep), often at the edges of pools or waterways, or from platforms or mats of vegetation over deep water. In the Murray-Darling Basin, in which Lake Cowal occurs, the Australasian Bittern is known to associate with floodplain swamps that may include Lignum within sedge or reed beds. However, although it occurs in several wetland types, breeding is known to occur in a sub-set of locations.

The Australasian Bittern is capable of moving between habitats as suitability changes (DoEE 2019a), which includes occurrence of suitable habitat and prey species. It can occur in high densities in temporary or infrequently filled wetlands during exceptionally wet years and will also use ephemeral wetlands when moving from areas that are drying out. As such habitat critical for the survival of the species is defined as:

- Any wetland habitat where the species is known or likely to occur (breeding or foraging habitat) within the indicative distribution map (Figure 1 of DoEE 2019a).
- Any location with suitable habitat outside the above area that may be periodically occupied by Australasian Bittern.

It is considered that critical habitat is present within the Additional disturbance area since there is wetland habitat within the area where the species is known or likely to occur and it is periodically occupied by Australasian Bittern. That is, based on the multiple recordings of Australasian Bittern recorded within and adjacent to the Additional disturbance area (including three records by EMM in November and December 2020; see Section 5.3.4ii), it assumed that all zones associated with PCTs 17, 53 and 249 (PCTs in the Study area associated with the Australasian Bittern) offer habitat critical to the survival of this species.

Table 9.7 provides an assessment of significance for the removal of up to 375.09 ha of Australasian Bittern habitat, in accordance with the assessment criteria for endangered species (DoE 2013a). This impact on Australasian Bittern was referred under the EPBC Act (EPBC 2022/09223). Upon review by DCEEEW, it was considered that the proposed action would have a significant impact to this species (date of decision 28 June 2022).

The potential impact of the Project on Australasian Bittern was referred under the EPBC Act (EPBC 2022/09223). At that time, the self-assessment concluded that there was a potential significant impact on Australasian Bittern, after all suitable habitat was surveyed. Upon review by DCEEEW, it was considered that there would be a significant impact to this species (date of decision 28 June 2022). Table 9.7 provides an assessment of significance for the removal of up to 375.09 ha of potential Australian Bittern habitat, in accordance with the assessment criteria for endangered species (DoE 2013a).

Table 9.7 Assessment of significance for the Australasian Bittern

Criteria	Discussion
1. Lead to a long-term decrease in the size of a population	**Unlikely**. Australasian Bittern are widely dispersed across south-eastern and south-western Australia, with the Additional disturbance area offering potential habitat for the south-eastern sub-population when inundated. Due the broad extent of potentially suitable wetland habitat in south-eastern Australia, it is considered unlikely that the Project would lead to a long-term decrease in the size of a population. Moreover, the retention and establishment of BSAs within the western half of Lake Cowal should also assist in securing and enhancing a large extent of remaining habitat in Lake Cowal.
2. Reduce the area of occupancy of the species	**Unlikely**. Australasian Bittern are widely dispersed across south-eastern Australia, so the loss of 375.09 ha of ephemeral habitat toward the middle of the distribution of the south-eastern population, is unlikely to reduce the area of occupancy for the species. Moreover, considering that suitable habitat will be retained and enhanced within BSAs within Lake Cowal, usage of this wetland by this species should be supported in the long term. Hence, it is unlikely that the Project would reduce the area of occupancy of the species.
3. Fragment an existing population into two or more populations	**Unlikely**. As the Australasian Bittern are highly mobile and widely dispersed across south-eastern Australia, it is not expected that the Project would fragment an existing population into two or more populations.

Table 9.7 Assessment of significance for the Australasian Bittern

Criteria	Discussion
4. Adversely affect habitat critical to the survival of a species	**Likely.** The Additional disturbance area is considered to provide habitat critical to the Australasian Bittern since there is wetland habitat within the area where the species is known or likely to occur and it is periodically occupied by Australasian Bittern (with three sightings by EMM across 2020 and 2021; and a record of this species in 1993 as part of Evolution waterbird monitoring). As such, the Project will impact all zones associated with PCTs 17, 53 and 249, which constitute habitat critical to the survival of the species. Section 8.2 details avoidance measures implemented by Evolution into the Project design to minimise impacts on habitat for this species. Moreover, establishment of BSA(s) within Lake Cowal will assist in protecting and enhancing areas of habitat to be retained (see Section 10: Biodiversity Offset Strategy).
5. Disrupt breeding cycle of a population	**Unlikely.** Although breeding of the Australasian Bittern has not been recorded in the Additional disturbance area, individual(s) were recorded by EMM in November and December 2020, which is within the breeding period for the species (DoEE 2019a). Nevertheless, based on the paucity of records of this species (as evidenced by the next recent recorded of one Australasian Bittern in Lake Cowal in January 1993), if breeding occurs in or nearby the Additional disturbance area, it may be an uncommon event. Based on the lack of evidence of regular breeding of Australasian Bittern in or near the Additional disturbance area, and the retention of habitat and establishment of BSAs (including active management that enhances habitat value) within the western half of Lake Cowal, it is considered unlikely that the Project would disrupt the breeding cycle of a population.
6. Modify, destroy, remove, isolate or degrade habitat	**Possible.** The Project will remove 375.09 ha of habitat for the Australasian Bittern in the Additional disturbance area. Based on the extent of habitat to be removed, where this species has been found to occur on multiple occasions, it is possible that the Project would modify, destroy, remove, isolate or degrade habitat to the extent that the species is likely to decline.
7.Result in invasive species	**Unlikely.** Soil disturbance for the Project has potential to result in the spread of invasive weeds to retained areas of vegetation and potential habitat. Weed control procedures will be developed during the EIS to minimise the impact on potential foraging habitat for the Australasian Bittern. BSA(s) to be established in Lake Cowal will implement pest animal control programs, including for foxes and cats, which are current threatening processes for the species (see Section 10: Biodiversity Offset Strategy).
8. Introduce disease	**Unlikely.** There are no known diseases listed as a threatening process for the species. Hence, the Project is unlikely to cause a disease outbreak.
9. Interfere with recovery	**Unlikely.** Recovery actions are yet to be formalised. Within the draft National Recovery Plan for the Australasian Bittern, actions proposed to achieve objectives aim to mitigate threats, enhance/improve protection of suitable habitat, increase knowledge of the species ecological requirements, and increase stakeholder participation in conservation and management (DoEE 2019a). As the Project will adversely affect habitat critical to the survival of the species, it may interfere with recovery by contravening the first objective of mitigating threats, despite the proposed actions in the draft recovery plan focusing heavily on water management. Nevertheless, to offset impacts of the Project to Austral Bittern habitat, BSAs will be established in Lake Cowal that should assist in the long-term recovery of the species (see Section 10: Biodiversity Offset Strategy). These BSAs will include active management measures, including reducing invasive predators such as foxes and cats, managing fire and minimising impacts of overgrazing. These actions are consistent with actions proposed in the draft recovery guidelines, that should increase the condition and extent of suitable habitat within the vicinity of Lake Cowal.
Conclusion	**Likely significant impact.** It is likely that the clearance of 375.09 ha of Australasian Bittern habitat will have a significant impact on the species through adversely affect habitat critical to survival, whilst may modify, destroy, remove, isolate or degrade habitat to the extent that the species is likely to decline. Impacts are known, predictable and irreversible.

e Australian Painted Snipe

The Commonwealth Conservation Advice for the Australian Painted Snipe (EPBC Act: Endangered) (TSSC 2013) describes the conservation status, distribution, biology/ecology and threats to the survival of the Australian Painted Snipe. This species is generally widespread across Australia, but important areas for this species include the Murray-Darling Basin (particularly the Riverina of Victoria and New South Wales), Queensland Channel Country, Fitzroy Basin of Central Queensland, south-eastern South Australia and adjacent parts of Victoria. It is estimated that the species' current population is 2500 mature individuals. This species has experienced a decline attributed to loss and degradation of wetland habitat, primarily through water drainage and diversions associated with agriculture. Other threats include grazing, trampling of wetland vegetation/nests and nutrient enrichment of habitat by livestock; reduced rainfall and runoff from climate change, predation by feral animals (namely cats and foxes) and weed invasions of wetland habitat.

The draft National Recovery Plan for the Australian Painted Snipe (DoEE 2019b) details the species biology, ecology, distribution, populations, habitat and threats. The draft recovery plan describes habitat for this species as generally shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. It is also known to use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Breeding habitat is however thought to be quite specific, with shallow wetlands with areas of bare wet mud and mixed heights of low vegetation. Gilgai micro relief, comprising extensive systems of small mounds (e.g. 1 to 3 m in diameter) and hollows (e.g. up to 0.5 m deep), are known to be especially suitable. It has been recorded nesting in and near swamps, canegrass swamps, flooded areas including grazing land, among cumbungi, sedges, tussock grasses, various couch grasses, and samphires (*Tecticornia* spp.), also in ground cover of water-buttons and grasses, at the base of tussocks and under low saltbush.

Due to the widespread and unpredictable movements of this species, habitat requirements are poorly understood (DoEE 2019b). Wetland mosaics are known to support the species; however their utility may vary seasonally in response to various biophysical factors, including plants, animals, water depth, geology, landforms, and climate. As such habitat critical for the survival of the species is defined as:

- Any habitat where the species is known or likely to occur (especially with suitable breeding habitat) within the indicative distribution map (Figure 1 of DoEE 2019b).
- Any location outside the above area that may be periodically occupied by Australian Painted Snipe when conditions are favourable.

It is considered that critical habitat Australian Painted Snipe may be present within the Additional disturbance area since there is suitable wetland habitat (including Lake Cowal and nearby gilgais) where the species is known or likely to occur. That is, although infrequent, Australian Painted Snipe has been historically recorded at Lake Cowal. The most recent record was of three records of single individuals in 2021 in Lake Cowal south (eBird 2023b). There are also four records of this species at Lake Cowal on BioNet, with the last recorded in 1997 (BioNet Atlas 2023). Nevertheless, no observations of breeding activity of this species were provided with those records. However, ongoing waterbird surveys by Evolution since 1989 and those undertaken by EMM have failed to detect this species. Nevertheless, based on the general habitat requirements for the species combined with these records, gilgais within PCT26 and 55, as well as wetland habitat within Lake Cowal and its foreshore (i.e. PCTs 17, 53 and 249) may provide important habitat for this species.

The potential impact of the Project on Australian Painted Snipe was referred under the EPBC Act (EPBC 2022/09223). At that time, the self-assessment concluded that there was a potential significant impact on Australian Painted Snipe, after all suitable habitat was surveyed. Upon review by DCEEEW, it was not considered that there would be a significant impact to this species (date of decision 28 June 2022). However, it was recommended that further assessment is required to determine if this protected matter is present, and if so, consider the extent to which those matters may be significantly impacted by the proposed action according to the department's Significant Impact Guidelines 1.1. Table 9.8 provides an assessment of significance for the removal of up to 375.09 ha of potential Australian Painted Snipe habitat, in accordance with the assessment criteria for endangered species (DoE 2013a).

Table 9.8 Assessment of significance for the Australian Painted Snipe

Criteria	Discussion
1. Lead to a long-term decrease in the size of a population	**Unlikely**. Australian Painted Snipe consist of a single population that is widely dispersed across Australia. Due to the broad extent of potentially suitable wetland habitat across its range, it is considered unlikely that the Project would lead to a long-term decrease in the size of a population. Moreover, the retention and establishment of BSAs within the western half of Lake Cowal should also assist in securing and enhancing a large extent of remaining habitat in Lake Cowal.
2. Reduce the area of occupancy of the species	**Unlikely**. Australian Painted Snipe are widely dispersed across Australia, so the loss of 375.09 ha of ephemeral habitat toward the middle of the known distribution of the species in eastern Australia, is unlikely to reduce the area of occupancy for the species. Moreover, considering that suitable habitat will be retained and enhanced within BSAs within Lake Cowal, usage of this wetland by this species should be supported in the long term. Hence, it is unlikely that the Project would reduce the area of occupancy of the species.
3. Fragment an existing population into two or more populations	**Unlikely**. As the Australian Painted Snipe are highly mobile and widely dispersed across Australia, it is not expected that the Project would fragment an existing population into two or more populations.
4. Adversely affect habitat critical to the survival of a species	**Possible.** The Additional disturbance area is considered to provide potential habitat critical to the Australian Painted Snipe since there is wetland habitat within the area where the species is known or likely to occur and it is periodically occupied by Australian Painted Snipe (last recorded in Lake Cowal in 2021; eBird 2023b). As such, the Project will impact all zones associated with wetland habitat PCTs 17, 53 and 249, which may constitute habitat critical to the survival of the species. Section 8.2 details avoidance measures implemented by Evolution into the Project design to minimise impacts on habitat for this species. Moreover, establishment of BSA(s) within Lake Cowal will assist in protecting and enhancing areas of habitat to be retained (see Section 10: Biodiversity Offset Strategy).
5. Disrupt breeding cycle of a population	**Unlikely.** Breeding of the Australian Painted Snipe has not been recorded in Lake Cowal, with all records of single individuals (BioNet Atlas 2023; eBird 2023b). Based on the paucity of records of this species and lack of observed breeding at Lake Cowal, if breeding occurs in or nearby the Additional disturbance area, it may be an uncommon event. Based on the lack of evidence of regular breeding of Australian Painted Snipe in or near the Additional disturbance area, and the retention of habitat and establishment of BSAs (including active management that enhances habitat value) within Lake Cowal, it is considered unlikely that the Project would disrupt the breeding cycle of a population.
6. Modify, destroy, remove, isolate or degrade habitat	**Possible.** The Project will remove 375.09 ha of habitat for the Australian Painted Snipe in the Additional disturbance area. Based on the extent of habitat to be removed, where this species has been found to occur nearby on multiple occasions, it is possible that the Project would modify, destroy, remove, isolate or degrade habitat to the extent that the species is likely to decline.

Table 9.8 Assessment of significance for the Australian Painted Snipe

Criteria	Discussion
7.Result in invasive species	**Unlikely.** Soil disturbance for the Project has potential to result in the spread of invasive weeds to retained areas of vegetation and potential habitat. Weed control procedures will be developed during the EIS to minimise the impact on potential foraging habitat for the Australian Painted Snipe. BSA(s) to be established in Lake Cowal will implement pest animal control programs, including for foxes and cats, which are current threatening processes for the species (see Section 10: Biodiversity Offset Strategy
8. Introduce disease	**Unlikely.** There are no known diseases listed as a threatening process for the species. Hence, the Project is unlikely to cause a disease outbreak.
9. Interfere with recovery	**Unlikely.** Recovery actions are yet to be formalised. Within the draft National Recovery Plan for the Australian Painted Snipe, actions proposed to achieve objectives aim to manage/protect breeding habitat, measure populations, reduce/eliminate threats, increase knowledge of the species ecological requirements, and increase stakeholder participation in conservation and management (DoEE 2019b). As the Project will adversely affect non-breeding habitat critical to the survival of the species, it may interfere with recovery by contravening the third objective of mitigating threats, despite the proposed actions in the draft recovery plan focusing heavily on water management. Nevertheless, to offset impacts of the Project to Australian Painted Snipe habitat, BSAs will be established in Lake Cowal that should assist in the long-term recovery of the species (Section 10). These BSAs will include active management measures, including reducing invasive predators such as foxes and cats, managing fire and minimising impacts of overgrazing. These actions are consistent with actions proposed in the draft recovery guidelines, that should increase the condition and extent of suitable habitat within the vicinity of Lake Cowal.
Conclusion	**Possible significant impact.** It is possible that the clearance of 375.09 ha of Australian Painted Snipe habitat will have a significant impact on the species through adversely affect non-breeding habitat critical to survival, whilst may modify, destroy, remove, isolate or degrade habitat to the extent that the species is likely to decline. Impacts are known, predictable and irreversible.

f Curlew sandpiper

The Curlew sandpiper breeds in the Arctic of northern Siberia (DCCEEW 2023c). Within Australia during non-breeding periods, the Curlew sandpiper occur around the coasts and are also quite widespread inland, though in smaller numbers. In NSW, they are widespread east of the Great Divide, especially in coastal regions. They are occasionally recorded in the Tablelands and are widespread in the Riverina and south-west NSW, with scattered records elsewhere. The estimated EAAF population is 135,000 (Hansen et al. 2016). This is approximately 13% of the global population, estimated to be 1,085,000–1,285,000 (Birdlife International 2023).

In Australia, the Curlew sandpiper occurs on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. Although less often found Inland, here they are known to associate with ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand.

Across Lake Cowal, the species has been recorded within Evolution's monitoring in only one survey event since 1989. The count during that survey was of 12 individuals. This species has not been recorded during UNSW monitoring or by EMM. There is no evidence of this species breeding at Lake Cowal. Table 9.9 provides an assessment of significance for the removal of up to 375.09 ha of potential Curlew Sandpiper habitat, in accordance with the assessment criteria for endangered species (DoE 2013a).

Table 9.9 Assessment of significance for the Curlew Sandpiper

Criteria	Discussion
1. Lead to a long-term decrease in the size of a population	**Unlikely**. Curlew Sandpiper consist of a single population that is widely dispersed across mostly coastal areas of Australia, but also visits erratically visits inland wetland habitats. Due to the broad extent of potentially suitable wetland habitat across its range, it is considered unlikely that the Project would lead to a long-term decrease in the size of a population. Moreover, the retention and establishment of BSAs within the western half of Lake Cowal should also assist in securing and enhancing a large extent of remaining habitat in Lake Cowal.
2. Reduce the area of occupancy of the species	**Unlikely**. Curlew Sandpiper are widely dispersed across Australia and mostly visit coastal habitat, so the loss of 375.09 ha of ephemeral inland habitat is unlikely to reduce the area of occupancy for the species. Moreover, considering that suitable habitat will be retained and enhanced within BSAs within Lake Cowal, usage of this wetland by this species should be supported in the long term. Hence, it is unlikely that the Project would reduce the area of occupancy of the species.
3. Fragment an existing population into two or more populations	**Unlikely**. As the Curlew Sandpiper are highly mobile and widely dispersed across Australia, it is not expected that the Project would fragment an existing population into two or more populations.
4. Adversely affect habitat critical to the survival of a species	**Unlikely**. Habitat critical to the survival of the species has not been defined within the Conservation Advice (TSSC 2019), whilst there is no recovery plan for the species. Lake Cowal is not one of the 22 internationally important sites for this species in Australia. Habitat within the Additional disturbance area is considered opportunistic foraging habitat only, where ephemeral wetland habitat in Lake Cowal may be infrequently used for foraging, so it is considered unlikely that the Project would adversely affect habitat critical to survival. That is, the species has only been recorded within Lake Cowal on one occasion by monitoring undertaken by Evolution since 1989. Nevertheless, Section 8.2 details avoidance measures implemented by Evolution into the Project design to minimise impacts on habitat for this species. Moreover, establishment of BSA(s) within Lake Cowal will assist in protecting and enhancing areas of habitat to be retained (see Section 10: Biodiversity Offset Strategy).
5. Disrupt breeding cycle of a population	**Unlikely.** Curlew Sandpiper is a migratory species that does not breed in Australia. Hence, it is considered unlikely that the Project would disrupt the breeding cycle of a population.
6. Modify, destroy, remove, isolate or degrade habitat	**Possible.** The Project will remove 375.09 ha of opportunistic foraging habitat for the Curlew Sandpiper in the Additional disturbance area. Based on the extent of habitat to be removed, where this species has been found to occur nearby on multiple occasions, it is possible that the Project would modify, destroy, remove, isolate or degrade habitat to the extent that the species is likely to decline.
7.Result in invasive species	**Unlikely.** Soil disturbance for the Project has potential to result in the spread of invasive weeds to retained areas of vegetation and potential habitat. Weed control procedures will be developed during the EIS to minimise the impact on potential foraging habitat for the Curlew Sandpiper. BSA(s) to be established in Lake Cowal will implement pest animal control programs, including for foxes and cats, which are current threatening processes for the species (see Section 10: Biodiversity Offset Strategy).
8. Introduce disease	**Unlikely.** There are no known diseases listed as a threatening process for the species. Hence, the Project is unlikely to cause a disease outbreak.
9. Interfere with recovery	**Unlikely.** Recovery actions are not proposed for this species, with approved conservation advice provides sufficient direction to implement priority actions and mitigate against key threats. Actions proposed to achieve objectives within the approved conservation advice aim to achieve a stable or increasing population; maintain and enhance important habitat; disturbance at key roosting and feeding sites reduce and raise awareness of curlew sandpiper within the local community. In alignment with these objectives, to offset impacts of the Project to Curlew Sandpiper, BSAs will be established in Lake Cowal that should assist in the long-term recovery of the species (see Section 10: Biodiversity Offset Strategy). These BSAs will include active management measures, including reducing invasive predators such as foxes and cats, managing fire and minimising impacts of overgrazing. These actions are consistent with actions proposed in the draft recovery guidelines, that should increase the condition and extent of suitable habitat within the vicinity of Lake Cowal.

Table 9.9 Assessment of significance for the Curlew Sandpiper

Criteria	Discussion
Conclusion	**Unlikely significant impact.** The Project would contribute to loss of 375.09 ha of potential foraging habitat for the Curlew Sandpiper. However, the loss of this foraging habitat is considered unlikely to be a significant impact since this species has only been recorded once in the study area within the current or past studies, with the species known to infrequently utilise such inland habitat. Moreover, as a migratory species, no breeding of this species occurs at Lake Cowal.

g Glossy-black Cockatoo

The Commonwealth Conservation Advice for the Glossy-black Cockatoo (EPBC Act: Vulnerable) (DCCEEW 2022) describes the conservation status, distribution, biology/ecology and threats to the survival of this species. They are widespread, but uncommon, and can be found from Mitchell, Queensland, through eastern New South Wales to East Gippsland, Victoria. Their distribution is continuous through the forested parts of the Great Dividing Range but becomes more scattered inland, to as far west as the Riverina in New South Wales. South-eastern glossy black cockatoos feed almost exclusively on the seeds of sheoaks (*Allocasuarina* spp. and *Casuarina* spp.), usually relying on one or two species within a region. South-eastern glossy black cockatoos are hollow nesters, utilising large hollows in both living and dead eucalypt trees. The main threat causing the decline of south-eastern glossy black cockatoo is a result of habitat loss, degradation, and fragmentation.

Foraging habitat considered to be critical to the survival of the species in inland NSW is considered to be Drooping sheoak (*A. verticillata*), Broombush sheoak (*A. diminuta*), Mallee sheoak (*A. gymnanathera*), Belah (*C. cristata*) are all important food, although other species [e.g. Bulloak (*A. luehmannii*)] may be utilised in some years. Noting that Belah (*C. cristata*) and Bulloak (*A. luehmannii*) were located in the Study area. Breeding habitat considered critical to the survival of the species is considered to be living or dead trees with potential nest hollows that are >8 m above the ground, located in branches >30 cm diameter, branch or stem no more than 45° from vertical and minimum entrance diameter of >15 cm. Tree species within the Study area that are known to support Glossy Black Cockatoo breeding are River red gums (*E. camaldulensis*), with other documented trees that potentially support breeding absent [e.g. Narrow-leaved ironbark (*Eucalyptus crebra*), Blue-leaved ironbark (*E. nubila*) and Blakely's red gum (*E. blakelyi*)].

Table 9.10 provides an assessment of significance for the removal of up to 55.99 ha of potential Glossy-black Cockatoo foraging habitat, in accordance with the assessment criteria for vulnerable species (DoE 2013a).

Table 9.10 Assessment of significance for the Glossy-black Cockatoo

Criteria	Discussion
1. Long-term decrease of an important population	**Unlikely**. This species consists of a single population that is widely dispersed across south-eastern Australia, and so no important population has been identified. Birds in the Riverina in NSW were previously thought to be isolated from the main population, but they are now considered to be connected.
2. Reduce occupancy area for important population	**Unlikely**. As above.
3. Fragment an important population	**Unlikely**. As above.

Table 9.10 Assessment of significance for the Glossy-black Cockatoo

Criteria	Discussion
4. Adversely affect habitat critical to survival	**Possible.** The Additional disturbance area is likely to provide potential foraging habitat for the Glossy-black cockatoo only since no breeding was detected within targeted surveys nor has been historically recorded in or near the Study area. However, wooded zones consisting of PCTs 55 and 82 present potential foraging opportunities as they provide potential feed trees in the form of Belah (*C. cristata*) and Bulloak (*A. luehmannii*). As such, the Project will impact 55.99 ha of potential foraging habitat, consisting of all zones with mature trees (poor, planted and medium) of PCTs 55 and 82, which constitutes of habitat this species is known to associate (BioNet TBDC 2023d). Note that this species may also associated with PCT 185 and 244, but vegetation zones in these communities largely lacked suitable feed trees, so were not considered foraging habitat. Despite the presence of potential feed trees within the study area, there is a lack of Glossy Black Cockatoo observed within the study area despite targeted diurnal surveys and historic bird surveys undertaken within the mining lease. As mentioned in the Commonwealth Conservation Advice, the Glossy Black Cockatoo shows strong preference to individual feed trees, owing to the size of cones, the number and weight of seeds contained therein, and their nutritional content. Based on a lack of detections in the study area, the value of potential food resources for the local population is not considered low. Hence, utilisation of these potential resources is considered low. Nevertheless, applying the precautionary principal to account for future resource needs in such a fragmented landscape, it was considered the Project could potentially affect habitat critical to survival. Section 8.2 details avoidance measures implemented by Evolution into the Project design to minimise impacts on habitat for this species. Moreover, establishment of BSA(s) within the Lake Cowal region will assist in protecting and enhancing areas of habitat for this species (see Section 10: Biodiversity Offset Strategy).
5. Disrupt breeding cycle	**Unlikely.** Breeding of the Glossy-black cockatoo has not been recorded in or nearby Lake Cowal (BioNet Atlas 2023; eBird 2023c). Based on the lack of evidence of regular breeding of Glossy-black cockatoo in or near the Additional disturbance area, and the retention of habitat and establishment of BSAs (including active management that enhances habitat value) within the Lake Cowal region, it is considered unlikely that the Project would disrupt the breeding cycle of a population.
6. Modify, destroy, remove, isolate or degrade habitat	**Unlikely.** The Project will remove 55.99 ha of low value foraging habitat for the Glossy Black Cockatoo in the Additional disturbance area. Based on the low utilisation of this habitat, with this species not detected in the study area despite targeted surveys during the current and historic studies, it is considered unlikely that the Project would modify, destroy, remove, isolate or degrade habitat to the extent that the species is likely to decline.
7.Result in invasive species	**Unlikely.** Soil disturbance for the Project has potential to result in the spread of invasive weeds to retained areas of vegetation and potential habitat. Weed control procedures will be developed during the EIS to minimise the impact on potential foraging habitat for the Glossy Black Cockatoo.
8. Introduce disease	**Unlikely.** There are no known diseases listed as a threatening process for the species. Hence, the Project is unlikely to cause a disease outbreak.
9. Interfere with recovery	**Possible.** A recovery plan has not yet been developed. Recovery priorities in the conservation advice list are clearing of native vegetation/timber harvesting and habitat fragmentation, inappropriate fire regimes and competition for nest hollows. As the Project will clearing of native vegetation including potential Sheoak feed trees, there is potential for the Project to interfere with recovery. Nevertheless, to offset impacts of the Project to Glossy Black Cockatoo foraging habitat, BSAs will be established in Lake Cowal region that should assist in the long-term recovery of the species (see Section 10: Biodiversity Offset Strategy). These BSAs will include active management measures, including reducing invasive predators such as foxes and cats, managing fire and minimising impacts of overgrazing. These actions are consistent with actions proposed in the recovery guidelines, that should increase the condition and extent of suitable habitat within the vicinity of Lake Cowal.
Conclusion	**Unlikely significant impact.** The Project would contribute to loss of 55.99 ha of potential foraging habitat for the Glossy-black Cockatoo. However, the loss of this foraging habitat is considered unlikely to be a significant impact since there is no evidence of this species occurring on the study area within the current or past studies, whilst the remaining foraging habitat is considered highly fragmented. However, the species was observed by EMM foraging nearby to the study area.

h Major Mitchell Cockatoo

The Commonwealth Conservation Advice for the Major Mitchell Cockatoo (EPBC Act: Endangered) (DCCEEW 2023d) describes the conservation status, distribution, biology/ecology and threats to the survival of this species. This species distributed through the Murray-Darling, Eyre and Bulloo River basins, from Isisford and Roma in the north, through western New South Wales to north-west Victoria and west to eastern South Australia. They inhabit a wide range of plant communities, mostly in arid and semi-arid woodlands, always within easy reach of surface water.

Habitat critical to the survival of the eastern Major Mitchell's cockatoo consists of:

- Arid and semi-arid woodlands dominated by Mulga (*Acacia aneura*), mallee and box eucalypts, Slender Cypress Pine (*Callitris gracilis*) or Belah (*Casuarina cristata*)
- Known habitat containing suitable attributes, which is typically where there are large mature trees with suitable hollows
- surrounding matrix of these areas for the role of providing movement corridors for dispersal across the landscape.

The main threat causing the decline of south-eastern glossy black cockatoo is a result of habitat loss, fire, shortage and competition for resources, anthropogenic threats (vehicle strike and bird/egg collection) and psittacine beak and feather disease. Good nesting habitat is more likely to be found in intact mature woodland, which are mainly eucalypts or cypress pines, and are usually old (average nesting tree diameter is 72.5 cm DBH). Remnant vegetation surrounding agricultural land has also been used for nesting. This bird feeds on seeds of native shrubs and trees, and sometimes roots, bulbs, insect larvae and seeds of crops and weeds. It typically feeds in or close to wooded areas.

Table 9.10 provides an assessment of significance for the removal of up to 59.45 ha of potential Major Mitchell Cockatoo foraging habitat, in accordance with the assessment criteria for vulnerable species (DoE 2013a).

Table 9.11 Assessment of significance for the Major Mitchell Cockatoo

Criteria	Discussion
1. Lead to a long-term decrease in the size of a population	**Unlikely**. Major Mitchell Cockatoo are widely dispersed across inland south-eastern Australia, with the Additional disturbance area offering potential foraging habitat for this population. As no breeding has been recorded within or adjacent to the Additional disturbance footprint, it is considered that the project would impact upon potential foraging habitat only. Due the broad extent of potentially foraging habitat throughout inland south-eastern Australia, it is considered unlikely that the Project would lead to a long-term decrease in the size of a population. Moreover, the retention and establishment of BSAs within woodland areas in the vicinity of Lake Cowal should also assist in securing and enhancing a large extent of remaining habitat locally.
2. Reduce the area of occupancy of the species	**Unlikely**. Major Mitchell Cockatoo are widely dispersed across inland south-eastern Australia, so the loss of 59.45 ha of potential foraging habitat, where surveys suggest utilisation is low based on survey results, is considered unlikely to reduce the area of occupancy for the species. Moreover, considering that suitable habitat will be retained and enhanced within BSAs within woodland in the vicinity of Lake Cowal should support the ongoing occupancy of the species locally. Hence, it is unlikely that the Project would reduce the area of occupancy of the species.
3. Fragment an existing population into two or more populations	**Unlikely**. As the Major Mitchell Cockatoo are highly mobile and widely dispersed across south-eastern Australia, it is not expected that the Project would fragment an existing population into two or more populations.

Table 9.11 Assessment of significance for the Major Mitchell Cockatoo

Criteria	Discussion
4. Adversely affect habitat critical to the survival of a species	**Unlikely.** The Additional disturbance area is not considered to provide habitat critical to the Major Mitchell Cockatoo since nesting of this species was not recorded during targeted surveys, whilst old growth, mature eucalyptus forest offering large hollows are typically lacking within the Additional disturbance footprint. As such, the remnant and largely fragmented woodland habitat within the Additional disturbance footprint is considered potential foraging habitat for the species only. Section 8.2 details avoidance measures implemented by Evolution into the Project design to minimise impacts on habitat for this species. Moreover, establishment of BSA(s) within Lake Cowal will assist in protecting and enhancing areas of habitat to be retained (see Section 10: Biodiversity Offset Strategy).
5. Disrupt breeding cycle of a population	**Unlikely.** Breeding of the Major Mitchell cockatoo has not been recorded in or nearby Lake Cowal (BioNet Atlas 2023; eBird 2023d). Based on the lack of evidence of regular breeding of Major Mitchell Cockatoo in or near the Additional disturbance area, and the retention of habitat and establishment of BSAs (including active management that enhances habitat value) within the Lake Cowal region, it is considered unlikely that the Project would disrupt the breeding cycle of a population.
6. Modify, destroy, remove, isolate or degrade habitat	**Unlikely.** The Project will remove 59.45 ha of potential foraging habitat for the Major Mitchell Cockatoo in the Additional disturbance area. Based on the extent of foraging habitat to be removed, when considering the extent of similar or higher condition woodland in floodplain areas nearby Lake Cowal, it is not considered that the Project would modify, destroy, remove, isolate or degrade habitat to the extent that the species is likely to decline.
7.Result in invasive species	**Unlikely.** Soil disturbance for the Project has potential to result in the spread of invasive weeds to retained areas of vegetation and potential habitat. Weed control procedures will be developed during the EIS to minimise the impact on potential foraging habitat for the Major Mitchell Cockatoo.
8. Introduce disease	**Unlikely.** Psittacine beak and feather disease is listed as a threatening process for the species. Transfer of this disease is linked to flocking behaviour, which may be influenced by availability of nesting hollows (i.e. less hollows can lead to greater chances of disease transmission). However, no breeding of Major Mitchell Cockatoo (or signs of) has been recorded within the Additional disturbance footprint, so the Project is unlikely to cause a disease outbreak.
9. Interfere with recovery	**Unlikely.** A recovery plan has not yet been developed. Recovery priorities in the conservation advice list are to increase nesting habitat availability within the subspecies' range and improve connectivity of woodland habitat. As the Project will involve clearing of woodland habitat there is potential for the Project to interfere with recovery. Nevertheless, to offset impacts of the Project to Major Mitchell Cockatoo foraging habitat, BSAs will be established in Lake Cowal region that should assist in the long-term recovery of the species (see Section 10: Biodiversity Offset Strategy). These BSAs will include active management measures, including reducing invasive predators such as foxes and cats, managing fire and minimising impacts of overgrazing. These actions are consistent with actions proposed in the recovery guidelines, that should increase the condition and extent of suitable habitat within the vicinity of Lake Cowal.
Conclusion	**Unlikely significant impact.** The Project would contribute to loss of 59.45 ha of potential foraging habitat for the Major Mitchell Cockatoo. However, the loss of this foraging habitat is considered unlikely to be a significant impact since although this species has been recorded near the study area within past studies, whilst the remaining foraging habitat is considered highly fragmented.

i Painted Honeyeater

The Commonwealth Conservation Advice for the Painted Honeyeater (EPBC Act: Vulnerable) (TSSC 2015) describes the conservation status, distribution, biology/ecology and threats to the survival of this species. This species is sparsely distributed from south-eastern Australia to north-western Queensland and eastern Northern Territory. The greatest concentrations and almost all records of breeding come from south of 26ºS, on inland slopes of the Great Dividing Range between the Grampians, Victoria and Roma, Queensland. It is estimated that the species' current population <10,000 individuals. This species has experienced a decline attributed to fragmentation of habitat due to clearing and over-grazing, particularly in box-ironbark and boree woodlands. Other threats include competition with noisy miner, predation by invasive species, destruction of mistletoe forests (i.e. food source), vehicle strike and nest predation by over-abundant Corvids.

The National Recovery Plan for the Painted Honeyeater (DAWE 2022) details the species biology, ecology, distribution, populations, habitat and threats. The recovery plan describes habitat for this species as mistletoes in eucalypt forests, woodlands, riparian woodlands of Black Box (*Eucalyptus largiflorens*) and River Red Gum (*E. camaldulensis*), box-ironbark- yellow gum woodlands, acacia-dominated woodlands, paperbarks, casuarinas, Callitris and trees on farmland or gardens. As the most specialised of Australia's honeyeaters, its diet mainly consists of fruits and nectar of mistletoe, but also feeds on nectar from eucalypts and possibly banksias, as well as arthropods. Hence, based on the importance of mistletoe as a food source, this species prefers woodlands with a higher number of mature trees, which host more mistletoes.

Nationally, there are seven Key Biodiversity Areas (KBA) with Painted Honeyeater as one of their trigger species (KBA partnership 2022). Such KBAs are internationally recognised as areas that contribute significantly to the global persistence of biodiversity. Relevant to the Project, the South-west Slopes of New South Wales has been identified as a KBA, where remnant patches of woodland and scattered large trees provide habitat for the Painted Honeyeaters, with Mugga Ironbark (*E. sideroxylon*), Grey Box (*E. microcarpa*) and River Red Gum (e.g. PCTs 82, 185 and 294) identified as important.

DAWE (2022) also identifies habitat critical to the survival of the Painted Honeyeater as:

- Known or likely breeding habitat on the inland slopes of the Great Dividing Range.
- All preferred foraging species within known and likely foraging habitat particularly mistletoes of the genus Amyema.
- Habitat for the long-term maintenance of the species, including all KBAs and future climate niches.

The Additional disturbance area is located outside South West Slopes KBA (KBA partnership 2022), which delineates critical habitat for the species. However, there are several records Painted Honeyeater within 5 km of the Additional disturbance area within the last 5 years (BioNet Atlas 2023), suggesting that the Additional disturbance area offers preferred foraging habitat, especially due to the presence of preferred foraging species (i.e. point 2 above). That is, poor, medium and high condition zones within the Additional disturbance area, where mature canopy trees occur belonging to key foraging species, are likely to offer high value foraging resources. In particular, suitable foraging resources are provided by Eucalypt woodland within PCTs 82, 185 and 249, which contain the preferred tree species Mugga Ironbark, Grey Box and River Red Gum. Medium and high condition zones of weeping Myall habitat (PCT 26) also present high value foraging opportunities for Painted Honeyeater, with mistletoe (*Amyema* spp.) common. Medium condition zones for PCTs 55 and 244 may also support this species, as per the BioNet TBDC (2023n).

The potential impact of the Project on Painted Honeyeater was referred under the EPBC Act (EPBC 2022/09223). At that time, the self-assessment concluded that there was a potential significant impact on Painted Honeyeater. Upon review by DCEEEW, it was not considered that there would be a significant impact to this species (date of decision 28 June 2022). However, it was recommended that further assessment is required to determine if this protected matter is present, and if so, consider the extent to which those matters may be significantly impacted

by the proposed action according to the department's *Significant Impact Guidelines 1.1*. Table 9.12 provides an assessment of significance for the removal of up to 125.89 ha of Painted Honeyeater foraging habitat, in accordance with the assessment criteria for vulnerable species (DoE 2013a).

Table 9.12 Assessment of significance for the Painted Honeyeater

Criteria	Discussion
1. Long-term decrease of an important population	Unlikely. This species consists of a single subpopulation that is widely dispersed across south-eastern Australia, and so no important population has been identified.
2. Reduce occupancy area for important population	Unlikely. As above.
3. Fragment an important population	Unlikely. As above.
4. Adversely affect habitat critical to survival	Possible. The Additional disturbance area is likely to provide habitat critical to the Painted Honeyeater since there is mature woodland with important food trees, in an area where the species is known to be occupied by Painted Honeyeater (several records within 10 km of the Additional disturbance area of the past 5 years; BioNet Atlas 2023). As such, the Project will impact 126.24 ha of potential foraging habitat, consisting of all zones with mature trees (poor, medium and good) of PCTs 26, 55, 82, 185, 244 and 249, which constitutes of habitat this species is known to associate (BioNet TBDC 2023n). Section 8.2 details avoidance measures implemented by Evolution into the Project design to minimise impacts on habitat for this species. Moreover, establishment of BSA(s) within the Lake Cowal region will assist in protecting and enhancing areas of habitat for this species (see Section 10: Biodiversity Offset Strategy).
5. Disrupt breeding cycle	Unlikely. Breeding of the Painted Honeyeater has not been recorded in or nearby Lake Cowal (BioNet Atlas 2023; eBird 2023e). Based on the lack of evidence of regular breeding of Painted Honeyeater in or near the Additional disturbance area, and the retention of habitat and establishment of BSAs (including active management that enhances habitat value) within the Lake Cowal region, it is considered unlikely that the Project would disrupt the breeding cycle of a population.
6. Modify, destroy, remove, isolate or degrade habitat	Possible. The Project will remove 126.24 ha of habitat for the Painted Honeyeater in the Additional disturbance area. Based on the extent of habitat to be removed, where this species has been found to occur nearby on multiple occasions, it is possible that the Project would modify, destroy, remove, isolate or degrade habitat to the extent that the species is likely to decline.
7.Result in invasive species	Unlikely. Soil disturbance for the Project has potential to result in the spread of invasive weeds to retained areas of vegetation and potential habitat. Weed control procedures will be developed during the EIS to minimise the impact on potential foraging habitat for the Painted Honeyeater. BSA(s) to be established in Lake Cowal will implement pest animal control programs, including for foxes and cats, which are current threatening processes for the species (see Section 10: Biodiversity Offset Strategy).
8. Introduce disease	Unlikely. There are no known diseases listed as a threatening process for the species. Hence, the Project is unlikely to cause a disease outbreak.
9. Interfere with recovery	Unlikely. Within the National Recovery Plan for the Painted Honeyeater, actions proposed to achieve objectives aim to manage/protect breeding/foraging habitat critical for survival, measure populations, reduce/eliminate threats, increase knowledge of the species ecological requirements, and increase community and stakeholder participation in conservation and management (DAWE 2022). As the Project will adversely affect habitat critical to the survival of the species, it may interfere with recovery by contravening the first objective. Nevertheless, to offset impacts of the Project to Painted Honeyeater habitat, BSAs will be established in Lake Cowal region that should assist in the long-term recovery of the species (see Section 10: Biodiversity Offset Strategy). These BSAs will include active management measures, including reducing invasive predators such as foxes and cats, managing fire and minimising impacts of overgrazing. These actions are consistent with actions proposed in the recovery guidelines, that should increase the condition and extent of suitable habitat within the vicinity of Lake Cowal.
Conclusion	Possible significant impact. It is possible that the clearance of 126.24 ha of Painted Honeyeater foraging habitat will have a significant impact on the species through adversely affect habitat critical to survival, whilst may modify, destroy, remove, isolate or degrade habitat to the extent that the species is likely to decline. Impacts are known, predictable and irreversible.

j Superb Parrot

The Commonwealth Conservation Advice for the Superb Parrot (EPBC Act: Vulnerable, TSSC 2016) describes the conservation status, distribution, biology/ecology and threats to the survival of the Superb Parrot. The Superb Parrot occurs west of the Great Dividing Range, in Canberra, Goulburn and west to Nyngan and Swan Hill. The Superb Parrot nests in large living or dead trees with many hollow branches, typically near watercourses. Following breeding, Superb Parrots disperse and forage on a variety woodland and other habitat types. Threats to the survival of the species comprise the loss and degradation of habitat, competition for nest hollows, roadkill, illegal collection of wild birds, Psittacine beak and feather disease, and climate change. The total population of the Superb Parrot has been estimated at 5,000 to 8,000 birds, 6,500 of which comprise adults.

The National Recovery Plan for the Superb Parrot (DAWE 2021) details the species biology, ecology, distribution, populations, habitat and threats. The recovery plan describes the species as nomadic, resident, dispersive and migratory, making regular seasonal movements between breeding and non-breeding areas, in response to changes in food availability. When making local foraging movements, the species usually moves through wooded corridors, rarely crossing large areas of open ground.

The breeding range of the Superb Parrot is concentrated on the NSW South Western Slopes and Riverina bioregions. Within the NSW South Western Slopes, the main breeding area comprises the area bounded by Molong, Rye Park, Yass, Coolac, Cootamundra and Young. OPC is located ~115 km northwest of Young, well outside of this main breeding area. DAWE (2021) identified a KBA, which includes the core distribution of the Superb Parrot, within the South West Slopes IBRA region. This KBA is defined as an 80 km-wide length of the inland slopes of the Great Dividing Range from Wagga Wagga to Orange, extending south-east through Boorowa and Yass to Queanbeyan, with an extension south to include the important Swift Parrot sites of Livingstone National Park, Tarcutta, Gundagai, Tumut and Adelong. The nearest length of this defined breeding habitat belt extends from Wagga Wagga to Orange. At the nearest point, the OPC is approximately 100 km to the west, which is well outside (~60 km) west of this KBA. Other key breeding areas, located outside the NSW South Western Slopes, are along the Murrumbidgee River between Wagga Wagga and Toganmain Station to Goolgowi, and along the Murray and Edward Rivers, east of Barmah and Millewa State Forest to south of Taylors Bridge. The species has also recently been recorded breeding in urban areas of Canberra (Rayner et al. 2016). Hence, the Additional disturbance is not within a key breeding area for the Superb Parrot. Moreover, no signs of Superb Parrot breeding were observed within or adjacent to the Additional disturbance area, despite considerable bird surveys undertaken by EMM and others during the September to November breeding season (see Section 5.3.3; BioNet TBDC 2023f).

Foraging habitat critical to the survival of the species is defined by the recovery plan (DAWE 2021) as all preferred foraging habitat during both breeding and non-breeding season. Foraging habitat is described as this species mostly feeding on the ground, where they take a variety of native and introduced seeds, but also in shrubs and trees on seeds and blossom. Based on the multiple recordings of Superb Parrot recorded within and adjacent to the Additional disturbance area (including records by EMM within the study area; see Section 5.3.4ii), and presence of low to high value foraging habitat offered by zones associated with PCTs 26, 55, 82, 244 and 249 (PCTs in the study area associated with the Superb Parrot), some foraging habitat critical to the survival of the species may be impacted by the Project.

The potential impact of the Project on Superb Parrot was referred under the EPBC Act (EPBC 2022/09223). At that time, the self-assessment concluded that there was a possible significant impact on Superb Parrot, with 91% of suitable breeding habitat surveyed. Upon review by DCEEEW, it was not considered that there would be a significant impact to this species (date of decision 28 June 2022). However, it was recommended that further assessment is required to determine if this protected matter is present, and if so, consider the extent to which those matters may be significantly impacted by the proposed action according to the department's *Significant Impact Guidelines 1.1*. Table 9.13 provides an assessment of significance for the removal of up to 126.24 ha of Superb Parrot foraging habitat following the completion of surveys, in accordance with the assessment criteria for vulnerable species (DoE 2013a).

Table 9.13 Assessment of significance for the Superb Parrot for the study area

Criteria	Discussion
1. Long-term decrease of an important population	**Unlikely**. Important populations have not been defined in the recovery plan for the Superb Parrot (DAWE 2021). A single population of the species exists, and therefore the Project cannot lead to the decrease of an important population.
2. Reduce occupancy area for important population	As above.
3. Fragment an important population	As above.
4. Adversely affect habitat critical to survival	**Possible**. Habitat critical to the survival of the species has been defined by the recovery plan (DAWE 2021), and is divided into their breeding habitat, foraging habitat, and habitat for long-term maintenance of the species. No breeding activity has been recorded during breeding season despite extensive surveys by EMM and others (Section 5.3.4iib), thus the Additional disturbance area does not represent breeding habitat critical to the survival of the species. The Additional disturbance area is also not consistent with habitat for the long-term maintenance of the species as it is outside of the KBA. The Additional disturbance area is however consistent with the definition of preferred foraging habitat during both breeding and non-breeding season (DAWE 2021), due to the multiple records of Superb Parrot inside and nearby the Additional disturbance area (over 20 records in last 5 years, including inside the Additional disturbance area). Based on the description of foraging habitat, feeding on the ground where they take a variety of native and introduced seeds, but also in shrubs and trees on seeds and blossom, all zones associated with PCTs 26, 55, 82, 244 and 249 constitute potential foraging habitat critical to the survival of the species. Section 8.2 details avoidance measures implemented by Evolution into the Project design to minimise impacts on habitat for this species. This included avoiding impacts to a large tract of land to the north-west of the study area where the majority of Superb Parrots have been historically recorded. Management of retained areas of species habitat on the site (see Section 8.2) will assist in protecting areas of habitat to be retained.
5. Disrupt breeding cycle	**Unlikely**. The Additional disturbance area is outside the species key breeding range. Moreover, no breeding activity has been observed within or adjacent to the Additional disturbance area despite extensive bird surveys undertaken during the September to November breeding period. Therefore, it is not expected that the Project will disrupt the species breeding cycle.
6. Modify, destroy, remove, isolate or degrade habitat	**Unlikely**. The Project will remove 126.24 ha of potential foraging habitat for the Superb Parrot in the Additional disturbance area. The Additional disturbance area is outside KBA, which encompasses the core distribution of the Superb Parrot. At a national scale, the species occurs in Tasmania and between Bendigo, Victoria and north-western NSW. The removal of this potential foraging habitat in which the species will not substantially reduce the national extent.
7.Result in invasive species	**Unlikely**. Soil disturbance for the Project has potential to result in the spread of invasive weeds to retained areas of vegetation and potential habitat. Weed control procedures will be developed during the EIS to minimise the impact on potential foraging habitat for the Superb Parrot.
8. Introduce disease	**Unlikely**. Superb Parrots may be susceptible to beak and feather disease. Disease outbreaks usually occur in wild animal populations where significant stresses arise. The clearance of potential foraging habitat is unlikely to cause significant stress such that a disease outbreak would occur.
9. Interfere with recovery	**Unlikely**. Recovery actions for the Superb Parrot aim to determine population trends, increase knowledge of the species ecological requirements, develop and implement strategic threat abatement strategies and increase community involvement and awareness of the recovery program (DAWE 2021). As recovery actions are focused on increasing knowledge of the species, the Project will not interfere with recovery actions. Nevertheless, to offset impacts to Superb Parrot foraging habitat, BSA sites containing suitable foraging habitat will be established. These sites will include management measures which aim to increase the condition, extent and connectivity of suitable habitat within the vicinity of Lake Cowal.

Table 9.13 Assessment of significance for the Superb Parrot for the study area

Criteria	Discussion
Conclusion	**Possible significant impact**. It is possible that the clearance of 126.24 ha of Superb Parrot foraging habitat will have a significant impact on the species through adversely affect foraging habitat critical to survival. That is, although the Additional disturbance area is outside the core distribution for this species, and no breeding habitat been observed, several recent records suggest preferred foraging habitat is present. Impacts are known, predictable and irreversible.

k White-throated Needletail

The Commonwealth Conservation Advice for the *H. caudacutus* (EPBC Act: Vulnerable) (TSSC 2019) describes the conservation status, distribution, biology/ecology and threats to the survival of this species. In eastern Australia, the species is recorded in all coastal regions of Queensland and NSW, extending inland to the western slopes of the Great Dividing Range and occasionally onto the adjacent inland plains. The breeding distribution of the White-throated Needletail is fragmented, with two subspecies occurring in different parts of Asia. As such, the migration movements to Australia occurs during the non-breeding season. Here, it feeds on insects aerially, occurring over most habitat types. As such, all vegetation zones offer potential foraging habitat for the species, with some roosting opportunity presented by dense foliage and or hollows within moderate condition woodland areas associated with PCTs 26, 55, 82, 244 and 249.

Table 9.14 provides an assessment of significance for the removal of up to 999.77 ha of White-throated Needletail foraging habitat, in accordance with the assessment criteria for vulnerable species (DoE 2013a). The potential impact on White-throated Needletail was considered as unlikely to be a significant impact within the referral under the EPBC Act (EPBC 2022/09223). Upon review by DCEEEW, it was considered that the proposed action would not have a significant impact to this species, nor was the species identified as having potential presence within 10 km of the proposed action area and may be impacted by the proposed action (date of decision 28 June 2022).

Table 9.14 Assessment of significance for White-throated Needletail

Criteria	Discussion
1. Long-term decrease of an important population	**Unlikely**. Important populations have not been defined for this species. Therefore, the Project cannot lead to the decrease of an important population.
2. Reduce occupancy area for important population	**Unlikely**. As above.
3. Fragment an important population	**Unlikely**. As above.
4. Adversely affect habitat critical to survival	**Unlikely**. Habitat critical to the survival of the species has not been defined within the Conservation Advice (TSSC 2019), whilst there is no recovery plan for the species. Habitat within the Additional disturbance area is considered foraging habitat only, where woodland vegetation may be opportunely used for roosting, so it is considered unlikely that the Project would adversely affect habitat critical to survival.
5. Disrupt breeding cycle	**Unlikely**. This species breeds in Asia. Hence, the Project will not disrupt the breeding cycle of the species.
6. Modify, destroy, remove, isolate or degrade habitat	**Unlikely**. White-throated Needletail is an aerial feeder, so removal of native vegetation associated with the Project is not expected to modify, destroy, remove, isolate or degrade habitat to the extent that the species is likely to decline.

Table 9.14 Assessment of significance for White-throated Needletail

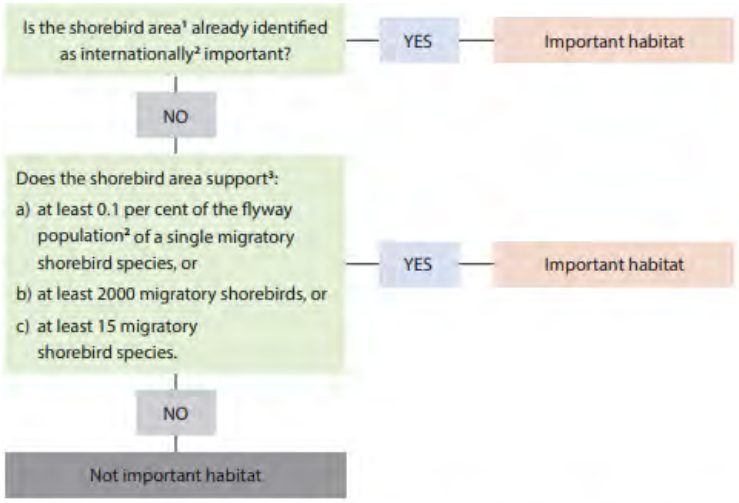
Criteria	Discussion
7.Result in invasive species	**Unlikely**. Soil disturbance for the Project has potential to result in the spread of invasive weeds to retained areas of vegetation and potential habitat. Weed control procedures will be developed during the EIS to minimise the impact on potential habitat.
8. Introduce disease	**Unlikely.** There are no known diseases listed as a threatening process for the species. Hence, the Project is unlikely to cause a disease outbreak.
9. Interfere with recovery	**Unlikely**. Recovery actions for White-throated Needletail listed in the Conservation Advice aim to reduce habitat loss, direct mortality (Wind turbines, overhead wires) and poisoning. The Project may contribute to loss of habitat in the non-breeding range through removal of woodland habitat. Nevertheless, given the generalised nature of foraging habitat from this species, this impact is not expected to interfere with recovery. Moreover, BSAs will be established which will include management measures which aim to increase the condition, extent and connectivity of potentially suitable habitat within the vicinity of Lake Cowal.
Conclusion	**Unlikely significant impact**. Although the Project may contribute to loss of some habitat in the non-breeding range through removal of woodland habitat, it is considered unlikely that the Project will have a significant impact on White-throated Needletail. This species is an aerial feeder that breeds in Asia and may opportunistically roost within the Additional footprint area only. Nevertheless, establishment of BSAs in the Lake Cowal vicinity to offset impacts of the Project should improve the quality and availability of suitable habitat for this species locally.

ii Migratory species

a Important habitat for migratory shorebirds

DoE (2015) identifies 37 migratory shorebirds that regularly and predictably visit Australia during their non-breeding season along the East Asian - Australasian Flyway, from the Austral spring to autumn. Australia's coastal and freshwater wetlands are important habitat during the non-breeding season as places for these migratory shorebirds to rest and feed, accumulating energy reserves to travel the long distance (up to 13,000 km) back to their breeding grounds. As some migratory shorebird populations decrease there is a growing need to minimise threats to the remaining habitats that are critical for their ongoing survival (MacKinnon et al. 2012), which are increasing with ongoing human development and associated loss of habitat. Efforts to conserve migratory shorebirds require cooperation by multiple countries in which cover these migrations, and hence driving the establishment of and Australia's commitments to the Bonn Convention and bilateral migratory bird agreements with Japan (JAMBA), China (CAMBA) and the Republic of Korea (ROKAMBA) to ensure adverse effects on listed migratory species and their habitats do not occur in Australia.

The EPBC Act seeks to prevent such adverse impacts by imposing civil penalties (Section 20) to persons who take actions that have, or are likely to have, a significant impact on a listed migratory species. *EPBC Act Policy Statement 3.21—Industry Guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species* (DoE 2017) provides assistance in determining the likelihood of a significant impact on migratory shorebirds. Plate 9.4 details the steps to determining if important habitat is present. Table 9.15 applies these criteria to the wetland habitat provided by Lake Cowal for migratory shorebirds, where the Additional disturbance area will impact.



1. Following Clemens et al. (2010) a shorebird area is defined as: the geographic area that had been used by the same group of shorebirds over the main non-breeding period. This is effectively the home range of the local population when present. Shorebird areas may include multiple roosting and feeding habitats. While most migratory shorebird areas will represent contiguous habitat, non-contiguous habitats may be included as part of the same area where there is evidence of regular bird movement between them. Migratory shorebird areas may therefore extend beyond the boundaries of a property or project area, and may also extend beyond Ramsar boundaries for internationally important areas. Existing information and/or appropriate surveys can determine the extent of a migratory shorebird area.
2. Population estimates for 37 migratory shorebirds in the East Asian–Australasian Flyway are available at www.environment.gov.au/biodiversity/migratory-species/migratory-birds. Shorebird population estimates, may, from time-to-time be updated as new information is made available. Further information can be found on the Department's website.
3. 'Support' is defined differently depending on whether the habitat is considered permanent or ephemeral.
   - For permanent wetlands, 'support' is defined as: *migratory shorebirds are recorded during surveys and/or known to have occurred within the area during the previous five years.*
   - For ephemeral wetlands, 'support' is defined as: *habitat that migratory shorebirds have ever been recorded in, and where that habitat has not been lost permanently due to previous actions.*

Plate 9.4 Process for identifying important habitat for migratory shorebirds – Decision Flowchart (DoE 2017)

Table 9.15 Application of criteria for identifying important migratory shorebird habitat

Criteria	Discussion
1. Is the shorebird area already identified as internationally important? Note: wetland habitat should be considered internationally important if it regularly supports: • 1% of the individuals in a population of one species or subspecies of waterbird; or • a total abundance of at least 20,000 waterbirds.	**Unlikely**. Lake Cowal is not considered an internationally important wetland under the Ramsar Convention. Moreover, Lake Cowal is not known to regularly support 1 per cent of the individuals in a population of one species or subspecies of waterbird. Although, on one occasion more than 1% of the overall population of Sharp-tailed Sandpiper was recorded at Lake Cowal. That is, during waterbird surveys by Evolution at Lake Cowal in October 2001, 1,445 Sharp-tailed Sandpiper were recorded. This is ~1.7% of the 85,000 overall population of Sharp-tailed Sandpiper, as estimated by Hensen et al. (2016). No other surveys detected enough of any migratory shorebird species that exceeded this criterion. From 2010 to 2020, UNSW annual surveys (excluding 2019 and 2020; note that these years coincided with drought conditions and Lake Cowal was dry) recorded >20,000 waterbirds on three occasions. However, total waterbirds counted by Evolution have not exceeded 20,000 individual waterbirds during any survey effort, which have extended annually since 1989. Hence, it is not considered that Lake Cowal regularly supports a total abundance of at least 20,000 waterbirds.

Table 9.15 Application of criteria for identifying important migratory shorebird habitat

Criteria	Discussion
2. Does the shorebird area support: **a) At least 0.1 per cent of the flyway population of a single migratory shorebird species; or** **b) At least 2,000 migratory shorebirds; or** **c) At least 15 migratory shorebird species.** **Note: Since Lake Cowal is an ephemeral wetland, the term 'support' is defined by DoE (2015) as *habitat that migratory shorebirds have ever been recorded in, and where that habitat has not been lost permanently due to previous actions*.**	**Likely**. On six occasions more than 0.1% of the overall population of Sharp-tailed Sandpiper were recorded at Lake Cowal. That is, during waterbird surveys by Evolution at Lake Cowal in January 1997, December 1997, October 2001, October 2014 (two occasions), January 2019, at least 0.1% of the Sharp-tailed Sandpiper flyway population were recorded, considering population estimates of 85,000 by Hensen et al. (2016). Hence, criteria a) is met. The maximum count of migratory shorebirds on a single occasion was by Evolution in October 2001 where 1,559 individuals were observed across Lake Cowal. Moreover, to our knowledge, no other monitoring program has recorded at least 2,000 of the 37 listed migratory shorebird species at Lake Cowal. Hence, criteria b) is not met. Across Evolution's annual waterbird monitoring between 1989 and 2021, 15 migratory shorebird species have been recorded. These species include: • Latham's Snipe (*Gallinago hardwickii*) • Common Sandpiper (*Actitis hypoleucos*) • Sharp-tailed Sandpiper (*Calidris acuminata*) • Pectoral Sandpiper (*Calidris melanotos*) • Bar-tailed Godwit (*Limosa lapponica*) • Common Greenshank (*Tringa nebularia*) • Red-necked Stint (*Calidris ruficollis*) • Marsh Sandpiper (*Tringa stagnatilis*) • Black-tailed Godwit (*Limosa limosa*) – also assessed as a Candidate species in Section 5.3.1 • Double-banded Plover (*Charadrius bicinctus*) • Pacific Golden Plover (*Pluvialis fulva*) • Little Curlew (*Numenius minutus*) • Curlew Sandpiper (*Calidris ferruginea*) – also assessed as a Candidate species in Section 5.3.1; • Whimbrel (*Numenius phaeopus*); and • Wood Sandpiper (*Tringa glareola*). As at least 15 of the 37 listed species have ever been recorded in the Lake Cowal wetland (DoEE 2015), criteria c) is met. Impacts to these species are assessed individually below.
Conclusion	**Likely important habitat**. When conditions are suitable (wet) Lake Cowal is likely to provide important habitat for migratory shorebirds since: • The shorebird area supports at least 0.1 per cent of the flyway population of a single migratory shorebird species, being the Sharp-tailed Sandpiper (i.e. criterion 2a). • At least 15 of the 37 listed species have ever been recorded in the Lake Cowal wetland.

The potential impact of the Project on migratory shorebirds was referred under the EPBC Act (EPBC 2022/09223). The self-assessment identified that Lake Cowal as important habitat for migratory shorebirds in ephemeral wetlands. Upon review by DCEEEW, it was considered that the proposed action is likely to have a significant impact on listed migratory species (date of decision 28 June 2022). In the decision letter, it was considered that the proposed action is also likely to have a significant impact on, but not limited to Sharp-tailed Sandpiper. An assessment of the Project against the thresholds of significant impacts on migratory shorebird as per DoE (2017) is provided in Table 9.16.

Table 9.16 Application of thresholds of significant impacts on important habitat for migratory shorebirds

Criteria	Discussion
Loss of habitat	**Likely.** The Project will clear 375.09 ha of important shorebird habitat.
Degradation of habitat leading to a substantial reduction in migratory shorebird numbers	**Possible**. The Project has the possibility of degrading habitat for migratory shorebirds in Lake Cowal if control strategies employed to reduce the risk of impacts during construction and/or operation of the Project fail. Indirect and prescribed impacts that may degrade important habitat, potentially to the point of a substantial reduction in migratory shorebird numbers are: • erosion and sedimentation • weed introduction and spread • vertebrate pest invasion into retained habitats • potential inadvertent disturbance of retained habitats • removal of habitat resources for threatened fauna • chemical and oil spills • increased noise, vibration and dust levels resulting in disturbance of fauna species, and consequent abandonment of habitat and/or changes in behaviour (including breeding behaviour) • lighting for night works, resulting in disturbance to fauna species and changes in occupancy or behaviour. Prescribed impacts that may impact migratory shorebirds are: • Waterbodies, water quality and hydrological processes, including alteration to hydrology for groundwater dependent ecosystems and cyanide contamination. • Vehicle strike. Measures to avoid and minimise these potential indirect and prescribed impacts on waterbirds through Project design and location are presented in Section 8.2. Following avoid and minimise measures during the design phase, residual impacts are assessed in Section 8.3.2 and 8.5. Mitigation and management measures for these potential indirect and prescribed impacts on migratory shorebirds are recommended in Section 8.3.1. Adaptive management for uncertain impacts on migratory shorebirds are provided in Section 8.3.2, which include potential noise impacts during construction and operation (including blasting), potential impacts associated with TSF and IWL during operation, including cyanide management, potential contamination of surface water or sediments in including Lake Cowal during construction and operation and potential impact of dust and particulate matter on threatened/ migratory waterbirds in Lake Cowal. Much of the recommended approach to managing potential indirect and prescribed impacts will be adopted from established environmental management plans that are currently employed at CGO. Management plans relevant to mitigating and managing potential impacts on migratory shorebirds include (but not limited to): NMP, BMP, PIRMP, WMP, FFMP, AQMP, CMP and ESCMP. These management plans have been developed in collaboration with relevant regulators and continually improved commencement of operations in 2005. The performance of each of these environmental plans is monitored and assessed as per the requirements prescribed in the Development Consent Conditions. Environmental performance of CGO is annually released to the public here: https://evolutionmining.com.au/compliance/#cowalpart.

Table 9.16 Application of thresholds of significant impacts on important habitat for migratory shorebirds

Criteria	Discussion
Increased disturbance leading to a substantial reduction in migratory shorebird numbers	**Possible**. If inappropriately managed, the Project may disturb migratory shorebirds adjacent to the Additional disturbance area through noise, dust, water pollution and night-lighting associated with construction and operations, with potential to lead to a substantial reduction of migratory shorebird numbers. Potential disturbance is likely to be most acute during the construction phase, with potential for disturbance expected to reduce following completion of the LPB and ICDS. That is, the LPB will provide a hard barrier to reduce indirect impacts of noise, dust and night-lighting. Risks of water pollution will also reduce due to hydrological separation of the Project by the LPB and capture/treatment of surface water onsite by the ICDS. During operation, noise related impacts (including blasting) are likely to present the greatest potential source of disturbance. The full range of potential indirect and prescribed impacts are assessed in Sections 8.7.2 and 8.5. The potential disturbance to migratory shorebirds will be mitigated through established mitigation measures, which will be updated in collaboration with relevant regulators. Mitigation measures recommended to reduce potential impacts on migratory shorebirds are provided in Section 8.3. Adaptive management plans to respond to uncertain impacts are provided in Section 8.3.2, which includes ongoing monitoring of migratory birds, triggers for action and contingency response plans. The initial disturbance to migratory waterbirds associated with the Project is likely to be higher as construction activities generate noise closer than current disturbances, which may deter use of Lake Cowal over the short-term. However, the long-term disturbance is not likely to substantially reduce migratory shorebird numbers. This is evidenced by repeated monitoring of waterbirds communities between 1989 and 2012 (mostly three replicate surveys undertaken annually), a period that was representative of before and after construction of the mine. Through analysing trends in waterbirds along the transect located immediately adjacent to the mine (T1), Australian Museum Business Services (2013) concluded that: *"While there are only a limited number of post-mine surveys when the lake contained water, there does not appear to be any difference in the number of birds, the number of species, or the diversity of birds recorded along the transect closest to the mine site, compared with those present prior to the development of Cowal Gold Mine."* Also, the effects of human disturbance on the quality of an area for migratory shorebirds may be reversible if the source of disturbance is removed or mitigated (e.g. Townshend & O'Connor 1993), so any disturbance arising from operational noise impacts at CGO are likely to be ameliorable by appropriate management and are not likely to be permanent.
Direct mortality of birds leading to a substantial reduction in migratory shorebird numbers.	**Unlikely**. If inappropriately managed, potential direct mortality for migratory shorebirds may occur through vehicle/vessel strikes and/ or cyanide poisoning. However, based on continuation of a similar operation phase of the Project, it is considered unlikely that the Project will notably increase these risks. That is, as the OPC has been in operation since 2005, and the Project is designed to increase the life of the mine and use existing gold processing infrastructure, so risks should not substantially change from that at present. As assessed in Section 8.5, there could be a short-term increase in vehicle/vessel strikes due to increased traffic associated during the construction phase only. Also assessed in Table 8.6, although the consequence of a chemical spill (including cyanide) could be acute and short term for migratory shorebirds if chemicals spill into surface waters of Lake Cowal, the design of the CGO site combined with best-practice control measures, should ensure this risk is minimised and controlled effectively in the unlikely case a pollution event occurs. Moreover, infrequent, incidental death of migratory birds may occur at the TFS/IWL, most likely by individuals getting stuck in the slurry. However, the potential for cyanide toxicosis for fauna is considered low since concentrations of cyanide are maintained below limits that are considered safe for wildlife. Based on past environmental performance, any migratory shorebird deaths are expected to be infrequent and no lead to a substantial reduction in migratory shorebird numbers. If in the unlikely case that a mortality occurs due to cyanide poisoning or vehicle strike, adaptive management (as detailed in Section 6.3.5) and including subsequent investigations, will ensure that factors that led to this mortality event are rapidly ameliorated to ensure that further mortalities do not occur.

Table 9.16 Application of thresholds of significant impacts on important habitat for migratory shorebirds

Criteria	Discussion
Conclusion	**Likely significant impact.** It is considered that clearing of 375.09 ha of important shorebird habitat would likely reduce availability of foraging and roosting areas for migratory shorebirds. Application of mitigation measures and adaptive management (Section 8.3) will be applied to minimise potential disturbance to migratory shorebirds arising from noise, dust, water pollution and night-lighting during construction and/or operation. Note that potential indirect and prescribed impacts will subside following completion of the mine.

b Latham's Snipe

Latham's Snipe breeds in Japan and in far eastern Russia during the northern summer and then migrates to Australia, where it remains for the duration of the northern winter. Latham's Snipe is a non-breeding visitor to south-eastern Australia, migrates through northern Australia to reach non-breeding areas located further south (DCCEEW 2023e). The species has been recorded along the east coast of Australia from Cape York Peninsula through to south-eastern South Australia. The range extends inland over the eastern tablelands in south-eastern Queensland to west of the Great Dividing Range in New South Wales. The species is widespread in Tasmania and is found in all regions of Victoria except for the north-west. Most birds spend the non-breeding period at sites located south of the Richmond River in NSW.

The size of the Latham's Snipe population that visits Australia is estimated at 25,000 to 100,000 birds (DCCEEW 2023e). Previous population estimates have ranged from 15,000 breeding birds to 37,000 breeding birds. The actual population size is difficult to estimate and is poorly known. In Australia, Latham's Snipe occurs in a single, dispersed non-breeding population.

Latham's Snipe occurs in permanent and ephemeral wetlands up to 2,000 m above sea-level. They usually inhabit open, freshwater wetlands with low, dense vegetation, including swamps, flooded grasslands or heathlands, around bogs and other water bodies (DCCEEW 2023e). However, they can also occur in habitats with saline or brackish water, in modified or artificial habitats, and in habitats located close to humans or human activity, such as where they were recorded in the study area.

The *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (DoE 2013a) defines important habitat for migratory species as areas periodically occupied by an ecologically significant proportion of the population, habitat critical to the species life cycle, habitat at the edge of their range or within an area where they are declining. The Industry Guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species (DoE 2015) defines important habitat for Latham's Snipe as areas that have previously been identified as internationally important for the species, or areas that support at least 18 individuals of the species. Only one site in Australia, Seaford Swamp in Victoria is recognised as an internationally important wetland for the species (Bamford et al. 2008).

EMM recorded Latham's Snipe on three occasions within the Additional disturbance area, whilst Latham's snipe has been recorded on 22 occasions within Lake Cowal as part of Evolution's ongoing waterbird monitoring. There is no evidence of this species breeding at Lake Cowal.

An assessment of significance (Table 9.17) was prepared for Latham's Snipe in relation to the Project, in accordance with the assessment criteria for migratory species (DoE 2013a).

Table 9.17 Assessment of significance for Latham's Snipe in the study area

Criteria	Discussion
1. Substantially modify important habitat	**Likely**. The only identified important sites for Latham's Snipe (based on the DoE guidelines), are six sites located in Victoria, Tasmania and South Australia. The *Industry Guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species* (DoE 2015) defines important habitat for Latham's Snipe as areas that have previously been identified as internationally important for the species, or areas that support at least 18 individuals of the species. EMM recorded Latham's Snipe on three occasions; observations were of 1, 4 and 14 individuals (Section 5.3.4ib). Across all of Evolution's monitoring from 1989 to present within Lake Cowal, 76 individuals were recorded in total across 22 occasions, with group sizes ranging from 1 to 14 individuals. Nevertheless, an eBird record from 2021 of 100 individuals (eBird 2023f) was recorded in Lake Cowal. Based on the regular observation across long term monitoring of this species within Lake Cowal and evidence of flocks >18 individuals, it is considered that important habitat is present. As the Project will remove 375.09 ha of potential foraging habitat for Latham's Snipe, it is considered likely that this will substantially modify important habitat.
2. Result in invasive species	**Unlikely**. Vegetation clearing and topsoil stripping are likely to lead to weed invasion in surrounding habitat, unless adequately mitigated. Measures to control weeds in retained habitats of the Project application area will be developed during preparation of a Biodiversity Management Plan. Moreover, weed management will be applied to BSA(s) to be established within Lake Cowal to offset impacts associated with the Project (Section 10). As a ground-dwelling bird, this species is vulnerable to predation from the invasive fauna, including red fox, cats and wild dogs. These introduced predators can spread into undisturbed areas when new access roads and tracks are created. As the Project will not create new tracks through undisturbed areas, it is unlikely to result in the spread of such invasive species. Nevertheless, invasive animal control programs (including targeted baiting/trapping programs for foxes, cats and wild dogs) undertaken by Evolution in Lake Cowal and nearby areas should reduce predation threat for this species. Moreover, establishment of BSA(s) within Lake Cowal will undertake management to improve habitat condition, including additional pest animal control efforts and restoration of waterbird sheltering habitat (e.g. Lignum and Cane grass) through measures such as cattle exclusion, which should benefit this species by further reducing predation threat (See Section 10, Biodiversity Offset Strategy).
3. Disrupt lifecycle of ecologically significant proportion of population	**Unlikely**. The Project application area does not contain an ecologically significant proportion of the species. That is, the estimated population size is estimated East Asian-Australasian Flyway (EAF) population of 30,000 (Hansen et al 2016), whilst the largest group recorded of 100 birds on one occasion (i.e. <0.1%). Hence, it is unlikely that the Project would disrupt an ecologically significant proportion of the population of Latham's Snipe.
Conclusion	**Likely significant impact**. It is considered likely that the clearance of 375.09 ha of important habitat for the Latham's Snipe will have a significant impact on this species.

c Common Sandpiper

The Common Sandpiper has a wide global range, including the British Isles, western and central continental Europe, Scandinavian, Baltic countries, Poland, Ukraine, around the shores of the Black and Caspian Seas and into Iran, Transbaikalia, coast of the Sea of Japan and northern Japan (DCCEEW 2023f). It mainly breeds in parts of Europe and Asia, and occasionally Africa, migrating to Australia during the non-breeding period. Important sites in Australia are Southeastern Gulf of Carpentaria and Kakadu National Park. The total population of the Common Sandpiper is in the order of 2,600,000–3,200,000 individuals (Birdlife International 2023). The East Asian-Australasian Flyway population is estimated to be 190,000 (Hansen et al. 2016).

This species typically forages in shallow water and on bare soft mud at the edges of wetlands, usually where obstacles project from the substrate, such as rocks or mangrove roots. Birds sometimes venture into grassy areas adjoining wetlands (DCCEEW 2023f). Roost sites are typically on rocks or in roots or branches of vegetation, especially mangroves.

EMM recorded two individuals within the Additional disturbance area. There are also four records of Common Sandpiper within 10 km of Lake Cowal, most recently in 2016 (BioNet Atlas 2023), but count data is not provided. Nevertheless, this species has not been recorded during Evolution's monitoring since 1989, UNSW monitoring or by EMM. There is no evidence of this species breeding at Lake Cowal.

An assessment of significance is provided for this species in Table 9.18.

Table 9.18 Assessment of significance for Common Sandpiper in the study area

Criteria	Discussion
1. Substantially modify important habitat	**Unlikely**. The Common Sandpiper is a widely distributed across a range of wetland habitats throughout Australia. Important habitats in Australia have been identified as Southeastern Gulf of Carpentaria and Kakadu National Park, which are well away from Lake Cowal. Moreover, it is unlikely that Lake Cowal supports an ecologically significant proportion of the population due to highly infrequent records. Habitat at Lake Cowal is also not at the limit of the species range, nor is this habitat in an area where the species is known to be declining. As such, the study area is unlikely meet the criteria for important habitat as defined in DoE (2013).
2. Result in invasive species	**Unlikely**. See assessment of this criteria for the Latham's Snipe above, which applies consistently to other migratory shorebirds/waterbirds.
3. Disrupt lifecycle of ecologically significant proportion of population	**Unlikely**. The population that uses the EAAF is estimated to be 190,000 (Hansen et al. 2016). Based on the highest record of two individuals, this represents approximately <0.01% of this estimated EAAF population. That is, it is below the 0.1% threshold to be considered a nationally important site. Based on this relatively low visitation of Lake Cowal, it is considered unlikely that the study area supports an ecologically significant proportion of the Common Sandpiper.
Conclusion	**Unlikely significant impact**. The Project will unlikely result in a significant impact on the Common Sandpiper as: • the area does not contain important habitat for the species • an ecologically significant proportion of the population will not be disrupted.

d Sharp-tailed Sandpiper

The Sharp-tailed Sandpiper breeds in northern Siberia, from the delta of the Lena River, east to Chaun Gulf and east of the Kolyma River delta. They migrant through eastern Mongolia, China, Korea, Japan, Micronesia, Philippines and south-east Asia, and less so in the Philippines, Burma, Malay Peninsula, Borneo, and Melanesia. Most of the population migrates to Australia, primarily to the south-east and are widespread in both inland and coastal locations and in both freshwater and saline habitats. During the non-breeding season, 39 important sites have been identified in Australia (DCCEEW 2023g). Lake Cowal is not identified as an important site using the using the 1% criterion (i.e. a site is considered important if it is occupied by more than 1% of the bird's total population). An estimated 85,000 Sharp-tailed Sandpipers occupy the EAAF (Hansen et al. 2016).

In Australia, the Sharp-tailed Sandpiper prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation (DCCEEW 2023g). This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, saltpans and hypersaline salt lakes inland. They also use flooded paddocks, sedgelands and other ephemeral wetlands, but leave when they are dry. They use intertidal mudflats in sheltered bays, inlets, estuaries or seashores, and also swamps and creeks lined with mangroves. They tend to occupy coastal mudflats mainly after ephemeral terrestrial wetlands have dried out, moving back during the wet season. They may be attracted to mats of algae and water weed either floating or washed up around terrestrial wetlands (Higgins & Davies 1996).

During Evolution's monitoring since 1989, more than 0.1% of the overall population of Sharp-tailed Sandpiper were recorded at Lake Cowal on six occasions, based on population estimates of 85,000 by Hensen et al. (2016). In Lake Cowal, >0.1% of the Sharp-tailed Sandpiper EAAF population occurred in January 1997, December 1997, October 2001, October 2014 (two occasions) and January 2019. The lowest count was 1 individual and highest count was 1,445 individuals, which is 1.7% of the EAAF. There are also 14 records of Sharp-tailed Sandpiper within 10 km of Lake Cowal, most recently in 2018, but count data is not provided (BioNet Atlas 2023). There is no evidence of this species breeding at Lake Cowal.

An assessment of significance is provided for this species in Table 9.19.

Table 9.19 Assessment of significance for Sharp-tailed Sandpiper in the study area

Criteria	Discussion
1. Substantially modify important habitat	**Likely**. The Sharp-tailed Sandpiper is a widely distributed across a range of wetland habitats throughout southeastern Australia. Thirty-nine important sites have been identified in Australia, none of which include Lake Cowal. However, it is likely that Lake Cowal supports an ecologically significant proportion of the population, including at times over the 1% of the bird's total population. As such, the study area likely meets the criteria for important habitat as defined in DoE (2013). However, habitat at Lake Cowal is not at the limit of the species range, nor is this habitat in an area where the species is known to be declining.
2. Result in invasive species	**Unlikely**. See assessment of this criteria for the Latham's Snipe above, which applies consistently to other migratory shorebirds/waterbirds.
3. Disrupt lifecycle of ecologically significant proportion of population	**Likely**. The population that uses the EAAF is estimated to be 85,000 (Hansen et al. 2016). On six occasions within Evolution's monitoring, Lake Cowal was found to support >0.1% of the EAAF population, including approximately 1.7% of this population in 2001. That is, it is above the 0.1% threshold to be considered a nationally important site. That is, it is below the 0.1% threshold to be considered a nationally important site. Based on this relatively high visitation of Lake Cowal, it is considered likely that the study area supports an ecologically significant proportion of the Sharp-tailed Sandpiper.
Conclusion	**Likely significant impact**. The Project will likely result in a significant impact on the Sharp-tailed Sandpiper as: • the area contains important habitat for the species • an ecologically significant proportion of the population will be disrupted.

e Pectoral Sandpiper

The Pectoral Sandpiper breeds in northern Russia and North America, migrating to Australia during the non-breeding period from September to June (DCCEEW 2023h). However, some sites in the non-breeding range support juveniles throughout the breeding season, until they reach maturity. In NSW, the Pectoral Sandpiper is widespread, but scattered. West of the Great Divide, the species is widespread in the Riverina and Lower Western regions. An estimated 1,220,000-1,930,00 Pectoral Sandpipers occupy the EAAF (Hansen et al. 2016).

In Australasia, the Pectoral Sandpiper prefers shallow fresh to saline wetlands. The species is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands (DCCEEW 2023h). Here it often associates with open fringing mudflats and low, emergent or fringing vegetation, such as grass or samphire.

EMM recorded two individuals within the Additional disturbance area. This species only been recorded once during Evolution's monitoring since 1989, with two individuals recorded in 1992. There are also only two records of Common Sandpiper within 10 km of Lake Cowal, most recently in 1997 (BioNet Atlas 2023), but count data is not provided. There is no evidence of this species breeding at Lake Cowal.

An assessment of significance is provided for this species in Table 9.20.

Table 9.20 Assessment of significance for Pectoral Sandpiper in the study area

Criteria	Discussion
1. Substantially modify important habitat	**Unlikely**. The Pectoral Sandpiper is a widely distributed across a range of wetland habitats throughout Australia, although more common along the coast. Important habitats in Australia have not been identified. Moreover, it is unlikely that Lake Cowal supports an ecologically significant proportion of the population due to highly infrequent records. Habitat at Lake Cowal is also not at the limit of the species range, nor is this habitat in an area where the species is known to be declining. As such, the study area is unlikely meet the criteria for important habitat as defined in DoE (2013).
2. Result in invasive species	**Unlikely**. See assessment of this criteria for the Latham's Snipe above, which applies consistently to other migratory shorebirds/waterbirds.
3. Disrupt lifecycle of ecologically significant proportion of population	**Unlikely**. The population that uses the EAAF is estimated at the lowest extent to be 1,220,000 (Hansen et al. 2016). Based on the highest record of two individuals, this represents approximately <0.01% of this estimated EAAF population. That is, it is below the 0.1% threshold to be considered a nationally important site. Based on this relatively low visitation of Lake Cowal, it is considered unlikely that the study area supports an ecologically significant proportion of the Pectoral Sandpiper.
Conclusion	**Unlikely significant impact**. The Project will unlikely result in a significant impact on the Pectoral Sandpiper as: • the area does not contain important habitat for the species • an ecologically significant proportion of the population will not be disrupted.

f Bar-tailed Godwit

The Bar-tailed Godwit breeds in the north of Scandinavia, Russia and north-west Alaska. However, some sites in the non-breeding range may support juveniles throughout the breeding season, until they reach maturity often spending their second Austral winter, over even their third winter here as well. When in Australia, the Bar-tailed Godwit has been recorded in the coastal areas of all Australian states. Most records are coastal, with a few inland records from NSW and Victoria. An estimated 325,000 Bar-tailed Godwits occupy the EAAF (Hansen et al. 2016).

In Australia, the Bar-tailed Godwit is found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays (DCCEEW 2023i). It is rarely found on inland wetlands or in areas of short grass, such as farmland, paddocks.

There are also only three records of Bar-tailed Godwit within 10 km of Lake Cowal, most recently in 1997, but count data is not provided (BioNet Atlas 2023). Nevertheless, this species has not been recorded during Evolution's monitoring since 1989, UNSW monitoring or by EMM. There is also no evidence of this species breeding at Lake Cowal.

An assessment of significance is provided for this species in Table 9.21.

Table 9.21 Assessment of significance for Bar-tailed Godwit in the study area

Criteria	Discussion
1. Substantially modify important habitat	**Unlikely**. The Bar-tailed Godwit is a widely distributed across a range of wetland habitats throughout Australia, although more common along the coast. Important habitats in Australia have not been identified. Moreover, it is unlikely that Lake Cowal supports an ecologically significant proportion of the population due to highly infrequent records. Habitat at Lake Cowal is also not at the limit of the species range, nor is this habitat in an area where the species is known to be declining. As such, the study area is unlikely meet the criteria for important habitat as defined in DoE (2013).
2. Result in invasive species	**Unlikely**. See assessment of this criteria for the Lathams Snipe above, which applies consistently to other migratory shorebirds/waterbirds.

Table 9.21 Assessment of significance for Bar-tailed Godwit in the study area

Criteria	Discussion
3. Disrupt lifecycle of ecologically significant proportion of population	**Unlikely**. The population that uses the EAAF is estimated at the lowest extent to be 325,000 (Hansen et al. 2016). Although counts of the three BioNet records are not provided, a lack of detection of this species by Evolution's monitoring since 1989, UNSW monitoring and targeted surveys by EMM suggests low visitation of Lake Cowal. As such, it is considered unlikely that the study area supports an ecologically significant proportion of the Bar-tailed Godwit.
Conclusion	**Unlikely significant impact**. The Project will unlikely result in a significant impact on the Bar-tailed Godwit as: • the area does not contain important habitat for the species • an ecologically significant proportion of the population will not be disrupted.

g Common Greenshank

The Common Greenshank is found in Europe, Africa, Asia, Melanesia and Australasia (DCCEEW 2023j). This species breeds in Eurasia, the northern British Isles, Scandanavia, east Estonia and north-east Belarus, and through Russia. There is also isolated breeding in northern Ukraine. The EAAF population is approximately 110,000 (Hansen et al. 2016), with 18,000-19,000 spending their non-breeding season in Australia.

The Common Greenshank occurs in a wide variety of inland and coastal wetlands (DCCEEW 2023j). Along the coast it typically associates with sheltered areas with large mudflats, saltmarsh, mangroves and seagrass. Inland habitat includes permanent and ephemeral terrestrial wetlands, including swamps, lakes, dams, rivers, creeks, billabongs, waterholes and inundated floodplains, claypans and saltflats.

Across Lake Cowal, the species has been recorded within Evolution's monitoring in 24 survey events since 1989. The lowest count during those surveys was of a single individual and a high of 82 individuals. In those surveys, 37-82 individuals were recorded on four occasions, whilst the rest were 1–8 individuals. This species has not been recorded during UNSW monitoring or by EMM. There is no evidence of this species breeding at Lake Cowal.

An assessment of significance is provided for this species in Table 9.22.

Table 9.22 Assessment of significance for Common Greenshank in the study area

Criteria	Discussion
1. Substantially modify important habitat	**Unlikely**. The Common Greenshank is a widely distributed across a range of wetland habitats throughout Australia, although more common along the coast. Important habitats in Australia have been identified, with the Hunter Estuary the only important site identified in NSW, which is well away from Lake Cowal and located on the coastline. Moreover, it is unlikely that Lake Cowal supports an ecologically significant proportion of the population due to typically low numbers of individuals recorded. Habitat at Lake Cowal is also not at the limit of the species range, nor is this habitat in an area where the species is known to be declining. As such, the study area is unlikely meet the criteria for important habitat as defined in DoE (2013).
2. Result in invasive species	**Unlikely**. See assessment of this criteria for the Lathams Snipe above, which applies consistently to other migratory shorebirds/waterbirds.
3. Disrupt lifecycle of ecologically significant proportion of population	**Unlikely**. The population that uses the EAAF is estimated to be 110,000 (Hansen et al. 2016). Based on the highest record of 82 individuals, this represents approximately 0.07% of this estimated EAAF population. That is, it is below the 0.1% threshold to be considered a nationally important site. Based on the relatively low numbers of individuals that visit Lake Cowal, it is considered unlikely that the study area supports an ecologically significant proportion of the Common Greenshank.

Table 9.22 Assessment of significance for Common Greenshank in the study area

Criteria	Discussion
Conclusion	**Unlikely significant impact**. The Project will unlikely result in a significant impact on the Common Greenshank as: • the area does not contain important habitat for the species • an ecologically significant proportion of the population will not be disrupted.

h Red-necked Stint

The Red-necked Stint breeds in Siberia and sporadically in north and west Alaska. It spends winter in Australasia, mostly in Australia, with smaller numbers in New Guinea and New Zealand. The EAAF population is approximately 450,000 (Hansen et al. 2016), with 80% of this population residing in Australia (i.e. 260,000 individuals).

In Australia, the Red-necked Stint is primarily found along the coast, occupying sheltered inlets, bays, lagoons and estuaries with intertidal mudflats, often near spits, islets and banks and, sometimes, on protected sandy or coralline shores (DCCEEW 2023k). They may also use ephemeral or permanent shallow wetlands near the coast or inland, including lagoons, lakes, swamps, riverbanks, waterholes, bore drains, dams, soaks and pools in saltflats.

Across Lake Cowal, the species has been recorded within Evolution's monitoring in four survey events since 1989. The lowest count during those surveys was of a single individual and a high of 20 individuals. This species has not been recorded during UNSW monitoring or by EMM. There is no evidence of this species breeding at Lake Cowal.

An assessment of significance is provided for this species in Table 9.23.

Table 9.23 Assessment of significance for Red-necked Stint in the study area

Criteria	Discussion
1. Substantially modify important habitat	**Unlikely**. The Red-necked Stint is a widely distributed across a range of wetland habitats throughout Australia, although more common along the coast. Important habitats in Australia have been identified, but no sites of importance have been identified NSW. Moreover, it is unlikely that Lake Cowal supports an ecologically significant proportion of the population due to typically low numbers of individuals recorded. Habitat at Lake Cowal is also not at the limit of the species range, nor is this habitat in an area where the species is known to be declining. As such, the study area is unlikely meet the criteria for important habitat as defined in DoE (2013).
2. Result in invasive species	**Unlikely**. See assessment of this criteria for the Latham's Snipe above, which applies consistently to other migratory shorebirds/waterbirds.
3. Disrupt lifecycle of ecologically significant proportion of population	**Unlikely**. The population that uses the EAAF is estimated to be 260,000 (Hansen et al. 2016). Based on the highest record of 20 individuals, this represents approximately <0.01% of this estimated EAAF population. That is, it is below the 0.1% threshold to be considered a nationally important site. Based on the relatively low numbers of individuals and frequency of visitations to Lake Cowal, it is considered unlikely that the study area supports an ecologically significant proportion of the Red-necked Stint.
Conclusion	**Unlikely significant impact**. The Project will unlikely result in a significant impact on the Red-necked Stint as: • the area does not contain important habitat for the species • an ecologically significant proportion of the population will not be disrupted.

i Marsh Sandpiper

The Marsh Sandpiper breeds from eastern Europe to eastern Siberia. The estimated EAAF population of 130,000 (Hansen et al. 2016), with the global population is estimated at 186,000–1,242,000 (Bamford et al. 2008).

The Marsh Sandpiper lives in permanent or ephemeral wetlands of varying salinity, including swamps, lagoons, billabongs, saltpans, saltmarshes, estuaries, pools on inundated floodplains, and intertidal mudflats and also regularly at sewage farms and saltworks (DCCEEW 2023l). They are recorded less often at reservoirs, waterholes, soaks, bore-drain swamps and flooded inland lakes.

Across Lake Cowal, the species has been recorded within Evolution's monitoring in 14 survey events since 1989. The lowest count during those surveys was of a single individual and a high of 82 individuals. This species has not been recorded during UNSW monitoring or by EMM. There is no evidence of this species breeding at Lake Cowal.

An assessment of significance is provided for this species in Table 9.24.

Table 9.24 Assessment of significance for Marsh Sandpiper in the study area

Criteria	Discussion
1. Substantially modify important habitat	**Unlikely**. The Marsh Sandpiper is a widely distributed across a range of wetland habitats throughout Australia, although more common along the coast. Important habitats in Australia have been identified, with four sites of national importance identified in NSW. The closest of these to Lake Cowal is Parkes Wetlands, >50 km northeast of Lake Cowal. Moreover, it is unlikely that Lake Cowal supports an ecologically significant proportion of the population due to typically low numbers of individuals recorded. Habitat at Lake Cowal is also not at the limit of the species range, nor is this habitat in an area where the species is known to be declining. As such, the study area is unlikely meet the criteria for important habitat as defined in DoE (2013).
2. Result in invasive species	**Unlikely**. See assessment of this criteria for the Lathams Snipe above, which applies consistently to other migratory shorebirds/waterbirds.
3. Disrupt lifecycle of ecologically significant proportion of population	**Unlikely**. The population that uses the EAAF is estimated to be 130,000 (Hansen et al. 2016). Based on the highest record of 82 individuals, this represents approximately 0.06% of this estimated EAAF population. That is, it is below the 0.1% threshold to be considered a nationally important site. Based on the relatively low numbers of individuals and frequency of visitations to Lake Cowal, it is considered unlikely that the study area supports an ecologically significant proportion of the Marsh Sandpiper.
Conclusion	**Unlikely significant impact**. The Project will unlikely result in a significant impact on the Marsh Sandpiper as: • the area does not contain important habitat for the species • an ecologically significant proportion of the population will not be disrupted.

j Black-tailed Godwit

For populations of Black-tailed Godwit occurring in the EAAF, breeding is believed to occur in the far-east Russia (DCCEEW 2023m). During the non-breeding period, the Black-tailed Godwit is found in all states and territories of Australia. However, it prefers coastal regions in Australia, with scarce inland records. The largest populations are found on the north coast between Darwin and Weipa. The estimated EAAF population is 160,000 (Hansen et al. 2016), with the global population estimated at 561,000 to 750,000.

The Black-tailed Godwit is primarily found intertidal mudflats or sandflats, in soft mud or shallow water and occasionally in shallow estuaries. They are found in muddy areas often open and unvegetated, but commonly use drying marshy wetlands.

There are three records of this species within 10 km of Lake Cowal (BioNet Atlas 2023), with the most recent in 1997. This species has not been recorded in Lake Cowal during Evolution's monitoring since 1989, UNSW monitoring or by EMM. There is no evidence of this species breeding at Lake Cowal.

An assessment of significance is provided for this species in Table 9.25.

Table 9.25 Assessment of significance for Black-tailed Godwit in the study area

Criteria	Discussion
1. Substantially modify important habitat	**Unlikely**. The Black-tailed Godwit is a widely distributed across a range of wetland habitats throughout Australia, although more common along the coast. Important habitats in Australia have been identified, with Hunter Estuary the only site of importance identified in NSW, which is well away from Lake Cowal. Moreover, it is unlikely that Lake Cowal supports an ecologically significant proportion of the population due to typically low numbers of individuals recorded. Habitat at Lake Cowal is also not at the limit of the species range, nor is this habitat in an area where the species is known to be declining. As such, the study area is unlikely meet the criteria for important habitat as defined in DoE (2013).
2. Result in invasive species	**Unlikely**. See assessment of this criteria for the Latham's Snipe above, which applies consistently to other migratory shorebirds/waterbirds.
3. Disrupt lifecycle of ecologically significant proportion of population	**Unlikely**. The population that uses the EAAF is estimated to be 160,000 (Hansen et al. 2016). Although counts of the three BioNet records are not provided, a lack of detection of this species by Evolution's monitoring since 1989, UNSW monitoring and targeted surveys by EMM suggests low visitation of Lake Cowal. As such, it is considered unlikely that the study area supports an ecologically significant proportion of the Black-tailed Godwit.
Conclusion	**Unlikely significant impact**. The Project will unlikely result in a significant impact on the Black-tailed Godwit as: • the area does not contain important habitat for the species • an ecologically significant proportion of the population will not be disrupted.

k Double-banded Plover

The Double-banded Plover can be found in both coastal and inland areas. The Double-banded Plover breeds only in New Zealand, where it is widespread (DCCEEW 2023n). During the non-breeding season, it is common in eastern and southern Australia, mainly between the Tropic of Capricorn and western Eyre Peninsula, with occasional records in northern Queensland and Western Australia. In Australia, the greatest numbers are found in Tasmania and Victoria, but numbers diminish to the north and west of these regions. The population is 19,000 (Hansen et al. 2016).

The Double-banded Plover is found on littoral, estuarine and fresh or saline terrestrial wetlands and also saltmarsh, grasslands and pasture. It occurs on muddy, sandy, shingled or sometimes rocky beaches, bays and inlets, harbours and margins of fresh or saline terrestrial wetlands such as lakes, lagoons and swamps, shallow estuaries and rivers. The species is sometimes associated with coastal lagoons, inland saltlakes and saltworks.

Across Lake Cowal, the species has been recorded within Evolution's monitoring in two survey events since 1989. The lowest count during those surveys was of 6 individuals and a high of 8 individuals. This species has not been recorded during UNSW monitoring or by EMM. There is no evidence of this species breeding at Lake Cowal.

An assessment of significance is provided for this species in Table 9.26.

Table 9.26 Assessment of significance for Double-banded Plover in the study area

Criteria	Discussion
1. Substantially modify important habitat	**Unlikely**. The Double-banded Plover is primarily found in coastal wetland and grassy habitats, particularly in southern Australia. There are no important identified in NSW. Moreover, it is unlikely that Lake Cowal supports an ecologically significant proportion of the population due to typically low numbers of individuals recorded. Habitat at Lake Cowal is also not at the limit of the species range, nor is this habitat in an area where the species is known to be declining. As such, the study area is unlikely meet the criteria for important habitat as defined in DoE (2013).
2. Result in invasive species	**Unlikely**. See assessment of this criteria for the Latham's Snipe above, which applies consistently to other migratory shorebirds/waterbirds.
3. Disrupt lifecycle of ecologically significant proportion of population	**Unlikely**. The population is estimated to be 19,000 (Hansen et al. 2016). Based on the highest record of 8 individuals, this represents approximately <0.01% of this estimated population. That is, it is below the 0.1% threshold to be considered a nationally important site. As such, it is considered unlikely that the study area supports an ecologically significant proportion of the Double-banded Plover.
Conclusion	**Unlikely significant impact**. The Project will unlikely result in a significant impact on the Double-banded Plover as: • the area does not contain important habitat for the species • an ecologically significant proportion of the population will not be disrupted.

l Pacific Golden Plover

The Pacific Golden Plover breeds mostly in northern Siberia, between the Yamal Peninsula and the Chukotski Peninsula and the Gulf of Anadyr (DCCEEW 2023o). Within Australia during non-breeding periods, the Pacific Golden Plover is widespread in coastal regions. There are also several inland records, usually along major river systems, especially the Murray and Darling Rivers and their tributaries. Most Pacific Golden Plovers occur along the east coast and are especially widespread along the Queensland and NSW coastlines. The estimated EAAF population is 120,000 (Hansen et al. 2016), with the global population estimated at 170,000 to 220,000 (Birdlife International 2023).

In Australia, this species usually inhabits coastal habitats, including beaches, mudflats and sandflats in sheltered areas including harbours, estuaries and lagoons, and also in evaporation ponds in saltworks (DCCEEW 2023o). It occurs around inland wetlands such as fresh, brackish or saline lakes, billabongs, pools, swamps and wet claypans.

Across Lake Cowal, the species has been recorded within Evolution's monitoring in only one survey event since 1989. The count during that survey was of one individual only. This species has not been recorded during UNSW monitoring or by EMM. There is no evidence of this species breeding at Lake Cowal.

An assessment of significance is provided for this species in Table 9.27.

Table 9.27 Assessment of significance for Pacific Golden Plover in the study area

Criteria	Discussion
1. Substantially modify important habitat	**Unlikely**. The Pacific Golden Plover is primarily found in coastal wetland habitats. There are three nationally important sites identified in NSW, all of which are coastal estuaries. Moreover, it is unlikely that Lake Cowal supports an ecologically significant proportion of the population due to the historic low numbers of individuals recorded. Habitat at Lake Cowal is also not at the limit of the species range, nor is this habitat in an area where the species is known to be declining. As such, the study area is unlikely meet the criteria for important habitat as defined in DoE (2013).
2. Result in invasive species	**Unlikely**. See assessment of this criteria for the Latham's Snipe above, which applies consistently to other migratory shorebirds/waterbirds.

Table 9.27 Assessment of significance for Pacific Golden Plover in the study area

Criteria	Discussion
3. Disrupt lifecycle of ecologically significant proportion of population	**Unlikely**. The population that uses the EAAF is estimated to be 120,000 (Hansen et al. 2016). Based on the highest record of 1 individual, this represents approximately <0.01% of this estimated population. That is, it is below the 0.1% threshold to be considered a nationally important site. As such, it is considered unlikely that the study area supports an ecologically significant proportion of the Pacific Golden Plover.
Conclusion	**Unlikely significant impact**. The Project will unlikely result in a significant impact on the Pacific Golden Plover as: • the area does not contain important habitat for the species • an ecologically significant proportion of the population will not be disrupted.

m Little Curlew

The Little Curlew breeds in central and north-east Russia and Siberia (DCCEEW 2023p). Within Australia during non-breeding periods, the Little Curlew frequents northern Australia from Port Hedland in Western Australia to the Queensland coast. There are also records of this species in inland Australia, with widespread but scattered records on the east coast. The estimated EAAF population is 180,000 (Hansen et al. 2016), with the global population estimated at >180,000 (Birdlife International 2023).

In Australia, the Little Curlew most often forages in short, dry grassland and sedgeland, including dry floodplains and blacksoil plains, which have scattered, shallow freshwater pools or areas seasonally inundated (DCCEEW 2023p). They often are found foraging in short grass, as within open woodlands, dry saltmarshes, coastal swamps, mudflats or sandflats of estuaries or beaches on sheltered coasts. During the day, they often congregate around pools, river beds and water-filled tidal channels, and shallow water at edges of billabongs.

Across Lake Cowal, the species has been recorded within Evolution's monitoring in only one survey event since 1989. The count during that survey was of one individual only. This species has not been recorded during UNSW monitoring or by EMM. There is no evidence of this species breeding at Lake Cowal.

An assessment of significance is provided for this species in Table 9.28.

Table 9.28 Assessment of significance for Little Curlew in the study area

Criteria	Discussion
1. Substantially modify important habitat	**Unlikely**. The Little Curlew is primarily found in grassy, coastal habitats. There are three nationally important sites identified in NSW, all of which are coastal estuaries. Moreover, it is unlikely that Lake Cowal supports an ecologically significant proportion of the population due to the historic low numbers of individuals recorded. Habitat at Lake Cowal is also not at the limit of the species range, nor is this habitat in an area where the species is known to be declining. As such, the study area is unlikely meet the criteria for important habitat as defined in DoE (2013).
2. Result in invasive species	**Unlikely**. See assessment of this criteria for the Latham's Snipe above, which applies consistently to other migratory shorebirds/waterbirds.
3. Disrupt lifecycle of ecologically significant proportion of population	**Unlikely**. The population that uses the EAAF is estimated to be 180,000 (Hansen et al. 2016). Based on the highest record of 2 individuals, this represents approximately <0.01% of this estimated population. That is, it is below the 0.1% threshold to be considered a nationally important site. As such, it is considered unlikely that the study area supports an ecologically significant proportion of the Little Curlew.
Conclusion	**Unlikely significant impact**. The Project will unlikely result in a significant impact on Little Curlew as: • the area does not contain important habitat for the species • an ecologically significant proportion of the population will not be disrupted.

n Curlew sandpiper

The potential for a significant impact on this species was also assessed against DoE (2013) Section J above. Please refer to the current understanding of the ecology and biology of this species in that section. An assessment of significance against the migratory species criteria is provided for this species in Table 9.29.

Table 9.29 Assessment of significance for Curlew sandpiper in the study area

Criteria	Discussion
1. Substantially modify important habitat	**Unlikely**. The Curlew sandpiper is primarily found in estuarine coastal habitats, with inland records much less frequent. Hunter Estuary is the important site identified in NSW, which is well away from Lake Cowal. Moreover, it is unlikely that Lake Cowal supports an ecologically significant proportion of the population due to the historic low numbers of individuals recorded. Habitat at Lake Cowal is also not at the limit of the species range, nor is this habitat in an area where the species is known to be declining. As such, the study area is unlikely meet the criteria for important habitat as defined in DoE (2013).
2. Result in invasive species	**Unlikely**. See assessment of this criteria for the Lathams Snipe above, which applies consistently to other migratory shorebirds/waterbirds.
3. Disrupt lifecycle of ecologically significant proportion of population	**Unlikely**. The population that uses the EAAF is estimated to be 135,000 (Hansen et al. 2016). Based on the highest record of 12 individuals, this represents approximately <0.01% of this estimated population. That is, it is below the 0.1% threshold to be considered a nationally important site. As such, it is considered unlikely that the study area supports an ecologically significant proportion of the Curlew sandpiper.
Conclusion	**Unlikely significant impact**. The Project will unlikely result in a significant impact on Curlew sandpiper as: • the area does not contain important habitat for the species • an ecologically significant proportion of the population will not be disrupted.

o Whimbrel

The Whimbrel breeds in north and west Alaska (DCCEEW 2023q). Within Australia during non-breeding periods, the Whimbrel occur primarily along the coast, but there are scattered, less frequent records inland. In NSW, they are widespread east of the Great Divide, especially in coastal regions. The estimated EAAF population is 55,000 (Hansen et al. 2016). The global population is estimated to be 1,000,000-2,300,000 individuals (Birdlife International 2023).

In Australia, the Whimbrel typically occur on the intertidal mudflats of sheltered coasts but can also be found less infrequently on sandy or rocky beaches, or on intertidal reefs and platforms (DCCEEW 2023q). There are a small number of inland records from saline lakes and canegrass swamps.

There is only one record of this species within 10 km of Lake Cowal on BioNet (BioNet Atlas 2023), made in 1997. This species has not been recorded in Lake Cowal during Evolution's monitoring since 1989, UNSW monitoring or by EMM. There is no evidence of this species breeding at Lake Cowal.

An assessment of significance is provided for this species in Table 9.30.

Table 9.30 Assessment of significance for Whimbrel in the study area

Criteria	Discussion
1. Substantially modify important habitat	**Unlikely**. The Whimbrel is primarily found in estuarine coastal habitats, with inland records much less frequent. There are no important sites in NSW. Moreover, it is unlikely that Lake Cowal supports an ecologically significant proportion of the population due to the historic low numbers of individuals recorded. Habitat at Lake Cowal is also not at the limit of the species range, nor is this habitat in an area where the species is known to be declining. As such, the study area is unlikely meet the criteria for important habitat as defined in DoE (2013).
2. Result in invasive species	**Unlikely**. See assessment of this criteria for the Latham's Snipe above, which applies consistently to other migratory shorebirds/waterbirds.
3. Disrupt lifecycle of ecologically significant proportion of population	**Unlikely**. The population that uses the EAAF is estimated to be 55,000 (Hansen et al. 2016). Although count for the single BioNet record is not provided, a lack of detection of this species by Evolution's monitoring since 1989, UNSW monitoring and targeted surveys by EMM suggests low visitation of Lake Cowal. As such, it is considered unlikely that the study area supports an ecologically significant proportion of the Whimbrel.
Conclusion	**Unlikely significant impact**. The Project will unlikely result in a significant impact on Whimbrel as: • the area does not contain important habitat for the species • an ecologically significant proportion of the population will not be disrupted.

p Wood Sandpiper

The Wood Sandpiper breeds throughout Eurasia (DCCEEW 2023r). Within Australia during non-breeding periods, the largest numbers of Wood sandpiper occur in north-west Australia. around the coasts. In NSW, there are records east of the Great Divide, from Stratheden and Casino, south to Nowra and elsewhere, mostly from the Riverina, but also from the Upper and Lower Western Regions. The estimated EAAF population is 130,000 (Hansen et al. 2016). This is approximately 4% of the global population, estimated to be 3,100,000-3,500,000 individuals (Birdlife International 2023).

In Australia, the Wood sandpiper typically uses well-vegetated, shallow, freshwater wetlands, such as swamps, billabongs, lakes, pools and waterholes. They also frequent inundated grasslands, short herbage or wooded floodplains, where floodwaters are temporary or receding, and irrigated crops.

There is only one record of this species within 10 km of Lake Cowal on BioNet (BioNet Atlas 2023), made in 1997. This species has not been recorded in Lake Cowal during Evolution's monitoring since 1989, UNSW monitoring or by EMM. There is no evidence of this species breeding at Lake Cowal.

An assessment of significance is provided for this species in Table 9.31.

Table 9.31 Assessment of significance for Wood Sandpiper in the study area

Criteria	Discussion
1. Substantially modify important habitat	**Unlikely**. The Wood Sandpiper is primarily found in wetland habitats in north-western Australia. There are no nationally or internationally important sites identified in NSW. Moreover, it is unlikely that Lake Cowal supports an ecologically significant proportion of the population due to the historic low numbers of individuals recorded. Habitat at Lake Cowal is also not at the limit of the species range, nor is this habitat in an area where the species is known to be declining. As such, the study area is unlikely meet the criteria for important habitat as defined in DoE (2013).
2. Result in invasive species	**Unlikely**. See assessment of this criteria for the Latham's Snipe above, which applies consistently to other migratory shorebirds/waterbirds.

Table 9.31 Assessment of significance for Wood Sandpiper in the study area

Criteria	Discussion
3. Disrupt lifecycle of ecologically significant proportion of population	**Unlikely**. The population that uses the EAAF is estimated to be 130,000 (Hansen et al. 2016). Although count for the single BioNet record is not provided, a lack of detection of this species by Evolution's monitoring since 1989, UNSW monitoring and targeted surveys by EMM suggests low visitation of Lake Cowal. As such, it is considered unlikely that the study area supports an ecologically significant proportion of the Wood Sandpiper.
Conclusion	**Unlikely significant impact**. The Project will unlikely result in a significant impact on Wood Sandpiper as: • the area does not contain important habitat for the species • an ecologically significant proportion of the population will not be disrupted.

q Glossy Ibis

The Glossy Ibis is located within eastern North America, from the Caribbean region to Europe, Russia and Siberia, through central Asia, south of the Sahara in Africa, Pakistan, India, Philippines, Indonesia, Papua New Guinea and Australia. The Australian population is estimated to be approximately 12% of the total Glossy Ibis population (Marchant & Higgins 1990). Migration occurs within Australia, which is thought to be in response to rainfall. The core breeding areas are within the Murray-Darling Basin region of NSW and Victoria, the Macquarie Marshes in New South Wales, and in southern Queensland.

The Glossy Ibis typically associates with freshwater marshes at the edges of lakes and rivers, lagoons, flood-plains, wet meadows, swamps, reservoirs, sewage ponds, rice-fields and cultivated areas under irrigation (DCCEEW 2023s). It is occasionally found in coastal locations such as estuaries, deltas, saltmarshes and coastal lagoons.

Glossy Ibis has been detected within the Additional disturbance area. Across Lake Cowal, the species has been recorded within Evolution's monitoring in 56 survey events since 1989. The lowest count during those surveys was of a single individual and a high of 100 individuals. The highest count recorded during an aerial survey by UNSW (2022) was 556 individuals. Breeding has been recorded within Lake Cowal within Evolution's monitoring in 1989 (20 pairs), 1992 (100 pairs), 2012 (110 pairs) and 2021 (300 pairs). No breeding activity of this species has been recorded along T1, the transect that runs adjacent to the existing CGO bund wall.

An assessment of significance is provided for this species in Table 9.32.

Table 9.32 Assessment of significance for Glossy Ibis in the study area

Criteria	Discussion
1. Substantially modify important habitat	**Likely**. The Glossy Ibis is widely distributed across a range of wetland habitats throughout Australia. Habitat at Lake Cowal is not at the limit of the species range, nor is this habitat in an area where the species is known to be declining. However, at times Lake Cowal can support an ecologically significant proportion of the population, including regular breeding. As such, the study area possibly meets the criteria for important habitat as defined in DoE (2013).
2. Result in invasive species	**Unlikely**. See assessment of this criteria for the Lathams Snipe above, which applies consistently to other migratory shorebirds/waterbirds.

Table 9.32 Assessment of significance for Glossy Ibis in the study area

Criteria	Discussion
3. Disrupt lifecycle of ecologically significant proportion of population	**Likely**. The global population estimate is 230,000 – 2,220,000 (Birdlife International 2019a). Based on the Australian population being estimated to be 12% of global population (Marchant & Higgins 1990), the Australian population (at the lower estimate) is approximately 27,600 individuals. Based on the highest record of 556 individuals, this represents approximately 2% of estimated Australian population. On 14 occasion the individuals recorded were above the 0.1% threshold to be considered a nationally important site. Due to the potential for Lake Cowal to support this extent of Glossy Ibis, combined with consistent breeding at Lake Cowal (most recently recorded in 2021), it is considered possible that the study area supports an ecologically significant proportion of the Glossy Ibis.
Conclusion	**Likely significant impact**. The Project will likely result in a significant impact on the Glossy Ibis as: • the Project may substantially modify important habitat • an ecologically significant proportion of the population may be disrupted.

r Caspian Tern

Globally, the Caspian Tern is found in North America, Europe, Africa, Asia, Australia and New Zealand (Higgins & Davies 1996). Within Australia, the Caspian Tern has a widespread occurrence and can be found in both coastal and inland habitat (Higgins & Davies 1996). In NSW, this species is widespread east of the Great Divide, mainly in coastal regions, and also in the Riverina and Lower and Upper Western Regions, with occasional records elsewhere (Higgins & Davies 1996). In NSW, breeding is known to occur at Menindee Lakes.

The Caspian Tern typically associates with found sheltered coastal embayments, such as harbours, lagoons, inlets, bays, estuaries and river deltas (DCCEEW 2023t). They also occur on near-coastal or inland terrestrial wetlands that are either fresh or saline, especially lakes (including ephemeral lakes), waterholes, reservoirs, rivers and creeks.

Caspian Tern has been detected within the Additional disturbance area. The species has been recorded within Evolution's monitoring in eight survey events since 1989. The lowest count during those surveys was of a single individual and a high of two individuals. The highest count recorded was by EMM with 20 individuals recorded. There is no evidence of this species breeding at Lake Cowal.

An assessment of significance is provided for this species in Table 9.33.

Table 9.33 Assessment of significance for Caspian Tern in the study area

Criteria	Discussion
1. Substantially modify important habitat	**Unlikely**. The Caspian Tern is a widely distributed across a range of wetland habitats throughout Australia. No important habitats have been identified for the species. Moreover, it is unlikely that Lake Cowal supports an ecologically significant proportion of the population due to highly infrequent records. Habitat at Lake Cowal is also not at the limit of the species range, nor is this habitat in an area where the species is known to be declining. As such, the study area is unlikely meet the criteria for important habitat as defined in DoE (2013).
2. Result in invasive species	**Unlikely**. See assessment of this criteria for the Latham's Snipe above, which applies consistently to other migratory shorebirds/waterbirds.
3. Disrupt lifecycle of ecologically significant proportion of population	**Unlikely**. The global population estimate is 250,000 – 470,000 (Birdlife International 2019b). Based on the highest record of 20 individuals, this represents approximately <0.01% of estimated Australian population. That is, it is below the 0.1% threshold to be considered a nationally important site. Based on this relatively low visitation of Lake Cowal, combined with no observed breeding at Lake Cowal, it is considered unlikely that the study area supports an ecologically significant proportion of the Caspian Tern.

Table 9.33 Assessment of significance for Caspian Tern in the study area

Criteria	Discussion
Conclusion	**Unlikely significant impact**. The Project will unlikely result in a significant impact on the Caspian Tern as: • the area does not contain important habitat for the species • an ecologically significant proportion of the population will not be disrupted.

s Australian Gull-billed Tern

The Australian Gull-billed Tern is a widespread species of Australia, Indonesia and Papua New Guinea. The global population is estimated to number 25,000 - 100,000 individuals (Birdlife International 2018). Species is typically found in marshier habitats than most other terns, usually near the coast but not on the ocean, though also occasionally seen on beaches and mudflats (DCCEEW 2023u).

The Australian Gull-billed Tern was detected within the Additional disturbance area. The species has been recorded within Evolution's monitoring in 14 survey events since 1989. The lowest count during those surveys was of a single individual and a high of 16 individuals. The highest count recorded by UNSW monitoring was 55 individuals. Breeding has been recorded within Lake Cowal within Evolution's monitoring in 1989 (3 pairs). No breeding activity of this species has been recorded along T1, the transect that runs adjacent to the existing CGO bund wall.

An assessment of significance is provided for this species in Table 9.34.

Table 9.34 Assessment of significance for Australian Gull-billed Tern in the study area

Criteria	Discussion
1. Substantially modify important habitat	**Unlikely**. The Australian Gull-billed Tern is a widely distributed and common across a range of wetland habitats throughout Australia. No important habitats have been identified for the species. Moreover, it is unlikely that Lake Cowal supports an ecologically significant proportion of the population due to highly infrequent records. Habitat at Lake Cowal is also not at the limit of the species range, nor is this habitat in an area where the species is known to be declining. As such, the study area is unlikely meet the criteria for important habitat as defined in DoE (2013).
2. Result in invasive species	**Unlikely**. See assessment of this criteria for the Latham's Snipe above, which applies consistently to other migratory shorebirds/waterbirds.
3. Disrupt lifecycle of ecologically significant proportion of population	**Unlikely**. The lower end of the global population estimate is 25,000 (Birdlife International 2018). Based on the highest record of 55 individuals, this represents approximately 0.22% of the estimated population. Based on this relatively low visitation of Lake Cowal, combined with highly infrequent observed breeding at Lake Cowal, it is considered unlikely that the study area supports an ecologically significant proportion of the Australian Gull-billed Tern.
Conclusion	**Unlikely significant impact**. The Project will unlikely result in a significant impact on the Australian Gull-billed Tern as: • the area does not contain important habitat for the species • an ecologically significant proportion of the population will not be disrupted.

t White-winged Black Tern

The White-winged Black Tern breeds in Eurasia, from central Europe through Russia to Eastern China. It is common to very common in parts of eastern Europe and central and eastern Asia, but very scarce in central Europe (Gochfeld & Burger 1996). In Australia, this species visits as a non-breeding migrant during Spring/Summer, where it is widespread and common along south-western, northern and central-eastern coasts. It is less frequent inland of the Great Divide, where there are scattered records within inland wetlands.

This species has a large global population, estimated to be 3,100,000–4,000,000 individuals (Birdlife International 2023). In Australia, the species mostly inhabits fresh, brackish or saline, and coastal or subcoastal wetlands (DCCEEW 2023v). They are also recorded within terrestrial wetlands, including swamps, lakes, billabongs, rivers, floodplains, reservoirs, saltworks, sewage ponds and outfalls are also inhabited. There are scarce records of this species associating with inland wetlands in Australia.

The White-winged Black Tern has been recorded within Lake Cowal by Evolution's monitoring in four survey events since 1989. The lowest count during those surveys was of a single individual and a high of four individuals. There is no evidence of this species breeding at Lake Cowal.

An assessment of significance is provided for this species in Table 9.35.

Table 9.35 Assessment of significance for White-winged Black Tern in the study area

Criteria	Discussion
1. Substantially modify important habitat	**Unlikely**. The White-winged Black Tern is widely distributed globally, visiting primarily coastal aquatic habitats during non-breeding periods. It scarcely visits inland lakes, such as Lake Cowal. No important habitats have been identified for the species. Moreover, it is unlikely that Lake Cowal supports an ecologically significant proportion of the population due to highly infrequent records. Habitat at Lake Cowal is also not at the limit of the species range, nor is this habitat in an area where the species is known to be declining. As such, the study area is unlikely meet the criteria for important habitat as defined in DoE (2013).
2. Result in invasive species	**Unlikely**. Vegetation clearing and topsoil stripping are likely to lead to weed invasion in surrounding habitat unless adequately mitigated. Measures to control weeds in retained habitats of the study area will be developed during the EIS. As a ground-dwelling bird, this species is vulnerable to predation from the invasive fauna, including red fox, cats and wild dogs. These introduced predators can spread into undisturbed areas when new access roads and tracks are created. As the Project will not create new tracks through undisturbed areas, it is unlikely to result in the spread of such invasive species. Nevertheless, invasive animal control programs (including targeted baiting/trapping programs for foxes, cats and wild dogs) undertaken by Evolution in Lake Cowal and nearby areas should reduce predation threat for this species. Moreover, establishment of BSA(s) within Lake Cowal will undertake management to improve habitat condition, including additional pest animal control efforts and restoration of waterbird sheltering habitat (e.g. Lignum and Cane grass) through measures such as cattle exclusion, which should benefit this species by further reducing predation threat (see Section 10: Biodiversity Offset Strategy).
3. Disrupt lifecycle of ecologically significant proportion of population	**Unlikely**. Lake Cowal offers foraging habitat for the White-winged Black Tern only when inundated. The lower end of the global population estimate is 3,100,000. Based on the highest record of four individuals, this represents approximately <0.01% of the estimated population. That is, it is below the 0.1% threshold to be considered a nationally important site. Based on this scarce visitation of non-breeding individuals to Lake Cowal, which is likely to occur only when inundated, it is considered unlikely that the study area supports an ecologically significant proportion of the White-winged Black Tern.
Conclusion	**Unlikely significant impact**. The Project will unlikely result in a significant impact on the White-winged Black Tern as: • the area does not contain important habitat for the species • an ecologically significant proportion of the population will not be disrupted.

u White-throated Needletail

The potential for a significant impact on this species was also assessed against DoE (2013) Section J above. Please refer to the current understanding of the ecology and biology of this species in that section. An assessment of significance against the migratory species criteria is provided for this species in Table 9.36.

Table 9.36 Assessment of significance for White-throated Needletail

Criteria	Discussion
1. Substantially modify important habitat	**Unlikely**. The White-throated Needletail is widely distributed in central and eastern Siberia, northern Mongolia, northern China and the Korean Peninsula, Sakhalin and Japan, and migrates to spend the non-breeding season in Australasia. This species does not breed in Australia, visiting Australia in September and October and returning northwards outside of Australia via Torres Strait in mid-March and April. The White-throated Needletail is also a habitat generalist, occurring over most habitats since this species is mostly aerial. It also does not breed in Australia. As such, there are no important habitats identified for this species in Australia. Moreover, it is unlikely that Lake Cowal supports an ecologically significant proportion of the population due to highly infrequent records. Habitat at Lake Cowal is also not at the limit of the species range, nor is this habitat in an area where the species is known to be declining. As such, the study area is unlikely meet the criteria for important habitat as defined in DoE (2013).
2. Result in invasive species	**Unlikely**. Vegetation clearing and topsoil stripping are likely to lead to weed invasion in surrounding habitat unless adequately mitigated. Measures to control weeds in retained habitats of the study area will be developed during the EIS.
3. Disrupt lifecycle of ecologically significant proportion of population	**Unlikely**. Lake Cowal offers foraging habitat for the White-throated Needletail. Based on this scarce visitation of non-breeding individuals to Lake Cowal, and general habitat requirements for this species as an aerial forager, it is considered unlikely that the study area support an ecologically significant proportion of the White-throated Needletail.
Conclusion	**Unlikely significant impact**. The Project will unlikely result in a significant impact on the White-throated Needletail as: • the area does not contain important habitat for the species • an ecologically significant proportion of the population will not be disrupted.

9.2 Environmental Planning and Assessment Act 1979

9.2.1 SEPP (Biodiversity and Conservation) 2021

Together, Chapter 3 (Koala Habitat Protection 2020) and 4 (Koala Habitat Protection 2021) of *State Environmental Planning Policy (Biodiversity and Conservation) 2021* aim to encourage the proper conservation and management of areas of natural vegetation that provide habitat for Koalas to ensure a permanent free-living population over their present range and reverse the current trend of Koala population decline. In nine metropolitan Sydney local government areas (Blue Mountains, Campbelltown, Hawkesbury, Ku-Ring-Gai, Liverpool, Northern Beaches, Hornsby, Wollondilly) and the Central Coast LGA, Chapter 4 of SEPP (Biodiversity and Conservation 2021 applies to all land use zones. Outside of these areas, Chapter 3 of SEPP (Biodiversity and Conservation 2021) continues to apply to all land zoned RU1, RU2, and RU3.

In the context of this proposal, Chapter 3 of SEPP (Biodiversity and Conservation 2021) applies because it is within the Bland local government area and is zoned RU1.

The Project is not a development application and does not require approval from Council, and thus consideration of the Koala SEPP 2020 and Koala SEPP 2021 are not triggered. Nonetheless, consideration has been given to the potential occurrence and impacts upon the koala within this report.

9.3 Biosecurity Act 2015

African boxthorn (*Lycium ferocissimum*) and Bathurst Burr (*Xanthium spinosum*) are species of concern within the Central West Local Land Services Region (LLS 2017). Other high threat weeds observed were Paspalum (*Paspalum dilatatum*) and Lippia (*Phyla canescens*).

These four weeds are regulated across all of NSW with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable. These species must also not be imported into NSW or sold.

The biodiversity management plan for the Project would directly address the control of these high threat weeds.

9.4 Water Management Act 2000

A water use approval under section 89, a water management work approval under section 90 or an activity approval (other than an aquifer interference approval) under section 91 of the WM Act will not be required as the Project is State significant development (SSD) as per section 4.41 of the EP&A Act.

10 Biodiversity Offset Strategy

As outlined in Sections 8 and 9, Evolution Mining (Evolution) requires a range of biodiversity offsets to meet New South Wales and Commonwealth legislative requirements to execute the project.

Evolution will pursue biodiversity offsets required for the Project. Biodiversity offsets will be staged to meet the respective offset liability for each of the five stages of Project construction.

The pathway includes:

- Establishment of Stewardship sites on Evolution-owned land.
- Purchase of credits (or land) from external landholders to meet the anticipated credit shortfall.
- Limited use of the NSW Government Biodiversity Conservation Fund (BCF).

Further details on the BoS pathway are provided in Section 10.1 to Section 10.3 below.

10.1 Evolution-owned land

Evolution will firstly pursue the establishment of Stewardship sites over their landholdings. Evolution has already undertaken vegetation mapping over their landholdings and potential credit generation and have identified that they have sufficient and adequate lands (subject to the decision to pursue Stewardship site arrangements over Evolution lands) to meet the biodiversity credit obligations for PCTs 17, 53, 82, 185, and 249.

Opportunities to generate credits for Austral Pillwort have also been identified with the species being recorded in multiple locations with Evolution's landholdings. Evolution is currently in the process of selecting lands from their own landholdings to proceed with Stewardship site assessment and establishment and has commenced discussions with the NSW Credits Supply Taskforce (the relevant agency for assessment of Stewardship sites).

Commonwealth specific offsets for EPBC Act listed Australasian Bittern, Latham's Snipe, Sharp-tailed Sandpiper, Glossy Ibis, Sharp-tailed Sandpiper and other migratory bird species are proposed to be met by the establishment of Stewardship site(s) over Evolution-owned land within or immediately adjacent to Lake Cowal.

10.2 Purchase of credits (or land) from external landholders to meet the anticipated credit shortfall

Evolution is expected to have a shortfall for PCTs 26, 55, and 244, irrespective of whether Stewardship site arrangements were pursued over all landholdings. Evolution will seek to meet any shortfall through purchasing credits (or land) across the same or adjoining IBRA subregion as the Project.

The potential to acquire credits or land from external landholders to meet this credit shortfall is currently being pursued. Preliminary vegetation mapping has also been undertaken across multiple landholdings near Lake Cowal to gauge the potential to generate credits for PCTs 26, 55, and 244. Landholdings have been also identified from SVTM suitable for generating suitable quantities of PCTs 26, 55, and 244 have also been identified to provide additional options to source residual credits, with feasibility studies to be pursued shortly.

10.3 Limited use of the NSW Government Biodiversity Conservation Fund

Any residual credit liability not met through the above offset strategies will be met through the payment into the NSW government Biodiversity Conservation Fund (BCF).

11 Conclusion

This BDAR has been prepared in accordance with BAM (DPIE 2020a), biodiversity-related SEARs issued by DPE and the associated agency-specific assessment requirements. A separate assessment has been completed for the purposes of assessment by the Department of Climate Change, Energy, the Environment and Water (DCCEEW).

Evolution has carried out annual biodiversity surveys within the study area prior to and since commencement of mining in 2015, including water bird surveys that have been undertaken annually since 1989. Combined with the surveys undertaken for this BDAR, these surveys have been used to inform the evolution of the mine design. This process has avoided and minimised impacts on biodiversity values, as far as practicable.

The mine development requires 20,046 ecosystem credits to compensate for impacts on native PCTs and ecosystem credit species. In addition to ecosystem credits, the Project also requires 39 species credits for the Austral Pillwort. Evolution will compensate for these residual impacts through the implementation of a biodiversity offset strategy (Chapter 10: Biodiversity Offset Strategy).

The BDAR has also considered impacts on species and ecological communities listed under the EPBC Act. The Project is expected to likely result in significant impacts on:

- Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia EEC
- Weeping Myall Woodlands EEC
- Australasian Bittern
- Latham's Snipe
- Sharp-tailed Sandpiper
- Glossy Ibis
- Habitat important to migratory shorebirds (according to Policy Statement 3.21; DoE 2015).

The Project may result in significant impacts on:

- Australian Painted Snipe
- Painted Honeyeater
- Superb Parrot (foraging habitat only).

Evolution proposes to meet the species and ecosystem credit requirements of the Project prior to commencement of each stage through a combination of establishing Stewardship sites over their landholdings and purchase of credits (or land) from external landholders. Any residual credit liability would be met through used of the BCF. Evolution has already mapped native vegetation over their landholdings, commenced preliminary discussions and vegetation mapping over some interested nearby landholders, and commenced discussions with Credits Supply Taskforce.

References

AMBS Ecology & Heritage 2018, *Cowal Gold Operations Processing Rate Modification – Biodiversity Assessment Report and Biodiversity Offset Strategy*, report prepared for Evolution Mining (Cowal) Pty Limited.

Anne Clements and Associates 1995, *Terrestrial Flora Report: Lake Cowal District*, Appendix F of NSR Environmental Consultants 1995, *Lake Cowal Gold Project Environmental Impact Statement*.

ANZECC 2020, Australian and New Zealand guidelines for fresh and marine water quality. Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra, 1, pp.1-314.

ATC Williams 2023, *Surface water assessment*, prepared for Evolution Mining (Cowal) Pty Limited.

Australian Museum Business Services 2012, *Cowal Gold Mine and Surrounds Flora Survey,* report prepared for Barrick (Australia Pacific) Limited.

Australian Museum Business Services 2013, *Lake Cowal Waterbird Monitoring (1989 to 2012) Compilation Report*, report prepared for Barrick (Australia Pacific) Limited.

AVH 2023a, *Occurrence records – Pilularia novae-hollandiae*, Australian Virtual Herbarium, accessed 1 February 2023, https://avh.ala.org.au/occurrences/search?q=taxa%3A%22austral+pillwort%22#tab_mapView

AVH 2023b, *Occurrence records – Austrostipa metatoris*, Australian Virtual Herbarium, accessed 1 February 2023, https://avh.ala.org.au/occurrences/search?q=taxa%3A%22austrostipa+metatoris%22#tab_mapView

AVH 2023c, *Occurrence records – Austrostipa wakoolica*, Australian Virtual Herbarium, accessed 1 February 2023, https://avh.ala.org.au/occurrences/search?q=taxa%3A%22austrostipa+wakoolica%22#tab_mapView

Barrick (Cowal) Limited 2003a, *Cowal Gold Project Land Management Plan*.

Barrick (Cowal) Limited 2003b, *Cowal Gold Project Implementation of the Threatened Species Management Protocol.*

Barrick (Cowal) Limited 2005a, *Cowal Gold Project – Vegetation Clearance Protocol Reports*, September 2005, VCP-Intro-B.

Barrick (Cowal) Limited 2005b, *Cowal Gold Project – Vegetation Clearance Protocol Report – Public Road within the Travelling Stock Reserve*, September 2005, VCP-R025-A.

Barrick (Cowal) Limited 2005c, *Cowal Gold Project – Vegetation Clearance Protocol Report – Access Road (Blow Clear Road)*, September 2005, VCP-AR-Blow-A Clear Road.

Barrick (Cowal) Limited 2005d, *Cowal Gold Project – Vegetation Clearance Protocol Report – Access Road (Wamboyne Road),* September 2005, VCP-AR-Wamboyne Road-A.

Barrick (Cowal) Limited 2005e, *Cowal Gold Project – Vegetation Clearance Protocol Report – Cowal West Borrow Pit (Extension)*, September 2005, VCP-CWBP-F.

Barrick (Cowal) Limited 2005f, *Cowal Gold Project – Vegetation Clearance Protocol Reports – Low Grade Ore Stockpile*, September 2005, VCP-LGOS-A.

Barrick (Cowal) Limited 2005g, *Cowal Gold Project – Vegetation Clearance Protocol Report – Borefield Pipeline*, September 2005, VCP-R001-D.

Barrick (Cowal) Limited 2005h, *Cowal Gold Project – Vegetation Clearance Protocol Report – Temporary Isolation Bund and Lake Protection Bund*, September 2005, VCP-R002-B.

Barrick (Cowal) Limited 2005i, *Cowal Gold Project – Vegetation Clearance Protocol Report – Northern tailings storage facility*, September 2005, VCP-R003-C.

Barrick (Cowal) Limited 2005j, *Cowal Gold Project – Vegetation Clearance Protocol Report – Up-Catchment Diversion System*, September 2005, VCP-R004-B.

Barrick (Cowal) Limited 2005k, *Cowal Gold Project – Vegetation Clearance Protocol Report – Permanent Catchment Divide*, September 2005, VCP-R005-C.

Barrick (Cowal) Limited 2005l, *Cowal Gold Project – Vegetation Clearance Protocol Report – Soil Stockpile 1*, September 2005, VCP-R006-C.

Barrick (Cowal) Limited 2005m, *Cowal Gold Project – Vegetation Clearance Protocol Report – Soil Stockpile 2*, September 2005, VCP-R007-B.

Barrick (Cowal) Limited 2005n, *Cowal Gold Project – Vegetation Clearance Protocol Report – Soil Stockpile 3,* September 2005, VCP-R008-B.

Barrick (Cowal) Limited 2005o, *Cowal Gold Project – Vegetation Clearance Protocol Report – Soil Stockpile 4,* September 2005, VCP-R009-B.

Barrick (Cowal) Limited 2005p, *Cowal Gold Project – Vegetation Clearance Protocol Report – Soil Stockpile 5,* September 2005, VCP-R010-B.

Barrick (Cowal) Limited 2005q, *Cowal Gold Project – Vegetation Clearance Protocol Report – Tailings Service Corridor*, September 2005, VCP-R011-B.

Barrick (Cowal) Limited 2005r, *Cowal Gold Project – Vegetation Clearance Protocol Report – Internal Mine Access Road*, September 2005, VCP-R012-B.

Barrick (Cowal) Limited 2005s, *Cowal Gold Project – Vegetation Clearance Protocol Report – Processing Plant, September 2005*, VCP-R013-C.

Barrick (Cowal) Limited 2005t, *Cowal Gold Project – Vegetation Clearance Protocol Report – Hardy Brothers Laydown Area (Southern Waste Emplacement)*, September 2005, VCP-R015-D.

Barrick (Cowal) Limited 2005u, *Cowal Gold Project – Vegetation Clearance Protocol Report – Open Pit, September 2005*, VCP-R017-B.

Barrick (Cowal) Limited 2005v, *Cowal Gold Project – Vegetation Clearance Protocol Report – Perimeter Waste Emplacement*, September 2005, VCP-R018-B.

Barrick (Cowal) Limited 2005w, *Cowal Gold Project – Vegetation Clearance Protocol Report – Cowal West Borrow Pit (Northern Waste Emplacement)*, September 2005, VCP-R020-B.

Barrick (Cowal) Limited 2005x, *Cowal Gold Project – Vegetation Clearance Protocol Report – Haul Road (Processing Plant to Tailings Storage Facilities)*, September 2005, VCP-R021-B.

Barrick (Cowal) Limited 2005y, *Cowal Gold Project – Vegetation Clearance Protocol Report – Contained Water Storage D2*, September 2005, VCP-R022-B.

Barrick (Cowal) Limited 2005z, *Cowal Gold Project – Vegetation Clearance Protocol Report – Contained Water Storage D8B*, September 2005, VCP-R023-B.

Barrick (Cowal) Limited 2005zi, *Cowal Gold Project – Vegetation Clearance Protocol Report – Southern tailings storage facility*, September 2005 VCP-R024-B.

Barrick (Cowal) Limited 2005ziii, *Cowal Gold Project 2003-2004 Annual Environmental Management Report.*

Barrick (Cowal) Limited 2005ziv, *Vegetation Clearing Protocol: Summary of Species Located on the MLA and Access Road*, V Jan 10th – 14th 2005.

Barrick (Cowal) Limited 2006a, *Cowal Gold Project – Vegetation Clearance Protocol Report – Northern Waste Emplacement*, September 2006, VCP-NWE-C.

Barrick (Cowal) Limited 2006b, *Cowal Gold Project – Vegetation Clearance Protocol Report – Magazine Laydown Area, Low Grade Ore Stockpile and Northern and Southern Tailings Storage Facilities Perimeter Fence Easement*, September 2006, VCP-R028-C.

Barrick (Cowal) Limited 2006c, *Cowal Gold Project – Vegetation Clearance Protocol Report – Contained Water Storage D9*, December 2006, VCP-R028-A.

Barrick (Cowal) Limited 2006d, *Cowal Gold Project 2004-2005 Annual Environmental Management Report*.

Barrick (Cowal) Limited 2007a, *Cowal Gold Project – Vegetation Clearance Protocol Report – Southern Waste Emplacement*, March 2007, VCP-SWE-B.

Barrick (Cowal) Limited 2007b, *Cowal Gold Project – Vegetation Clearance Protocol Report – Northern Waste Emplacement – Southern Section*, August 2007, VCP-NWE-SS-C.

Barrick (Cowal) Limited 2007c, *Cowal Gold Project – Vegetation Clearance Protocol Report – Soil Stockpile 6,* August 2007, VCP-SS6-C.

Barrick (Cowal) Limited 2007d, *Cowal Gold Project – Vegetation Clearance Protocol Report – Southern tailings storage facility – First Lift*, August 2007, VCP-southern tailings storage facility FL-C.

Barrick (Cowal) Limited 2007e, *Cowal Gold Project – Vegetation Clearance Protocol Report – Ammonium Nitrate Facility*, August 2007, VCP-ANF-C.

Barrick (Cowal) Limited 2007f, *Cowal Gold Project – Vegetation Clearance Protocol Report – Magazine Area,* September 2007, VCP_MA_A.

Barrick (Cowal) Limited 2007g, *Cowal Gold Project 2005-2006 Annual Environmental Management Report*.

Barrick (Cowal) Limited 2008a, *Cowal Gold Project – Vegetation Clearance Protocol Report – Southern Waste Emplacement (Campaign 2)*, August 2008, VCP-SWE(C2)-B.

Barrick (Cowal) Limited 2008b, *Cowal Gold Project 2006-2007 Annual Environmental Management Report*.

Barrick (Cowal) Limited 2009a, *Cowal Gold Project – Vegetation Clearance Protocol Report – Northern Waste Emplacement Area (August 2009)*, November 2009, VCP-NWE-A.

Barrick (Cowal) Limited 2009b, *Cowal Gold Project – Vegetation Clearance Protocol Report – Soil Stockpile Areas (November 2009)*, November 2009, VCP-SS-B.

Barrick (Cowal) Limited 2009c, *Cowal Gold Project 2007-2008 Annual Environmental Management Report*.

Barrick (Cowal) Limited 2010a, *Cowal Gold Project Vegetation Clearance Protocol Report Northern and Southern Waste Emplacement Areas and Soil Stockpile (March 2010)*, VCP-MARCH10-A.

Barrick (Cowal) Limited 2010b, *Cowal Gold Project 2008-2009 Annual Environmental Management Report*.

Barrick (Cowal) Limited 2011, *Cowal Gold Project 2010-2011 Annual Environmental Management Report*.

Barrick (Cowal) Limited 2012a, *Cowal Gold Project Vegetation Clearance Protocol Report Southern Waste Rock Emplacement (Cowal West Shearing Shed) and Topsoil and Subsoil Stockpile Areas East of the Southern Tailings Storage Facility (May 2012)*, VCP-MAY12-A.

Barrick (Cowal) Limited 2012b, *Cowal Gold Project 2011-2012 Annual Environmental Management Report*.

Barrick (Cowal) Limited 2013, *Cowal Gold Project 2011-2012 Annual Environmental Management Report*.

Barrick (Cowal) Limited 2014, *Cowal Gold Project 2012-2013 Annual Environmental Management Report*.

Barrick (Cowal) Limited 2015, *Cowal Gold Mine 2014 Annual Review Report*.

Beck Engineering 2020, *Geotechnical assessment of surface impacts for proposed underground mining at Lake Cowal*, prepared for EMM Consulting and Evolution.

Beranek C, Roff A, Denholm B, Howell L & Witt R 2020, Trialling a real-time drone detection and validation protocol for the koala (Phascolarctos cinereus), *Australian Mammalogy* 43(2), pp. 260–264, doi: 10.1071/AM20043.

BirdLife International 2018, *Gelochelidon macrotarsa*, The IUCN Red List of Threatened Species 2018: e.T62026537A132671766. http://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T62026537A132671766.en

BirdLife International 2019a, *Plegadis falcinellus* (amended version of 2016 assessment), The IUCN Red List of Threatened Species 2019: e.T22697422A155528413, http://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T22697422A155528413.en

BirdLife International 2019b, *Hydroprogne caspia* (amended version of 2018 assessment), The IUCN Red List of Threatened Species 2019: e.T22694524A155509311. http://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T22694524A155509311.en

BirdLife International 2022, *Botaurus poiciloptilus,* The IUCN Red List of Threatened Species 2022*:* e.T22697353A217377735, Accessed on 02 February 2023, https://www.iucnredlist.org/species/22697353/217377735

BirdLife International 2023, *IUCN Red List for birds*, downloaded from http://www.birdlife.org on 28/02/2023.

BoM 2023a, *Climate Data Online*, Australian Government Bureau of Meteorology, accessed 1 February 2023, http://www.bom.gov.au/climate/data/

BoM 2023b, *Groundwater Dependent Ecosystems Atlas*, Australian Government Bureau of Meteorology, accessed 10 February 2023, http://www.bom.gov.au/water/groundwater/gde/

Bower C 1997, *Cowal Gold Project: Flora – Threatened Species Assessment*, report prepared for North Limited.

Bower C 1998a, *Survey of the Cowal Project Area and surrounds for the Austral Pillwort (Pilularia novae-hollandiae),* unpublished report by Orchid Research for North Limited.

Bower C 1998b, *Survey for the Endangered Peppercress, Lepidium Hyssopifolium Desv. (Brassicaceae), on the Proposed Cowal Gold Project Site and the Route of the Borefield Pipeline,* unpublished report by Orchid Research for North Limited.

Bower C 2003a*, Vegetation Community Mapping along the Pipeline/Borefield Route.*

Bower C 2003b, *Vegetation Community Mapping along the Access Road*.

Bower C 2004, *Occurrence of the Spiny Peppercress (Lepidium aschersonii) on the Temora-Cowal Electricity Transmission Line,* report prepared for Country Energy.

Brown A 1990, *Measuring the effect of aircraft noise on sea birds*, Environmental International, 16(4-6), pp. 587-592.

CALM 1992, *Urban Erosion and Sediment Control Handbook*, Department of Conservation and Land Management.

Caorsi V, Guerra V, Furtado R, Llusia D, Miron LR, Borges-Martins M, Both C, Narins PM, Meenderink SW & Márquez, R 2019, Anthropogenic substrate-borne vibrations impact anuran calling, *Scientific reports*, 9(1), p.19456.

Carlos EH, Gibson M & Weston, MA 2014, Weeds and wildlife: perceptions and practices of weed managers, *Conservation and Society*, 12(1), pp.54-64.

Cenwest Environmental Services 2009, *Cowal Gold Mine E42 Modification – Modified Request Fauna Assessment*, Report prepared for Barrick (Cowal) Limited.

Cenwest Environmental Services 2011, *Cowal Augmentation Project Amphibian Survey*, report prepared for Barrick (Cowal) Limited

Charles Sturt University 1997, *Cowal Gold Project Area Botanical Survey*, report prepared for North Limited.

Clements A & Rodd, A 1995, *Terrestrial Flora Report: Lake Cowal District. Appendix F, Lake Cowal Gold Project Environmental Impact Statement*, NSR Environmental Consultants, Hawthorn.

Coffey 2020, *Mine Site Hydrogeological Assessment*, prepared for EMM Consulting.

Coffer 2021, *CGO Underground Development EIS - Addendum 2 of the hydrogeological assessment*, prepared for EMM Consulting.

Country Energy 2004, *Temora to Cowal Electricity Transmission Line – Implementation of the Threatened Species Management Protocol*.

Cross SL, Cross AT, Tomlinson S, Clark-Ioannou SM, Nevill PG & Bateman PW 2021, Mitigation and management plans should consider all anthropogenic disturbances to fauna, *Global Ecology and Conservation*, 26, p.e01500.

Cutts N, Hemingway K & J Spencer 2013, Waterbird disturbance mitigation toolkit informing estuarine planning and construction projects, Institute of Estuarine and Coastal Studies (IECS) University of Hull, United Kingdom.

Davies N 1953. *Investigations on the soil and water relations of the river red gum forests*. Final Report Murray Management Survey. Forestry Commission of New South Wales, Resources Branch Report No. R.124.

DAWE 2021, *National Recovery Plan for the Superb Parrot Polytelis swainsonii*, Department of Agriculture, Water and Environment, Canberra.

DAWE 2022, *National Recovery Plan for the Painted Honeyeater Grantiella picta*, Department of Agriculture, Water and the Environment, Canberra

DCCEEW 2021a, *Interactive Flying-fox Web Viewer,* Department of Climate Change, Energy, the Environment and Water, viewed 10 July 2022, https://www.dcceew.gov.au/environment/biodiversity/threatened/species/flying-fox-monitoring

DCCEEW 2021b, *Threatened ecological communities, Department of Climate Change, Energy, the Environment and Water*, viewed 22 February 2023, https://www.dcceew.gov.au/environment/biodiversity/threatened/communities#:~:text=An%20ecological%20community%20is%20a,altitude%2C%20climate%20and%20water%20availability.

DCCEEW 2022, *Conservation Advice for Calyptorhynchus lathami lathami (South-eastern Glossy Black Cockatoo)*, Department of Climate Change, Energy, the Environment and Water.

DCCEEW 2023a, *Protected Matters Search Tool (PMST),* Department of Climate Change, Energy, the Environment and Water, viewed 2 February 2023, https://www.dcceew.gov.au/environment/epbc/protected-matters-search-tool

DCCEEW 2023b, *Directory of Important Wetlands in Australia,* Department of Climate Change, Energy, the Environment and Water, viewed 5 Jan 2023, https://www.environment.gov.au/cgi-bin/wetlands/report.pl

DCCEEW 2023c, *Calidris ferruginea — Curlew Sandpiper: SPRAT Profile*, Department of Climate Change, Energy, the Environment and Water, viewed 5 January 2023, http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=856

DCCEEW 2023d, *Lophochroa leadbeateri leadbeateri (eastern Major Mitchell's cockatoo)*, Department of Climate Change, Energy, the Environment and Water.

DCCEEW 2023e, *Gallinago hardwickii — Latham's Snipe, Japanese Snipe: SPRAT Profile*, Department of Climate Change, Energy, the Environment and Water, viewed 5 January 2023, http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=863

DCCEEW 2023f, *Actitis hypoleucos — Common Sandpiper: SPRAT Profile*, Department of Climate Change, Energy, the Environment and Water, viewed 5 January 2023, http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=59309

DCCEEW 2023g, *Calidris acuminata — Sharp-tailed Sandpiper: SPRAT Profile*, Department of Climate Change, Energy, the Environment and Water, viewed 5 January 2023, http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=874

DCCEEW 2023h, *Calidris melanotos — Pectoral Sandpiper: SPRAT Profile*, Department of Climate Change, Energy, the Environment and Water, viewed 5 January 2023, http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=858

DCCEEW 2023i, *Limosa lapponica — Bar-tailed Godwit: SPRAT Profile*, Department of Climate Change, Energy, the Environment and Water, viewed 5 January 2023, http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=844

DCCEEW 2023j, *Tringa nebularia — Common Greenshank, Greenshank: SPRAT Profile*, Department of Climate Change, Energy, the Environment and Water, viewed 5 January 2023, http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=832

DCCEEW 2023k, *Calidris ruficollis — Red-necked Stint: SPRAT Profile*, Department of Climate Change, Energy, the Environment and Water, viewed 5 January 2023, http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=860

DCCEEW 2023l, *Tringa stagnatilis — Marsh Sandpiper, Little Greenshank: SPRAT Profile*, Department of Climate Change, Energy, the Environment and Water, viewed 5 January 2023, http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=833

DCCEEW 2023m, *Limosa limosa — Black-tailed Godwit: SPRAT Profile*, Department of Climate Change, Energy, the Environment and Water, viewed 5 January 2023, http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?showprofile=Y&taxon_id=845

DCCEEW 2023n, *Charadrius bicinctus — Double-banded Plover: SPRAT Profile*, Department of Climate Change, Energy, the Environment and Water, viewed 5 January 2023, http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?showprofile=Y&taxon_id=895

DCCEEW 2023o, *Pluvialis fulva — Pacific Golden Plover: SPRAT Profile*, Department of Climate Change, Energy, the Environment and Water, viewed 5 January 2023, http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=25545

DCCEEW 2023p, *Numenius minutus — Little Curlew, Little Whimbrel: SPRAT Profile*, Department of Climate Change, Energy, the Environment and Water, viewed 5 January 2023, http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=848

DCCEEW 2023q, *Numenius phaeopus — Whimbrel: SPRAT Profile*, Department of Climate Change, Energy, the Environment and Water, viewed 5 January 2023, http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=849

DCCEEW 2023r, *Tringa glareola — Wood Sandpiper: SPRAT Profile*, Department of Climate Change, Energy, the Environment and Water, viewed 5 January 2023, http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=829

DCCEEW 2023s, *Plegadis falcinellus — Glossy Ibis: SPRAT Profile*, Department of Climate Change, Energy, the Environment and Water, viewed 5 January 2023, https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=991

DCCEEW 2023t, *Hydroprogne caspia — Caspian Tern: SPRAT Profile*, Department of Climate Change, Energy, the Environment and Water, viewed 5 January 2023, http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=808

DCCEEW 2023u, *Gelochelidon nilotica — Gull-billed Tern: SPRAT Profile*, Department of Climate Change, Energy, the Environment and Water, viewed 5 January 2023, https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=806

DCCEEW 2023v, *Chlidonias leucopterus — White-winged Tern, White-winged Black Tern: SPRAT Profile*, Department of Climate Change, Energy, the Environment and Water, viewed 5 January 2023, https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=59598

DEC 2004, *Threatened Biodiversity Survey and Assessment: Guidelines for Development and Activities*, Department of the Environment and Conservation.

DECC 2008, *Managing Urban Stormwater: Soils and Construction Volume 2E – Mines and quarries*, Department of Environment and Climate Change.

DECC 2009, *Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna Amphibians*, Department of Environment and Climate Change.

DES 2013, Gilgai wetlands, Department of Environment and Science, State of Queensland, viewed 22 February 2023, https://www.dcceew.gov.au/environment/biodiversity/threatened/communities#:~:text=An%20ecological%20community%20is%20a,altitude%2C%20climate%20and%20water%20availability.

DEWHA 2009, *Weeping Myall Woodlands. A nationally threatened ecological community Environment Protection and Biodiversity Conservation Act 1999 Policy Statement 3.17*, Department of Environment, Water, Heritage and the Arts.

DEWHA 2010*, Approved Conservation Advice for the Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-east Australia*, Department of the Environment, Water, Heritage and the Arts.

DIIS 2008, *Leading practice sustainable development program for the mining industry*, Department of Industry, Innovation and Science.

Donato Environmental Services 2010a, *Seasonal Wildlife Use Patterns of the Cowal Gold Mine tailings storage facility: 1 April 2009 to 30 September 2009*, prepared for Barrick (Cowal) Pty limited.

Donato Environmental Services 2010b, *Seasonal Wildlife Use Patterns of the Cowal Gold Mine tailings storage facility: 1 October 2009 to 31 March 2010*, prepared for Barrick (Cowal) Pty limited.

Donato Environmental Services 2011a, *Seasonal Wildlife Use Patterns of the Cowal Gold Mine tailings storage facility: 1 April to 30 September 2010*, prepared for Barrick (Cowal) Pty limited.

Donato Environmental Services 2011b, *Seasonal Wildlife Use Patterns of the Cowal Gold Mine tailings storage facility: 1 October 2010 to 31 March 2011*, prepared for Barrick (Cowal) Pty limited.

Donato Environmental Services 2012a, *Seasonal Wildlife Use Patterns of the Cowal Gold Mine tailings storage facility: 1 April 2011 to 30 September 2011*, prepared for Barrick (Cowal) Pty limited.

Donato Environmental Services 2012b, *Seasonal Wildlife Use Patterns of the Cowal Gold Mine tailings storage facility: 1 October 2011 to 31 March 2012,* prepared for Barrick (Cowal) Pty limited.

Donato Environmental Services 2013a, *Seasonal wildlife use patterns of the Cowal Gold Mine tailings storage facility: 1 April to 30 June 2013*, prepared for Barrick (Cowal) Pty limited.

Donato Environmental Services 2013b, *Seasonal wildlife use patterns of the Cowal Gold Mine tailings storage facility: 1 July to 30 December 2013*, prepared for Barrick (Cowal) Pty limited.

Donato Environmental Services 2014a, *Seasonal wildlife use patterns of the Cowal Gold Mine tailings storage facility: 1 January to 30 June 2014*, prepared for Barrick (Cowal) Pty limited.

Donato Environmental Services 2014b, *Seasonal wildlife use patterns of the Cowal Gold Mine tailings storage facility: 1 July to 31 December 2014*, prepared for Barrick (Cowal) Pty limited.

Donato Environmental Services 2015a, *Seasonal wildlife use patterns of the Cowal Gold Mine tailings storage facility: 1 January to 30 June 2015*, prepared for Evolution Mining

Donato Environmental Services 2015b, *Seasonal wildlife use patterns of the Cowal Gold Mine tailings storage facility: 1 July to 31 December 2015*, prepared for Evolution Mining

Donato Environmental Services 2016a, *Seasonal wildlife use patterns of the Cowal Gold Mine tailings storage facility: 1 January to 30 June 2016*, prepared for Evolution Mining

Donato Environmental Services 2016b*, Seasonal wildlife use patterns of the Cowal Gold Mine tailings storage facility: 1 July to 31 December 2016*, prepared for Evolution Mining

Donato Environmental Services 2019a, *Seasonal wildlife use patterns of the Cowal Gold Mine tailings storage facility: 1 January to 30 June 2019*, prepared for Evolution Mining

Donato Environmental Services 2019b, *Seasonal wildlife use patterns of the Cowal Gold Mine tailings storage facility: 1 July to 31 December 2019*, prepared for Evolution Mining

Donato Environmental Services 2020a*, Seasonal wildlife use patterns of the Cowal Gold Mine tailings storage facility: 1 January to 30 June 2020*, prepared for Evolution Mining

Donato Environmental Services 2020b, *Seasonal wildlife use patterns of the Cowal Gold Mine tailings storage facility: 1 July to 31 December 2020*, prepared for Evolution Mining

Donato Environmental Services 2021a, *Seasonal wildlife use patterns of the Cowal Gold Mine tailings storage facility: 1 January to 30 June 2021*, prepared for Evolution Mining

Donato Environmental Services 2021b*, Seasonal wildlife use patterns of the Cowal Gold Mine tailings storage facility: 1 July to 31 December 2021*, prepared for Evolution Mining

Donato Environmental Services 2022*, Seasonal wildlife use patterns of the Cowal Gold Operations integrated waste landform: 1 January to 30 June 2022*, prepared for Evolution Mining

Donato Environmental Services 2022, *Seasonal wildlife use patterns of the Cowal Gold Operations integrated waste landform: 1 July to 31 December 2022*, prepared for Evolution Mining

DnA Environmental 2008, *Remnant Vegetation Enhancement Program: 2008 Monitoring Results*, prepared for Barrick (Australia Pacific) Limited

DnA Environmental 2010, *Remnant Vegetation Enhancement Program: 2009 Monitoring Results*, prepared for Barrick (Australia Pacific) Limited.

DnA Environmental 2011a, *2010 Compensatory Wetland Regeneration Monitoring Results*, report prepared for Cowal Gold Mine.

DnA Environmental 2011b, *2010 Rehabilitation Monitoring Report*, prepared for Cowal Gold Mine.

DnA Environmental 2011c, *Remnant Vegetation Enhancement Program: 2010 Monitoring Results*, prepared for Barrick (Australia Pacific) Limited.

DnA Environmental 2012a, *2011 Compensatory Wetland Regeneration Monitoring Results*, prepared for Cowal Gold Mine.

DnA Environmental 2012b, *2011 Rehabilitation Monitoring Report*, prepared for Cowal Gold Mine.

DnA Environmental 2012c, *2011 Austral Pillwort Survey*, report prepared for Cowal Gold Mine.

DnA Environmental 2012d, *Remnant Vegetation Enhancement Program: 2011 Monitoring Results*, prepared for Barrick (Australia Pacific) Limited.

DnA Environmental 2013a, *2012 Compensatory Wetland Regeneration Monitoring Results*, report prepared for Cowal Gold Mine.

DnA Environmental 2013b, *2012 Rehabilitation Monitoring Report*, prepared for Cowal Gold Mine.

DnA Environmental 2013c, *2012 Austral Pillwort Survey*, prepared for Cowal Gold Mine.

DnA Environmental 2013d, *Remnant Vegetation Enhancement Program: 2012 Monitoring Results*, prepared for Barrick (Australia Pacific) Limited.

DnA Environmental 2014a*, 2013 Compensatory Wetland Regeneration Monitoring Results*, report prepared for Cowal Gold Mine.

DnA Environmental 2014b, *2013 Rehabilitation Monitoring Report*, prepared for Cowal Gold Mine.

DnA Environmental 2014c, *2013 Austral Pillwort Survey*, prepared for Cowal Gold Mine.

DnA Environmental 2015a, *2015 Compensatory Wetland Regeneration Monitoring Report*, prepared for Evolution Cowal Limited.

DnA Environmental 2015b, *2014 Rehabilitation Monitoring Report*, prepared for Evolution Cowal Limited.

DnA Environmental 2015c, *2014 Austral Pillwort Survey*, prepared for Evolution Cowal Limited.

DnA Environmental 2016a, *2015 Compensatory Wetland Regeneration Monitoring Report*, prepared for Evolution Cowal Limited

DnA Environmental 2016b, *2015 Rehabilitation Monitoring Report*, prepared for Evolution Cowal Limited.

DnA Environmental 2016c, *2015 Austral Pillwort Survey*, report prepared for Evolution Cowal Limited.

DnA Environmental 2016d, *2015 Remnant Vegetation Enhancement Program Monitoring Report*, prepared for Cowal Gold Operations Evolution (Cowal) Limited

DnA Environmental 2017a, *2016 Compensatory Wetland Regeneration Monitoring Report*, prepared for Evolution Cowal Limited.

DnA Environmental 2017b, *2016 Rehabilitation Monitoring Report*, prepared for Evolution Cowal Limited.

DnA Environmental 2017c, *2016 Austral Pillwort Survey*, report prepared for Evolution Cowal Limited.

DnA Environmental 2017d, *2016 Remnant Vegetation Enhancement Program Monitoring Report*, prepared for Cowal Gold Operations Evolution (Cowal) Limited

DnA Environmental 2018a, *2017 Compensatory Wetland Regeneration Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2018b, *2018 Rehabilitation Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2018c, *2017 Austral Pillwort Survey*, report prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2018d, *2017d Remnant Vegetation Enhancement Program Monitoring Report*, prepared for Cowal Gold Operations Evolution Mining (Cowal) Limited

DnA Environmental 2018e, *2017 Biodiversity Offset Areas Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2019a, *2018 Compensatory Wetland Regeneration Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2019b, *2018 Rehabilitation Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2019c, *2018 Austral Pillwort Survey*, report prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2019d, *2018 Remnant Vegetation Enhancement Program Monitoring Report*, prepared for Cowal Gold Operations Evolution Mining (Cowal) Limited

DnA Environmental 2019e, *2018 Biodiversity Offset Areas Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2020a, *2019 Compensatory Wetland Regeneration Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2020b, *2019 Rehabilitation Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2020c, *2019 Austral Pillwort Survey*, report prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2020d, *2020 Remnant Vegetation Enhancement Program Monitoring Report*, prepared for Cowal Gold Operations Evolution Mining (Cowal) Limited

DnA Environmental 2020e, *2019 Biodiversity Offset Areas Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2021a, *2020 Compensatory Wetland Regeneration Monitoring Report*, report prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2021b, *2020 Rehabilitation Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2021c, *2020 Austral Pillwort Survey*, report prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2021d, *2020 Remnant Vegetation Enhancement Program Monitoring Report*, prepared for Cowal Gold Operations Evolution Mining (Cowal) Limited

DnA Environmental 2021e, *2020 Biodiversity Offset Areas Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2022a, *2021 Compensatory Wetland Regeneration Monitoring Report*, report prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2022b, *2021 Rehabilitation Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2022c, *2021 Austral Pillwort Survey*, report prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2022d, *2021 Remnant Vegetation Enhancement Program Monitoring Report*, prepared for Cowal Gold Operations Evolution Mining (Cowal) Limited

DnA Environmental 2022e, *2021 Biodiversity Offset Areas Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

DoE 2015, *Wildlife Conservation Plan for Migratory Shorebirds*, Commonwealth of Australia, Department of Environment.

DoEE 2017a, *Interim Biogeographic Regionalisation of Australia (IBRA) Version 7*, Department of Energy and Environment.

DoEE 2017b, *EPBC Act Policy Statement 3.21 Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species*, Commonwealth of Australia, Department of Energy and Environment.

DoEE 2019a, *Draft National Recovery Plan for the Australasian Bittern Botaurus poiciloptilus*, Department of Energy and Environment.

DoEE 2019b, *Draft National Recovery Plan for the Australian Painted Snipe Rostratula australis*, Department of Energy and Environment.

DoEE 2019c, *Conservation Advice (including listing advice) for the Poplar Box Grassy Woodland on Alluvial Plains*, Department of Energy and Environment.

DoEE 2020, *National Light Pollution Guidelines for Wildlife Including marine turtles, seabirds and migratory shorebirds*, Department of Energy and Environment.

DPE 2016a, *SEED NSW (Mitchell) Landscapes – version 3.1*, NSW Department of Planning and Environment.

DPE 2016b, *The Dark Sky Planning Guideline*, Department of Planning and Environment.

DPE 2018a, *Woolly Ragwort – profile*, Department of Planning and Environment, accessed 1 December 2022, https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10750

DPE 2018b, High Ecological Values Aquatic Ecosystems (HEVAE) mapping, Department of Planning and Environment.

DPE 2022a, *NSW Plant Community Type Classification*, Department of Planning and Environment, viewed 2 February 2023, https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/nsw-bionet/nsw-plant-community-type-classification

DPE 2022b, *NSW State Vegetation Type Map*, Department of Planning and Environment.

DPE 2022c, *NSW Wetlands – dataset*, Department of Planning and Environment, accessed 5 December 2022, https://data.nsw.gov.au/data/dataset/nsw-wetlands047c7

DPE 2022d, *Koala (Phascolarctos cinereus) Biodiversity Assessment Method Survey Guide*, Department of Planning and Environment.

DPE 2022e, *Austral Pillwort – profile*, Department of Planning and Environment, accessed 10 December 2022, https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10628#:~:text=Austral%20Pillwort%20is%20a%20semiaquatic%20fern%2C%20resembling%20a,pills%20that%20form%20at%20the%20base%20of%20fronds.

DPE 2023, *About the Biodiversity Offsets Scheme, Department of Planning*, Industry and Environment, accessed 22 February 2023, https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity-offsets-scheme/about-the-biodiversity-offsets-scheme

DPE BioNet 2023, *Species sightings search*, Department of Planning and Environment, accessed 4 Feb 2023, https://www.environment.nsw.gov.au/atlaspublicapp/UI_Modules/ATLAS_/AtlasSearch.aspx?who=f79a4868-ab11-446b-a618-fb4012d9f84e

DPE BioNet Vis 2023, *BioNet Vegetation Classification Database*, Department of Planning and Environment, accessed 4 February, https://www.environment.nsw.gov.au/NSWVCA20PRapp/Default.aspx

DPE TBDC 2023a, *BioNet Threatened Biodiversity Database Collection – Ecological data: Koala,* Department of Planning and Environment, accessed 4 Feb 2023, https://www.environment.nsw.gov.au/AtlasApp/UI_Modules/TSM_/ProfileEdit.aspx?pId=10616&pType=SpeciesCode

DPE TBDC 2023b, *BioNet Threatened Biodiversity Database Collection – Ecological data: Austral Pillwort,* Department of Planning and Environment, accessed 4 Feb 2023, https://www.environment.nsw.gov.au/AtlasApp/UI_Modules/TSM_/ProfileEdit.aspx?pId=10628&pType=SpeciesCode

DPE TBDC 2023c, *BioNet Threatened Biodiversity Database Collection - Profiles*, Department of Planning and Environment, accessed 4 Feb 2023, https://www.environment.nsw.gov.au/AtlasApp/UI_Modules/TSM_/Default.aspx

DPE TBDC 2023d, *BioNet Threatened Biodiversity Database Collection – Ecological data: Glossy Black-cockatoo,* Department of Planning and Environment, accessed 4 Feb 2023, https://www.environment.nsw.gov.au/AtlasApp/UI_Modules/TSM_/ProfileEdit.aspx?pId=10140&pType=SpeciesCode

DPE TBDC 2023e, *BioNet Threatened Biodiversity Database Collection – Ecological data: Major Mitchell's Cockatoo*, Department of Planning and Environment, accessed 4 Feb 2023,

https://www.environment.nsw.gov.au/AtlasApp/UI_Modules/TSM_/ProfileEdit.aspx?pId=10116&pType=SpeciesCode

DPE TBDC 2023f, *BioNet Threatened Biodiversity Database Collection – Ecological data: Superb Parrot,* Department of Planning and Environment, accessed 4 Feb 2023, https://www.environment.nsw.gov.au/AtlasApp/UI_Modules/TSM_/ProfileEdit.aspx?pId=10645&pType=SpeciesCode

DPE TBDC 2023g, *BioNet Threatened Biodiversity Database Collection – Ecological data: Black-breasted Buzzard,* Department of Planning and Environment, accessed 4 Feb 2023, https://www.environment.nsw.gov.au/AtlasApp/UI_Modules/TSM_/ProfileEdit.aspx?pId=10395&pType=SpeciesCode

DPE TBDC 2023h, *BioNet Threatened Biodiversity Database Collection – Ecological data: Masked Owl,* Department of Planning and Environment, accessed 4 Feb 2023, https://www.environment.nsw.gov.au/AtlasApp/UI_Modules/TSM_/ProfileEdit.aspx?pId=10820&pType=SpeciesCode

DPE TBDC 2023i, *BioNet Threatened Biodiversity Database Collection – Ecological data: Barking Owl,* Department of Planning and Environment, accessed 4 Feb 2023, https://www.environment.nsw.gov.au/AtlasApp/UI_Modules/TSM_/ProfileEdit.aspx?pId=10561&pType=SpeciesCode

DPE TBDC 2023j, *BioNet Threatened Biodiversity Database Collection – Ecological data: Bush-stone Curlew,* Department of Planning and Environment, accessed 4 Feb 2023, https://www.environment.nsw.gov.au/AtlasApp/UI_Modules/TSM_/ProfileEdit.aspx?pId=10113&pType=SpeciesCode

DPE TBDC 2023k, *BioNet Threatened Biodiversity Database Collection – Ecological data: Squirrel Glider,* Department of Planning and Environment, accessed 4 Feb 2023, https://www.environment.nsw.gov.au/AtlasApp/UI_Modules/TSM_/ProfileEdit.aspx?pId=10604&pType=SpeciesCode

DPE TBDC 2023l, *BioNet Threatened Biodiversity Database Collection – Ecological data: Southern Myotis,* Department of Planning and Environment, accessed 4 Feb 2023, https://www.environment.nsw.gov.au/AtlasApp/UI_Modules/TSM_/ProfileEdit.aspx?pId=10549&pType=SpeciesCode

DPE TBDC 2023m, *BioNet Threatened Biodiversity Database Collection – Ecological data: Sloane's Froglet,* Department of Planning and Environment, accessed 4 Feb 2023, https://www.environment.nsw.gov.au/AtlasApp/UI_Modules/TSM_/ProfileEdit.aspx?pId=20088&pType=SpeciesCode

DPE TBDC 2023n, *BioNet Threatened Biodiversity Database Collection – Ecological data: Painted Honeyeater,* Department of Planning and Environment, accessed 4 Feb 2023, https://www.environment.nsw.gov.au/AtlasApp/UI_Modules/TSM_/ProfileEdit.aspx?pId=10357&pType=SpeciesCode

DPIE 2012, *NSW Aquifer Interference Policy: NSW Government policy for the licensing and assessment of aquifer interference activities*, State of New South Wales, publication number 11445.

DPIE 2017, *NSW Land Use 2017 v1.2*, Department of Planning, Industry and Environment, Sydney.

DPIE 2020a, *Biodiversity Assessment Method*, Department of Planning, Industry and Environment.

DPIE 2020b, *Surveying threatened plants and their habitats NSW survey guide for the Biodiversity Assessment Method*, State of NSW and Department of Planning, Industry and Environment.

DPIE 2020c, *NSW Survey Guide for Threatened Frogs*, Department of Planning, Industry and Environment.

DSEWPaC 2010a, *Survey Guidelines for Australia's Threatened Birds*, Department of Sustainability, Environment, Water, Population and Communities.

DSEWPaC 2010b, *Survey Guidelines for Australia's Threatened Frogs*, Department of Sustainability, Environment, Water, Population and Communities.

DSEWPaC 2011, *Survey Guidelines for Australia's Threatened Mammals*, Department of Sustainability, Environment, Water, Population and Communities.

DSEWPaC 2012, *Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-Eastern Australia: A guide to the identification, assessment and management of a nationally threatened ecological community Environment Protection and Biodiversity Conservation Act 1999*, Department of Sustainability, Environment, Water, Population and Communities.

EAAFP 2023, *EAAFP Flyway Site Network*, viewed 5 January 2023, https://www.eaaflyway.net/

eBird 2023a, *Species Maps search – Grey Falcon*, ebird: An online database of bird distribution and abundance, ebird, Ithaca, New York, accessed 1 February 2023, https://ebird.org/map

eBird 2023b, *Species Maps search – Australian Painted Snipe*, ebird: An online database of bird distribution and abundance, ebird, Ithaca, New York, accessed 1 February 2023, https://ebird.org/map

eBird 2023c, *Species Maps search – Glossy-black Cockatoo*, ebird: An online database of bird distribution and abundance, ebird, Ithaca, New York, accessed 1 February 2023, https://ebird.org/map

eBird 2023d, *Species Maps search – Major Mitchell Cockatoo*, ebird: An online database of bird distribution and abundance, ebird, Ithaca, New York, accessed 1 February 2023, https://ebird.org/map

eBird 2023e, *Species Maps search – Painted Honeyeater*, ebird: An online database of bird distribution and abundance, ebird, Ithaca, New York, accessed 1 February 2023, https://ebird.org/map

eBird 2023f, *Species Maps search – Latham's Snipe*, ebird: An online database of bird distribution and abundance, ebird, Ithaca, New York, accessed 1 February 2023, https://ebird.org/map

EES 1999, *Waterbirds at Lake Cowal, New South Wales, Australia: Assemblage shifts over a complete filling and drying cycle*, report prepared for North Mining Pty Ltd

EMM 2023a, *Aquatic ecology assessment*, prepared for Evolution Mining (Cowal) Pty Limited.

EMM 2023b, *Groundwater assessment*, prepared for Evolution Mining (Cowal) Pty Limited.

EMM 2023c, *Noise impact assessment*, prepared for Evolution Mining (Cowal) Pty Limited.

EMM 2023d, *Rehabilitation management plan*, prepared for Evolution Mining (Cowal) Pty Limited.

EMM 2023e, *Traffic impact assessment*, prepared for Evolution Mining (Cowal) Pty Limited.

EMM 2023f, *Visual impact assessment*, prepared for Evolution Mining (Cowal) Pty Limited.

EMM 2023g, *Air quality and greenhouse gas assessment*, prepared for Evolution Mining (Cowal) Pty Limited.

Evolution Mining (Cowal) Pty Limited 2003, *Cowal Gold Operation Land Management Plan*.

Evolution Mining (Cowal) Pty Limited 2015a, *Cowal Gold Operations Air Quality Management Plan*.

Evolution Mining (Cowal) Pty Limited 2015b, *Cowal Gold Operations Blast Management Plan*.

Evolution Mining (Cowal) Pty Limited 2015c, *Cowal Gold Mine Flora and Fauna Management Plan*.

Evolution Mining (Cowal) Pty Limited 2015d, *Biodiversity Offset Management Plan.*

Evolution Mining (Cowal) Pty Limited 2018, *Cowal Gold Operations Surface Water, Groundwater, Meteorological and Biological Monitoring Programme*.

Evolution Mining (Cowal) Pty Limited 2020a, *Cowal Gold Operations Cyanide Management Plan*.

Evolution Mining (Cowal) Pty Limited 2020b, *Cowal Gold Operations Hazardous Materials Management Plan*.

Evolution Mining (Cowal) Pty Limited 2021, *Cowal Gold Operations Environmental Management Strategy*.

Evolution Mining (Cowal) Pty Limited 2022a, *Cowal Gold Operations Erosion and Sediment Control Management Plan.*

Evolution Mining (Cowal) Pty Limited 2022b, *Cowal Gold Operations Noise Management Plan*.

Evolution Mining (Cowal) Pty Limited 2022c, *Pollution Incident Response Management Plan*, accessed 17 February 2023, https://evolutionmining.com.au/compliance/#cowalpart

Evolution Mining (Cowal) Pty Limited 2022d, *Cowal Gold Operations Rehabilitation Management Plan*.

Evolution Mining (Cowal) Pty Limited 2022e, *Cowal Gold Operations Soil Stripping Management Plan*.

Evolution Mining (Cowal) Pty Limited 2022f, *Cowal Gold Operations Transport Management Plan*.

Evolution Mining (Cowal) Pty Limited 2022g, *Cowal Gold Operations Water Management Plan*

FloraSearch 2008, *Cowal Gold Mine E42 Modification Flora Assessment*, report prepared for Barrick Australia Ltd.

FloraSearch 2013, *Cowal Gold Mine Modification - Proposed Pump Station: Impact on Flora*, report to Barrick Australia Ltd.

Garnett S, Szabo, J & Duston, G 2011, *The Action Plan for Australian Birds 2010*, CSIRO Publishing, Melbourne.

Gell P 2005, *Lake Cowal Waterbird Monitoring Survey: Progress Report – October 2005*, report prepared for Barrick Gold Corporation.

Gell P & Peake, P 2011, *Lake Cowal Waterbird Monitoring Survey: Progress Report January 2011*, report prepared for Barrick Gold Corporation.

Gell P & Peake, P 2012*, Lake Cowal Waterbird Monitoring Survey Progress Report October 2012*, report prepared for Barrick Gold Corporation.

Gell P & Peake, P 2013a, *Lake Cowal Waterbird Monitoring Survey Progress Report January 2013*, report prepared for Barrick Gold Corporation.

Gell P & Peake, P 2013b, *Lake Cowal Waterbird Monitoring Survey Progress Report August 2013*, report prepared for Cowal Gold Corporation.

Gell P & Peake, P 2013c, *Lake Cowal Waterbird Monitoring Survey Progress Report October 2013*, report prepared for Cowal Gold Corporation.

Gell P & Peake, P 2014a, *Lake Cowal Waterbird Monitoring Survey Progress Report January 2014*, report prepared for Cowal Gold Corporation.

Gell P & Peake, P 2014b, *Lake Cowal Waterbird Monitoring Survey Progress Report August 2014*, report prepared for Cowal Gold Corporation

Gell P & Peake, P 2014c, *Lake Cowal Waterbird Monitoring Survey Progress Report October 2014*, report prepared for Cowal Gold Corporation

Gell P 2015a, *Lake Cowal Waterbird Monitoring Survey Progress Report January 2015*, report prepared for Cowal Gold Corporation

Gell P 2015b, *Lake Cowal Waterbird Monitoring Survey Progress Report August 2015*, report prepared for Cowal Gold Corporation

Gell P 2015c, *Lake Cowal Waterbird Monitoring Survey Progress Report October 2015*, report prepared for Evolution Mining (Cowal) Pty Limited

Gell P 2016a, *Lake Cowal Waterbird Monitoring Survey Progress Report January 2016*, report prepared for Evolution Mining (Cowal) Pty Limited

Gell P 2016b, *Lake Cowal Waterbird Monitoring Survey Progress Report August 2016*, report prepared for Evolution Mining (Cowal) Pty Limited

Gell P 2016c, *Lake Cowal Waterbird Monitoring Survey Progress Report October 2016*, report prepared for Evolution Mining (Cowal) Pty Limited

Gell P 2017a, *Lake Cowal Waterbird Monitoring Survey Progress Report January 2017*, report prepared for Evolution Mining (Cowal) Pty Limited

Gell P 2017b, *Lake Cowal Waterbird Monitoring Survey Progress Report August 2017*, report prepared for Evolution Mining (Cowal) Pty Limited

Gell P 2017c, *Lake Cowal Waterbird Monitoring Survey Progress Report October 2017*, report prepared for Evolution Mining (Cowal) Pty Limited

Gell P 2018a, *Lake Cowal Waterbird Monitoring Survey Progress Report January 2018*, report prepared for Evolution Mining (Cowal) Pty Limited

Gell P 2018b, *Lake Cowal Waterbird Monitoring Survey Progress Report August 2018*, report prepared for Evolution Mining (Cowal) Pty Limited

Gell P 2018c, *Lake Cowal Waterbird Monitoring Survey Progress Report October 2018*, report prepared for Evolution Mining (Cowal) Pty Limited

Gell P 2019a, *Lake Cowal Waterbird Monitoring Survey Progress Report January 2019*, report prepared for Evolution Mining (Cowal) Pty Limited

Gell P 2019b, *Lake Cowal Waterbird Monitoring Survey Progress Report August 2019*, report prepared for Evolution Mining (Cowal) Pty Limited

Gell P 2019c, *Lake Cowal Waterbird Monitoring Survey Progress Report October 2019*, report prepared for Evolution Mining (Cowal) Pty Limited

Gell P 2020a, *Lake Cowal Waterbird Monitoring Survey Progress Report January 2020*, report prepared for Evolution Mining (Cowal) Pty Limited

Gell P 2020b, *Lake Cowal Waterbird Monitoring Survey Progress Report August 2020*, report prepared for Evolution Mining (Cowal) Pty Limited

Gell P 2020c, *Lake Cowal Waterbird Monitoring Survey Progress Report October 2020*, report prepared for Evolution Mining (Cowal) Pty Limited

Gell P 2021a, *Lake Cowal Waterbird Monitoring Survey Progress Report March 2021*, report prepared for Evolution Mining (Cowal) Pty Limited

Gell P 2021b, *Lake Cowal Waterbird Monitoring Survey Progress Report August 2021*, report prepared for Evolution Mining (Cowal) Pty Limited

Gell P 2021c, *Lake Cowal Waterbird Monitoring Survey Progress Report October 2021*, report prepared for Evolution Mining (Cowal) Pty Limited

Gell P 2022a, *Lake Cowal Waterbird Monitoring Survey Progress Report January 2022*, report prepared for Evolution Mining (Cowal) Pty Limited

Gell P 2022b, *Lake Cowal Waterbird Monitoring Survey Progress Report August 2022*, report prepared for Evolution Mining (Cowal) Pty Limited

Gochfeld M & Burger, J 1996, Family Sternidae (Terns), in *Handbook of the Birds of the World*, eds del Hoyo, Elliott, JA & Sargatal, J, Volume 3: Hoatzin to Auks, Page(s) 624-667, Lynx Edicions, Barcelona.

Green D, Petrovic J, Moss P & Burrell, M 2011, *Water resources and management overview: Lachlan catchment*, NSW Office of Water, Sydney.

Greg Richards and Associates Pty Ltd 1997a, *Results of a Bat Fauna Survey to Target Threatened Species*, attachment A7 of Resource Strategies Pty Ltd, Commonwealth Scientific and Industrial Research Organisation Wildlife and Ecology, Goldney, D. and Greg Richards and Associates Pty Ltd 1997, *Cowal Gold Project Species Impact Statement,* Appendix A of North Limited 1998, *Cowal Gold Project Environmental Impact Statement*.

Greg Richards and Associates Pty Ltd 1997b, *Cowal Gold Project Significance of Operations on Threatened Bat Species*, in Appendix A of North Limited 1998, *Cowal Gold Project Electricity Transmission Line Environmental Impact Statement*, report prepared by Resource Strategies Pty Ltd.

Groves RH & Willis, AJ 1999, Environmental weeds and loss of native plant biodiversity: some Australian examples, *Australian Journal of Environmental Management*, 6(3), pp.164-171.

Gunninah Consultants Pty Ltd 1995, *Fauna Impact Statement*, in Appendix A of North Limited 1995, *CGM Environmental Impact Statement*, prepared by NSR Environmental Consultants Pty Ltd.

Hansen B, Fuller R, Watkins D, Rogers D, Clemens R, Newman M, Woehler E & Weller, D 2016, *Revision of the East Asian-Australasian Flyway Population Estimates for 37 listed Migratory Shorebird Species*, Unpublished report for the Department of the Environment, BirdLife Australia, Melbourne.

Hirvonen H 2001, Impacts of highway construction and traffic on a wetland bird community, *Proceedings of the 2003 International Conference on Ecology & Transportation*, pp. 369-372.

Hunter J 2006, *Vegetation and floristics of Brigalow Park and Claremont Nature Reserves*, report to NSW National Parks and Wildlife Service, Narrabri Area.

Higgins PJ & Davies, SJJF (eds) 1996, *Handbook of Australian, New Zealand and Antarctic Birds. Volume Three - Snipe to Pigeons*, Oxford University Press, Melbourne, Victoria.

IECA 2008, *Best Practice Erosion & Sediment Control guidelines*, International Erosion Control Association, Australasian guidelines.

Jones DL 1998, Marsileaceae, *Flora of Australia, Volume 48, Ferns, Gymnosperms and Allied Groups*, pp.166-173. ABRS/CSIRO Australia.

Jones C, Stanton D, Hamer N, Denner S, Singh K, Flook S & Dyring M 2020, Field investigation of potential terrestrial groundwater-dependent ecosystems within Australia's Great Artesian Basin, Hydrogeology Journal, 28(1), pp. 237-261.

Kerle A 2013a, *Cowal Gold Mine and Surrounds Fauna Report*, report prepared for Barrick (Cowal) Limited.

Kerle A 2013b, *Proposed Pump Station – Cowal Gold Mine Extension Modification Potential Fauna Habitat*, report prepared for Barrick (Cowal) Limited.

KBA Partnership 2022, Key Biodiversity Areas: Explore Data, accessed 22 December 22, https://www.keybiodiversityareas.org/home

Landcom 2004, *Managing Urban Stormwater – Soils and Construction Volume 1*.

LLS 2017, *Central West Regional Strategic Weed Management Plan 2017 – 2022,* Riverina Local Land Services.

LLS 2018, *Riverina Regional strategic Pest Animal Management Plan 2018-2023,* Riverina Local Land Services.

Malone, CR & Proctor, VW 1965, Dispersal of *Marsilea mucronata* by water birds, *American Fern Journal*, 55(4), pp.167-170.

Marchant S & Higgins, PJ (eds) 1990, *Handbook of Australian, New Zealand and Antarctic Birds. Volume One - Ratites to Ducks*, Oxford University Press, Melbourne, Victoria.

Marchant S & Higgins, PJ (eds) 1993, *Handbook of Australian, New Zealand and Antarctic Birds. Volume 2 - Raptors to Lapwings*, Oxford University Press, Melbourne, Victoria.

Mount King Ecological Surveys 1997, *Fauna Report - Temora to Cowal Gold Project Electricity Transmission Line Fauna Assessment*, in Appendix D of North Limited 1998, *Cowal Gold Project Environmental Impact Statement*, prepared by Resource Strategies Pty Ltd.

NSR Environmental Consultants 1995, *Lake Cowal Gold Project Environmental Impact Statement*, prepared for North Mining Limited.

OEH 2018, *'Species credit' threatened bats and their habitats, NSW survey guide for the Biodiversity Assessment Method,* NSW Office of Environment and Heritage.

Orellana F, Verma P, Loheide, SP & Daly E. 2012. Monitoring and modelling water-vegetation interactions in groundwater-dependent ecosystems. *Reviews of Geophysics*, *50*(3).

Resource Strategies Pty. Ltd. 2013, *Cowal Gold Mine Extension Modification Threatened Species Assessment*, report prepared for Barrick Australia Ltd.

Schneider H & Pryer, KM 2002, Structure and function of spores in the aquatic heterosporous fern family Marsileaceae, *International Journal of Plant Sciences*, 163(4), pp.485-505.

Smit CJ & Visser, GJ 1993, *Effects of disturbance on shorebirds: a summary of existing knowledge from the Dutch Wadden Sea and Delta area*, Wader Study Group Bulletin 68, pp. 6-19.

Townshend D & O'connor, D 1993, *Some effects of disturbance to waterfowl from bait-digging and wildfowling at Lindisfarne National Nature Reserve, north-east England*, Whuighesader Study Group Bulletin 68(47): p. 52.

TSSC 2008, *Approved Conservation Advice for Weeping Myall Woodlands ecological community*, Threatened Species Scientific Committee, Department of the Environment, Water, Heritage and the Arts, Canberra, ACT.

TSSC 2010, *Commonwealth Listing Advice on Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia*, Threatened Species Scientific Committee, Department of the Environment, Water, Heritage and the Arts, Canberra, ACT.

NSW TSSC 2011, *Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions - Determination to make a minor amendment to Part 3 of Schedule 1 of the Threatened Species Conservation Act*, NSW Threatened Species Scientific Committee, Parramatta, NSW.

TSSC 2013, *Approved Conservation Advice for Rostratula australis (Australian painted snipe)*, Threatened Species Scientific Committee, Department of Sustainability, Environment, Water, Population and Communities, Canberra, ACT.

TSSC 2016, *Conservation Advice Superb Parrot (Polytelis swainsonii),* Threatened Species Scientific Committee, Department of the Environment, Canberra, ACT.

TSSC 2019, *Conservation Advice (including listing advice) for the Poplar Box Grassy Woodland on Alluvial Plains*, Threatened Species Scientific Committee, Department of the Environment and Energy, Canberra, ACT.

TSSC 2019b, *Conservation Advice Australasian Bittern (Botaurus poiciloptilus)*, Threatened Species Scientific Committee, Department of the Environment and Energy, Canberra, ACT.

UNSW 2022, *Eastern Australian Waterbird Survey – waterbird database,* University of New South Wales, data accessed 5 December 2022, https://www.unsw.edu.au/research/ecosystem/our-research/rivers-and-wetlands/eastern-australian-waterbird-survey

Vestjens W 1977, *Status, habitats and food of vertebrates at Lake Cowal, NSW,* Division of Wildlife Research Technical Memorandum No. 12 Commonwealth Scientific and Industrial Research Organisation, Canberra.

Wassens S, Watts RJ, Jansen A & Roshier, D 2008, Movement patterns of southern bell frogs (*Litoria raniformis*) in response to flooding, *Wildlife Research*, 35(1), pp. 50-58.

Western Research Institute 2008, *Appendix E Cowal Gold Mine E42 Modification Fauna Assessment*. Appendix E in Barrick Australia Limited 2008, *Cowal Gold Mine E42 Modification Environmental Assessment*.

Wetlands International 2006, *Waterbird Population Estimates - Fourth Edition*, Wetlands International, Wageningen, The Netherlands

Wright MD, Goodman P & Cameron TC 2010, Exploring behavioural responses of shorebirds to impulsive noise, *Wildfowl* 60, pp. 150-167.

Appendix A
BAM plot data

EMM
creating opportunities

BAM Site – Field Survey Form

Plot ID:	Co012	**Date:**	22/04/22	**Project number:**	J190417	**Plot dimensions:**	20x20
Datum:	GDA94	**Easting:**	536,798	**Recorders:**	KV, SJ		
Zone:	55	**Northing:**	6,274,848	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	340
Plant Community Type:		26: Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion		**Condition class:**	DNG	**PCT confidence:**	high
Vegetation Class:		Riverine Plain Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	4
	Grasses etc.:	2
	Forbs:	4
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	7.7
	Grasses etc.:	65
	Forbs:	2.3
	Ferns:	0
	Other:	0.1
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	40	35	10	10	20
Average litter cover (%):	23				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Low rise, thick grassland

Plot Disturbance

Previous clearing. No soil disturbance

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	KV, SJ	**Plot ID:**	Co012	**Date:**	22/04/22

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	5	100	no	N
Shrub (SG)	*Sclerolaena spp. (Copperburr, Poverty-bush)*	5	25	no	N
Forb (FG)	*Oxalis perennans*	0.1	50	no	N
	Lactuca saligna (Willow-leaved Lettuce)	0.1	50	no	E
Grass & grasslike (GG)	*Cynodon dactylon (Common Couch)*	60	500	no	N
Forb (FG)	*Dichondra repens (Kidney Weed)*	2	200	no	N
Forb (FG)	*Vittadinia sulcata*	0.1	15	no	N
Forb (FG)	*Sida cunninghamii (Ridge Sida)*	0.1	10	no	N
Shrub (SG)	*Atriplex semibaccata (Creeping Saltbush)*	2	7	no	N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	0.5	10	no	N
Other (OG)	*Convolvulus spp. (A Bindweed)*	0.1	50	no	N
	Trifolium angustifolium (Narrow-leaved Clover)	5	1000	no	E
	Trifolium spp. (A Clover)	0.2	100	no	E
Shrub (SG)	*Maireana aphylla (Cotton Bush)*	0.2	2	no	N
	Lepidium africanum (Common Peppercress)	0.1	15	no	E
	Marrubium vulgare (White Horehound)	0.1	3	no	E
	Polygonum aviculare (Wireweed)	0.1	25	no	E

BAM Site – Field Survey Form

Plot ID:	19	**Date:**	22/03/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	536,787	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,275,527	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	252
Plant Community Type:		26: Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion		**Condition class:**	DNG	**PCT confidence:**	medium
Vegetation Class:		Riverine Plain Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	4
	Grasses etc.:	8
	Forbs:	11
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	10.9
	Grasses etc.:	16.7
	Forbs:	9.8
	Ferns:	0
	Other:	1
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	0	3	5	1	0
Average litter cover (%):	1.8				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain

Plot Disturbance

Cleared grazed / cropped

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	19	**Date:**	22/03/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Sporobolus caroli (Fairy Grass)*	1	60		N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	10	800		N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	4	800		N
Shrub (SG)	*Salsola australis*	10	1400		N
Grass & grasslike (GG)	*Dactyloctenium radulans (Button Grass)*	0.1	10		N
Forb (FG)	*Goodenia fascicularis (Mallee Goodenia)*	4	1600		N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	1	400		N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	0.5	6		N
Shrub (SG)	*Sclerolaena muricata (Black Rolypoly)*	0.3	20		N
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	4	1200		N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	0.1	30		N
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	0.3	6		N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	0.5	600		N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	1	60		N
Grass & grasslike (GG)	*Tragus australianus (Small Burrgrass)*	0.4	400		N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	0.1	40		N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.1	15		N
	Trifolium dubium (Yellow Suckling Clover)	0.1	50		E
Forb (FG)	*Dysphania spp.*	0.1	1		N
Forb (FG)	*Alternanthera denticulata (Lesser Joyweed)*	0.1	3		N
Shrub (SG)	*Sclerolaena stelligera (Star Copperburr)*	0.1	5		N
Forb (FG)	*Solanum esuriale (Quena)*	0.3	40		N
	Cucumis myriocarpus subsp. leptodermis (Paddy Melon)	0.1	1		E
Forb (FG)	*Boerhavia dominii (Tarvine)*	0.1	1		N
Forb (FG)	*Portulaca oleracea (Pigweed)*	0.2	9		N
Grass & grasslike (GG)	*Austrostipa spp. (A Speargrass)*	0.1	5		N

BAM Site – Field Survey Form

Plot ID:	1	**Date:**	21/03/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	535,269	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,275,587	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	199
Plant Community Type:		26: Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion		**Condition class:**	DNG	**PCT confidence:**	low
Vegetation Class:		Riverine Plain Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	3
	Grasses etc.:	9
	Forbs:	14
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	0.8
	Grasses etc.:	57.5
	Forbs:	3.5
	Ferns:	0
	Other:	1
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	1	1	3	5	2
Average litter cover (%):	2.4				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain edge / footslope of small hill

Plot Disturbance

Cleared and cropped. However, natives are coming back, making this area variable.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	1	**Date:**	21/03/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	40	2000	no	N
Shrub (SG)	*Salsola australis*	0.3	12	no	N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	0.4	9	no	N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	0.1	20	no	N
	Medicago spp. (A Medic)	0.5	1600	no	E
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	10	4000	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.1	20	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	1	400	no	N
Forb (FG)	*Dichondra repens (Kidney Weed)*	2	2000	no	N
	Heliotropium europaeum (Potato Weed)	0.2	400	no	E
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	0.5	10	no	N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	0.2	50	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.1	50	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	4	no	N
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	0.8	50	no	N
	Chondrilla juncea (Skeleton Weed)	0.1	4	no	E
Grass & grasslike (GG)	*Austrostipa scabra subsp. scabra (Rough Speargrass)*	5	90	no	N
Forb (FG)	*Boerhavia dominii (Tarvine)*	0.1	30	no	N
Forb (FG)	*Goodenia pinnatifida (Scrambles Eggs)*	0.1	50	no	N
	Echium vulgare (Viper's Bugloss)	3	1600	no	E
Forb (FG)	*Wahlenbergia spp. (Bluebell)*	0.2	100	no	N
	Trifolium spp. (A Clover)	0.1	50	no	E
Forb (FG)	*Oxalis perennans*	0.1	4	no	N
Forb (FG)	*Solanum esuriale (Quena)*	0.1	18	no	N
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	0.1	5	no	N
Grass & grasslike (GG)	*Bothriochloa macra (Red Grass)*	0.2	2	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.1	6	no	N
	Cucumis myriocarpus subsp. leptodermis (Paddy Melon)	0.1	1	no	E
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	3	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	0.8	10	no	N
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	0.1	1	no	N
Grass & grasslike (GG)	*Sporobolus caroli (Fairy Grass)*	0.1	1	no	N
Shrub (SG)	*Sclerolaena muricata (Black Rolypoly)*	0.1	2	no	N

BAM Site – Field Survey Form

Plot ID:	20	**Date:**	20/03/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	537,076	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,279,495	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	124
Plant Community Type:		26: Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion		**Condition class:**	DNG	**PCT confidence:**	medium
Vegetation Class:		Riverine Plain Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	4
	Grasses etc.:	5
	Forbs:	6
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	9
	Grasses etc.:	69
	Forbs:	6.5
	Ferns:	0
	Other:	1.5
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	2	2	5	5	10
Average litter cover (%):	4.8				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain

Plot Disturbance

Cleared, grazed / cropped

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	20	**Date:**	20/03/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	40	1200		N
Shrub (SG)	*Pimelea micrantha (Silky Rice-flower)*	8	2000		N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	5	1000		N
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	20	1600		N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	1.5	400		N
Forb (FG)	*Goodenia fascicularis (Mallee Goodenia)*	0.1	30		N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	5	400		N
Shrub (SG)	*Maireana decalvans (Black Cotton Bush)*	0.4	5		N
Shrub (SG)	*Atriplex semibaccata (Creeping Saltbush)*	0.5	5		N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.2	200		N
Grass & grasslike (GG)	*Paspalidium jubiflorum (Warrego Grass)*	2	60		N
Forb (FG)	*Solanum esuriale (Quena)*	1	80		N
Grass & grasslike (GG)	*Walwhalleya proluta*	2	50		N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	2		N
Shrub (SG)	*Sclerolaena spp. (Copperburr, Poverty-bush)*	0.1	1		N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.1	10		N

BAM Site – Field Survey Form

Plot ID:	25	**Date:**	20/05/20	**Project number:**	J190417		**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	536,866	**Recorders:**	GS RP			
Zone:	55	**Northing:**	6,280,063	**IBRA region:**	NSW South Western Slopes		**Midline bearing:**	250
Plant Community Type:		26: Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion			**Condition class:**	DNG	**PCT confidence:**	medium
Vegetation Class:		Riverine Plain Woodlands			**EEC:**	no	**EEC confidence:**	medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	7
	Grasses etc.:	7
	Forbs:	10
	Ferns:	1
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	1
	Grasses etc.:	43.3
	Forbs:	7.9
	Ferns:	0.2
	Other:	16
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	5	2	10	5	10
Average litter cover (%):	6.4				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain

Plot Disturbance

Cleared and grazed

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	25	**Date:**	20/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Forb (FG)	*Hypoxis exilis (Swamp Star)*	0.1	25	yes	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	1	100	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	5	1700	no	N
	Medicago spp. (A Medic)	1	100	no	E
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	5	50	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	5	50	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	30	250	no	N
Fern (EG)	*Cheilanthes sieberi (Rock Fern)*	0.2	4	no	N
Grass & grasslike (GG)	*Echinochloa colona (Awnless Barnyard Grass)*	1	100	no	N
Shrub (SG)	*Salsola australis*	0.2	35	no	N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	0.3	50	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.2	100	no	N
Forb (FG)	*Crassula sieberiana (Australian Stonecrop)*	0.1	100	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	16	1600		N
Shrub (SG)	*Rhagodia parabolica*	0.1	15	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.5	75	no	N
Shrub (SG)	*Maireana spp. (Cotton Bush, Bluebush, Fissure-weed)*	0.2	15	yes	N
	Sonchus oleraceus (Common Sowthistle)	0.3	20	no	E
Grass & grasslike (GG)	*Tragus australianus (Small Burrgrass)*	0.1	10	no	N
Shrub (SG)	*Sclerolaena stelligera (Star Copperburr)*	0.2	10	no	N
Forb (FG)	*Goodenia spp.*	0.5	100	yes	N
Grass & grasslike (GG)	*Dichanthium sericeum (Queensland Bluegrass)*	2	200	yes	N
	Brassica x napus (Rape)	0.5	50	no	E
Shrub (SG)	*Sclerolaena spp. (Copperburr, Poverty-bush)*	0.1	5	yes	N
	Avena spp. (Oats)	0.1	10	no	E
Forb (FG)	*Oxalis perennans*	0.1	20	no	N
	Chenopodium album (Fat Hen)	0.1	10	no	E
Forb (FG)	*Solanum esuriale (Quena)*	0.1	5	no	N
Grass & grasslike (GG)	*Sporobolus caroli (Fairy Grass)*	0.2	50	no	N
Shrub (SG)	*Maireana spp. (Cotton Bush, Bluebush, Fissure-weed)*	0.1	1	yes	N
	Hypochaeris radicata (Catsear)	0.1	5	no	E
Shrub (SG)	*Maireana spp. (Cotton Bush, Bluebush, Fissure-weed)*	0.1	30	no	N

BAM Site – Field Survey Form

Plot ID:	44	**Date:**	23/05/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	537,718	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,275,976	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	226
Plant Community Type:		26: Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion		**Condition class:**	DNG	**PCT confidence:**	medium
Vegetation Class:		Riverine Plain Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	5
	Grasses etc.:	8
	Forbs:	11
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	2.2
	Grasses etc.:	36.2
	Forbs:	57.8
	Ferns:	0
	Other:	0.8
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	5	10	10	15	5
Average litter cover (%):	9				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain

Plot Disturbance

Cleared, weedy

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	44	**Date:**	23/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	50	4000	no	N
	Avena spp. (Oats)	13	150	no	E
Grass & grasslike (GG)	*Walwhalleya proluta*	5	500	no	N
Grass & grasslike (GG)	*Echinochloa colona (Awnless Barnyard Grass)*	1	300	no	N
Grass & grasslike (GG)	*Dichanthium setosum (Bluegrass)*	10	400	no	N
	Medicago polymorpha (Burr Medic)	35	800	no	E
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	10	150	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	5	150	no	N
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	2	50	no	N
Grass & grasslike (GG)	*Sporobolus caroli (Fairy Grass)*	2	100	no	N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	1	60	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	1.6	1000	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.6	100	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.8	100	no	N
Forb (FG)	*Dichondra repens (Kidney Weed)*	3	5000	no	N
Forb (FG)	*Oxalis perennans*	0.2	60		N
Forb (FG)	*Solanum esuriale (Quena)*	0.8	60		N
	Sonchus oleraceus (Common Sowthistle)	0.2	5		E
	Lolium perenne (Perennial Ryegrass)	1.3	60		E
Grass & grasslike (GG)	*Paspalidium jubiflorum (Warrego Grass)*	1.2	22		N
Shrub (SG)	*Maireana brevifolia*	0.5	5		N
Shrub (SG)	*Atriplex spp. (A Saltbush)*	1	10		N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	0.1	10		N
Shrub (SG)	*Maireana spp. (Cotton Bush, Bluebush, Fissure-weed)*	0.2	2		N
	Hypochaeris glabra (Smooth Catsear)	0.1	5		E
	Medicago spp. (A Medic)	0.4	10		E
	Sanguisorba minor subsp. muricata (Sheep's Burnet)	0.4	50		E
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	0.4	15		N
Forb (FG)	*Eclipta platyglossa (Yellow Twin-heads)*	0.1	5		N
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	0.2	50		N
Shrub (SG)	*Sclerolaena spp. (Copperburr, Poverty-bush)*	0.1	5		N
Forb (FG)	*Crassula sieberiana (Australian Stonecrop)*	0.2	4000		N

BAM Site – Field Survey Form

Plot ID:	23	**Date:**	26/05/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	535,727	**Recorders:**	RP GS		
Zone:	55	**Northing:**	6,275,710	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	271
Plant Community Type:	26: Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion			**Condition class:**	DNG	**PCT confidence:**	medium
Vegetation Class:	Riverine Plain Woodlands			**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	6
	Grasses etc.:	11
	Forbs:	16
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	6.4
	Grasses etc.:	110.5
	Forbs:	47
	Ferns:	0
	Other:	1
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	5	5	10	5	10
Average litter cover (%):	7				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Low hill slope

Plot Disturbance

Cleared

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	RP GS	**Plot ID:**	23	**Date:**	26/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	40	400	no	N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	40	400	no	N
Grass & grasslike (GG)	*Echinochloa colona (Awnless Barnyard Grass)*	2	400	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	10	400	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	1	400	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	1	400	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	40	400	no	N
Forb (FG)	*Calotis hispidula (Bogan Flea)*	1	400	no	N
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	4	150	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	1	400	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.4	150	no	N
Shrub (SG)	*Sclerolaena muricata (Black Rolypoly)*	0.4	100	no	N
Shrub (SG)	*Salsola australis*	0.4	75	no	N
Shrub (SG)	*Maireana spp. (Cotton Bush, Bluebush, Fissure-weed)*	5	60	no	N
	Echium plantagineum (Patterson's Curse)	15	75	no	E
Grass & grasslike (GG)	*Sporobolus caroli (Fairy Grass)*	1	400	no	N
Forb (FG)	*Wahlenbergia spp. (Bluebell)*	0.4	50	no	N
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	0.1	10	no	N
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	0.4	35	no	N
Forb (FG)	*Solanum esuriale (Quena)*	0.4	50	no	N
	Lepidium africanum (Common Peppercress)	0.1	4	no	E
Grass & grasslike (GG)	*Paspalidium jubiflorum (Warrego Grass)*	2	100	no	N
	Sonchus oleraceus (Common Sowthistle)	0.1	7	no	E
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	1	50		N
Forb (FG)	*Rumex brownii (Swamp Dock)*	0.1	3		N
	Sisymbrium officinale (Hedge Mustard)	1	50		E
Grass & grasslike (GG)	*Austrostipa scabra (Speargrass)*	6	100		N
Forb (FG)	*Goodenia fascicularis (Mallee Goodenia)*	1	400		N
Forb (FG)	*Hibiscus trionum (Flower-of-an-hour)*	0.1	2		N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	5	400		N
Shrub (SG)	*Sclerolaena birchii (Galvinized Burr)*	0.1	25		N
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	0.1	25		N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	0.4	50		N
	Medicago laciniata (Cut-leaved Medic)	0.2	30		E
Forb (FG)	*Erodium spp. (Crowfoot)*	0.2	50		N
Forb (FG)	*Portulaca oleracea (Pigweed)*	0.1	15		N
Shrub (SG)	*Maireana humillima*	0.1	35		N
	Medicago arabica (Spotted Burr Medic)	5	100		E
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	5		N
	Avena spp. (Oats)	0.3	50		E
Grass & grasslike (GG)	*Rytidosperma spp.*	0.1	5		N

BAM Site – Field Survey Form

Plot ID:	Co001	**Date:**	22/04/22	**Project number:**	J190417	**Plot dimensions:**	20x50
Datum:	GDA94	**Easting:**	536,447	**Recorders:**	KV, SJ		
Zone:	55	**Northing:**	6,275,169	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	250
Plant Community Type:		26: Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion		**Condition class:**	Poor	**PCT confidence:**	low
Vegetation Class:		Riverine Plain Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	5
	Grasses etc.:	3
	Forbs:	9
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	3
	Shrubs:	6.6
	Grasses etc.:	75
	Forbs:	1.5
	Ferns:	0
	Other:	0
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	9
80 + cm:	0		
50 – 79 cm:	1		
30 – 49 cm:	1		
20 – 29 cm:	0	Tree hollow count	1
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	20	25	1	15	1
Average litter cover (%):	12.4				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Low rise on floodplain, thick grassland with distant scsttered clumps of Myall. Red clays

Plot Disturbance

Historic grazing and cropping. No recent disturbances.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	KV, SJ	**Plot ID:**	Co001	**Date:**	22/04/22

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Alectryon oleifolius (Western Rosewood)*	3	1	no	N
Forb (FG)	*Oxalis spp.*	0.3	500	no	N
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	20	200	no	N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	0.5	10	no	N
Shrub (SG)	*Atriplex semibaccata (Creeping Saltbush)*	5	20	no	N
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	0.3	30	no	N
Forb (FG)	*Solanum esuriale (Quena)*	0.1	15	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	30	no	N
	Polygonum arenastrum (Wireweed)	0.1	50	no	E
Forb (FG)	*Sida cunninghamii (Ridge Sida)*	0.1	7	no	N
Shrub (SG)	*Sclerolaena spp. (Copperburr, Poverty-bush)*	0.5	30	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	50	300	no	N
	Lepidium africanum (Common Peppercress)	0.1	30	no	E
Forb (FG)	*Dichondra repens (Kidney Weed)*	0.3	500	no	N
Shrub (SG)	*Salsola australis*	0.5	40	no	N
Shrub (SG)	*Geijera parviflora (Wilga)*	0.1	1	no	N
Forb (FG)	*Portulaca oleracea (Pigweed)*	0.1	5	no	N
Forb (FG)	*Tribulus micrococcus (Spineless Caltrop)*	0.1	20	no	N
	Conyza spp. (A Fleabane)	0.1	50	no	E
	Trifolium spp. (A Clover)	0.1	30	no	E
Grass & grasslike (GG)	*Eragrostis spp. (A Lovegrass)*	5	60	no	N
Forb (FG)	*Calotis cuneifolia (Purple Burr-Daisy)*	0.1	3	no	N

BAM Site – Field Survey Form

Plot ID:	33	**Date:**	21/03/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	536,228	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,275,376	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	89
Plant Community Type:		26: Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion		**Condition class:**	Poor	**PCT confidence:**	medium
Vegetation Class:		Riverine Plain Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	6
	Grasses etc.:	6
	Forbs:	11
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	91.9
	Grasses etc.:	12.5
	Forbs:	6.1
	Ferns:	0
	Other:	0
High Threat Weed cover:		1

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	14
80 + cm:	0		
50 – 79 cm:	2		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	40	80	60	20	25
Average litter cover (%):	45				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain / edge of foot slope

Plot Disturbance

Cleared,cropped / grazed

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	33	**Date:**	21/03/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Shrub (SG)	*Geijera parviflora (Wilga)*	10	2	no	N
Shrub (SG)	*Salsola australis*	70	1600	no	N
Forb (FG)	*Solanum esuriale (Quena)*	3	100	no	N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	1.5	15	no	N
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	0.5	20	no	N
Shrub (SG)	*Sclerolaena muricata (Black Rolypoly)*	10	1200	no	N
	Tribulus terrestris (Cat-head)	2	100	no	E
	Malva parviflora (Small-flowered Mallow)	40	1600	no	E
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	0.1	3	no	N
	Cucumis myriocarpus subsp. leptodermis (Paddy Melon)	1	10	no	E
Grass & grasslike (GG)	*Dactyloctenium radulans (Button Grass)*	2	50	no	N
Forb (FG)	*Portulaca oleracea (Pigweed)*	0.1	5	no	N
	Brassica x napus (Rape)	1	30	no	E
Shrub (SG)	*Rhagodia spinescens (Thorny Saltbush)*	0.2	4	no	N
Grass & grasslike (GG)	*Paspalidium jubiflorum (Warrego Grass)*	1	20	no	N
Shrub (SG)	*Maireana brevifolia*	0.2	2	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.2	5	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	5	50	no	N
Forb (FG)	*Oxalis spp.*	0.1	3	no	N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	0.2	3	no	N
Forb (FG)	*Boerhavia dominii (Tarvine)*	0.1	15	no	N
	Xanthium spinosum (Bathurst Burr)	1	20	no	HTE
Grass & grasslike (GG)	*Echinochloa colona (Awnless Barnyard Grass)*	2	40	no	N
Forb (FG)	*Alternanthera denticulata (Lesser Joyweed)*	0.1	5	no	N
	Heliotropium europaeum (Potato Weed)	0.5	100	no	E
	Poaceae indeterminate (Grasses, reeds and bamboos)	0.5	20	no	E
Grass & grasslike (GG)	*Chloris truncata (Windmill Grass)*	2	60	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	2	100	no	N
	Sonchus oleraceus (Common Sowthistle)	0.2	10	no	E
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	1	no	N
	Solanum nigrum (Black-berry Nightshade)	0.2	4	no	E
	Marrubium vulgare (White Horehound)	0.3	3	no	E
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	0.1	1	no	N

BAM Site – Field Survey Form

Plot ID:	32	**Date:**	22/03/20	**Project number:**	J190417	**Plot dimensions:**	10 x 100
Datum:	GDA94	**Easting:**	536,527	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,275,465	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	87
Plant Community Type:		26: Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion		**Condition class:**	Planted	**PCT confidence:**	low
Vegetation Class:		Riverine Plain Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	4
	Grasses etc.:	1
	Forbs:	4
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	30
	Shrubs:	8.3
	Grasses etc.:	0.1
	Forbs:	1.2
	Ferns:	0
	Other:	0.1
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	1		
20 – 29 cm:	1	Tree hollow count	0
10 – 19 cm:	1		
5 – 9 cm:	1		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	80	90	70	98	55
Average litter cover (%):	78.6				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain

Plot Disturbance

Cleared and revegetetated

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	32	**Date:**	22/03/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Casuarina cristata (Belah)*	30	13		N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	8	150		N
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	0.1	12		N
Forb (FG)	*Boerhavia dominii (Tarvine)*	0.1	1		N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	0.1	7		N
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	0.9	18		N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.1	1		N
Shrub (SG)	*Salsola australis*	0.1	23		N
Shrub (SG)	*Rhagodia parabolica*	0.1	4		N
Shrub (SG)	*Sclerolaena spp. (Copperburr, Poverty-bush)*	0.1	2		N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	0.1	1		N

BAM Site – Field Survey Form

Plot ID:	31	**Date:**	20/05/20	**Project number:**	J190417			**Plot dimensions:**	20 x50
Datum:	GDA94	**Easting:**	536,638	**Recorders:**	RP GS				
Zone:	55	**Northing:**	6,280,116	**IBRA region:**	NSW South Western Slopes			**Midline bearing:**	68
Plant Community Type:			26: Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion			**Condition class:**	Planted	**PCT confidence:**	medium
Vegetation Class:			Riverine Plain Woodlands			**EEC:**	no	**EEC confidence:**	medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	8
	Grasses etc.:	10
	Forbs:	8
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	30
	Shrubs:	1.5
	Grasses etc.:	30.8
	Forbs:	8.6
	Ferns:	0
	Other:	9
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	1		
5 – 9 cm:	1		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	3	2	65	1	50
Average litter cover (%):	24.2				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain

Plot Disturbance

Cleared and planted

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	RP GS	**Plot ID:**	31	**Date:**	20/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Eucalyptus moluccana (Grey Box)*	30	5		N
Shrub (SG)	*Atriplex spp. (A Saltbush)*	0.5	15	yes	N
Shrub (SG)	*Maireana spp. (Cotton Bush, Bluebush, Fissure-weed)*	0.1	15	yes	N
Forb (FG)	*Goodenia fascicularis (Mallee Goodenia)*	1	30	no	N
Forb (FG)	*Alternanthera denticulata (Lesser Joyweed)*	0.1	10	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	25	200	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	7	1000	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	9	1400	no	N
Shrub (SG)	*Salsola australis*	0.1	15	no	N
Shrub (SG)	*Maireana spp. (Cotton Bush, Bluebush, Fissure-weed)*	0.3	150	yes	N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	0.2	22	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.1	150	no	N
	Avena sativa (Oats)	0.1	3	no	E
Grass & grasslike (GG)	*Paspalidium jubiflorum (Warrego Grass)*	5	350	no	N
Grass & grasslike (GG)	*Echinochloa colona (Awnless Barnyard Grass)*	0.1	3	yes	N
Forb (FG)	*Boerhavia dominii (Tarvine)*	0.1	10	no	N
	Trifolium spp. (A Clover)	5	800	no	E
Grass & grasslike (GG)	*Sporobolus caroli (Fairy Grass)*	0.1	5	no	N
Forb (FG)	*Goodenia pinnatifida (Scrambles Eggs)*	0.1	15	yes	N
	Sonchus oleraceus (Common Sowthistle)	0.1	1	no	E
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	0.1	1	no	N
Shrub (SG)	*Maireana spp. (Cotton Bush, Bluebush, Fissure-weed)*	0.1	15	yes	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	50	no	N
	Solanum nigrum (Black-berry Nightshade)	0.1	1	no	E
	Brassica x napus (Rape)	0.1	1	no	E
Shrub (SG)	*Sclerolaena spp. (Copperburr, Poverty-bush)*	0.1	8	no	N
Grass & grasslike (GG)	*Dactyloctenium radulans (Button Grass)*	0.1	5		N
Forb (FG)	*Wahlenbergia spp. (Bluebell)*	0.1	10		N
	Lolium perenne (Perennial Ryegrass)	0.1	1		E
Grass & grasslike (GG)	*Dichanthium spp.*	0.1	1		N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	0.1	5		N
Grass & grasslike (GG)	*Walwhalleya spp.*	0.1	5		N
Grass & grasslike (GG)	*Austrostipa scabra (Speargrass)*	0.1	1	no	N
Shrub (SG)	*Acacia spp. (Wattle)*	0.1	1	no	N

BAM Site – Field Survey Form

Plot ID:	30	**Date:**	26/05/20	**Project number:**	J190417		**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	535,337	**Recorders:**	GS RP			
Zone:	55	**Northing:**	6,275,846	**IBRA region:**	NSW South Western Slopes		**Midline bearing:**	305
Plant Community Type:		26: Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion		**Condition class:**	Planted		**PCT confidence:**	medium
Vegetation Class:		Riverine Plain Woodlands		**EEC:**	no		**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	3
	Shrubs:	7
	Grasses etc.:	9
	Forbs:	9
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	44
	Shrubs:	12.8
	Grasses etc.:	5.8
	Forbs:	1.4
	Ferns:	0
	Other:	0.2
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	3		
20 – 29 cm:	1	Tree hollow count	0
10 – 19 cm:	1		
5 – 9 cm:	0		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	20	40	35	10	25
Average litter cover (%):	26				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Low hillslope

Plot Disturbance

Cleared and revegetated

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	30	**Date:**	26/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Eucalyptus spp.*	8	1	no	N
Tree (TG)	*Eucalyptus melliodora (Yellow Box)*	16	2	no	N
Tree (TG)	*Eucalyptus spp.*	20	3	no	N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	5	50	no	N
Shrub (SG)	*Salsola australis*	5	600	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	5	400	no	N
	Medicago spp. (A Medic)	1	500	no	E
	Echium plantagineum (Patterson's Curse)	1	50	no	E
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	0.1	50	no	N
Shrub (SG)	*Atriplex spp. (A Saltbush)*	0.1	50	no	N
Other (OG)	*Convolvulus spp. (A Bindweed)*	0.2	50	no	N
Forb (FG)	*Oxalis perennans*	0.2	42	no	N
	Avena spp. (Oats)	2	400	no	E
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.1	100	no	N
Grass & grasslike (GG)	*Austrostipa spp. (A Speargrass)*	0.1	100	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	0.1	50	no	N
Grass & grasslike (GG)	*Cyperus spp.*	0.1	5	no	N
Shrub (SG)	*Dodonaea viscosa (Sticky Hop-bush)*	2	3	no	N
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	0.1	15	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	0.1	10	no	N
Forb (FG)	*Dichondra repens (Kidney Weed)*	0.5	100	no	N
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	0.1	25	no	N
Forb (FG)	*Solanum esuriale (Quena)*	0.1	15	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.1	50	no	N
Grass & grasslike (GG)	*Rytidosperma spp.*	0.1	15	no	N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	0.1	15	no	N
	Medicago arabica (Spotted Burr Medic)	0.1	20	no	E
Shrub (SG)	*Rhagodia parabolica*	0.2	7	no	N
Grass & grasslike (GG)	*Echinochloa colona (Awnless Barnyard Grass)*	0.1	5	no	N
Shrub (SG)	*Sclerolaena birchii (Galvinized Burr)*	0.4	30	no	N
Shrub (SG)	*Maireana brevifolia*	0.1	5	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.1	5	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	5	no	N

BAM Site – Field Survey Form

Plot ID:	Plot 017	**Date:**	27/04/21	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	536,732	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,279,794	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	143
Plant Community Type:		26: Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion		**Condition class:**	Medium	**PCT confidence:**	medium
Vegetation Class:		Riverine Plain Woodlands		**EEC:**	yes	**EEC confidence:**	medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	6
	Grasses etc.:	6
	Forbs:	6
	Ferns:	0
	Other:	2
Sum of Cover of native vascular plants by growth form group	Trees:	65
	Shrubs:	32.2
	Grasses etc.:	8.7
	Forbs:	16.4
	Ferns:	0
	Other:	0.2
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	2
80 + cm:	0		
50 – 79 cm:	1		
30 – 49 cm:	0		
20 – 29 cm:	1	Tree hollow count	0
10 – 19 cm:	1		
5 – 9 cm:	1		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	1	10	2	10	10
Average litter cover (%):	6.6				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain slight rise. Moderate to poor drainage. Red brown clay.

Plot Disturbance

Past cleared and grazed

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	Plot 017	**Date:**	27/04/21

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Acacia stenophylla (River Cooba)*	65	26	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	1	100	no	N
Grass & grasslike (GG)	*Sporobolus caroli (Fairy Grass)*	5	600	no	N
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	0.5	30	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	1	100	no	N
Grass & grasslike (GG)	*Carex spp.*	1	50	no	N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	5	60	no	N
Shrub (SG)	*Rhagodia spinescens (Thorny Saltbush)*	14	25	no	N
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	15	2000	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	1	100	no	N
Shrub (SG)	*Atriplex spp. (A Saltbush)*	8	600	no	N
Shrub (SG)	*Sclerolaena birchii (Galvinized Burr)*	5	100	no	N
Forb (FG)	*Boerhavia dominii (Tarvine)*	0.1	6	no	N
Other (OG)	*Amyema spp. (Mistletoe)*	0.1	2	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.1	20	no	N
	Lepidium africanum (Common Peppercress)	0.1	10	no	E
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	5	no	N
Forb (FG)	*Calotis cuneifolia (Purple Burr-Daisy)*	0.1	2	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	0.2	20	no	N
Shrub (SG)	*Maireana spp. (Cotton Bush, Bluebush, Fissure-weed)*	0.1	3	no	N
Forb (FG)	*Dichondra repens (Kidney Weed)*	0.1	10	no	N
Shrub (SG)	*Maireana aphylla (Cotton Bush)*	0.1	4	no	N

BAM Site – Field Survey Form

Plot ID:	C6	**Date:**	17/12/22	**Project number:**	J190417	**Plot dimensions:**	20 x 50 m
Datum:	GDA94	**Easting:**	536,296	**Recorders:**	TO		
Zone:	55	**Northing:**	6,275,564	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	105
Plant Community Type:		26: Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion		**Condition class:**	Medium	**PCT confidence:**	High
Vegetation Class:		Riverine Plain Woodlands		**EEC:**	yes	**EEC confidence:**	high

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	5
	Grasses etc.:	10
	Forbs:	9
	Ferns:	0
	Other:	2
Sum of Cover of native vascular plants by growth form group	Trees:	20
	Shrubs:	7.4
	Grasses etc.:	32.9
	Forbs:	0.6
	Ferns:	0
	Other:	2.05
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	2	Tree hollow count	0
10 – 19 cm:	22		
5 – 9 cm:	5		
< 5 cm:	2		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	50	70	20	20	30
Average litter cover (%):	38				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Plot Disturbance

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	TO	**Plot ID:**	C6	**Date:**	17/12/22

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Acacia pendula (Weeping Myall, Boree)*	20	25		N
Grass & grasslike (GG)	*Austrostipa blackii*	30	3000	yes	N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	2	250		N
Shrub (SG)	*Chenopodium desertorum subsp. anidiophyllum*	5	40	yes	N
Forb (FG)	*Vittadinia cuneata (A Fuzzweed)*	0.01	1		N
Other (OG)	*Amyema quandang var. quandang (Grey Mistletoe)*	2	20	yes	N
Grass & grasslike (GG)	*Rytidosperma caespitosum (Ringed Wallaby Grass)*	0.3	50	yes	N
	Sonchus oleraceus (Common Sowthistle)	0.1	20		E
	Medicago polymorpha (Burr Medic)	0.1	250		E
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	0.1	50		N
Shrub (SG)	*Atriplex semibaccata (Creeping Saltbush)*	0.1	10	yes	N
Forb (FG)	*Dichondra sp. A (Kidney Weed)*	0.2	20		N
Shrub (SG)	*Sclerolaena muricata (Black Rolypoly)*	0.1	20	yes	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	0.5	100		N
	Conyza spp. (A Fleabane)	0.1	10		E
	Lolium rigidum (Wimmera Ryegrass)	5	250		E
Grass & grasslike (GG)	*Chloris truncata (Windmill Grass)*	1	100		N
Forb (FG)	*Euchiton sphaericus (Star Cudweed)*	0.2	20		N
	Trifolium angustifolium (Narrow-leaved Clover)	0.2	10		E
Grass & grasslike (GG)	*Paspalidium gracile (Slender Panic)*	0.2	30		N
	Vulpia muralis (Wall Fescue)	0.1	50		E
	Trifolium glomeratum (Clustered Clover)	0.2	250		E
Grass & grasslike (GG)	*Panicum spp. (Panicum)*	0.1	10		N
Grass & grasslike (GG)	*Austrostipa gibbosa (Speargrass)*	0.2	30	yes	N
	Avena fatua (Wild Oats)	0.1	10		E
Grass & grasslike (GG)	*Austrostipa scabra (Speargrass)*	0.2	20		N
	Lactuca serriola (Prickly Lettuce)	0.01	1		E
	Lepidium africanum (Common Peppercress)	0.05	5		E
Grass & grasslike (GG)	*Sporobolus caroli (Fairy Grass)*	0.1	10		N
Grass & grasslike (GG)	*Walwhalleya proluta*	0.3	50		N
Forb (FG)	*Xerochrysum bracteatum (Golden Everlasting)*	0.01	1		N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.05	5		N
	Sisymbrium erysimoides (Smooth Mustard)	0.01	1		E
	Trifolium arvense (Haresfoot Clover)	0.05	1		E
	Chenopodiaceae indeterminate (Salt-bushes)	0.01	1		E
Shrub (SG)	*Salsola australis*	0.2	50		N
Forb (FG)	*Vittadinia cuneata var. hirsuta*	0.01	1	yes	N
Forb (FG)	*Solanum esuriale (Quena)*	0.01	1		N
Forb (FG)	*Einadia spp.*	0.05	1		N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.01	3		N

BAM Site – Field Survey Form

Plot ID:	Plot 008	**Date:**	29/03/21	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	537,029	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,275,186	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	117
Plant Community Type:		26: Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion		**Condition class:**	High	**PCT confidence:**	high
Vegetation Class:		Riverine Plain Woodlands		**EEC:**	yes	**EEC confidence:**	medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	2
	Shrubs:	6
	Grasses etc.:	8
	Forbs:	12
	Ferns:	0
	Other:	2
Sum of Cover of native vascular plants by growth form group	Trees:	25.1
	Shrubs:	23.5
	Grasses etc.:	51.5
	Forbs:	1.5
	Ferns:	0
	Other:	0.2
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	9
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	1		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	1		
5 – 9 cm:	1		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	10	2	20	10	4
Average litter cover (%):	9.2				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain, very low rise. Red clay, good drainage.

Plot Disturbance

Partial clearing

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	Plot 008	**Date:**	29/03/21

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Sporobolus caroli (Fairy Grass)*	25	2000	no	N
Grass & grasslike (GG)	*Austrostipa scabra (Speargrass)*	20	1500	no	N
Grass & grasslike (GG)	*Rytidosperma caespitosum (Ringed Wallaby Grass)*	0.1	2	no	N
Tree (TG)	*Acacia pendula (Weeping Myall, Boree)*	25	5	no	N
Tree (TG)	*Alectryon oleifolius (Western Rosewood)*	0.1	1	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	5	600	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	1	200	no	N
Forb (FG)	*Oxalis perennans*	0.1	10	no	N
Forb (FG)	*Vittadinia cuneata (A Fuzzweed)*	0.1	30	no	N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	22	200	no	N
Shrub (SG)	*Rhagodia spinescens (Thorny Saltbush)*	0.2	4	no	N
Shrub (SG)	*Sclerolaena birchii (Galvinized Burr)*	0.1	15	no	N
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	0.1	10	no	N
Grass & grasslike (GG)	*Paspalidium jubiflorum (Warrego Grass)*	0.1	20	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	0.2	50	no	N
Shrub (SG)	*Sclerolaena diacantha (Grey Copperburr)*	1	30	no	N
Shrub (SG)	*Salsola australis*	0.1	20	no	N
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	0.3	50	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.1	15	no	N
Forb (FG)	*Solanum esuriale (Quena)*	0.1	10	no	N
Shrub (SG)	*Maireana aphylla (Cotton Bush)*	0.1	10	no	N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	0.2	50	no	N
Forb (FG)	*Portulaca oleracea (Pigweed)*	0.1	2	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.1	13	no	N
	Lepidium africanum (Common Peppercress)	0.1	5	no	E
Forb (FG)	*Vittadinia gracilis (Woolly New Holland Daisy)*	0.1	20	no	N
Forb (FG)	*Dichondra repens (Kidney Weed)*	0.1	20	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.1	13	no	N
Forb (FG)	*Goodenia fascicularis (Mallee Goodenia)*	0.1	2	no	N
Grass & grasslike (GG)	*Carex spp.*	0.1	1	no	N
Other (OG)	*Amyema spp. (Mistletoe)*	0.1	5	no	N

BAM Site – Field Survey Form

Plot ID:	Co013	**Date:**	21/04/22	**Project number:**	J190417	**Plot dimensions:**	20x50
Datum:	GDA94	**Easting:**	537,138	**Recorders:**	KV, SJ		
Zone:	55	**Northing:**	6,275,680	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	250
Plant Community Type:		26: Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion		**Condition class:**	High	**PCT confidence:**	medium
Vegetation Class:		Riverine Plain Woodlands		**EEC:**	yes	**EEC confidence:**	high

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	4
	Grasses etc.:	4
	Forbs:	4
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	15
	Shrubs:	1.6
	Grasses etc.:	30
	Forbs:	0.4
	Ferns:	0
	Other:	0
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	9	Tree hollow count	0
10 – 19 cm:	36		
5 – 9 cm:	7		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	5	15	10	5	5
Average litter cover (%):	8				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Low lying floodplain, orange clays, grassy woodland structure, small patch surrounded by native grassland

Plot Disturbance

None evident

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	KV, SJ	**Plot ID:**	Co013	**Date:**	21/04/22

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Acacia pendula (Weeping Myall, Boree)*	15	5	no	N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	0.5	50	no	N
Shrub (SG)	*Salsola australis*	0.1	25	no	N
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	5	100	no	N
Grass & grasslike (GG)	*Notodanthonia spp.*	10	200	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	10	200	no	N
Shrub (SG)	*Atriplex spp. (A Saltbush)*	0.5	15	yes	N
Shrub (SG)	*Atriplex semibaccata (Creeping Saltbush)*	0.5	40	no	N
Forb (FG)	*Vittadinia sulcata*	0.1	30	no	N
Forb (FG)	*Oxalis perennans*	0.1	50	no	N
Forb (FG)	*Goodenia spp.*	0.1	20	no	N
Forb (FG)	*Sida cunninghamii (Ridge Sida)*	0.1	15	no	N
Grass & grasslike (GG)	*Austrostipa spp. (A Speargrass)*	5	100	no	N

BAM Site – Field Survey Form

Plot ID:	28	**Date:**	22/03/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	537,106	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,275,473	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	198
Plant Community Type:	26: Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion			**Condition class:**	High	**PCT confidence:**	medium
Vegetation Class:	Riverine Plain Woodlands			**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	9
	Grasses etc.:	7
	Forbs:	9
	Ferns:	0
	Other:	2
Sum of Cover of native vascular plants by growth form group	Trees:	10
	Shrubs:	11.5
	Grasses etc.:	5.6
	Forbs:	4.9
	Ferns:	0
	Other:	2.1
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	1		
30 – 49 cm:	1		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	1		
5 – 9 cm:	1		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	95	10	20	30	5
Average litter cover (%):	32				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain

Plot Disturbance

Possibly cleared, grazed in the past. Adjacent to cleared, cropped / grazed paddock

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	28	**Date:**	22/03/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Acacia pendula (Weeping Myall, Boree)*	10	12		N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	3	400		N
Shrub (SG)	*Salsola australis*	2	55		N
Grass & grasslike (GG)	*Sporobolus caroli (Fairy Grass)*	1	10		N
Shrub (SG)	*Rhagodia parabolica*	0.7	8		N
Other (OG)	*Amyema quandang var. quandang (Grey Mistletoe)*	2	13		N
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	0.5	20		N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	4	230		N
Forb (FG)	*Solanum esuriale (Quena)*	0.2	15		N
Forb (FG)	*Goodenia spp.*	0.5	50		N
Forb (FG)	*Goodenia fascicularis (Mallee Goodenia)*	1	400		N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	1	300		N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	1	80		N
Shrub (SG)	*Sclerolaena diacantha (Grey Copperburr)*	3	200		N
Shrub (SG)	*Sclerolaena muricata (Black Rolypoly)*	0.5	10		N
Grass & grasslike (GG)	*Rytidosperma setaceum (Small-flowered Wallaby-grass)*	0.1	20		N
Grass & grasslike (GG)	*Paspalidium jubiflorum (Warrego Grass)*	0.1	2		N
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	0.5	10		N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.1	30		N
Shrub (SG)	*Maireana humillima*	1	80		N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.1	5		N
Shrub (SG)	*Sclerolaena stelligera (Star Copperburr)*	1	50		N
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	0.1	30		N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	0.2	13		N
Shrub (SG)	*Maireana decalvans (Black Cotton Bush)*	0.2	8		N
Grass & grasslike (GG)	*Dactyloctenium radulans (Button Grass)*	0.1	1		N
Shrub (SG)	*Geijera parviflora (Wilga)*	0.1	1		N
	Cucumis myriocarpus subsp. leptodermis (Paddy Melon)	0.1	1		E
Forb (FG)	*Oxalis perennans*	0.1	22		N

BAM Site – Field Survey Form

Plot ID:	27	**Date:**	22/03/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	536,892	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,274,715	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	222
Plant Community Type:		26: Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion		**Condition class:**	High	**PCT confidence:**	medium
Vegetation Class:		Riverine Plain Woodlands		**EEC:**	yes	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	9
	Grasses etc.:	9
	Forbs:	15
	Ferns:	1
	Other:	2
Sum of Cover of native vascular plants by growth form group	Trees:	6
	Shrubs:	4.2
	Grasses etc.:	5.1
	Forbs:	6.7
	Ferns:	0.1
	Other:	2.5
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	16
80 + cm:	0		
50 – 79 cm:	1		
30 – 49 cm:	1		
20 – 29 cm:	1	Tree hollow count	0
10 – 19 cm:	1		
5 – 9 cm:	0		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	15	5	90	20	30
Average litter cover (%):	32				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain

Plot Disturbance

Possible past clearing, grazing, adjacent to cleared and cropped / grazed lands.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	27	**Date:**	22/03/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Acacia pendula (Weeping Myall, Boree)*	6	3	no	N
Shrub (SG)	*Salsola australis*	0.2	10	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	3	105	no	N
Forb (FG)	*Goodenia spp.*	0.1	1	no	N
Shrub (SG)	*Sclerolaena diacantha (Grey Copperburr)*	2	200	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.5	50	no	N
Grass & grasslike (GG)	*Paspalidium jubiflorum (Warrego Grass)*	0.1	15	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.5	50	no	N
Grass & grasslike (GG)	*Rytidosperma setaceum (Small-flowered Wallaby-grass)*	1	100	no	N
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	1	30	no	N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	1	80	no	N
Other (OG)	*Amyema quandang var. quandang (Grey Mistletoe)*	2	4	no	N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	1	50	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	0.2	12	no	N
Forb (FG)	*Goodenia fascicularis (Mallee Goodenia)*	1	150	no	N
Shrub (SG)	*Sclerolaena muricata (Black Rolypoly)*	0.5	20	no	N
	Cyperaceae indeterminate (Sedges)	0.1	6	no	E
Fern (EG)	*Cheilanthes sieberi (Rock Fern)*	0.1	12	no	N
Grass & grasslike (GG)	*Sporobolus caroli (Fairy Grass)*	0.4	20	no	N
	Cucumis myriocarpus subsp. leptodermis (Paddy Melon)	0.1	1	no	E
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.1	10	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.5	20	no	N
	Brassica napus (Canola)	0.1	1	no	E
	Sonchus oleraceus (Common Sowthistle)	0.1	2	no	E
Grass & grasslike (GG)	*Panicum spp. (Panicum)*	0.1	10	no	N
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	1	100	no	N
Shrub (SG)	*Acacia spp. (Wattle)*	0.1	1	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	0.1	1	no	N
Forb (FG)	*Oxalis perennans*	0.1	7	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	1	no	N
Forb (FG)	*Leptorhynchos squamatus (Scaly Buttons)*	0.5	25	no	N
Shrub (SG)	*Geijera parviflora (Wilga)*	0.1	1	no	N
Forb (FG)	*Solanum esuriale (Quena)*	0.5	15	no	N
Grass & grasslike (GG)	*Carex spp.*	0.1	1	no	N
Forb (FG)	*Goodenia spp.*	0.1	5	no	N
Forb (FG)	*Alternanthera denticulata (Lesser Joyweed)*	0.1	2	no	N
Forb (FG)	*Portulaca oleracea (Pigweed)*	0.1	10	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	0.1	4	no	N
Shrub (SG)	*Maireana decalvans (Black Cotton Bush)*	0.1	1	no	N
Shrub (SG)	*Maireana humillima*	0.1	1	no	N
Shrub (SG)	*Sclerolaena birchii (Galvinized Burr)*	0.1	1	no	N

BAM Site – Field Survey Form

Plot ID:	26	**Date:**	19/03/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	536,457	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,279,855	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	26
Plant Community Type:		26: Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion		**Condition class:**	High	**PCT confidence:**	medium
Vegetation Class:		Riverine Plain Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	7
	Grasses etc.:	4
	Forbs:	11
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	45
	Shrubs:	16.7
	Grasses etc.:	8.6
	Forbs:	15.2
	Ferns:	0
	Other:	0.5
High Threat Weed cover:		0.1

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	7
80 + cm:	0		
50 – 79 cm:	1		
30 – 49 cm:	1		
20 – 29 cm:	1	Tree hollow count	0
10 – 19 cm:	1		
5 – 9 cm:	0		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	75	25	50	60	20
Average litter cover (%):	46				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain, gilgai

Plot Disturbance

Likely limited disturbance recent past

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	26	**Date:**	19/03/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Acacia pendula (Weeping Myall, Boree)*	45	13		N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	3	50		N
Shrub (SG)	*Salsola australis*	2	50		N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	5	50		N
Shrub (SG)	*Sclerolaena diacantha (Grey Copperburr)*	5	50		N
Grass & grasslike (GG)	*Sporobolus caroli (Fairy Grass)*	3	20		N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.1	20		N
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	5	20		N
Shrub (SG)	*Sclerolaena muricata (Black Rolypoly)*	5	80		N
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	5	50		N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	1	23		N
Forb (FG)	*Oxalis perennans*	0.1	3		N
Forb (FG)	*Boerhavia dominii (Tarvine)*	0.2	20		N
Forb (FG)	*Dichondra repens (Kidney Weed)*	0.1	5		N
Forb (FG)	*Leptorhynchos spp.*	0.1	2		N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	3	25		N
Shrub (SG)	*Rhagodia spinescens (Thorny Saltbush)*	1.5	3		N
Shrub (SG)	*Maireana spp. (Cotton Bush, Bluebush, Fissure-weed)*	0.1	1		N
	Lycium ferocissimum (African Boxthorn)	0.1	1		HTE
Other (OG)	*Amyema quandang var. quandang (Grey Mistletoe)*	0.5	1		N
Shrub (SG)	*Eremophila spp.*	0.1	1		N
Forb (FG)	*Goodenia fascicularis (Mallee Goodenia)*	0.5	100		N
Grass & grasslike (GG)	*Carex spp.*	0.5	100		N
Grass & grasslike (GG)	*Rytidosperma spp.*	0.1	50		N
Forb (FG)	*Vittadinia cuneata (A Fuzzweed)*	0.1	1		N

BAM Site – Field Survey Form

Plot ID:	29	**Date:**	25/05/20	**Project number:**	J190417	**Plot dimensions:**	20 X 50
Datum:	GDA94	**Easting:**	536,242	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,279,868	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	221
Plant Community Type:		26: Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion		**Condition class:**	High	**PCT confidence:**	medium
Vegetation Class:		Riverine Plain Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	5
	Grasses etc.:	9
	Forbs:	19
	Ferns:	0
	Other:	2
Sum of Cover of native vascular plants by growth form group	Trees:	20
	Shrubs:	10.5
	Grasses etc.:	54.7
	Forbs:	4.8
	Ferns:	0
	Other:	1.5
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	23
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	5		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	1		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	55	5	50	15	20
Average litter cover (%):	29				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain

Plot Disturbance

Grazed

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	29	**Date:**	25/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Acacia pendula (Weeping Myall, Boree)*	20	2	no	N
Other (OG)	*Amyema pendula*	1	6	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	25	400	no	N
Grass & grasslike (GG)	*Sporobolus caroli (Fairy Grass)*	25	400	no	N
	Medicago arabica (Spotted Burr Medic)	25	4000	no	E
Shrub (SG)	*Sclerolaena muricata (Black Rolypoly)*	10	100	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	0.5	25	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	0.5	50	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	0.1	15	no	N
Shrub (SG)	*Salsola australis*	0.1	40	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	50	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	1	100	no	N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	0.1	50	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.5	50	no	N
	Echium plantagineum (Patterson's Curse)	0.1	10	no	E
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.2	175	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.2	80	no	N
Forb (FG)	*Calotis hispidula (Bogan Flea)*	1	100	no	N
Shrub (SG)	*Atriplex spp. (A Saltbush)*	0.2	25	no	N
Forb (FG)	*Goodenia fascicularis (Mallee Goodenia)*	0.1	25	no	N
Shrub (SG)	*Maireana spp. (Cotton Bush, Bluebush, Fissure-weed)*	0.1	75	no	N
Forb (FG)	*Plantago varia*	0.1	25	no	N
Grass & grasslike (GG)	*Paspalidium jubiflorum (Warrego Grass)*	0.2	50	no	N
	Lolium perenne (Perennial Ryegrass)	0.2	30	no	E
	Hypochaeris glabra (Smooth Catsear)	0.1	6	no	E
Forb (FG)	*Goodenia pinnatifida (Scrambles Eggs)*	0.1	5		N
Forb (FG)	*Heliotropium spp. (A Heliotrope)*	0.8	400		N
Grass & grasslike (GG)	*Cyperus spp.*	3	30		N
	Cucumis myriocarpus subsp. leptodermis (Paddy Melon)	0.1	10		E
Forb (FG)	*Solanum esuriale (Quena)*	0.2	50		N
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	0.2	50		N
	Brassica rapa subsp. campestris (Turnip)	0.1	10		E
Forb (FG)	*Portulaca oleracea (Pigweed)*	0.1	3		N
Forb (FG)	*Oxalis perennans*	0.1	50		N
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	0.1	20		N
Forb (FG)	*Crassula sieberiana (Australian Stonecrop)*	0.2	200		N
Shrub (SG)	*Rhagodia parabolica*	0.1	25		N
Forb (FG)	*Rumex brownii (Swamp Dock)*	0.1	2		N
	Solanum nigrum (Black-berry Nightshade)	0.1	5		E
Forb (FG)	*Ptilotus spp.*	0.1	5		N
Forb (FG)	*Lepidium spp. (A Peppercress)*	0.1	3		N
Forb (FG)	*Calocephalus spp.*	0.1	1		N

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	29	**Date:**	25/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Echinochloa colona (Awnless Barnyard Grass)*	0.2	50		N

BAM Site – Field Survey Form

Plot ID:	36	**Date:**	23/03/20	**Project number:**	J190417			**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	538,162	**Recorders:**	GS RP				
Zone:	55	**Northing:**	6,279,795	**IBRA region:**	NSW South Western Slopes			**Midline bearing:**	346
Plant Community Type:			53: Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains			**Condition class:**	Medium	**PCT confidence:**	medium
Vegetation Class:			Inland Floodplain Swamps			**EEC:**	yes	**EEC confidence:**	medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	0
	Grasses etc.:	2
	Forbs:	5
	Ferns:	1
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	0
	Grasses etc.:	81
	Forbs:	6.9
	Ferns:	0.1
	Other:	0
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	90	95	95	90	95
Average litter cover (%):	93				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain / floodplain / ephemeral inland lake

Plot Disturbance

Grazed / possible cropping.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	36	**Date:**	23/03/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Forb (FG)	*Glycyrrhiza acanthocarpa (Native Liquorice)*	0.7	20	no	N
Grass & grasslike (GG)	*Sporobolus mitchellii (Rat's Tail Couch)*	80	4000	no	N
	Medicago polymorpha (Burr Medic)	10	600	no	E
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	5	400	no	N
Grass & grasslike (GG)	*Eragrostis australasica (Canegrass)*	1	10	no	N
	Solanum nigrum (Black-berry Nightshade)	0.1	2	no	E
	Onopordum acanthium subsp. acanthium (Scotch Thistle)	0.1	3	no	E
	Poaceae indeterminate (Grasses, reeds and bamboos)	0.1	10	no	E
Forb (FG)	*Sida corrugata (Corrugated Sida)*	1	100	no	N
	Abutilon grandifolium	0.1	1	no	E
Fern (EG)	*Marsilea costulifera*	0.1	1	no	N
Forb (FG)	*Alternanthera denticulata (Lesser Joyweed)*	0.1	1	no	N
Forb (FG)	*Rumex tenax (Shiny Dock)*	0.1	1	no	N

BAM Site – Field Survey Form

Plot ID:	34	**Date:**	20/05/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	537,461	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,280,108	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	157
Plant Community Type:		53: Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains		**Condition class:**	Medium	**PCT confidence:**	medium
Vegetation Class:		Inland Floodplain Swamps		**EEC:**	no	**EEC confidence:**	medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	1
	Grasses etc.:	2
	Forbs:	4
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	4
	Shrubs:	0.1
	Grasses etc.:	75
	Forbs:	1.7
	Ferns:	0
	Other:	0
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	35		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	20	15	20	10	35
Average litter cover (%):	20				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Ephemeral lake bed

Plot Disturbance

Grazed

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	34	**Date:**	20/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Eragrostis australasica (Canegrass)*	10	200	no	N
Grass & grasslike (GG)	*Sporobolus mitchellii (Rat's Tail Couch)*	65	600	no	N
	Trifolium spp. (A Clover)	85	10000		E
Tree (TG)	*Eucalyptus camaldulensis (River Red Gum)*	4	35		N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	0.2	10	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	5	no	N
Forb (FG)	*Glycyrrhiza acanthocarpa (Native Liquorice)*	0.4	12	no	N
	Chenopodium album (Fat Hen)	8	800	no	E
Forb (FG)	*Sida corrugata (Corrugated Sida)*	1	80	no	N
Shrub (SG)	*Duma florulenta (Lignum)*	0.1	8	no	N
	Solanum nigrum (Black-berry Nightshade)	0.1	5	no	E
	Malva parviflora (Small-flowered Mallow)	8	50	no	E
	Sonchus oleraceus (Common Sowthistle)	0.1	1	no	E
	Cirsium vulgare (Spear Thistle)	0.1	1	no	E

BAM Site – Field Survey Form

Plot ID:	35	**Date:**	21/05/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	538,196	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,278,753	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	115
Plant Community Type:		53: Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains		**Condition class:**	Medium	**PCT confidence:**	medium
Vegetation Class:		Inland Floodplain Swamps		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	1
	Grasses etc.:	5
	Forbs:	4
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	0.1
	Grasses etc.:	66.3
	Forbs:	2.3
	Ferns:	0
	Other:	0.1
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	30	30	20	25	15
Average litter cover (%):	24				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Ephemeral lake bed

Plot Disturbance

Grazed

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	35	**Date:**	21/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
	Medicago polymorpha (Burr Medic)	90	50000	no	E
Grass & grasslike (GG)	*Sporobolus mitchellii (Rat's Tail Couch)*	60	5000	no	N
Grass & grasslike (GG)	*Eragrostis australasica (Canegrass)*	6	100	no	N
Forb (FG)	*Polygonum plebeium (Small Knotweed)*	0.1	10	no	N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	1	30	no	N
Forb (FG)	*Glycyrrhiza acanthocarpa (Native Liquorice)*	0.2	15	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	1	75	no	N
Shrub (SG)	*Abutilon spp. (Lantern-bush)*	0.1	5	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.1	5	no	N
	Sonchus oleraceus (Common Sowthistle)	0.1	6	no	E
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	0.1	9	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	0.1	20	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	0.1	3	no	N

BAM Site – Field Survey Form

Plot ID:	38	**Date:**	22/05/20	**Project number:**	J190417		**Plot dimensions:**	20x50
Datum:	GDA94	**Easting:**	538,694	**Recorders:**	RP GS			
Zone:	55	**Northing:**	6,276,561	**IBRA region:**	NSW South Western Slopes		**Midline bearing:**	35
Plant Community Type:		53: Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains		**Condition class:**	Medium		**PCT confidence:**	medium
Vegetation Class:		Inland Floodplain Swamps		**EEC:**	no		**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	0
	Grasses etc.:	1
	Forbs:	3
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	0
	Grasses etc.:	99
	Forbs:	2.2
	Ferns:	0
	Other:	0
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	60	60	60	60	60
Average litter cover (%):	60				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Lake bed. Ephemeral.

Plot Disturbance

No evidence. Grazed by kangaroos and emus.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	RP GS	**Plot ID:**	38	**Date:**	22/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Sporobolus mitchellii (Rat's Tail Couch)*	99	16000	no	N
Forb (FG)	*Glycyrrhiza acanthocarpa (Native Liquorice)*	2	60	no	N
	Medicago polymorpha (Burr Medic)	0.1	200	no	E
	Abutilon grandifolium	0.1	25	no	E
	Cirsium vulgare (Spear Thistle)	0.1	2	no	E
	Sonchus oleraceus (Common Sowthistle)	0.1	5	no	E
Forb (FG)	*Polygonum plebeium (Small Knotweed)*	0.1	30	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.1	1	no	N

BAM Site – Field Survey Form

Plot ID:	39	**Date:**	22/05/20	**Project number:**	J190417	**Plot dimensions:**	20 X 50
Datum:	GDA94	**Easting:**	538,121	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,276,742	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	92
Plant Community Type:		53: Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains		**Condition class:**	Medium	**PCT confidence:**	medium
Vegetation Class:		Inland Floodplain Swamps		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	0
	Grasses etc.:	5
	Forbs:	7
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	0
	Grasses etc.:	105.2
	Forbs:	7.3
	Ferns:	0
	Other:	0
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	70	70	70	70	70
Average litter cover (%):	70				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Ephemeral lake bed

Plot Disturbance

No evidence

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	39	**Date:**	22/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
	Sanguisorba spp.	0.2	20	no	E
Grass & grasslike (GG)	*Walwhalleya proluta*	45	4000	no	N
Grass & grasslike (GG)	*Eragrostis australasica (Canegrass)*	55	4000	no	N
Forb (FG)	*Glycyrrhiza acanthocarpa (Native Liquorice)*	5	10	no	N
	Medicago polymorpha (Burr Medic)	10	1600	no	E
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	1	200	no	N
	Malva parviflora (Small-flowered Mallow)	1	50	no	E
	Lactuca serriola (Prickly Lettuce)	0.1	20	no	E
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.2	30	no	N
	Sonchus oleraceus (Common Sowthistle)	0.2	17	no	E
	Abutilon grandifolium	0.6	7	no	E
Forb (FG)	*Alternanthera denticulata (Lesser Joyweed)*	0.1	15	no	N
Grass & grasslike (GG)	*Sporobolus mitchellii (Rat's Tail Couch)*	5	200	no	N
	Solanum nigrum (Black-berry Nightshade)	0.2	5	no	E
Forb (FG)	*Polygonum plebeium (Small Knotweed)*	0.8	10	no	N
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	0.1	50	no	N
	Cirsium vulgare (Spear Thistle)	0.5	5	no	E
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.1	4	no	N
Grass & grasslike (GG)	*Dichanthium spp.*	0.1	2		N
Forb (FG)	*Solanum esuriale (Quena)*	0.1	5		N

BAM Site – Field Survey Form

Plot ID:	37	**Date:**	23/05/20	**Project number:**	J190417	**Plot dimensions:**	20x20
Datum:	GDA94	**Easting:**	538,528	**Recorders:**	RP GS		
Zone:	55	**Northing:**	6,275,248	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	17
Plant Community Type:		53: Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains		**Condition class:**	Medium	**PCT confidence:**	medium
Vegetation Class:		Inland Floodplain Swamps		**EEC:**	no	**EEC confidence:**	medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	0
	Grasses etc.:	4
	Forbs:	2
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	0
	Grasses etc.:	75.6
	Forbs:	1.5
	Ferns:	0
	Other:	0
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count		
80 + cm:	0	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	35	25	30	30	20
Average litter cover (%):	28				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Within lake cowal (currently dry)

Plot Disturbance

No evidence except very weedy. Previously grazed and maybe cropped. All trees near plot are dead or nearly so.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	RP GS	**Plot ID:**	37	**Date:**	23/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Sporobolus mitchellii (Rat's Tail Couch)*	75	4000	no	N
	Medicago polymorpha (Burr Medic)	80	6000	no	E
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.5	50	no	N
Forb (FG)	*Glycyrrhiza acanthocarpa (Native Liquorice)*	1	14	no	N
	Sonchus oleraceus (Common Sowthistle)	0.2	2	no	E
Grass & grasslike (GG)	*Eragrostis australasica (Canegrass)*	0.4	10	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	0.1	4	no	N
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	0.1	1	no	N

BAM Site – Field Survey Form

Plot ID:	40	**Date:**	22/05/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	538,925	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,277,623	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	148
Plant Community Type:		53: Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains		**Condition class:**	Medium	**PCT confidence:**	medium
Vegetation Class:		Inland Floodplain Swamps		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	1
	Grasses etc.:	2
	Forbs:	6
	Ferns:	0
	Other:	2
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	0.1
	Grasses etc.:	65.4
	Forbs:	11.4
	Ferns:	0
	Other:	0.5
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	10	45	60	35	35
Average litter cover (%):	37				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Ephemeral lake bed

Plot Disturbance

Weedy

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	40	**Date:**	22/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Other (OG)	*Glycine spp.*	0.1	15	no	N
Grass & grasslike (GG)	*Eragrostis australasica (Canegrass)*	65	4000	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.4	350	no	N
	Abutilon grandifolium	10	450	no	E
Forb (FG)	*Glycyrrhiza acanthocarpa (Native Liquorice)*	10	1600	no	N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	0.8	200	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.2	50	no	N
	Sonchus oleraceus (Common Sowthistle)	0.4	7	no	E
	Cirsium vulgare (Spear Thistle)	0.4	3	no	E
	Medicago polymorpha (Burr Medic)	1.2	400	no	E
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.2	60	no	N
Grass & grasslike (GG)	*Sporobolus mitchellii (Rat's Tail Couch)*	0.4	145	no	N
	Lactuca serriola (Prickly Lettuce)	0.1	2	no	E
	Conyza bonariensis (Flaxleaf Fleabane)	0.1	7	no	E
Shrub (SG)	*Salsola australis*	0.1	3	no	N
Forb (FG)	*Rumex brownii (Swamp Dock)*	0.1	2	no	N
Forb (FG)	*Senecio gunnii*	0.1	1	no	N

BAM Site – Field Survey Form

Plot ID:	Plot 009	**Date:**	29/03/21	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	533,492	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,279,951	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	80
Plant Community Type:		55: Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.		**Condition class:**	DNG	**PCT confidence:**	medium
Vegetation Class:		North-west Floodplain Woodlands		**EEC:**	no	**EEC confidence:**	medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	4
	Grasses etc.:	11
	Forbs:	9
	Ferns:	1
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	2.3
	Grasses etc.:	70.9
	Forbs:	7.6
	Ferns:	0.1
	Other:	0.1
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	8	10	10	20	8
Average litter cover (%):	11.2				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain, some small gilgai present. Tan - grey clay soil. Poor drainage.

Plot Disturbance

Cleared and grazed

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	Plot 009	**Date:**	29/03/21

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Austrostipa blackii*	2	80	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	5	500	no	N
Grass & grasslike (GG)	*Austrostipa scabra (Speargrass)*	0.5	50	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	20	2000	no	N
Grass & grasslike (GG)	*Rytidosperma caespitosum (Ringed Wallaby Grass)*	0.1	20	no	N
Grass & grasslike (GG)	*Paspalidium jubiflorum (Warrego Grass)*	20	3000	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.1	20	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	3	400	no	N
Grass & grasslike (GG)	*Sporobolus caroli (Fairy Grass)*	20	3000	no	N
Shrub (SG)	*Salsola australis*	0.1	30	no	N
Shrub (SG)	*Maireana decalvans (Black Cotton Bush)*	2	20	no	N
Forb (FG)	*Vittadinia cuneata (A Fuzzweed)*	1	100	no	N
Fern (EG)	*Marsilea drummondii (Common Nardoo)*	0.1	15	no	N
Forb (FG)	*Oxalis perennans*	0.1	20	no	N
Forb (FG)	*Lobelia concolor (Poison Pratia)*	0.1	20	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.1	15	no	N
Forb (FG)	*Solanum esuriale (Quena)*	0.1	10	no	N
Grass & grasslike (GG)	*Juncus usitatus*	0.1	3	no	N
Grass & grasslike (GG)	*Carex spp.*	0.1	5	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.1	30	no	N
Forb (FG)	*Alternanthera nana (Hairy Joyweed)*	0.1	50	no	N
Shrub (SG)	*Sclerolaena birchii (Galvinized Burr)*	0.1	10	no	N
Shrub (SG)	*Atriplex spp. (A Saltbush)*	0.1	1	no	N
Forb (FG)	*Vittadinia gracilis (Woolly New Holland Daisy)*	1	100	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	5	1000	no	N
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	0.1	10	no	N

BAM Site – Field Survey Form

Plot ID:	43	**Date:**	20/03/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	535,514	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,279,411	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	82
Plant Community Type:		55: Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.		**Condition class:**	DNG	**PCT confidence:**	medium
Vegetation Class:		North-west Floodplain Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	2
	Grasses etc.:	7
	Forbs:	11
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	2.1
	Grasses etc.:	28.3
	Forbs:	30.7
	Ferns:	0
	Other:	5
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	5	2	2	10	10
Average litter cover (%):	5.8				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain

Plot Disturbance

Cleared, grazed / cropped. Placement of long rows and piles of logs.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	43	**Date:**	20/03/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	10	1200	no	N
Forb (FG)	*Dysphania spp.*	5	1600	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	5	400	no	N
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	5	1600	no	N
Forb (FG)	*Dichondra repens (Kidney Weed)*	5	10000	no	N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	10	4000	no	N
Shrub (SG)	*Sclerolaena muricata (Black Rolypoly)*	0.1	5	no	N
	Echium vulgare (Viper's Bugloss)	3	400	no	E
	Cyperaceae indeterminate (Sedges)	0.1	9	no	E
Forb (FG)	*Sida corrugata (Corrugated Sida)*	5	100	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	5	4	no	N
Shrub (SG)	*Salsola australis*	2	4	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	5	20	no	N
Forb (FG)	*Boerhavia dominii (Tarvine)*	0.1	1	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	5	50	no	N
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	0.1	4	no	N
Forb (FG)	*Solanum esuriale (Quena)*	0.2	20	no	N
	Cucumis myriocarpus subsp. leptodermis (Paddy Melon)	0.1	1	no	E
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	0.1	1	no	N
Forb (FG)	*Oxalis perennans*	0.1	1	no	N
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	0.1	1	no	N
Grass & grasslike (GG)	*Carex spp.*	0.2	4	no	N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	0.1	4	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	3	100	no	N

BAM Site – Field Survey Form

Plot ID:	49	**Date:**	19/03/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	534,437	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,279,863	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	252
Plant Community Type:		55: Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.		**Condition class:**	DNG	**PCT confidence:**	low
Vegetation Class:		North-west Floodplain Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	3
	Grasses etc.:	7
	Forbs:	12
	Ferns:	1
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	1.6
	Grasses etc.:	58.1
	Forbs:	53.8
	Ferns:	0.1
	Other:	10
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	**Tree stem count**		
80 + cm:	0	**Length of logs (m) (≥10 cm diameter, >50 cm in length)**	0
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	**Tree hollow count**	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	**1**	**2**	**3**	**4**	**5**
Subplot score (%):	1	1	2	1	1
Average litter cover (%):	1.2				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain

Plot Disturbance

Cleared, cropped/grazed in past

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	49	**Date:**	19/03/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	15	400	no	N
Shrub (SG)	*Salsola australis*	1	66	no	N
Forb (FG)	*Solanum esuriale (Quena)*	1	50	no	N
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	8	100	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	20	10000	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	10	1600	no	N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	10	5000	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	5	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	5	100	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	5	200	no	N
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	5	50	no	N
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	8	150	no	N
	Cyperaceae indeterminate (Sedges)	0.1	5	no	E
Grass & grasslike (GG)	*Paspalidium jubiflorum (Warrego Grass)*	20	1600	no	N
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	5	200	no	N
Forb (FG)	*Einadia hastata (Berry Saltbush)*	5	500	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	4	80	no	N
Forb (FG)	*Boerhavia dominii (Tarvine)*	0.1	5	no	N
Forb (FG)	*Alternanthera nana (Hairy Joyweed)*	0.1	4	no	N
Forb (FG)	*Goodenia fascicularis (Mallee Goodenia)*	0.3	50	no	N
Shrub (SG)	*Maireana brevifolia*	0.3	4	no	N
Shrub (SG)	*Sclerolaena muricata (Black Rolypoly)*	0.3	5	no	N
Forb (FG)	*Wahlenbergia spp. (Bluebell)*	0.2	30	no	N
	Echium vulgare (Viper's Bugloss)	0.1	1	no	E
Fern (EG)	*Cheilanthes sieberi (Rock Fern)*	0.1	1	no	N
Grass & grasslike (GG)	*Chloris truncata (Windmill Grass)*	0.1	1	no	N

BAM Site – Field Survey Form

Plot ID:	41	**Date:**	22/05/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	536,150	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,279,621	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	49
Plant Community Type:		55: Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.		**Condition class:**	DNG	**PCT confidence:**	medium
Vegetation Class:		North-west Floodplain Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	4
	Grasses etc.:	7
	Forbs:	9
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	2.1
	Grasses etc.:	44.9
	Forbs:	6
	Ferns:	0
	Other:	1
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	5	10	10	5	10
Average litter cover (%):	8				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain

Plot Disturbance

Cleared grazed

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	41	**Date:**	22/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	15	1600	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	15	1600	no	N
	Medicago arabica (Spotted Burr Medic)	40	3400	no	E
Forb (FG)	*Solanum esuriale (Quena)*	0.4	100	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	1	200	no	N
Grass & grasslike (GG)	*Sporobolus caroli (Fairy Grass)*	5	400		N
Grass & grasslike (GG)	*Walwhalleya proluta*	5	100		N
	Echium plantagineum (Patterson's Curse)	0.1	5		E
	Sonchus oleraceus (Common Sowthistle)	0.8	10		E
Shrub (SG)	*Salsola australis*	0.4	15		N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	4	150		N
Shrub (SG)	*Maireana humillima*	0.8	15		N
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	0.4	25		N
	Poaceae indeterminate (Grasses, reeds and bamboos)	0.5	7		E
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	2	200		N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	2	200		N
Grass & grasslike (GG)	*Paspalidium jubiflorum (Warrego Grass)*	0.5	30		N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.6	30		N
	Medicago spp. (A Medic)	0.1	6		E
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	0.4	50		N
Forb (FG)	*Erodium spp. (Crowfoot)*	0.1	20		N
Forb (FG)	*Lobelia concolor (Poison Pratia)*	0.1	5		N
Shrub (SG)	*Sclerolaena spp. (Copperburr, Poverty-bush)*	0.8	50		N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.1	30		N
Shrub (SG)	*Sclerolaena spp. (Copperburr, Poverty-bush)*	0.1	6		N
Forb (FG)	*Goodenia fascicularis (Mallee Goodenia)*	0.3	100		N

BAM Site – Field Survey Form

Plot ID:	42	**Date:**	23/05/20	**Project number:**	J190417	**Plot dimensions:**	20 X 50
Datum:	GDA94	**Easting:**	537,783	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,275,241	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	14
Plant Community Type:		55: Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.		**Condition class:**	DNG	**PCT confidence:**	medium
Vegetation Class:		North-west Floodplain Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	3
	Grasses etc.:	11
	Forbs:	16
	Ferns:	1
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	5.4
	Grasses etc.:	61.7
	Forbs:	10.3
	Ferns:	0.6
	Other:	1.2
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	5	5	10	10	5
Average litter cover (%):	7				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain with gilgai adjacent

Plot Disturbance

Cleared

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	42	**Date:**	23/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	22	4000	no	N
Grass & grasslike (GG)	*Paspalidium jubiflorum (Warrego Grass)*	18	2000	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	10	1000	no	N
Grass & grasslike (GG)	*Rytidosperma spp.*	4	250	no	N
Grass & grasslike (GG)	*Echinochloa colona (Awnless Barnyard Grass)*	3	250	no	N
Shrub (SG)	*Sclerolaena muricata (Black Rolypoly)*	5	250	no	N
Forb (FG)	*Dichondra repens (Kidney Weed)*	1	2000	no	N
Forb (FG)	*Alternanthera denticulata (Lesser Joyweed)*	1	400	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	1.2	300	no	N
	Brassica rapa subsp. campestris (Turnip)	0.4	6	no	E
	Medicago polymorpha (Burr Medic)	1.2	200	no	E
Forb (FG)	*Goodenia fascicularis (Mallee Goodenia)*	1	250	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.4	300	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	1.2	300	no	N
	Lolium perenne (Perennial Ryegrass)	0.2	15	no	E
Grass & grasslike (GG)	*Sporobolus mitchellii (Rat's Tail Couch)*	0.8	10	no	N
Forb (FG)	*Rumex brownii (Swamp Dock)*	0.1	3	no	N
Forb (FG)	*Plectranthus spp.*	0.1	5	no	N
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	0.2	8	no	N
Forb (FG)	*Wahlenbergia spp. (Bluebell)*	0.1	5	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	0.1	2	no	N
	Trifolium spp. (A Clover)	0.8	15	no	E
Grass & grasslike (GG)	*Rytidosperma spp.*	1.6	50	yes	N
Grass & grasslike (GG)	*Cyperus spp.*	1.2	60	yes	N
Grass & grasslike (GG)	*Walwhalleya proluta*	0.8	30	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.8	600	no	N
	Echium plantagineum (Patterson's Curse)	0.2	3	no	E
Forb (FG)	*Asperula conferta (Common Woodruff)*	0.4	50	no	N
Forb (FG)	*Calostemma purpureum (Garland Lily)*	0.1	1	no	N
Forb (FG)	*Lobelia concolor (Poison Pratia)*	2.9	55	no	N
Fern (EG)	*Marsilea spp. (A Nardoo)*	0.6	100	no	N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	0.4	15	no	N
Forb (FG)	*Oxalis perennans*	0.2	50	no	N
Shrub (SG)	*Sclerolaena birchii (Galvinized Burr)*	0.1	4	yes	N
Forb (FG)	*Solanum esuriale (Quena)*	0.5	50	no	N
	Hypochaeris glabra (Smooth Catsear)	0.1	15	no	E
	Sonchus oleraceus (Common Sowthistle)	0.2	10	no	E
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.1	400	no	N
Shrub (SG)	*Maireana brevifolia*	0.3	5	no	N

BAM Site – Field Survey Form

Plot ID:	46	**Date:**	24/05/20	**Project number:**	J190417	**Plot dimensions:**	20 X 50
Datum:	GDA94	**Easting:**	535,618	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,276,354	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	156
Plant Community Type:		55: Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.		**Condition class:**	DNG	**PCT confidence:**	medium
Vegetation Class:		North-west Floodplain Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	2
	Grasses etc.:	12
	Forbs:	13
	Ferns:	1
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	1.1
	Grasses etc.:	78.2
	Forbs:	61
	Ferns:	0.2
	Other:	0.4
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	15	15	15	15	10
Average litter cover (%):	14				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain

Plot Disturbance

Cleared

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	46	**Date:**	24/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	45	200	no	N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	22	400	no	N
	Medicago polymorpha (Burr Medic)	22	400	no	E
Forb (FG)	*Hibiscus trionum (Flower-of-an-hour)*	15	1600	no	N
	Avena spp. (Oats)	15	4000	no	E
Grass & grasslike (GG)	*Walwhalleya proluta*	5	100	no	N
Grass & grasslike (GG)	*Paspalidium jubiflorum (Warrego Grass)*	15	400	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	15	1600	no	N
Forb (FG)	*Goodenia fascicularis (Mallee Goodenia)*	0.2	75	no	N
Grass & grasslike (GG)	*Dichanthium spp.*	0.1	7	no	N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	0.1	15	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	1	1000	no	N
Forb (FG)	*Erodium spp. (Crowfoot)*	5	800	no	N
Forb (FG)	*Oxalis perennans*	0.5	50	no	N
Grass & grasslike (GG)	*Echinochloa colona (Awnless Barnyard Grass)*	5	200	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	5	80	no	N
	Sonchus oleraceus (Common Sowthistle)	0.1	7	no	E
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	1	50	no	N
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	0.6	60	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.4	50	no	N
Forb (FG)	*Solanum esuriale (Quena)*	0.5	60	no	N
Forb (FG)	*Crassula sieberiana (Australian Stonecrop)*	1	10000		N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.2	50		N
	Medicago arabica (Spotted Burr Medic)	22	4000		E
Shrub (SG)	*Maireana brevifolia*	0.4	5		N
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	0.1	10		N
Grass & grasslike (GG)	*Aristida spp. (A Wiregrass)*	0.2	15		N
Shrub (SG)	*Atriplex spp. (A Saltbush)*	0.7	20		N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	1	50		N
Fern (EG)	*Cheilanthes sieberi (Rock Fern)*	0.2	50		N
	Brassica rapa subsp. campestris (Turnip)	0.1	5		E
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.4	600		N
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	0.1	20		N
Grass & grasslike (GG)	*Sporobolus caroli (Fairy Grass)*	0.2	30		N

BAM Site – Field Survey Form

Plot ID:	45	**Date:**	24/05/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	536,685	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,275,873	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	170
Plant Community Type:		55: Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.		**Condition class:**	Dng	**PCT confidence:**	medium
Vegetation Class:		North-west Floodplain Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	3
	Grasses etc.:	13
	Forbs:	11
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	3.2
	Grasses etc.:	102.5
	Forbs:	17.4
	Ferns:	0
	Other:	1
High Threat Weed cover:		0.8

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	20	15	5	55	15
Average litter cover (%):	22				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain

Plot Disturbance

Cleared, previously grazed

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	45	**Date:**	24/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
	Avena spp. (Oats)	30	200	no	E
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	40	800	no	N
	Medicago polymorpha (Burr Medic)	30	4000	no	E
Grass & grasslike (GG)	*Cyperus spp.*	10	50	no	N
Grass & grasslike (GG)	*Sporobolus caroli (Fairy Grass)*	10	100	no	N
Forb (FG)	*Erodium spp. (Crowfoot)*	7	400	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	1	400	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	5	400	no	N
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	1	50	no	N
	Xanthium spinosum (Bathurst Burr)	0.8	50	no	HTE
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	1	100	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.4	900	no	N
Grass & grasslike (GG)	*Echinochloa colona (Awnless Barnyard Grass)*	15	500	no	N
	Sonchus oleraceus (Common Sowthistle)	0.2	8	no	E
Grass & grasslike (GG)	*Walwhalleya proluta*	15	100	no	N
	Brassica rapa subsp. campestris (Turnip)	1	25	no	E
Forb (FG)	*Plantago varia*	0.5	60	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	1	75	no	N
Forb (FG)	*Oxalis perennans*	0.1	15	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	1	1001	no	N
Shrub (SG)	*Maireana spp. (Cotton Bush, Bluebush, Fissure-weed)*	0.1	10	no	N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	3	40	no	N
	Lolium perenne (Perennial Ryegrass)	0.4	15	no	E
Grass & grasslike (GG)	*Paspalidium jubiflorum (Warrego Grass)*	10	100	no	N
Grass & grasslike (GG)	*Dichanthium spp.*	0.1	7	no	N
Forb (FG)	*Solanum esuriale (Quena)*	0.5	50	no	N
	Hypochaeris glabra (Smooth Catsear)	0.1	7	no	E
Shrub (SG)	*Maireana spp. (Cotton Bush, Bluebush, Fissure-weed)*	0.1	5	no	N
Forb (FG)	*Hibiscus trionum (Flower-of-an-hour)*	0.1	10	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	0.1	3		N
Grass & grasslike (GG)	*Isolepis spp. (Club-rush)*	0.1	10		N
	Restionaceae indeterminate (Southern rushes)	0.1	10		E
Forb (FG)	*Lobelia concolor (Poison Pratia)*	1	50		N
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	0.1	2		N
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	0.1	5		N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	0.8	20		N

BAM Site – Field Survey Form

Plot ID:	48	**Date:**	25/05/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	535,872	**Recorders:**	RP GS		
Zone:	55	**Northing:**	6,280,250	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	243
Plant Community Type:		55: Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.		**Condition class:**	DNG	**PCT confidence:**	medium
Vegetation Class:		North-west Floodplain Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	3
	Grasses etc.:	7
	Forbs:	8
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	11.1
	Grasses etc.:	160
	Forbs:	9.9
	Ferns:	0
	Other:	12
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	5	5	5	5	5
Average litter cover (%):	5				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain

Plot Disturbance

Cleared and grazed

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	RP GS	**Plot ID:**	48	**Date:**	25/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	60	800	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	40	400	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	30	800	no	N
Shrub (SG)	*Salsola australis*	10	300	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	12	1000	no	N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	3	100	no	N
Shrub (SG)	*Sclerolaena muricata (Black Rolypoly)*	1	80	no	N
Forb (FG)	*Crassula sieberiana (Australian Stonecrop)*	0.4	400	no	N
Shrub (SG)	*Maireana spp. (Cotton Bush, Bluebush, Fissure-weed)*	0.1	50	no	N
Grass & grasslike (GG)	*Paspalidium jubiflorum (Warrego Grass)*	25	800	no	N
Grass & grasslike (GG)	*Echinochloa colona (Awnless Barnyard Grass)*	1	250	no	N
Forb (FG)	*Alternanthera denticulata (Lesser Joyweed)*	0.6	250	no	N
	Echium plantagineum (Patterson's Curse)	0.1	5	no	E
Forb (FG)	*Dichondra repens (Kidney Weed)*	0.5	200	no	N
	Sisymbrium officinale (Hedge Mustard)	0.2	15	no	E
	Restionaceae indeterminate (Southern rushes)	0.2	100	no	E
Forb (FG)	*Goodenia fascicularis (Mallee Goodenia)*	5	550	no	N
Forb (FG)	*Hypoxis exilis (Swamp Star)*	0.1	25	no	N
Forb (FG)	*Solanum esuriale (Quena)*	0.2	50		N
	Hypochaeris glabra (Smooth Catsear)	0.1	15		E
	Medicago arabica (Spotted Burr Medic)	5	100		E
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	3	80		N
Grass & grasslike (GG)	*Aristida ramosa (Purple Wiregrass)*	1	100		N
	Sonchus oleraceus (Common Sowthistle)	0.1	10		E
	Restionaceae indeterminate (Southern rushes)	0.1	10		E
Forb (FG)	*Plantago varia*	0.1	5		N

BAM Site – Field Survey Form

Plot ID:	50	**Date:**	25/05/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	535,070	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,280,103	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	330
Plant Community Type:		55: Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.		**Condition class:**	DNG	**PCT confidence:**	medium
Vegetation Class:		North-west Floodplain Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	2
	Grasses etc.:	8
	Forbs:	12
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	0.4
	Grasses etc.:	82.3
	Forbs:	88.9
	Ferns:	0
	Other:	1
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	5	10	5	5	15
Average litter cover (%):	8				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain, Casurina and Wilga paddock trees nearby

Plot Disturbance

Cleared and grazed

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	50	**Date:**	25/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	75	4000	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	40	800	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	30	600	no	N
Forb (FG)	*Dichondra repens (Kidney Weed)*	8	8000	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	2	2000	no	N
Forb (FG)	*Alternanthera denticulata (Lesser Joyweed)*	0.1	15	no	N
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	1	200	no	N
Forb (FG)	*Polygonum plebeium (Small Knotweed)*	0.1	25	no	N
Grass & grasslike (GG)	*Echinochloa colona (Awnless Barnyard Grass)*	1	400	no	N
Forb (FG)	*Calotis hispidula (Bogan Flea)*	1	150	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.4	150	no	N
Forb (FG)	*Crassula sieberiana (Australian Stonecrop)*	1	8000	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	1	200	no	N
Shrub (SG)	*Salsola australis*	0.2	75	no	N
Shrub (SG)	*Sclerolaena muricata (Black Rolypoly)*	0.2	30	no	N
	Echium vulgare (Viper's Bugloss)	0.2	2	no	E
	Lolium perenne (Perennial Ryegrass)	0.2	40	no	E
	Lepidium africanum (Common Peppercress)	0.1	15	no	E
	Sisymbrium irio (London Rocket)	0.3	12		E
Grass & grasslike (GG)	*Cyperus spp.*	0.1	3		N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	0.8	50		N
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	0.3	80		N
Forb (FG)	*Rumex brownii (Swamp Dock)*	0.1	5		N
Grass & grasslike (GG)	*Paspalidium jubiflorum (Warrego Grass)*	10	300		N
Grass & grasslike (GG)	*Bothriochloa macra (Red Grass)*	0.1	10		N
Forb (FG)	*Wahlenbergia spp. (Bluebell)*	0.1	50		N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	0.1	10		N

BAM Site – Field Survey Form

Plot ID:	51	**Date:**	25/05/20	**Project number:**	J190417	**Plot dimensions:**	20x20
Datum:	GDA94	**Easting:**	535,752	**Recorders:**	RP GS		
Zone:	55	**Northing:**	6,280,039	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	7
Plant Community Type:		55: Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.		**Condition class:**	DNG	**PCT confidence:**	medium
Vegetation Class:		North-west Floodplain Woodlands		**EEC:**	yes	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	4
	Grasses etc.:	7
	Forbs:	14
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	8.1
	Grasses etc.:	72.2
	Forbs:	19.2
	Ferns:	0
	Other:	1
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	2	2	2	5	10
Average litter cover (%):	4.2				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Flat. Alluvial plain. Veg zone changed to high. Lower forb diversity due mainly to season, not to poorer quality land. Maybe change PCT 26 (The Weeping Myall) based on nearest trees. Far off trees look like euxalypts.

Plot Disturbance

Grazed. Historically logged.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	RP GS	**Plot ID:**	51	**Date:**	25/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	25	400	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	25	400	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	10	200	no	N
Grass & grasslike (GG)	*Paspalidium jubiflorum (Warrego Grass)*	4	100	no	N
Grass & grasslike (GG)	*Echinochloa colona (Awnless Barnyard Grass)*	3	100	no	N
Shrub (SG)	*Sclerolaena muricata (Black Rolypoly)*	5	50	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	4	400	no	N
	Medicago arabica (Spotted Burr Medic)	25	1600	no	E
Forb (FG)	*Calotis hispidula (Bogan Flea)*	1	50	no	N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	0.6	200	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	1	200	no	N
Shrub (SG)	*Salsola australis*	2	400	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.8	800	no	N
Forb (FG)	*Crassula sieberiana (Australian Stonecrop)*	1	2000	no	N
Forb (FG)	*Goodenia pinnatifida (Scrambles Eggs)*	0.4	100	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	1	400	no	N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	1	400	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	5	400	no	N
Shrub (SG)	*Atriplex semibaccata (Creeping Saltbush)*	1	100	no	N
Forb (FG)	*Goodenia fascicularis (Mallee Goodenia)*	8	3000	no	N
Forb (FG)	*Solanum esuriale (Quena)*	1	150	no	N
	Hypochaeris glabra (Smooth Catsear)	0.1	6	no	E
	Echium plantagineum (Patterson's Curse)	0.1	5	no	E
	Sisymbrium officinale (Hedge Mustard)	0.1	5	yes	E
Forb (FG)	*Wahlenbergia spp. (Bluebell)*	0.1	75	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	10	no	N
Grass & grasslike (GG)	*Sporobolus caroli (Fairy Grass)*	0.2	25	no	N
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	0.1	25	no	N
Forb (FG)	*Alternanthera denticulata (Lesser Joyweed)*	0.1	5	no	N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	0.1	5	no	N

BAM Site – Field Survey Form

Plot ID:	Plot 015	**Date:**	27/04/21	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	537,187	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,275,029	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	67
Plant Community Type:		55: Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.		**Condition class:**	Poor	**PCT confidence:**	high
Vegetation Class:		North-west Floodplain Woodlands		**EEC:**	no	**EEC confidence:**	high

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	4
	Grasses etc.:	5
	Forbs:	5
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	33.1
	Grasses etc.:	1
	Forbs:	10.4
	Ferns:	0
	Other:	0
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	14
80 + cm:	0		
50 – 79 cm:	1		
30 – 49 cm:	2		
20 – 29 cm:	0	Tree hollow count	2
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	10	60	30	40	15
Average litter cover (%):	31				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain, red brown clay, flat to very small gradient. Moderate to poor drainage

Plot Disturbance

Highly disturbed. Cleared and cropped, weedy.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	Plot 015	**Date:**	27/04/21

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Shrub (SG)	*Geijera parviflora (Wilga)*	20	1	no	N
Grass & grasslike (GG)	*Sporobolus caroli (Fairy Grass)*	0.2	20	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	0.1	13	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	0.1	10	no	N
	Echium plantagineum (Patterson's Curse)	0.1	20	no	E
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	8	40	no	N
	Triticum aestivum (Wheat)	5	100	no	E
	Cucumis myriocarpus subsp. leptodermis (Paddy Melon)	0.5	40	no	E
	Lolium perenne (Perennial Ryegrass)	60	8000	no	E
	Conyza bonariensis (Flaxleaf Fleabane)	0.3	15	no	E
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	10	100	no	N
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	0.1	20	no	N
	Heliotropium europaeum (Potato Weed)	0.1	8	no	E
Shrub (SG)	*Sclerolaena birchii (Galvinized Burr)*	5	40	no	N
Forb (FG)	*Solanum esuriale (Quena)*	0.1	10	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.1	5	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	0.5	20	no	N
	Solanum nigrum (Black-berry Nightshade)	0.1	4	no	E
Shrub (SG)	*Atriplex spp. (A Saltbush)*	0.1	3	no	N
Forb (FG)	*Dichondra repens (Kidney Weed)*	0.1	23	no	N
Forb (FG)	*Euchiton spp. (A Cudweed)*	0.1	10	no	N
	Medicago spp. (A Medic)	0.1	5	no	E

BAM Site – Field Survey Form

Plot ID:	Plot 016	**Date:**	27/04/21	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	537,381	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,274,986	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	25
Plant Community Type:		55: Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.		**Condition class:**	Poor	**PCT confidence:**	high
Vegetation Class:		North-west Floodplain Woodlands		**EEC:**	no	**EEC confidence:**	high

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	3
	Grasses etc.:	6
	Forbs:	7
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	18
	Shrubs:	8.9
	Grasses etc.:	5.6
	Forbs:	6.6
	Ferns:	0
	Other:	0.1
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	28
80 + cm:	0		
50 – 79 cm:	1		
30 – 49 cm:	1		
20 – 29 cm:	1	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	5	30	10	10	5
Average litter cover (%):	12				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain, slight rise. Red brown clay. Moderate drainage.

Plot Disturbance

Highly disturbed, cleared and cropped, very isolated small patch.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	Plot 016	**Date:**	27/04/21

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Alectryon oleifolius (Western Rosewood)*	18	2	no	N
	Lepidium africanum (Common Peppercress)	0.1	15	no	E
Shrub (SG)	*Sclerolaena birchii (Galvinized Burr)*	8	200	no	N
	Solanum nigrum (Black-berry Nightshade)	0.1	10	no	E
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	6	100	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.1	40	no	N
	Medicago spp. (A Medic)	0.1	20	no	E
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	0.4	25	no	N
Forb (FG)	*Euchiton spp. (A Cudweed)*	0.1	10	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.1	16	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	2	50	no	N
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	0.1	10	no	N
	Lolium perenne (Perennial Ryegrass)	20	4000	no	E
Grass & grasslike (GG)	*Sporobolus caroli (Fairy Grass)*	3	200	no	N
Shrub (SG)	*Atriplex spp. (A Saltbush)*	0.5	28	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	0.2	20	no	N
	Conyza bonariensis (Flaxleaf Fleabane)	0.2	30	no	E
	Cucumis myriocarpus subsp. leptodermis (Paddy Melon)	0.1	10	no	E
	Brassica spp. (Brassica)	0.1	16	no	E
Forb (FG)	*Boerhavia dominii (Tarvine)*	0.1	1	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.1	12	no	N
	Triticum aestivum (Wheat)	2	100	no	E
Forb (FG)	*Polygonum plebeium (Small Knotweed)*	0.1	5	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	0.1	5	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	0.2	20	no	N
Forb (FG)	*Portulaca oleracea (Pigweed)*	0.1	1	no	N

BAM Site – Field Survey Form

Plot ID:	Plot 021	**Date:**	27/04/21	**Project number:**	J190417	**Plot dimensions:**	20x50
Datum:	GDA94	**Easting:**	533,211	**Recorders:**	RP GS		
Zone:	55	**Northing:**	6,280,327	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	194
Plant Community Type:		55: Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.		**Condition class:**	Poor	**PCT confidence:**	medium
Vegetation Class:		North-west Floodplain Woodlands		**EEC:**	no	**EEC confidence:**	medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	3
	Grasses etc.:	12
	Forbs:	13
	Ferns:	2
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	1
	Shrubs:	0.5
	Grasses etc.:	73.9
	Forbs:	3.1
	Ferns:	0.2
	Other:	0.2
High Threat Weed cover:		0.2

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	1		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	6	2	34	8	4
Average litter cover (%):	10.8				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain with gilgai

Plot Disturbance

Historically grazed and cleared

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	RP GS	**Plot ID:**	Plot 021	**Date:**	27/04/21

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Casuarina cristata (Belah)*	1	2	no	N
	Xanthium spinosum (Bathurst Burr)	0.2	3	no	HTE
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	20	1200	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	10	400	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	5	300	no	N
Grass & grasslike (GG)	*Sporobolus caroli (Fairy Grass)*	4	250	no	N
Grass & grasslike (GG)	*Paspalidium jubiflorum (Warrego Grass)*	15	1200	no	N
Grass & grasslike (GG)	*Austrostipa scabra (Speargrass)*	1	50	no	N
Grass & grasslike (GG)	*Carex spp.*	15	1000	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	3	150	no	N
Grass & grasslike (GG)	*Sporobolus creber (Slender Rat's Tail Grass)*	0.3	25	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.3	150	no	N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	0.1	30	no	N
Shrub (SG)	*Sclerolaena spp. (Copperburr, Poverty-bush)*	0.1	10	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.5	80	no	N
Forb (FG)	*Solanum esuriale (Quena)*	0.2	30	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.2	100	no	N
Shrub (SG)	*Atriplex spp. (A Saltbush)*	0.1	2	no	N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	0.1	8	no	N
Grass & grasslike (GG)	*Juncus usitatus*	0.2	4	no	N
Shrub (SG)	*Maireana decalvans (Black Cotton Bush)*	0.3	6	no	N
Forb (FG)	*Oxalis perennans*	0.1	5	no	N
Forb (FG)	*Dichondra repens (Kidney Weed)*	1	100	no	N
Fern (EG)	*Marsilea spp. (A Nardoo)*	0.1	30	no	N
Forb (FG)	*Lobelia concolor (Poison Pratia)*	0.2	20	no	N
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	0.2	25	no	N
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	0.2	20	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.2	25	no	N
Forb (FG)	*Eclipta platyglossa (Yellow Twin-heads)*	0.1	3	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.1	4	no	N
Forb (FG)	*Alternanthera spp. (Joyweed)*	0.1	3	no	N
Forb (FG)	*Goodenia fascicularis (Mallee Goodenia)*	0.1	35	no	N
Fern (EG)	*Cheilanthes sieberi (Rock Fern)*	0.1	4	no	N

BAM Site – Field Survey Form

Plot ID:	58	**Date:**	24/03/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	537,520	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,275,521	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	202
Plant Community Type:		55: Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.		**Condition class:**	Poor	**PCT confidence:**	medium
Vegetation Class:		North-west Floodplain Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	3
	Grasses etc.:	7
	Forbs:	5
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	5
	Shrubs:	0.6
	Grasses etc.:	2.6
	Forbs:	0.5
	Ferns:	0
	Other:	0.8
High Threat Weed cover:		0.1

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	1		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	5	70	1	5	10
Average litter cover (%):	18.2				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Slight rise on alluvial plain, 2 degree southerly aspect

Plot Disturbance

Cleared, recently cropped.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	58	**Date:**	24/03/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Casuarina cristata (Belah)*	5	1	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	0.2	30	no	N
Grass & grasslike (GG)	*Echinochloa colona (Awnless Barnyard Grass)*	1	110	no	N
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	0.1	3	no	N
	Cucumis myriocarpus subsp. leptodermis (Paddy Melon)	3	100	no	E
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	1	80	no	N
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	0.1	5	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.8	40	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	1	no	N
	Sonchus oleraceus (Common Sowthistle)	0.1	4	no	E
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.1	2	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.1	2	no	N
	Medicago spp. (A Medic)	0.1	4	no	E
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	0.1	20	no	N
Forb (FG)	*Calotis hispidula (Bogan Flea)*	0.1	1	no	N
	Xanthium spinosum (Bathurst Burr)	0.1	3	no	HTE
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	0.4	16	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	0.1	3	no	N
	Proboscidea louisianica (Purple-flowered Devil's Claw)	0.1	1	no	E
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	0.1	1	no	N
Shrub (SG)	*Maireana microphylla (Small-leaf Bluebush)*	0.1	1	no	N
Shrub (SG)	*Rhagodia parabolica*	0.1	1	no	N

BAM Site – Field Survey Form

Plot ID:	47	**Date:**	19/03/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	535,047	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,279,649	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	55
Plant Community Type:		55: Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.		**Condition class:**	Poor	**PCT confidence:**	low
Vegetation Class:		North-west Floodplain Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	5
	Grasses etc.:	7
	Forbs:	11
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	89
	Grasses etc.:	44.1
	Forbs:	72.4
	Ferns:	0
	Other:	5
High Threat Weed cover:		0.1

BAM Attribute (1000 m2 plot) DBH			
DBH	**Tree stem count**	**Length of logs (m) (≥10 cm diameter, >50 cm in length)**	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	1		
20 – 29 cm:	0	**Tree hollow count**	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	**1**	**2**	**3**	**4**	**5**
Subplot score (%):	1	5	25	5	5
Average litter cover (%):	8.2				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain

Plot Disturbance

Cleared, cropping / grazing

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	47	**Date:**	19/03/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Shrub (SG)	*Geijera parviflora (Wilga)*	45	2		N
Shrub (SG)	*Salsola australis*	16	1600		N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	8	400		N
Forb (FG)	*Portulaca oleracea (Pigweed)*	1	15		N
Forb (FG)	*Boerhavia dominii (Tarvine)*	5	40		N
Forb (FG)	*Dysphania spp.*	20	1600		N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.2	10		N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	5	80		N
Shrub (SG)	*Sclerolaena stelligera (Star Copperburr)*	10	150		N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	1	20		N
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	5	20		N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	8	100		N
	Echium vulgare (Viper's Bugloss)	0.2	20		E
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	10	400		N
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	5	50		N
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	10	100		N
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	10	100		N
	Sonchus oleraceus (Common Sowthistle)	10	100		E
	Malva parviflora (Small-flowered Mallow)	8	60		E
Forb (FG)	*Oxalis perennans*	0.1	10		N
Forb (FG)	*Einadia hastata (Berry Saltbush)*	10	100		N
	Xanthium spinosum (Bathurst Burr)	0.1	5		HTE
	Cucumis myriocarpus subsp. leptodermis (Paddy Melon)	2	10		E
	Tribulus terrestris (Cat-head)	0.1	1		E
Shrub (SG)	*Sclerolaena muricata var. villosa (Black Rolypoly)*	8	80		N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	15	400		N
	Heliotropium europaeum (Potato Weed)	0.1	15		E
	Medicago spp. (A Medic)	0.1	20		E
Shrub (SG)	*Sclerolaena spp. (Copperburr, Poverty-bush)*	10	100		N
	Lactuca serriola (Prickly Lettuce)	5	80		E
Forb (FG)	*Solanum esuriale (Quena)*	0.1	20		N
	Solanum nigrum (Black-berry Nightshade)	0.1	2		E
	Medicago laciniata (Cut-leaved Medic)	0.1	20		E
	Proboscidea louisianica (Purple-flowered Devil's Claw)	0.1	1		E
Grass & grasslike (GG)	*Paspalidium jubiflorum (Warrego Grass)*	8	100		N
Grass & grasslike (GG)	*Echinochloa colona (Awnless Barnyard Grass)*	0.1	1		N

BAM Site – Field Survey Form

Plot ID:	57	**Date:**	23/05/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	538,295	**Recorders:**	RP GS		
Zone:	55	**Northing:**	6,274,828	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	231
Plant Community Type:		55: Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.		**Condition class:**	Poor	**PCT confidence:**	medium
Vegetation Class:		North-west Floodplain Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	5
	Grasses etc.:	8
	Forbs:	17
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	25
	Shrubs:	4.9
	Grasses etc.:	15.7
	Forbs:	3.9
	Ferns:	0
	Other:	0.1
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	5
80 + cm:	1		
50 – 79 cm:	1		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	1
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	35	5	25	5	10
Average litter cover (%):	16				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain

Plot Disturbance

Cleared, cropped, weedy

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	RP GS	**Plot ID:**	57	**Date:**	23/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Casuarina cristata (Belah)*	25	1	no	N
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	2	400	no	N
	Lolium perenne (Perennial Ryegrass)	50	4000	no	E
	Echium plantagineum (Patterson's Curse)	2	50	no	E
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	1	200	no	N
Shrub (SG)	*Sclerolaena muricata (Black Rolypoly)*	4	30	no	N
	Conyza bonariensis (Flaxleaf Fleabane)	0.2	15	no	E
	Medicago polymorpha (Burr Medic)	3	300	no	E
Forb (FG)	*Dichondra repens (Kidney Weed)*	0.1	30	no	N
	Brassica rapa subsp. campestris (Turnip)	0.4	6	no	E
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	12	400	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.1	20	no	N
	Malva parviflora (Small-flowered Mallow)	2	50	no	E
Grass & grasslike (GG)	*Echinochloa colona (Awnless Barnyard Grass)*	0.4	25	no	N
Grass & grasslike (GG)	*Sporobolus caroli (Fairy Grass)*	0.4	25	no	N
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	0.1	15	no	N
Forb (FG)	*Portulaca oleracea (Pigweed)*	0.1	15	no	N
	Sonchus oleraceus (Common Sowthistle)	0.1	7	no	E
Forb (FG)	*Calotis hispidula (Bogan Flea)*	0.1	6	no	N
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	0.4	150	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.1	30		N
Forb (FG)	*Asteraceae indeterminate (Daisies)*	0.2	20		N
Grass & grasslike (GG)	*Paspalidium jubiflorum (Warrego Grass)*	0.1	20		N
	Cirsium vulgare (Spear Thistle)	0.1	3		E
Forb (FG)	*Rumex brownii (Swamp Dock)*	0.3	15		N
Forb (FG)	*Alternanthera denticulata (Lesser Joyweed)*	0.4	30		N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.2	40		N
	Cucumis myriocarpus subsp. leptodermis (Paddy Melon)	0.4	20		E
	Lepidium africanum (Common Peppercress)	0.1	5		E
Shrub (SG)	*Atriplex spp. (A Saltbush)*	0.2	10		N
Shrub (SG)	*Sclerolaena birchii (Galvinized Burr)*	0.2	5		N
Shrub (SG)	*Maireana brevifolia*	0.2	5		N
	Solanum nigrum (Black-berry Nightshade)	0.1	5		E
	Allium spp.	0.1	10		E
Forb (FG)	*Crassula sieberiana (Australian Stonecrop)*	0.1	400		N
Forb (FG)	*Limosella australis (Australian Mudwort)*	0.2	50		N
Forb (FG)	*Cotula australis (Common Cotula)*	0.1	50		N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	0.3	10		N
Forb (FG)	*Lobelia concolor (Poison Pratia)*	0.1	10		N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	0.3	10		N
Forb (FG)	*Polygonum spp.*	0.2	15		N
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	0.3	30		N

Project name:	J190417				
Recorders:	RP GS	Plot ID:	57	Date:	23/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Forb (FG)	*Oxalis perennans*	0.3	30		N
Forb (FG)	*Epilobium spp.*	0.1	3		N

BAM Site – Field Survey Form

Plot ID:	66	**Date:**	24/03/20	**Project number:**	J190417	**Plot dimensions:**	10 x 100
Datum:	GDA94	**Easting:**	532,888	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,278,016	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	339
Plant Community Type:		55: Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.		**Condition class:**	planted	**PCT confidence:**	medium
Vegetation Class:		North-west Floodplain Woodlands		**EEC:**	yes	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	4
	Shrubs:	4
	Grasses etc.:	4
	Forbs:	9
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	21
	Shrubs:	7
	Grasses etc.:	5.3
	Forbs:	5.8
	Ferns:	0
	Other:	0.1
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	1	Tree hollow count	0
10 – 19 cm:	1		
5 – 9 cm:	1		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	1	1	3	5	90
Average litter cover (%):	20				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain

Plot Disturbance

Cleared, grazed / cropped. Recently planted circa 15 years

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	66	**Date:**	24/03/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Eucalyptus populnea subsp. bimbil (Bimble Box)*	3	2	no	N
Tree (TG)	*Eucalyptus microcarpa (Western Grey Box)*	8	6	no	N
Tree (TG)	*Casuarina cristata (Belah)*	6	4	no	N
Shrub (SG)	*Salsola australis*	5	132	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	4	52	no	N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	0.1	30	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	5	240	no	N
Shrub (SG)	*Dodonaea viscosa subsp. cuneata (Wedge-leaf Hop-bush)*	0.4	4	no	N
Tree (TG)	*Acacia pendula (Weeping Myall, Boree)*	4	4	no	N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	1.5	17	no	N
Forb (FG)	*Boerhavia dominii (Tarvine)*	0.1	4	no	N
	Medicago spp. (A Medic)	0.1	60	no	E
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	1	40	no	N
Forb (FG)	*Goodenia fascicularis (Mallee Goodenia)*	0.2	75	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.1	3	no	N
Shrub (SG)	*Maireana decalvans (Black Cotton Bush)*	0.1	1	no	N
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	0.1	10	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.1	3	no	N
Grass & grasslike (GG)	*Tragus australianus (Small Burrgrass)*	0.1	6	no	N
Forb (FG)	*Solanum esuriale (Quena)*	0.1	4	no	N
Grass & grasslike (GG)	*Carex spp.*	0.1	1	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	2	no	N
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	0.1	1	no	N

BAM Site – Field Survey Form

Plot ID:	56	**Date:**	19/03/20	**Project number:**	J190417	**Plot dimensions:**	10 x 100
Datum:	GDA94	**Easting:**	536,388	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,279,422	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	255
Plant Community Type:		55: Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.		**Condition class:**	Planted	**PCT confidence:**	medium
Vegetation Class:		North-west Floodplain Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	2
	Shrubs:	5
	Grasses etc.:	1
	Forbs:	8
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	28
	Shrubs:	1.3
	Grasses etc.:	8
	Forbs:	4.7
	Ferns:	0
	Other:	0.1
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	1		
20 – 29 cm:	1	Tree hollow count	0
10 – 19 cm:	1		
5 – 9 cm:	1		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	50	75	90	1	95
Average litter cover (%):	62.2				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain

Plot Disturbance

Clearing grazing/cropping, planted 5 - 10 years ago

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	56	**Date:**	19/03/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Eucalyptus populnea subsp. bimbil (Bimble Box)*	20	13	no	N
Tree (TG)	*Casuarina cristata (Belah)*	8	5	no	N
Shrub (SG)	*Eremophila longifolia (Emubush)*	0.1	1	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	8	800	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	2	350	no	N
Forb (FG)	*Solanum esuriale (Quena)*	0.1	5	no	N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	1	200	no	N
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	1	50	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.1	10	no	N
Forb (FG)	*Goodenia fascicularis (Mallee Goodenia)*	0.3	30	no	N
Shrub (SG)	*Salsola australis*	0.5	45	no	N
	Medicago spp. (A Medic)	0.1	1	no	E
Shrub (SG)	*Maireana brevifolia*	0.1	15	no	N
Forb (FG)	*Alternanthera denticulata (Lesser Joyweed)*	0.1	1	no	N
Shrub (SG)	*Maireana decalvans (Black Cotton Bush)*	0.5	10	no	N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	0.1	1	no	N
Shrub (SG)	*Sclerolaena muricata (Black Rolypoly)*	0.1	2	no	N
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	0.1	2	no	N

BAM Site – Field Survey Form

Plot ID:	24	**Date:**	18/03/20	**Project number:**	J190417	**Plot dimensions:**	10 x 100
Datum:	GDA94	**Easting:**	535,259	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,279,633	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	93
Plant Community Type:		55: Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.		**Condition class:**	Planted	**PCT confidence:**	medium
Vegetation Class:		North-west Floodplain Woodlands		**EEC:**	no	**EEC confidence:**	medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	2
	Shrubs:	6
	Grasses etc.:	2
	Forbs:	8
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	15
	Shrubs:	5.3
	Grasses etc.:	10.2
	Forbs:	8.7
	Ferns:	0
	Other:	0.1
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	1		
20 – 29 cm:	1	Tree hollow count	0
10 – 19 cm:	1		
5 – 9 cm:	1		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	5	80	10	15	85
Average litter cover (%):	39				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain

Plot Disturbance

Previously cleared, probable grazing and or cropping. Planted 5 to 10 years ago

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	24	**Date:**	18/03/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Eucalyptus populnea subsp. bimbil (Bimble Box)*	11	5		N
Tree (TG)	*Casuarina cristata (Belah)*	4	3		N
Shrub (SG)	*Hakea tephrosperma (Hooked Needlewood)*	3	20		N
Forb (FG)	*Goodenia fascicularis (Mallee Goodenia)*	0.1	7		N
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	0.1	2		N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	10	1600		N
Grass & grasslike (GG)	*Paspalidium jubiflorum (Warrego Grass)*	0.2	20		N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	1	13		N
Forb (FG)	*Alternanthera denticulata (Lesser Joyweed)*	0.1	2		N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	8	400		N
Shrub (SG)	*Maireana decalvans (Black Cotton Bush)*	0.1	8		N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.1	2		N
Forb (FG)	*Boerhavia dominii (Tarvine)*	0.1	2		N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	0.1	2		N
Shrub (SG)	*Salsola australis*	1	27		N
Shrub (SG)	*Maireana brevifolia*	0.1	2		N
Shrub (SG)	*Acacia deanei subsp. paucijuga (Green Wattle)*	0.1	1		N
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	0.1	1		N
Forb (FG)	*Solanum esuriale (Quena)*	0.1	8		N

BAM Site – Field Survey Form

Plot ID:	55	**Date:**	24/05/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	535,437	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,276,212	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	248
Plant Community Type:		55: Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.		**Condition class:**	Planted	**PCT confidence:**	medium
Vegetation Class:		North-west Floodplain Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	2
	Shrubs:	9
	Grasses etc.:	10
	Forbs:	15
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	20
	Shrubs:	7.3
	Grasses etc.:	111.3
	Forbs:	14.3
	Ferns:	0
	Other:	0
High Threat Weed cover:		0.4

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	1		
5 – 9 cm:	1		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	5	80	40	30	10
Average litter cover (%):	33				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain

Plot Disturbance

Cleared and planted

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	55	**Date:**	24/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
	Avena spp. (Oats)	25	400	no	E
Tree (TG)	*Eucalyptus populnea subsp. bimbil (Bimble Box)*	10	4	no	N
Tree (TG)	*Acacia dealbata (Silver Wattle)*	10	5	no	N
Shrub (SG)	*Hakea spp.*	1	1	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	40	400	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	40	400	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	10	100	no	N
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	0.4	50	no	N
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	10	200	no	N
Forb (FG)	*Solanum esuriale (Quena)*	0.5	45	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	5	1600	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	1	800	no	N
Forb (FG)	*Dichondra repens (Kidney Weed)*	0.4	800	no	N
Forb (FG)	*Crassula sieberiana (Australian Stonecrop)*	0.4	4000	no	N
Forb (FG)	*Boerhavia dominii (Tarvine)*	0.4	500	no	N
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	10	500	no	N
Forb (FG)	*Hibiscus trionum (Flower-of-an-hour)*	0.4	25	no	N
Forb (FG)	*Polygonum plebeium (Small Knotweed)*	0.2	50	no	N
	Xanthium spinosum (Bathurst Burr)	0.4	15	no	HTE
Grass & grasslike (GG)	*Dichanthium sericeum (Queensland Bluegrass)*	0.1	5	no	N
Forb (FG)	*Wahlenbergia spp. (Bluebell)*	0.1	50	no	N
Grass & grasslike (GG)	*Echinochloa colona (Awnless Barnyard Grass)*	0.3	200	no	N
Grass & grasslike (GG)	*Dichanthium spp.*	0.1	5		N
Shrub (SG)	*Salsola australis*	0.2	10		N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	0.4	6		N
	Sonchus oleraceus (Common Sowthistle)	0.1	3		E
	Echium plantagineum (Patterson's Curse)	0.4	8		E
Shrub (SG)	*Atriplex spp. (A Saltbush)*	0.1	5		N
Shrub (SG)	*Rhagodia parabolica*	0.4	10		N
	Malva parviflora (Small-flowered Mallow)	0.3	50		E
Forb (FG)	*Oxalis perennans*	0.1	30		N
	Heliotropium europaeum (Potato Weed)	0.1	5		E
Forb (FG)	*Rumex brownii (Swamp Dock)*	0.1	2		N
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	0.4	25		N
Shrub (SG)	*Dodonaea viscosa (Sticky Hop-bush)*	0.3	2		N
	Cyperaceae indeterminate (Sedges)	5	30		E
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	10		N
	Solanum nigrum (Black-berry Nightshade)	0.1	5		E
Shrub (SG)	*Maireana spp. (Cotton Bush, Bluebush, Fissure-weed)*	0.1	5		N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.2	50		N
	Lepidium africanum (Common Peppercress)	0.1	5		E
Forb (FG)	*Lobelia concolor (Poison Pratia)*	5	50		N

Project name:	J190417				
Recorders:	GS RP	Plot ID:	55	Date:	24/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
	Triticum aestivum (Wheat)	2	50		E
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	5	100		N
	Medicago laciniata (Cut-leaved Medic)	0.4	50		E
	Medicago polymorpha (Burr Medic)	6	100		E
Shrub (SG)	*Geijera parviflora (Wilga)*	0.1	1		N
Shrub (SG)	*Sclerolaena spp. (Copperburr, Poverty-bush)*	0.1	2		N

BAM Site – Field Survey Form

Plot ID:	Plot 018	**Date:**	27/04/21	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	532,926	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,279,817	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	186
Plant Community Type:		55: Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.		**Condition class:**	Medium	**PCT confidence:**	high
Vegetation Class:		North-west Floodplain Woodlands		**EEC:**	no	**EEC confidence:**	medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	2
	Shrubs:	6
	Grasses etc.:	4
	Forbs:	7
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	40
	Shrubs:	46.1
	Grasses etc.:	11.1
	Forbs:	20.6
	Ferns:	0
	Other:	0.1
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	14
80 + cm:	0		
50 – 79 cm:	1		
30 – 49 cm:	2		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	5	5	15	3	33
Average litter cover (%):	12.2				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain, gilgai present. Poor drainage. Tan clay

Plot Disturbance

Cleared and grazed

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	Plot 018	**Date:**	27/04/21

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Casuarina cristata (Belah)*	30	2	no	N
Tree (TG)	*Alectryon oleifolius (Western Rosewood)*	10	1	no	N
Grass & grasslike (GG)	*Sporobolus caroli (Fairy Grass)*	8	500	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	2	200	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	1	70	no	N
Shrub (SG)	*Sclerolaena birchii (Galvinized Burr)*	25	1000	no	N
Shrub (SG)	*Maireana microphylla (Small-leaf Bluebush)*	0.1	4	no	N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	5	26	no	N
	Solanum nigrum (Black-berry Nightshade)	0.1	5	no	E
Forb (FG)	*Oxalis spp.*	0.1	10	no	N
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	20	1000	no	N
Shrub (SG)	*Atriplex spp. (A Saltbush)*	15	500	no	N
	Brassica spp. (Brassica)	0.1	5	no	E
Shrub (SG)	*Salsola australis*	0.5	50	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	1	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.1	20	no	N
Forb (FG)	*Solanum esuriale (Quena)*	0.1	3	no	N
Forb (FG)	*Boerhavia dominii (Tarvine)*	0.1	5	no	N
Shrub (SG)	*Rhagodia spinescens (Thorny Saltbush)*	0.5	6	no	N
Forb (FG)	*Dichondra repens (Kidney Weed)*	0.1	10	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.1	5	no	N
Grass & grasslike (GG)	*Carex spp.*	0.1	5	no	N

BAM Site – Field Survey Form

Plot ID:	14	**Date:**	18/03/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	535,641	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,279,472	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	72
Plant Community Type:		55: Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.		**Condition class:**	Medium	**PCT confidence:**	medium
Vegetation Class:		North-west Floodplain Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	5
	Grasses etc.:	9
	Forbs:	10
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	15
	Shrubs:	56
	Grasses etc.:	14.4
	Forbs:	42.9
	Ferns:	0
	Other:	1
High Threat Weed cover:		0.1

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	50
80 + cm:	0		
50 – 79 cm:	1		
30 – 49 cm:	0		
20 – 29 cm:	1	Tree hollow count	1
10 – 19 cm:	1		
5 – 9 cm:	1		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	2	0	5	60	0
Average litter cover (%):	13.4				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain

Plot Disturbance

Previously cleared and grazed

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	14	**Date:**	18/03/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Casuarina cristata (Belah)*	15	2		N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	20	40		N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	5	800		N
Shrub (SG)	*Salsola australis*	15	800		N
Shrub (SG)	*Rhagodia parabolica*	15	30		N
Shrub (SG)	*Geijera parviflora (Wilga)*	1	6		N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	25	16000		N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	1	15		N
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	1	20		N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	10	200		N
	Medicago spp. (A Medic)	0.5	1		E
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.1	20		N
Forb (FG)	*Boerhavia dominii (Tarvine)*	0.1	10		N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	1	150		N
Shrub (SG)	*Sclerolaena muricata (Black Rolypoly)*	5	50		N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	1	10		N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	1	10		N
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	1	10		N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	1	10		N
	Xanthium spinosum (Bathurst Burr)	0.1	3		HTE
Forb (FG)	*Calotis hispidula (Bogan Flea)*	0.1	1		N
Grass & grasslike (GG)	*Echinochloa colona (Awnless Barnyard Grass)*	0.1	1		N
Forb (FG)	*Einadia nutans subsp. linifolia (Climbing Saltbush)*	5	20		N
Forb (FG)	*Solanum esuriale (Quena)*	0.5	50		N
Grass & grasslike (GG)	*Paspalidium jubiflorum (Warrego Grass)*	0.1	20		N
	Echium vulgare (Viper's Bugloss)	0.1	3		E
	Solanum nigrum (Black-berry Nightshade)	0.1	10		E
	Sonchus oleraceus (Common Sowthistle)	0.1	10		E
Forb (FG)	*Taraxacum spp. (Dandelion)*	0.1	15		N
	Cucumis myriocarpus subsp. leptodermis (Paddy Melon)	0.2	5		E
	Malva parviflora (Small-flowered Mallow)	0.5	50		E
Grass & grasslike (GG)	*Carex spp.*	0.2	4		N
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	5	50		N

BAM Site – Field Survey Form

Plot ID:	17	**Date:**	17/03/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	532,881	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,278,249	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	260
Plant Community Type:		55: Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.		**Condition class:**	Medium	**PCT confidence:**	medium
Vegetation Class:		North-west Floodplain Woodlands		**EEC:**	no	**EEC confidence:**	medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	3
	Grasses etc.:	9
	Forbs:	13
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0.3
	Shrubs:	6.1
	Grasses etc.:	16.3
	Forbs:	22.5
	Ferns:	0
	Other:	3
High Threat Weed cover:		1

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	50
80 + cm:	1		
50 – 79 cm:	1		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	20	5	50	75	80
Average litter cover (%):	46				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Flat alluvial plain, dry clay loamy soil, grey brown

Plot Disturbance

Possible pasture improved, grazing

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	17	**Date:**	17/03/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Casuarina cristata (Belah)*	0.3	1		N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	5	1200		N
Forb (FG)	*Oxalis spp.*	2	200		N
Forb (FG)	*Sida spp.*	3	400		N
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	3	200		N
Grass & grasslike (GG)	*Sporobolus caroli (Fairy Grass)*	4	150		N
	Medicago spp. (A Medic)	4	600		E
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	3	800		N
	Medicago spp. (A Medic)	3	400		E
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	3	800		N
	Erodium cicutarium (Common Crowfoot)	3	400		E
Forb (FG)	*Boerhavia dominii (Tarvine)*	2	50		N
	Xanthium spinosum (Bathurst Burr)	1	20		HTE
Shrub (SG)	*Sclerolaena muricata (Black Rolypoly)*	3	75		N
Grass & grasslike (GG)	*Tragus australianus (Small Burrgrass)*	2	200		N
Forb (FG)	*Solanum esuriale (Quena)*	3	150		N
Forb (FG)	*Dichondra repens (Kidney Weed)*	0.1	1		N
	Hypochaeris spp. (A Catsear)	1	50		E
Grass & grasslike (GG)	*Dichanthium sericeum (Queensland Bluegrass)*	0.1	1		N
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	1	50		N
Forb (FG)	*Einadia hastata (Berry Saltbush)*	0.1	1		N
	Malva parviflora (Small-flowered Mallow)	0.5	100		E
	Heliotropium europaeum (Potato Weed)	2	50		E
Shrub (SG)	*Salsola australis*	3	100		N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	1	50		N
Grass & grasslike (GG)	*Walwhalleya proluta*	1	20		N
Forb (FG)	*Vittadinia cuneata var. cuneata (A Fuzzweed)*	0.2	6		N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	0.1	2		N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	2	100		N
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	3	30		N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	3	20		N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	0.1	1		N
Grass & grasslike (GG)	*Echinochloa turneriana (Channel Millet)*	0.1	2		N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	0.1	10		N

BAM Site – Field Survey Form

Plot ID:	52	**Date:**	22/05/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	536,346	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,279,573	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	272
Plant Community Type:		55: Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.		**Condition class:**	Medium	**PCT confidence:**	medium
Vegetation Class:		North-west Floodplain Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	5
	Grasses etc.:	8
	Forbs:	15
	Ferns:	1
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	18
	Shrubs:	36
	Grasses etc.:	41.2
	Forbs:	3.2
	Ferns:	0.2
	Other:	0.1
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	1		
30 – 49 cm:	1		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	1		
5 – 9 cm:	1		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	20	5	2	60	20
Average litter cover (%):	21.4				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain

Plot Disturbance

Cleared grazed regenerated

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	52	**Date:**	22/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Casuarina cristata (Belah)*	18	21	yes	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	10	200	no	N
Shrub (SG)	*Rhagodia parabolica*	0.3	5	no	N
Forb (FG)	*Goodenia fascicularis (Mallee Goodenia)*	0.3	50	no	N
	Sonchus oleraceus (Common Sowthistle)	0.3	3	no	E
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	0.1	3	no	N
Grass & grasslike (GG)	*Cyperus spp.*	6	50	no	N
Grass & grasslike (GG)	*Juncus spp. (A Rush)*	2	50	no	N
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	0.2	6	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	22	500	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.8	400	no	N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	0.1	6	no	N
Forb (FG)	*Boerhavia dominii (Tarvine)*	0.1	3	no	N
	Brassica rapa subsp. campestris (Turnip)	0.3	8	no	E
Forb (FG)	*Oxalis perennans*	0.1	6	no	N
Fern (EG)	*Marsilea spp. (A Nardoo)*	0.2	15	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.2	27	no	N
Grass & grasslike (GG)	*Echinochloa colona (Awnless Barnyard Grass)*	0.5	80	no	N
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	0.4	17	yes	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.1	3	no	N
Shrub (SG)	*Sclerolaena spp. (Copperburr, Poverty-bush)*	0.4	60	no	N
Grass & grasslike (GG)	*Paspalidium jubiflorum (Warrego Grass)*	0.1	25	yes	N
Forb (FG)	*Alternanthera denticulata (Lesser Joyweed)*	0.1	8	no	N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	0.1	22	no	N
Grass & grasslike (GG)	*Sporobolus caroli (Fairy Grass)*	0.5	50	no	N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	0.1	1	no	N
Forb (FG)	*Portulaca oleracea (Pigweed)*	0.2	50	no	N
Shrub (SG)	*Sclerolaena spp. (Copperburr, Poverty-bush)*	35	1600	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.1	30	no	N
Forb (FG)	*Goodenia pinnatifida (Scrambles Eggs)*	0.3	30	no	N
Forb (FG)	*Calotis hispidula (Bogan Flea)*	0.1	6	no	N
Forb (FG)	*Dichondra repens (Kidney Weed)*	0.1	30	no	N
Shrub (SG)	*Salsola australis*	0.2	20	no	N
	Medicago spp. (A Medic)	0.5	50		E

BAM Site – Field Survey Form

Plot ID:	54	**Date:**	24/05/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	536,541	**Recorders:**	RP GS		
Zone:	55	**Northing:**	6,276,132	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	71
Plant Community Type:		55: Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.		**Condition class:**	Medium	**PCT confidence:**	medium
Vegetation Class:		North-west Floodplain Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	3
	Grasses etc.:	8
	Forbs:	10
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	45
	Shrubs:	25.2
	Grasses etc.:	17.3
	Forbs:	4
	Ferns:	0
	Other:	0.4
High Threat Weed cover:		0.1

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	19
80 + cm:	1		
50 – 79 cm:	2		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	1		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	80	35	60	80	2
Average litter cover (%):	51.4				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain

Plot Disturbance

Selective clearing and grazing in the past, now rehab area.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	RP GS	**Plot ID:**	54	**Date:**	24/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Casuarina cristata (Belah)*	45	3	no	N
Shrub (SG)	*Rhagodia parabolica*	12.5	25	no	N
	Sisymbrium spp.	12.5	100	yes	E
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	12.5	800	no	N
Grass & grasslike (GG)	*Cyperus spp.*	15	4000	no	N
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	0.1	6	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.4	600	no	N
Grass & grasslike (GG)	*Echinochloa colona (Awnless Barnyard Grass)*	0.4	200	no	N
Grass & grasslike (GG)	*Sporobolus caroli (Fairy Grass)*	0.4	100	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	1	50	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.4	75	no	N
Forb (FG)	*Plantago varia*	0.1	6	no	N
Shrub (SG)	*Sclerolaena muricata (Black Rolypoly)*	0.2	75	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	1.2	350	no	N
	Lolium perenne (Perennial Ryegrass)	0.2	25	no	E
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	0.4	75	no	N
	Xanthium spinosum (Bathurst Burr)	0.1	15	no	HTE
	Sonchus oleraceus (Common Sowthistle)	0.4	15	no	E
	Avena spp. (Oats)	1	15	no	E
	Echium plantagineum (Patterson's Curse)	1	15	no	E
	Malva parviflora (Small-flowered Mallow)	0.2	10	no	E
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	0.2	50	no	N
	Solanum nigrum (Black-berry Nightshade)	0.1	5	no	E
Forb (FG)	*Asperula conferta (Common Woodruff)*	0.2	150	no	N
Forb (FG)	*Oxalis perennans*	0.1	15	no	N
Forb (FG)	*Dichondra repens (Kidney Weed)*	0.3	150	no	N
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	0.1	25	no	N
Grass & grasslike (GG)	*Dichanthium spp.*	0.1	5	no	N
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	0.2	30		N
Forb (FG)	*Erodium spp. (Crowfoot)*	1	100		N
	Hypochaeris glabra (Smooth Catsear)	0.1	30		E
	Medicago laciniata (Cut-leaved Medic)	12.5	350		E
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	20		N

BAM Site – Field Survey Form

Plot ID:	53	**Date:**	23/05/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	537,982	**Recorders:**	RP GS		
Zone:	55	**Northing:**	6,275,247	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	51
Plant Community Type:		55: Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.		**Condition class:**	Medium	**PCT confidence:**	medium
Vegetation Class:		North-west Floodplain Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	2
	Grasses etc.:	12
	Forbs:	17
	Ferns:	1
	Other:	2
Sum of Cover of native vascular plants by growth form group	Trees:	10
	Shrubs:	38.1
	Grasses etc.:	43.3
	Forbs:	11.7
	Ferns:	0.1
	Other:	1.1
High Threat Weed cover:		3.1

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	10
80 + cm:	2		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	5	10	2	15	15
Average litter cover (%):	9.4				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain with gilgai

Plot Disturbance

Selectively cleared, weedy

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	RP GS	**Plot ID:**	53	**Date:**	23/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Shrub (SG)	*Sclerolaena muricata (Black Rolypoly)*	38	95	no	N
Tree (TG)	*Casuarina cristata (Belah)*	10	1	no	N
	Lolium perenne (Perennial Ryegrass)	15	200	no	E
Forb (FG)	*Solanum esuriale (Quena)*	1.2	40	no	N
	Medicago polymorpha (Burr Medic)	1.2	50	no	E
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.8	400	no	N
	Medicago sativa (Lucerne)	0.1	7	no	E
Forb (FG)	*Alternanthera denticulata (Lesser Joyweed)*	0.2	20	no	N
	Xanthium spinosum (Bathurst Burr)	0.1	15	no	HTE
Forb (FG)	*Cotula australis (Common Cotula)*	0.4	800	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.1	30	no	N
Forb (FG)	*Dichondra repens (Kidney Weed)*	0.4	300	no	N
Forb (FG)	*Oxalis perennans*	0.1	20	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	1.2	1200	no	N
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	0.2	20	no	N
Grass & grasslike (GG)	*Sporobolus caroli (Fairy Grass)*	4	50	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	4	50	no	N
Grass & grasslike (GG)	*Echinochloa colona (Awnless Barnyard Grass)*	2	50	no	N
Forb (FG)	*Daucus glochidiatus (Native Carrot)*	0.1	100	no	N
	Phyla canescens (Lippia)	3	10	no	HTE
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	5	100	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	5	25	no	N
Forb (FG)	*Limosella australis (Australian Mudwort)*	3	4000	no	N
Grass & grasslike (GG)	*Sporobolus mitchellii (Rat's Tail Couch)*	1	100	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	1	50	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	1	50	no	N
Grass & grasslike (GG)	*Eragrostis spp. (A Lovegrass)*	0.1	3	no	N
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	1.2	25	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	4	90	no	N
Forb (FG)	*Goodenia fascicularis (Mallee Goodenia)*	0.2	40	no	N
	Abutilon grandifolium	0.1	15	no	E
Grass & grasslike (GG)	*Cyperus spp.*	12	400	yes	N
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	2	35	no	N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	0.2	30	no	N
	Sonchus oleraceus (Common Sowthistle)	0.1	15	no	E
Forb (FG)	*Glycyrrhiza acanthocarpa (Native Liquorice)*	0.4	12	no	N
Other (OG)	*Kennedia spp.*	0.1	7	no	N
Fern (EG)	*Marsilea spp. (A Nardoo)*	0.1	15	no	N
Grass & grasslike (GG)	*Rytidosperma spp.*	5	100	no	N
	Restionaceae indeterminate (Southern rushes)	20	400	no	E
Forb (FG)	*Polygonum plebeium (Small Knotweed)*	0.1	6	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	5	no	N

Project name:	J190417				
Recorders:	RP GS	**Plot ID:**	53	**Date:**	23/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
	Haloragaceae indeterminate (Raspworts and milfoils)	0.1	15	no	E
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	0.1	3	no	N
	Sisymbrium spp.	0.1	15	no	E
	Medicago spp. (A Medic)	0.1	5	no	E
	Cucumis myriocarpus subsp. leptodermis (Paddy Melon)	0.2	7	no	E
	Solanum nigrum (Black-berry Nightshade)	12	500	no	E
	Lepidium africanum (Common Peppercress)	0.1	5		E

BAM Site – Field Survey Form

Plot ID:	Plot 003	**Date:**	27/03/21	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	532,201	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,279,574	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	52
Plant Community Type:		82: Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion		**Condition class:**	DNG	**PCT confidence:**	medium
Vegetation Class:		Floodplain Transition Woodlands		**EEC:**	no	**EEC confidence:**	medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	2
	Grasses etc.:	4
	Forbs:	10
	Ferns:	1
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	0.3
	Grasses etc.:	75
	Forbs:	2.1
	Ferns:	0.1
	Other:	0.2
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	5	10	10	30	40
Average litter cover (%):	19				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Rise / foot slope low to very low gradient above drainage line of alluvial plain. E aspect. Red brown clay loam. Moderate to poor drainage.

Plot Disturbance

Cleared and grazed, no recent grazing. Low weeds.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	Plot 003	**Date:**	27/03/21

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	10	600	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	25	1500	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	35	2000	no	N
Grass & grasslike (GG)	*Austrostipa scabra (Speargrass)*	5	400	no	N
	Salvia verbenaca (Vervain)	0.2	120	no	E
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.2	100	no	N
Fern (EG)	*Cheilanthes sieberi (Rock Fern)*	0.1	50	no	N
	Chondrilla juncea (Skeleton Weed)	0.1	20	no	E
	Conyza bonariensis (Flaxleaf Fleabane)	0.1	10	no	E
Forb (FG)	*Vittadinia cuneata (A Fuzzweed)*	0.1	10	no	N
Forb (FG)	*Boerhavia dominii (Tarvine)*	0.1	5	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.2	50	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	5	no	N
Shrub (SG)	*Maireana spp. (Cotton Bush, Bluebush, Fissure-weed)*	0.1	20	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	1	500	no	N
Shrub (SG)	*Atriplex spp. (A Saltbush)*	0.2	30	no	N
Forb (FG)	*Dichondra repens (Kidney Weed)*	0.1	10	no	N
Forb (FG)	*Wahlenbergia communis (Tufted Bluebell)*	0.1	12	no	N
Forb (FG)	*Oxalis perennans*	0.2	100	no	N
Forb (FG)	*Solanum esuriale (Quena)*	0.1	5	no	N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	0.1	1	no	N

BAM Site – Field Survey Form

Plot ID:	Plot 007	**Date:**	29/03/21	**Project number:**	J190417		**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	535,926	**Recorders:**	GS RP			
Zone:	55	**Northing:**	6,274,819	**IBRA region:**	NSW South Western Slopes		**Midline bearing:**	63
Plant Community Type:		82: Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion		**Condition class:**	DNG		**PCT confidence:**	medium
Vegetation Class:		Floodplain Transition Woodlands		**EEC:**	yes		**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	0
	Grasses etc.:	7
	Forbs:	11
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	0
	Grasses etc.:	92.2
	Forbs:	1.1
	Ferns:	0
	Other:	4
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	30	30	20	25	40
Average litter cover (%):	29				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Rise on alluvial plain, very low gradient NE aspect. Red clay soil. Moderate - poor drainage.

Plot Disturbance

Cleared and grazed.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	Plot 007	**Date:**	29/03/21

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Walwhalleya proluta*	10	1500	no	N
Grass & grasslike (GG)	*Austrostipa scabra (Speargrass)*	0.5	60	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	80	4000	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	0.5	50	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	4	300	no	N
	Echium plantagineum (Patterson's Curse)	0.1	20	no	E
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	1	120	no	N
Forb (FG)	*Boerhavia dominii (Tarvine)*	0.1	6	no	N
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	0.1	1	no	N
Forb (FG)	*Vittadinia cuneata (A Fuzzweed)*	0.1	10	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.1	20	no	N
Forb (FG)	*Oxalis perennans*	0.1	12	no	N
Forb (FG)	*Dichondra repens (Kidney Weed)*	0.1	20	no	N
Forb (FG)	*Solanum esuriale (Quena)*	0.1	6	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.1	10	no	N
	Trifolium arvense (Haresfoot Clover)	0.1	15	no	E
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.1	10	no	N
	Tribulus terrestris (Cat-head)	0.2	100	no	E
Forb (FG)	*Calotis cuneifolia (Purple Burr-Daisy)*	0.1	5	no	N
Grass & grasslike (GG)	*Carex spp.*	0.1	1	no	N
Forb (FG)	*Wahlenbergia communis (Tufted Bluebell)*	0.1	5	no	N
	Chondrilla juncea (Skeleton Weed)	0.1	1	no	E
	Lepidium africanum (Common Peppercress)	0.1	3	no	E
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	0.1	8	no	N

BAM Site – Field Survey Form

Plot ID:	Plot 012	**Date:**	30/03/21	**Project number:**	J190417		**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	531,868	**Recorders:**	GS RP			
Zone:	55	**Northing:**	6,280,915	**IBRA region:**	NSW South Western Slopes		**Midline bearing:**	102
Plant Community Type:			82: Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion		**Condition class:**	DNG	**PCT confidence:**	medium
Vegetation Class:			Floodplain Transition Woodlands		**EEC:**	yes	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	3
	Grasses etc.:	6
	Forbs:	8
	Ferns:	1
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	1.2
	Grasses etc.:	96.3
	Forbs:	1
	Ferns:	0.5
	Other:	0.2
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	5	4	5	7	3
Average litter cover (%):	4.8				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Flat of alluvial terrace / rise. Very low gradient E aspect. Red loamy clay, moderate to poor drainage.

Plot Disturbance

Cleared and grazed.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	Plot 012	**Date:**	30/03/21

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Walwhalleya proluta*	85	12000	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	10	1500	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	1	100	no	N
Grass & grasslike (GG)	*Aristida ramosa (Purple Wiregrass)*	0.1	5	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	0.1	20	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.1	40	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.1	15	no	N
Shrub (SG)	*Salsola australis*	0.1	10	no	N
Forb (FG)	*Wahlenbergia communis (Tufted Bluebell)*	0.1	10	no	N
	Chondrilla juncea (Skeleton Weed)	0.1	8	no	E
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.2	30	no	N
Fern (EG)	*Cheilanthes sieberi (Rock Fern)*	0.5	150	no	N
Forb (FG)	*Oxalis perennans*	0.3	100	no	N
Forb (FG)	*Vittadinia gracilis (Woolly New Holland Daisy)*	0.1	20	no	N
Forb (FG)	*Dichondra repens (Kidney Weed)*	0.1	100	no	N
Shrub (SG)	*Atriplex spp. (A Saltbush)*	0.1	4	no	N
	Trifolium arvense (Haresfoot Clover)	0.1	50	no	E
Forb (FG)	*Solanum esuriale (Quena)*	0.1	10	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.1	20	no	N
Shrub (SG)	*Maireana aphylla (Cotton Bush)*	1	2	no	N
Grass & grasslike (GG)	*Juncus falcatus*	0.1	1	no	N

BAM Site – Field Survey Form

Plot ID:	Plot 022	**Date:**	27/04/21	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	532,476	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,279,148	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	75
Plant Community Type:		82: Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion		**Condition class:**	DNG	**PCT confidence:**	medium
Vegetation Class:		Floodplain Transition Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	3
	Grasses etc.:	8
	Forbs:	10
	Ferns:	1
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	0.3
	Grasses etc.:	95.2
	Forbs:	1
	Ferns:	0.5
	Other:	0.2
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	15	20	5	10	10
Average litter cover (%):	12				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain / foot slope. Low S gradient. Moderate drainage. Red brown clay

Plot Disturbance

Historic clearing and grazing.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	Plot 022	**Date:**	27/04/21

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Austrostipa scabra (Speargrass)*	20	1500	no	N
Grass & grasslike (GG)	*Bothriochloa decipiens var. decipiens (Pitted Bluegrass)*	3	200	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	35	4000	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	30	3000	no	N
Grass & grasslike (GG)	*Paspalidium jubiflorum (Warrego Grass)*	2	100	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	5	400	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	12	no	N
Fern (EG)	*Cheilanthes sieberi (Rock Fern)*	0.5	60	no	N
Forb (FG)	*Oxalis perennans*	0.1	20	no	N
	Hypochaeris glabra (Smooth Catsear)	0.1	6	no	E
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.2	50	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.1	15	no	N
Forb (FG)	*Solanum esuriale (Quena)*	0.1	8	no	N
	Trifolium arvense (Haresfoot Clover)	0.1	10	no	E
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.1	15	no	N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	0.1	5	no	N
Forb (FG)	*Wahlenbergia communis (Tufted Bluebell)*	0.1	20	no	N
Forb (FG)	*Vittadinia cuneata (A Fuzzweed)*	0.1	20	no	N
Shrub (SG)	*Atriplex spp. (A Saltbush)*	0.1	24	no	N
	Medicago spp. (A Medic)	0.1	10	no	E
Shrub (SG)	*Salsola australis*	0.1	12	no	N
Forb (FG)	*Dichondra repens (Kidney Weed)*	0.1	30	no	N
Grass & grasslike (GG)	*Rytidosperma spp.*	0.1	20	no	N
	Chondrilla juncea (Skeleton Weed)	0.1	5	no	E
Grass & grasslike (GG)	*Carex spp.*	0.1	10	no	N
Shrub (SG)	*Sclerolaena birchii (Galvinized Burr)*	0.1	3	no	N
Forb (FG)	*Rumex brownii (Swamp Dock)*	0.1	4	no	N
	Salvia verbenaca (Vervain)	0.1	8	no	E

BAM Site – Field Survey Form

Plot ID:	Co008	**Date:**	20/04/22	**Project number:**	J190417	**Plot dimensions:**	50x20
Datum:	GDA94	**Easting:**	535,836	**Recorders:**	KV, SJ		
Zone:	55	**Northing:**	6,277,060	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	25
Plant Community Type:		82: Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion		**Condition class:**	DNG	**PCT confidence:**	medium
Vegetation Class:		Floodplain Transition Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	3
	Grasses etc.:	4
	Forbs:	6
	Ferns:	1
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	4.6
	Grasses etc.:	41
	Forbs:	1.5
	Ferns:	0.1
	Other:	0.1
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	15	15	15	20	10
Average litter cover (%):	15				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Flat floodplains

Plot Disturbance

Scattered paddock trees, historic drainage lines, underpowerline easement

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	KV, SJ	**Plot ID:**	Co008	**Date:**	20/04/22

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Chloris truncata (Windmill Grass)*	15	60	no	N
Shrub (SG)	*Maireana brevifolia*	0.1	4	no	N
Grass & grasslike (GG)	*Eragrostis spp. (A Lovegrass)*	25	200	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.1	40	no	N
	Trifolium angustifolium (Narrow-leaved Clover)	1	200	no	E
Shrub (SG)	*Atriplex semibaccata (Creeping Saltbush)*	4	100	yes	N
Forb (FG)	*Dichondra repens (Kidney Weed)*	1	200	no	N
Shrub (SG)	*Salsola australis*	0.5	20	yes	N
Forb (FG)	*Vittadinia sulcata*	0.1	25	no	N
Forb (FG)	*Wahlenbergia spp. (Bluebell)*	0.1	3	no	N
Fern (EG)	*Marsilea spp. (A Nardoo)*	0.1	60	no	N
Forb (FG)	*Oxalis perennans*	0.1	15	no	N
	Conyza bonariensis (Flaxleaf Fleabane)	0.3	100	no	E
Grass & grasslike (GG)	*Bothriochloa macra (Red Grass)*	0.5	100	no	N
Forb (FG)	*Pelargonium australe (Native Storksbill)*	0.1	8	yes	N
Other (OG)	*Convolvulus spp. (A Bindweed)*	0.1	40	yes	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	0.5	50		N

BAM Site – Field Survey Form

Plot ID:	Co010	**Date:**	20/04/22	**Project number:**	J190417		**Plot dimensions:**	20x20
Datum:	GDA94	**Easting:**	532,875	**Recorders:**	RP ST			
Zone:	55	**Northing:**	6,277,392	**IBRA region:**	NSW South Western Slopes		**Midline bearing:**	349
Plant Community Type:			82: Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion		**Condition class:**	DNG	**PCT confidence:**	high
Vegetation Class:			Floodplain Transition Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	1
	Grasses etc.:	8
	Forbs:	7
	Ferns:	1
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	1
	Grasses etc.:	86.1
	Forbs:	11.6
	Ferns:	0.1
	Other:	0
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	100	100	95	100	100
Average litter cover (%):	99				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Flat, with drainage line running through part of the plot. Gilgais present. Spotted Marsh Frog and Eastern Sign-bearing Froglet calling. No drainage.

Plot Disturbance

Adjacent to sealed road

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	RP ST	**Plot ID:**	Co010	**Date:**	20/04/22

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Paspalum distichum (Water Couch)*	5	50	no	N
Grass & grasslike (GG)	*Juncus subglaucus (Rush)*	10	105	no	N
Shrub (SG)	*Sclerolaena muricata (Black Rolypoly)*	1	5	no	N
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	10	100	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	1	25	no	N
Grass & grasslike (GG)	*Dichanthium sericeum (Queensland Bluegrass)*	20	50	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	5	50	no	N
Forb (FG)	*Eclipta platyglossa (Yellow Twin-heads)*	1	25	no	N
Forb (FG)	*Oxalis perennans*	0.2	80	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.1	5	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	5	50	no	N
Fern (EG)	*Marsilea drummondii (Common Nardoo)*	0.1	25	no	N
	Gomphrena celosioides (Gomphrena Weed)	0.1	5	no	E
Forb (FG)	*Wahlenbergia spp. (Bluebell)*	0.1	3	no	N
	Lepidium africanum (Common Peppercress)	0.1	5	no	E
Forb (FG)	*Solanum esuriale (Quena)*	0.1	6	no	N
Grass & grasslike (GG)	*Cyperus spp.*	0.1	5	no	N
	Echinochloa crus-galli (Barnyard Grass)	0.1	10	no	E
	Polygonum bellardii (Tree Hogweed)	0.1	5	no	E
Forb (FG)	*Rumex brownii (Swamp Dock)*	0.1	3	no	N
	Datura stramonium (Common Thornapple)	0.5	16	no	E
	Sonchus oleraceus (Common Sowthistle)	0.1	2	no	E
Grass & grasslike (GG)	*Cynodon dactylon (Common Couch)*	40	50	no	N

BAM Site – Field Survey Form

Plot ID:	Co009	**Date:**	20/04/22	**Project number:**	J190417			**Plot dimensions:**	20x20
Datum:	GDA94	**Easting:**	533,063	**Recorders:**	RP ST				
Zone:	55	**Northing:**	6,276,275	**IBRA region:**	NSW South Western Slopes			**Midline bearing:**	211
Plant Community Type:			82: Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion			**Condition class:**	DNG	**PCT confidence:**	high
Vegetation Class:			Floodplain Transition Woodlands			**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	5
	Grasses etc.:	5
	Forbs:	3
	Ferns:	1
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	4.3
	Grasses etc.:	93
	Forbs:	1.2
	Ferns:	12
	Other:	0
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	90	90	85	90	90
Average litter cover (%):	89				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain, poor drainage, slightly red, mostly brown, silt-clay soil. No gravel or rocks.

Plot Disturbance

No evidenfe

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	RP ST	**Plot ID:**	Co009	**Date:**	20/04/22

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Shrub (SG)	*Duma florulenta (Lignum)*	0.4	2	no	N
Shrub (SG)	*Rhagodia parabolica*	0.6	2	no	N
Grass & grasslike (GG)	*Austrostipa scabra (Speargrass)*	55	850	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	15	50	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	5	50	no	N
Grass & grasslike (GG)	*Sporobolus caroli (Fairy Grass)*	8	50	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	10	100	no	N
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	1	10	no	N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	3	10	no	N
Fern (EG)	*Cheilanthes sieberi (Rock Fern)*	12	100	no	N
Shrub (SG)	*Salsola australis*	0.1	80	no	N
	Sida acuta (Spinyhead Sida)	0.5	80	no	E
Shrub (SG)	*Maireana decalvans (Black Cotton Bush)*	0.2	15	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	35	no	N
Forb (FG)	*Oxalis perennans*	0.1	8	no	N

BAM Site – Field Survey Form

Plot ID:	Co003	**Date:**	20/04/22	**Project number:**	J190417			**Plot dimensions:**	20x20
Datum:	GDA94	**Easting:**	534,963	**Recorders:**	RP ST				
Zone:	55	**Northing:**	6,274,922	**IBRA region:**	NSW South Western Slopes			**Midline bearing:**	47
Plant Community Type:			82: Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion			**Condition class:**	DNG	**PCT confidence:**	medium
Vegetation Class:			Floodplain Transition Woodlands			**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	5
	Grasses etc.:	10
	Forbs:	8
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	1.1
	Grasses etc.:	97.4
	Forbs:	10.6
	Ferns:	0
	Other:	0.1
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	95	100	100	90	100
Average litter cover (%):	97				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Very very slight hillslope. Poor drainage. Red brown clay-silt soil.

Plot Disturbance

No evidence

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	RP ST	**Plot ID:**	Co003	**Date:**	20/04/22

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Chloris truncata (Windmill Grass)*	35	500	no	N
Grass & grasslike (GG)	*Dichanthium sericeum (Queensland Bluegrass)*	10	250	no	N
Grass & grasslike (GG)	*Austrostipa scabra (Speargrass)*	35	600	no	N
Grass & grasslike (GG)	*Sporobolus caroli (Fairy Grass)*	1	30	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	5	50	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	10	30	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	1	30	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	4	100	no	N
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	6	30	no	N
Forb (FG)	*Dichondra repens (Kidney Weed)*	0.1	30	no	N
Forb (FG)	*Oxalis perennans*	0.1	30	no	N
	Lepidium africanum (Common Peppercress)	0.1	6	no	E
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.1	30	no	N
Shrub (SG)	*Sclerolaena muricata (Black Rolypoly)*	0.3	15	no	N
Forb (FG)	*Solanum esuriale (Quena)*	0.1	20	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.1	10	no	N
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	0.1	5	no	N
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	0.1	5	no	N
	Medicago arabica (Spotted Burr Medic)	0.2	50	no	E
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.1	30	no	N
Shrub (SG)	*Maireana brevifolia*	0.3	4	no	N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	0.2	4	no	N
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	0.2	6	no	N
	Chondrilla juncea (Skeleton Weed)	0.1	1	no	E
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.1	3	no	N
Shrub (SG)	*Maireana aphylla (Cotton Bush)*	0.2	4	no	N
Shrub (SG)	*Salsola australis*	0.1	2	no	N

BAM Site – Field Survey Form

Plot ID:	Co005	**Date:**	20/04/22	**Project number:**	J190417			**Plot dimensions:**	20x20
Datum:	GDA94	**Easting:**	535,080	**Recorders:**	RP ST				
Zone:	55	**Northing:**	6,275,345	**IBRA region:**	NSW South Western Slopes			**Midline bearing:**	332
Plant Community Type:			82: Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion			**Condition class:**	DNG	**PCT confidence:**	medium
Vegetation Class:			Floodplain Transition Woodlands			**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	5
	Grasses etc.:	5
	Forbs:	9
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	2
	Grasses etc.:	81.1
	Forbs:	2.5
	Ferns:	0
	Other:	0.2
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	90	100	100	100	100
Average litter cover (%):	98				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Very very gentle hillslope, red browm clay silt soil, no rocks or gravel. Some drainage.

Plot Disturbance

No evidence, except for white cypress pine regenerating vegetation

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	RP ST	**Plot ID:**	Co005	**Date:**	20/04/22

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Austrostipa scabra (Speargrass)*	50	1600	no	N
Grass & grasslike (GG)	*Chloris truncata (Windmill Grass)*	5	30	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	1	15	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	25	400	no	N
Shrub (SG)	*Sclerolaena muricata (Black Rolypoly)*	1	8	no	N
Shrub (SG)	*Sclerolaena birchii (Galvinized Burr)*	0.2	2	no	N
	Conyza bonariensis (Flaxleaf Fleabane)	0.1	2	no	E
Forb (FG)	*Oxalis perennans*	0.2	15	no	N
Shrub (SG)	*Salsola australis*	0.3	20	no	N
Forb (FG)	*Solanum esuriale (Quena)*	0.1	15	no	N
	Polygonum bellardii (Tree Hogweed)	0.1	5	no	E
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.3	25	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.2	35	no	N
	Gomphrena celosioides (Gomphrena Weed)	0.1	3	no	E
Forb (FG)	*Dichondra repens (Kidney Weed)*	0.4	50	no	N
Shrub (SG)	*Maireana brevifolia*	0.3	2	no	N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	0.2	2	no	N
Grass & grasslike (GG)	*Juncus spp. (A Rush)*	0.1	1	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.2	40	no	N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	0.1	1	no	N
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	0.5	3	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.2	50	no	N
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	0.5	2	no	N

BAM Site – Field Survey Form

Plot ID:	Co002	**Date:**	21/04/22	**Project number:**	J190417	**Plot dimensions:**	20x20
Datum:	GDA94	**Easting:**	534,643	**Recorders:**			
Zone:	55	**Northing:**	6,275,359	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	57
Plant Community Type:		82: Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion		**Condition class:**	DNG	**PCT confidence:**	low
Vegetation Class:		Floodplain Transition Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	1
	Grasses etc.:	9
	Forbs:	13
	Ferns:	1
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	0.4
	Grasses etc.:	67.9
	Forbs:	17.4
	Ferns:	0.1
	Other:	0.1
High Threat Weed cover:		0.1

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	85	100	100	100	90
Average litter cover (%):	95				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Very very gentle hillslope. Alectryon oleifolius, Western Grey Box, and White Cypress Pine all within 200m of the plot, though none helpful with PCT ID. Some Drainage, though Juncus is present, so could be PCT 55. Soil red brownclay

Plot Disturbance

Continued from above: no rock. Soil is close enough to brown to map this as PCT 26. PCT 82 is also fine but just looks so odd isolated like this on the map.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:		**Plot ID:**	Co002	**Date:**	21/04/22

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Austrostipa scabra (Speargrass)*	20	200	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	15	100	no	N
Grass & grasslike (GG)	*Chloris truncata (Windmill Grass)*	25	400	no	N
Grass & grasslike (GG)	*Dichanthium sericeum (Queensland Bluegrass)*	0.5	6	no	N
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	0.2	10	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	5	50	no	N
Grass & grasslike (GG)	*Carex spp.*	0.5	10	no	N
Grass & grasslike (GG)	*Juncus spp. (A Rush)*	1.5	12	no	N
	Conyza bonariensis (Flaxleaf Fleabane)	0.2	30	no	E
Forb (FG)	*Dichondra repens (Kidney Weed)*	15	150	no	N
Forb (FG)	*Oxalis perennans*	0.2	30	no	N
	Lepidium africanum (Common Peppercress)	0.1	15	no	E
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.3	10	no	N
	Chondrilla juncea (Skeleton Weed)	0.2	5	no	E
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	0.5	10	no	N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	0.5	50	no	N
	Trifolium spp. (A Clover)	0.5	70	no	E
Forb (FG)	*Epilobium spp.*	0.1	2	no	N
Shrub (SG)	*Maireana aphylla (Cotton Bush)*	0.4	5	no	N
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	0.2	10	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.1	10	no	N
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	0.1	6	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.1	10	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.1	6	no	N
Fern (EG)	*Cheilanthes sieberi (Rock Fern)*	0.1	2	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.2	20	no	N
Forb (FG)	*Solanum esuriale (Quena)*	0.1	10	no	N
Forb (FG)	*Euchiton involucratus (Star Cudweed)*	0.1	5	no	N
	Echium vulgare (Viper's Bugloss)	0.2	5	no	E
	Gomphrena celosioides (Gomphrena Weed)	0.1	3	no	E
Forb (FG)	*Xerochrysum bracteatum (Golden Everlasting)*	0.1	1	no	N
	Xanthium spinosum (Bathurst Burr)	0.1	3	no	HTE
	Sonchus oleraceus (Common Sowthistle)	0.1	4	no	E

BAM Site – Field Survey Form

Plot ID:	Co011	**Date:**	23/04/22	**Project number:**	J190417		**Plot dimensions:**	20x20
Datum:	GDA94	**Easting:**	534,440	**Recorders:**	KV, SJ			
Zone:	55	**Northing:**	6,275,858	**IBRA region:**	NSW South Western Slopes		**Midline bearing:**	270
Plant Community Type:		82: Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion		**Condition class:**	DNG		**PCT confidence:**	high
Vegetation Class:		Floodplain Transition Woodlands		**EEC:**	no		**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	5
	Grasses etc.:	6
	Forbs:	6
	Ferns:	1
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	6.5
	Grasses etc.:	86
	Forbs:	0.8
	Ferns:	0.1
	Other:	0.1
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	5	5	10	1	10
Average litter cover (%):	6.2				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Low lying floodplain,pale orange clays. Scattered distant Myall and White Cypress Pine

Plot Disturbance

No disturbance evident

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	KV, SJ	**Plot ID:**	Co011	**Date:**	23/04/22

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Enteropogon ramosus (Curly Windmill Grass)*	60	500	no	N
Shrub (SG)	*Atriplex semibaccata (Creeping Saltbush)*	5	15	no	N
Shrub (SG)	*Salsola australis*	0.2	30	no	N
Grass & grasslike (GG)	*Cynodon spp.*	25	200	no	N
	Trifolium angustifolium (Narrow-leaved Clover)	0.2	100	no	E
Shrub (SG)	*Sclerolaena spp. (Copperburr, Poverty-bush)*	1	20	no	N
Shrub (SG)	*Maireana brevifolia*	0.2	5	no	N
Forb (FG)	*Oxalis spp.*	0.1	40	no	N
Forb (FG)	*Dichondra repens (Kidney Weed)*	0.3	200	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	6	no	N
Fern (EG)	*Cheilanthes spp. (Cloak Fern, Mulga Fern, Rock Fern)*	0.1	7	no	N
	Chondrilla juncea (Skeleton Weed)	0.1	15	no	E
Forb (FG)	*Sida cunninghamii (Ridge Sida)*	0.1	20	no	N
Other (OG)	*Convolvulus clementii (Desert Bindweed)*	0.1	30	no	N
	Conyza spp. (A Fleabane)	0.1	15	no	E
	Polygonum arenastrum (Wireweed)	0.1	30	no	E
Grass & grasslike (GG)	*Juncus usitatus*	0.1	5		N
Forb (FG)	*Solanum esuriale (Quena)*	0.1	3	no	N
Forb (FG)	*Wahlenbergia spp. (Bluebell)*	0.1	3	no	N
	Poaceae indeterminate (Grasses, reeds and bamboos)	1	50		E
Shrub (SG)	*Sclerolaena birchii (Galvinized Burr)*	0.1	2	no	N
Grass & grasslike (GG)	*Bothriochloa macra (Red Grass)*	0.5	75	no	N
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	0.2	50	no	N
Grass & grasslike (GG)	*Eragrostis australasica (Canegrass)*	0.2	4	no	N

BAM Site – Field Survey Form

Plot ID:	59	**Date:**	24/03/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	533,145	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,276,727	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	166
Plant Community Type:		82: Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion		**Condition class:**	DNG	**PCT confidence:**	medium
Vegetation Class:		Floodplain Transition Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	4
	Grasses etc.:	12
	Forbs:	15
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	6.6
	Grasses etc.:	100.1
	Forbs:	31.5
	Ferns:	0
	Other:	0.2
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	**Tree stem count**		
80 + cm:	0	**Length of logs (m) (≥10 cm diameter, >50 cm in length)**	0
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	**Tree hollow count**	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	**1**	**2**	**3**	**4**	**5**
Subplot score (%):	35	40	20	25	15
Average litter cover (%):	27				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain

Plot Disturbance

Cleared, grazed

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	59	**Date:**	24/03/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	40	320	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	2	75	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	4	800	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	20	160	no	N
	Medicago spp. (A Medic)	1	400	no	E
Forb (FG)	*Solanum esuriale (Quena)*	1	180	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	1	25	no	N
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	9	3200	no	N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	8	2000	no	N
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	6	60	no	N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	0.1	10	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.3	100	no	N
Shrub (SG)	*Salsola australis*	1	30	no	N
	Echium vulgare (Viper's Bugloss)	12	350	no	E
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	6	400	no	N
Grass & grasslike (GG)	*Tragus australianus (Small Burrgrass)*	0.1	20	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	6	1600	no	N
	Cyperaceae indeterminate (Sedges)	0.1	5	no	E
Grass & grasslike (GG)	*Walwhalleya proluta*	10	80	no	N
	Heliotropium europaeum (Potato Weed)	0.1	18	no	E
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	8	800	no	N
Grass & grasslike (GG)	*Echinochloa colona (Awnless Barnyard Grass)*	0.3	42	no	N
Forb (FG)	*Oxalis perennans*	0.1	11	no	N
Shrub (SG)	*Maireana decalvans (Black Cotton Bush)*	3	30	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.2	20	no	N
Forb (FG)	*Boerhavia dominii (Tarvine)*	0.1	3	no	N
Forb (FG)	*Wahlenbergia spp. (Bluebell)*	2	100	no	N
	Cucumis myriocarpus subsp. leptodermis (Paddy Melon)	0.1	5	no	E
Grass & grasslike (GG)	*Austrostipa spp. (A Speargrass)*	4.6	46	no	N
Forb (FG)	*Dichondra repens (Kidney Weed)*	0.5	100	no	N
Forb (FG)	*Alternanthera denticulata (Lesser Joyweed)*	0.3	5	no	N
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	0.1	10	no	N
Shrub (SG)	*Sclerolaena muricata (Black Rolypoly)*	2.5	11	no	N
Grass & grasslike (GG)	*Carex spp.*	1	3	no	N
Grass & grasslike (GG)	*Paspalidium jubiflorum (Warrego Grass)*	1	3	no	N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	0.1	1	no	N
Forb (FG)	*Eclipta platyglossa (Yellow Twin-heads)*	0.1	1	no	N
	Chondrilla juncea (Skeleton Weed)	0.1	1	no	E

BAM Site – Field Survey Form

Plot ID:	61	**Date:**	24/03/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	533,000	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,277,633	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	327
Plant Community Type:		82: Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion		**Condition class:**	DNG	**PCT confidence:**	medium
Vegetation Class:		Floodplain Transition Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	3
	Grasses etc.:	6
	Forbs:	8
	Ferns:	1
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	8.6
	Grasses etc.:	26.8
	Forbs:	13.1
	Ferns:	0.1
	Other:	0.5
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	15	10	5	5	20
Average litter cover (%):	11				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain

Plot Disturbance

Cleared, grazed / cropped

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	61	**Date:**	24/03/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Shrub (SG)	*Salsola australis*	0.5	33	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	20	250	no	N
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	2	100	no	N
	Medicago spp. (A Medic)	3	5000	no	E
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	2	1000	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.5	50	no	N
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	0.5	30	no	N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	5	4000	no	N
Fern (EG)	*Cheilanthes sieberi (Rock Fern)*	0.1	8	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	5	2000	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	1.8	20	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	2	25	no	N
Grass & grasslike (GG)	*Tragus australianus (Small Burrgrass)*	0.5	27	no	N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	0.3	18	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	6	no	N
Forb (FG)	*Boerhavia dominii (Tarvine)*	0.1	1	no	N
Shrub (SG)	*Maireana decalvans (Black Cotton Bush)*	8	70	no	N
Forb (FG)	*Solanum esuriale (Quena)*	0.5	59	no	N
Shrub (SG)	*Sclerolaena spp. (Copperburr, Poverty-bush)*	0.1	1	no	N
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	0.1	3	no	N

BAM Site – Field Survey Form

Plot ID:	5	**Date:**	21/03/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	535,542	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,275,505	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	68
Plant Community Type:		82: Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion		**Condition class:**	DNG	**PCT confidence:**	medium
Vegetation Class:		Floodplain Transition Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	1
	Grasses etc.:	10
	Forbs:	10
	Ferns:	1
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	0.1
	Grasses etc.:	48.8
	Forbs:	7.2
	Ferns:	0.1
	Other:	0
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	3	10	10	10	10
Average litter cover (%):	8.6				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Ridge line of small hill, 5 degree northly aspect

Plot Disturbance

Cleared

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	5	**Date:**	21/03/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	20	600	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	1	50	no	N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	4	1200	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	20	600	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.5	400	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	2	300	no	N
Grass & grasslike (GG)	*Austrostipa scabra (Speargrass)*	2	25	no	N
	Medicago spp. (A Medic)	0.1	10	no	E
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	3	50	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.1	10	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	0.1	10	no	N
Forb (FG)	*Boerhavia dominii (Tarvine)*	0.1	30	no	N
	Heliotropium europaeum (Potato Weed)	0.5	100	no	E
Grass & grasslike (GG)	*Aristida muricata*	0.5	10	no	N
Fern (EG)	*Cheilanthes spp. (Cloak Fern, Mulga Fern, Rock Fern)*	0.1	3	no	N
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	2	25	no	N
Forb (FG)	*Alternanthera denticulata (Lesser Joyweed)*	0.1	1	no	N
Forb (FG)	*Dichondra repens (Kidney Weed)*	0.1	50	no	N
	Tribulus terrestris (Cat-head)	0.1	1	no	E
	Trifolium spp. (A Clover)	0.1	10	no	E
Forb (FG)	*Solanum esuriale (Quena)*	0.1	4	no	N
Grass & grasslike (GG)	*Chloris truncata (Windmill Grass)*	0.1	5	no	N
Shrub (SG)	*Salsola australis*	0.1	2	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	1	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	1	no	N
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	0.1	1	no	N

BAM Site – Field Survey Form

Plot ID:	2	**Date:**	21/03/20	**Project number:**	J190417			**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	535,387	**Recorders:**	GS RP				
Zone:	55	**Northing:**	6,275,543	**IBRA region:**	NSW South Western Slopes			**Midline bearing:**	155
Plant Community Type:			82: Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion			**Condition class:**	DNG	**PCT confidence:**	medium
Vegetation Class:			Floodplain Transition Woodlands			**EEC:**	no	**EEC confidence:**	medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	3
	Grasses etc.:	10
	Forbs:	13
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	1.2
	Grasses etc.:	58.2
	Forbs:	2.6
	Ferns:	0
	Other:	1
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	5	5	5	8	20
Average litter cover (%):	8.6				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain / footslope of small hill

Plot Disturbance

Cleared, cropped / grazed

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	2	**Date:**	21/03/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	30	2000	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	5	200	no	N
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	20	8000	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	1	400	no	N
Forb (FG)	*Rumex tenax (Shiny Dock)*	0.1	4	no	N
Forb (FG)	*Wahlenbergia spp. (Bluebell)*	0.1	25	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	4	no	N
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	0.1	3	no	N
	Heliotropium europaeum (Potato Weed)	0.5	200	no	E
	Echium vulgare (Viper's Bugloss)	2	800	no	E
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.5	200	no	N
	Medicago spp. (A Medic)	0.1	20	no	E
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.1	3	no	N
Forb (FG)	*Dichondra repens (Kidney Weed)*	1	1600	no	N
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	1	100	no	N
Grass & grasslike (GG)	*Bothriochloa macra (Red Grass)*	1.5	60	no	N
Grass & grasslike (GG)	*Austrostipa scabra (Speargrass)*	0.1	15	no	N
	Chondrilla juncea (Skeleton Weed)	0.1	3	no	E
Forb (FG)	*Boerhavia dominii (Tarvine)*	0.1	15	no	N
Forb (FG)	*Oxalis perennans*	0.1	15	no	N
	Avena fatua (Wild Oats)	0.1	1	no	E
	Trifolium spp. (A Clover)	0.1	10	no	E
Grass & grasslike (GG)	*Carex spp.*	0.1	3	no	N
	Melinis repens (Red Natal Grass)	0.1	1	no	E
Shrub (SG)	*Salsola australis*	0.1	3	no	N
Shrub (SG)	*Sclerolaena muricata (Black Rolypoly)*	1	22	no	N
Shrub (SG)	*Maireana brevifolia*	0.1	1	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	0.1	1	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	0.3	3	no	N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	0.1	20	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	3	no	N
	Tribulus terrestris (Cat-head)	0.1	1	no	E
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	0.1	3	no	N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	0.1	10	no	N
Forb (FG)	*Solanum esuriale (Quena)*	0.1	1	no	N

BAM Site – Field Survey Form

Plot ID:	3	**Date:**	24/05/20	**Project number:**	J190417			**Plot dimensions:**	20 x 20
Datum:	GDA94	**Easting:**	535,679	**Recorders:**	RP GS				
Zone:	55	**Northing:**	6,275,370	**IBRA region:**	NSW South Western Slopes			**Midline bearing:**	151
Plant Community Type:			82: Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion			**Condition class:**	DNG	**PCT confidence:**	medium
Vegetation Class:			Floodplain Transition Woodlands			**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	**Trees:**	0
	Shrubs:	3
	Grasses etc.:	10
	Forbs:	12
	Ferns:	1
	Other:	1
Sum of Cover of native vascular plants by growth form group	**Trees:**	0
	Shrubs:	0.4
	Grasses etc.:	39.1
	Forbs:	77.4
	Ferns:	0.1
	Other:	2
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	**Tree stem count**		
80 + cm:	0	**Length of logs (m) (≥10 cm diameter, >50 cm in length)**	0
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	**Tree hollow count**	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	**1**	**2**	**3**	**4**	**5**
Subplot score (%):	2	5	5	2	5
Average litter cover (%):	3.8				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Low hillslope

Plot Disturbance

Cleared grazed

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	RP GS	**Plot ID:**	3	**Date:**	24/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	75	40000	no	N
	Echium plantagineum (Patterson's Curse)	20	1500	no	E
	Medicago polymorpha (Burr Medic)	10	5000	no	E
Grass & grasslike (GG)	*Aristida spp. (A Wiregrass)*	2	75	no	N
Grass & grasslike (GG)	*Aristida behriana (Bunch Wiregrass)*	2	50	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	0.5	50	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	10	45	no	N
Grass & grasslike (GG)	*Echinochloa colona (Awnless Barnyard Grass)*	0.5	50	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	2	80	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	20	75	no	N
Grass & grasslike (GG)	*Austrostipa scabra (Speargrass)*	2	30	no	N
Forb (FG)	*Dichondra repens (Kidney Weed)*	0.5	1000	no	N
Forb (FG)	*Solanum esuriale (Quena)*	0.4	50	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	1	25	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.2	100	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.4	100	no	N
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	1	50	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.3	75	no	N
Grass & grasslike (GG)	*Lomandra spp. (Mat-rush)*	0.1	25	no	N
Forb (FG)	*Wahlenbergia spp. (Bluebell)*	0.1	25	no	N
	Trifolium arvense (Haresfoot Clover)	0.1	10	no	E
Fern (EG)	*Cheilanthes sieberi (Rock Fern)*	0.1	6	no	N
Forb (FG)	*Oxalis perennans*	0.1	6	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.1	100	no	N
Forb (FG)	*Goodenia fascicularis (Mallee Goodenia)*	0.1	25	no	N
Forb (FG)	*Goodenia pinnatifida (Scrambles Eggs)*	0.1	20	no	N
	Avena fatua (Wild Oats)	0.1	3	no	E
Shrub (SG)	*Pimelea curviflora (Rice Flower)*	0.1	10	no	N
Shrub (SG)	*Maireana aphylla (Cotton Bush)*	0.1	2	no	N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	0.1	5	no	N
Shrub (SG)	*Salsola australis*	0.2	1	no	N

BAM Site – Field Survey Form

Plot ID:	4	**Date:**	24/05/20	**Project number:**	J190417			**Plot dimensions:**	20 x 20
Datum:	GDA94	**Easting:**	535,735	**Recorders:**	GS RP				
Zone:	55	**Northing:**	6,275,512	**IBRA region:**	NSW South Western Slopes			**Midline bearing:**	106
Plant Community Type:			82: Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion			**Condition class:**	DNG	**PCT confidence:**	medium
Vegetation Class:			Floodplain Transition Woodlands			**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	5
	Grasses etc.:	10
	Forbs:	9
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	1.9
	Grasses etc.:	81
	Forbs:	27.1
	Ferns:	0
	Other:	0.3
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	5	15	10	5	5
Average litter cover (%):	8				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Low hillslope

Plot Disturbance

Cleared grazed

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	4	**Date:**	24/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	25	2000	no	N
	Medicago polymorpha (Burr Medic)	25	2000	no	E
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	25	1000	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	25	1000	no	N
	Echium plantagineum (Patterson's Curse)	10	400	no	E
Shrub (SG)	*Salsola australis*	1.2	100	no	N
Forb (FG)	*Wahlenbergia communis (Tufted Bluebell)*	0.2	50	no	N
	Salvia verbenaca (Vervain)	0.8	200	no	E
Forb (FG)	*Solanum esuriale (Quena)*	0.2	50	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.3	100	no	N
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	0.3	25	no	N
	Avena fatua (Wild Oats)	0.6	9	no	E
Grass & grasslike (GG)	*Echinochloa colona (Awnless Barnyard Grass)*	0.1	50	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.3	600	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.4	200	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	1	200	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.4	100	no	N
Grass & grasslike (GG)	*Austrostipa scabra (Speargrass)*	2	50	no	N
Shrub (SG)	*Sclerolaena spp. (Copperburr, Poverty-bush)*	0.1	15	no	N
Grass & grasslike (GG)	*Aristida behriana (Bunch Wiregrass)*	2	50	no	N
Grass & grasslike (GG)	*Aristida ramosa (Purple Wiregrass)*	0.6	50	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	25	1000	no	N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	0.2	50	no	N
	Medicago spp. (A Medic)	0.1	20	no	E
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.2	50	no	N
Forb (FG)	*Goodenia fascicularis (Mallee Goodenia)*	0.1	50	no	N
Grass & grasslike (GG)	*Sporobolus caroli (Fairy Grass)*	0.1	7	no	N
Shrub (SG)	*Maireana humillima*	0.1	20	no	N
Shrub (SG)	*Maireana aphylla (Cotton Bush)*	0.3	3	no	N
Grass & grasslike (GG)	*Rytidosperma spp.*	0.2	20	no	N
	Lolium perenne (Perennial Ryegrass)	0.4	15	no	E

BAM Site – Field Survey Form

Plot ID:	65	**Date:**	25/05/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	532,978	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,277,786	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	90
Plant Community Type:		82: Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion		**Condition class:**	DNG	**PCT confidence:**	medium
Vegetation Class:		Floodplain Transition Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	4
	Grasses etc.:	8
	Forbs:	14
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0.2
	Shrubs:	6.1
	Grasses etc.:	15.9
	Forbs:	23.8
	Ferns:	0
	Other:	3
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	1		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	5	70	10	2	15
Average litter cover (%):	20.4				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features
Alluvial grass

Plot Disturbance
Cleared

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	65	**Date:**	25/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	20	600	no	N
	Medicago arabica (Spotted Burr Medic)	25	400	no	E
	Medicago polymorpha (Burr Medic)	0.4	50	no	E
Shrub (SG)	*Sclerolaena birchii (Galvinized Burr)*	0.9	20	no	N
Tree (TG)	*Acacia pendula (Weeping Myall, Boree)*	0.2	1	yes	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	5	100	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.1	50	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.7	100	no	N
Shrub (SG)	*Salsola australis*	0.1	15	no	N
Forb (FG)	*Crassula sieberiana (Australian Stonecrop)*	0.2	400	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.2	50	no	N
Grass & grasslike (GG)	*Echinochloa colona (Awnless Barnyard Grass)*	1	50	no	N
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	0.7	50	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	100	no	N
Grass & grasslike (GG)	*Tragus australianus (Small Burrgrass)*	0.1	20	no	N
Forb (FG)	*Alternanthera denticulata (Lesser Joyweed)*	0.1	50	no	N
Forb (FG)	*Calotis hispidula (Bogan Flea)*	1	50	no	N
Forb (FG)	*Goodenia pinnatifida (Scrambles Eggs)*	0.5	50	no	N
	Hypochaeris glabra (Smooth Catsear)	0.1	7	no	E
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	3	100	no	N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	0.1	25	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	3	100	no	N
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	0.1	50	no	N
Grass & grasslike (GG)	*Paspalidium jubiflorum (Warrego Grass)*	5	100	no	N
Forb (FG)	*Solanum esuriale (Quena)*	0.5	75	no	N
Forb (FG)	*Oxalis perennans*	0.1	15	no	N
	Lolium perenne (Perennial Ryegrass)	0.3	40	no	E
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.1	50	no	N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	5	50	no	N
Shrub (SG)	*Maireana spp. (Cotton Bush, Bluebush, Fissure-weed)*	0.1	25	no	N
Grass & grasslike (GG)	*Austrostipa scabra (Speargrass)*	1	50	no	N
	Avena fatua (Wild Oats)	0.1	5	no	E
Grass & grasslike (GG)	*Rytidosperma spp.*	0.1	5	yes	N

BAM Site – Field Survey Form

Plot ID:	C7	**Date:**	17/12/22	**Project number:**	J190417	**Plot dimensions:**	20 x 50 m
Datum:	GDA94	**Easting:**	532,473	**Recorders:**	TO		
Zone:	55	**Northing:**	6,278,654	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	48
Plant Community Type:		82: Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion		**Condition class:**	Poor	**PCT confidence:**	High
Vegetation Class:		Floodplain Transition Woodlands		**EEC:**	no	**EEC confidence:**	high

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	4
	Grasses etc.:	8
	Forbs:	14
	Ferns:	1
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	3
	Shrubs:	5.85
	Grasses etc.:	78.3
	Forbs:	1.09
	Ferns:	1
	Other:	0.05
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	9
80 + cm:	0		
50 – 79 cm:	1		
30 – 49 cm:	0		
20 – 29 cm:	2	Tree hollow count	0
10 – 19 cm:	1		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	50	60	40	20	50
Average litter cover (%):	44				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Plot Disturbance

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	TO	**Plot ID:**	C7	**Date:**	17/12/22

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Alectryon oleifolius (Western Rosewood)*	3	3		N
Grass & grasslike (GG)	*Austrostipa aristiglumis (Plains Grass)*	45	1000		N
Grass & grasslike (GG)	*Rytidosperma caespitosum (Ringed Wallaby Grass)*	25	1000	yes	N
	Centaurium tenuiflorum (Branched Centaury, Slender centaury)	0.1	10		E
Forb (FG)	*Pseudognaphalium luteoalbum (Jersey Cudweed)*	0.05	5		N
	Trifolium angustifolium (Narrow-leaved Clover)	0.1	10		E
Fern (EG)	*Cheilanthes sieberi (Rock Fern)*	1	250		N
Forb (FG)	*Euchiton sphaericus (Star Cudweed)*	0.1	20		N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	5	500		N
	Vulpia muralis (Wall Fescue)	0.3	500		E
	Trifolium glomeratum (Clustered Clover)	0.2	50		E
Forb (FG)	*Oxalis perennans*	0.1	50		N
Shrub (SG)	*Salsola australis*	0.05	5		N
Shrub (SG)	*Atriplex semibaccata (Creeping Saltbush)*	5	250		N
	Sonchus oleraceus (Common Sowthistle)	0.1	10		E
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.1	30		N
Forb (FG)	*Actinobole uliginosum (Flannel Cudweed)*	0.01	1		N
	Conyza spp. (A Fleabane)	0.05	5		E
Grass & grasslike (GG)	*Austrostipa scabra subsp. falcata (Rough Speargrass)*	2	250		N
	Echium plantagineum (Patterson's Curse)	0.1	20		E
Grass & grasslike (GG)	*Anthosachne scabra (Wheatgrass, Common Wheatgrass)*	0.5	50		N
Forb (FG)	*Vittadinia cuneata (A Fuzzweed)*	0.1	5		N
	Lactuca serriola (Prickly Lettuce)	0.05	2		E
	Avena spp. (Oats)	0.2	20		E
	Gamochaeta purpurea (Purple Cudweed)	0.01	2		E
Grass & grasslike (GG)	*Walwhalleya proluta*	0.3	30		N
	Oenothera stricta subsp. stricta	0.01	1		E
Forb (FG)	*Epilobium billardierianum*	0.1	10		N
Other (OG)	*Convolvulus angustissimus*	0.05	2	yes	N
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	0.2	20		N
Grass & grasslike (GG)	*Carex inversa (Knob Sedge)*	0.3	50		N
Shrub (SG)	*Sclerolaena muricata (Black Rolypoly)*	0.3	20		N
Forb (FG)	*Dichondra sp. A (Kidney Weed)*	0.1	10		N
Forb (FG)	*Rumex brownii (Swamp Dock)*	0.1	3		N
	Lolium rigidum (Wimmera Ryegrass)	0.3	50		E
Forb (FG)	*Heliotropium spp. (A Heliotrope)*	0.1	5		N
	Bromus hordeaceus (Soft Brome)	0.1	10		E
Grass & grasslike (GG)	*Lachnagrostis filiformis*	0.2	20		N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	0.5	50		N
	Trifolium campestre (Hop Clover)	0.1	2		E
	Medicago truncatula (Barrel Medic)	0.05	1		E
	Lepidium africanum (Common Peppercress)	0.01	1		E

Project name:	J190417				
Recorders:	TO	Plot ID:	C7	Date:	17/12/22

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Forb (FG)	*Vittadinia cuneata var. hirsuta*	0.01	1		N
Forb (FG)	*Wahlenbergia spp. (Bluebell)*	0.01	1	yes	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.01	2		N

BAM Site – Field Survey Form

Plot ID:	C8	**Date:**	17/12/22	**Project number:**	J190417	**Plot dimensions:**	20 x 50 m
Datum:	GDA94	**Easting:**	532,647	**Recorders:**	TO		
Zone:	55	**Northing:**	6,280,274	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	57
Plant Community Type:		82: Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion		**Condition class:**	Poor	**PCT confidence:**	High
Vegetation Class:		Floodplain Transition Woodlands		**EEC:**	no	**EEC confidence:**	high

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	4
	Grasses etc.:	10
	Forbs:	14
	Ferns:	1
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	25
	Shrubs:	25.7
	Grasses etc.:	44.4
	Forbs:	1.05
	Ferns:	0.2
	Other:	0
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	1		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	20	30	25	45	10
Average litter cover (%):	26				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Poor condition Inland Greybox Woodland. Tree cover but highly disturbed understorey.

Plot Disturbance

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	TO	**Plot ID:**	C8	**Date:**	17/12/22

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Shrub (SG)	*Geijera parviflora (Wilga)*	25	31		N
Grass & grasslike (GG)	*Austrostipa blackii*	25	1000	yes	N
	Echium plantagineum (Patterson's Curse)	0.2	20		E
	Bromus hordeaceus (Soft Brome)	0.1	10		E
	Medicago truncatula (Barrel Medic)	0.1	10		E
	Avena spp. (Oats)	0.1	5		E
Grass & grasslike (GG)	*Walwhalleya spp.*	3	250		N
	Vulpia muralis (Wall Fescue)	1	1000		E
	Sonchus oleraceus (Common Sowthistle)	0.1	30		E
Forb (FG)	*Oxalis perennans*	0.05	5		N
	Trifolium angustifolium (Narrow-leaved Clover)	2	250		E
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.1	30		N
Grass & grasslike (GG)	*Chloris truncata (Windmill Grass)*	5	500		N
Grass & grasslike (GG)	*Austrostipa scabra subsp. falcata (Rough Speargrass)*	0.3	50		N
	Bromus molliformis (Soft Brome)	0.1	5		E
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	10	500		N
	Polygonum aviculare (Wireweed)	0.1	5		E
Fern (EG)	*Cheilanthes sieberi (Rock Fern)*	0.2	50		N
Tree (TG)	*Brachychiton populneus (Kurrajong)*	25	1		N
Forb (FG)	*Vittadinia cuneata (A Fuzzweed)*	0.05	1		N
	Trifolium campestre (Hop Clover)	0.1	10		E
Forb (FG)	*Euchiton sphaericus (Star Cudweed)*	0.1	10		N
Forb (FG)	*Dichondra sp. A (Kidney Weed)*	0.1	10		N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	0.3	50		N
Grass & grasslike (GG)	*Rytidosperma caespitosum (Ringed Wallaby Grass)*	0.5	100	yes	N
Grass & grasslike (GG)	*Carex inversa (Knob Sedge)*	0.1	10		N
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	0.2	30		N
Shrub (SG)	*Sclerolaena muricata (Black Rolypoly)*	0.2	10		N
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	0.3	50		N
	Lactuca serriola (Prickly Lettuce)	0.05	2		E
	Conyza spp. (A Fleabane)	0.05	5		E
Shrub (SG)	*Maireana humillima*	0.2	20	yes	N
	Solanum nigrum (Black-berry Nightshade)	0.05	1		E
Forb (FG)	*Vittadinia cuneata var. hirsuta*	0.01	1		N
Grass & grasslike (GG)	*Paspalidium gracile (Slender Panic)*	0.2	20		N
	Centaurium tenuiflorum (Branched Centaury, Slender centaury)	0.1	10		E
	Petrorhagia nanteuilii (Proliferous Pink)	0.05	5		E
Forb (FG)	*Pseudognaphalium luteoalbum (Jersey Cudweed)*	0.01	1		N
Forb (FG)	*Crassula sieberiana (Australian Stonecrop)*	0.05	50		N
	Rostraria cristata (Annual Cat's Tail)	0.05	2		E
	Gamochaeta purpurea (Purple Cudweed)	0.01	1		E
Forb (FG)	*Epilobium billardierianum*	0.05	2		N

Project name:	J190417				
Recorders:	TO	**Plot ID:**	C8	**Date:**	17/12/22

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Lachnagrostis filiformis*	0.1	5		N
Forb (FG)	*Isoetopsis graminifolia (Grass Cushion)*	0.01	1		N
Forb (FG)	*Wahlenbergia spp. (Bluebell)*	0.01	1		N
Grass & grasslike (GG)	*Digitaria brownii (Cotton Panic Grass)*	0.2	30		N
Forb (FG)	*Goodenia fascicularis (Mallee Goodenia)*	0.01	1		N
	Trifolium glomeratum (Clustered Clover)	0.2	50		E

BAM Site – Field Survey Form

Plot ID:	64	**Date:**	24/03/20	**Project number:**	J190417	**Plot dimensions:**	10 x 100
Datum:	GDA94	**Easting:**	533,083	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,277,048	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	171
Plant Community Type:		82: Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion		**Condition class:**	Planted	**PCT confidence:**	medium
Vegetation Class:		Floodplain Transition Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	3
	Shrubs:	5
	Grasses etc.:	2
	Forbs:	2
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	8
	Shrubs:	14.5
	Grasses etc.:	8.1
	Forbs:	1.1
	Ferns:	0
	Other:	0
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	1	Tree hollow count	0
10 – 19 cm:	1		
5 – 9 cm:	1		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	20	25	10	45	2
Average litter cover (%):	20.4				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain

Plot Disturbance

Cleared, grazed / cropped. Recently planted circa 15 years

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	64	**Date:**	24/03/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Eucalyptus populnea subsp. bimbil (Bimble Box)*	2.5	5	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	8	100	no	N
Shrub (SG)	*Maireana decalvans (Black Cotton Bush)*	8	104	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	1	16	no	N
Shrub (SG)	*Salsola australis*	6	128	no	N
Shrub (SG)	*Atriplex semibaccata (Creeping Saltbush)*	0.2	16	no	N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	0.1	30	no	N
Tree (TG)	*Acacia pendula (Weeping Myall, Boree)*	4.5	4	no	N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	0.2	7	no	N
Shrub (SG)	*Sclerolaena muricata (Black Rolypoly)*	0.1	10	no	N
Grass & grasslike (GG)	*Austrostipa spp. (A Speargrass)*	0.1	1	no	N
Tree (TG)	*Casuarina cristata (Belah)*	1	1	no	N

BAM Site – Field Survey Form

Plot ID:	Plot 002	**Date:**	27/03/21	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	532,048	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,279,944	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	339
Plant Community Type:		82: Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion		**Condition class:**	Regenerating	**PCT confidence:**	medium
Vegetation Class:		Floodplain Transition Woodlands		**EEC:**	no	**EEC confidence:**	medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	2
	Grasses etc.:	9
	Forbs:	10
	Ferns:	1
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	2
	Shrubs:	4.1
	Grasses etc.:	70.6
	Forbs:	1.9
	Ferns:	2
	Other:	0.2
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	1		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	50	15	7	15	60
Average litter cover (%):	29.4				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Low slope / rise above alluvial plain drainage line. Low gradient, S aspect. Red brown clay. Moderate to poor drainage.

Plot Disturbance

Cleared, grazed. Regenerating with Calitris.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	Plot 002	**Date:**	27/03/21

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Callitris glaucophylla (White Cypress Pine)*	2	12	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	45	1200	no	N
Fern (EG)	*Cheilanthes sieberi (Rock Fern)*	2	1000	no	N
Shrub (SG)	*Atriplex spp. (A Saltbush)*	4	500	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	10	800	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.5	200	no	N
Forb (FG)	*Oxalis perennans*	0.5	800	no	N
Other (OG)	*Convolvulus spp. (A Bindweed)*	0.2	100	no	N
	Trifolium repens (White Clover)	0.1	5	no	E
Forb (FG)	*Alternanthera nana (Hairy Joyweed)*	0.1	10	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	10	500	no	N
Grass & grasslike (GG)	*Austrostipa scabra (Speargrass)*	5	500	no	N
Forb (FG)	*Dichondra repens (Kidney Weed)*	0.2	200	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	0.1	10	no	N
	Echium plantagineum (Patterson's Curse)	0.1	30	no	E
	Chondrilla juncea (Skeleton Weed)	0.2	40	no	E
Forb (FG)	*Wahlenbergia spp. (Bluebell)*	0.1	10	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.1	20	no	N
Forb (FG)	*Boerhavia dominii (Tarvine)*	0.1	10	no	N
Forb (FG)	*Vittadinia cuneata (A Fuzzweed)*	0.1	20	no	N
Grass & grasslike (GG)	*Juncus usitatus*	0.1	5	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	20	no	N
	Salvia verbenaca (Vervain)	0.1	5	no	E
Grass & grasslike (GG)	*Bothriochloa decipiens var. decipiens (Pitted Bluegrass)*	0.2	30	no	N
Grass & grasslike (GG)	*Anthosachne scabra (Wheatgrass, Common Wheatgrass)*	0.1	10	no	N
Shrub (SG)	*Sclerolaena birchii (Galvinized Burr)*	0.1	5	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.1	10	no	N
	Lepidium africanum (Common Peppercress)	0.1	2	no	E
	Conyza bonariensis (Flaxleaf Fleabane)	0.1	5	no	E
Grass & grasslike (GG)	*Rytidosperma spp.*	0.1	6	no	N

BAM Site – Field Survey Form

Plot ID:	Plot 004	**Date:**	27/03/21	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	532,240	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,279,455	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	37
Plant Community Type:		82: Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion		**Condition class:**	Regenerating	**PCT confidence:**	medium
Vegetation Class:		Floodplain Transition Woodlands		**EEC:**	no	**EEC confidence:**	medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	2
	Shrubs:	4
	Grasses etc.:	7
	Forbs:	5
	Ferns:	1
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	13
	Shrubs:	2
	Grasses etc.:	44.1
	Forbs:	0.5
	Ferns:	0.1
	Other:	0.5
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count		
80 + cm:	0	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	1		
5 – 9 cm:	1		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	20	2	20	5	8
Average litter cover (%):	11				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Hill slope. Moderate to low gradient NE aspect. Red clay loam.

Plot Disturbance

Cleared, grazed, delapidated buildings nearby. Low weeds.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	Plot 004	**Date:**	27/03/21

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Aristida behriana (Bunch Wiregrass)*	0.5	30	no	N
Grass & grasslike (GG)	*Rytidosperma spp.*	0.1	10	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	20	1000	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	0.5	20	no	N
Grass & grasslike (GG)	*Austrostipa scabra (Speargrass)*	2	200	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	20	1000	no	N
	Salvia verbenaca (Vervain)	0.5	120	no	E
Forb (FG)	*Wahlenbergia communis (Tufted Bluebell)*	0.1	15	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.1	20	no	N
	Chondrilla juncea (Skeleton Weed)	0.1	30	no	E
Forb (FG)	*Vittadinia gracilis (Woolly New Holland Daisy)*	0.1	12	no	N
Forb (FG)	*Oxalis perennans*	0.1	50	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.5	100	no	N
Shrub (SG)	*Maireana spp. (Cotton Bush, Bluebush, Fissure-weed)*	1	30	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.1	20	no	N
Shrub (SG)	*Maireana spp. (Cotton Bush, Bluebush, Fissure-weed)*	0.1	15	no	N
Shrub (SG)	*Atriplex spp. (A Saltbush)*	0.8	50	no	N
Fern (EG)	*Cheilanthes sieberi (Rock Fern)*	0.1	50	no	N
Tree (TG)	*Callitris glaucophylla (White Cypress Pine)*	3	4	no	N
Tree (TG)	*Alectryon oleifolius (Western Rosewood)*	10	1	no	N
	Conyza bonariensis (Flaxleaf Fleabane)	0.1	20	no	E
Grass & grasslike (GG)	*Aristida ramosa (Purple Wiregrass)*	1	50	no	N
Shrub (SG)	*Sclerolaena birchii (Galvinized Burr)*	0.1	2	no	N

BAM Site – Field Survey Form

Plot ID:	Plot 001	**Date:**	27/03/21	**Project number:**	J190417	**Plot dimensions:**	20x20
Datum:	GDA94	**Easting:**	532,310	**Recorders:**	RP GS		
Zone:	55	**Northing:**	6,280,105	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	7
Plant Community Type:		82: Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion		**Condition class:**	Regenerating	**PCT confidence:**	medium
Vegetation Class:		Floodplain Transition Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	4
	Grasses etc.:	7
	Forbs:	11
	Ferns:	1
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0.1
	Shrubs:	2.2
	Grasses etc.:	62.2
	Forbs:	2.4
	Ferns:	5
	Other:	0.1
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	1		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	2	10	20	10	40
Average litter cover (%):	16.4				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Upper hill slope, easterly aspect, well drained, low gradient, red clay. Gravel on surface.

Plot Disturbance

No evidence

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	RP GS	**Plot ID:**	Plot 001	**Date:**	27/03/21

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Shrub (SG)	*Acacia deanei (Green Wattle)*	1	11	no	N
Grass & grasslike (GG)	*Austrostipa scabra subsp. falcata (Rough Speargrass)*	5	150	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	30	800	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.5	400	no	N
Forb (FG)	*Oxalis spp.*	0.1	30	no	N
Grass & grasslike (GG)	*Aristida ramosa (Purple Wiregrass)*	1	25	no	N
Forb (FG)	*Vittadinia cuneata (A Fuzzweed)*	1	200	no	N
Fern (EG)	*Cheilanthes sieberi (Rock Fern)*	5	150	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	25	800	no	N
Shrub (SG)	*Maireana humillima*	1	200	no	N
Forb (FG)	*Goodenia fascicularis (Mallee Goodenia)*	0.1	10	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.1	50	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	1	30	no	N
Forb (FG)	*Solanum esuriale (Quena)*	0.1	10	no	N
Tree (TG)	*Callitris glaucophylla (White Cypress Pine)*	0.1	1	no	N
	Conyza spp. (A Fleabane)	0.1	1	no	E
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.1	40	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	0.1	10	yes	N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	0.1	1	no	N
Forb (FG)	*Portulaca oleracea (Pigweed)*	0.1	20	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.1	50	no	N
Grass & grasslike (GG)	*Rytidosperma spp.*	0.1	5	yes	N
Shrub (SG)	*Atriplex spp. (A Saltbush)*	0.1	1	no	N
Shrub (SG)	*Sclerolaena birchii (Galvinized Burr)*	0.1	1	no	N
Forb (FG)	*Wahlenbergia communis (Tufted Bluebell)*	0.1	10	no	N
Forb (FG)	*Vittadinia gracilis (Woolly New Holland Daisy)*	0.1	20	no	N

BAM Site – Field Survey Form

Plot ID:	Co004	**Date:**	20/04/22	**Project number:**	J190417		**Plot dimensions:**	20x20
Datum:	GDA94	**Easting:**	532,167	**Recorders:**	RP ST			
Zone:	55	**Northing:**	6,279,288	**IBRA region:**	NSW South Western Slopes		**Midline bearing:**	27
Plant Community Type:			82: Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion		**Condition class:**	Regenerating	**PCT confidence:**	high
Vegetation Class:			Floodplain Transition Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	2
	Shrubs:	1
	Grasses etc.:	9
	Forbs:	10
	Ferns:	1
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	9
	Shrubs:	40
	Grasses etc.:	95
	Forbs:	2.4
	Ferns:	15
	Other:	0.2
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	1		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	95	90	95	80	95
Average litter cover (%):	91				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Very very gentle hillslope, red brown clay soil, ocassionally pieces of quart and some patches of gravel, but mostly he patch lcos gravel. Moderately well drained, aspect NA.

Plot Disturbance

No evidence

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	RP ST	**Plot ID:**	Co004	**Date:**	20/04/22

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Callitris glaucophylla (White Cypress Pine)*	8	53	no	N
Shrub (SG)	*Acacia deanei (Green Wattle)*	40	41	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	25	400	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	25	400	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	1	15	no	N
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	5	25	no	N
Grass & grasslike (GG)	*Aristida ramosa (Purple Wiregrass)*	5	25	no	N
Grass & grasslike (GG)	*Austrostipa verticillata (Slender Bamboo Grass)*	5	25	no	N
Grass & grasslike (GG)	*Austrostipa scabra (Speargrass)*	20	350	no	N
Grass & grasslike (GG)	*Rytidosperma spp.*	1	25	no	N
Fern (EG)	*Cheilanthes sieberi (Rock Fern)*	15	2000	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	1	25	no	N
Forb (FG)	*Xerochrysum bracteatum (Golden Everlasting)*	0.1	10	no	N
Grass & grasslike (GG)	*Bothriochloa macra (Red Grass)*	8	50	no	N
	Salvia verbenaca (Vervain)	0.5	50	no	E
	Cirsium vulgare (Spear Thistle)	0.2	100	no	E
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.2	25	no	N
Tree (TG)	*Acacia dealbata (Silver Wattle)*	1	3	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.2	15	no	N
Forb (FG)	*Goodenia fascicularis (Mallee Goodenia)*	0.1	15	no	N
	Conyza bonariensis (Flaxleaf Fleabane)	3	50	no	E
Forb (FG)	*Oxalis perennans*	0.1	40	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.1	25	no	N
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	0.5	5	no	N
Forb (FG)	*Solanum esuriale (Quena)*	0.1	25	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.1	40	no	N
Forb (FG)	*Chrysocephalum apiculatum (Common Everlasting)*	0.1	3	no	N

BAM Site – Field Survey Form

Plot ID:	67	**Date:**	25/05/20	**Project number:**	J190417		**Plot dimensions:**	20 X 50
Datum:	GDA94	**Easting:**	533,247	**Recorders:**	GS RP			
Zone:	55	**Northing:**	6,276,426	**IBRA region:**	NSW South Western Slopes		**Midline bearing:**	196
Plant Community Type:		82: Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion		**Condition class:**	Medium		**PCT confidence:**	medium
Vegetation Class:		Floodplain Transition Woodlands		**EEC:**	no		**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	3
	Grasses etc.:	10
	Forbs:	10
	Ferns:	1
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	21
	Shrubs:	5.2
	Grasses etc.:	73.2
	Forbs:	14.5
	Ferns:	0.1
	Other:	0.3
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	44
80 + cm:	0		
50 – 79 cm:	1		
30 – 49 cm:	1		
20 – 29 cm:	1	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	20	15	2	5	65
Average litter cover (%):	21.4				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain

Plot Disturbance

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	67	**Date:**	25/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Alectryon oleifolius (Western Rosewood)*	21	21	no	N
Grass & grasslike (GG)	*Rytidosperma spp.*	0.4	25	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	40	200	no	N
	Medicago polymorpha (Burr Medic)	0.1	50	no	E
Forb (FG)	*Crassula sieberiana (Australian Stonecrop)*	5	10000	no	N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	0.2	50	no	N
Grass & grasslike (GG)	*Echinochloa colona (Awnless Barnyard Grass)*	0.1	50	no	N
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	0.1	25	no	N
Shrub (SG)	*Sclerolaena birchii (Galvinized Burr)*	0.1	50	no	N
Grass & grasslike (GG)	*Paspalidium jubiflorum (Warrego Grass)*	30	200	no	N
	Avena spp. (Oats)	0.2	15	no	E
Grass & grasslike (GG)	*Sporobolus caroli (Fairy Grass)*	1	50	no	N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	1	100	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	0.4	25	no	N
	Sisymbrium officinale (Hedge Mustard)	0.1	7	no	E
	Sonchus oleraceus (Common Sowthistle)	0.1	5	no	E
Shrub (SG)	*Maireana brevifolia*	5	85	no	N
Fern (EG)	*Cheilanthes sieberi (Rock Fern)*	0.1	10	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	1	50	no	N
	Medicago laciniata (Cut-leaved Medic)	0.4	25	no	E
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	5	100	no	N
Forb (FG)	*Goodenia pinnatifida (Scrambles Eggs)*	0.4	75	no	N
Forb (FG)	*Solanum esuriale (Quena)*	1	30	no	N
Forb (FG)	*Hypoxis exilis (Swamp Star)*	0.1	5	no	N
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	0.1	50	no	N
Shrub (SG)	*Maireana decalvans (Black Cotton Bush)*	0.1	25	no	N
Forb (FG)	*Goodenia fascicularis (Mallee Goodenia)*	0.4	100	no	N
Grass & grasslike (GG)	*Dichanthium sericeum (Queensland Bluegrass)*	0.1	5	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.3	80	no	N
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	0.4	50		N
Forb (FG)	*Calotis spp. (A Burr-daisy)*	1	100		N

BAM Site – Field Survey Form

Plot ID:	Plot 006	**Date:**	29/03/21	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	535,537	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,275,060	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	127
Plant Community Type:		185: Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion		**Condition class:**	DNG	**PCT confidence:**	medium
Vegetation Class:		Inland Rocky Hill Woodlands		**EEC:**	no	**EEC confidence:**	high

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	1
	Grasses etc.:	6
	Forbs:	7
	Ferns:	1
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	0.1
	Grasses etc.:	97.2
	Forbs:	0.7
	Ferns:	0.1
	Other:	0.1
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	15	20	10	40	15
Average litter cover (%):	20				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Hillslope / crest moderate gradient NE aspect. Brown loamy clay soil, some gravel.

Plot Disturbance

Cleared and grazed.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	Plot 006	**Date:**	29/03/21

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Walwhalleya proluta*	85	4000	no	N
Grass & grasslike (GG)	*Paspalidium jubiflorum (Warrego Grass)*	1	400	no	N
Grass & grasslike (GG)	*Austrostipa scabra (Speargrass)*	0.1	20	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	3	600	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	8	1000	no	N
Fern (EG)	*Cheilanthes sieberi (Rock Fern)*	0.1	20	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.1	10	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.1	50	no	N
	Trifolium arvense (Haresfoot Clover)	0.1	10	no	E
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.1	15	no	N
Forb (FG)	*Boerhavia dominii (Tarvine)*	0.1	6	no	N
Shrub (SG)	*Maireana brevifolia*	0.1	1	no	N
Forb (FG)	*Vittadinia cuneata (A Fuzzweed)*	0.1	5	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.1	2	no	N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	0.1	10	no	N
Forb (FG)	*Alternanthera nana (Hairy Joyweed)*	0.1	15	no	N
Grass & grasslike (GG)	*Aristida ramosa (Purple Wiregrass)*	0.1	6	no	N

BAM Site – Field Survey Form

Plot ID:	Plot 019	**Date:**	27/04/21	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	531,999	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,280,471	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	253
Plant Community Type:		185: Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion		**Condition class:**	DNG	**PCT confidence:**	medium
Vegetation Class:		Inland Rocky Hill Woodlands		**EEC:**	no	**EEC confidence:**	high

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	3
	Grasses etc.:	8
	Forbs:	8
	Ferns:	1
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	2.2
	Grasses etc.:	97.4
	Forbs:	1.2
	Ferns:	0.5
	Other:	0.1
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	5	10	10	8	10
Average litter cover (%):	8.6				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Hillcrest. Gravel brown loamy clay soil. Good drainage.

Plot Disturbance

Cleared and grazed

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	Plot 019	**Date:**	27/04/21

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Austrostipa scabra (Speargrass)*	20	2800	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	65	6000	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	10	1000	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	2	50	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	0.1	5	no	N
Fern (EG)	*Cheilanthes sieberi (Rock Fern)*	0.5	100	no	N
Forb (FG)	*Oxalis perennans*	0.1	8	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.1	30	no	N
Shrub (SG)	*Salsola australis*	0.1	5	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	10	no	N
Forb (FG)	*Boerhavia dominii (Tarvine)*	0.1	15	no	N
Shrub (SG)	*Atriplex spp. (A Saltbush)*	0.1	6	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.1	20	no	N
	Hypochaeris glabra (Smooth Catsear)	0.1	5	no	E
Forb (FG)	*Wahlenbergia communis (Tufted Bluebell)*	0.1	20	no	N
	Conyza bonariensis (Flaxleaf Fleabane)	0.1	4	no	E
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.1	24	no	N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	0.1	5	no	N
	Lepidium africanum (Common Peppercress)	0.1	5	no	E
	Chondrilla juncea (Skeleton Weed)	0.1	2	no	E
Grass & grasslike (GG)	*Rytidosperma spp.*	0.1	5	no	N
	Echium plantagineum (Patterson's Curse)	0.1	6	no	E
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	0.1	10	no	N
Shrub (SG)	*Maireana microphylla (Small-leaf Bluebush)*	2	5	no	N
Forb (FG)	*Vittadinia muelleri (A Fuzzweed)*	0.5	30	no	N
Grass & grasslike (GG)	*Aristida behriana (Bunch Wiregrass)*	0.1	4	no	N

BAM Site – Field Survey Form

Plot ID:	Plot 005	**Date:**	29/03/21	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	535,589	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,275,277	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	237
Plant Community Type:		185: Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion		**Condition class:**	Medium	**PCT confidence:**	medium
Vegetation Class:		Inland Rocky Hill Woodlands		**EEC:**	no	**EEC confidence:**	medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	2
	Shrubs:	7
	Grasses etc.:	6
	Forbs:	10
	Ferns:	1
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	35.1
	Shrubs:	1.7
	Grasses etc.:	49.5
	Forbs:	1.9
	Ferns:	0.1
	Other:	0.1
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	12
80 + cm:	0		
50 – 79 cm:	2		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	45	40	30	60	70
Average litter cover (%):	49				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Hillcrest / ridge, NE aspect. Moderate gradient. Brown clay loamy soil.

Plot Disturbance

Partially cleared and grazed. Minimal weeds, regen present

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	Plot 005	**Date:**	29/03/21

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Eucalyptus dwyeri (Dwyer's Red Gum)*	35	3	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	25	2000	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	1	200	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	20	2000	no	N
	Lepidium africanum (Common Peppercress)	0.1	10	no	E
Forb (FG)	*Einadia hastata (Berry Saltbush)*	1	40	no	N
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	1	25	no	N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	1	50	no	N
Shrub (SG)	*Sclerolaena birchii (Galvinized Burr)*	0.1	5	no	N
Shrub (SG)	*Maireana spp. (Cotton Bush, Bluebush, Fissure-weed)*	0.1	5	no	N
Forb (FG)	*Boerhavia dominii (Tarvine)*	0.1	7	no	N
Forb (FG)	*Alternanthera nana (Hairy Joyweed)*	0.1	4	no	N
Forb (FG)	*Vittadinia cuneata (A Fuzzweed)*	0.1	20	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.1	30	no	N
Shrub (SG)	*Maireana aphylla (Cotton Bush)*	0.1	3	no	N
Grass & grasslike (GG)	*Austrostipa scabra (Speargrass)*	0.5	200	no	N
Fern (EG)	*Cheilanthes sieberi (Rock Fern)*	0.1	10	no	N
Shrub (SG)	*Atriplex spp. (A Saltbush)*	0.1	10	no	N
Shrub (SG)	*Salsola australis*	0.1	5	no	N
Forb (FG)	*Solanum esuriale (Quena)*	0.1	15	no	N
	Conyza bonariensis (Flaxleaf Fleabane)	0.1	10	no	E
Grass & grasslike (GG)	*Aristida ramosa (Purple Wiregrass)*	2	200	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.1	20	no	N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	0.1	1	no	N
Tree (TG)	*Alectryon oleifolius (Western Rosewood)*	0.1	1	no	N
	Solanum nigrum (Black-berry Nightshade)	0.1	5	no	E
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	0.1	20	no	N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	0.1	20	no	N
Forb (FG)	*Wahlenbergia communis (Tufted Bluebell)*	0.1	2	no	N
Shrub (SG)	*Rhagodia spinescens (Thorny Saltbush)*	0.2	15	no	N

BAM Site – Field Survey Form

Plot ID:	Co006	**Date:**	20/04/22	**Project number:**	J190417	**Plot dimensions:**	20x50
Datum:	GDA94	**Easting:**	535,539	**Recorders:**	KV, SJ		
Zone:	55	**Northing:**	6,274,732	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	340
Plant Community Type:		185: Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion		**Condition class:**	Medium	**PCT confidence:**	medium
Vegetation Class:		Inland Rocky Hill Woodlands		**EEC:**	no	**EEC confidence:**	medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	2
	Shrubs:	3
	Grasses etc.:	2
	Forbs:	1
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	43
	Shrubs:	0.4
	Grasses etc.:	2.1
	Forbs:	5
	Ferns:	0
	Other:	0
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	52
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	2		
20 – 29 cm:	7	Tree hollow count	1
10 – 19 cm:	61		
5 – 9 cm:	53		
< 5 cm:	17		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	50	100	10	25	1
Average litter cover (%):	37.2				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Low rise over floodplain

Plot Disturbance

Historic tracks and fences, lots of eucalyptus saplings, earthmoving disturbance

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	KV, SJ	**Plot ID:**	Co006	**Date:**	20/04/22

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Eucalyptus sideroxylon (Mugga Ironbark)*	40	50	no	N
Tree (TG)	*Eucalyptus dwyeri (Dwyer's Red Gum)*	3	25	no	N
Shrub (SG)	*Ozothamnus diosmifolius (White Dogwood)*	0.1	3	yes	N
Shrub (SG)	*Sclerolaena birchii (Galvinized Burr)*	0.1	10	no	N
Forb (FG)	*Einadia hastata (Berry Saltbush)*	5	50	no	N
Grass & grasslike (GG)	*Poa spp.*	2	60	no	N
	Conyza spp. (A Fleabane)	0.1	30	no	E
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	0.1	25	no	N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	0.2	6	no	N

BAM Site – Field Survey Form

Plot ID:	Co007	**Date:**	20/04/22	**Project number:**	J190417	**Plot dimensions:**	20x50
Datum:	GDA94	**Easting:**	535,581	**Recorders:**	KV, SJ		
Zone:	55	**Northing:**	6,274,893	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	320
Plant Community Type:		185: Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion		**Condition class:**	Medium	**PCT confidence:**	low
Vegetation Class:		Inland Rocky Hill Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	4
	Grasses etc.:	3
	Forbs:	7
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	20
	Shrubs:	0.9
	Grasses etc.:	67
	Forbs:	3.6
	Ferns:	0
	Other:	0
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	9
80 + cm:	1		
50 – 79 cm:	1		
30 – 49 cm:	1		
20 – 29 cm:	5	Tree hollow count	0
10 – 19 cm:	4		
5 – 9 cm:	5		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	40	30	40	5	10
Average litter cover (%):	25				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

North facing gentle slope, red clays

Plot Disturbance

Grazing and clearing of trees

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	KV, SJ	**Plot ID:**	Co007	**Date:**	20/04/22

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Eucalyptus dwyeri (Dwyer's Red Gum)*	20	13	yes	N
Shrub (SG)	*Geijera parviflora (Wilga)*	0.2	3	no	N
Forb (FG)	*Einadia hastata (Berry Saltbush)*	3	50	no	N
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	25	100	no	N
Grass & grasslike (GG)	*Chloris truncata (Windmill Grass)*	40	200	no	N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	0.5	20	no	N
Shrub (SG)	*Atriplex semibaccata (Creeping Saltbush)*	0.1	10	yes	N
Shrub (SG)	*Maireana aphylla (Cotton Bush)*	0.1	3	no	N
Forb (FG)	*Gonocarpus spp. (Raspwort)*	0.1	10	no	N
	Polygonum arenastrum (Wireweed)	0.1	30	yes	E
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.1	25	yes	N
Forb (FG)	*Oxalis perennans*	0.1	30	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.1	15	no	N
Forb (FG)	*Portulaca oleracea (Pigweed)*	0.1	2	no	N
Forb (FG)	*Calotis spp. (A Burr-daisy)*	0.1	25	yes	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	2	100	no	N

BAM Site – Field Survey Form

Plot ID:	Plot 010	**Date:**	30/03/21	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	531,691	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,280,562	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	294
Plant Community Type:		185: Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion		**Condition class:**	High	**PCT confidence:**	medium
Vegetation Class:		Inland Rocky Hill Woodlands		**EEC:**	no	**EEC confidence:**	high

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	3
	Shrubs:	2
	Grasses etc.:	9
	Forbs:	10
	Ferns:	1
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	39
	Shrubs:	0.4
	Grasses etc.:	56.5
	Forbs:	1.9
	Ferns:	0.1
	Other:	0.1
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	119
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	1		
20 – 29 cm:	1	Tree hollow count	6
10 – 19 cm:	1		
5 – 9 cm:	1		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	25	8	20	2	5
Average litter cover (%):	12				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Hillslope / crest, moderate gradient E aspect. Gravel with red brown clay loam soil. Good drainage.

Plot Disturbance

Partially cleared and grazed, some storm damage.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	Plot 010	**Date:**	30/03/21

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Eucalyptus dwyeri (Dwyer's Red Gum)*	25	5	no	N
Tree (TG)	*Eucalyptus sideroxylon (Mugga Ironbark)*	10	1	no	N
Tree (TG)	*Brachychiton populneus (Kurrajong)*	4	1	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	50	8000	no	N
Grass & grasslike (GG)	*Austrostipa scabra (Speargrass)*	2	500	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	2	500	no	N
Grass & grasslike (GG)	*Rytidosperma caespitosum (Ringed Wallaby Grass)*	2	500	no	N
Grass & grasslike (GG)	*Paspalidium jubiflorum (Warrego Grass)*	0.1	10	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	0.1	5	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	0.1	15	no	N
Shrub (SG)	*Maireana aphylla (Cotton Bush)*	0.3	5	no	N
Forb (FG)	*Oxalis perennans*	0.1	50	no	N
Fern (EG)	*Cheilanthes sieberi (Rock Fern)*	0.1	40	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.1	10	no	N
Grass & grasslike (GG)	*Dichelachne crinita (Longhair Plumegrass)*	0.1	20	no	N
Forb (FG)	*Gonocarpus elatus (A Raspwort)*	0.1	50	no	N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	0.1	30	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.1	15	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	1	200	no	N
	Solanum nigrum (Black-berry Nightshade)	0.1	5	no	E
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	0.1	10	no	N
Forb (FG)	*Calotis cuneifolia (Purple Burr-Daisy)*	0.1	5	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.1	10	no	N
	Conyza bonariensis (Flaxleaf Fleabane)	0.1	2	no	E
Shrub (SG)	*Salsola australis*	0.1	4	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	1	no	N
Forb (FG)	*Boerhavia dominii (Tarvine)*	0.1	4	no	N
Grass & grasslike (GG)	*Rytidosperma pallidum (Redanther Wallaby Grass; Silvertop Wallaby Grass)*	0.1	10	no	N

BAM Site – Field Survey Form

Plot ID:	Plot 011	**Date:**	30/03/21	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	531,529	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,281,055	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	268
Plant Community Type:		185: Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion		**Condition class:**	High	**PCT confidence:**	medium
Vegetation Class:		Inland Rocky Hill Woodlands		**EEC:**	no	**EEC confidence:**	medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	2
	Shrubs:	3
	Grasses etc.:	9
	Forbs:	11
	Ferns:	1
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	50
	Shrubs:	0.7
	Grasses etc.:	82.4
	Forbs:	3.4
	Ferns:	0.1
	Other:	0
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	115
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	2		
20 – 29 cm:	1	Tree hollow count	2
10 – 19 cm:	1		
5 – 9 cm:	1		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	15	30	30	5	60
Average litter cover (%):	28				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Hillslope / crest, low hills above alluvial plain. Moderate gradient N aspect. Gravel with red brown clay loam soil.

Plot Disturbance

Partially cleared and grazed, some storm damage.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	Plot 011	**Date:**	30/03/21

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Eucalyptus dwyeri (Dwyer's Red Gum)*	40	9	no	N
Tree (TG)	*Eucalyptus sideroxylon (Mugga Ironbark)*	10	1	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	65	10000	no	N
Grass & grasslike (GG)	*Austrostipa scabra (Speargrass)*	8	1000	no	N
Forb (FG)	*Gonocarpus elatus (A Raspwort)*	1	300	no	N
Grass & grasslike (GG)	*Rytidosperma caespitosum (Ringed Wallaby Grass)*	4	600	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	2	200	no	N
Grass & grasslike (GG)	*Aristida behriana (Bunch Wiregrass)*	0.1	30	no	N
Forb (FG)	*Oxalis perennans*	1	300	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.1	30	no	N
Forb (FG)	*Goodenia spp.*	0.1	1	no	N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	0.2	100	no	N
Fern (EG)	*Cheilanthes sieberi (Rock Fern)*	0.1	50	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.5	300	no	N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	0.1	1	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	3	200	no	N
Shrub (SG)	*Maireana aphylla (Cotton Bush)*	0.1	6	no	N
Grass & grasslike (GG)	*Rytidosperma pallidum (Redanther Wallaby Grass; Silvertop Wallaby Grass)*	0.1	25	no	N
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	0.1	20	no	N
Forb (FG)	*Calotis cuneifolia (Purple Burr-Daisy)*	0.1	5	no	N
Forb (FG)	*Vittadinia cuneata (A Fuzzweed)*	0.1	10	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.1	12	no	N
	Conyza bonariensis (Flaxleaf Fleabane)	0.1	6	no	E
Grass & grasslike (GG)	*Aristida ramosa (Purple Wiregrass)*	0.1	15	no	N
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	0.1	5	no	N
Shrub (SG)	*Dodonaea viscosa (Sticky Hop-bush)*	0.5	3	no	N
Shrub (SG)	*Atriplex spp. (A Saltbush)*	0.1	1	no	N

BAM Site – Field Survey Form

Plot ID:	Plot 013	**Date:**	30/03/21	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	532,098	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,280,471	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	66
Plant Community Type:		185: Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion		**Condition class:**	High	**PCT confidence:**	medium
Vegetation Class:		Inland Rocky Hill Woodlands		**EEC:**	no	**EEC confidence:**	medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	3
	Shrubs:	6
	Grasses etc.:	7
	Forbs:	12
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	58
	Shrubs:	1.4
	Grasses etc.:	40.1
	Forbs:	24.3
	Ferns:	0
	Other:	0
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	48
80 + cm:	0		
50 – 79 cm:	5		
30 – 49 cm:	4		
20 – 29 cm:	1	Tree hollow count	4
10 – 19 cm:	1		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	38	90	70	15	55
Average litter cover (%):	53.6				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Hillslope / crest moderate gradient E aspect. Red brown clay loam soil with gravel. Good drainage.

Plot Disturbance

Partially cleared, grazed. Storm damage.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	Plot 013	**Date:**	30/03/21

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Eucalyptus dwyeri (Dwyer's Red Gum)*	30	6	no	N
Tree (TG)	*Eucalyptus sideroxylon (Mugga Ironbark)*	20	3	no	N
Tree (TG)	*Alectryon oleifolius (Western Rosewood)*	8	6	no	N
Grass & grasslike (GG)	*Rytidosperma caespitosum (Ringed Wallaby Grass)*	15	1200	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	13	1000	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	5	600	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	2	100	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	2	80	no	N
Grass & grasslike (GG)	*Carex spp.*	0.1	3	no	N
Grass & grasslike (GG)	*Austrostipa scabra (Speargrass)*	3	250	no	N
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	20	800	no	N
Forb (FG)	*Rumex brownii (Swamp Dock)*	0.5	30	no	N
Shrub (SG)	*Sclerolaena birchii (Galvinized Burr)*	0.5	60	no	N
Forb (FG)	*Solanum esuriale (Quena)*	0.1	25	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	1	100	no	N
Forb (FG)	*Oxalis perennans*	2	50	no	N
Shrub (SG)	*Atriplex spp. (A Saltbush)*	0.1	4	no	N
Shrub (SG)	*Maireana aphylla (Cotton Bush)*	0.5	6	no	N
Forb (FG)	*Vittadinia cuneata (A Fuzzweed)*	0.1	18	no	N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	0.1	40	no	N
Shrub (SG)	*Salsola australis*	0.1	5	no	N
	Conyza bonariensis (Flaxleaf Fleabane)	0.1	5	no	E
Forb (FG)	*Portulaca oleracea (Pigweed)*	0.1	3	no	N
Forb (FG)	*Einadia hastata (Berry Saltbush)*	0.1	4	no	N
	Lepidium africanum (Common Peppercress)	0.1	6	no	E
Shrub (SG)	*Maireana decalvans (Black Cotton Bush)*	0.1	5	no	N
Forb (FG)	*Boerhavia dominii (Tarvine)*	0.1	10	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.1	7	no	N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	0.1	5	no	N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	0.1	3	no	N

BAM Site – Field Survey Form

Plot ID:	Plot 020	**Date:**	27/04/21	**Project number:**	J190417	**Plot dimensions:**	20x50
Datum:	GDA94	**Easting:**	531,875	**Recorders:**	RP GS		
Zone:	55	**Northing:**	6,280,415	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	207
Plant Community Type:		185: Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion		**Condition class:**	High	**PCT confidence:**	high
Vegetation Class:		Inland Rocky Hill Woodlands		**EEC:**	no	**EEC confidence:**	high

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	2
	Shrubs:	3
	Grasses etc.:	8
	Forbs:	11
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	10
	Shrubs:	1.5
	Grasses etc.:	46.2
	Forbs:	2
	Ferns:	0
	Other:	0.1
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	54
80 + cm:	0		
50 – 79 cm:	2		
30 – 49 cm:	1		
20 – 29 cm:	1	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	32	13	7	10	21
Average litter cover (%):	16.6				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Hillcrest

Plot Disturbance

Grazed by cattle

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	RP GS	**Plot ID:**	Plot 020	**Date:**	27/04/21

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Eucalyptus dwyeri (Dwyer's Red Gum)*	5	3	no	N
Tree (TG)	*Eucalyptus sideroxylon (Mugga Ironbark)*	5	3	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	12	100	no	N
Grass & grasslike (GG)	*Rytidosperma spp.*	1	30	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	8	100	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	5	50	no	N
Grass & grasslike (GG)	*Austrostipa scabra (Speargrass)*	12	200	no	N
Grass & grasslike (GG)	*Digitaria spp. (A Finger Grass)*	0.1	10	no	N
Grass & grasslike (GG)	*Rytidosperma spp.*	8	80	no	N
Shrub (SG)	*Atriplex spp. (A Saltbush)*	0.2	3	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.6	50	no	N
Forb (FG)	*Boerhavia dominii (Tarvine)*	0.2	35	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.2	30	no	N
Forb (FG)	*Oxalis perennans*	0.1	5	no	N
Other (OG)	*Convolvulus spp. (A Bindweed)*	0.1	30	no	N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	0.1	20	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	0.1	10	no	N
Forb (FG)	*Rumex brownii (Swamp Dock)*	0.2	8	no	N
	Solanum nigrum (Black-berry Nightshade)	0.1	2	no	E
Shrub (SG)	*Maireana microphylla (Small-leaf Bluebush)*	1	11	no	N
Shrub (SG)	*Maireana aphylla (Cotton Bush)*	0.3	6	no	N
	Chondrilla juncea (Skeleton Weed)	0.1	2	no	E
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	0.2	8	no	N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	0.1	2	no	N
Forb (FG)	*Alternanthera nana (Hairy Joyweed)*	0.1	3	no	N
Forb (FG)	*Gonocarpus tetragynus (Poverty Raspwort)*	0.1	4	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	1	no	N

BAM Site – Field Survey Form

Plot ID:	62	**Date:**	21/05/20	**Project number:**	J190417	**Plot dimensions:**	20 X 50
Datum:	GDA94	**Easting:**	536,870	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,279,290	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	84
Plant Community Type:		244: Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).		**Condition class:**	DNG	**PCT confidence:**	medium
Vegetation Class:		Floodplain Transition Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	4
	Grasses etc.:	8
	Forbs:	12
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	0.9
	Grasses etc.:	59.7
	Forbs:	14
	Ferns:	0
	Other:	0
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	5	5	15	5	5
Average litter cover (%):	7				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain

Plot Disturbance

Cleared grazed

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	62	**Date:**	21/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	20	70	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	2	100	no	N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	1	400	no	N
Grass & grasslike (GG)	*Sporobolus mitchellii (Rat's Tail Couch)*	30	1500	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	8	1200	no	N
Grass & grasslike (GG)	*Echinochloa colona (Awnless Barnyard Grass)*	1	200	no	N
	Solanum nigrum (Black-berry Nightshade)	0.1	9	no	E
	Medicago polymorpha (Burr Medic)	1	60	no	E
Grass & grasslike (GG)	*Walwhalleya proluta*	2	50	no	N
	Brassica rapa subsp. campestris (Turnip)	0.2	6	no	E
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	1	200	no	N
	Lolium spp. (A Ryegrass)	0.2	25	yes	E
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	1	20	yes	N
Forb (FG)	*Limosella curdieana (Large Mudwort)*	0.3	50	yes	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	1	200	no	N
Shrub (SG)	*Maireana decalvans (Black Cotton Bush)*	0.4	30	yes	N
Forb (FG)	*Goodenia spp.*	0.1	50	no	N
Forb (FG)	*Asteraceae indeterminate (Daisies)*	0.1	5	yes	N
Shrub (SG)	*Salsola australis*	0.2	6	no	N
	Cyperaceae indeterminate (Sedges)	0.1	6		E
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	4	50		N
Forb (FG)	*Dichondra repens (Kidney Weed)*	1	100		N
Forb (FG)	*Goodenia pinnatifida (Scrambles Eggs)*	0.1	20		N
Grass & grasslike (GG)	*Paspalidium jubiflorum (Warrego Grass)*	0.6	50		N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	10		N
Forb (FG)	*Calostemma purpureum (Garland Lily)*	0.3	20		N
Shrub (SG)	*Sclerolaena spp. (Copperburr, Poverty-bush)*	0.1	10		N
Shrub (SG)	*Maireana spp. (Cotton Bush, Bluebush, Fissure-weed)*	0.2	30		N
	Echium plantagineum (Patterson's Curse)	0.1	5		E
Grass & grasslike (GG)	*Cyperus spp.*	0.1	5		N
	Avena sativa (Oats)	0.1	6		E

BAM Site – Field Survey Form

Plot ID:	21	**Date:**	21/05/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	537,236	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,279,135	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	261
Plant Community Type:		244: Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).		**Condition class:**	DNG	**PCT confidence:**	medium
Vegetation Class:		Floodplain Transition Woodlands		**EEC:**	no	**EEC confidence:**	medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	8
	Grasses etc.:	9
	Forbs:	13
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	2
	Grasses etc.:	108.1
	Forbs:	11.7
	Ferns:	0
	Other:	0.3
High Threat Weed cover:		1

BAM Attribute (1000 m2 plot) DBH			
DBH	**Tree stem count**	**Length of logs (m) (≥10 cm diameter, >50 cm in length)**	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	**Tree hollow count**	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	**1**	**2**	**3**	**4**	**5**
Subplot score (%):	30	15	20	10	5
Average litter cover (%):	16				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain

Plot Disturbance

Cleared grazed

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	21	**Date:**	21/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	50	1600	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	6	1800	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	1	400	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	1	200	no	N
Forb (FG)	*Crassula sieberiana (Australian Stonecrop)*	0.5	1600	no	N
Grass & grasslike (GG)	*Echinochloa colona (Awnless Barnyard Grass)*	1	50	no	N
Shrub (SG)	*Sclerolaena birchii (Galvinized Burr)*	0.5	9	yes	N
	Poaceae indeterminate (Grasses, reeds and bamboos)	1	50	no	E
	Medicago polymorpha (Burr Medic)	3	100	no	E
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.3	50	no	N
Grass & grasslike (GG)	*Sporobolus caroli (Fairy Grass)*	1	100	no	N
Grass & grasslike (GG)	*Dichanthium sericeum (Queensland Bluegrass)*	1	100	yes	N
	Phyla canescens (Lippia)	1	20	no	HTE
Forb (FG)	*Oxalis perennans*	0.5	50	no	N
Grass & grasslike (GG)	*Sporobolus mitchellii (Rat's Tail Couch)*	15	100	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	1	600	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	25	200	no	N
	Sonchus oleraceus (Common Sowthistle)	0.1	10	no	E
Shrub (SG)	*Salsola australis*	0.5	20	no	N
Shrub (SG)	*Sclerolaena spp. (Copperburr, Poverty-bush)*	0.1	1	yes	N
	Brassica x napus (Rape)	0.1	10		E
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	5	10		N
Forb (FG)	*Dichondra repens (Kidney Weed)*	0.1	150		N
Forb (FG)	*Oreomyrrhis spp.*	0.1	25		N
Shrub (SG)	*Sclerolaena spp. (Copperburr, Poverty-bush)*	0.1	10		N
Forb (FG)	*Solanum esuriale (Quena)*	1	400		N
Shrub (SG)	*Atriplex spp. (A Saltbush)*	0.5	50		N
Forb (FG)	*Goodenia pinnatifida (Scrambles Eggs)*	0.2	70		N
	Trifolium spp. (A Clover)	0.1	25		E
	Medicago spp. (A Medic)	0.5	400		E
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	0.1	10		N
Forb (FG)	*Calostemma purpureum (Garland Lily)*	0.1	10		N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	10	500		N
Forb (FG)	*Goodenia spp.*	0.1	50		N
Grass & grasslike (GG)	*Eragrostis australasica (Canegrass)*	0.1	10		N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	50		N
Shrub (SG)	*Abutilon spp. (Lantern-bush)*	0.1	5		N
Shrub (SG)	*Maireana spp. (Cotton Bush, Bluebush, Fissure-weed)*	0.1	10		N
	Chenopodiaceae indeterminate (Salt-bushes)	0.1	5		E

BAM Site – Field Survey Form

Plot ID:	C9	**Date:**	18/12/22	**Project number:**	J190417	**Plot dimensions:**	20 x 50 m
Datum:	GDA94	**Easting:**	536,572	**Recorders:**	TO		
Zone:	55	**Northing:**	6,279,362	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	65
Plant Community Type:		244: Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).		**Condition class:**	Medium	**PCT confidence:**	High
Vegetation Class:		Floodplain Transition Woodlands		**EEC:**	no	**EEC confidence:**	high

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	1
	Grasses etc.:	7
	Forbs:	4
	Ferns:	1
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	2
	Shrubs:	0.1
	Grasses etc.:	37.7
	Forbs:	10.65
	Ferns:	0.1
	Other:	0
High Threat Weed cover:		1

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	1		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	50	40	20	10	10
Average litter cover (%):	26				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Derived native grassland for Poplar Box Woodland community. No trees.

Plot Disturbance

Storm damage- severity 2, recent, flood affected.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	TO	**Plot ID:**	C9	**Date:**	18/12/22

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Eucalyptus spp.*	2	1		N
Grass & grasslike (GG)	*Juncus aridicola (Tussock Rush)*	2	100		N
	Cyperus eragrostis (Umbrella Sedge)	1	20		HTE
Grass & grasslike (GG)	*Carex inversa (Knob Sedge)*	20	2000		N
	Phalaris paradoxa (Paradoxa Grass)	0.1	5		E
	Lolium rigidum (Wimmera Ryegrass)	0.1	10		E
Forb (FG)	*Lobelia concolor (Poison Pratia)*	10	1000		N
Forb (FG)	*Alternanthera denticulata (Lesser Joyweed)*	0.5	100	yes	N
Grass & grasslike (GG)	*Walwhalleya proluta*	5	250		N
	Oenothera stricta subsp. stricta	0.1	5		E
Grass & grasslike (GG)	*Paspalidium distans*	0.1	20		N
Grass & grasslike (GG)	*Juncus aridicola (Tussock Rush)*	0.1	5	yes	N
Shrub (SG)	*Sclerolaena muricata (Black Rolypoly)*	0.1	10		N
Forb (FG)	*Rumex brownii (Swamp Dock)*	0.1	10		N
Grass & grasslike (GG)	*Amphibromus nervosus (Swamp Wallaby Grass)*	0.5	2	yes	N
	Bromus hordeaceus (Soft Brome)	0.05	1		E
	Avena fatua (Wild Oats)	0.05	1		E
Fern (EG)	*Marsilea hirsuta (Short-fruited Nardoo)*	0.1	30		N
Forb (FG)	*Wahlenbergia fluminalis (River Bluebell)*	0.05	1	yes	N
	Polypogon monspeliensis (Annual Beardgrass)	0.05	2		E
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	10	500		N

BAM Site – Field Survey Form

Plot ID:	60	**Date:**	20/03/20	**Project number:**	J190417			**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	536,267	**Recorders:**	GS RP				
Zone:	55	**Northing:**	6,279,318	**IBRA region:**	NSW South Western Slopes			**Midline bearing:**	90
Plant Community Type:			244: Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).			**Condition class:**	Poor	**PCT confidence:**	medium
Vegetation Class:			Floodplain Transition Woodlands			**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	5
	Grasses etc.:	15
	Forbs:	20
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	8
	Shrubs:	0.5
	Grasses etc.:	27.6
	Forbs:	44.5
	Ferns:	0
	Other:	1
High Threat Weed cover:		0.1

BAM Attribute (1000 m2 plot) DBH			
DBH	**Tree stem count**	**Length of logs (m) (≥10 cm diameter, >50 cm in length)**	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	**Tree hollow count**	0
10 – 19 cm:	1		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	**1**	**2**	**3**	**4**	**5**
Subplot score (%):	10	55	8	30	10
Average litter cover (%):	22.6				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain, adjacent to dry creek bed

Plot Disturbance

Cleared, likely cropping and or grazing in past

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	60	**Date:**	20/03/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Eucalyptus populnea subsp. bimbil (Bimble Box)*	8	1	no	N
Forb (FG)	*Calostemma purpureum (Garland Lily)*	10	1200	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	5	400	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	5	400	no	N
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	2	200	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	8	no	N
	Medicago spp. (A Medic)	5	1600	no	E
Forb (FG)	*Geranium gardneri (Rough Cranes-bill)*	10	600	no	N
Grass & grasslike (GG)	*Cyperus spp.*	2	2000	no	N
	Hypochaeris spp. (A Catsear)	0.2	20	no	E
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	2	100	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	5	400	no	N
Forb (FG)	*Lobelia concolor (Poison Pratia)*	5	1600	no	N
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	10	70	no	N
Forb (FG)	*Oxalis perennans*	0.1	8	no	N
Forb (FG)	*Portulaca oleracea (Pigweed)*	0.1	1	no	N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	0.1	1	no	N
Grass & grasslike (GG)	*Sporobolus mitchellii (Rat's Tail Couch)*	3	200	no	N
	Malva parviflora (Small-flowered Mallow)	0.1	1	no	E
	Sonchus oleraceus (Common Sowthistle)	0.1	20	no	E
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	5	no	N
Grass & grasslike (GG)	*Echinochloa colona (Awnless Barnyard Grass)*	1	100	no	N
	Echium vulgare (Viper's Bugloss)	0.5	15	no	E
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	1	100	no	N
	Xanthium spinosum (Bathurst Burr)	0.1	10	no	HTE
Grass & grasslike (GG)	*Dactyloctenium radulans (Button Grass)*	0.1	2	no	N
Grass & grasslike (GG)	*Paspalidium jubiflorum (Warrego Grass)*	1	50	no	N
	Heliotropium europaeum (Potato Weed)	0.1	10	no	E
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	1	100	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	8	1000	no	N
	Solanum nigrum (Black-berry Nightshade)	0.1	5	no	E
Grass & grasslike (GG)	*Paspalum spp.*	0.2	3	no	N
Forb (FG)	*Wahlenbergia spp. (Bluebell)*	0.1	20	no	N
Grass & grasslike (GG)	*Carex spp.*	0.1	3	no	N
Shrub (SG)	*Salsola australis*	0.1	15	no	N
	Avena spp. (Oats)	0.1	5	no	E
Shrub (SG)	*Sclerolaena muricata (Black Rolypoly)*	0.1	10	no	N
Forb (FG)	*Goodenia spp.*	0.1	16	no	N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	0.1	20	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.1	15	no	N
Grass & grasslike (GG)	*Juncus spp. (A Rush)*	0.1	1	no	N
	Medicago sativa (Lucerne)	0.1	5	no	E

Project name:	J190417				
Recorders:	GS RP	Plot ID:	60	Date:	20/03/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.1	2	no	N
Forb (FG)	*Rumex spp. (Dock)*	0.1	1	no	N
Shrub (SG)	*Rhagodia parabolica*	0.1	1	no	N
	Cirsium spp.	0.1	15	no	E
	Cyperaceae indeterminate (Sedges)	0.1	5	no	E
Forb (FG)	*Eclipta platyglossa (Yellow Twin-heads)*	0.1	3	no	N
Forb (FG)	*Solanum esuriale (Quena)*	0.1	10	no	N
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	0.1	1	no	N
	Cucumis myriocarpus subsp. leptodermis (Paddy Melon)	0.1	1	no	E
Grass & grasslike (GG)	*Chloris truncata (Windmill Grass)*	0.1	1	no	N
Forb (FG)	*Boerhavia dominii (Tarvine)*	0.1	1	no	N
Shrub (SG)	*Maireana decalvans (Black Cotton Bush)*	0.1	1	no	N
Forb (FG)	*Goodenia fascicularis (Mallee Goodenia)*	0.1	1	no	N

BAM Site – Field Survey Form

Plot ID:	63	**Date:**	20/03/20	**Project number:**	J190417		**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	536,514	**Recorders:**	GS RP			
Zone:	55	**Northing:**	6,279,353	**IBRA region:**	NSW South Western Slopes		**Midline bearing:**	32
Plant Community Type:		244: Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).		**Condition class:**	Medium		**PCT confidence:**	medium
Vegetation Class:		Floodplain Transition Woodlands		**EEC:**	no		**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	4
	Grasses etc.:	10
	Forbs:	17
	Ferns:	1
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	25
	Shrubs:	0.7
	Grasses etc.:	66.2
	Forbs:	16.9
	Ferns:	0.3
	Other:	0
High Threat Weed cover:		0.1

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	37
80 + cm:	2		
50 – 79 cm:	5		
30 – 49 cm:	1		
20 – 29 cm:	0	Tree hollow count	5
10 – 19 cm:	1		
5 – 9 cm:	1		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	15	60	30	90	85
Average litter cover (%):	56				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain adjacent to creek

Plot Disturbance

Some clearing in past, probable grazing

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	63	**Date:**	20/03/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Eucalyptus populnea subsp. bimbil (Bimble Box)*	25	2	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	30	1600	no	N
	Echium vulgare (Viper's Bugloss)	10	800	no	E
Grass & grasslike (GG)	*Carex spp.*	25	1600	no	N
Forb (FG)	*Wahlenbergia spp. (Bluebell)*	0.1	30	no	N
Shrub (SG)	*Geijera parviflora (Wilga)*	0.3	1	no	N
Forb (FG)	*Einadia trigonos (Fishweed)*	0.1	5	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	5	400	no	N
Fern (EG)	*Marsilea spp. (A Nardoo)*	0.3	50	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.1	30	no	N
Forb (FG)	*Alternanthera denticulata (Lesser Joyweed)*	1	1600	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	5	400	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	0.5	20	no	N
Forb (FG)	*Boerhavia dominii (Tarvine)*	0.1	20	no	N
Forb (FG)	*Oxalis perennans*	0.1	10	no	N
	Medicago spp. (A Medic)	1	50	no	E
Forb (FG)	*Lobelia concolor (Poison Pratia)*	3	400	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	0.1	5	no	N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	1	50	no	N
	Xanthium spinosum (Bathurst Burr)	0.1	4	no	HTE
	Lactuca serriola (Prickly Lettuce)	0.1	1	no	E
Forb (FG)	*Calostemma purpureum (Garland Lily)*	0.1	1	no	N
	Brassica napus (Canola)	0.1	1	no	E
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	5	100	no	N
Grass & grasslike (GG)	*Echinochloa colona (Awnless Barnyard Grass)*	5	100	no	N
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	0.1	2	no	N
Forb (FG)	*Rumex brownii (Swamp Dock)*	0.4	10	no	N
Shrub (SG)	*Sclerolaena muricata (Black Rolypoly)*	0.2	5	no	N
Shrub (SG)	*Salsola australis*	0.1	1	no	N
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	0.1	5	no	N
	Abutilon grandifolium	0.1	2	no	E
Forb (FG)	*Asteraceae indeterminate (Daisies)*	0.1	8	no	N
Forb (FG)	*Portulaca oleracea (Pigweed)*	0.1	5	no	N
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	0.1	5	no	N
Shrub (SG)	*Rhagodia spinescens (Thorny Saltbush)*	0.1	1	no	N
Forb (FG)	*Maireana enchylaenoides (Wingless Fissure-weed)*	0.1	1	no	N
Forb (FG)	*Alternanthera spp. (Joyweed)*	0.5	50	no	N
	Solanum nigrum (Black-berry Nightshade)	0.1	5	no	E
Grass & grasslike (GG)	*Paspalidium jubiflorum (Warrego Grass)*	0.3	4	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	0.1	1	no	N
	Cyperaceae indeterminate (Sedges)	0.1	1	no	E

BAM Site – Field Survey Form

Plot ID:	22	**Date:**	21/05/20	**Project number:**	J190417	**Plot dimensions:**	20 X 50
Datum:	GDA94	**Easting:**	536,668	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,279,323	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	79
Plant Community Type:		244: Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).		**Condition class:**	Medium	**PCT confidence:**	medium
Vegetation Class:		Floodplain Transition Woodlands		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	5
	Grasses etc.:	7
	Forbs:	8
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	20
	Shrubs:	1.2
	Grasses etc.:	14.6
	Forbs:	2.2
	Ferns:	0
	Other:	0
High Threat Weed cover:		3.3

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	31
80 + cm:	1		
50 – 79 cm:	2		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	2
10 – 19 cm:	0		
5 – 9 cm:	1		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	80	80	15	5	5
Average litter cover (%):	37				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain

Plot Disturbance

Grazed

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	22	**Date:**	21/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Eucalyptus microcarpa (Western Grey Box)*	20	2	no	N
	Echium plantagineum (Patterson's Curse)	80	16000	no	E
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	5	50	no	N
Grass & grasslike (GG)	*Cyperus spp.*	5	50	no	N
	Xanthium spinosum (Bathurst Burr)	3	50	no	HTE
	Malva parviflora (Small-flowered Mallow)	5	50	no	E
	Solanum nigrum (Black-berry Nightshade)	5	50	no	E
Forb (FG)	*Rumex brownii (Swamp Dock)*	0.2	15	no	N
	Lolium perenne (Perennial Ryegrass)	40	4000	no	E
Forb (FG)	*Portulaca oleracea (Pigweed)*	0.1	5	no	N
	Paspalum dilatatum (Paspalum)	0.3	5	no	HTE
	Cyperaceae indeterminate (Sedges)	4	10	no	E
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	1	15	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.1	20	no	N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	0.3	5	no	N
	Medicago polymorpha (Burr Medic)	3	50	no	E
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	0.1	5	no	N
Forb (FG)	*Boerhavia dominii (Tarvine)*	0.1	5	no	N
	Sonchus oleraceus (Common Sowthistle)	0.3	10	no	E
Forb (FG)	*Dichondra repens (Kidney Weed)*	1	50	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	2	25	no	N
Shrub (SG)	*Rhagodia parabolica*	0.5	5	no	N
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	0.5	20	no	N
Grass & grasslike (GG)	*Paspalidium jubiflorum (Warrego Grass)*	1	15	no	N
Shrub (SG)	*Maireana spp. (Cotton Bush, Bluebush, Fissure-weed)*	0.2	6	no	N
Shrub (SG)	*Sclerolaena spp. (Copperburr, Poverty-bush)*	0.1	6	no	N
Shrub (SG)	*Salsola australis*	0.1	9	no	N
	Triticum aestivum (Wheat)	0.1	5	no	E
Forb (FG)	*Alternanthera spp. (Joyweed)*	0.1	3	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	0.5	20	no	N
Forb (FG)	*Oxalis perennans*	0.1	15	no	N
	Brassica rapa subsp. campestris (Turnip)	0.5	6	no	E

BAM Site – Field Survey Form

Plot ID:	8	**Date:**	23/03/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	537,100	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,279,789	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	154
Plant Community Type:		249: River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW		**Condition class:**	DNG	**PCT confidence:**	medium
Vegetation Class:		Inland Riverine Forests		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	6
	Grasses etc.:	11
	Forbs:	13
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0.1
	Shrubs:	0.7
	Grasses etc.:	13
	Forbs:	19
	Ferns:	0
	Other:	0.1
High Threat Weed cover:		2.3

BAM Attribute (1000 m2 plot) DBH			
DBH	**Tree stem count**	**Length of logs (m) (≥10 cm diameter, >50 cm in length)**	6
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	**Tree hollow count**	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	4		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	**1**	**2**	**3**	**4**	**5**
Subplot score (%):	20	30	25	25	15
Average litter cover (%):	23				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain / broad flood channel

Plot Disturbance

Cleared and grazed

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	8	**Date:**	23/03/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Forb (FG)	*Sida corrugata (Corrugated Sida)*	1	200	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	0.3	8	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	1	120	no	N
Forb (FG)	*Teucrium racemosum (Grey Germander)*	0.1	9	no	N
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	1	400	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	15	2000	no	N
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	0.4	50	no	N
Grass & grasslike (GG)	*Paspalidium jubiflorum (Warrego Grass)*	0.5	30	no	N
	Onopordum acanthium subsp. acanthium (Scotch Thistle)	1	50	no	E
Shrub (SG)	*Sclerolaena muricata (Black Rolypoly)*	0.2	3	no	N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	0.2	50	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	0.2	50	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	0.1	30	no	N
	Xanthium spinosum (Bathurst Burr)	0.3	20	no	HTE
	Phyla canescens (Lippia)	2	20	no	HTE
Shrub (SG)	*Sclerolaena stelligera (Star Copperburr)*	0.1	5	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	0.1	5	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	10	200	no	N
Forb (FG)	*Lepidium pseudohyssopifolium (Peppercress)*	0.1	1	no	N
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	0.1	1	no	N
Grass & grasslike (GG)	*Sporobolus mitchellii (Rat's Tail Couch)*	0.1	20	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.1	3	no	N
Shrub (SG)	*Maireana decalvans (Black Cotton Bush)*	0.1	1	no	N
Forb (FG)	*Solanum esuriale (Quena)*	0.1	12	no	N
Forb (FG)	*Goodenia fascicularis (Mallee Goodenia)*	0.1	1	no	N
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	0.2	3	no	N
Shrub (SG)	*Salsola australis*	0.1	2	no	N
Grass & grasslike (GG)	*Austrostipa spp. (A Speargrass)*	0.1	1	no	N
Grass & grasslike (GG)	*Eragrostis australasica (Canegrass)*	0.3	8	no	N
Forb (FG)	*Glycyrrhiza acanthocarpa (Native Liquorice)*	0.8	8	no	N
Shrub (SG)	*Duma florulenta (Lignum)*	0.1	1	no	N
Forb (FG)	*Hibiscus spp.*	0.1	7	no	N
	Echium vulgare (Viper's Bugloss)	0.2	7	no	E
Forb (FG)	*Oxalis perennans*	0.1	2	no	N
	Cucumis myriocarpus subsp. leptodermis (Paddy Melon)	0.4	15	no	E
Shrub (SG)	*Maireana spp. (Cotton Bush, Bluebush, Fissure-weed)*	0.1	1	no	N
Tree (TG)	*Acacia stenophylla (River Cooba)*	0.1	4	no	N

BAM Site – Field Survey Form

Plot ID:	6	**Date:**	23/03/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	537,385	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,279,396	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	179
Plant Community Type:		249: River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW		**Condition class:**	DNG	**PCT confidence:**	medium
Vegetation Class:		Inland Riverine Forests		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	5
	Grasses etc.:	9
	Forbs:	10
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	0.5
	Grasses etc.:	73.4
	Forbs:	16.7
	Ferns:	0
	Other:	0.1
High Threat Weed cover:		0.8

BAM Attribute (1000 m2 plot) DBH			
DBH	**Tree stem count**		
80 + cm:	0	**Length of logs (m) (≥10 cm diameter, >50 cm in length)**	1
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	**Tree hollow count**	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	**1**	**2**	**3**	**4**	**5**
Subplot score (%):	15	50	75	80	75
Average litter cover (%):	59				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain / adjacent to flood channel

Plot Disturbance

Cleared and grazed / cropped

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	6	**Date:**	23/03/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	1	140	no	N
Grass & grasslike (GG)	*Sporobolus mitchellii (Rat's Tail Couch)*	60	4000	yes	N
	Phyla canescens (Lippia)	0.7	50	yes	HTE
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	10	1000	yes	N
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	1	100		N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	1	80	yes	N
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	10	1000		N
Forb (FG)	*Centipeda cunninghamii (Common Sneezeweed)*	0.1	3	yes	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	5	800		N
Shrub (SG)	*Atriplex semibaccata (Creeping Saltbush)*	0.1	1	no	N
Shrub (SG)	*Salsola australis*	0.1	4		N
Shrub (SG)	*Sclerolaena spp. (Copperburr, Poverty-bush)*	0.1	2		N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	0.1	10		N
Forb (FG)	*Oxalis perennans*	0.1	3		N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.1	10		N
Forb (FG)	*Solanum esuriale (Quena)*	0.1	3		N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	0.1	1		N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	8		N
	Xanthium spinosum (Bathurst Burr)	0.1	1		HTE
Grass & grasslike (GG)	*Walwhalleya proluta*	0.1	1		N
Grass & grasslike (GG)	*Austrostipa scabra (Speargrass)*	0.1	1	yes	N
Grass & grasslike (GG)	*Rytidosperma spp.*	0.1	1	yes	N
Shrub (SG)	*Atriplex spp. (A Saltbush)*	0.1	1	yes	N
	Medicago spp. (A Medic)	0.1	1		E
Forb (FG)	*Brachyscome spp.*	0.1	1	yes	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.1	20		N
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	0.1	1		N
Forb (FG)	*Chamaesyce australis*	1	100		N

BAM Site – Field Survey Form

Plot ID:	7	**Date:**	20/05/20	**Project number:**	J190417	**Plot dimensions:**	20 x 20
Datum:	GDA94	**Easting:**	537,075	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,280,189	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	141
Plant Community Type:		249: River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW		**Condition class:**	DNG	**PCT confidence:**	medium
Vegetation Class:		Inland Riverine Forests		**EEC:**	no	**EEC confidence:**	medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	3
	Grasses etc.:	9
	Forbs:	18
	Ferns:	1
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	0.7
	Grasses etc.:	43.8
	Forbs:	14.5
	Ferns:	0.1
	Other:	0.1
High Threat Weed cover:		0.5

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	4
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	10	10	5	10	5
Average litter cover (%):	8				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain

Plot Disturbance

Cleared and grazed

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	7	**Date:**	20/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.5	200	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	20	600	no	N
Forb (FG)	*Oxalis perennans*	5	500	no	N
	Hypochaeris radicata (Catsear)	0.1	10	no	E
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	1	100	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	15	1000	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.3	100	no	N
Forb (FG)	*Calotis hispidula (Bogan Flea)*	1	40	no	N
Forb (FG)	*Crassula sieberiana (Australian Stonecrop)*	0.2	500	no	N
	Medicago polymorpha (Burr Medic)	2	1200	no	E
	Brassica x napus (Rape)	0.1	5	no	E
	Sonchus oleraceus (Common Sowthistle)	0.1	5	no	E
Fern (EG)	*Marsilea costulifera*	0.1	10	no	N
	Echium vulgare (Viper's Bugloss)	0.1	5	no	E
Forb (FG)	*Solanum esuriale (Quena)*	0.1	15	no	N
Forb (FG)	*Alternanthera denticulata (Lesser Joyweed)*	0.1	50	no	N
Forb (FG)	*Senecio spp. (Groundsel, Fireweed)*	0.1	5	no	N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	5	200	no	N
Grass & grasslike (GG)	*Eragrostis australasica (Canegrass)*	2	20	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	5	100	no	N
	Cirsium vulgare (Spear Thistle)	0.1	1	no	E
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.5	250	no	N
Grass & grasslike (GG)	*Dactyloctenium radulans (Button Grass)*	0.1	10	no	N
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	0.5	20	no	N
Forb (FG)	*Plantago varia*	0.1	2	no	N
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	1	10	no	N
Shrub (SG)	*Sclerolaena muricata (Black Rolypoly)*	0.1	1	no	N
Forb (FG)	*Glycyrrhiza acanthocarpa (Native Liquorice)*	0.1	1	no	N
Shrub (SG)	*Sclerolaena spp. (Copperburr, Poverty-bush)*	0.5	2	no	N
	Hypochaeris glabra (Smooth Catsear)	0.2	30	no	E
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.1	20	yes	N
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	0.1	10	no	N
Forb (FG)	*Portulaca oleracea (Pigweed)*	0.1	3	no	N
	Phyla canescens (Lippia)	0.5	30	no	HTE
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	0.1	10	no	N
Forb (FG)	*Goodenia pinnatifida (Scrambles Eggs)*	0.1	1	no	N
Grass & grasslike (GG)	*Sporobolus caroli (Fairy Grass)*	0.1	50	no	N
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	0.1	5	no	N
Forb (FG)	*Lobelia concolor (Poison Pratia)*	0.1	20	no	N
Shrub (SG)	*Salsola australis*	0.1	5	no	N

BAM Site – Field Survey Form

Plot ID:	13	**Date:**	23/03/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	537,784	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,279,546	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	210
Plant Community Type:		249: River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW		**Condition class:**	Regenerating	**PCT confidence:**	medium
Vegetation Class:		Inland Riverine Forests		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	1
	Grasses etc.:	6
	Forbs:	6
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	8
	Shrubs:	0.2
	Grasses etc.:	60.1
	Forbs:	65.9
	Ferns:	0
	Other:	0.1
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	75	90	90	90	30
Average litter cover (%):	75				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Floodplain / channel on ephemeral lake

Plot Disturbance

Grazing

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	13	**Date:**	23/03/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Eucalyptus camaldulensis (River Red Gum)*	8	150	no	N
	Abutilon grandifolium	1	100	no	E
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	65	4000	no	N
Forb (FG)	*Glycyrrhiza acanthocarpa (Native Liquorice)*	0.5	30	no	N
	Medicago spp. (A Medic)	15	1000	no	E
Grass & grasslike (GG)	*Eragrostis australasica (Canegrass)*	40	800	no	N
Grass & grasslike (GG)	*Echinochloa colona (Awnless Barnyard Grass)*	10	900	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	1	25	no	N
Shrub (SG)	*Duma florulenta (Lignum)*	0.2	200	no	N
	Cucumis myriocarpus subsp. leptodermis (Paddy Melon)	0.2	30	no	E
	Malva parviflora (Small-flowered Mallow)	15	800	no	E
Forb (FG)	*Rumex spp. (Dock)*	0.1	1	no	N
Grass & grasslike (GG)	*Leptochloa spp.*	8	900	no	N
Grass & grasslike (GG)	*Paspalidium jubiflorum (Warrego Grass)*	1	200	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	0.1	5	no	N
	Sonchus oleraceus (Common Sowthistle)	0.1	3	no	E
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.1	30	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.1	1	no	N
Forb (FG)	*Solanum spp.*	0.1	2	no	N
Forb (FG)	*Portulaca oleracea (Pigweed)*	0.1	1	no	N
	Conyza parva (Fleabane)	0.1	1	no	E

BAM Site – Field Survey Form

Plot ID:	18	**Date:**	20/05/20	**Project number:**	J190417		**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	537,222	**Recorders:**	RP GS			
Zone:	55	**Northing:**	6,280,015	**IBRA region:**	NSW South Western Slopes		**Midline bearing:**	190
Plant Community Type:		249: River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW		**Condition class:**	Regenerating		**PCT confidence:**	medium
Vegetation Class:		Inland Riverine Forests		**EEC:**	no		**EEC confidence:**	medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	3
	Grasses etc.:	9
	Forbs:	10
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	8
	Shrubs:	15.2
	Grasses etc.:	81.7
	Forbs:	12
	Ferns:	0
	Other:	0.5
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	10	5	20	10	5
Average litter cover (%):	10				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Ephemeral lake bed

Plot Disturbance

Grazed

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	RP GS	**Plot ID:**	18	**Date:**	20/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Eucalyptus camaldulensis (River Red Gum)*	8	55	no	N
Grass & grasslike (GG)	*Eragrostis australasica (Canegrass)*	50	10000	no	N
	Trifolium spp. (A Clover)	75	5000	no	E
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	0.5	25	no	N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	10	800	no	N
Grass & grasslike (GG)	*Sporobolus mitchellii (Rat's Tail Couch)*	15	5000	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	1	50	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	5	80	no	N
	Chenopodium album (Fat Hen)	6	75	no	E
Forb (FG)	*Lobelia concolor (Poison Pratia)*	0.1	15	no	N
	Sonchus oleraceus (Common Sowthistle)	0.5	25	no	E
	Cirsium vulgare (Spear Thistle)	0.1	2	no	E
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	0.1	8	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.2	50	no	N
Shrub (SG)	*Duma florulenta (Lignum)*	15	150	no	N
Forb (FG)	*Polygonum plebeium (Small Knotweed)*	0.1	1	yes	N
Forb (FG)	*Rumex brownii (Swamp Dock)*	0.1	2	yes	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	1	50	no	N
Forb (FG)	*Glycyrrhiza acanthocarpa (Native Liquorice)*	0.2	4	no	N
	Lolium spp. (A Ryegrass)	0.1	5	no	E
Forb (FG)	*Lepidium pseudohyssopifolium (Peppercress)*	0.1	1	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.5	25	no	N
Shrub (SG)	*Salsola australis*	0.1	3	no	N
	Echium vulgare (Viper's Bugloss)	0.2	4	no	E
Forb (FG)	*Calocephalus spp.*	0.1	4	yes	N
Grass & grasslike (GG)	*Walwhalleya proluta*	9	150	yes	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	1	50	no	N
Shrub (SG)	*Atriplex spp. (A Saltbush)*	0.1	12	yes	N
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	0.1	5	no	N
	Malvaceae indeterminate (Mallows, jutes and lantern bushes)	0.1	1	yes	E
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	15	no	N

BAM Site – Field Survey Form

Plot ID:	16	**Date:**	21/05/20	**Project number:**	J190417	**Plot dimensions:**	20 x 20
Datum:	GDA94	**Easting:**	537,496	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,279,915	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	180
Plant Community Type:		249: River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW		**Condition class:**	Regenerating	**PCT confidence:**	medium
Vegetation Class:		Inland Riverine Forests		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	1
	Grasses etc.:	4
	Forbs:	5
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	1
	Shrubs:	0.3
	Grasses etc.:	54.1
	Forbs:	2.6
	Ferns:	0
	Other:	0.1
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	30	20	10	15	15
Average litter cover (%):	18				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Ephemeral lake bed

Plot Disturbance

Grazed

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	16	**Date:**	21/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
	Medicago polymorpha (Burr Medic)	80	50000	no	E
Grass & grasslike (GG)	*Eragrostis australasica (Canegrass)*	10	50	no	N
Grass & grasslike (GG)	*Sporobolus mitchellii (Rat's Tail Couch)*	40	10000	no	N
Tree (TG)	*Eucalyptus camaldulensis (River Red Gum)*	1	50	no	N
Shrub (SG)	*Duma florulenta (Lignum)*	0.3	20	no	N
	Sonchus oleraceus (Common Sowthistle)	0.1	3	no	E
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.1	8	no	N
	Malva parviflora (Small-flowered Mallow)	1	50	no	E
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.4	50	no	N
Forb (FG)	*Polygonum plebeium (Small Knotweed)*	0.1	5	yes	N
Grass & grasslike (GG)	*Paspalidium jubiflorum (Warrego Grass)*	0.1	15	yes	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	1	50	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	4	200	no	N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	1	60	no	N
Forb (FG)	*Glycyrrhiza acanthocarpa (Native Liquorice)*	0.1	9	no	N

BAM Site – Field Survey Form

Plot ID:	15	**Date:**	21/05/20	**Project number:**	J190417	**Plot dimensions:**	20 x 20
Datum:	GDA94	**Easting:**	537,400	**Recorders:**	RP GS		
Zone:	55	**Northing:**	6,279,650	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	303
Plant Community Type:		249: River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW		**Condition class:**	Regenerating	**PCT confidence:**	medium
Vegetation Class:		Inland Riverine Forests		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	5
	Grasses etc.:	7
	Forbs:	10
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	5
	Shrubs:	5.5
	Grasses etc.:	127.3
	Forbs:	14.5
	Ferns:	0
	Other:	1
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	1		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	10	0	30	35	10
Average litter cover (%):	17				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Ephemeral lake bed

Plot Disturbance

Previously Grazed

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	RP GS	**Plot ID:**	15	**Date:**	21/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Eragrostis australasica (Canegrass)*	60	10000	no	N
	Medicago polymorpha (Burr Medic)	80	50000	no	E
Tree (TG)	*Eucalyptus camaldulensis (River Red Gum)*	5	12	no	N
Grass & grasslike (GG)	*Sporobolus mitchellii (Rat's Tail Couch)*	60	5000	no	N
Grass & grasslike (GG)	*Bothriochloa macra (Red Grass)*	0.1	1	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	5	100	no	N
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	0.1	15	no	N
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	0.1	8	no	N
	Abutilon grandifolium	0.1	6	no	E
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	2	80	no	N
	Lactuca serriola (Prickly Lettuce)	0.2	15	no	E
Forb (FG)	*Rumex brownii (Swamp Dock)*	0.1	5	no	N
	Echium vulgare (Viper's Bugloss)	0.1	1	no	E
Forb (FG)	*Lobelia concolor (Poison Pratia)*	3	200	no	N
Shrub (SG)	*Maireana brevifolia*	0.2	3	no	N
	Sonchus oleraceus (Common Sowthistle)	0.3	17	no	E
Shrub (SG)	*Rhagodia parabolica*	0.1	15	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	2	200	no	N
Shrub (SG)	*Atriplex semibaccata (Creeping Saltbush)*	4	250	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	2	200	no	N
Forb (FG)	*Glycyrrhiza acanthocarpa (Native Liquorice)*	0.2	15	no	N
Forb (FG)	*Alternanthera denticulata (Lesser Joyweed)*	0.1	7	no	N
	Malva parviflora (Small-flowered Mallow)	0.3	15	no	E
Forb (FG)	*Erodium spp. (Crowfoot)*	1	50	no	N
Shrub (SG)	*Salsola australis*	0.2	20	no	N
Forb (FG)	*Asteraceae indeterminate (Daisies)*	0.1	9	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	3	300	no	N
	Cirsium vulgare (Spear Thistle)	0.1	1	no	E
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	3	300	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	1	100	no	N
Shrub (SG)	*Duma florulenta (Lignum)*	1	5	no	N

BAM Site – Field Survey Form

Plot ID:	Co014	**Date:**	21/04/22	**Project number:**	J190417	**Plot dimensions:**	20x50
Datum:	GDA94	**Easting:**	538,083	**Recorders:**	KV, SJ		
Zone:	55	**Northing:**	6,275,830	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	280
Plant Community Type:		249: River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW		**Condition class:**	Medium	**PCT confidence:**	low
Vegetation Class:		Inland Riverine Forests		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	7
	Grasses etc.:	3
	Forbs:	9
	Ferns:	1
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0.5
	Shrubs:	2
	Grasses etc.:	20
	Forbs:	3.9
	Ferns:	0.1
	Other:	0.1
High Threat Weed cover:		0.1

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	15
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	1		
< 5 cm:	3		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	5	20	20	10	1
Average litter cover (%):	11.2				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Lake edge, E.camaldulensis in shallow water adjacent

Plot Disturbance

Historic clearing, fencing

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	KV, SJ	**Plot ID:**	Co014	**Date:**	21/04/22

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Acacia stenophylla (River Cooba)*	0.5	5	yes	N
	Conyza spp. (A Fleabane)	10	300	no	E
Grass & grasslike (GG)	*Cynodon dactylon (Common Couch)*	10	500	no	N
Forb (FG)	*Vittadinia sulcata*	3	200	no	N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	1	50	no	N
Shrub (SG)	*Salsola australis*	0.1	30	no	N
Shrub (SG)	*Sclerolaena muricata var. semiglabra (Black Rolypoly)*	0.1	20	no	N
Forb (FG)	*Portulaca oleracea (Pigweed)*	0.1	3	no	N
Shrub (SG)	*Maireana aphylla (Cotton Bush)*	0.1	1	no	N
Fern (EG)	*Cheilanthes spp. (Cloak Fern, Mulga Fern, Rock Fern)*	0.1	10	no	N
Shrub (SG)	*Atriplex semibaccata (Creeping Saltbush)*	0.5	30	yes	N
Forb (FG)	*Alternanthera denticulata (Lesser Joyweed)*	0.1	50	no	N
Forb (FG)	*Oxalis perennans*	0.1	100	no	N
Forb (FG)	*Tribulus micrococcus (Spineless Caltrop)*	0.1	15	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.2	200	no	N
Forb (FG)	*Boerhavia dominii (Tarvine)*	0.1	15	no	N
Forb (FG)	*Solanum esuriale (Quena)*	0.1	4	no	N
Shrub (SG)	*Discaria nitida (Leafy Anchor Plant)*	0.1	3	yes	N
	Polygonum aviculare (Wireweed)	0.1	30	no	E
Other (OG)	*Convolvulus graminetinus*	0.1	20		N
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	0.1	4	no	N
Shrub (SG)	*Sclerolaena spp. (Copperburr, Poverty-bush)*	0.1	20	no	N
Grass & grasslike (GG)	*Walwhalleya subxerophila (Gilgai Grass)*	5	200	no	N
	Solanum nigrum (Black-berry Nightshade)	0.1	20	no	E
	Lepidium africanum (Common Peppercress)	0.1	30	no	E
	Xanthium spinosum (Bathurst Burr)	0.1	6	no	HTE
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	5	100	no	N

BAM Site – Field Survey Form

Plot ID:	10	**Date:**	23/03/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	537,216	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,279,768	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	246
Plant Community Type:		249: River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW		**Condition class:**	Medium	**PCT confidence:**	medium
Vegetation Class:		Inland Riverine Forests		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	2
	Shrubs:	9
	Grasses etc.:	8
	Forbs:	10
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	8
	Shrubs:	5.6
	Grasses etc.:	16.5
	Forbs:	11.5
	Ferns:	0
	Other:	0.1
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	41
80 + cm:	2		
50 – 79 cm:	1		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	3
10 – 19 cm:	1		
5 – 9 cm:	1		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	15	20	15	30	90
Average litter cover (%):	34				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Ephemeral lake / flood channel

Plot Disturbance

Grazing

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	10	**Date:**	23/03/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Eucalyptus camaldulensis (River Red Gum)*	5	5		N
Tree (TG)	*Acacia stenophylla (River Cooba)*	3	5	yes	N
Forb (FG)	*Glycyrrhiza acanthocarpa (Native Liquorice)*	3	60		N
Grass & grasslike (GG)	*Eragrostis australasica (Canegrass)*	2	50		N
Shrub (SG)	*Duma florulenta (Lignum)*	3	4		N
Grass & grasslike (GG)	*Sporobolus mitchellii (Rat's Tail Couch)*	10	200		N
	Trifolium spp. (A Clover)	2	200		E
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	3	100		N
Forb (FG)	*Rumex tenax (Shiny Dock)*	0.1	2	yes	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.8	80		N
Forb (FG)	*Solanum esuriale (Quena)*	0.1	4		N
Grass & grasslike (GG)	*Walwhalleya proluta*	4	40		N
Forb (FG)	*Calotis hispidula (Bogan Flea)*	0.3	200	yes	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	3	150		N
Shrub (SG)	*Sclerolaena muricata (Black Rolypoly)*	0.3	15		N
Shrub (SG)	*Salsola australis*	0.1	2		N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	0.2	5		N
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	1	14		N
Shrub (SG)	*Rhagodia spinescens (Thorny Saltbush)*	0.1	2		N
Shrub (SG)	*Sclerolaena stelligera (Star Copperburr)*	1.5	20		N
Shrub (SG)	*Maireana decalvans (Black Cotton Bush)*	0.1	1		N
Shrub (SG)	*Sclerolaena spp. (Copperburr, Poverty-bush)*	0.1	1		N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	0.1	1		N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.1	6		N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	0.1	15		N
	Abutilon grandifolium	0.1	1		E
Grass & grasslike (GG)	*Carex spp.*	0.1	3		N
	Echium vulgare (Viper's Bugloss)	0.1	2		E
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	0.1	3		N
Shrub (SG)	*Maireana brevifolia*	0.2	4		N
Forb (FG)	*Wahlenbergia spp. (Bluebell)*	0.1	1		N
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	0.1	10		N
Grass & grasslike (GG)	*Echinochloa colona (Awnless Barnyard Grass)*	0.1	10		N

BAM Site – Field Survey Form

Plot ID:	9	**Date:**	23/03/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	537,610	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,279,272	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	209
Plant Community Type:		249: River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW		**Condition class:**	Medium	**PCT confidence:**	medium
Vegetation Class:		Inland Riverine Forests		**EEC:**	yes	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	9
	Grasses etc.:	9
	Forbs:	7
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	6
	Shrubs:	2.6
	Grasses etc.:	31.5
	Forbs:	2.1
	Ferns:	0
	Other:	0
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	37
80 + cm:	3		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	2
10 – 19 cm:	1		
5 – 9 cm:	1		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	85	15	20	15	5
Average litter cover (%):	28				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain / lake edge / floodplain channel edge

Plot Disturbance

Grazing

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	9	**Date:**	23/03/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Eucalyptus camaldulensis (River Red Gum)*	6	2	no	N
Shrub (SG)	*Rhagodia parabolica*	0.1	2	no	N
Forb (FG)	*Glycyrrhiza acanthocarpa (Native Liquorice)*	0.5	30	no	N
Shrub (SG)	*Duma florulenta (Lignum)*	1	10	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.3	50	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.2	100	no	N
Grass & grasslike (GG)	*Sporobolus mitchellii (Rat's Tail Couch)*	30	4000	no	N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	0.2	3	no	N
	Medicago spp. (A Medic)	0.1	50	no	E
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	0.2	50	no	N
Shrub (SG)	*Atriplex semibaccata (Creeping Saltbush)*	0.5	5	no	N
Grass & grasslike (GG)	*Eragrostis australasica (Canegrass)*	0.5	20	no	N
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	0.1	1	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	8	no	N
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	0.2	5	no	N
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	0.8	40	no	N
Shrub (SG)	*Maireana decalvans (Black Cotton Bush)*	0.1	2	no	N
Shrub (SG)	*Maireana brevifolia*	0.1	1	no	N
Shrub (SG)	*Salsola australis*	0.1	1	no	N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	0.1	5	no	N
Shrub (SG)	*Sclerolaena stelligera (Star Copperburr)*	0.4	20	no	N
Shrub (SG)	*Sclerolaena muricata (Black Rolypoly)*	0.1	1	no	N
Grass & grasslike (GG)	*Austrostipa scabra (Speargrass)*	0.1	3	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	0.2	20	no	N
Forb (FG)	*Alternanthera denticulata (Lesser Joyweed)*	0.1	2	no	N
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	0.1	10	no	N
	Juncaceae indeterminate (Rushes)	0.1	2	no	E
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	0.1	20	no	N

BAM Site – Field Survey Form

Plot ID:	11	**Date:**	22/05/20	**Project number:**	J190417	**Plot dimensions:**	20 x 20
Datum:	GDA94	**Easting:**	537,901	**Recorders:**	RP GS		
Zone:	55	**Northing:**	6,276,765	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	92
Plant Community Type:		249: River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW		**Condition class:**	Medium	**PCT confidence:**	medium
Vegetation Class:		Inland Riverine Forests		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	7
	Grasses etc.:	10
	Forbs:	17
	Ferns:	1
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	45
	Shrubs:	2
	Grasses etc.:	7
	Forbs:	34.5
	Ferns:	0.3
	Other:	0.6
High Threat Weed cover:		0.1

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	55
80 + cm:	1		
50 – 79 cm:	1		
30 – 49 cm:	0		
20 – 29 cm:	1	Tree hollow count	2
10 – 19 cm:	1		
5 – 9 cm:	1		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	50	15	20	20	15
Average litter cover (%):	24				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Drainage line / bank of ephemeral lake

Plot Disturbance

Clearing adjacent, gravel dumping

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	RP GS	**Plot ID:**	11	**Date:**	22/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Eucalyptus camaldulensis (River Red Gum)*	45	25	no	N
Forb (FG)	*Lobelia concolor (Poison Pratia)*	30	4000	no	N
	Echium plantagineum (Patterson's Curse)	10	800	no	E
	Cyperaceae indeterminate (Sedges)	30	4000	no	E
	Lepidium africanum (Common Peppercress)	1	8	no	E
Shrub (SG)	*Salsola australis*	0.4	5	no	N
Grass & grasslike (GG)	*Paspalidium jubiflorum (Warrego Grass)*	0.4	50	no	N
Fern (EG)	*Marsilea spp. (A Nardoo)*	0.3	75	no	N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	0.2	25	no	N
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	0.4	30	no	N
Grass & grasslike (GG)	*Sporobolus mitchellii (Rat's Tail Couch)*	1	30	no	N
	Lolium perenne (Perennial Ryegrass)	10	400	no	E
	Solanum nigrum (Black-berry Nightshade)	5	30	no	E
Forb (FG)	*Glycyrrhiza acanthocarpa (Native Liquorice)*	0.2	5	no	N
	Medicago polymorpha (Burr Medic)	0.4	100	no	E
Shrub (SG)	*Rhagodia parabolica*	0.1	15	no	N
	Lactuca serriola (Prickly Lettuce)	0.2	15	no	E
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	0.8	25	no	N
	Sonchus oleraceus (Common Sowthistle)	0.4	15	no	E
Forb (FG)	*Alternanthera denticulata (Lesser Joyweed)*	0.1	15	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.2	30	no	N
Forb (FG)	*Oxalis perennans*	0.1	7	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.6	50	no	N
Forb (FG)	*Eclipta platyglossa (Yellow Twin-heads)*	0.2	5	no	N
	Brassica napus (Canola)	0.1	6	no	E
Grass & grasslike (GG)	*Eragrostis australasica (Canegrass)*	1	10	no	N
Grass & grasslike (GG)	*Cynodon dactylon (Common Couch)*	0.5	75	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	0.6	25	no	N
Forb (FG)	*Dichondra repens (Kidney Weed)*	0.4	15	no	N
Shrub (SG)	*Sclerolaena muricata (Black Rolypoly)*	0.4	25	no	N
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	0.2	20	no	N
Forb (FG)	*Chamaesyce drummondii (Caustic Weed)*	1.2	30	no	N
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	0.4	25	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	2	100	no	N
Forb (FG)	*Portulaca oleracea (Pigweed)*	0.1	30	no	N
Grass & grasslike (GG)	*Echinochloa colona (Awnless Barnyard Grass)*	0.8	50	no	N
	Xanthium spinosum (Bathurst Burr)	0.1	7	no	HTE
Shrub (SG)	*Maireana brevifolia*	0.1	5	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.1	15	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.3	20	no	N
Forb (FG)	*Hibiscus spp.*	0.1	3	no	N
Forb (FG)	*Rumex brownii (Swamp Dock)*	0.1	5	no	N

Project name:	J190417				
Recorders:	RP GS	**Plot ID:**	11	**Date:**	22/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Shrub (SG)	*Atriplex semibaccata (Creeping Saltbush)*	0.3	15	no	N
	Avena fatua (Wild Oats)	0.1	6	no	E
Forb (FG)	*Solanum esuriale (Quena)*	0.1	15	no	N
Forb (FG)	*Epilobium billardierianum*	0.1	5	no	N
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	0.1	15	no	N
Shrub (SG)	*Duma florulenta (Lignum)*	0.5	6	no	N

BAM Site – Field Survey Form

Plot ID:	12	**Date:**	23/05/20	**Project number:**	J190417	**Plot dimensions:**	20 x 20
Datum:	GDA94	**Easting:**	538,228	**Recorders:**	RP GS		
Zone:	55	**Northing:**	6,275,487	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	313
Plant Community Type:		249: River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW		**Condition class:**	Medium	**PCT confidence:**	medium
Vegetation Class:		Inland Riverine Forests		**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	7
	Grasses etc.:	7
	Forbs:	10
	Ferns:	1
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	50
	Shrubs:	41.8
	Grasses etc.:	28.9
	Forbs:	3.3
	Ferns:	0.1
	Other:	0.1
High Threat Weed cover:		0.1

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	44
80 + cm:	1		
50 – 79 cm:	5		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	6
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	60	45	50	30	70
Average litter cover (%):	51				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Ephemeral lake edge, levy bank

Plot Disturbance

Weedy

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	RP GS	**Plot ID:**	12	**Date:**	23/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Eucalyptus camaldulensis (River Red Gum)*	50	5	no	N
	Malva parviflora (Small-flowered Mallow)	13	50	no	E
Shrub (SG)	*Duma florulenta (Lignum)*	0.6	35	no	N
Grass & grasslike (GG)	*Eragrostis australasica (Canegrass)*	25	300	no	N
Shrub (SG)	*Sclerolaena muricata (Black Rolypoly)*	25	15	no	N
	Medicago polymorpha (Burr Medic)	7	800	no	E
Shrub (SG)	*Maireana brevifolia*	10	40	no	N
	Sonchus oleraceus (Common Sowthistle)	0.2	5	no	E
Forb (FG)	*Glycyrrhiza acanthocarpa (Native Liquorice)*	1	15	no	N
	Hypochaeris glabra (Smooth Catsear)	0.1	5	no	E
	Abutilon grandifolium	0.1	5	no	E
Grass & grasslike (GG)	*Cynodon dactylon (Common Couch)*	0.4	15	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.4	80	no	N
	Cyperaceae indeterminate (Sedges)	0.4	3	no	E
Forb (FG)	*Alternanthera denticulata (Lesser Joyweed)*	0.4	6	no	N
Fern (EG)	*Marsilea spp. (A Nardoo)*	0.1	4	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	1	50	no	N
Forb (FG)	*Rumex brownii (Swamp Dock)*	0.1	3	no	N
Forb (FG)	*Senecio spp. (Groundsel, Fireweed)*	0.2	4	no	N
	Xanthium spinosum (Bathurst Burr)	0.1	4	no	HTE
	Cucumis myriocarpus subsp. leptodermis (Paddy Melon)	0.1	5	no	E
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.1	10	no	N
Shrub (SG)	*Salsola australis*	4	60	no	N
Forb (FG)	*Einadia nutans (Climbing Saltbush)*	0.5	6	no	N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	2	10	no	N
Grass & grasslike (GG)	*Enteropogon acicularis (Curly Windmill Grass)*	0.1	5	no	N
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	0.3	6	no	N
Grass & grasslike (GG)	*Sporobolus mitchellii (Rat's Tail Couch)*	2	15	no	N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	0.4	5	no	N
Shrub (SG)	*Rhagodia parabolica*	0.1	2	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.1	7	no	N
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	0.1	3	no	N
	Chenopodium album (Fat Hen)	0.1	2	no	E
	Lepidium africanum (Common Peppercress)	0.2	3	no	E
	Sisymbrium officinale (Hedge Mustard)	0.2	5	no	E
Shrub (SG)	*Sclerolaena birchii (Galvinized Burr)*	0.1	1	no	N
	Solanum nigrum (Black-berry Nightshade)	0.1	1	no	E
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	1	no	N
Forb (FG)	*Atriplex spinibractea (Spiny-fruit Saltbush)*	0.1	1	no	N

Appendix B
Vegetation integrity plot data

EMM
creating opportunities

plot	pct	area	patch size	condition class	zone	easting	northing	bearing	comp Tree	comp Shrub	comp Grass	comp Forbs	comp Ferns	comp Other	struc Tree	struc Shrub	struc Grass	struc Forbs	struc Ferns	struc Other	funLarge Trees	fun Hollow trees	funLitterCover	funLen Fallen Logs	fun TreeStem 5to9	fun TreeStem 10to19	fun TreeStem 20to29	fun TreeStem 30to49	fun TreeStem 50to79	fun Tree Regen	fun High Threat Exotic
Co012	26	179.14	101	DNG	55	536798	6274848	340	0	4	2	4	0	1	0.0	7.7	65.0	2.3	0.0	0.1	0	0	23.0	0.0	0	0	0	0	0	0.0
19	26	179.14	101	DNG	55	536787	6275527	252	0	4	8	11	0	1	0.0	10.9	16.7	9.8	0.0	1.0	0	0	1.8	0.0	0	0	0	0	0	0	0.0
1	26	179.14	101	DNG	55	535269	6275587	199	0	3	9	14	0	1	0.0	0.8	57.5	3.5	0.0	1.0	0	0	2.4	0.0	0	0	0	0	0	0	0.0
20	26	179.14	101	DNG	55	537076	6279495	124	0	4	5	6	0	1	0.0	9.0	69.0	6.5	0.0	1.5	0	0	4.8	0.0	0	0	0	0	0	0	0.0
25	26	179.14	101	DNG	55	536866	6280063	250	0	7	7	10	1	1	0.0	1.0	43.3	7.9	0.2	16.0	0	0	6.4	0.0	0	0	0	0	0	0	0.0
44	26	179.14	101	DNG	55	537718	6275976	226	0	5	8	11	0	1	0.0	2.2	36.2	57.8	0.0	0.8	0	0	9.0	0.0	0	0	0	0	0	0	0.0
23	26	179.14	101	DNG	55	535727	6275710	271	0	6	11	16	0	1	0.0	6.4	110.5	47.0	0.0	1.0	0	0	7.0	0.0	0	0	0	0	0	0	0.0
Co001	26	4.04	101	Poor	55	536447	6275169	250	1	5	3	9	0	0	3.0	6.6	75.0	1.5	0.0	0.0	2	1	12.4	9.0	0	0	0	0	1	1	0.0
33	26	4.04	101	Poor	55	536228	6275376	89	0	6	6	11	0	0	0.0	91.9	12.5	6.1	0.0	0.0	2	0	45.0	14.0	0	0	0	0	1	0	1.0
32	26	10.57	101	Planted	55	536527	6275465	87	1	4	1	4	0	1	30.0	8.3	0.1	1.2	0.0	0.1	1	0	78.6	0.0	1	1	1	1	0	1	0.0
31	26	10.57	101	Planted	55	536638	6280116	68	1	8	10	8	0	1	30.0	1.5	30.8	8.6	0.0	9.0	0	0	24.2	0.0	1	1	0	0	0	1	0.0
30	26	10.57	101	Planted	55	535337	6275846	305	3	7	9	9	0	1	44.0	12.8	5.8	1.4	0.0	0.2	3	0	26.0	0.0	0	1	1	1	0	1	0.0
Plot 017	26	2.58	101	Medium	55	536732	6279794	143	1	6	6	6	0	2	65.0	32.2	8.7	16.4	0.0	0.2	1	0	6.6	2.0	1	1	1	0	1	1	0.0
C6	26	2.58	101	Medium	55	536296	6275564	105	1	5	10	9	0	2	20.0	7.4	32.9	0.6	0.0	2.1	0	0	38.0	0.0	1	1	1	0	0	1	0.0
Plot 008	26	4.49	101	High	55	537029	6275186	117	2	6	8	12	0	2	25.1	23.5	51.5	1.5	0.0	0.2	1	0	9.2	9.0	1	1	0	1	0	1	0.0
Co013	26	4.49	101	High	55	537138	6275680	250	1	4	4	4	0	0	15.0	1.6	30.0	0.4	0.0	0.0	0	0	8.0	0.0	1	1	1	0	0	1	0.0
28	26	4.49	101	High	55	537106	6275473	198	1	9	7	9	0	2	10.0	11.5	5.6	4.9	0.0	2.1	2	0	32.0	0.0	1	1	0	1	1	1	0.0
27	26	4.49	101	High	55	536892	6274715	222	1	9	9	15	1	2	6.0	4.2	5.1	6.7	0.1	2.5	2	0	32.0	16.0	0	1	1	1	1	1	0.0
26	26	4.49	101	High	55	536457	6279855	26	1	7	4	11	0	1	45.0	16.7	8.6	15.2	0.0	0.5	2	0	46.0	7.0	0	1	1	1	1	1	0.1
29	26	4.49	101	High	55	536242	6279868	221	1	5	9	19	0	2	20.0	10.5	54.7	4.8	0.0	1.5	5	0	29.0	23.0	1	0	0	1	0	0	0.0
36	53	311.08	101	Medium	55	538162	6279795	346	0	0	2	5	1	0	0.0	0.0	81.0	6.9	0.1	0.0	0	0	93.0	0.0	0	0	0	0	0	0	0.0
34	53	311.08	101	Medium	55	537461	6280108	157	1	1	2	4	0	0	4.0	0.1	75.0	1.7	0.0	0.0	0	0	20.0	0.0	0	0	0	0	0	1	0.0
35	53	311.08	101	Medium	55	538196	6278753	115	0	1	5	4	0	1	0.0	0.1	66.3	2.3	0.0	0.1	0	0	24.0	0.0	0	0	0	0	0	0	0.0
38	53	311.08	101	Medium	55	538694	6276561	35	0	0	1	3	0	0	0.0	0.0	99.0	2.2	0.0	0.0	0	0	60.0	0.0	0	0	0	0	0	0	0.0
39	53	311.08	101	Medium	55	538121	6276742	92	0	0	5	7	0	0	0.0	0.0	105.2	7.3	0.0	0.0	0	0	70.0	0.0	0	0	0	0	0	0	0.0
37	53	311.08	101	Medium	55	538528	6275248	17	0	0	4	2	0	0	0.0	0.0	75.6	1.5	0.0	0.0	0	0	28.0	0.0	0	0	0	0	0	0	0.0
40	53	311.08	101	Medium	55	538925	6277623	148	0	1	2	6	0	2	0.0	0.1	65.4	11.4	0.0	0.5	0	0	37.0	0.0	0	0	0	0	0	0	0.0
Plot 009	55	166.34	101	DNG	55	533492	6279951	80	0	4	11	9	1	1	0.0	2.3	70.9	7.6	0.1	0.1	0	0	11.2	0.0	0	0	0	0	0	0	0.0
43	55	166.34	101	DNG	55	535514	6279411	82	0	2	7	11	0	1	0.0	2.1	28.3	30.7	0.0	5.0	0	0	5.8	0.0	0	0	0	0	0	0	0.0
49	55	166.34	101	DNG	55	534437	6279863	252	0	3	7	12	1	1	0.0	1.6	58.1	53.8	0.1	10.0	0	0	1.2	0.0	0	0	0	0	0	0	0.0
41	55	166.34	101	DNG	55	536150	6279621	49	0	4	7	9	0	1	0.0	2.1	44.9	6.0	0.0	1.0	0	0	8.0	0.0	0	0	0	0	0	0	0.0
42	55	166.34	101	DNG	55	537783	6275241	14	0	3	11	16	1	1	0.0	5.4	61.7	10.3	0.6	1.2	0	0	7.0	0.0	0	0	0	0	0	0	0.0
46	55	166.34	101	DNG	55	535618	6276354	156	0	2	12	13	1	1	0.0	1.1	78.2	61.0	0.2	0.4	0	0	14.0	0.0	0	0	0	0	0	0	0.0
45	55	166.34	101	DNG	55	536685	6275873	170	0	3	13	11	0	1	0.0	3.2	102.5	17.4	0.0	1.0	0	0	22.0	0.0	0	0	0	0	0	0	0.8
48	55	166.34	101	DNG	55	535872	6280250	243	0	3	7	8	0	1	0.0	11.1	160.0	9.9	0.0	12.0	0	0	5.0	0.0	0	0	0	0	0	0	0.0
50	55	166.34	101	DNG	55	535070	6280103	330	0	2	8	12	0	1	0.0	0.4	82.3	88.9	0.0	1.0	0	0	8.0	0.0	0	0	0	0	0	0	0.0
51	55	166.34	101	DNG	55	535752	6280039	7	0	4	7	14	0	1	0.0	8.1	72.2	19.2	0.0	1.0	0	0	4.2	0.0	0	0	0	0	0	0	0.0
Plot 015	55	6.14	101	Poor	55	537187	6275029	67	0	4	5	5	0	0	0.0	33.1	1.0	10.4	0.0	0.0	3	2	31.0	14.0	0	0	0	1	1	0	0.0
Plot 016	55	6.14	101	Poor	55	537381	6274986	25	1	3	6	7	0	1	18.0	8.9	5.6	6.6	0.0	0.1	2	0	12.0	28.0	0	0	1	1	1	0	0.0
Plot 021	55	6.14	101	Poor	55	533211	6280327	194	1	3	12	13	2	1	1.0	0.5	73.9	3.1	0.2	0.2	0	0	10.8	0.0	1	0	0	0	0	1	0.2
58	55	6.14	101	Poor	55	537520	6275521	202	1	3	7	5	0	1	5.0	0.6	2.6	0.5	0.0	0.8	1	0	18.2	0.0	0	0	0	0	1	0	0.1
47	55	6.14	101	Poor	55	535047	6279649	55	0	5	7	11	0	1	0.0	89.0	44.1	72.4	0.0	5.0	1	0	8.2	0.0	0	0	0	0	1	0	0.1
57	55	6.14	101	Poor	55	538295	6274828	231	1	5	8	17	0	1	25.0	4.9	15.7	3.9	0.0	0.1	2	1	16.0	5.0	0	0	0	0	1	0	0.0
66	55	8.83	101	Planted	55	532888	6278016	339	4	4	4	9	0	1	21.0	7.0	5.3	5.8	0.0	0.1	0	0	20.0	0.0	1	1	1	0	0	1	0.0
56	55	8.83	101	Planted	55	536388	6279422	255	2	5	1	8	0	1	28.0	1.3	8.0	4.7	0.0	0.1	1	0	62.2	0.0	1	1	1	1	0	1	0.0
24	55	8.83	101	Planted	55	535259	6279633	93	2	6	2	8	0	1	15.0	5.3	10.2	8.7	0.0	0.1	1	0	39.0	0.0	1	1	1	1	0	0	0.0
55	55	8.83	101	Planted	55	535437	6276212	248	2	9	10	15	0	0	20.0	7.3	111.3	14.3	0.0	0.0	0	0	33.0	0.0	1	1	0	0	0	1	0.4
Plot 018	55	33.87	101	Medium	55	532926	6279817	186	2	6	4	7	0	1	40.0	46.1	11.1	20.6	0.0	0.1	3	0	12.2	14.0	0	0	0	1	1	0	0.0
14	55	33.87	101	Medium	55	535641	6279472	72	1	5	9	10	0	1	15.0	56.0	14.4	42.9	0.0	1.0	1	1	13.4	50.0	1	1	1	0	1	1	0.1
17	55	33.87	101	Medium	55	532881	6278249	260	1	3	9	13	0	1	0.3	6.1	16.3	22.5	0.0	3.0	2	0	46.0	50.0	0	0	0	0	1	1	1.0
52	55	33.87	101	Medium	55	536346	6279573	272	1	5	8	15	1	1	18.0	36.0	41.2	3.2	0.2	0.1	2	0	21.4	0.0	1	1	0	1	1	1	0.0
54	55	33.87	101	Medium	55	536541	6276132	71	1	3	8	10	0	1	45.0	25.2	17.3	4.0	0.0	0.4	3	0	51.4	19.0	1	0	0	0	1	1	0.1
53	55	33.87	101	Medium	55	537982	6275247	51	1	2	12	17	1	2	10.0	38.1	43.3	11.7	0.1	1.1	2	0	9.4	10.0	0	0	0	0	0	0	3.1
Plot 003	82	113.02	101	DNG	55	532201	6279574	52	0	2	4	10	1	1	0.0	0.3	75.0	2.1	0.1	0.2	0	0	19.0	0.0	0	0	0	0	0	0	0.0
Plot 007	82	113.02	101	DNG	55	535926	6274819	63	0	0	7	11	0	1	0.0	0.0	92.2	1.1	0.0	4.0	0	0	29.0	0.0	0	0	0	0	0	0	0.0
Plot 012	82	113.02	101	DNG	55	531868	6280915	102	0	3	6	8	1	1	0.0	1.2	96.3	1.0	0.5	0.2	0	0	4.8	0.0	0	0	0	0	0	0	0.0
Plot 022	82	113.02	101	DNG	55	532476	6279148	75	0	3	8	10	1	1	0.0	0.3	95.2	1.0	0.5	0.2	0	0	12.0	0.0	0	0	0	0	0	0	0.0
Co008	82	113.02	101	DNG	55	535836	6277060	25	0	3	4	6	1	1	0.0	4.6	41.0	1.5	0.1	0.1	0	0	15.0	0.0	0	0	0	0	0	0	0.0
Co010	82	113.02	101	DNG	55	532875	6277392	349	0	1	8	7	1	0	0.0	1.0	86.1	11.6	0.1	0.0	0	0	99.0	0.0	0	0	0	0	0	0	0.0
Co009	82	113.02	101	DNG	55	533063	6276275	211	0	5	5	3	1	0	0.0	4.3	93.0	1.2	12.0	0.0	0	0	89.0	0.0	0	0	0	0	0	0	0.0
Co003	82	113.02	101	DNG	55	534963	6274922	47	0	5	10	8	0	1	0.0	1.1	97.4	10.6	0.0	0.1	0	0	97.0	0.0	0	0	0	0	0	0	0.0
Co005	82	113.02	101	DNG	55	535080	6275345	332	0	5	5	9	0	1	0.0	2.0	81.1	2.5	0.0	0.2	0	0	98.0	0.0	0	0	0	0	0	0	0.0
Co002	82	113.02	101	DNG	55	534643	6275359	57	0	1	9	13	1	1	0.0	0.4	67.9	17.4	0.1	0.1	0	0	95.0	0.0	0	0	0	0	0	0	0.1
Co011	82	113.02	101	DNG	55	534440	6275858	270	0	5	6	6	1	1	0.0	6.5	86.0	0.8	0.1	0.1	0	0	6.2	0.0	0	0	0	0	0	0	0.0
59	82	113.02	101	DNG	55	533145	6276727	166	0	4	12	15	0	1	0.0	6.6	100.1	31.5	0.0	0.2	0	0	27.0	0.0	0	0	0	0	0	0	0.0
61	82	113.02	101	DNG	55	533000	6277633	327	0	3	6	8	1	1	0.0	8.6	26.8	13.1	0.1	0.5	0	0	11.0	0.0	0	0	0	0	0	0	0.0
5	82	113.02	101	DNG	55	535542	6275505	68	0	1	10	10	1	0	0.0	0.1	48.8	7.2	0.1	0.0	0	0	8.6	0.0	0	0	0	0	0	0	0.0
2	82	113.02	101	DNG	55	535387	6275543	155	0	3	10	13	0	1	0.0	1.2	58.2	2.6	0.0	1.0	0	0	8.6	0.0	0	0	0	0	0	0	0.0
3	82	113.02	101	DNG	55	535679	6275370	151	0	3	10	12	1	1	0.0	0.4	39.1	77.4	0.1	2.0	0	0	3.8	0.0	0	0	0	0	0	0	0.0
4	82	113.02	101	DNG	55	535735	6275512	106	0	5	10	9	0	1	0.0	1.9	81.0	27.1	0.0	0.3	0	0	8.0	0.0	0	0	0	0	0	0	0.0
65	82	113.02	101	DNG	55	532978	6277786	90	1	4	8	14	0	1	0.2	6.1	15.9	23.8	0.0	3.0	0	0	20.4	0.0	1	0	0	0	0	0	0.0

plot	pct	area	patch size	condition class	zone	easting	northing	bearing	comp Tree	comp Shrub	comp Grass	comp Forbs	comp Ferns	comp Other	struc Tree	struc Shrub	struc Grass	struc Forbs	struc Ferns	struc Other	funLarge Trees	fun Hollow trees	funLitterCover	funLen Fallen Logs	fun TreeStem 5to9	fun TreeStem 10to19	fun TreeStem 20to29	fun TreeStem 30to49	fun TreeStem 50to79	fun Tree Regen	fun High Threat Exotic
C7	82	0.94	101	Poor	55	532473	6278654	48	1	4	8	14	1	1	3.0	5.9	78.3	1.1	1.0	0.1	1	0	44.0	9.0	0	1	1	0	1	0	0.0
C8	82	0.94	101	Poor	55	532647	6280274	57	1	4	10	14	1	0	25.0	25.7	44.4	1.1	0.2	0.0	1	0	26.0	0.0	0	0	0	0	1	0	0.0
64	82	0.37	101	Planted	55	533083	6277048	171	3	5	2	2	0	0	8.0	14.5	8.1	1.1	0.0	0.0	0	0	20.4	0.0	1	1	1	0	0	1	0.0
Plot 002	82	5.23	101	Regen	55	532048	6279944	339	1	2	9	10	1	1	2.0	4.1	70.6	1.9	2.0	0.2	0	0	29.4	0.0	1	0	0	0	0	1	0.0
Plot 004	82	5.23	101	Regen	55	532240	6279455	37	2	4	7	5	1	1	13.0	2.0	44.1	0.5	0.1	0.5	0	0	11.0	0.0	1	1	0	0	0	1	0.0
Plot 001	82	5.23	101	Regen	55	532310	6280105	7	1	4	7	11	1	1	0.1	2.2	62.2	2.4	5.0	0.1	0	0	16.4	0.0	1	0	0	0	0	1	0.0
Co004	82	5.23	101	Regen	55	532167	6279288	27	2	1	9	10	1	1	9.0	40.0	95.0	2.4	15.0	0.2	0	0	91.0	0.0	1	0	0	0	0	1	0.0
67	82	0.62	101	Medium	55	533247	6276426	196	1	3	10	10	1	1	21.0	5.2	73.2	14.5	0.1	0.3	1	0	21.4	44.0	0	0	1	1	1	1	0.0
Plot 006	185	3.56	101	DNG	55	535537	6275060	127	0	1	6	7	1	1	0.0	0.1	97.2	0.7	0.1	0.1	0	0	20.0	0.0	0	0	0	0	0	0	0.0
Plot 019	185	3.56	101	DNG	55	531999	6280471	253	0	3	8	8	1	1	0.0	2.2	97.4	1.2	0.5	0.1	0	0	8.6	0.0	0	0	0	0	0	0	0.0
Plot 005	185	1.50	101	Medium	55	535589	6275277	237	2	7	6	10	1	1	35.1	1.7	49.5	1.9	0.1	0.1	2	0	49.0	12.0	0	0	0	0	1	1	0.0
Co006	185	1.50	101	Medium	55	535539	6274732	340	2	3	2	1	0	0	43.0	0.4	2.1	5.0	0.0	0.0	2	1	37.2	52.0	1	1	1	1	0	1	0.0
Co007	185	1.50	101	Medium	55	535581	6274893	320	1	4	3	7	0	0	20.0	0.9	67.0	3.6	0.0	0.0	3	0	25.0	9.0	1	1	1	1	1	1	0.0
Plot 010	185	0.00	101	High	55	531691	6280562	294	3	2	9	10	1	1	39.0	0.4	56.5	1.9	0.1	0.1	1	6	12.0	119.0	1	1	1	1	0	1	0.0
Plot 011	185	0.00	101	High	55	531529	6281055	268	2	3	9	11	1	0	50.0	0.7	82.4	3.4	0.1	0.0	2	2	28.0	115.0	1	1	1	1	0	1	0.0
Plot 013	185	0.00	101	High	55	532098	6280471	66	3	6	7	12	0	0	58.0	1.4	40.1	24.3	0.0	0.0	9	4	53.6	48.0	0	1	1	1	1	0	0.0
Plot 020	185	0.00	101	High	55	531875	6280415	207	2	3	8	11	0	1	10.0	1.5	46.2	2.0	0.0	0.1	3	0	16.6	54.0	0	0	1	1	1	0	0.0
62	244	10.33	101	DNG	55	536870	6279290	84	0	4	8	12	0	0	0.0	0.9	59.7	14.0	0.0	0.0	0	0	7.0	0.0	0	0	0	0	0	0	0.0
21	244	10.33	101	DNG	55	537236	6279135	261	0	8	9	13	0	1	0.0	2.0	108.1	11.7	0.0	0.3	0	0	16.0	0.0	0	0	0	0	0	0	1.0
C9	244	1.75	101	DNG	55	536572	6279362	65	1	1	7	4	1	0	2.0	0.1	37.7	10.7	0.1	0.0	0	0	26.0	0.0	1	0	0	0	0	0	1.0
60	244	0.21	101	Poor	55	536267	6279318	90	1	5	15	20	0	1	8.0	0.5	27.6	44.5	0.0	1.0	0	0	22.6	0.0	0	1	0	0	0	0	0.1
63	244	1.75	101	Medium	55	536514	6279353	32	1	4	10	17	1	0	25.0	0.7	66.2	16.9	0.3	0.0	7	5	56.0	37.0	1	1	0	1	1	1	0.1
22	244	1.75	101	Medium	55	536668	6279323	79	1	5	7	8	0	0	20.0	1.2	14.6	2.2	0.0	0.0	3	2	37.0	31.0	1	0	0	0	1	1	3.3
8	249	6.85	101	DNG	55	537100	6279789	154	1	6	11	13	0	1	0.1	0.7	13.0	19.0	0.0	0.1	0	0	23.0	6.0	0	0	0	0	0	1	2.3
6	249	6.85	101	DNG	55	537385	6279396	179	0	5	9	10	0	1	0.0	0.5	73.4	16.7	0.0	0.1	0	0	59.0	1.0	0	0	0	0	0	0	0.8
7	249	6.85	101	DNG	55	537075	6280189	141	0	3	9	18	1	1	0.0	0.7	43.8	14.5	0.1	0.1	0	0	8.0	4.0	0	0	0	0	0	0	0.5
13	249	16.53	101	Regen	55	537784	6279546	210	1	1	6	6	0	1	8.0	0.2	60.1	65.9	0.0	0.1	0	0	75.0	0.0	0	0	0	0	0	1	0.0
18	249	16.53	101	Regen	55	537222	6280015	190	1	3	9	10	0	1	8.0	15.2	81.7	12.0	0.0	0.5	0	0	10.0	0.0	0	0	0	0	0	1	0.0
16	249	16.53	101	Regen	55	537496	6279915	180	1	1	4	5	0	1	1.0	0.3	54.1	2.6	0.0	0.1	0	0	18.0	0.0	0	0	0	0	0	1	0.0
15	249	16.53	101	Regen	55	537400	6279650	303	1	5	7	10	0	1	5.0	5.5	127.3	14.5	0.0	1.0	0	0	17.0	0.0	1	0	0	0	0	1	0.0
Co014	249	28.52	101	Medium	55	538083	6275830	280	1	7	3	9	1	1	0.5	2.0	20.0	3.9	0.1	0.1	0	0	11.2	15.0	1	0	0	0	0	1	0.1
10	249	28.52	101	Medium	55	537216	6279768	246	2	9	8	10	0	1	8.0	5.6	16.5	11.5	0.0	0.1	3	3	34.0	41.0	1	1	0	0	1	1	0.0
9	249	28.52	101	Medium	55	537610	6279272	209	1	9	9	7	0	0	6.0	2.6	31.5	2.1	0.0	0.0	3	2	28.0	37.0	1	1	0	0	0	0	0.0
11	249	28.52	101	Medium	55	537901	6276765	92	1	7	10	17	1	1	45.0	2.0	7.0	34.5	0.3	0.6	2	2	24.0	55.0	1	1	1	0	1	1	0.1
12	249	28.52	101	Medium	55	538228	6275487	313	1	7	7	10	1	1	50.0	41.8	28.9	3.3	0.1	0.1	6	6	51.0	44.0	0	0	0	0	1	1	0.1

Appendix C

PCT 250 re-mapping for MOD 14

EMM
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Memorandum

14 October 2022

To: Vanessa Owen and Miranda Kerr

From: Steven Ward

Subject: **Evolution Mining (Cowal) Pty Limited (DA1498) Biodiversity Offsets - resolution of PCT 250 credit liability**

Dear Vanessa and Miranda,

This letter is a response to South West Branch's email regarding EMM's provision of re-mapped PCT 250 spatial files, sections and listing of points restructured for referencing purposes [ROG South West Region Mailbox, 27 October 2021 Subject: HPE CM: BCD Response RE: FW Statement of Reasonable Equivalence - Evolution Mining (Cowal) Pty Limited (DA1498)]. Specifically, this letter addresses the following feedback:

> 2. South West Branch disagrees with the method described by EMM for re-mapping PCT 250 to pre-clearing vegetation type. We suggest revising the re-mapping based on existing floristic and landscape information, or provide a more robust justification for the approach. The explanation provided by EMM is insufficient.

On behalf of Evolution Mining (Cowal), EMM seeks endorsement by BCD for the updated re-mapping of PCT 250 for MOD 14, so that the biodiversity offset requirements can be resolved in their entirety.

This letter provides a legislative background to the MOD 14 offset liability, followed by the updated methods and results for the updated re-mapping of PCT 250. The final section provides a response to the queries raised by BCD in the email cited above.

1 Background

1.1 Changes in assessment method and credits generated from offset areas

Evolution's MOD 14 project spanned the transition of NSW legislation and processes governing assessment of biodiversity impacts and offsets from the *Threatened Species Conservation Act 1995* (TSC Act) to the *Biodiversity Conservation Act 2016* (BC Act). The impacts arising from MOD 14 were assessed under the Framework for Biodiversity Assessment (FBA) under the previous TSC Act. An offset strategy was developed for the project that identified four offset areas; these areas were assessed under the BioBanking Assessment Methodology (BBAM). This analysis indicated the offset areas met the offset requirements for MOD 14 with a significant credit surplus available.

MOD 14 was approved in October 2018 and the Project Approval (10/07074-5) requires the retirement of offset credits secured under a Biodiversity Stewardship Agreement (BSA) or their equivalent under a statement of reasonable credit equivalence (Conditions 5 - 8).

A Statement of Reasonable Equivalence (SRE) was sought in March 2020 and the offset areas were reassessed under the Biodiversity Assessment Method (BAM) 2017 (OEH 2017). The method for establishing Stewardship sites has now been updated to BAM 2020 (DPIE 2020). The reanalysis under the BAM identified a deficit between the MOD 14 offset requirements and number of credits generated in the offset areas, particularly for PCTs 26 and 55, despite increases in the areas of each PCT. A summary of the offset liability for MOD 14, as determined by the SRE, is provided in Table 1.1. This matter is the subject of separate discussions with BCD.

Table 1.1 Ecosystem credit liability for MOD 14 under BBAM and BAM, as determined by SRE

PCT	BBAM	BAM (as per SRE)
PCT 26 Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion (LA212)	109	120
PCT 55 Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions (LA105)	193	210
PCT 82 Western Grey Box – Poplar Box – White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion (LA152)	816	398
PCT 185 Dwyers Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion (LA144)	18	10
PCT 249 River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW (LA191)	19	9
PCT 250 Derived tussock grassland of the central western plains and lower slopes of NSW (LA138)	2,532	1,783

1.2 Plant community type 250

The biodiversity assessment undertaken for MOD 14 by AMBS Ecology and Heritage (AMBS 2018) and Resource Strategies Australia (RSA 2018a, 2018b) mapped 234.30 ha of the biometric vegetation type (BVT) of LA138 – Highly Modified Derived Grasslands, which corresponds to the BAM plant community type (PCT) 250 with a BBAM credit requirement of 2,532 credits. The SRE converted this offset liability to 1,783 credits under the BAM (DPIE 2020).

PCT 250 is a derived native grassland (DNG) community and not a natural grassland. As it is not best practice to use such derived PCTs in biodiversity assessments; we understand BCD no longer permits accredited assessors to select derived PCTs when applying the BAM. Rather, practitioners should map a derived condition state of the original pre-European PCT(s) and calculate the offset liability accordingly.

Furthermore, PCT 250 sits within the Western Slopes Grassland vegetation class and Grasslands vegetation formation. Thus, if this PCT were to be utilised under the offset trading rules for both the TSC Act and the BC Act, Evolution must find grassland vegetation to offset impacts to PCT 250. This would deny delivery of outcomes that would seek to conserve, manage, and improve the original vegetation types that would have originally occurred at the impact site (albeit that they were heavily degraded DNG at the time of the impact assessment).

1.3 Resolving the issues

1.3.1 SRE

Following discussion between EMM, Evolution and BCD on 8 September 2021, Evolution applied to have the SRE reviewed and amended. This has since occurred, and the updated SRE now states that if the credits for PCTs 26 and 55 are delivered via an offset site owned by Evolution containing approximately the same areas of PCTs 26 and 55, then the credits generated at these sites are equivalent to those required by MOD 14. We note that to formalise this, EMM is in the process of updating the Stewardship site boundaries and accounting for some service easements that have been found to pass through the southern proposed offset site, adjacent to Blow Clear Road. Once complete, the area of vegetation within the Stewardship sites and credits potentially generated will be sent to BCD for their review, seeking SRE approval.

1.3.2 PCT 250 re-mapping

EMM undertook an exercise to “re-map” areas of PCT 250 to originally occurring PCTs. EMM used PCT mapping from the Cowal Gold Mine, undertaken by both AMBS (2018) and EMM (2020-2022), to undertake this assessment and then reallocated PCT 250 credits on a proportional basis based on this revised mapping. The credit results and spatial files of the re-mapping were provided to BCD for review.

On review, South West BCD Branch stated that:

> 1. South West Branch supports the approach to create credits for PCT26 and PCT82 within a BSA associated with DA1498 MOD 14, and to use these credits in their entirety to offset impacts associated with DA1498 MOD 14 for PCT26 and PCT82.
>
> 2. South West Branch disagrees with the method described by EMM for re-mapping PCT 250 to pre-clearing vegetation type. We suggest revising the re-mapping based on existing floristic and landscape information, or provide a more robust justification for the approach. The explanation provided by EMM is insufficient.

A follow up meeting between EMM and BCD in June 2022 detailed the method applied to re-mapping PCT 250 and addressed some of the issues raised by BCD with the initial mapping. The following outcomes of the meeting as agreed by Vanessa Owen and Miranda Kerr (emails on 5/7/2022), were:

> From the meeting it is understood that BCD broadly agree with the proposed approach to remapped of the areas mapped as derived native grassland (DNG); noting that BCD will need to receive and review the outcomes before formal approval is issued.
>
> Actions from the online meeting held between BCD and EMM on 16/6/2022 were that:
>
> 1. EMM was to send through a copy of the PCT 250 remapping methods presentation
>
> 2. EMM to send through the breakdown of the credit outcomes (outside of PCT 250) for Stewardship sites 3 and 6 (noting that boundaries have had some revisions), to seek a revised statement of reasonable credit equivalence for some PCT's. BCD to review and provide written confirmation, if agreed to by BCD, that the proposed Stewardship sites 3 and 6 will "zero out" the ecosystem credit requirements for some PCTs (this will exclude PCT250 requirements which are to be determined as per the action item 3 below). I will send this email request through separately to Vanessa.
>
> 3. EMM will complete the remapping of PCT250 (we anticipate that we will be able to complete this in a few weeks) and provide a brief memo to BCD on the methods and results, as well as shapefile data. As discussed, we are seeking to have the mapping consistent across the broader Open Pit Continuation (OPC) study area which is currently undergoing survey, and the remapping of PCT250 for MOD14. BCD to provide approval, if agreed, to the remapped PCT250 areas so that that set of biodiversity offsets for Mod14 can be resolved.

Action 1 has been addressed, with the presentation sent by Steven Ward (email on 4/7/2022). The email to address Action 2 will be shortly released, as it was delayed to allow the locations and extent of underground infrastructure within the proposed stewardship sites to be determined. This memo addresses Action 3.

1.4 Purpose of memo

The purpose of this memo is to provide BCD with the revised methodology used to re-map PCT 250 and how comments by BCD were addressed in the revision and re-mapping of PCT 250 areas. A direct response to each of BCD's specific concerns is also provided.

2 Methodology

When re-mapping PCT 250, EMM consulted a combination of past vegetation mapping from Evolution Mining (Cowal) and NSW DPE datasets, as well as extensive fieldwork recently undertaken by EMM for Evolution Mining (Cowal). Details of the resources used and approach to re-mapping PCT 250 are provided below.

2.1 Data sources

In re-mapping PCT 250 and vegetation mapping for the broader area, EMM reviewed existing mapping and vegetation data from the following relevant sources:

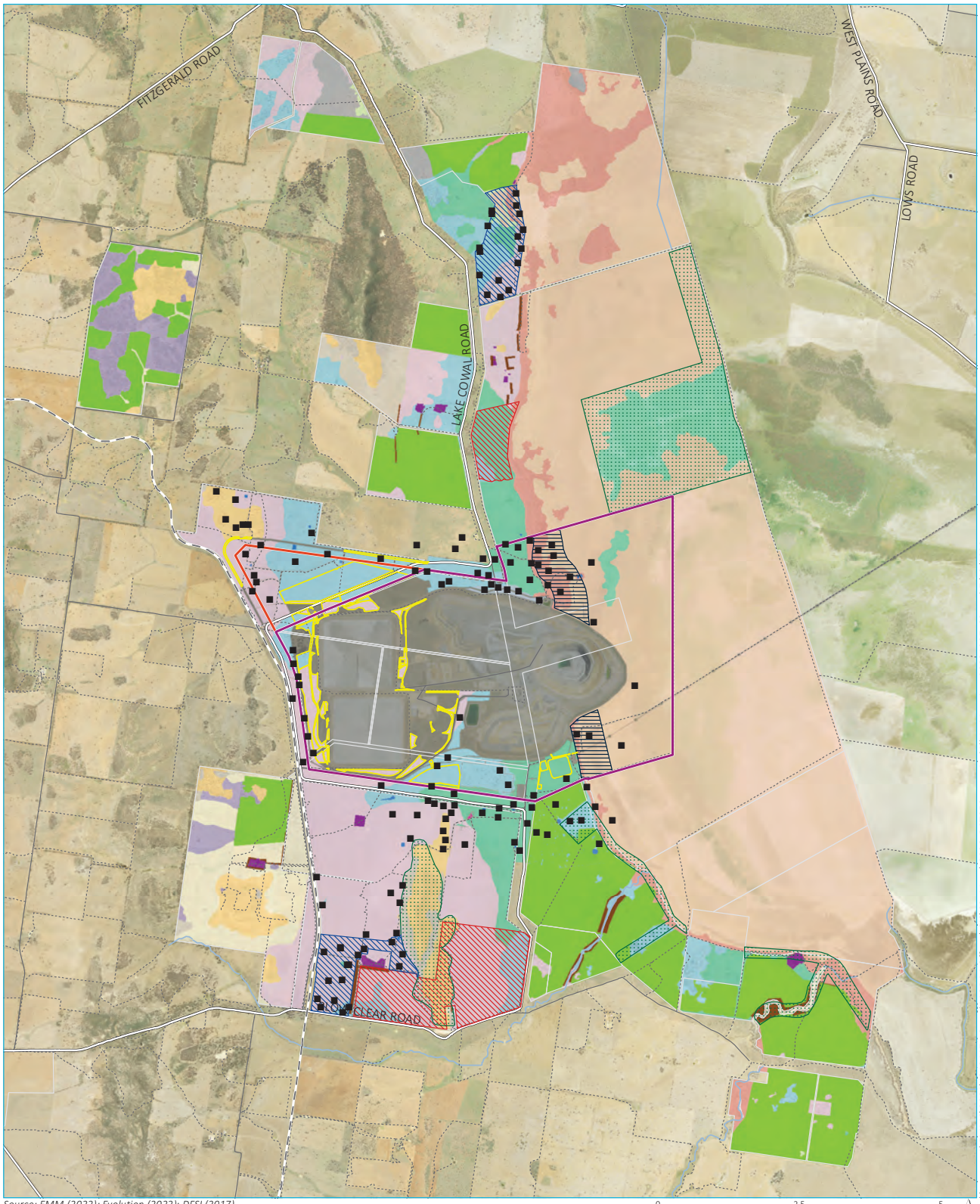
- AMBS 2018, *Cowal Gold Operations Processing Rate Modification - Flora and Fauna Survey Report.* Prepared for Evolution Mining (Cowal) by Australian Museum Business Services Ecology and Heritage, Sydney;
- Resource Strategies 1998, *Cowal Gold Project – Environmental Impact Statement*. Prepared for North Limited, Resource Strategies, Brisbane;
- Resource Strategies 2013, *Cowal Gold Mine Extension Modification (MOD 11) Appendix D: Threatened species assessment*. Prepared for Barrick Cowal, Resource Strategies, Brisbane;
- Resource Strategies 2018, *Cowal Gold Operations Processing Rate Modification (MOD 14) – Environmental Assessment Appendix C: Biodiversity Assessment Report and Biodiversity Offset Strategy*. Prepared for Evolution Mining, Resource Strategies, Brisbane;
- State Vegetation Type Map: Central West / Lachlan Region Version 1.3. VIS_ID 4468 (DPIE 2015); and
- BioNet Vegetation Classification database (DPIE 2021).

2.2 EMM Fieldwork

EMM has completed extensive ecological surveys in the area on behalf of Evolution since 2019, which were used to inform the re-mapping of PCT 250. These works relate to the preparation of a Biodiversity Development Assessment Report (BDAR) to support Evolution's OPC (Open Pit Continuation) project, development of a BSA related to the MOD 14 offset liability, as well as vegetation mapping over most of Evolution's landholdings to assist with the Biodiversity Offset Strategy for the OPC project (Figure 1). Works relevant to the re-mapping of PCT 250 completed by EMM include:

- detailed vegetation mapping of approximately 1,700 ha within the study area of the OPC project, covering approximately a 4 km radius surrounding the MOD 14 mapped PCT 250 areas;
- detailed vegetation mapping of approximately 260 ha associated with offset sites for MOD 14, located approximately 5 km south and 7 km north of the MOD 14 mapped PCT 250 areas;
- vegetation mapping of approximately 10,600 ha (4,600 ha within Lake Cowal) across Evolution owned land within a 10 km radius of the MOD 14 mapped PCT 250 areas;
- approximately 90 BAM plots within the OPC study area; and
- approximately 45 BAM plots within proposed MOD 14 offset areas.

The location of the vegetation mapping and BAM plots undertaken are shown in Figure 1.



Source: EMM (2022); Evolution (2022); DFSI (2017)

0 2.5 5 km

GDA 1994 MGA Zone 55

N

\\emmsvr1\EMM3\2021\J210417 - Cowal MOD14 Offsets\GIS\02_Maps\G006_PCT250remapAndAllVegMapping_20221007_02.mxd 7/10/2022

KEY

- Mining lease (ML1535)
- Mining lease (ML1791)
- Approved surface disturbance
- AMBS PCT 250 remapping (EMM 2022)

Vegetation offset/management

- Remnant vegetation enhancement program area
- Compensatory Wetland
- Existing offset area
- Proposed offset area

- EMM BAM plots

Vegetation mapping - EMM (20220929)

- PCT17
- PCT26
- PCT53
- PCT55
- PCT56
- PCT70
- PCT80
- PCT82
- PCT176
- PCT185
- PCT217
- PCT244
- PCT249
- Cleared
- Planted
- Cropped
- Exotic Grassland
- Dam
- Infrastructure

- Rail line
- Major road
- Minor road
- Vehicular track
- Named watercourse
- Evolution owned land

Vegetation mapping and BAM plots undertaken by EMM for Evolution Mining (Cowal)

Evolution Mining
Cowal Gold Operations
MOD14 offsets
Figure 1

EMM
creating opportunities

2.2.1 EMM vegetation mapping methodology

Due to the complex mosaic of woodlands resulting from small differences in landform elements, determining original PCTs of DNG areas is a challenging task, particularly across an alluvial plain. Nevertheless, past vegetation mapping and landform data, combined with adjacent remnant vegetation, was used to provide a model of the vegetation that once occurred in the PCT 250 areas of MOD 14. Specifically, vegetation mapping completed by AMBS (2018), as included in Resource Strategies (2018), was used as the base dataset for the re-mapping of PCT 250. EMM's vegetation mapping surrounding the MOD 14 area, and extensive vegetation mapping of the broader region, was overlaid onto the historic vegetation mapping to identify patterns and consistencies or inconsistencies amongst the mapping data. As soil and vegetation data could not be collected by EMM in PCT 250 areas since they are now disturbed, contour mapping, Digital Elevation Models (DEMs) and drainage patterns were also consulted to identify likely landform elements associated with the PCTs that may have historically occurred. Areas of remnant woodland for all PCTs (located within the Lake Cowal area) were also inspected to gain an understanding of soils, landscape position and trees typically associated with vegetation communities in an undisturbed state. An understanding of characteristic features of potential PCTs that may occur within DNG areas was applied to the PCT 250 area. Where present, scattered trees and remnant woodland areas nearby the PCT 250 area for MOD 14 were informative for allocating PCTs, provided the landscape position and geology were also consistent.

Identified in order of application, the following features were used to re-map PCT 250:

1. landscape position / topography;
2. soils;
3. proximity to intact woodland (where present);
4. remnant and regenerating canopy species scattered trees;
5. AMBS mapping of the MOD 14 areas; and
6. land use.

The application of the above factors to re-map PCT 250 are summarised in Table 2.1 below.

Table 2.1 Summary of features used to re-map PCT 250

Feature	Application
Landscape position / topography / drainage	• Contour mapping, Digital Elevation Models (DEMs) and drainage patterns were used to inform landscape landform elements within the MOD 14 area, which are now modified. • PCT 82 was mapped on a broad range of landform elements, including hillslopes, foot slopes, floodplains and areas of the alluvial plain associated with better drainage in areas surrounding MOD 14. Typically, PCT 82 was located at a slightly higher elevation than PCTs 55 and 26. • PCT 55 and 26 were mapped in flat and undulating areas across the alluvial plain. PCT 26 was associated with small rises where apparent and PCT 55 with poorer drainage areas, however, this was not a limiting factor to extent. • Gilgais were associated with both PCT 55 and 26. Not associated with PCT 82. • PCT 185 was mapped on hillslopes and hillcrests as it is restricted to these landscape positions locally.
Soils	• Soils of PCT 82 were typically red brown clay loams, sometimes containing gravel. • PCTs 55 and 26 were identified as having brown to red clay and loamy clay soils. • Some areas of PCT 55 had predominately grey clays. • Some areas of PCT 55 had predominately grey clays.
Proximity to intact woodland (where present)	• Proximity to woodland patches of PCT 26, 55 and 82 indicated the presence of the relevant PCT in adjacent DNG areas if associated landform elements and soils also occurred. • Remnant woodlands of these PCTs were readily distinguished where landform elements and soils align. • PCT 82 was identified by dominance or codominance of Western Grey Box (*Eucalyptus microcarpa*). • PCT 26 was identified by the dominance or codominance of Weeping Myall (*Acacia pendula*). • PCT 55 may have Weeping Myall present, however, the canopy is clearly dominated by Belah (*Casuarina cristata*). • Across the alluvial plain, woodland patches of PCT 55 and PCT 26 were noted to frequently form a mosaic of small patches of both woodlands with ecotones between. • PCT 55 and 26 displayed a similarity of soils and landform elements, a mosaic occurrence pattern and lack of discernible difference in floristics of ground cover. • Where soil colour differences and landform elements (small rises and poorer drainage areas) were not readily apparent, scattered trees and proximity to woodland patches were considered viable, but limited, indicators of PCTs. • DNG areas adjacent to remnant woodlands were considered part of the same PCT unless other factors, primarily landscape position or soils, strongly indicated a different PCT.
Scattered trees	• Scattered trees commonly associated with PCT 82 were Western Grey Box, Poplar Box (*Eucalyptus populnea*), Kurrajong (*Brachychiton populneus*) and White Cypress Pine (*Callitris glaucophylla*). • Belah was found to be more commonly associated with PCT 55, so areas adjacent scattered Belah (where the landscape position was considered consistent) were indicative of PCT 55 DNG. • Wilga (*Geijera parviflora*) and Western Rosewood (*Alectryon oleifolius*) were identified to occur very infrequently in PCT 26 woodland and were much more common in PCT 55. So, PCT 55 was considered as potentially occurring where scattered Wilga and Western Rosewood were dominant. • The occurrence of Weeping Myall as scattered trees or very small patches was considered to indicate the presence of PCT 26. • Weeping Myall was found to less likely to regenerate in isolated areas. On this basis, PCT 26 was not discounted where there was a lack of Weeping Myall scattered trees.

Table 2.1 Summary of features used to re-map PCT 250

Feature	Application
AMBS mapping of the MOD 14 areas	• AMBS (2018) vegetation mapping was used as the basis for the re-mapping of PCT 250. • EMM's vegetation mapping was overlaid to identify patterns that may assist in the re-mapping of PCT 250 and identify any inconsistencies between the mapping data sets. • AMBS (2018) also included gilgais as features of both LA212 (PCT 26) and LA105 (PCT 55), as noted in S3.1.3, pages 24 and 30 respectively.
Land use	• Past land use was considered in PCT determination mostly on high hillslopes and hillcrests, which were not cleared for agriculture. However, the footslopes and floodplains have broadly experienced intensive agriculture, so land use was a less useful diagnostic for PCTs allocated in these areas.

Although BCD suggested using plot data to inform the allocation of PCT 250, this data was not available over the DNG areas. Furthermore, homogeneity of ground cover amongst DNG areas makes this diagnostic unreliable, so was avoided in the re-mapping exercise. That is, ground cover species across the landscape are typically ubiquitous due to past and current land uses. These issues were also highlighted in AMBS (2018) (see S1.7 pg 4; S2.2.2 pg 7; S3.1.1 pg 21; S3.1.3 pg 31 and 32). Multiple changes in vegetation mapping across various reports from 1998 to 2018 similarly indicates the difficulties inherent in determining the original vegetation communities present in the area.

For example, AMBS (2018) notes:

> 'Multivariate analyses of floristic data collected during the survey did not provide clarity on distinctions between plant communities or any historic pre-clearing information, as clearing, followed by many years of grazing, has resulted in a suite of native species becoming ubiquitous across the landscape.' (see S2.2.2 pg 7).

EMM also recently found floristics was an unreliable indicator of PCTs associated with DNG areas. Multivariate analysis recently undertaken by EMM of 140 BAM plots across OPC and MOD 14 stewardship site study sites, including 69 DNG plots, found >40% similarity amongst most plots for PCT 26, 55 and 82, regardless of vegetation zone condition (eg DNG, low and medium condition). Hence, groundcover floristic composition was not found to be useful for allocating PCTs to areas with a derived condition state.

3 Results

3.1 Results of EMM's vegetation mapping

Across approximately 12,300 ha of the landscape, the following 13 PCTs were mapped by EMM:

- Freshwater Wetlands, PCT 17 (Inland Floodplain Shrublands) and PCT 53 (Inland Floodplain Swamps);
- Forested Wetlands, PCT 249 (Inland Riverine Forests);
- Semi-arid Woodlands (Grass sub-formation), PCT 26 (Riverine Plain Woodlands) and PCT 55 (North-west Floodplain Woodlands);
- Grassy Woodlands, PCT 56, PCT 80, PCT 82, PCT 244 and PCT 70 (all Floodplain Transition Woodlands);
- Dry Sclerophyll Forests (Shrubby sub-formation), PCT 217 (Western Slopes Dry Sclerophyll Forests); and
- Semi-arid Woodlands (Shrubby sub-formation), PCT 185 and PCT 176 (both Inland Rocky Hill Woodlands).

Within the OPC project area, located immediately adjacent to the MOD 14 area, PCTs mapped are PCT 17, PCT 26, PCT 53, PCT 55, PCT 82, PCT 185, PCT 244 and PCT 249.

To date, the majority of DNG areas across Evolution's local landholdings have been identified as PCT 55, PCT 26 or PCT 82. This vegetation mapping is displayed in Figure 1. A small area of PCT 185 was also identified in the bend of Lake Cowal Road to the northwest of the Cowal Gold mine (Figure 2).

The re-mapped PCT250 areas are presented in Figure 2, and the re-mapped PCT250 areas with the associated surrounding vegetation mapping for the OPC are provided in Figure 3.

3.2 Re-mapping PCT 250

It was found that most mapped woodland patches and DNG areas were the same or very similar across the mapping data sets. The greatest difference between the mapping of DNG areas of AMBS (2018) and EMM's mapping was the extent of PCT 55. Specifically, PCT 55 was not represented in DNG areas mapped by AMBS (2018). Given the similarity in extent of woodland patches of PCT 55, 26 and 82 across the landscape, the tendency of PCT 55 and PCT 26 to form a mosaic across the alluvial plain, the occurrence of landform elements and soils associated with PCT 55 in DNG areas, and dominance of Belah and lack of Weeping Myall in many areas where scattered trees were present, EMM determined that restricting PCT 55 to woodland areas only was not supported by the evidence. Hence, PCT 55 was considered to have originally occurred in many areas mapped as PCT 250.

PCTs assigned to remnant woodland patches nearby MOD 14 by AMBS (2018) and EMM were also relevant to re-mapping of PCT 250 (see Figure 3). That is, a relatively large patch of woodland immediately south of the mine was mapped by AMBS (2018) as Weeping Myall Woodland (Semi Cleared in Moderate Condition, Figure 6a, Resource Strategies 2018). However, EMM found this woodland to be dominated by Belah, with little to no occurrence of Weeping Myall (refer to label 1 within Figure 3). As such, EMM mapped this woodland as PCT 55, not PCT 26. A small woodland patch adjoining this Belah woodland to the northeast is dominated by Weeping Myall and was mapped as PCT 26 (refer to label 2 within Figure 3). The PCT 250 area immediately to the west of the PCT 55 woodland was considered part of the same landform element (refer to label 3 in Figure 3) and small patches of Belah recorded immediately to the north of this DNG area. As such, the majority of PCT 250 in this area was mapped as PCT 55 DNG, with a small area of PCT 26 DNG adjoining a slight a rise to the south (refer to label 4 in Figure 3) and a small area of PCT 82 DNG associated with a drainage line and floodplain to the west (refer to label 5 in Figure 3).

PCT 185 was allocated to the north-eastern extent of the PCT 250 area, corresponding with a hill-rise. Remnant PCT 185 woodland [dominated by Dwyer's Red Gum (*Eucalyptus dwyeri*) and Mugga Ironbark (*Euycalyptus sideroxylon*)] immediately adjacent to this area, located in a comparable topographic position, indicated that PCT 185 was the most suitable PCT to allocate to this area (refer to label 6 in Figure 3).

3.2.1 Revision of original re-mapping of PCT 250

Review of BCD South West Branch's comments relating to the original PCT 250 re-mapping prompted revision of EMM's mapping, particularly reconsidering the land systems, soils and elevation data provided in Resource Strategies (1998) EIS.

Elevation data of the area in Resource Strategies 1998 (Section 4) prior to the mine development showed a small hill that is now completely obscured by the mine development. It was predicted that floodplain transition woodlands occurred on the foot slopes and slopes in this area, so the extent of PCT 82 was increased where PCT 250 was previously mapped toward the centre of the mine area (refer to label 7 in Figure 3).

The extent of PCT 82 DNG areas was also increased in areas identified by topographic mapping as predicted transition areas between the alluvial plain and surrounding foot slopes (refer to label 8 in Figure 3).

An area of PCT 250 to the east previously mapped as PCT 55 was revised to PCT 26 (refer to label 9 in Figure 3). Very little evidence was present in that area of the alluvial plain to delineate between PCT 55 and PCT 26. Given the closest adjacent woodland area was identified as PCT 26, DNG surrounding this area, including that mapped in MOD 14 as PCT 250, was considered most likely to be PCT 26 DNG.

3.2.2 Summary of re-mapped PCT 250 and credit liability

A summary of the PCTs within the original and updated re-mapping of PCT 250 for MOD 14, as well as the pro-rata allocation of ecosystem credits is provided in Table 3.1 below. Figure 2 shows the extent of each PCT within the PCT 250 areas as per MOD 14 only. For context, Figure 3 shows the PCT types within the PCT 250 areas as per MOD 14, combined with the adjacent vegetation mapping undertaken recently for the OPC project.

Table 3.1 Original and updated re-mapping of PCT 250 and the associated credit liability calculated pro-rata

PCT ID	PCT Name	UPDATED Area (ha) of PCT 250 area	UPDATED % of PCT 250 area	UPDATED Credits liability (pro-rata; rounded to nearest whole no.)	ORIGINAL Area (ha) of PCT 250 area	ORIGINAL % of PCT 250 area	ORIGINAL Credits (pro rata; rounded to nearest whole no.)
26	Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	16.94	7.24	129	2.24	0.95%	17
55	Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions	131.96	56.36	1005	203.41	86.82%	1548
82	Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	84.86	36.25	646	28.29	12.07%	215
185	Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion	0.36	0.15	3	0.36	0.15%	3
Total		234.12[2]		1783[1]	234.30		1783

1. Note that the credit liability of PCT 250 as per the Statement of Reasonable Equivalence was 1783 Credits under the BAM. Allocation of these credits to PCTs 26, 55, 82 and 185 was calculated on a pro-rata basis, which depended on the % of area these PCTs contributed.

2. Assessment of impacts on PCT 250 by AMBS (2018) was 234.3 ha (Table 25). However, a GIS clipping error was found by EMM when reviewing the AMBS mapping data. The area of impact to the PCT 250 area, after correcting this GIS error during this re-mapping exercise, was found to be 234.12 ha. Regardless of this disparity, the offset liability was allocated here proportionally, based on area of each PCT. Considering this, and that the corrected area of impact is less than that in the original assessment, this inconsistency is considered inconsequential to the offset liability for PCT 250.



Mining lease (ML1535)
Mining lease (ML1791)
Approved Mod14 surface disturbance
Approved surface disturbance
Rail line
Major road
Minor road

AMBS PCT 250 remapping (EMM 2022)

PCT 26 | Weeping Myall open woodland of the Riverina Bioregion and NSW South

PCT 55 | Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains

PCT 82 | Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar

PCT 185 | Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South

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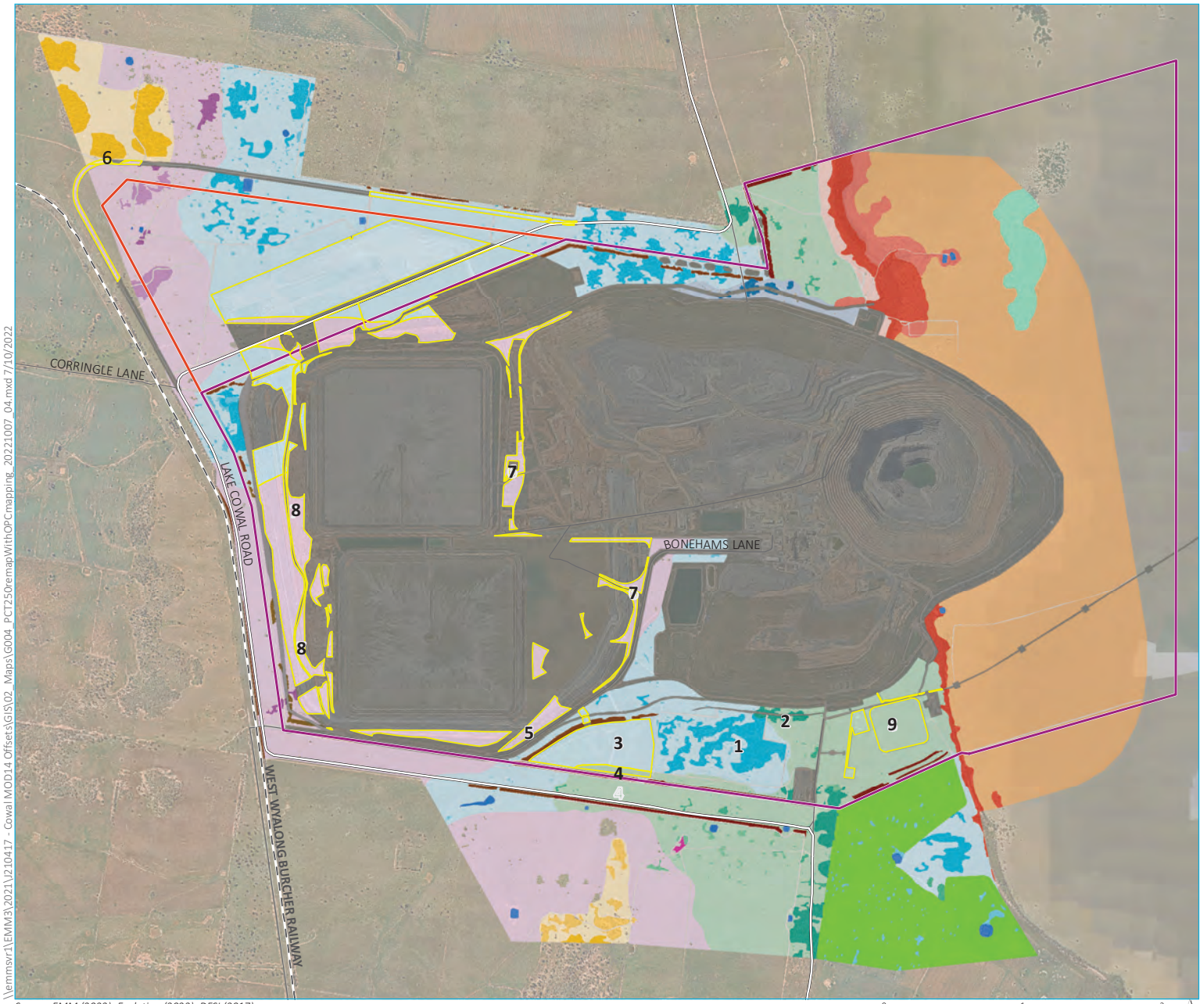
Source: EMM (2022); Evolution (2022); DFSI (2017)

0 1 2 km
GDA 1994 MGA Zone 55
N

PCTs re-mapped within the PCT 250 areas (as per MOD14)

Evolution Mining
Cowal Gold Operations
MOD14 offsets
Figure 2

EMM
creating opportunities



KEY

- Mining lease (ML1535)
- Mining lease (ML1791)
- Approved surface disturbance
- AMBS PCT 250 remapping (EMM 2022)
- Rail line
- Major road
- Minor road

Vegetation mapping - (EMM 20220929)

PCT 17 | Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)
- Medium

PCT 26 | Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
- High
- Medium
- Poor
- Derived native grassland
- Planted

PCT 53 | Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains
- Medium

PCT 55 | Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions
- Medium
- Poor
- Derived native grassland
- Planted

PCT 82 | Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion
- Medium
- Regenerating
- Derived native grassland
- Planted

PCT 185 | Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
- High
- Medium
- Derived native grassland

PCT 244 | Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).
- Medium
- Derived native grassland

PCT 249 | River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW
- Medium
- Regenerating
- Derived native grassland

Other
- Dam
- Exotic Grassland
- Cleared
- Cropped

PCTs re-mapped within the PCT 250 areas (as per MOD14), combined with adjacent vegetation mapped for the OPC project

Evolution Mining
Cowal Gold Operations
MOD14 offsets
Figure 3

Source: EMM (2022); Evolution (2022); DFSI (2017)

0 1 2 km
GDA 1994 MGA Zone 55
N

\\emmsvr1\EMM3\2021\210417 - Cowal MOD14 Offsets\GIS\02_Maps\G004_PCT250remapWithOPCmapping_20221007_04.mxd 7/10/2022

creating opportunities

4 EMM response to BCD comments

4.1 Comment 1

> "BCD agreed that re-mapping of PCT 250 to likely original vegetation types is needed, however we do not agree with EMM's proportional approach used below. In our meeting on 8 September 2021, we discussed using the existing mapping and landscape/vegetation features to indicate the probable original PCT."

A proportional approach was not used to re-map PCT 250. As discussed above, EMM's methodology for re-mapping PCT 250 extensively utilised existing mapping, landscape/vegetation features, floristic plots and on ground vegetation mapping of the surrounding area to indicate the probable original PCT.

A proportional approach was used to reallocate PCT 250 credits based on the re-mapping, not to determine how PCT 250 was re-mapped. The original SRE determined that the 234.30 ha of PCT 250 required 1783 credits to be retired. As agreed by BCD, the most reasonable approach to retiring these credits would be to re-map PCT 250 to the probable original PCTs. After PCT 250 was re-mapped using the methodology outlined above, the percentage of each re-mapped PCT of the total area (previously PCT 250, 234.30 ha) was determined and the 1783 PCT 250 credits were allocated to re-mapped PCTs in proportion to their percentage of the total area of PCT 250 (as presented in Table 3.1).

4.2 Comment 2

> "The proportional approach may not consider the selectiveness of past clearing for agriculture. While PCT 55 Belah woodland is highly cleared across its distribution (83%), it is possible that it remains in the landscape around Lake Cowal because the understorey did not provide the same high quality forage that resulted from clearing grassy woodlands like PCTs 82 or 26, or the soils are less suitable for cropping compared with grassier woodlands."

Past land use and selective clearing were considered in the re-mapping of PCT 250, however it was determined that was only marginally useful in PCT determination, given the expansive extent of agricultural land use in the local area.

Across the landscape there are remnant patches of PCT 82, 55 and 26, however they are typically small and isolated. Within the OPC study area, EMM mapped a larger amount of PCT 55 woodland (~65 ha) than PCT 26 woodland (~20 ha) and PCT 82 woodland (~5 ha). Vegetation mapping completed by EMM across all Evolution owned land in the area identified approximately ~100 ha of PCT 26 woodland, ~110 ha of PCT 55 woodland and ~135 ha of PCT 82 and PCT 80 woodland. PCTs across the landscape that consistently occur as large and very large patches of remnant or partially remnant woodland are PCT 176 (~150 ha), PCT 185 (~290 ha) and PCT 249 (~250 ha). These larger remnant extents are consistent with PCTs that are hillslopes or forested wetlands, which are typically unsuitable for agricultural purposes. If PCT 55 was similarly unsuitable for agriculture in the area, it would be expected for it to also be represented by large patches of remnant or partially remnant woodland. That is, it appears that PCT 55 has also been cleared extensively through past agricultural land use.

In addition, patches of PCT 55 and PCT 26 woodland are typically found in flatter areas of the alluvial plain, typically at an elevation slightly above Lake Cowal and slightly lower than floodplain transition woodlands such as PCT 80, PCT 82 and PCT 217. Soils in these areas have a higher clay content than transition woodlands, poorer drainage, typically lack gravel and may have gilgais. Of the ~1,900 ha mapped as cropped across Evolution owned land, by far the most prevalent scattered tree in these cropped areas is Belah and so it is probable that these cropped areas were historically a mix of PCT 55 and PCT 26. This occurrence of PCT 55 and PCT 26 is evident in a remnant patch of crown land that is in a comparable landscape position to and surrounded by cropped land, approximately 3 km to the southeast of the OPC project study area.

Based on species listed in the BioNet Vegetation Information System (VIS) for each PCT and native pasture varieties used in NSW (DPI 2012), PCT 55 has the highest number of native pasture species (eight), whilst PCT 82 has seven and PCT 26 has just four. All species are grasses except *Atriplex nummularia* (PCT 26). VIS states that prior to European settlement, PCT 26 probably had a denser understory of saltbushes. These may have been palatable to stock. Weeping Myall can also be used as drought fodder, which may have placed additional pressure on PCT 26 in area. PCT 55 and PCT 26 are both within the Semi-arid Woodlands (Grassy sub-formation) vegetation formation. Given the heavy clays and gilgais often associated with PCT 55, it is likely to have been less suitable for agriculture, however these factors are also relevant to PCT 26. Ongoing grazing of livestock (cattle and sheep) within remnant areas of PCT 55 within the OPC project area also demonstrates the potential utility of this vegetation community to agriculture.

Given the similarity in agricultural suitability between PCT 55 and PCT 26, and the evidence of remnant woodland patches in the area and pattern of current agricultural land use, it is considered unlikely that PCT 55 would have been selectively excluded from clearing for agricultural purposes to the point that DNG areas would not be derived from PCT 55.

4.3 Comment 3

> Re-mapping should be based on existing knowledge and data:
>
> a) Existing floristic plot data and vegetation mapping should form the basis for re-mapping PCT 250.
>
> i) The revised vegetation mapping from MOD 14 (Resource Strategies 2018) (Fig 6a attached) does not appear to have informed re-mapping of PCT 250 (Map 1 attached).

As outlined in the re-mapping methodology, this revised vegetation mapping strongly informed re-mapping of PCT 250, particularly in areas where mapped woodland had been cleared during the MOD 14 works. There are some areas, particularly existing remnant woodland south of the mine site, where EMM disagreed with AMBS mapping based on floristic composition. In this instance, AMBS (2018) mapped the entire area as Weeping Myall woodland, however, the majority of this area is dominated by Belah with none or very few Weeping Myall. There are relatively clear transitions east of this patch where Weeping Myall is dominant and Belah are not present.

> ii) AMBS (2018) describe derived grassland on the site as occurring "throughout the study area in habitats that may have previously supported both LA152 [PCT 82 Inland Grey Box - Poplar Box - White Cypress Pine woodland] and LA212 [PCT 26 Myall woodland] prior to clearing for agricultural purposes" (page 32). There is no indication that AMBS considered it to be derived from LA105 Belah woodland or LA144 Dwyer's Red Gum shrubby woodland.

AMBS (2018) also note in the same section that in relation to the derived grasslands *"Either the Keith Formations KF_CH3 Grassy Woodlands or KF_CH11A – Semi-arid woodlands (Grassy sub-formation) would have applied prior to clearing"* (page 31). EMM agree that this would likely have included PCT 82 and PCT 26, however we can see no reason why it could not have also included PCT 55, which is also a KF_CH11A – Semi-arid woodlands (Grassy sub-formation), particularly given the prevalence of PCT 55 and PCT 26 woodland in the Lake Cowal area. EMM does not agree that the relevant evidence within the area precludes PCT 55 DNG occurring within PCT 250. Based on the limited evidence available, some areas are considered most likely to have been PCT 55 DNG.

PCT 185 (LA144) is restricted to gravel soils on hillslopes and hillcrests throughout the area, including on the hillslopes in the north-western area immediately adjacent to an area mapped as PCT 250. This area is also mapped as LA144 Dwyer's Red Gum in the revised vegetation mapping from MOD 14 (Resource Strategies 2018; Fig 6a). It is likely that PCT 185 transitions downslope into PCT 217, PCT 82 and PCT 80. EMM has mapped DNG areas below the hillcrest as PCT 82. The specific area covered by MOD 14 PCT 250 mapping is predominately mapped as PCT 82 and is likely to be in the eco-tone between PCT 185 and PCT 82 or PCT 217. Only a very small part of this area is mapped as PCT 185, which is highest up the hillslope.

iii) AMBS (2018) state that this grassland was quantitatively confirmed as being derived from Myall Woodland (S3.3.1 page 14; S3.4.3 page 69).

Sections 3.3.1 and 3.4.3 were not found in AMBS (2018). References to Myall Woodland on these stated pages were not found in AMBS (2018), both pages address fauna. We are unsure which grassland is being referred to here. In relation to PCT 250 areas, EMM re-mapped the area of PCT 250 mapped by AMBS (2018).

Section 3.1.3 page 24 of AMBS (2018) specifically addresses vegetation zones mapped as LA212 (PCT 26). It does not provide any method as to how any DNG areas were confirmed as being derived from Myall Woodland. Either way, EMM has revised some areas previously mapped as PCT 55 DNG to PCT 26 DNG.

iv) AMBS (2018) also considered that much of the remaining grassland was likely to be derived from Inland Grey Box – Belah – Poplar Box woodland (i.e. PCT82).

EMM could not find this statement in AMBS (2018). EMM agree that some, but not all, areas were likely to have been PCT 82. Our re-mapping reflects this, with PCT 82 mapped in the Lake Cowal area as occurring in broad range of landform elements including hillslopes, foot slopes, floodplains and areas of the alluvial plain associated with better drainage. Although PCT 82 was represented in the PCT 250 mapping as ~36.25%, it should be highlighted that much of the PCT 250 for MOD 14 occurred in floodplain areas that typically support PCT 26 and 55, rather than floodplain transition landscapes where PCT 82 most often occurs.

v) Myall woodland-derived grassland was mapped by AMBS (2012) in the south-east of the mine lease area, but this has been re-mapped by EMM as PCT 55 Belah woodland.

In relevance to PCT 250 credit determination, EMM only re-mapped areas mapped by AMBS (2018) as PCT 250. All areas have been re-mapped in a DNG state. Some areas mapped by AMBS outside of the PCT 250 area have been changed as a result of extensive fieldwork completed by EMM in relation to the OPC project. EMM re-mapped an area previously identified as Myall woodland as PCT 55 woodland in the south-east of the mine lease area, as addressed above. DNG areas were not re-mapped as woodland.

vi) It would be appropriate to check the existing floristic plot data for indicator species, including the species composition for plots LC14, LC19, LC50, LC43, LC46 or LC29 shown on Figure 6a could also be reviewed, however full floristic datasheets were not provided to BCD (then OEH) with the MOD 14 EIS – only the first page of the field datasheets with BioBanking summary data were in the data package, not the 2nd page full floristic species lists. We acknowledge that the derived grassland consists of species that are ubiquitous throughout the landscape and that species composition can be strongly influenced by past land management, so the result may not be conclusive.

EMM also does not have access to AMBS plot data. Nevertheless, AMBS (2018) noted that floristic data was not useful in determining plant communities in DNG areas. EMM also completed 20 DNG plots in the surrounding area and found that ground cover floristics were not useful in determining PCTs in DNG areas. A broader analysis of plot data across OPC project area and offset sites for MOD 14 revealed >40% similarity of flora within plots from PCT 26, 55 and 82, regardless of vegetation condition classes (i.e. DNG, poor, low and medium). Hence, floristics were not considered a reliable indicator of PCTs in such a modified landscape.

b) Extrapolation of existing information should consider soil and landform associated with each PCT

i) The description of land systems, soils and elevation data provided in the 1998 EIS may indicate where landforms are likely to change.

This data has been utilised in revision on EMM's re-mapping.

ii) According to the PCT description in BioNet Classification, PCT 55 occurs on alluvial brown or grey clay soils that may be gilgaied (DPIE 2021). Gilgai are landscape features that are evident on aerial imagery, including after ploughing.

EMM agree that gilgais are often associated with PCT 55, however the absence of gilgais does not preclude the occurrence of PCT 55. This is evident in remnant woodland patches of PCT 55 across the landscape. Gilgais are also prevalent in areas of PCT 26. Gilgais are considered useful in excluding PCT 82, however were not useful in delineating between PCT 55 and PCT 26.

5 Conclusion

This memo was prepared to provide BCD with the methodology used to re-map PCT 250 and how comments by BCD were actioned in the revision and re-mapping of PCT 250 areas from MOD 14. Following an update of re-mapping of PCT 250 based on this revised approach, the credit liability for each PCT was calculated based on the proportion of the PCT 250 area it occupied multiplied by the credit liability for PCT 250 (1783 Ecosystem Credits).

The Ecosystem Credit liability calculated by EMM for PCT 250 is:

- 129 credits for PCT 26 Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion;
- 1,005 credits for PCT 55 Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions;
- 646 credits for PCT 82 Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion; and
- 3 credits for PCT 185 Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion.

On behalf of Evolution Mining (Cowal), EMM seeks endorsement by BCD for the updated re-mapping of PCT 250 and calculated offset liability, so that the biodiversity offset requirements for MOD 14 can be resolved in their entirety.

Yours sincerely



Dr Steven Ward
Associate Ecologist
sward@emmconsulting.com.au

6 References

AMBS (2018). Cowal Gold Operations Processing Rate Modification - Flora and Fauna Survey Report. Prepared for Evolution Mining (Cowal) by Australian Museum Business Services Ecology and Heritage, Sydney.

DPI (2012) Pasture varieties used in New South Wales 2012-2013. Department of Primary Industries.

DPIE (2021). BioNet Vegetation Classification database. Department of Planning, Industry and Environment.

Resource Strategies (1998). Cowal Gold Project – Environmental Impact Statement. Prepared for North Limited, Resource Strategies, Brisbane.

Resource Strategies (2013). Cowal Gold Mine Extension Modification (MOD 11) Appendix D: Threatened species assessment. Prepared for Barrick Cowal, Resource Strategies, Brisbane.

Resource Strategies (2018). Cowal Gold Operations Processing Rate Modification (MOD 14) – Environmental Assessment Appendix C: Biodiversity Assessment Report and Biodiversity Offset Strategy. Prepared for Evolution Mining, Resource Strategies, Brisbane.

Appendix D
BCD Correspondence

EMM
creating opportunities

From:	Miranda Kerr on behalf of ROG South West Region Mailbox
To:	Steven Ward
Cc:	Shaune.Finn@evolutionmining.com; Grace Derrick; Hayden Beck; Tammy Tammy.Rawson@evolutionmining.comRawson; ROG South West Region Mailbox; Vanessa Owen; Leigh Maloney
Subject:	RE: Evolution Mining (Cowal) Pty Limited (DA1498) Biodiversity Offsets - allocation of DNG to plant community types
Date:	Friday, 11 November 2022 3:28:17 PM
Attachments:	image001.png image002.png image003.png image004.png image005.png image006.png image007.png image008.png image009.png PCT_250_BCD_memo_20221014_V2.pdf PCT250ReMapping_01pg_EMM_20221005.zip

CAUTION: This email originated outside of the Organisation.

Hi Steven

Thanks for providing the spatial data and explanation for assigning PCT 250 derived native grassland (DNG) to PCTs 26, 55, 82 and 185.

BCD agree with the method described in the memo to BCD dated 14 October 2022 (V2), and endorse the PCT mapping as per the supplied dataset 'PCT250ReMapping_01pg_EMM_20221005.shp'.

We appreciate the thorough consideration of our feedback. It's particularly useful to know that EMM's analyses (using a larger dataset from across the site) corroborate the findings of AMBS (2018) – that ground layer floristic composition was determined not to be useful for allocating DNG to PCTs in the Lake Cowal landscape.

Please confirm if you'd like the revised Statement of Reasonable Equivalence to re-allocate the equivalent BAM credits for derived native grassland (PCT 250) to PCTs 26, 55, 82 and 185 as per the revised mapping.

Regards

Miranda Kerr (she/her)
Senior Biodiversity Conservation Officer, South West

Biodiversity and Conservation | Department of Planning and Environment
T 02 6022 0607 | **M** 0407 752 822 | **E** miranda.kerr@environment.nsw.gov.au
512 Dean St ALBURY | PO Box 1040 ALBURY NSW 2640 | www.dpie.nsw.gov.au

Working hours: Tuesday to Friday, 9 am – 5 pm

Contact the South West Planning Team about biodiversity and flood management planning matters by emailing rog.southwest@environment.nsw.gov.au

The Department of Planning and Environment acknowledges that it stands on Aboriginal land. We acknowledge the traditional custodians of the land and we show our respect for elders past, present and emerging through thoughtful and collaborative approaches to our work, seeking to demonstrate our ongoing commitment to providing places in which Aboriginal people are included socially, culturally and economically.

From: Steven Ward <sward@emmconsulting.com.au>
Sent: Friday, 14 October 2022 1:58 PM
To: Miranda Kerr <Miranda.Kerr@environment.nsw.gov.au>; ROG South West Region Mailbox <rog.southwest@environment.nsw.gov.au>
Cc: Simon Coates <simon.coates@evolutionmining.com>; Grace Derrick <Grace.Derrick@evolutionmining.com>; Hayden Beck <hbeck@emmconsulting.com.au>; Tammy Tammy.Rawson@evolutionmining.comRawson <tammy.rawson@evolutionmining.com>
Subject: RE: Evolution Mining (Cowal) Pty Limited (DA1498) Biodiversity Offsets - Outcomes of meeting on 16/6/2022

Miranda / South West Planning mailbox,

This email is a follow up on previous discussions with regards to Evolution Mining (Cowal) Pty Limited (DA1498) Biodiversity Offsets, specifically the discussions around remapping vegetation mapped by AMBS as derived native grassland (DNG; PCT250).

From previous discussions an action was:

3. *EMM will complete the remapping of PCT250 (we anticipate that we will be able to complete this in a few weeks) and provide a brief memo to BCD on the methods and results, as well as shapefile data. As discussed, we are seeking to have the mapping consistent across the broader Open Pit Continuation (OPC) study area which is currently undergoing survey, and the remapping of PCT250 for MOD14. BCD to provide approval, if agreed, to the remapped PCT250 areas so that that set of biodiversity offsets for Mod14 can be resolved.*

We have attached a memo which sets out the approach to, and the outcomes of, the PCT 250 remapping exercise. We have also attached a GIS shapefile with the remapped PCT250 areas. We seek BCD's review and, if agreed, approval.

Regards,

Steven Ward
Associate Ecologist / Biodiversity Offsets Lead
Bushfire, Ecology, Heritage and Spatial Solutions

M 0457 770 411

www.emmconsulting.com.au

I work flexibly. I'm sending you this message now because it's a good time for me, but do not expect you to read, respond or action it outside your regular hours.

From: Miranda Kerr <Miranda.Kerr@environment.nsw.gov.au>
Sent: Tuesday, 5 July 2022 9:48 AM
To: Steven Ward <sward@emmconsulting.com.au>
Cc: Glenn Stuckey <gstuckey@emmconsulting.com.au>; Simon Coates <simon.coates@evolutionmining.com>; OEH ROD BOSCREDITS Mailbox <BOSCREDITS@environment.nsw.gov.au>; Vanessa Owen <Vanessa.Owen@environment.nsw.gov.au>

Subject: RE: Evolution Mining (Cowal) Pty Limited (DA1498) Biodiversity Offsets - Outcomes of meeting on 16/6/2022

CAUTION: This email originated outside of the Organisation.

Hi Steven

Yes, that reflects my understanding too.

Point 3, please note:

- Requests for my team's input are to be sent via the South West Planning mailbox rog.southwest@environment.nsw.gov.au
- Review of material by me or our team will typically take a minimum of three weeks, but may be longer depending on our statutory commitments.

Miranda Kerr *(she/her)*
Senior Biodiversity Conservation Officer – South West

Biodiversity and Conservation | Department of Planning and Environment
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512 Dean St ALBURY | PO Box 1040 ALBURY NSW 2640 | www.dpie.nsw.gov.au

Part time hours: I'm unavailable on Mondays

Contact the South West Planning Team about biodiversity and flood management planning matters by emailing rog.southwest@environment.nsw.gov.au

The Department of Planning and Environment acknowledges that it stands on Aboriginal land. We acknowledge the traditional custodians of the land and we show our respect for elders past, present and emerging through thoughtful and collaborative approaches to our work, seeking to demonstrate our ongoing commitment to providing places in which Aboriginal people are included socially, culturally and economically.

From: Vanessa Owen <Vanessa.Owen@environment.nsw.gov.au>
Sent: Tuesday, 5 July 2022 7:40 AM
To: Steven Ward <sward@emmconsulting.com.au>; Miranda Kerr <Miranda.Kerr@environment.nsw.gov.au>
Cc: Glenn Stuckey <gstuckey@emmconsulting.com.au>; Simon Coates <simon.coates@evolutionmining.com>; OEH ROD BOSCREDITS Mailbox <BOSCREDITS@environment.nsw.gov.au>
Subject: RE: Evolution Mining (Cowal) Pty Limited (DA1498) Biodiversity Offsets - Outcomes of meeting on 16/6/2022

Hi Steven,
Yes that reflects my understanding of the actions from this meeting.

A revised statement of reasonable credit equivalence will be drafted once we have received data relating to item 2 below.

Regards,
Vanessa

Dr Vanessa Owen *(she/her)*
Senior Project Officer, Ecosystem Programs
Biodiversity and Conservation Division
Department of Planning and Environment

T (02) 4927 3116 **E** vanessa.owen@environment.nsw.gov.au

dpie.nsw.gov.au

The Store
6 Stewart Avenue
Newcastle West NSW 2300

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I acknowledge the traditional custodians of the land and pay respects to Elders past and present. I also acknowledge all the Aboriginal and Torres Strait Islander staff working with NSW Government at this time.

Please consider the environment before printing this email.

From: Steven Ward <sward@emmconsulting.com.au>
Sent: Monday, 4 July 2022 4:12 PM
To: Vanessa Owen <Vanessa.Owen@environment.nsw.gov.au>; Miranda Kerr <Miranda.Kerr@environment.nsw.gov.au>
Cc: Glenn Stuckey <gstuckey@emmconsulting.com.au>; Simon Coates <simon.coates@evolutionmining.com>
Subject: Evolution Mining (Cowal) Pty Limited (DA1498) Biodiversity Offsets - Outcomes of meeting on 16/6/2022

Vanessa and Miranda,

Apologies for the delay on sending this through after the meeting (16/6/2022) on Evolution Mining (Cowal) Pty Limited (DA1498) Biodiversity Offsets, and specifically the discussion around remapping vegetation mapped by AMBS as derived native grassland (DNG; PCT250). Please find

attached the slides from our presentation on the method EMM proposes for remapping for of PCT250.

From the meeting it is understood that BCD broadly agree with the proposed approach to remapped of the areas mapped as derived native grassland (DNG); noting that BCD will need to receive and review the outcomes before formal approval is issued.

Actions from the online meeting held between BCD and EMM on 16/6/2022 (as I understand them) were that:

1. EMM was to send through a copy of the PCT 250 remapping methods presentation (attached to this email)
2. EMM to send through the breakdown of the credit outcomes (outside of PCT 250) for Stewardship sites 3 and 6 (noting that boundaries have had some revisions), to seek a revised statement of reasonable credit equivalence for some PCT's. BCD to review and provide written confirmation, if agreed to by BCD, that the proposed Stewardship sites 3 and 6 will "zero out" the ecosystem credit requirements for some PCTs (this will exclude PCT250 requirements which are to be determined as per the action item 3 below). I will send this email request through separately to Vanessa.
3. EMM will complete the remapping of PCT250 (we anticipate that we will be able to complete this in a few weeks) and provide a brief memo to BCD on the methods and results, as well as shapefile data. As discussed, we are seeking to have the mapping consistent across the broader Open Pit Continuation (OPC) study area which is currently undergoing survey, and the remapping of PCT250 for MOD14. BCD to provide approval, if agreed, to the remapped PCT250 areas so that that set of biodiversity offsets for Mod14 can be resolved.

Please let me know if any of the above does not reflect your understanding of the meeting.

Regards,

Steven Ward
Associate Ecologist / Biodiversity Offsets Lead
Bushfire, Ecology, Heritage and Spatial Solutions

M 0457 770 411

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Memorandum

28 November 2022

To: Michael Todd and Andrew Fisher

From: Steven Ward

Subject: EMM response to BCD feedback on OPC BDAR approach

Dear Michael,

This memorandum is a response to Biodiversity Conservation Division (BCD) South West Branch's letter (DOC22/717039; 4 October 2022) regarding the minutes of our meeting on 31 August 2022 in relation to EMM's proposed approach to the Biodiversity Development Assessment Report (BDAR) for the Cowal Gold Operations Open Pit Continuation Project (OPC; sent 16 September 2022; Appendix A). The meeting and this follow-up are seeking, where possible, to reach agreement with BCD upon an approach to assessing biodiversity values within Lake Cowal for the OPC BDAR. This is sought as outstanding terrestrial biodiversity surveys for the OPC cannot be completed due to Lake Cowal being fully inundated; and the likelihood that this inundation will persist until the end of 2023, and potentially longer.

This letter provides a response to the feedback provided by BCD from the meeting (dated 4 October 2022; Appendix B). Here we either agree with approaches proposed by BCD, seek further clarification, or seek agreement on a revised approach after considering BCD's feedback. Our response is structured in the same order as BCD's feedback. Major headings represent proposed approaches in our original correspondence by EMM, with BCDs feedback italicised immediately below. An additional item is also presented to register Dr Colin Bower as a Species Expert to assess potential habitat for Austral Pillwort and Spiny Peppercress within the OPC project footprint, which are species that cannot be surveyed in entirety due to inundation of Lake Cowal.

1 Application of modified benchmark data

BCD Feedback: Is the proposal to review and apply 'wet' benchmarks to all other PCTs on the proposal site? Do the other PCTs have 'wet' benchmarks?

We are seeking to apply the most appropriate benchmark condition to PCTs within the OPC area. All PCTs currently identified within the OPC footprint have 'dry', 'average' and 'wet' benchmark values applicable to the South West Slopes IBRA region available within NSW BioNet Vegetation Classification (Veg-C). Further complicating matters is that we have noted that the default benchmarks for OPC vegetation communities within the biodiversity assessment method calculator (BAM-C) differ to 'dry', 'average' and 'wet' benchmark values. That is, the default benchmark in BAM-C differs again to the three available rainfall-related benchmarks.

We have now considered DPIE (2020) *Guidance for assessors and decision-makers in applying modified benchmarks to assessments of vegetation integrity*[1]. Although the guideline speaks to applying rainfall calibrated benchmarks, it does not provide guidance where plot data has been collected across multiple months or years, and thus where plots have been collected within varying rainfall conditions. Instead, the guideline appears to assume that all plots will have been undertaken over a short period, and can be assigned to one rainfall category. For the OPC Project, plots were undertaken from 2020 to 2022, which spans El niño and La niña ENSO events that were characterised by below and above average rainfall, respectively. This has occurred due to the size of the OPC project, which has necessitated a longer fieldwork program.

The challenge here is that only one benchmark condition can be inserted for each vegetation zone in the BAM-C. That is, the BAM-C does not allow entry of adjusted benchmark values to individual plots. Therefore, a decision must be made as to a reasonable and appropriate overall benchmark value to be applied to the plot data.

Our proposed approach, in which we seek formal agreement from BCD, involves applying benchmarks applicable to each PCT based on the most common rainfall condition ('dry', 'average' or 'wet') for 12 months prior to when each plot was undertaken. It is noted that even application of the 'average' rainfall benchmark will mean adjusting the BAM-C generated default benchmarks (because as noted above the default BAMC data is not the same as the 'average' rainfall benchmark values).

Our proposed approach involves:

1) Summing all rainfall data (collected at West Wyalong; nearest BOM weather station) 365 days prior to each day BAM plots were undertaken;

2) Assigning each plot undertaken as 'dry', 'average' or 'wet', based on rainfall thresholds for the 12 months prior to each plot surveyed, based on PCT specific benchmarks in BioNet Veg-C. We note that each PCT has its own rainfall thresholds that are specific to the South West Slopes IBRA region.

3) Determine the most common rainfall condition ('dry', 'average' and 'wet'; as per the BioNet Veg-C) when BAM plots were undertaken within each PCT. This will be considered the highest number of plots undertaken during 'dry', 'average' or 'wet' conditions.

4) For each PCT, the benchmark data to be applied in the BAM-C will then be based on the rainfall condition associated with when the most plots were undertaken.

As required by the DPIE (2020) guideline, we seek formal approval from BCD to apply the above approach to applying rainfall benchmarks within the BAM-C.

2 Assessment of PCT 17: Options 1 to 3 for assessing inundated land

BCD Feedback Row 1: Option 1 [Survey another patch (if available) and use as representative in BAM-C] is supported if an appropriate local site can be found, BCD expect it to be on land owned by Evolution and under the same management, including grazing regime.

Noted. EMM has looked at this. No such sites currently exist that are accessible (due to Lake Cowal inundation) under the same ownership, and grazing history. Further significant rainfall has occurred since the meeting with BCD. As such, we do not foresee that access to PCTs (even alternative patches) within Lake Cowal will become available prior to submission of the EIS and associated BDAR.

[1] DPIE (2020) Guidance for assessors and decision-makers in applying modified benchmarks to assessments of vegetation integrity. Biodiversity Assessment Method. Department of Planning, Industry and Environment, NSW.

BCD Feedback Row 2: Option 2 (Survey zone post-approval. Survey requirement part of conditions) is supported. This approach is most likely to meet requirements of the BAM. This approach would be applied for any other site that is not able to be accessed before the EIS is submitted.

We will seek to apply Option 2. In the meantime, as survey of PCT 17 is highly unlikely prior to EIS lodgement, EMM proposes to apply benchmark data for PCT 17 in the BDAR (Option 3).

BCD Feedback Row 2: Revision of PCTs present, boundaries and vegetation zones may be needed as water recedes (as commented elsewhere in letter; as commented on pages 1 and 2).

Noted. For clarity, EMM had proposed survey post-consent only for vegetation plots within PCT 17, as this would have been changing from a conservative assessment of condition to once based on actual site conditions. It is not proposed to undertake revision of PCTs present, boundaries and vegetation zones if water recedes prior to construction. This is not considered to be necessary as the evidence that EMM has gathered supports the vegetation classification (discussion of BCD's questions about other potentially occurring vegetation communities is provided below). It is also noted that Evolution will need to pursue sourcing the credits required for the project; potential changes in the type of credits required could cause significant challenges in Evolution sourcing these credits in a timely manner.

BCD Feedback: BCD do not agree with Option 4 (Assign average plot values from PCT 53 to PCT 17, and use aerial photography to account for Lignum cover).

Noted. BCD seemed to misunderstand the suggested approach, as they discussed applying benchmarks to PCT 17 whereas it had been proposed to utilise plot data from PCT 53.

On review, although both PCT's are in the same vegetation formation (KF_CH8 Freshwater Wetlands), Option 4 will not be applied due to challenges around the differing benchmarks for the two communities. As discussed above, in absence of survey, PCT 17 will generally be represented as benchmark condition within the BDAR, with the exception of overstorey benchmarks (discussed below).

To determine whether any Eucalypt overstorey is present EMM has reviewed recent Nearmap August 2016, November 2018, and October 2021 aerial imagery. From this inspection, eucalypts can be clearly discerned within PCT 249 vegetation mapped to the west. No eucalypts are present within the PCT 17 vegetation within the OPC study area (Figure 1). As such EMM proposes that in addition to using benchmark values for all other attributes, a value of zero is entered into plot data used for PCT 17 for: tree species richness, and tree cover. As a shrubland community no function condition scores are utilised. In our view the available aerial photography evidence supports this approach.

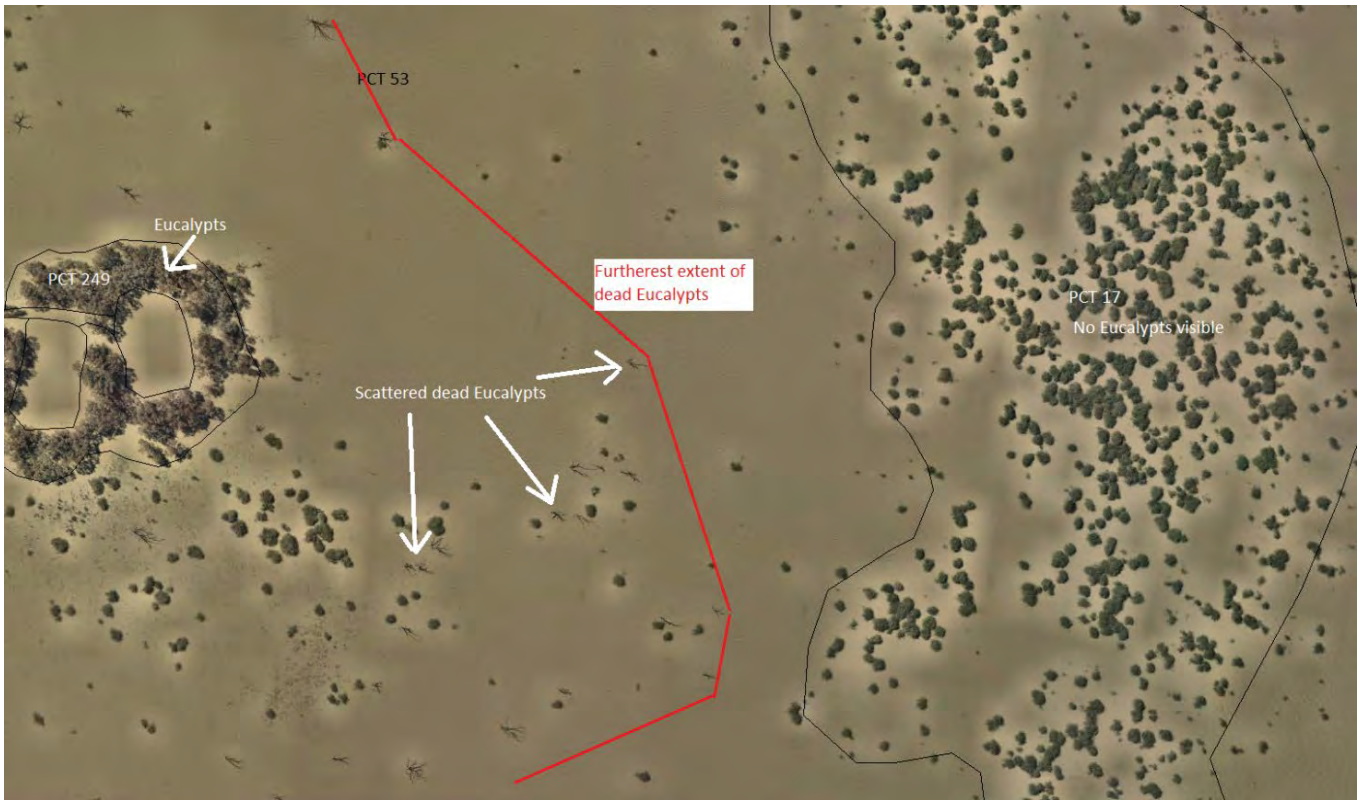


Figure 1 **Aerial imagery of PCT 17 within OPC study area showing Eucalypt overstorey assessment**

BCD Feedback: Has the presence of other PCTs been considered in the inundated area?

- PCT 24 'Canegrass swamp tall grassland wetland of drainage depressions, lakes and pans of the inland plains' (also commented on pg 5: Transitional vegetation between PCT 17 and PCT 53 may be PCT 24.)

Re-analysis of vegetation data from BAM plots collected across the OPC area and within Lake Cowal identified varying cover of Canegrass (*Eragrostis australiasica*), at the time of floristic surveys (ie June 2020). Of the plot data available, most areas had a low cover of Canegrass (ie 0-10%). But there was a notably higher density of Canegrass recorded toward the south of the Lake Protection Bund (LPB) area. Specifically, two of the eight BAM plots at the southern extent of the LPB area (plots 39 and 40) had a 55-65% cover of Canegrass (Figure 2).

Assessment of the photographs of these plots revealed a mosaic of a grassland/sedgeland formation appearance (Photographs 1 and 2). Apart from Canegrass, no other flora species diagnostic of PCT 24 were located at either Plot 39 or 40. Further, Rat's Tail Couch (*Sporobolus mitchellii*), Lesser Joyweed (*Alternanthera denticulata*) and Swamp Dock (*Rumex brownii*) were recorded at these plots, which are diagnostic species of PCT 53 (Appendix C provides plot data). Hence, there were floristic elements of both PCT 53 and 24 in that area. In support of our vegetation mapping, the State Vegetation mapping allocates PCT53 across the OPC footprint area, whilst mapping PCT24 toward the centre of the lake, outside of the OPC (Figure 2).



KEY

- BAM plot
- EIS study area
- Mining lease (ML1535)
- Mining lease (ML1791)
- Lake Cowal Road

NSW State Vegetation Type Mapping (SVTM)

- PCT 24 | Canegrass swamp tall grassland wetland of drainage depressions, lakes and pans of the inland plains
- PCT 26 | Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
- PCT 45 | Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion
- PCT 53 | Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains
- PCT 76 | Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions
- PCT 80 | Western Grey Box - White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion
- PCT 185 | Dwyers Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
- PCT 217 | Mugga Ironbark - Western Grey Box - cypress pine tall woodland on footslopes of low hills in the NSW South Western Slopes Bioregion
- PCT 248 | Mixed box eucalypt woodland on low sandy-loam rises on alluvial plains in central western NSW
- PCT 249 | River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW

NSW State Vegetation Type Mapping

Evolution Mining
Cowal Gold Operations
Open pit continuation project
Figure 2

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Photograph 1 **Plot 39 (June 2020)**



Photograph 2 **Plot 40 (June 2020)**

There is no alternative accurate and recent mapping (noting that the State Vegetation mapping shown in Figure 2 was undertaken on a regional scale) that can be used to complement our mapping dataset. Other vegetation mapping to guide allocation of vegetation communities is now highly outdated and appears to be inaccurate. The best mapping we have available to our current knowledge is EES (1999)[2], who undertook vegetation mapping as part of their water bird assessment. This mapping focused on identifying the broad bird nesting habitat types Canegrass, Lignum and River Red Gum, rather than vegetation communities *per se* (Figure 3 below

[2] EES (1999) Waterbirds at Lake Cowal, New South Wales, Australia: Assemblage shifts over a complete filling and drying cycle. Prepared for North Mining Pty Ltd, March 1999.

shows the OPC section of that mapping). This mapping indicated presence of Canegrass in the southern LPB area. But the accuracy of this mapping is questionable since it was produced over 20 years ago, whilst this mapping focus on fauna habitat attributes. There are also notable inaccuracies given large stands of mature Red River Gum (which have evidently not changed in extent over 20 yrs) are not displayed at all along the Lake Cowal foreshore, despite large areas mapped in this vicinity by EMM as part of the BDAR. Hence, we have no reliable historic dataset at hand to guide vegetation community allocation and their extent.

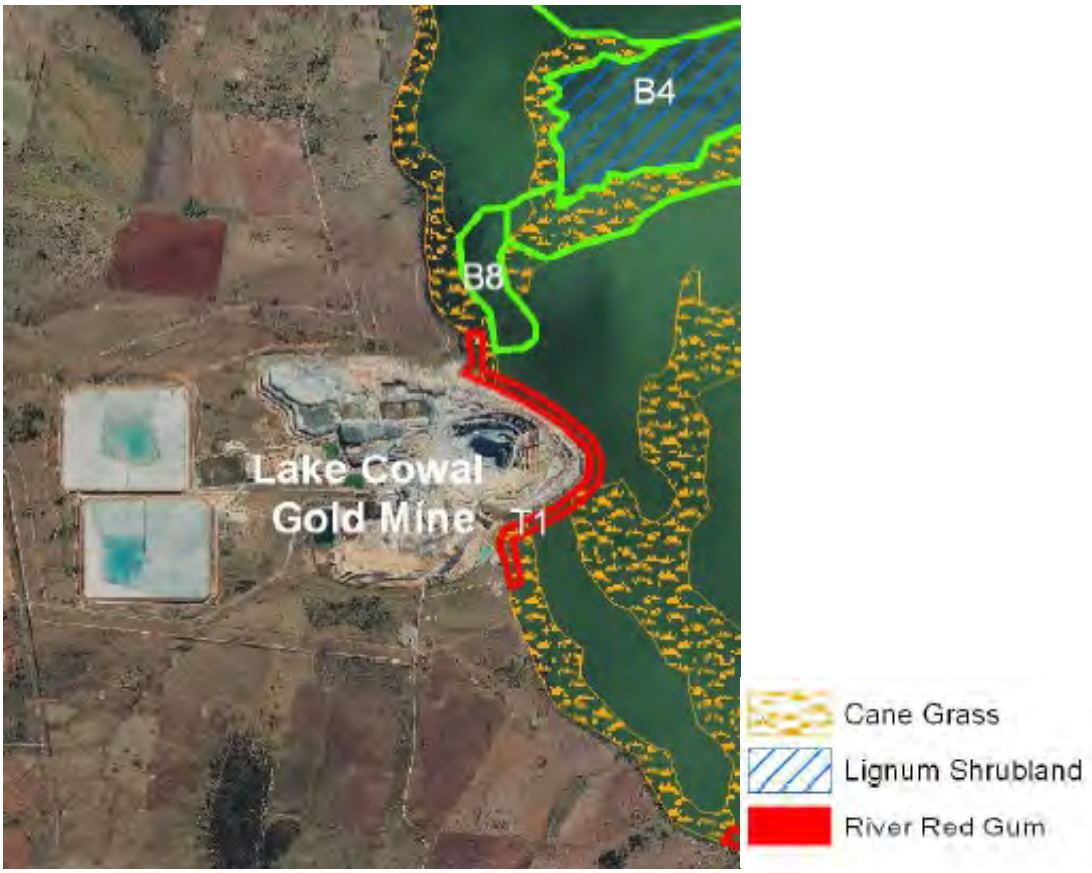


Figure 3 Waterbird habitat mapping by EES (1999)

The other issue with allocating vegetation communities in Lake Cowal is it is highly ephemeral, so the vegetation composition is likely to change through time. That is, in such a hydraulically dynamic ecosystem, vegetation will typically succeed between sedgeland and grassland across wetting and drying cycles, respectively. Accordingly, PCT53 was considered a more representative vegetation community since it is a grassland/sedgeland community rather than purely a grassland only as in PCT24.

Allocating vegetation to PCT 53, rather than questionably allocating areas to PCT24, was also considered a more conservative approach since:

- PCT 53 is a higher offset trading group (Inland Floodplain Swamps greater than or equal to 50% and less than 70%) than PCT24 (Inland Floodplain Shrublands less than 50%); and
- PCT 53 has more threatened species associated than PCT 24.

- PCT 360 'Gilgai wetland mosaic in the southern NSW South Western Slopes Bioregion'

Presence of PCT 360 has been considered. However, at least within the OPC footprint, Lake Cowal appears to generally lack gilgais. This is demonstrated by a Digital Terrain Model (DTM), which shows high uniformity of elevation throughout the Lake Cowal when assessed at a 10cm elevation differential (Figure 4 and Figure 5), as opposed to an area with known gilgais which shows a 'stippled' appearance due to the presence of gilgais (Figure 6).

None of the diagnostic species for PCT 360 were detected in any of the eight BAM plots undertaken by EMM within Lake Cowal (as per BioNet Veg-C). Similarly, no diagnostic species were detected in any of the seven plots undertaken in Lake Cowal as part of annual monitoring of wetland condition with Evolution's mining lease (DnA Environmental 2022[3]).

The presence of PCT 360 is also geographically unlikely at Lake Cowal as it is well north of the known distribution of PCT 360. That is, PCT 360 has been located at Holbrook, Albury and Jindera, in the southern-most part of the NSW South-western Slopes Bioregion (ie >230km south; DPE 2022).

It is therefore considered that there is currently no evidence to support the occurrence of PCT 360 at Lake Cowal.

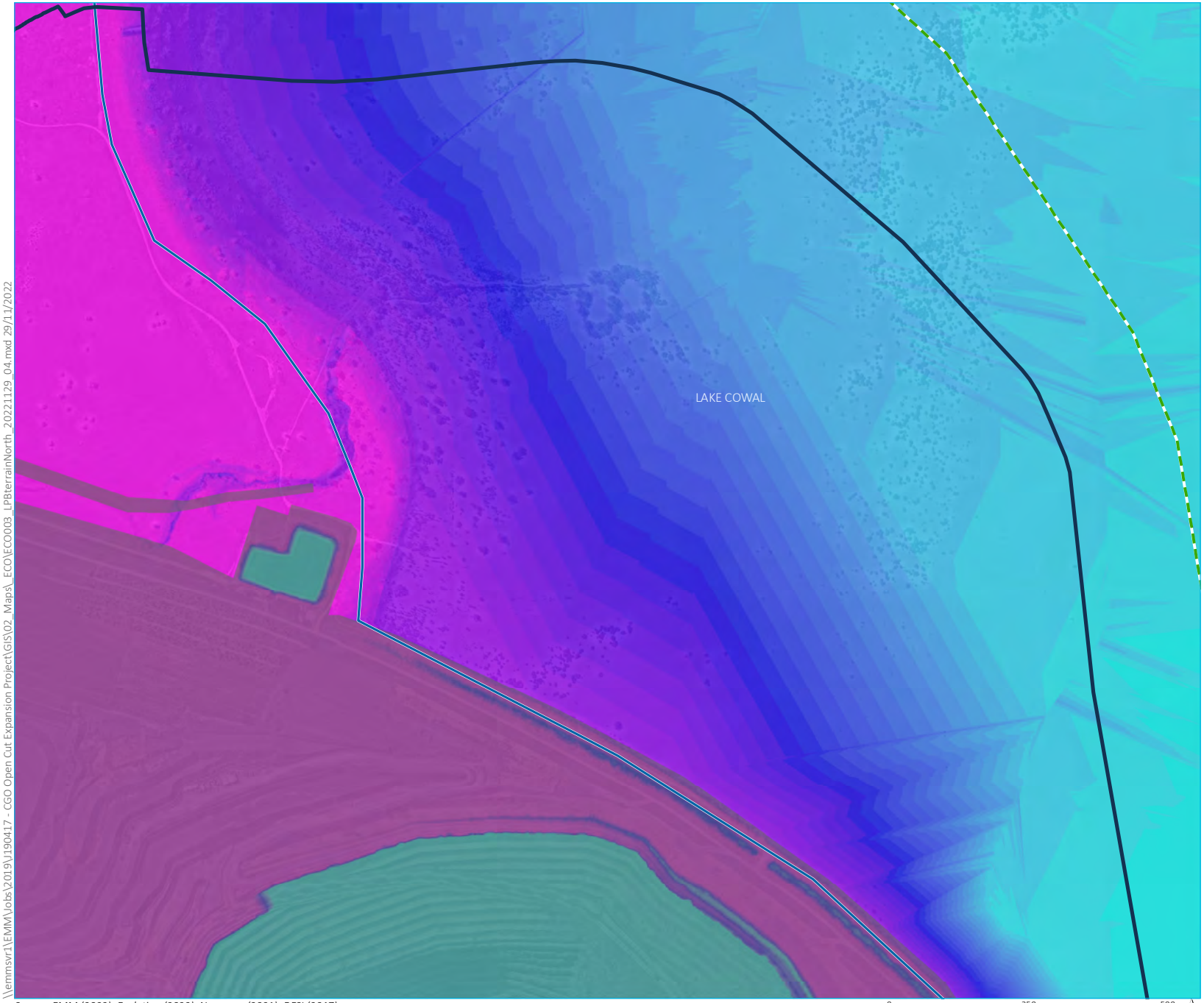
2. Table 1.1 has average scores but PCT 53 BAM plot data has not been supplied. Without that it is difficult to assess if the result is ecologically meaningful.

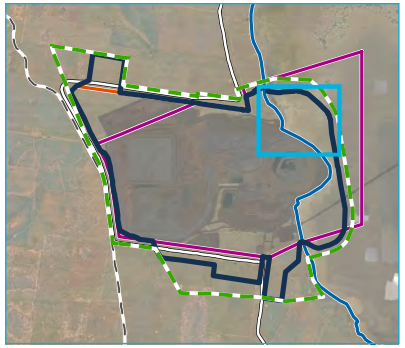
This is no longer relevant since we are adopting benchmark conditions for PCT 17 (Option 3), at least until survey of PCT17 is possible. Nonetheless, plot data for PCT 53 has been supplied in this response (Appendix C).

3. 2018 and 2019 were very dry years (annual rainfall at West Wyalong of 239 and 250mm), so assumptions about a high condition state may not be correct. Delineation of lignum from photography should represent the boundary of PCT 17. It is not clear if or why this area would not be a separate vegetation zone in BAM-C.

As suggested by BCD, the extent of Lignum from aerial photography was used to represent the boundary of PCT 17. To confirm, PCT17 will be treated as a separate zone in the BAM-C with benchmark data will be applied (ie. Option 3) in absence of plot data, with the exception of overstorey as proposed earlier in this letter response (Section 1, Option 4 discussion).

[3] DnA Environmental (2022) 2021 Remnant Vegetation Enhancement Program Monitoring Report. Prepared for Cowal Gold Operations, Evolution Mining (Cowal) Pty Ltd





KEY

- EIS study area
- Proposed disturbance footprint
- DA14/98 approved surface disturbance
- Mining lease (ML1535)
- Mining lease (ML1791)
- Rail line
- Lake Cowal Road
- Lake Cowal extent

Elevation (mAHD)

- < 203.4
- 203.4 - 203.5
- 203.5 - 203.6
- 203.6 - 203.7
- 203.7 - 203.8
- 203.8 - 203.9
- 203.9 - 204.0
- 204.0 - 204.1
- 204.1 - 204.2
- 204.2 - 204.3
- 204.3 - 204.4
- 204.4 - 204.5
- 204.5 - 204.6
- 204.6 - 204.7
- 204.7 - 204.8
- 204.8 - 204.9
- 204.9 - 205.0
- 205.0 - 205.1
- 205.1 - 205.2
- 205.2 - 205.3
- 205.3 - 205.4
- 205.4 - 205.5
- 205.5 - 205.6
- 205.6 - 205.7
- 205.7 - 205.8
- 205.8 - 205.9
- 205.9 - 206.0
- 206.0 - 206.1
- 206.1 - 206.2
- > 206.2

Source: EMM (2022); Evolution (2022); Nearmap (2021); DFSI (2017)

0 250 500 m

GDA 1994 MGA Zone 55

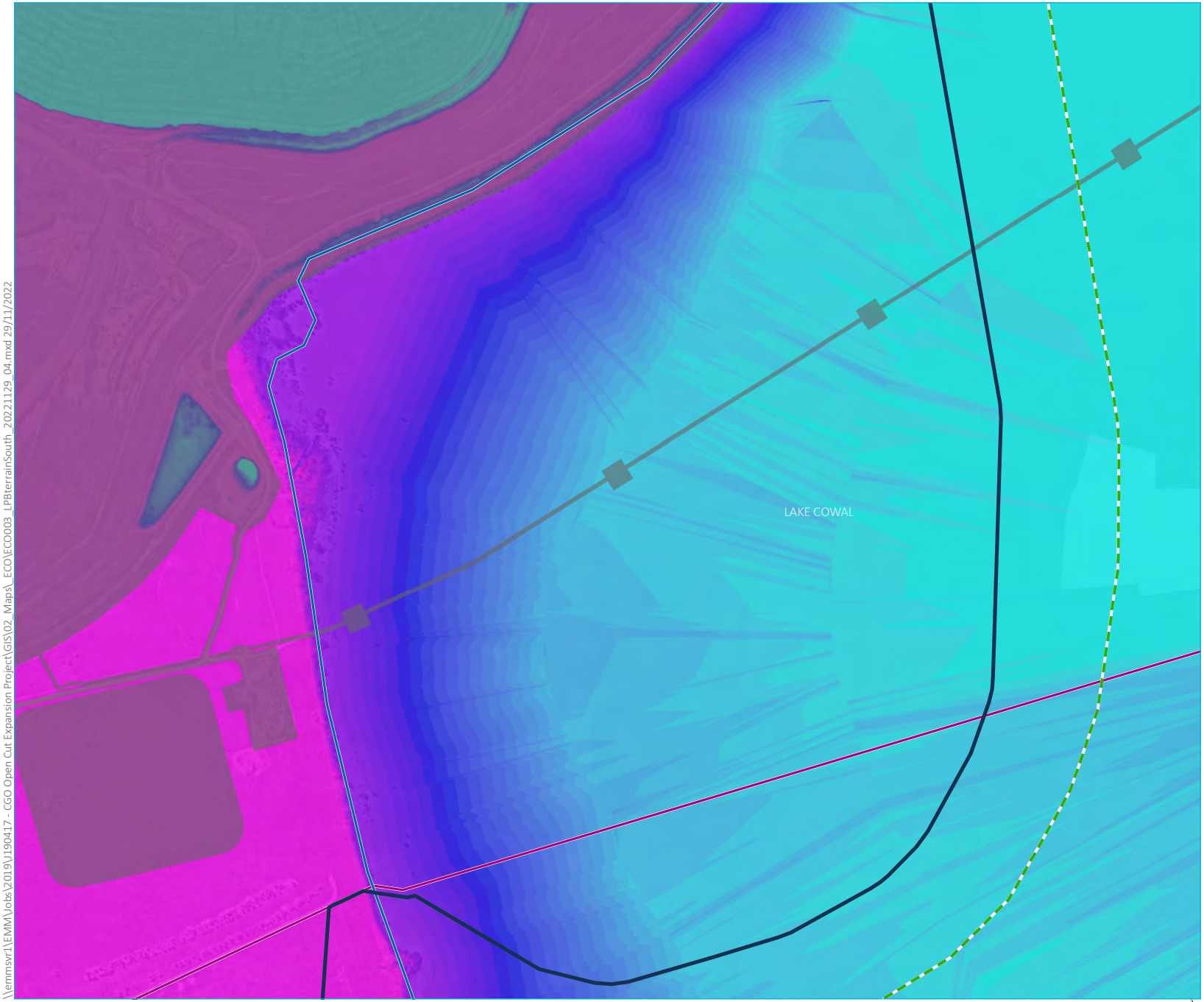
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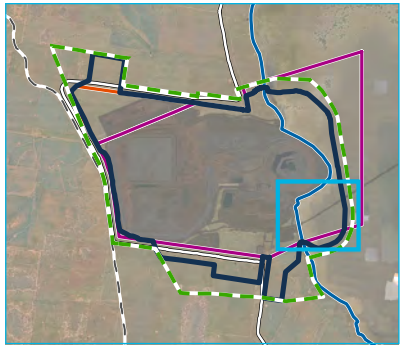
Current elevation around future LPB - north

Evolution Mining
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Open pit continuation project
Figure 4

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KEY

- EIS study area
- Proposed disturbance footprint
- DA14/98 approved surface disturbance
- Mining lease (ML1535)
- Mining lease (ML1791)
- Rail line
- Lake Cowal Road
- Lake Cowal extent

Elevation (mAHD)

< 203.4	204.8 - 204.9
203.4 - 203.5	204.9 - 205.0
203.5 - 203.6	205.0 - 205.1
203.6 - 203.7	205.1 - 205.2
203.7 - 203.8	205.2 - 205.3
203.8 - 203.9	205.3 - 205.4
203.9 - 204.0	205.4 - 205.5
204.0 - 204.1	205.5 - 205.6
204.1 - 204.2	205.6 - 205.7
204.2 - 204.3	205.7 - 205.8
204.3 - 204.4	205.8 - 205.9
204.4 - 204.5	205.9 - 206.0
204.5 - 204.6	206.0 - 206.1
204.6 - 204.7	206.1 - 206.2
204.7 - 204.8	> 206.2

Current elevation around future LPB - south

Evolution Mining
Cowal Gold Operations
Open pit continuation project
Figure 5

Source: EMM (2022); Evolution (2022); Nearmap (2021); DFSI (2017)

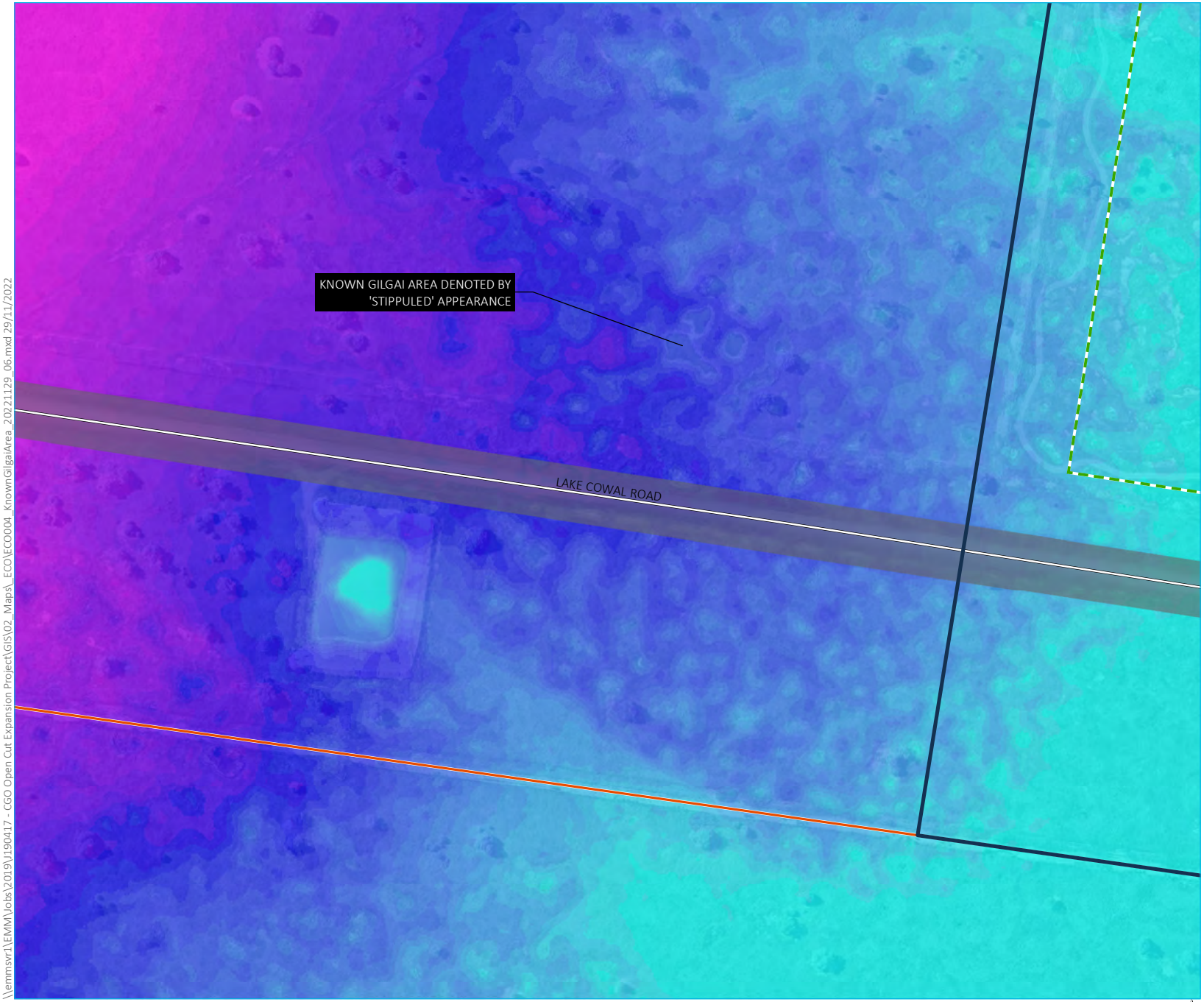
0 250 500 m

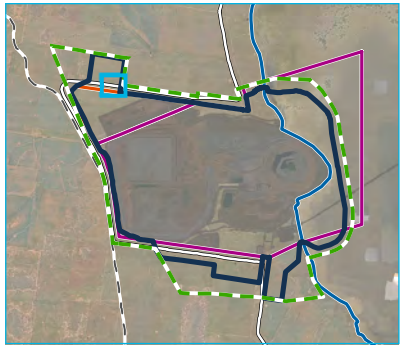
GDA 1994 MGA Zone 55

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KEY

- EIS study area
- Proposed disturbance footprint
- DA14/98 approved surface disturbance
- Mining lease (ML1535)
- Mining lease (ML1791)
- Rail line
- Lake Cowal Road
- Lake Cowal extent

Elevation (mAHD)

< 222.0	224.8 - 225.0
222.0 - 222.2	225.0 - 225.2
222.2 - 222.4	225.2 - 225.4
222.4 - 222.6	225.4 - 225.6
222.6 - 222.8	225.6 - 225.8
222.8 - 223.0	225.8 - 226.0
223.0 - 223.2	226.0 - 226.2
223.2 - 223.4	226.2 - 226.4
223.4 - 223.6	226.4 - 226.6
223.6 - 223.8	226.6 - 226.8
223.8 - 224.0	226.8 - 227.0
224.0 - 224.2	227.0 - 227.2
224.2 - 224.4	227.2 - 227.4
224.4 - 224.6	227.4 - 227.6
224.6 - 224.8	> 227.6

\\emmsvr1\EMM\Jobs\2019\I190417 - CGO Open Cut Expansion Project\GIS\02_Maps_ECO\ECO004_KnownGilgaiArea_20221129_06.mxd 29/11/2022

Source: EMM (2022); Evolution (2022); Nearmap (2021); DFSI (2017)

0 100 200 m

GDA 1994 MGA Zone 55

N

Current elevation around known gilgai area

Evolution Mining
Cowal Gold Operations
Open pit continuation project
Figure 6

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3 Targeted threatened flora: Options 1 to 4

BCD Feedback: BCD support assuming presence for species not able to be surveyed, with an appropriate, agreed mechanism for modifying the credit liability based on survey after project approval and before construction.

EMM and Evolution must provide evidence in the BDAR that NSW Planning agree to enable this approach through conditions of consent.

EMM in part agrees with this approach for Austral Pillwort (*Pilularia novae-hollandiae*), *Austrostipa wakoolica* (A spear-grass), *Eleocharis obicis* (A Spike-Rush), Spiny Peppercress (*Lepidium aschersonii*) and Floating Swamp Wallaby-Grass (*Amphibromus fluitans*). That is, we believe there is a case to demonstrate that these threatened species are not present, and thereby eliminating, or reducing areas to be offset to potentially suitable habitat only, would be appropriate.

However, we note that in October 2022, a total of 141 mm of rainfall was recorded at the West Wyalong weather station. With such frequent and high rainfall events, Lake Cowal is completely inundated, and may continue to be at the start of construction (June 2024), depending on rainfall, evaporation and outflows from Lake Cowal. In this regard, we note that allowing for survey prior to commencement of construction may not alleviate this issue. Therefore, option 2 is strongly preferred.

BCD Feedback: Option 2 (Put forward case for species not being present) may apply to some species, depending on adequate justification and evidence that micro-habitats are absent.

EMM put forward justifications in the meeting and follow up minutes provided to BCD. EMM proposes this pathway and seeks BCD's support.

A response to feedback from BCD regarding the case for lack of suitable microhabitat for Austral Pillwort (*Pilularia novae-hollandiae*) is provided in section 4 below.

To provide additional evidence that micro-habitats are absent or limited within Lake Cowal, EMM are seeking expert reports from Dr Colin Bower for Austral Pillwort (*Pilularia novae-hollandiae*) and Spiny Peppercress (*Lepidium aschersonii*) for the OPC Project (subject to getting him registered as a species expert). Please see Section 5.

BCD Feedback: Option 3, re SAII – note that the BDAR provides the data with a description of limitations and assumptions. The recommendation about whether the impact has a serious and irreversible impact is made by the decision maker.

Noted, and it is agreed that the BDAR supplies information, with the decision about whether a serious and irreversible impact will occur being made by the decision maker.

As per Section 9 of BAM (2020), the BDAR must contain details of the assessment of SAIIs, in accordance with the criteria set out in Subsection 9.1.2 for each threatened species. EMM understand that BCD has technical data for SAII entities and seeks this for use in the BDAR. Can BCD please provide the SAII technical data (which can be hard to source) for Austral Pillwort (*Pilularia novae-hollandiae*)?

4 Case for lack of suitable microhabitat for Austral Pillwort (*Pilularia novae-hollandiae*) in Lake Cowal

BCD Feedback: Successful survey for Austral Pillwort requires very specific timing. Under 'Justification', the description of yellowing plants found in drier depressions may simply indicate that the plant has reached the end of its life cycle following inundation, rather than being in poor health due to lack of habitat.

Agreed. We note that EMM has recently (in the week of 14th November) detected Austral Pillwort within gilgai outside of Lake Cowal, which had been undertaken targeting the suitable conditions referenced by BCD. These results will be worked up and include in the BDAR. The comments made below by Dr Colin Bower are still considered to be relevant, which is discussed further below.

1. Is there a record of the conversation with Colin Bower?

A record of this conversation is provided in Appendix D. In that correspondence, Dr Colin Bower confirms:

- Austral Pillwort were primarily found in Gilgais on the ridge above the shoreline of Lake Cowal;
- Austral Pillwort were never found in Lake Cowal or along the shoreline of Lake Cowal;
- Austral Pillwort favour gilgai depressions lacking invasive grasses, which likely explains the reduced population of Austral Pillwort at the Lake Cowal locality (ie lack of recent detections); and
- The species is likely to be much more common than currently understood, as it is small/inconspicuous, highly seasonal and easily overlooked.

Dr Colin Bower also added: "*I looked for it along the edge of Lake Cowal at the same time and did not see any sign at all, the habitat being quite different from that in a gilgai*."

More specific information about the location of the original Austral Pillwort record is needed, given it was recorded as "common in gilgai depressions. Occurred in 38 out of 65 depressions examined. At the time of sampling the ponds were drying out and most had little free water". Also "Gilgai soils - predominantly grey cracking clays. Dominant tree species are Eucalyptus populnea and Casuarina cristata. Occurs mainly around edges of the gilgai depressions in open areas among short sedges and rushes"

A copy of Bower (1998)[4] is provided in Appendix E. Table 1 provides a description of the locations where gilgais were examined, and those where Austral Pillwort was recorded. Actual locations of these gilgais are not available.

2. Evidence has not yet been provided to demonstrate whether suitable habitat is present on Lake Cowal when the water is receding.

Based on the highly specific association of Austral Pillwort with gilgais and the lack of gilgais within Lake Cowal, EMM believes this species should discounted from occurring in Lake Cowal. The relatively flat nature of Lake Cowal is demonstrated by a DTM (see Figure 4 and Figure 5), with a subtle gradation in depth away from the shoreline and no dimple-like formations that are associated with gilgais (as shown in Figure 6).

[4] Bower, CC (1998) Survey of the Cowal Gold Project Area and surrounds for the Austral Pillwort (*Pilularia Novae-hollandiae*).

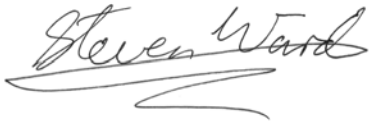
Based on Dr Colin Bower's commentary and an apparent lack of gilgais in Lake Cowal, EMM are seeking agreement from BCD that the Austral Pillwort should be excluded from requiring survey effort in Lake Cowal given its low chance of occurring.

5 Additional item: Species expert for Austral Pillwort and Spiny Peppercress

We have been continuing discussions with Dr Colin Bower regarding the potential for threatened plants to occur within Lake Cowal, and based on his experience, has agreed to prepare an expert report for Austral Pillwort and *Lepidium aschersonii* for the OPC project. As such, Dr Colin Bower lodged an application to become a species expert for these species, and we are awaiting approval by BCD.

We note that Dr Colin Bower is experienced with providing expert reports under then BAM, being registered as a species expert for *Acacia meiantha* and Tarango Leek Orchid (*Prasophyllum petilum*). Given his extensive local experience with both species, Dr Colin Bower is well positioned to assist with identifying potential habitat for Austral Pillwort and Spiny Peppercress without survey and predicting their density/distribution where/if suitable habitat is identified. Based on the time constraints of this project, and inundation likely to extend beyond commencement of construction, we would appreciate the support for Dr Colin Bower to be registered as a species expert for these two species as soon as possible.

Yours sincerely



Dr Steven Ward
Associate Ecologist
sward@emmconsulting.com.au

Appendix A

EMM letter to BCD: 16 September 2022

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Cowal Gold Operations Open Pit Continuation Project – BCD Meeting Notes and Next Steps

Date/time:	Wednesday, 31 August 2022, 2 pm to 3.15pm	
Facilitator:	Janet Krick Associate Environmental Planner	
Attendees:	Janet Krick (JK), EMM	Steven Ward (SW), EMM
	Hayden Beck (HB), EMM	Rob Morris (RM), EMM
	Glenn Stuckey (GS), EMM	Pierre Miquel (PM), Evolution Mining (Evolution)
	Simon Coates (SC), Evolution	Steve O'Donoghue (SO), Department of Planning and Environment (DPE)
	Philip Nevill (PN), DPE	Michael Todd (MT), NSW Biodiversity Conservation Division (BCD)
	Leigh Maloney (LM), BCD	Andrew Fisher (AM), BCD

Agenda

Item	Agenda Item	Presenter	Time
1	Project Overview Summary: Introduction of Project location and components of Cowal Gold Operations Open Pit Continuation Project (the Project)	Janet Krick	14:00 – 14:10pm
2	Vegetation communities and threatened species Summary: Summary of surveys undertaken to date, findings regarding vegetation mapping and threatened species. Identification of outstanding survey gaps, with focus placed on inundation of Lake Cowal constraining BAM plots (in patch of PCT 17) and threatened flora surveys.	Hayden Beck	14:10 – 14:15pm
3	Timeframe (program) Summary: High level overview of timeline of project assessment, application lodgement, and construction commencement timeframes.	Janet Krick	14:15 – 14:20pm
4	Approach to environmental offsets Summary: Identification of land parcels available to Evolution for establishing biodiversity stewardship sites, to offset impacts on biodiversity associated with the Project. Introduction of the plan to stage timing of	Steven Ward	14:20 – 14:30pm

Item	Agenda Item	Presenter	Time
	offset delivery. Current areas subject to management were also highlighted.		
5	Assessment challenges Summary: Overview of the challenges that inundation of Lake Cowal presents to completing the BDAR. Key challenges identified were assessing two construction scenarios (Lake full and empty); proposed offset sites in Lake Cowal are underwater which will create challenges to evaluating and establishing BSA(s); inundation of Lake Cowal limits survey for threatened species and patch of PCT due to inundation. Options (in order of preference) provided to overcome these survey challenges.	Steven Ward	14:30 – 14:40pm
6	Questions and next steps	Open forum	14:40 – 15:20pm

Minutes

Follow the presentation by EMM (see Appendix A for copy of presentation), an open discussion with DPE, Evolution Mining and EMM occurred to seek resolve the assessment challenges and timely delivery of offsets, given the inundation of Lake Cowal. Below provides a summary of the points raised, grouped under discussion themes.

Offset site establishment in Lake Cowal

- SO: Asked about timeframes and approach to offsetting.
- SW: Highlighted the need for timely delivery of offsets, so that the majority of offsets required for the initial stage(s) are available at the commencement of the project. The approach to offsetting will be determined through a Biodiversity Offset Strategy (BOS). The BOS will identify the land parcels required to generate sufficient offset credits to meet the requirements of the Project. It is anticipated that the construction of the Lake Protection Bund (LPB) will likely be an early stage of work, and thus credits for vegetation within Lake Cowal is likely to be required early. Evolution have substantial landholdings within Lake Cowal, but the current inundation of Lake Cowal means that it will not be possible to gather BAM plot data from proposed lands for some time.
- MT: Suggested EMM/Evolution talk to the Biodiversity Credit Supply Task Force to discuss approach to offsetting, given inundation of the lake.

Inundation of Lake Cowal impeding survey of PCT 17

- MT: Identified the likely bounce-back of vegetation condition after water recedes, as well as more terrestrial vegetation communities.
- SW: Post-approval survey may allow for a more precautionary approach, given vegetation condition would be greater.
- LW: Identified the need for two benchmarks, during dry and wet periods, given the great flux in vegetation community diversity/abundance between these periods.
    - NOTE (post meeting) – Upon review of benchmark data for PCT 17, there are three options for NSW South Western Slopes according to annual rainfall (<334; 334-573; >573 mm). If required by BCD, the relevant benchmark will be applied. It appears that the default benchmark (according to

VIS) is meant to be the "average" rainfall average year (334-573mm), but the actual benchmarks applied in the BAMC appear to more closely align with the "wet" rainfall average year (>573mm), but with a number of differences. It is unclear how the benchmarks utilised should be approached as BAM plot data has been gathered over multiple years since 2020, with variable rainfall conditions over that time, and noting that BAM training does not cover variable benchmarks. EMM suggests that since many plots have been gathered during 2021 and 2022 in high rainfall years, that the "wet" rainfall average year should be applied to all PCT's. EMM seeks BCD's concurrence with this proposed approach.

- LW: Questioned the ability to access surrogate areas to survey PCT 17 nearby.
- SW: Identified likely challenges to find and get access to surrogate areas of PCT 17 given the inundation of Lake Cowal and other areas may be located on private lands, but noted that EMM had not yet checked whether other areas of this PCT may be accessible.
- SO: Proposed using aerial photography to look at the condition (eg. overstorey cover) and change in condition of PCT 17 over time. Can look at periods following the shoreline receding to gauge the condition during wet periods (when condition is highest).
- PM: Confirmed that Evolution has aerial photography captured annually, however the coverage of the Lignum area (PCT 17) needs to be checked.
- AF: Suggested that surveying the zone post-approval as part of conditions can be messy with BCD wanting to avoid if possible.

Inundation of Lake Cowal impeding survey of threatened plants

- LM: BCD can provide guidance on the assessment of the threatened plants in Lake Cowal if assuming presence, including SAII species.

Actions

Action Item	Owner	Due date
EMM request: Details and data held by BCD relevant to serious and irreversible impact (SAII) assessment for the Austral Pillwort to please be provided (EMM understands that BCD has data for all SAII listed entities relevant to SAII assessments).	BCD	30-9-22
MT request: Request to provide presentation and indicative time frames for a response.	EMM	16-9-22
EMM request: Feedback on the proposed approaches to site assessment given the inundation of Lake Cowal (see 'Proposed pathways forward' section below).	BCD	30-9-22
AF: Proposed approaches to offset site assessment to be discussed with the Biodiversity Credit Supply Task Force.	EMM	-

Proposed pathway forward

Table 1 Proposed pathway forward

Matter	Proposed pathway forward
Assessment of PCT 17	**<u>Options put forward in the presentation to BCD and comment after subsequent further investigations by EMM</u>** The range of options available is discussed, followed by identification of the proposed approach to be adopted. **Option 1: Survey another patch (if available) and use as representative in BAM-C.** Given widespread inundation of Lake Cowal and Nerang Cowal, there are no known areas that could be feasibly surveyed as a surrogate for this inundated vegetation zone, at least within accessible land at present. This option may become possible once these waterbodies drain, however this is not expected to occur any time soon. Thus, whilst this option would be desirable, it is not currently considered likely to be achievable. **Option 2: Survey zone post-approval. Survey requirement part of conditions.** This option would provide the most accurate assessment of the integrity of this vegetation zone. This would also allow for a more precautionary approach, given that the condition in such ephemeral systems is typically highest once waters recede. However, there remains uncertainty regarding the time for the lake to drain enough to allow for a survey effort. If the option presented below is not agreed upon, this would be the preferred approach. **Option 3: Assume benchmark condition. However, patch highly disturbed by agriculture.** Given the disturbed nature of the patch of PCT 17, owing to past agriculture, the assignment of benchmark condition is not representative. This option would present negative financial consequences for Evolution. **Option 4 (new option): Assign average plot values from PCT 53 to PCT 17, and use aerial photography to account for Lignum cover.** On review, EMM considered that an alternative and more representative option would be to adopt plot data acquired for the adjacent PCT 53. This approach was developed drawing upon feedback during the meeting with BCD/DPE regarding using historic imagery to determine the condition of this patch (see comment from SO above). The justification and proposed approach are presented below. **Justification:** The area currently mapped as PCT 17 was originally mapped as PCT 53 by EMM, and the two communities have multiple similarities. EMM believes that the vegetation present is transitional between PCT 17 and PCT 53. Serious consideration was given by EMM to leaving this vegetation classified as PCT 53, but was eventually remapped to PCT 17 as the observed lignum density appeared to be a slightly better fit for PCT 17. Vegetation integrity plot data collected from PCT 53 within the proposed footprint for Lake Cowal is considered representative of the patch of PCT 17 since: • PCT 53 also has Lignum (*Muehlenbeckia florulenta*) as diagnostic species[1]; • The PCT 17 polygon present within the proposed OPC footprint lacks Black Box (*Eucalyptus largiflorens*), which is a diagnostic species for PCT 17; • PCT 53 and PCT 17 occur at the same elevation (approx. 205 m Above Sea Level), so the landscape position is consistent; • PCT 53 and PCT 17 has had the same land use history (agriculture); • PCT 53 and PCT 17 both occur on Lake Cowal Soil Landscape[2]; and • Previous mapping considers all vegetation in Lake Cowal within the mining lease as *Medicago polymopha* and Canegrass (*Eragrotis australasia*), with the Lignum community located northeast of the mining lease (see **Figure 1**). That is, the area currently mapped as PCT 17 was previously mapped

[1] As per vegetation description in BCD's BioNet Vegetation Information System (last accessed 1 September 2022)

[2] King, D.P., 2010, Soil Landscapes of the Forbes 1:250,000 Sheet map, Edition 2, Department of Environment, Climate Change and Water NSW, Sydney.

as not being part of the Lignum community, but instead aligning with the broader PCT 53 within Lake Cowal.



Figure 1: Mapping of vegetation within Lake Cowal by Bower (2003). 5 = Lignum; 6 = Lake Bed – Scattered areas of *Medicago polymopha* and Canegrass (*Eragrotis australasia*).

Source: Cowal Gold Operation Biodiversity Offset Management Plan.

Proposed approach:

- Adopt the PCT 53 BAM plot data for the composition, structure and function score componentsfor plots undertaken in PCT 53 for the vegetation integrity assessment within the BAM Calculator for the Lignum thickets (PCT 17);
- Estimate the Lignum cover using recent aerial imagery. Note that high resolution Nearmap™ imagery is available for 2019, prior to the most recent inundation of the lake. Also, 2019 should represent a high condition state since the lake had only just dried since inundation in 2018 (Figure 2). It is further noted that the all the benchmarks for PCT 17 utilise a shrub cover benchmark score of 9 – 13 and that in practice it is likely that a benchmark score will be applied for the shrub cover;
- Account for the greater Lignum cover by adding it as an extra shrub species and increasing the shrub layer cover by adding the cover of Lignum, as determined by aerial photography.

A comparison between the average PCT 53 plot score to benchmark PCT 17 scores is provided in Table 1. Note that the vast differences (other than perhaps shrub cover) would lead to an inaccurate estimate of vegetation condition if benchmark values were to be adopted.

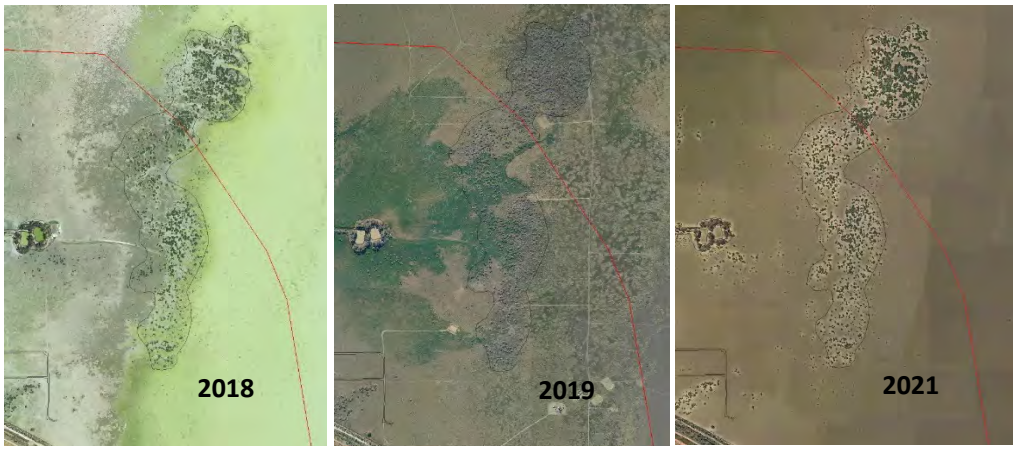
Table 1. Comparison of average PCT 53 plot scores to benchmark PCT 17 for a "wet" rainfall average year. Table a) = Composition; b) = Structure and c) = function.

a)	compTree	compShrub	compGrass	compForbs	compFerns	compOther
Average PCT 53	0.14	0.43	3.00	4.43	0.14	0.43
Benchmark PCT 17	1	3	6	7	1	1

b)	strucTree	strucShrub	strucGrass	strucForbs	strucFerns	strucOther
Average PCT 53	0.57	0.04	81.07	4.76	0.01	0.09
Benchmark PCT 17	0	13	10	5	0	0

c)	funLargeTrees	funHollowtrees	funLitterCover	funLenFallenLogs
Average PCT 53	0	0	47.43	0
Benchmark PCT 17	0	0	30	65

Table 1 Proposed pathway forward

Matter	Proposed pathway forward
	 **Figure 2:** Aerial photographs of Lignum patch (black outline) during 2018 (partial inundated), 2019 (dry) and 2021 (fully inundated). Red line indicates EIS study area boundary. Source: Nearmap™
Target threatened flora survey	**<u>Options put forward in the presentation to BCD</u>** **Option 1: Survey for species post-approval, with survey requirement part of conditions of consent.** This option would provide the most accurate assessment of the presence and extent of these threatened flora. This would also allow for a more precautionary approach, given that the condition in such ephemeral systems is typically highest once waters recede, so chance of detection should be greater for most species. However, there remains uncertainty regarding the time for the lake to drain enough to allow for a survey effort (ie whether the lake will have drained sufficiently prior to the proposed commencement of works to allow target survey to proceed). **Option 2: Put forward case for species not being present (similar to previous Biodiversity Certification).** This option explores the merit of excluding species from requiring survey within inundated Lake Cowal vegetation zones based on a lack of suitable microhabitat in Lake Cowal (step 3 of the BAM threatened species assessment process), or the known distribution of the species. A preliminary case for some species is provided below. **Option 3: Assume presence where no survey coverage, noting challenge for Austral Pillwort (SAII).** Given that suitable microhabitat is not present within Lake Cowal and/or the chance of a species occurring is considered low given its known distribution, assuming presence is considered an unsuitable option. This option would present negative financial consequences for Evolution. Furthermore, assuming presence for Austral Pillwort (SAII) would also complicate the SAII assessment. **Option 4: Seek expert report. However, ability to for species expert to assess habitat obscured by inundation. Also, no Species expert found for Austral Pillwort (SAII).** Even if a species expert were available, the ability to determine location and extent of suitable habitat would be hindered by water inundation. Following a review of the microhabitat requirements and/or distribution of the species, and the amount of survey undertaken to date within Lake Cowal, we believe there is a strong case that the survey effort undertaken to date is representative and that the microhabitats within Lake Cowal are not suitable for the relevant species (i.e. Option 2 is the preferred approach). That is, EMM proposes that these flora species can be ruled out from requiring further survey (or offsetting) in Lake Cowal given their low chance of occurring. A preliminary case for each flora species is provided below.

Case for lack of suitable microhabitat for Austral Pillwort (*Pilularia novae-hollandiae)* in Lake Cowal	**Justification:** EMM had sought to make contact with Colin Bower, who observed and documented the presence of Austral Pillwort at Lake Cowal, prior to the meeting with BCD, but was unable to make contact. After the meeting EMM was able to speak to Colin Bower (pers. comm. 5-9-22), who stated that during his previous surveys at Lake Cowal, the Austral Pillwort: • were only found in gilgai, and not in or along the lake edge at Lake Cowal; and • favoured gilgai depressions lacking invasive grasses. These statements were supported by findings of all previous studies that targeted this species in Lake Cowal. Austral Pillwort were only located in gilgai at Lake Cowal by Clements and Rodd (1995) and Bower (1998) and not been located since despite extensive and targeted searches since 2006 by EMM, AMBS[3] in 2015/2016 and target survey by Environmental DNA annually from 2006 to 2021. Where found at Lake Cowal, all Australian Pillwort individuals were found to associated with: • gilgai's with free water or recently receded water, not within Lake Cowal; • moist soils, with less Austral Pillwort plants found in drier depressions. Individuals found in drier gilgais displayed poorer health (i.e. yellowing off); and • more open areas among sparse rushes or bare ground, which allowed more light penetration.

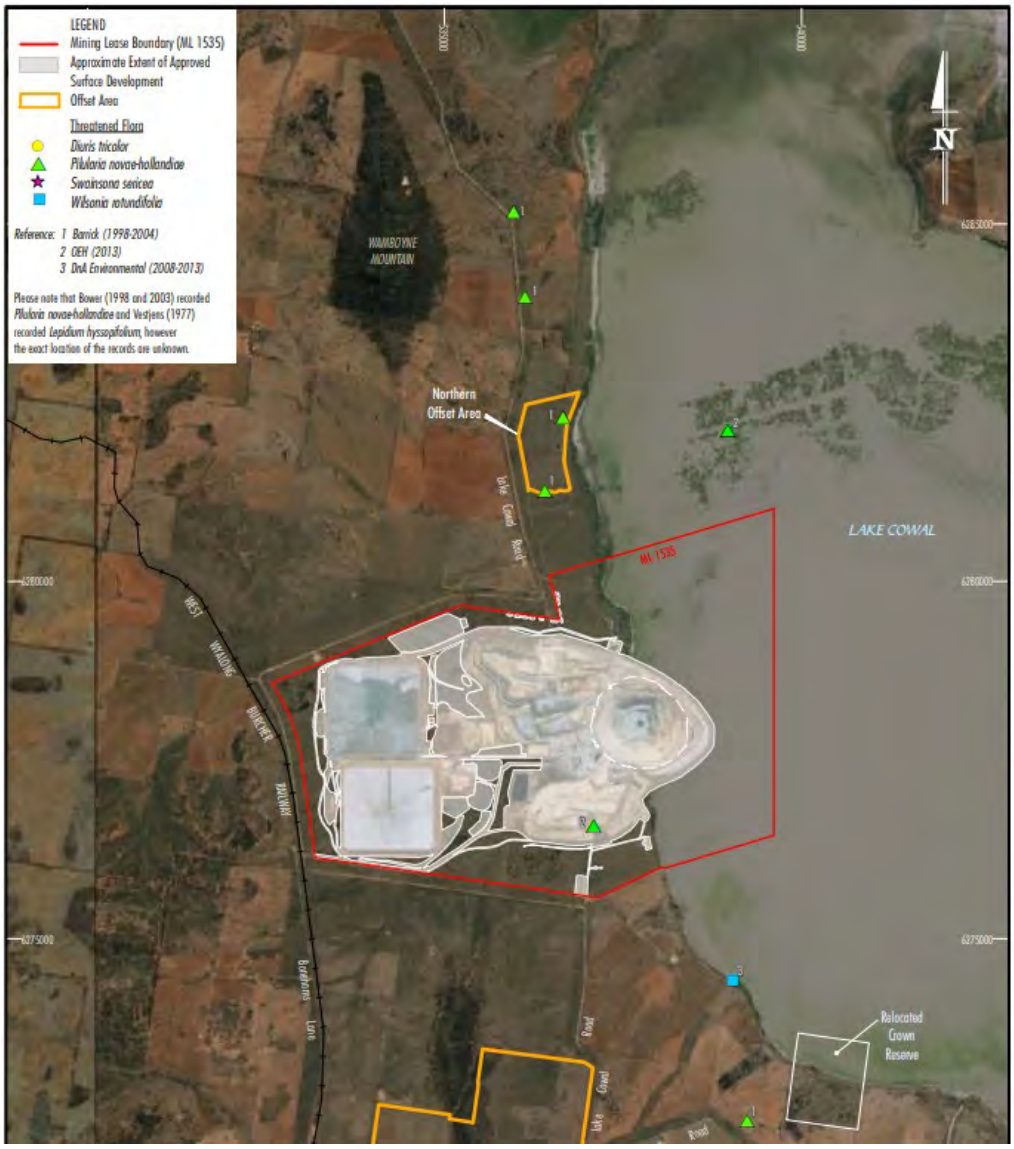
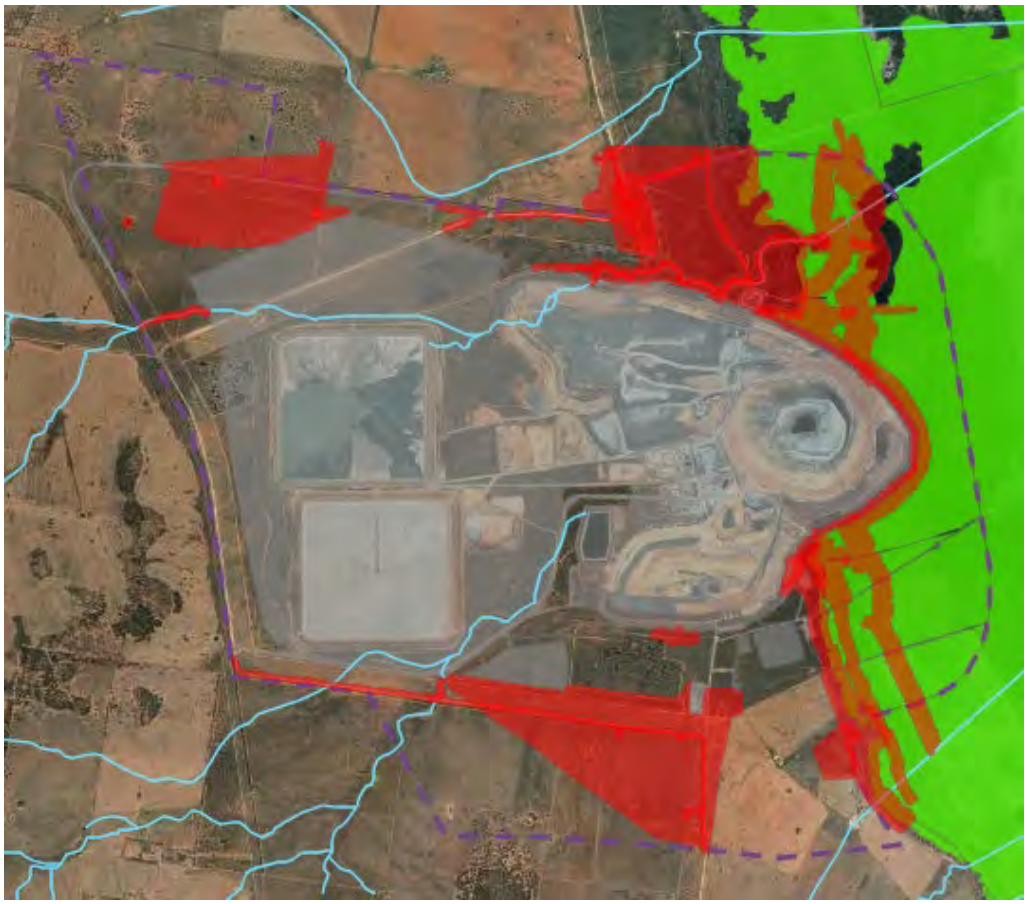


Figure 2: Records of Austral Pillwort (green triangles) nearby Lake Cowal [note that record in lake is spatially denatured by BCD and belongs to Bower (1998) where found in 38 of 65 depressions examined]. Source: Cowal Gold Operation Biodiversity Offset Management Plan.

Despite the known association of Austral Pillwort with gilgai, EMM still undertook surveys within Lake Cowal in November and December 2020. To this point 212.81 ha of surveys have been undertaken for this species, with 165.3 ha (36.79%) of PCT 53 within Lake Cowal surveyed (Figure 3). These surveys

Table 1 Proposed pathway forward

Matter	Proposed pathway forward
	focused on targeting areas that were wet at the time of survey (ie. targeting areas with better microhabitat conditions for the species within Lake Cowal). Nevertheless, EMM failed to detect this species and believes that this survey effort was spatially representative of PCT 53.  **Figure 3:** Survey effort within Lake Cowal by EMM. Red polygons represent outer extent of targeted surveys for Austral Pillwort. Green polygon represents PCT 53. Dashed line represents the Project Area. **Proposed approach:** • Focus survey effort on gilgai depressions outside of Lake Cowal, where this species has been previously found; and Seek agreement with BCD to rule out PCT 53 within Lake Cowal based on a lack of suitable microhabitat (i.e. Step 3 of the BAM assessment for threatened species).

[3] AMBS Ecology & Heritage (2018) Cowal Gold Operations Processing Rate Modification – Flora and Fauna Survey Report. Prepared for Evolution Mining (Cowal) Pty Limited

Case for lack of suitable microhabitat for *Lepidium aschersonii* (Spiny Peppercress) in Lake Cowal	**Justification:** The Spiny Peppercress is known to typically associate with gilgais. The species has been located in the region of the project area; the nearest record is approx. 17km to the southwest[4]. The strong association of Spiny Peppercress with gilgais is highlighted within this species profile within BCD's BioNet, which describes habitat as ridges of gilgai clays dominated by Brigalow (*Acacia harpophylla*), Belah (*Casuarina cristata*), Buloke (*Allocasuarina luehmanii*) and Grey Box (*Eucalyptus microcarpa*) and, in the south, has been recorded growing in Bull Mallee (*Eucalyptus behriana*)[5]. A review of all NSW BioNet[6] records of this species supports this, with the following habitat descriptions attached to records: • slight depression in grey clay soils (with sandy/silty upper layer) within a mature *Casuarina cristata* woodland community; • Mostly in gilgai depressions. Grey clay. Growing in *Acacia harpophylla*; • Green Mallee Low Open Forest near crest of low hill. Soil a grey sandy loam; • Brigalow woodland habitat; • In mallee community dominated by *Eucalyptus behriana*; • Grassland (predominantly Danthonia species) with *Acacia harpophylla* scattered throughout open area; • Growing well under dry conditions in a lea paddock; and • In vegetation community dominated by *Eucalyptus microcarpa* and *Allocasuarina luehmannii*. All records occur within woodland, with none aligning with a flood plain swamp, such as PCT 53. The need to focus surveys on gilgai, rather than within Lake Cowal is supported by the lack of detections within surveys by EMM. Despite the known association of Spiny Peppercress with gilgai, EMM undertook surveys within Lake Cowal in November and December 2020. To this point 212.81 ha of surveys have been undertaken for this species, with the 165.3 ha (36.79%) of PCT 53 within Lake Cowal surveyed (Figure 3). These surveys focused on targeting areas at the time that were wet at the time of survey. Nevertheless, EMM failed to detect this species and EMM believes that this survey effort was spatially representative of PCT 53.

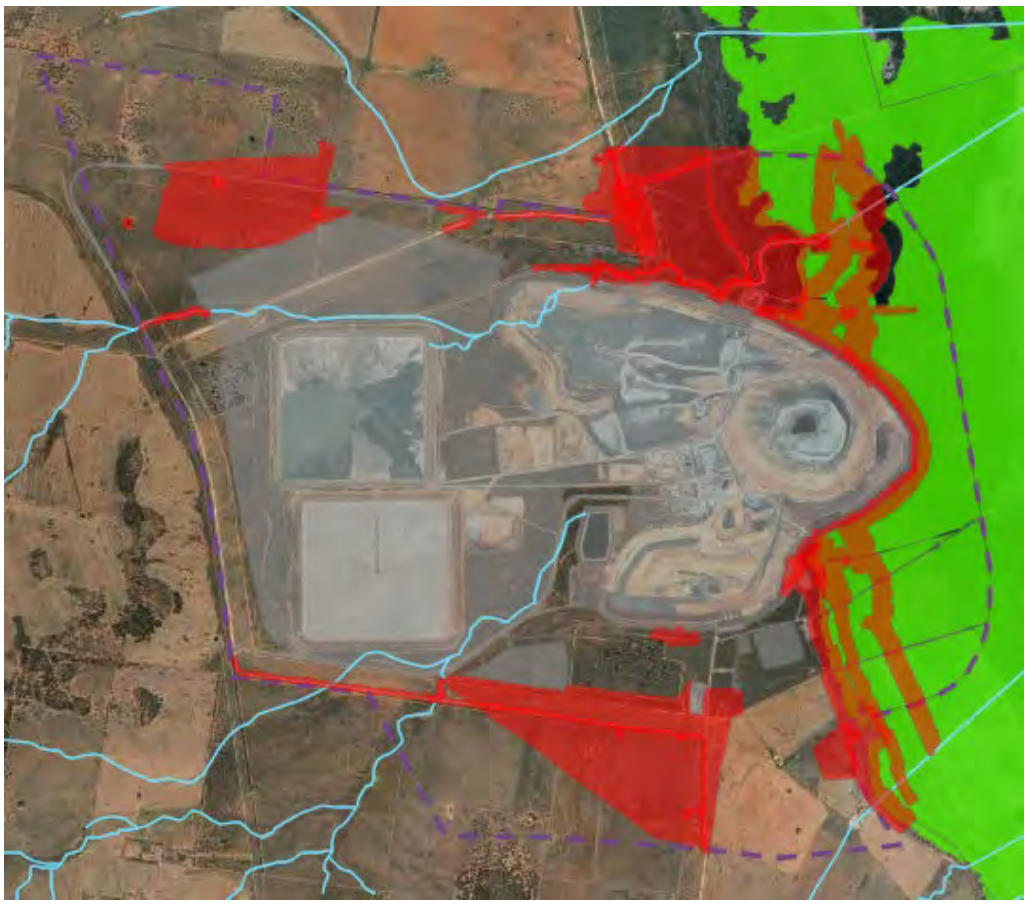


Figure 4: Survey effort within Lake Cowal by EMM. Red polygons represent outer extent of targeted surveys for Spiny Peppercress. Green polygon represents PCT 53. Dashed line represents the Project Area.

Table 1 Proposed pathway forward

Matter	Proposed pathway forward
	Proposed approach: • Focus survey effort on gilgai depressions only, where this species has been previously found; and Seek agreement with BCD to rule out PCT 53 within Lake Cowal based on a lack of suitable microhabitat (i.e. Step 3 of the BAM assessment for threatened species).
Case for lack of suitable microhabitat for *Austrostipa wakoolica* (A spear-grass) in Lake Cowal	**Justification:** *Austrostipa wakoolica* grows in open woodland, on grey silty clay or sandy loam soils[7]. It has been located in the region of the project area; the nearest record is approx. 3km to the west. Although *A. wakoolica* typically associates with open woodland, it can associate with edges of lignum swamp. As such, the patch of lignum within Lake Cowal may offer potential habitat for this species, but typical associated overstory species are lacking[7] (i.e. *Callitris glaucophylla*, *Eucalyptus macrocarpa* and *E. populnea*). An association of this species with open woodland is demonstrated by habitat descriptions where this species has been recorded in NSW[6], which are: • *Callitris glaucophylla* forest on low range; • Box woodland growing in dry cracking clay soil in open *Callitris columillaris*, *Eucalyptus microcarpa*, *E. populnea* community; • Mixed Acacia species open woodland with dense understorey of *Austrostipa* sp.; and • Weeping Myall Shrubland remnant. Despite this, substantial survey effort has occurred within the lignum patch. EMM has failed to detect *A. wakoolica*. That is, 62.29% of the Lignum patch was surveyed. *A. wakoolica* is also yet to be found by EMM despite searching areas of more appropriate habitat in grassy woodland areas (**Figure 5**). Similarly, previous surveys by AMBS[3] in 2015/2016 for MOD 14 in areas overlapping and adjacent to the Project failed to detect this species.

4 Atlas of Living Australia (2022) https://www.ala.org.au. Accessed 5 September 2022.

5 DPE (2022) *Lepidium aschersonii* (Spiny Peppercress) - profile: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10461

6 DPE (2022b) BioNet Atlas Records https:// https://www.environment.nsw.gov.au/atlaspublicapp/UI_Modules/ATLAS_/atlasreport.aspx. Accessed 6 September 2022.

7 DPE (2022) *Austrostipa wakoolica* - profile. https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10082

Table 1 Proposed pathway forward

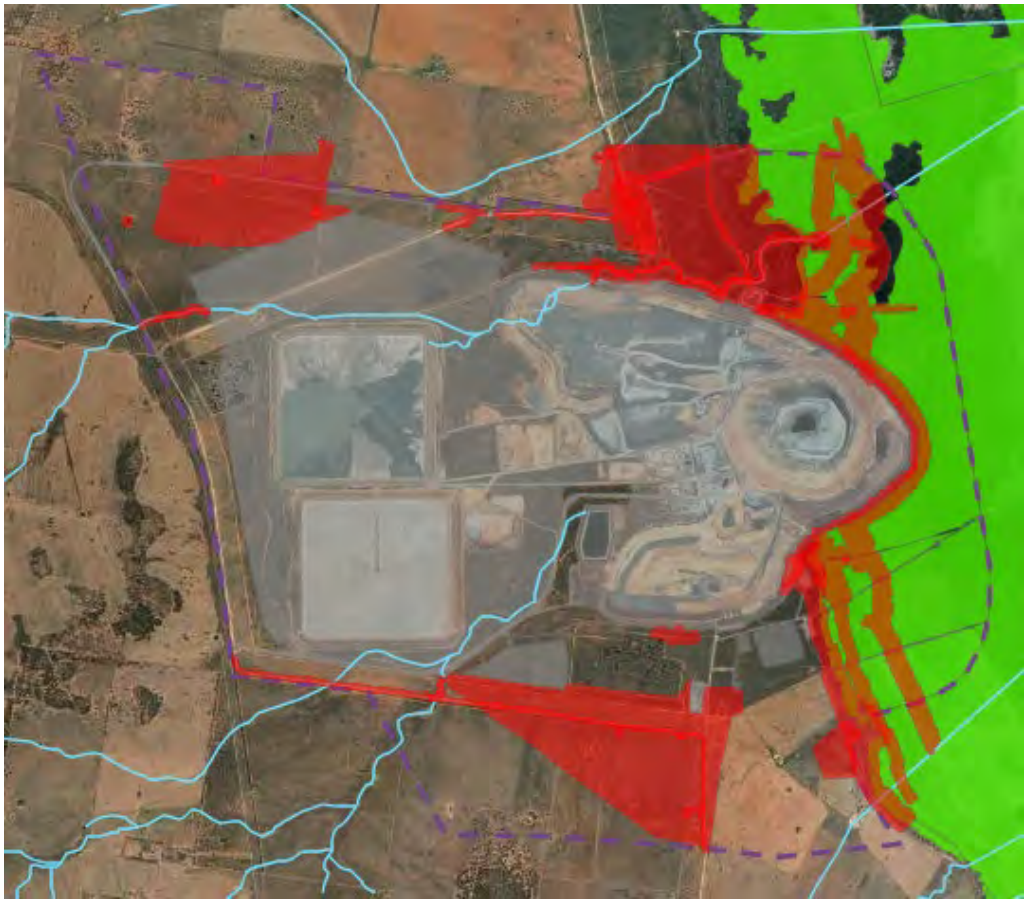
Matter	Proposed pathway forward
	 **Figure 5:** Survey effort within Lake Cowal by EMM. Red polygons represent outer extent of targeted surveys for *A. wakoolica*. Green polygon represents PCT 17. Dashed line represents the Project Area. **Proposed approach:** • Focus survey effort on open woodland on land only, which is the microhabitats that this species has been previously detected in; and • Seek agreement with BCD to rule out PCT 17 within Lake Cowal based on a lack of suitable microhabitat (i.e. Step 3 of the BAM assessment for threatened species).

Table 1 Proposed pathway forward

Matter	Proposed pathway forward
Case for lack of suitable microhabitat for *Amphibromus fluitans* (Floating Swamp Wallaby-Grass) in Lake Cowal	**Justification:** *Amphibromus fluitans* grows in periodically inundated sites (including table drains and farm dams), notably wetlands on riverine floodplain[8]. As such, the associated PCT 17 offers potentially suitable habitat for this species, though it is noted that EMM considers that this vegetation is transitional between PCT 17 and PCT 53. The nearest record for this species is adjacent to the Murrumbidgee River, approx. 140 km south of the Project. Moreover, surveys by EMM or previous surveys for Evolution mining[3] have yet to detect this species. This includes targeted surveys by EMM within 62.29% of the lignum patch, which offers potential habitat (**Figure 6**). Based on failure of targeted surveys at Lake Cowal to detect this species, and the distance to known records, it is considered this species has a low chance of occurring.  **Figure 6:** Survey effort within Lake Cowal by EMM. Red polygons represent outer extent of targeted surveys for *A. fluitans*. Green polygon represents PCT 17. Dashed line represents the Project Area. **Proposed approach:** Seek agreement with BCD to rule out the need to undertake further surveys within Lake Cowal based on that the microhabitats required are absent, due to the substantial distance from currently documented observations and that the vegetation is transitional between PCT 17 and PCT 53 (and the species is not associated in the BAM with PCT 53) , and that survey of 62% of potential PCT 17 habitat has not detected the species (i.e. Step 3 of the BAM assessment for threatened species).

[8] DPE (2022) *Amphibromus fluitans* - profile. https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10045

Table 1 Proposed pathway forward

Matter	Proposed pathway forward
Case for lack of suitable microhabitat for *Eleocharis obicis* (A spike-rush) in Lake Cowal	**Justification:** *Eleocharis obicis* grows in ephemerally wet situations, such as roadside mitre drains and depressions, and usually low-lying grasslands[9]. As such, wetland within the ephemeral Lake Cowal presents suitable potentially habitat for this species, with this species considered to be associated with PCT 53. However, based on the scarcity and age of nearby records, it is considered a low potential to occur. That is, there are only three records of *E. obicis* at the edge of the Lower Slopes IBRA subregion. These records were all made in 1973-1983, approximately over 70 km northwest of the Project Area[4]. Recent efforts to search for this species in Lake Cowal have also failed to detect it, even given that survey efforts to date by EMM focused on moist areas of Lake Cowal (at the time of survey) and covered 165.3 ha (36.79%) of PCT 53. Moreover, historic flora surveys[3] at Lake Cowal also failed to detect this species. Based on scarce and approx. 40 years since any records of this species in the Lower Slopes IBRA subregion, it is considered that the survey effort to date for this species within Lake Cowal is considered representative given the moderate-low chance of this species occurring.  **Figure 7:** Survey effort within Lake Cowal by EMM. Red polygons represent outer extent of targeted surveys for *Eleocharis obicis*. Green polygon represents PCT 53. Dashed line represents the Project Area. **Proposed approach:** Seek agreement with BCD to rule out the need to undertake further surveys within Lake Cowal based on that the microhabitats required are absent, due to the substantial distance from currently documented observations, and that survey of 36.8% of potential PCT 53 habitat has not detected the species (i.e. Step 3 of the BAM assessment for threatened species).

[9] DPE (2022) *Eleocharis obicis* - profile. https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10264

Appendix A

Presentation for BCD: 31 August 2022

EMM
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CGO Open Pit Continuation Project

Biodiversity Conservation Division

31 August 2022

Agenda

01 Project overview

02 Biodiversity surveys to date

03 Vegetation communities and threatened species

04 Timeframe (program)

05 Approach to environmental offsets

06 Assessment challenges

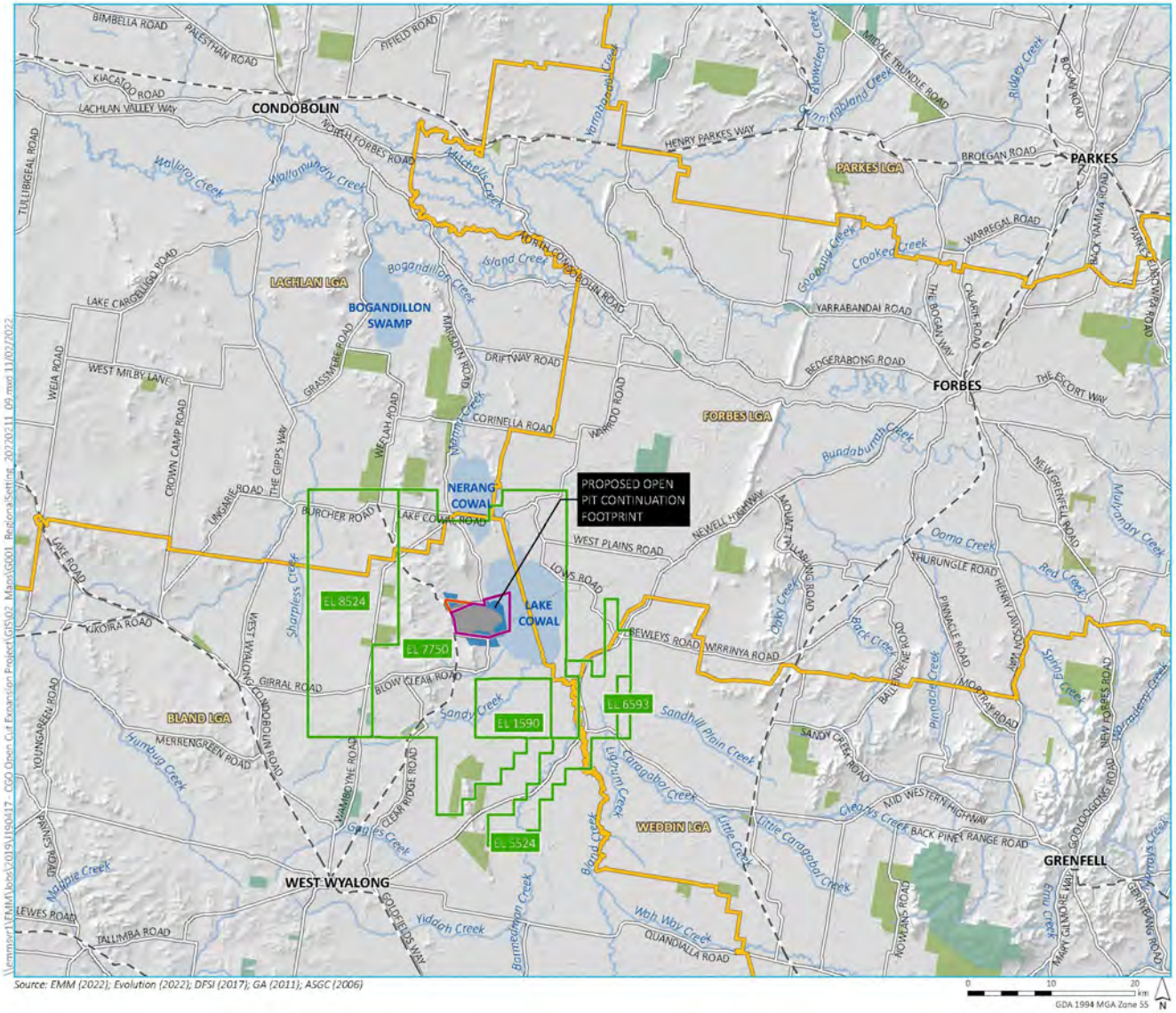
07 Questions and next steps

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Project overview

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overview – location





KEY

- Proposed disturbance footprint
- DA14/98 approved surface disturbance
- Mining lease (ML1535)
- Mining lease (ML1791)
- Exploration licence (EL)
- Rail line
- Main road
- Named watercourse
- Named waterbody
- Local government area
- NPWS reserve
- State forest

Regional context

Evolution Mining
Cowal Gold Operations
Open pit continuation project

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Project overview – CGO history

- CGO open-cut mine commenced operation in 2005 under NSW Development Consent DA 14/98, within ML 1535 and ML 1791. DA 14/98 modified 16 times since it was granted
- Evolution has an excellent track record of compliance and is also a significant contributor to the local community / economy
- CGO is located in the Lachlan Catchment, directly adjacent to Lake Cowal, an ephemeral freshwater lake
- CGO consents comprise of DA 14/98 for the open-cut mine and associated activities, and a NSW State Significant Development Consent (SSD 10367) for the underground mine and associated activities

Project overview – key components

(1) NEW OPEN-CUT MINING PITS
Development of new open-cut mining satellite pits to the north and south of the existing open-cut pit. Proposed expansion to existing open-cut mining pit to the east and south.

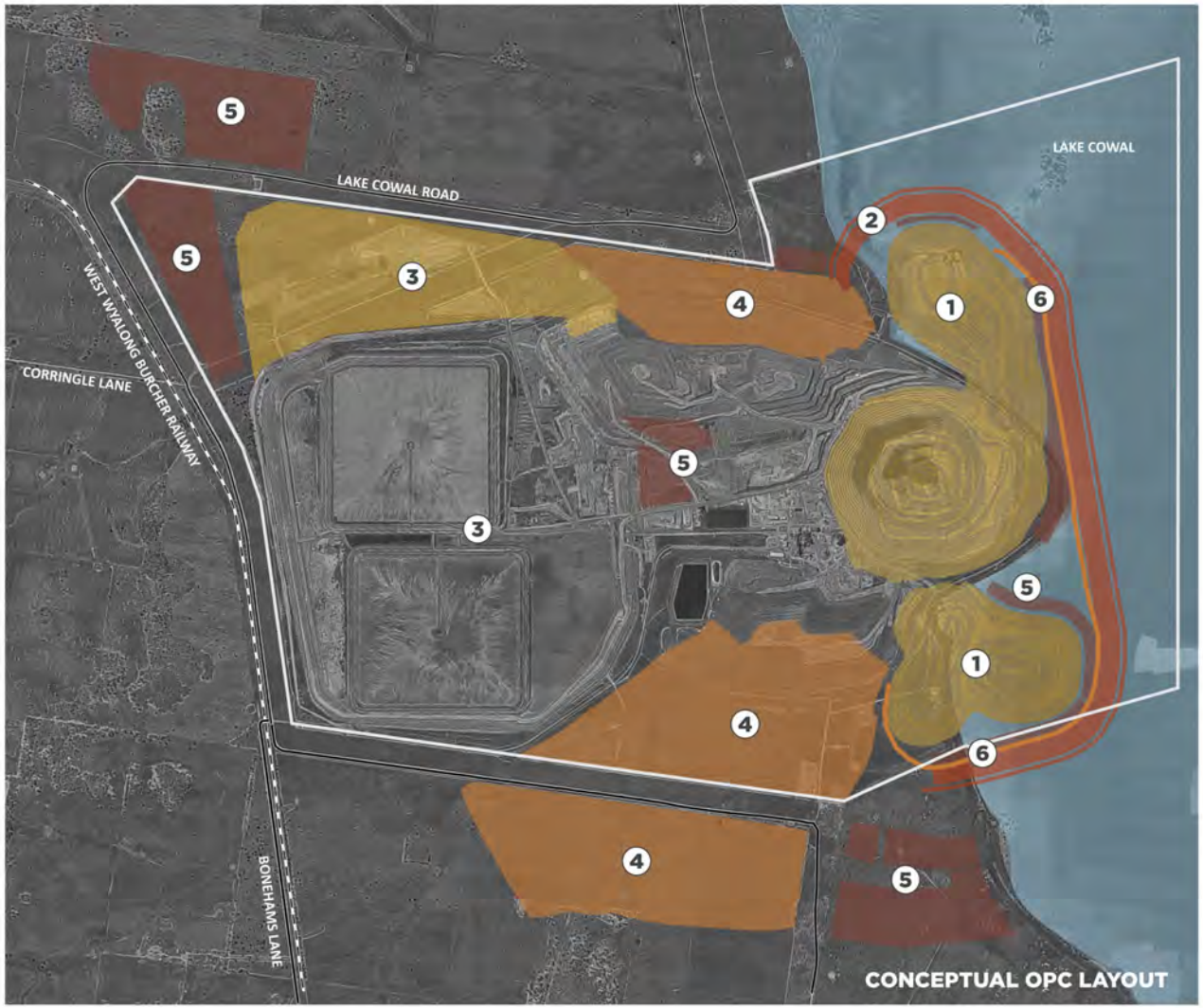
(2) LAKE PROTECTION BUND
Expansion of the lake protection bund system to provide separation and mutual protection between Lake Cowal and CGO.

(3) INTEGRATED WASTE LANDFORM
Continued use of the approved integrated waste landform to safely store tailings from ore processing, with either an 'upstream raise' on the existing facility or 'northern expansion', to ensure sufficient capacity for the project.

(4) WASTE ROCK EMPLACEMENT
Extension to waste rock emplacement to the north and south of the existing open-cut mining pit.

(5) TEMPORARY SOIL STOCKPILES
New topsoil and subsoil stockpiles, with materials to be temporarily stored for later use during mine rehabilitation.

(6) WATER STORAGE & UPGRADES
New water storage dams and upgrades to surface water drainage system, including proposed realignment of water supply pipeline and drainage system.



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Project overview – key components

(1) NEW OPEN-CUT MINING PITS
Development of new open-cut mining satellite pits to the north and south of the existing open-cut pit. Proposed expansion to existing open-cut mining pit to the east and south.

(2) LAKE PROTECTION BUND
Expansion of the lake protection bund system to provide separation and mutual protection between Lake Cowal and CGO.

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New water storage dams and upgrades to surface water drainage system, including proposed realignment of water supply pipeline and drainage pipeline.

Existing mining leases

Rail line — Main road

N 0 2 4 km



CONCEPTUAL OPC LAYOUT

Aerial Image: NearMap, 2021

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Project overview – key components

- Continuation of open-cut pit mining at CGO
- Further extension of E42 pit with Stage I cutback (currently mining Stage H)
- Mining of three adjacent orebodies, known as ‘E46’, ‘GR’ and ‘E41’
- Preliminary estimates show that 1.7 Moz of additional gold is expected to be produced from 255.6 Mt of waste mining and 65.2 Mt of ore mining over the term of the Project
- Ore will continue to be processed on-site at a rate of up to 9.8 Mtpa (current approved rate)
- Extend open-cut mine life by ~10 years to 2036 and total mine life ~2 years to 2042
- Other benefits:
  - Extend local job security and retention of the open-cut pit mining work force
  - Continued economic benefits to the region via sustained local services and procurement
  - Continued support for the community and local shires through sponsorship, donations and other contributions, to foster strong, sustainable communities that can thrive well beyond the life of mine
  - Continuation of royalties and State / Commonwealth tax payments

Vegetation Communities and Threatened Species

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Ecology assessment: background

- Team:
  - Glenn Stuckey – Ecology Project Coordinator/Manager (Jun 21 - Aug 22)
  - Hayden Beck – Ecology Project Manager (Aug 22 onward)
  - Steven Ward – Ecology Project Director (since Jan 21)
- Ecology surveys started January 2020
- Some survey gaps due to COVID-19 restrictions in Spring/Summer 2021 and design revisions
- Surveys still ongoing - scheduled to conclude December 2022
- Recent rainfall has filled Lake Cowal – can take years to drain and more rain predicted. This has created challenges to completion of surveys.



Survey effort to date: EMM



Terrestrial ecology surveys completed by EMM include:

- vegetation mapping and BAM plot surveys (88 plots);
- threatened flora surveys (Two-phase grid and searches targeting ephemeral drainage microhabitat; 1,527 ha survey effort);
- diurnal and nocturnal bird surveys;
- migratory and wetland bird survey;
- arboreal fauna trapping – mammal surveys;
- Grey-headed Flying Fox surveys; and
- aural/visual frog surveys.

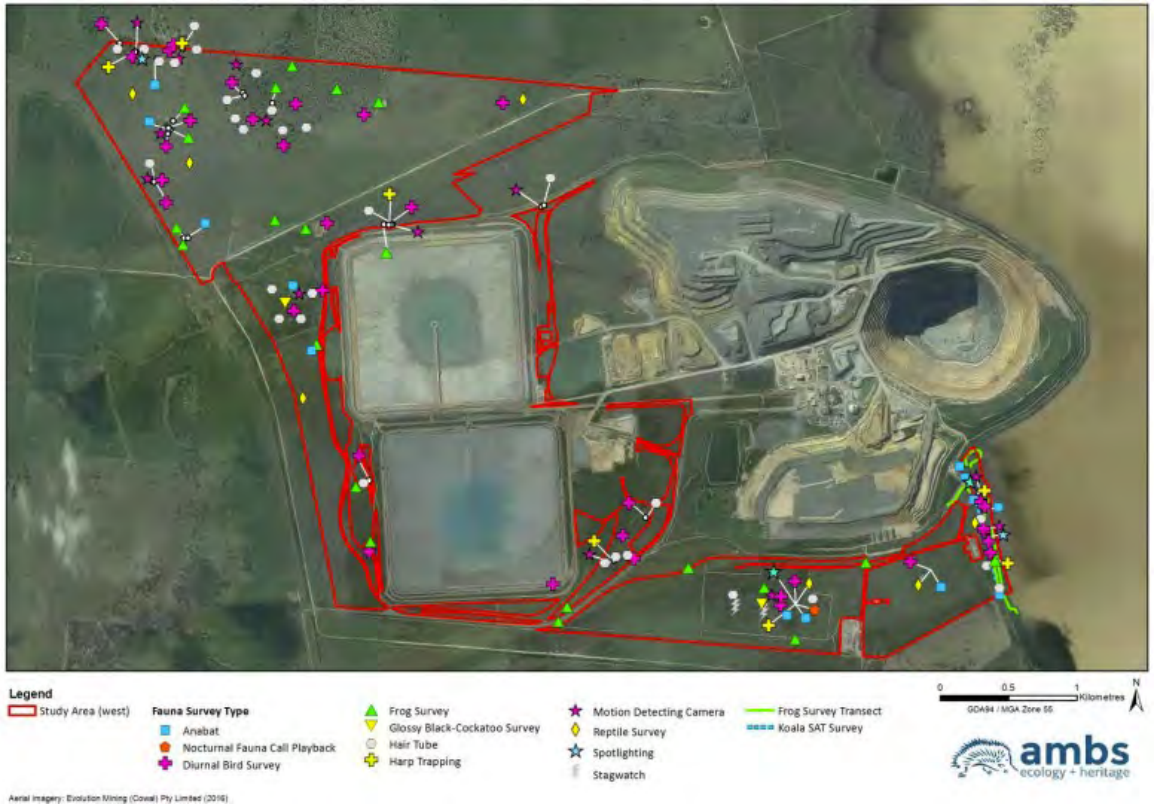
Survey effort to date: AMBS and Evolution

Terrestrial ecology surveys completed by AMBS during 2016 and 2017 for MOD 14 (immediately adjacent with some overlap):

- vegetation mapping and vegetation plot survey;
- threatened flora survey;
- diurnal and nocturnal bird surveys;
- Arboreal and ground-dwelling mammal survey - camera traps, hair tubes and spotlighting;
- Anabat and harp-trapping for microbats; and
- aural/visual frog survey.

Ongoing annual monitoring by Evolution include:

- migratory and wetland bird survey since 1989;
- vegetation plot monitoring; and
- targeted surveys for Austral Pillwort (BC Act: Endangered) since 2006.

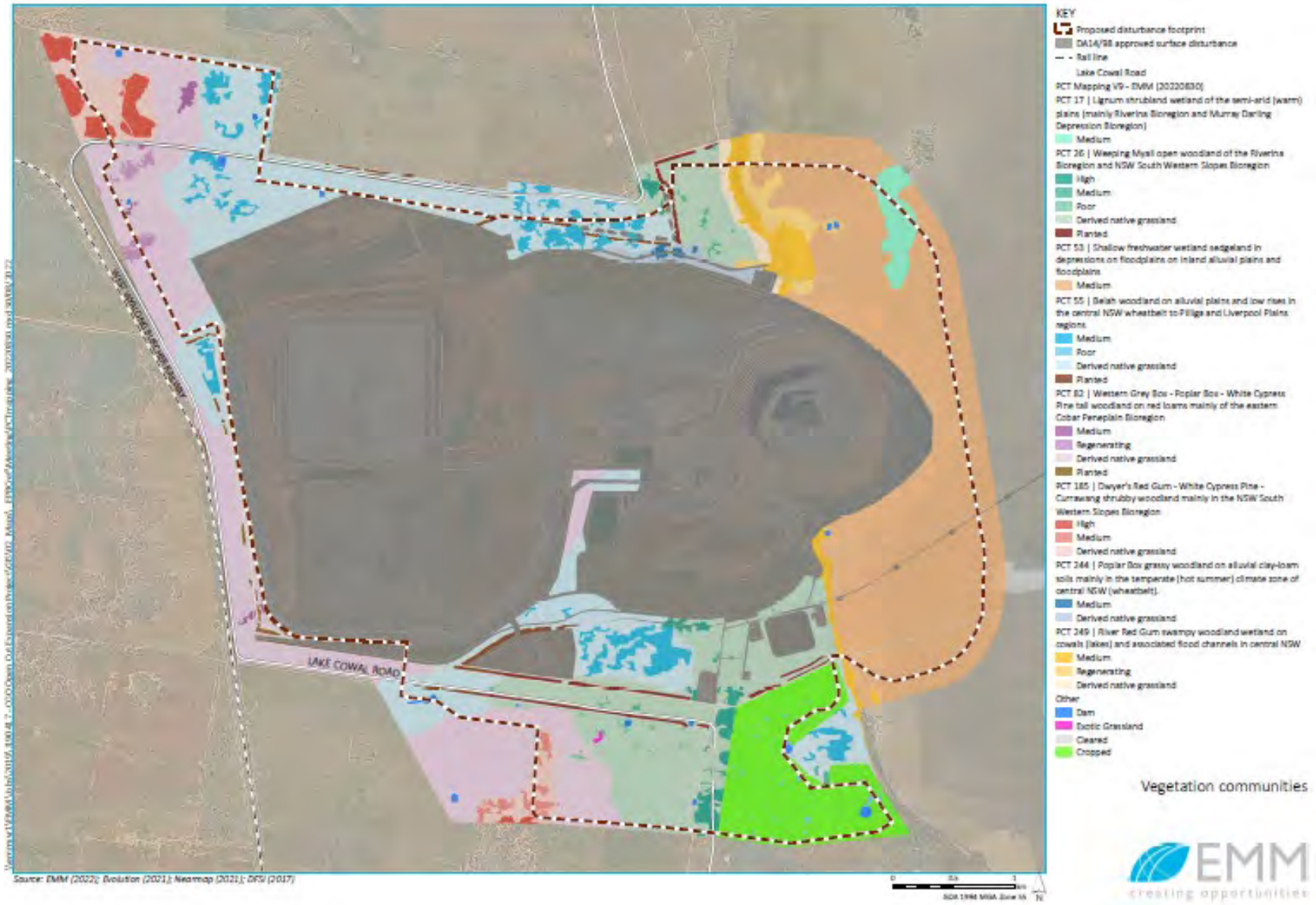


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Findings: PCTs within the disturbance footprint

PCT number	Name	BC Act listing	EPBC Act listing	Approx. disturbance (ha)
17	Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	-	-	14.76
26	Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions	Weeping Myall Woodlands	234.34
53	Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains	-	-	335.99
55	Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions	-	-	250.70
82	Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions	Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-Eastern Australia	146.10
185	Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion	-	-	41.33
244	Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).	-	Poplar Box Grassy Woodland on Alluvial Plains	12.50
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	-	-	53.65
	Total native vegetation			1089.41

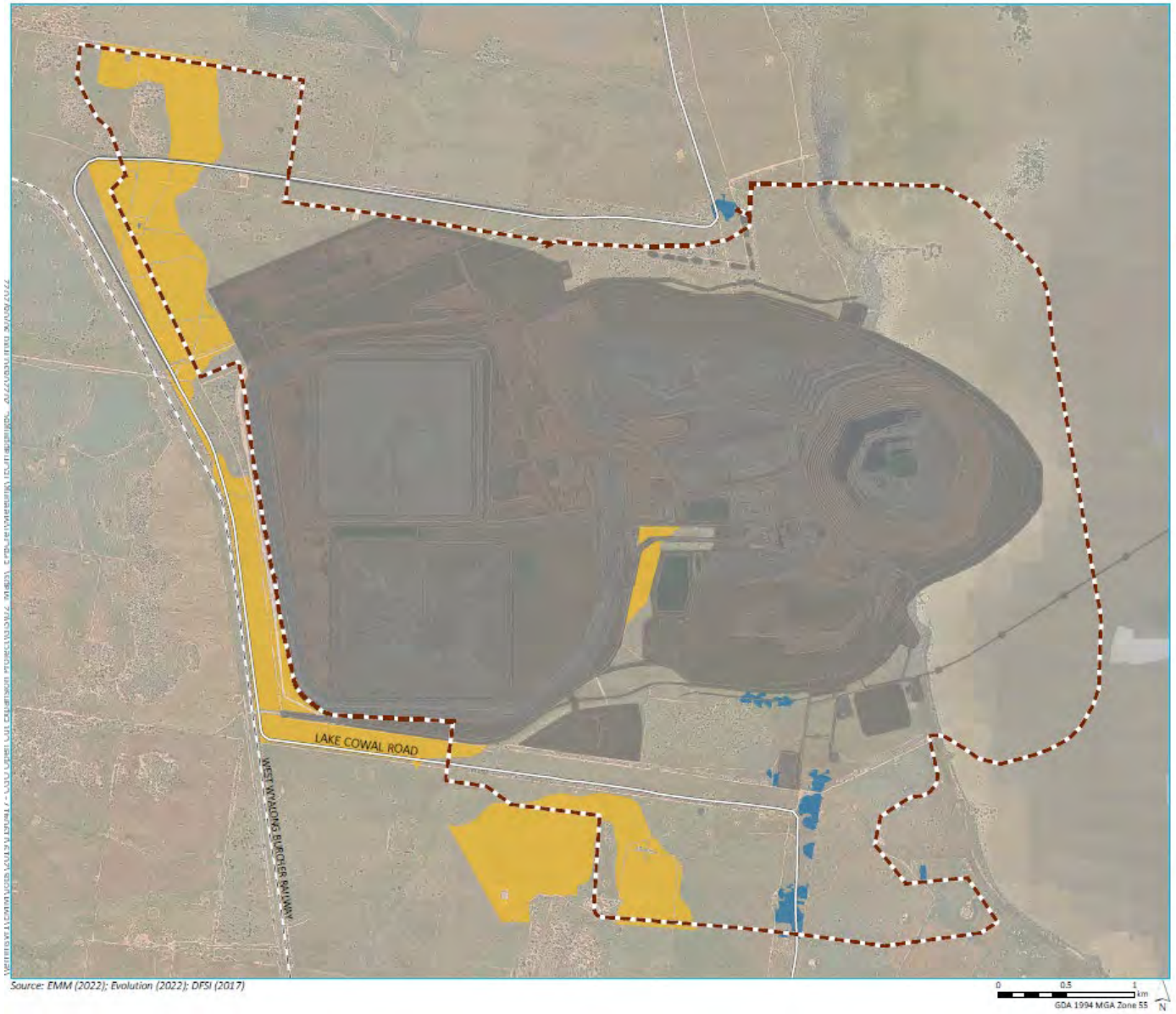
Findings: PCT mapping



Vegetation communities

- Grey polygon is the existing approved disturbance footprint
- 8 plant community types present
- The project area has been previously cleared for agriculture and thus most of the area is derived native grassland

Findings: BC Act threatened ecological communities



KEY

- Proposed disturbance footprint
- DA14/98 approved surface disturbance
- Rail line
- Lake Cowal Road

NSW BC Act listing

- Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions
- Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions

BC Act
threatened ecological communities

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Findings: EPBC Act threatened ecological communities



KEY

- Proposed disturbance footprint
- DA14/98 approved surface disturbance
- Rail line
- Lake Cowal Road

EPBC Act listing

- Weeping Myall Woodlands
- Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-Eastern Australia
- Poplar Box Grassy Woodland on Alluvial Plains

EPBC Act
threatened ecological communities

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Findings: Threatened Species

- No threatened flora detected by AMBS, Evolution or EMM to date
- Threatened flora previously detected in approved disturbance area:

Scientific name	Common name	BC Act	EPBC Act	SAII	Biodiversity Credit Class
Pilularia novae-hollandiae	Austral Pillwort	E	-	Yes	Species (Area)

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Findings: Threatened Species

- Following threatened fauna detected by EMM:

Scientific name	Common name	BC Act	EPBC Act	SAII	Biodiversity Credit Class
Botaurus poiciloptilus	Australasian Bittern	E	E	No	Ecosystem
Oxyura australis	Blue-billed Duck	V	-	No	Ecosystem
Epthianura albifrons	White-fronted Chat	V	-	No	Ecosystem
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	-	No	Dual (no breeding obs.)
Lophoictinia isura	Square-tailed Kite	V	-	No	Dual (no breeding obs.)
Oxyura australis	Blue-billed Duck	V	-	No	Ecosystem
Pomatostomus temporalis	Grey-crowned Babbler	V	-	No	Ecosystem
Stagonopleura guttata	Diamond Firetail	V	-	No	Ecosystem
Polytelis swainsonii	Superb Parrot	V	V	No	Dual (no breeding obs.)

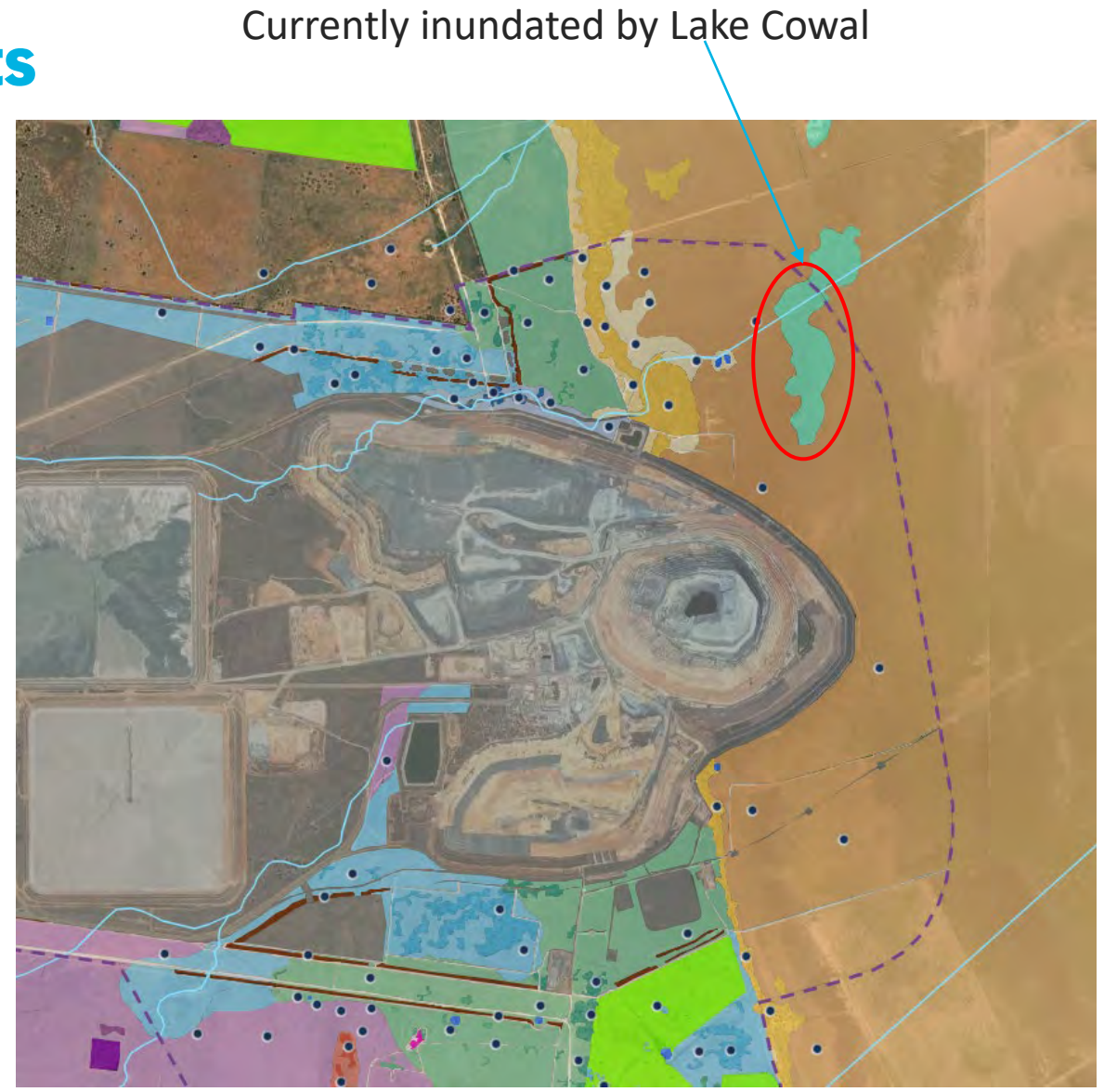
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Outstanding Surveys

- Substantial survey effort has been previously undertaken by EMM
- Survey requirements completed for seven Candidate species
- Some additional surveys required in Spring/Summer 2022 to cover gaps in spatial coverage

Outstanding surveys: BAM plots

- BAM plots are generally completed except those in PCT 17 Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)
- Three plots required in PCT 17 (14.76 ha patch)
- Entire extent of PCT 17 is currently inundated
- No plots available nearby to use as a substitute.



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Currently inundated by Lake Cowal

Outstanding surveys: Threatened Fauna

- Threatened fauna surveys outstanding (partial survey undertaken for all):

Scientific name	Common name	Timing	SAII	PCT 17	PCT 26	PCT 53	PCT 55	PCT 82	PCT 185	PCT 244	PCT 249
Haliaeetus leucogaster	White-bellied Sea-Eagle	Oct	N	✓	✓	✓	✓	✓	✓	✓	✓
Hamirostra melanosternon	Black-breasted Buzzard	Oct	N	✓			✓				
Lophochroa leadbeateri	Major Mitchell's Cockatoo	Oct	N		✓		✓	✓	✓	✓	✓
Lophoictinia isura	Square-tailed Kite	Oct	N		✓		✓				
Polytelis swainsonii	Superb Parrot	Oct	N		✓		✓	✓		✓	✓
Hieraaetus morphnoides	Little Eagle	Oct	N	✓	✓	✓	✓	✓	✓	✓	✓
Pteropus poliocephalus	Grey-headed Flying-fox	Oct	N				✓			✓	

- Threatened fauna surveys outstanding (full survey required):

Scientific name	Common name	Timing	SAII	PCT 17	PCT 26	PCT 53	PCT 55	PCT 82	PCT 185	PCT 244	PCT 249
Phascolarctos cinereus	Koala	Oct	N		✓		✓	✓	✓	✓	✓
Myotis macropus	Southern Myotis	Nov	N								✓

Outstanding surveys: Threatened Flora

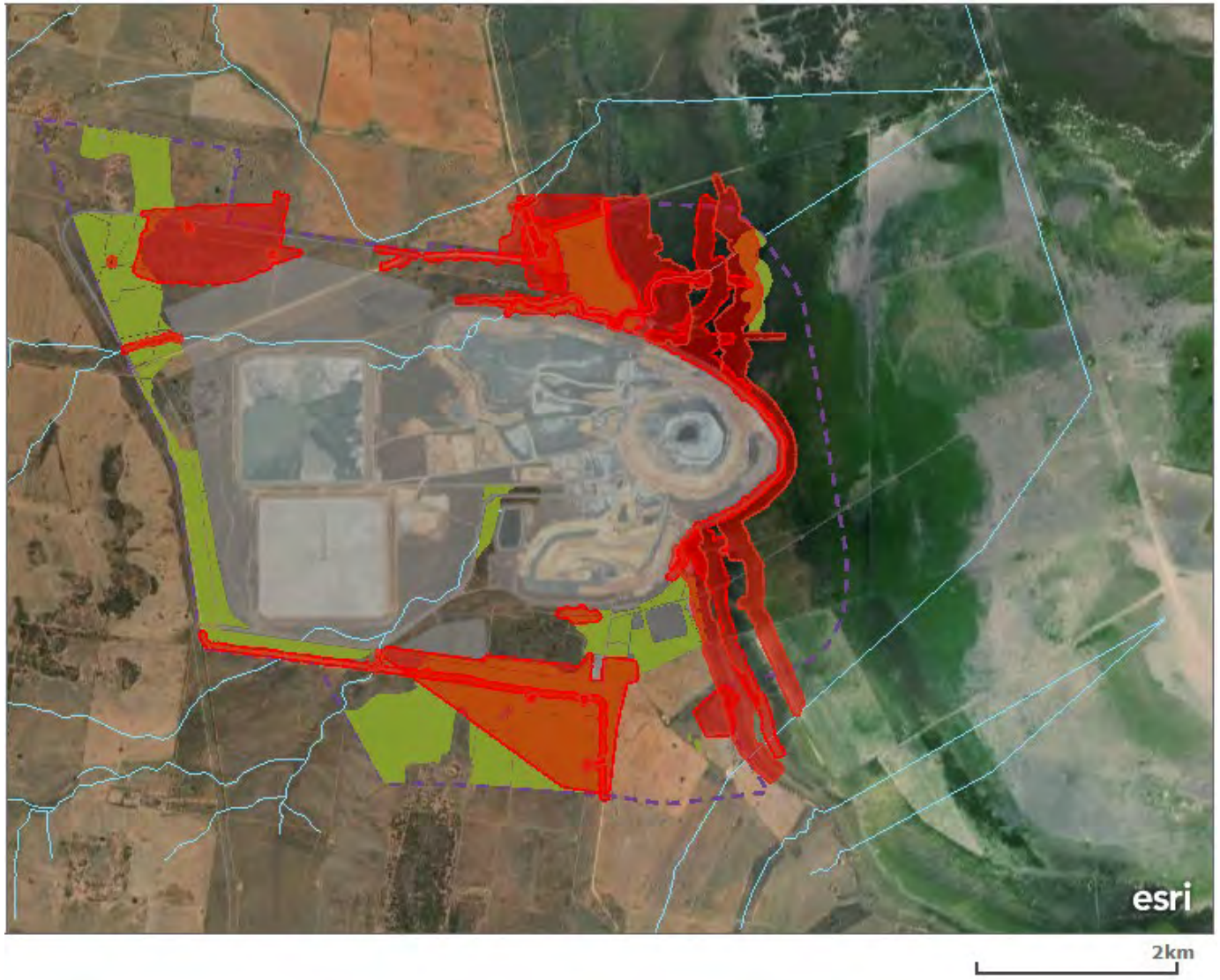
Currently inundated by Lake Cowal

- Threatened flora surveys outstanding (partial survey undertaken for all):

Scientific name	Common name	Timing	SAII	PCT 17	PCT 26	PCT 53	PCT 55	PCT 82	PCT 185	PCT 244	PCT 249
Diuris tricolor	Pine Donkey Orchid	Sep	N					✓			
Lepidium monoplocoides	Winged Peppercress	Sep	N		✓					✓	
Swainsona murrayana	Slender Darling Pea	Sep	N		✓		✓	✓			
Senecio garlandii	Woolly Ragwort	Sep	N						✓		
Swainsona sericea	Silky Swainson-pea	Nov	N		✓			✓		✓	
Austrostipa metatoris	A spear-grass	Nov	N					✓		✓	
Austrostipa wakoolica	A spear-grass	Nov	N	✓	✓			✓		✓	
Eleocharis obicis	Spike-Rush	Nov	N	✓		✓				✓	
Lepidium aschersonii	Spiny Peppercress	Nov	N		✓	✓	✓				
Pilularia novae-hollandiae	Austral Pillwort	Nov	Y		✓	✓					
Amphibromus fluitans	Floating Swamp Wallaby-grass	Dec	N	✓							

Outstanding surveys: Threatened Flora

- Outstanding survey requirements for *Austrostipa wakoolica* (A speargrass, BC Act: E; EPBC Act: E):



Associated PCTs

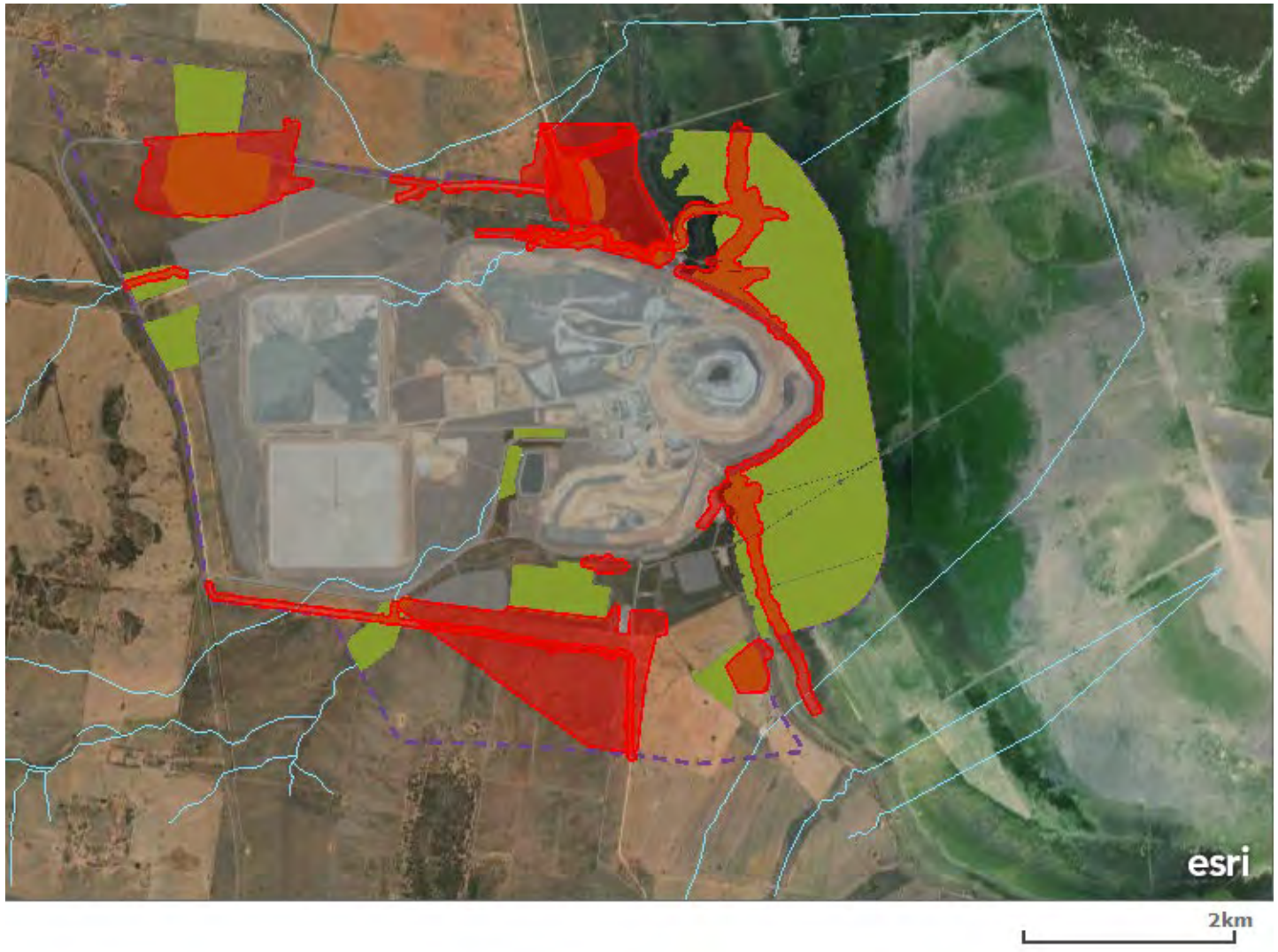
Survey effort to date



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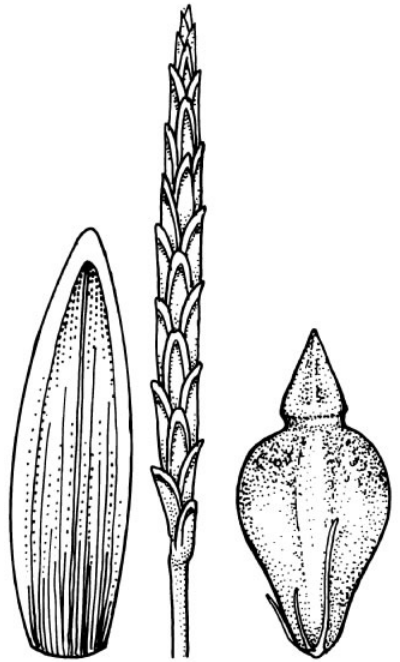
Outstanding surveys: Threatened Flora

- Outstanding survey requirements for *Eleocharis obicis* (A Spike-Rush, BC Act: V; EPBC Act: V):



Associated PCTs

Survey effort to date

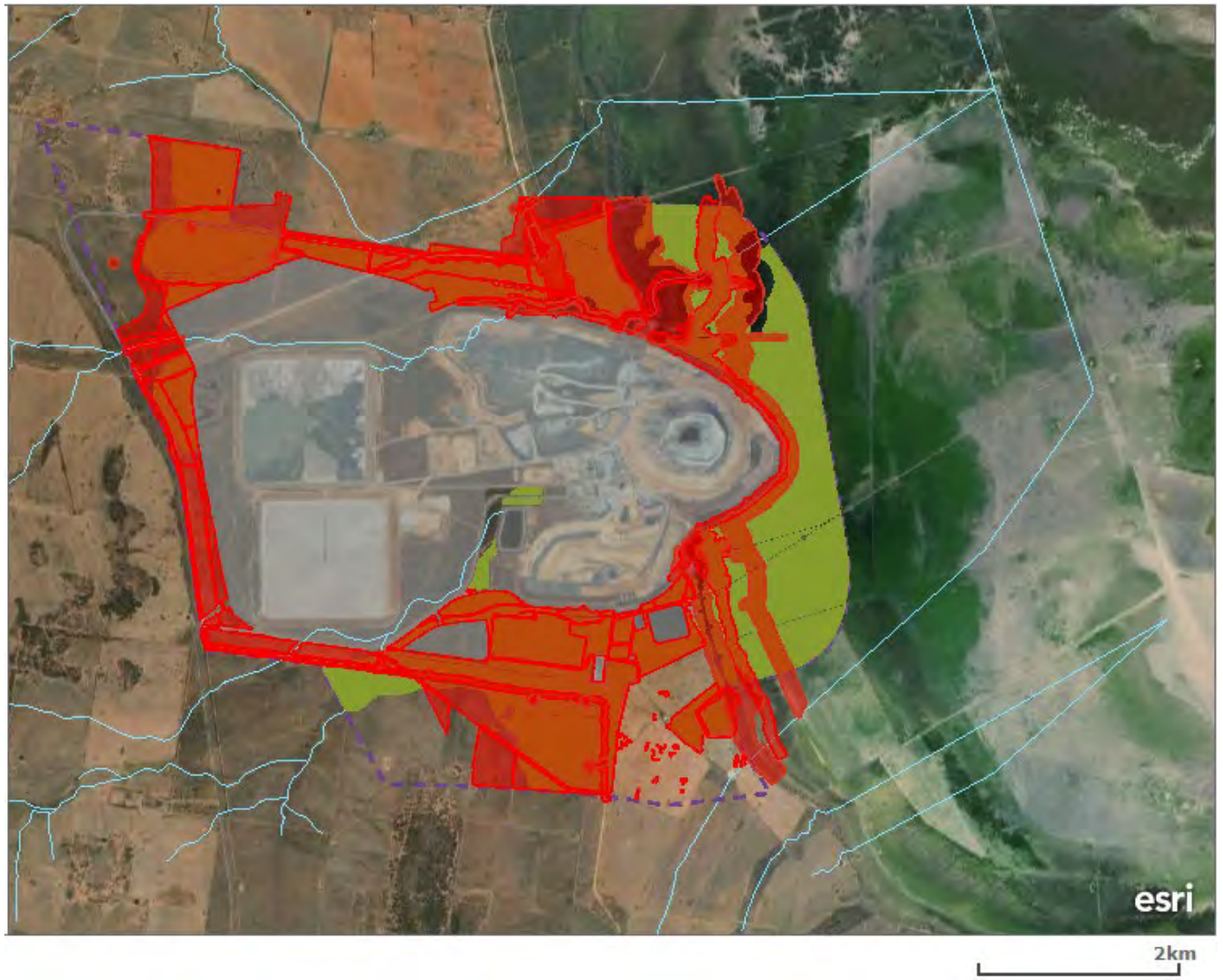


Source: Botanic Gardens Trust

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Outstanding surveys: Threatened Flora

- Outstanding survey requirements for *Lepidium aschersonii* (Spiny Peppercress, BC Act: V; EPBC Act: V):



Associated PCTs

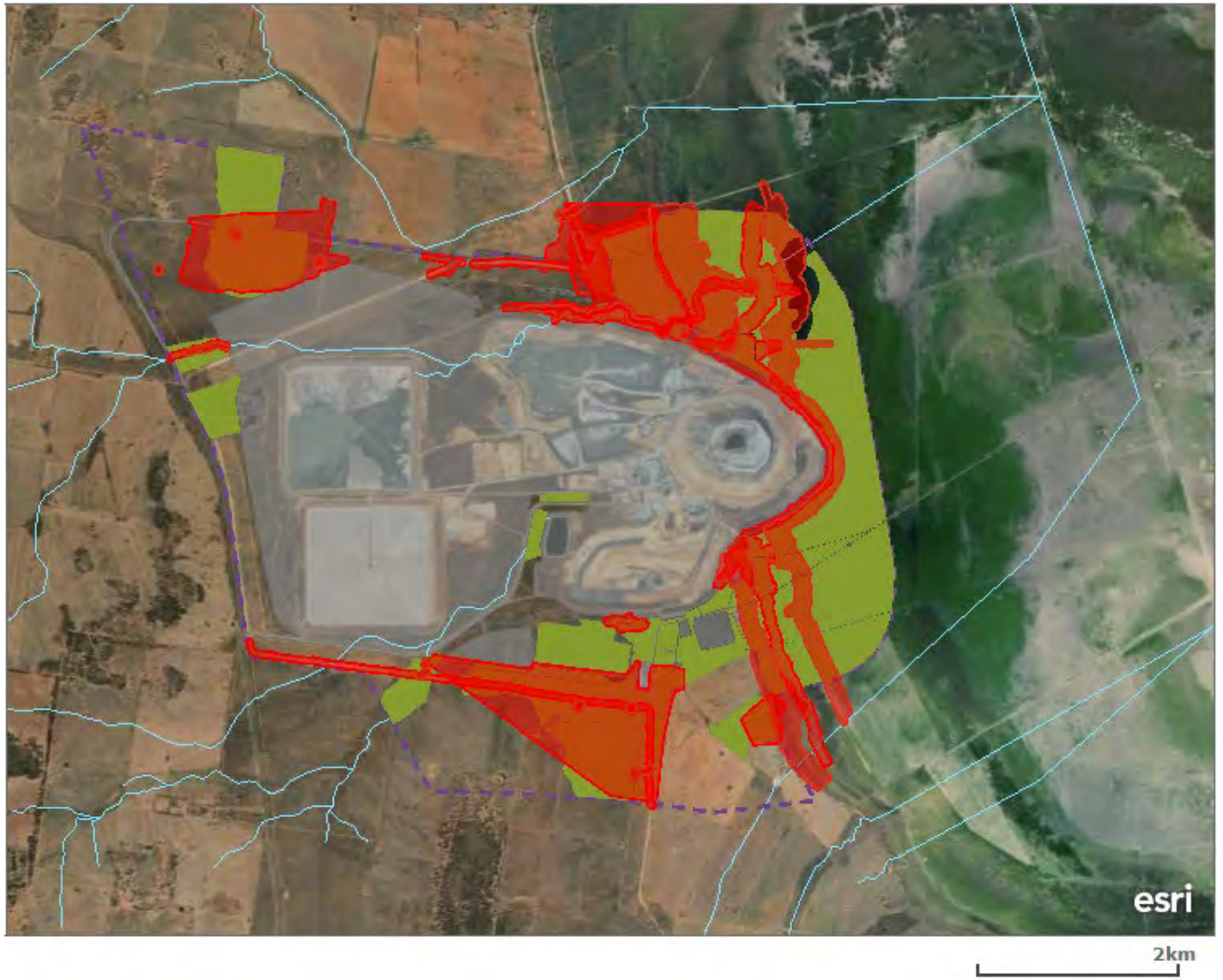
Survey effort to date



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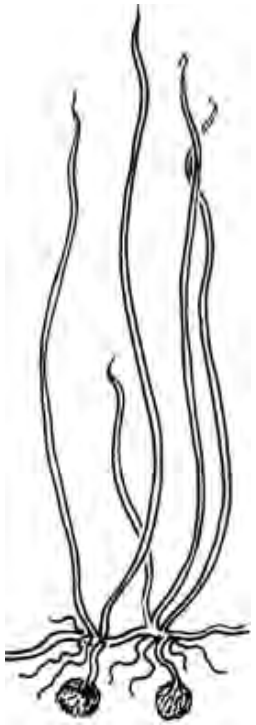
Outstanding surveys: Threatened Flora

- Outstanding survey requirements for *Pilularia novae-hollandiae* (Austral Pillwort; BC Act: E; **SAII**):



Associated PCTs

Survey effort to date



Source: Botanic Gardens Trust

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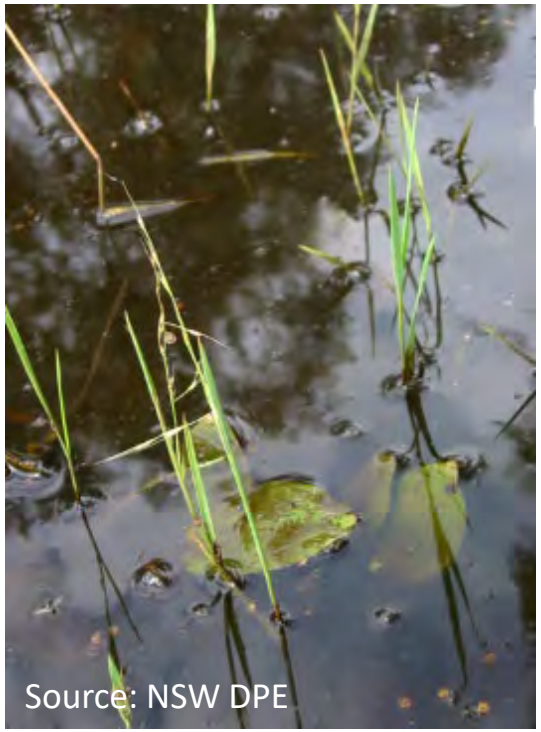
Outstanding surveys: Threatened Flora

- Outstanding survey requirements for *Amphibromus fluitans* (Floating Wallaby-grass, BC Act: V; EPBC Act: V):



Associated PCTs

Survey effort to date


Source: NSW DPE

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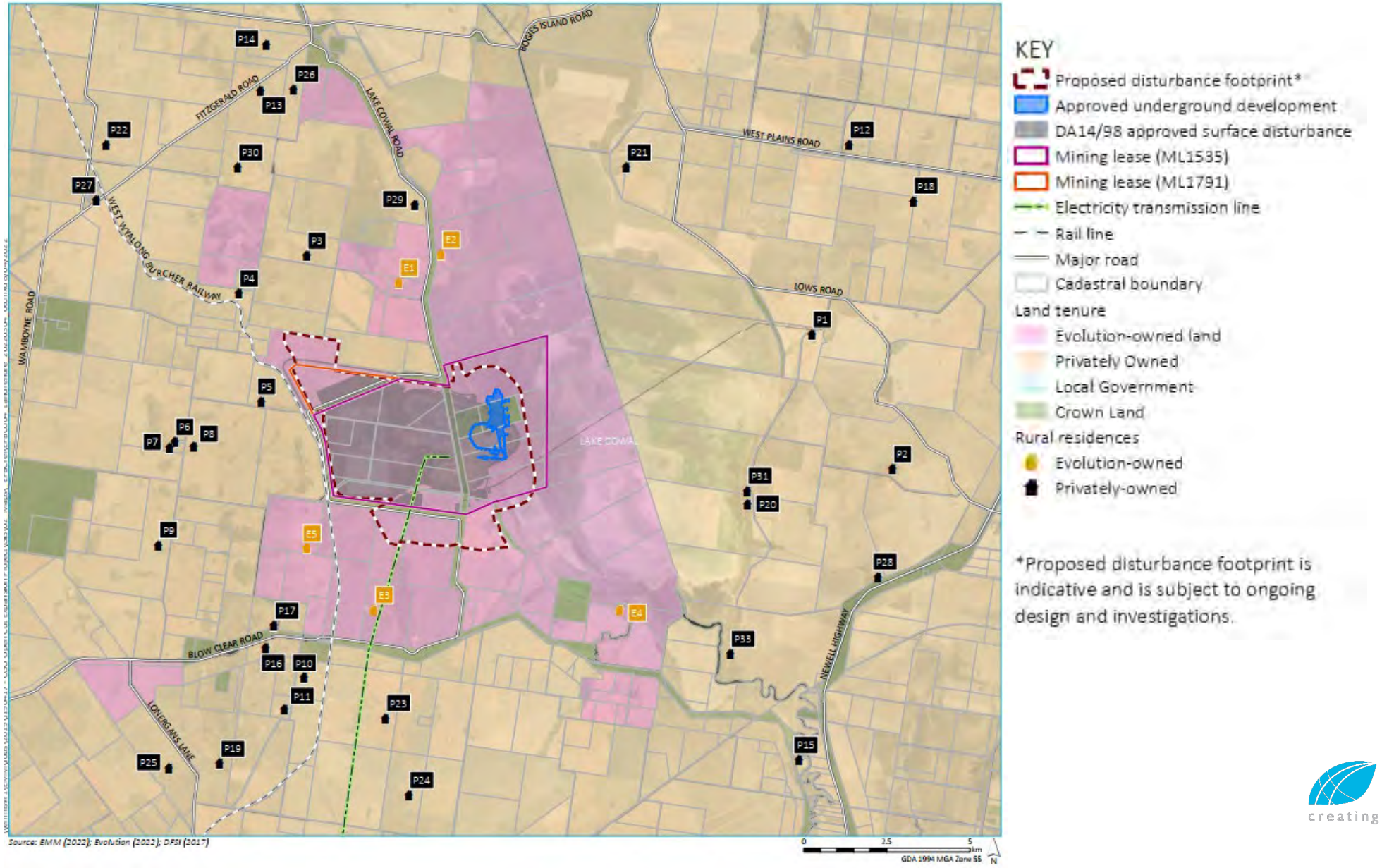
Environmental offsets

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Environmental offsets

- Evolution is currently investigating offset options
- Evolution has a number of landholdings in the locality, including the western portion of Lake Cowal
- It is currently anticipated that Stewardship sites under the NSW *Biodiversity Conservation Act 2016* could be established on Evolution-owned land
- Stewardship sites would provide high security ecological outcomes, with all assessments and management actions subject to review and approval
- EMM has already broadly mapped and identifying the vegetation across Evolution's landholdings, and will be looking at suitability of lands for Stewardship sites to meet the anticipated OPC credit obligations
- Evolution will also consider staging of the development, and associated staging of ecological offsets
- Evolution will be seeking to have credits for the initial stage ready for intended project commencement

Evolution owned land



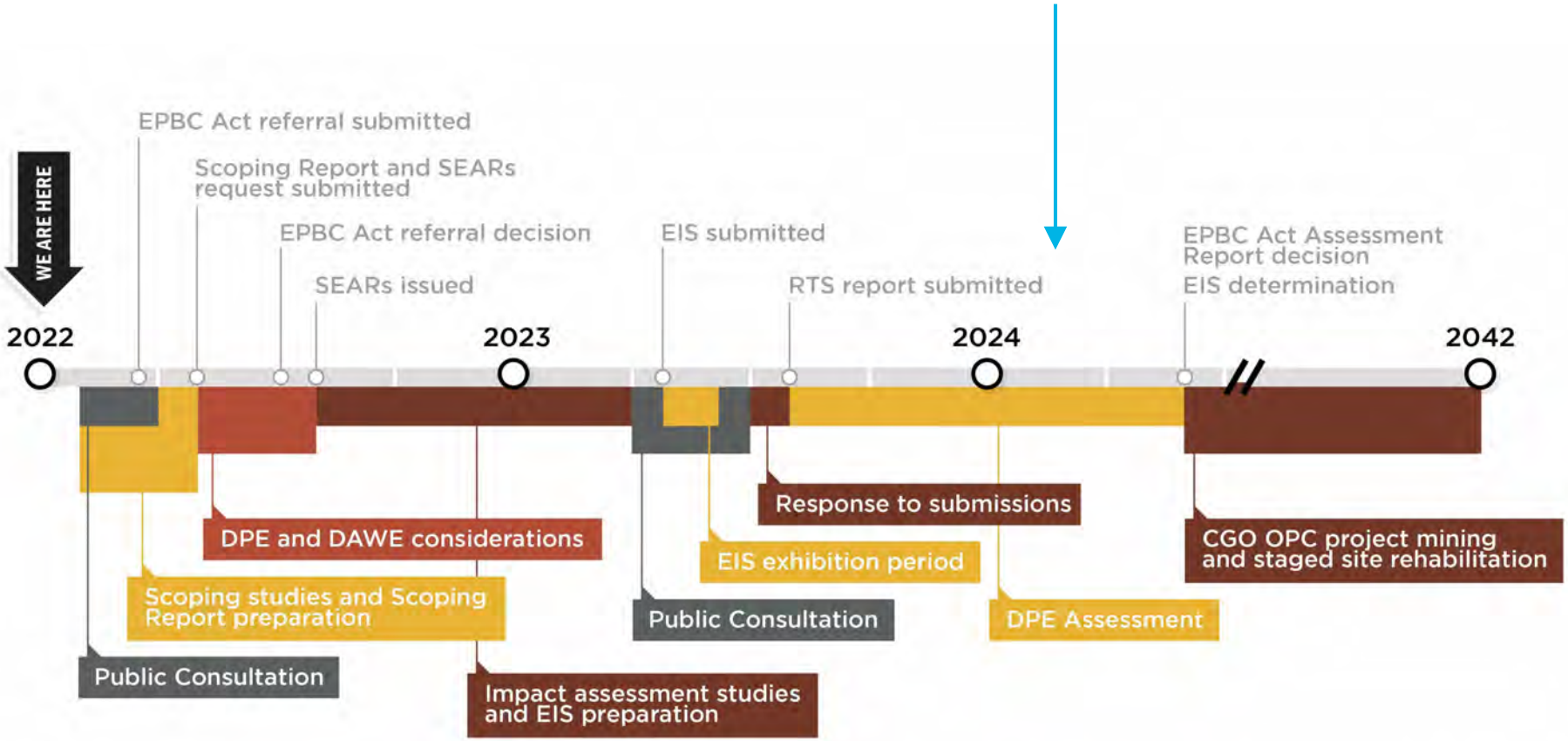
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Timeframes

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Timeframes

Project scheduled to commence June 2024



DAWE	Commonwealth Department of Agriculture, Water and the Environment
DPE	NSW Department of Planning and Environment
EIS	Environmental Impact Statement
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
RTS	Response to Submissions
SEARs	Secretary's Environmental Assessment Requirements

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Assessment challenges for discussion

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Assessment challenges

- Two construction scenarios for the Lake Protection Bund (LPB; ie dry vs inundated)
  - Anticipated that the BDAR will identify, assess and provide mitigation measures for the two options
- Offset site(s) within Lake Cowal (gathering plot data due to inundation). Anticipated this will need to proceed early to allow delivery of credits in time for project commencement. Options include:
  - 1. BAM plot data from OPC project used (ie. surrogate plot data)
  - 2. Could allow for credit generation based on surrogate data, with actual plot data to be gathered once water recedes, and credit generation outcomes to be confirmed
- Previous offset sites
  - Suggest that new Stewardship site areas within Lake Cowal are established based on condition of vegetation within impact area
  - Stewardship sites may include RVEP (to convert these to in perpetuity management)
- SAII assessment - EMM will request relevant background data from BCD
- Current inundation of Lake Cowal results in OPC survey limitations (discussed on next slide)

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Assessment challenges

Entity	Common name	BC Act	EPBC Act	SAII	Extent of inundation	Proposed approach (in order of preference)
PCT 17	Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	-	-	N	Entire patch of PCT 17	• **Option 1:** Survey another patch (if available) and use as representative in BAM-C. • **Option 2:** Survey zone post-approval. Survey requirement part of conditions. • **Option 3:** Assume benchmark condition. However, patch highly disturbed by agriculture.

Entity	Common name	BC Act	EPBC Act	SAII	Extent of inundation	Proposed approach (in order of preference)
Austrostipa wakoolica	A spear-grass	E	E	N	PCT 17	• **Option 1:** Survey for species post-approval. Survey requirement part of conditions. • **Option 2:** Put forward case for species not being present (similar to previous Biodiversity Certification). • **Option 3:** Assume presence where no survey coverage. But challenge for Austral Pillwort (SAII). • **Option 4:** Seek expert report. However, ability to assess habitat obscured by inundation. Also, no Species expert found for Austral Pillwort (SAII).
Eleocharis obicis	Spike-Rush	V	V	N	PCT 17 and 53	
Lepidium aschersonii	Spiny Peppercress	V	V	N	PCT 53	
Pilularia novae-hollandiae	Austral Pillwort	E	-	**Y**	PCT 53	
Amphibromus fluitans	Floating Swamp Wallaby-grass	V	V	N	PCT 17	

Questions and next steps

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Perth WA 6000



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emmconsulting.com.au

Appendix B

BCD response: 4 October 2022

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Department of Planning and Environment

Janet Crick
Associate Environmental Planner
EMM

Our ref: DOC22/717039
Sender's ref: J190417

Via email: jcrick@emmconsulting.com.au

4 October 2022

Dear Janet

Subject: **Cowal Gold Operations Open Pit Continuation Project – BCD Meeting Notes and Next Steps**

Thank you for your email dated 16 September 2022 seeking feedback from the Biodiversity and Conservation Division (BCD) of the Department of Planning and Environment.

We have reviewed supplied information that includes the minutes of our meeting on 31 August 2022 and EMM's proposed approach to the Biodiversity Development Assessment Report (BDAR). The following comments are provided for consideration.

Reference	Proposed approach	BCD Feedback
Page 2	NOTE (post meeting) – PCT 17 It is unclear how the benchmarks utilised should be approached as BAM plot data has been gathered over multiple years. EMM suggest the "wet" rainfall average year should be applied to all PCTs.	Agree. Is the proposal to review and apply 'wet' benchmarks to all other PCTs on the proposal site? Do the other PCTs have 'wet' benchmarks?
Table 1	Assessment of PCT 17 Options 1 to 3 for assessing inundated land	Option 1 is supported if an appropriate local site can be found, BCD expect it to be on land owned by Evolution and under the same management, including grazing regime. Option 2 is supported. This approach is most likely to meet requirements of the BAM. This approach would be applied for any other site that is not able to be accessed before the EIS is submitted. Revision of PCTs present, boundaries and vegetation zones may be needed as water recedes.

Reference	Proposed approach	BCD Feedback
Table 1, page 4 &5	Assessment of PCT 17 - Option 4 1. Justification 2. Adopt PCT 53 BAM data for PCT 17 3. Estimate the Lignum cover using aerial photography from 2019, which should represent a high condition state.	BCD do not agree with Option 4 The outcome of applying PCT 53 benchmarks to areas able to be delineated as PCT 17 on aerial photos is unclear. Are there two vegetation zones entered into BAM-C as PCT 53, which then influences the candidate species list, effectively removing species predicted by PCT 17? 1. PCTs 17 and 53 are in different vegetation classes, and the benchmarks are very different. For example: - PCT 53 is described as a low to mid-high sedgeland/grassland with a 'wet' benchmark for Grass/grass like plant cover of 102, and shrub cover of 0. - PCT17 is open-shrubland usually to 2m high and has a 'wet' benchmark grass and grass-like of 10. Has the presence of other PCTs been considered in the inundated area? - PCT 24 'Canegrass swamp tall grassland wetland of drainage depressions, lakes and pans of the inland plains' - PCT 360 'Gilgai wetland mosaic in the southern NSW South Western Slopes Bioregion' 2. Table 1.1 has average scores but PCT 53 BAM plot data has not been supplied. Without that it is difficult to assess if the result is ecologically meaningful. 3. 2018 and 2019 were very dry years (annual rainfall at West Wyalong of 239 and 250mm), so assumptions about a high condition state may not be correct. Delineation of lignum from photography should represent the boundary of PCT 17. It is not clear if or why this area would not be a separate vegetation zone in BAM-C. Revision of PCTs present, boundaries and vegetation zones may be needed as water recedes.

Reference	Proposed approach	BCD Feedback
Table 1, page 6	Targeted threatened flora Options 1 to 4	BCD support assuming presence for species not able to be surveyed, with an appropriate, agreed mechanism for modifying the credit liability based on survey after project approval and before construction. EMM and Evolution must provide evidence in the BDAR that NSW Planning agree to enable this approach through conditions of consent. Option 2 may apply to some species, depending on adequate justification and evidence that micro-habitats are absent. Option 3, re SAII – note that the BDAR provides the data with a description of limitations and assumptions. The recommendation about whether the impact has a serious and irreversible impact is made by the decision maker.
Table 1, page 7 & 8	Case for lack of suitable microhabitat for Austral Pillwort (*Pilularia novae-hollandiae*) in Lake Cowal Proposed approach: 1. Focus survey effort on gilgai depressions outside Lake Cowal, where this species has previously been found 2. Seek agreement with BCD to rule out PCT 53 within Lake Cowal based on lack of suitable microhabitat	Successful survey for Austral Pillwort requires very specific timing. Under 'Justification', the description of yellowing plants found in drier depressions may simply indicate that the plant has reached the end of its life cycle following inundation, rather than being in poor health due to lack of habitat. 1. Is there a record of the conversation with Colin Bower? More specific information about the location of the original Austral Pillwort record is needed, given it was recorded as "common in gilgai depressions. Occurred in 38 out of 65 depressions examined. At the time of sampling the ponds were drying out and most had little free water". Also "Gilgai soils - predominantly grey cracking clays. Dominant tree species are Eucalyptus populnea and Casuarina cristata. Occurs mainly around edges of the gilgai depressions in open areas among short sedges and rushes" 2. Evidence has not yet been provided to demonstrate whether suitable habitat is present on Lake Cowal when the water is receding.
Table 1, page 9 & 10	Case for lack of suitable microhabitat for *Lepidium aschersonii* (Spiny Peppercress) in Lake Cowal Case for lack of suitable microhabitat for *Austrostipa wakoolica* (A spear-grass) in Lake Cowal	Evidence has not yet been provided to demonstrate whether suitable habitat is present on Lake Cowal when the water is receding. Note that AMBS surveys were limited in scope and not likely to conform to BAM requirements.

Reference	Proposed approach	BCD Feedback
Table 1, page 12	Case for lack of suitable microhabitat for *Amphibromus fluitans* (Floating Swamp Wallaby-Grass) in Lake Cowal	Transitional vegetation between PCT 17 and PCT 53 may be PCT 24. Evidence has not yet been provided to demonstrate whether suitable habitat is present on Lake Cowal when the water is receding.

If you have any questions about this advice, please contact Michael Todd, Senior Conservation Planning Officer, via rog.southwest@environment.nsw.gov.au or 03 5021 8915.

Yours sincerely



Andrew Fisher
Senior Team Leader Planning
South West Branch
Biodiversity and Conservation Division
Department of Planning and Environment

Appendix C
BAM Plot data for PCT 53

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BAM Site – Field Survey Form

Plot ID:	34	**Date:**	20/05/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	537,461	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,280,108	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	157
Plant Community Type:	53: Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains			**Condition class:**	Medium	**PCT confidence:**	medium
Vegetation Class:	Inland Floodplain Swamps			**EEC:**	no	**EEC confidence:**	medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	1
	Grasses etc.:	2
	Forbs:	4
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	4
	Shrubs:	0.1
	Grasses etc.:	75
	Forbs:	1.7
	Ferns:	0
	Other:	0
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	20	15	20	10	35
Average litter cover (%):	20				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Ephemeral lake bed

Plot Disturbance

Grazed

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	34	**Date:**	20/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Eragrostis australasica (Canegrass)*	10	200	no	N
Grass & grasslike (GG)	*Sporobolus mitchellii (Rat's Tail Couch)*	65	600	no	N
	Trifolium spp. (A Clover)	85	10000		E
Tree (TG)	*Eucalyptus camaldulensis (River Red Gum)*	4	35		N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	0.2	10	no	N
Forb (FG)	*Vittadinia spp. (Fuzzweed)*	0.1	5	no	N
Forb (FG)	*Glycyrrhiza acanthocarpa (Native Liquorice)*	0.4	12	no	N
	Chenopodium album (Fat Hen)	8	800	no	E
Forb (FG)	*Sida corrugata (Corrugated Sida)*	1	80	no	N
Shrub (SG)	*Duma florulenta (Lignum)*	0.1	8	no	N
	Solanum nigrum (Black-berry Nightshade)	0.1	5	no	E
	Malva parviflora (Small-flowered Mallow)	8	50	no	E
	Sonchus oleraceus (Common Sowthistle)	0.1	1	no	E
	Cirsium vulgare (Spear Thistle)	0.1	1	no	E

BAM Site – Field Survey Form

Plot ID:	35	**Date:**	21/05/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	538,196	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,278,753	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	115
Plant Community Type:	53: Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains			**Condition class:**	Medium	**PCT confidence:**	medium
Vegetation Class:	Inland Floodplain Swamps			**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	1
	Grasses etc.:	5
	Forbs:	4
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	0.1
	Grasses etc.:	66.3
	Forbs:	2.3
	Ferns:	0
	Other:	0.1
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	**Tree stem count**	**Length of logs (m) (≥10 cm diameter, >50 cm in length)**	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	**Tree hollow count**	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	**1**	**2**	**3**	**4**	**5**
Subplot score (%):	30	30	20	25	15
Average litter cover (%):	24				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Ephemeral lake bed

Plot Disturbance

Grazed

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	35	**Date:**	21/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
	Medicago polymorpha (Burr Medic)	90	50000	no	E
Grass & grasslike (GG)	*Sporobolus mitchellii (Rat's Tail Couch)*	60	5000	no	N
Grass & grasslike (GG)	*Eragrostis australasica (Canegrass)*	6	100	no	N
Forb (FG)	*Polygonum plebeium (Small Knotweed)*	0.1	10	no	N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	1	30	no	N
Forb (FG)	*Glycyrrhiza acanthocarpa (Native Liquorice)*	0.2	15	no	N
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	1	75	no	N
Shrub (SG)	*Abutilon spp. (Lantern-bush)*	0.1	5	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.1	5	no	N
	Sonchus oleraceus (Common Sowthistle)	0.1	6	no	E
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	0.1	9	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	0.1	20	no	N
Grass & grasslike (GG)	*Walwhalleya proluta*	0.1	3	no	N

BAM Site – Field Survey Form

Plot ID:	36	**Date:**	23/03/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	538,162	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,279,795	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	346
Plant Community Type:	53: Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains			**Condition class:**	Medium	**PCT confidence:**	medium
Vegetation Class:	Inland Floodplain Swamps			**EEC:**	yes	**EEC confidence:**	medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	0
	Grasses etc.:	2
	Forbs:	5
	Ferns:	1
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	0
	Grasses etc.:	81
	Forbs:	6.9
	Ferns:	0.1
	Other:	0
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	90	95	95	90	95
Average litter cover (%):	93				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Alluvial plain / floodplain / ephemeral inland lake

Plot Disturbance

Grazed / possible cropping.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	36	**Date:**	23/03/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Forb (FG)	*Glycyrrhiza acanthocarpa (Native Liquorice)*	0.7	20	no	N
Grass & grasslike (GG)	*Sporobolus mitchellii (Rat's Tail Couch)*	80	4000	no	N
	Medicago polymorpha (Burr Medic)	10	600	no	E
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	5	400	no	N
Grass & grasslike (GG)	*Eragrostis australasica (Canegrass)*	1	10	no	N
	Solanum nigrum (Black-berry Nightshade)	0.1	2	no	E
	Onopordum acanthium subsp. acanthium (Scotch Thistle)	0.1	3	no	E
	Poaceae indeterminate (Grasses, reeds and bamboos)	0.1	10	no	E
Forb (FG)	*Sida corrugata (Corrugated Sida)*	1	100	no	N
	Abutilon grandifolium	0.1	1	no	E
Fern (EG)	*Marsilea costulifera*	0.1	1	no	N
Forb (FG)	*Alternanthera denticulata (Lesser Joyweed)*	0.1	1	no	N
Forb (FG)	*Rumex tenax (Shiny Dock)*	0.1	1	no	N

BAM Site – Field Survey Form

Plot ID:	37	**Date:**	23/05/20	**Project number:**	J190417	**Plot dimensions:**	20x20
Datum:	GDA94	**Easting:**	538,528	**Recorders:**	RP GS		
Zone:	55	**Northing:**	6,275,248	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	17
Plant Community Type:		53: Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains		**Condition class:**	Medium	**PCT confidence:**	medium
Vegetation Class:		Inland Floodplain Swamps		**EEC:**	no	**EEC confidence:**	medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	0
	Grasses etc.:	4
	Forbs:	2
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	0
	Grasses etc.:	75.6
	Forbs:	1.5
	Ferns:	0
	Other:	0
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	35	25	30	30	20
Average litter cover (%):	28				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Within lake cowal (currently dry)

Plot Disturbance

No evidence except very weedy. Previously grazed and maybe cropped. All trees near plot are dead or nearly so.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	RP GS	**Plot ID:**	37	**Date:**	23/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Sporobolus mitchellii (Rat's Tail Couch)*	75	4000	no	N
	Medicago polymorpha (Burr Medic)	80	6000	no	E
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.5	50	no	N
Forb (FG)	*Glycyrrhiza acanthocarpa (Native Liquorice)*	1	14	no	N
	Sonchus oleraceus (Common Sowthistle)	0.2	2	no	E
Grass & grasslike (GG)	*Eragrostis australasica (Canegrass)*	0.4	10	no	N
Grass & grasslike (GG)	*Eragrostis parviflora (Weeping Lovegrass)*	0.1	4	no	N
Grass & grasslike (GG)	*Panicum effusum (Hairy Panic)*	0.1	1	no	N

BAM Site – Field Survey Form

Plot ID:	38	**Date:**	22/05/20	**Project number:**	J190417	**Plot dimensions:**	20x50
Datum:	GDA94	**Easting:**	538,694	**Recorders:**	RP GS		
Zone:	55	**Northing:**	6,276,561	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	35
Plant Community Type:	53: Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains			**Condition class:**	Medium	**PCT confidence:**	medium
Vegetation Class:	Inland Floodplain Swamps			**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	0
	Grasses etc.:	1
	Forbs:	3
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	0
	Grasses etc.:	99
	Forbs:	2.2
	Ferns:	0
	Other:	0
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	60	60	60	60	60
Average litter cover (%):	60				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Lake bed. Ephemeral.

Plot Disturbance

No evidence. Grazed by kangaroos and emus.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	RP GS	**Plot ID:**	38	**Date:**	22/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Sporobolus mitchellii (Rat's Tail Couch)*	99	16000	no	N
Forb (FG)	*Glycyrrhiza acanthocarpa (Native Liquorice)*	2	60	no	N
	Medicago polymorpha (Burr Medic)	0.1	200	no	E
	Abutilon grandifolium	0.1	25	no	E
	Cirsium vulgare (Spear Thistle)	0.1	2	no	E
	Sonchus oleraceus (Common Sowthistle)	0.1	5	no	E
Forb (FG)	*Polygonum plebeium (Small Knotweed)*	0.1	30	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.1	1	no	N

BAM Site – Field Survey Form

Plot ID:	39	**Date:**	22/05/20	**Project number:**	J190417	**Plot dimensions:**	20 X 50
Datum:	GDA94	**Easting:**	538,121	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,276,742	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	92
Plant Community Type:	53: Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains			**Condition class:**	Medium	**PCT confidence:**	medium
Vegetation Class:	Inland Floodplain Swamps			**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	0
	Grasses etc.:	5
	Forbs:	7
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	0
	Grasses etc.:	105.2
	Forbs:	7.3
	Ferns:	0
	Other:	0
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	70	70	70	70	70
Average litter cover (%):	70				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Ephemeral lake bed

Plot Disturbance

No evidence

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	39	**Date:**	22/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
	Sanguisorba spp.	0.2	20	no	E
Grass & grasslike (GG)	*Walwhalleya proluta*	45	4000	no	N
Grass & grasslike (GG)	*Eragrostis australasica (Canegrass)*	55	4000	no	N
Forb (FG)	*Glycyrrhiza acanthocarpa (Native Liquorice)*	5	10	no	N
	Medicago polymorpha (Burr Medic)	10	1600	no	E
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	1	200	no	N
	Malva parviflora (Small-flowered Mallow)	1	50	no	E
	Lactuca serriola (Prickly Lettuce)	0.1	20	no	E
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.2	30	no	N
	Sonchus oleraceus (Common Sowthistle)	0.2	17	no	E
	Abutilon grandifolium	0.6	7	no	E
Forb (FG)	*Alternanthera denticulata (Lesser Joyweed)*	0.1	15	no	N
Grass & grasslike (GG)	*Sporobolus mitchellii (Rat's Tail Couch)*	5	200	no	N
	Solanum nigrum (Black-berry Nightshade)	0.2	5	no	E
Forb (FG)	*Polygonum plebeium (Small Knotweed)*	0.8	10	no	N
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	0.1	50	no	N
	Cirsium vulgare (Spear Thistle)	0.5	5	no	E
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.1	4	no	N
Grass & grasslike (GG)	*Dichanthium spp.*	0.1	2		N
Forb (FG)	*Solanum esuriale (Quena)*	0.1	5		N

BAM Site – Field Survey Form

Plot ID:	40	**Date:**	22/05/20	**Project number:**	J190417	**Plot dimensions:**	20 x 50
Datum:	GDA94	**Easting:**	538,925	**Recorders:**	GS RP		
Zone:	55	**Northing:**	6,277,623	**IBRA region:**	NSW South Western Slopes	**Midline bearing:**	148
Plant Community Type:	53: Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains			**Condition class:**	Medium	**PCT confidence:**	medium
Vegetation Class:	Inland Floodplain Swamps			**EEC:**	no	**EEC confidence:**	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	1
	Grasses etc.:	2
	Forbs:	6
	Ferns:	0
	Other:	2
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	0.1
	Grasses etc.:	65.4
	Forbs:	11.4
	Ferns:	0
	Other:	0.5
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	**Tree stem count**	**Length of logs (m) (≥10 cm diameter, >50 cm in length)**	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	**Tree hollow count**	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	**1**	**2**	**3**	**4**	**5**
Subplot score (%):	10	45	60	35	35
Average litter cover (%):	37				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Ephemeral lake bed

Plot Disturbance

Weedy

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190417				
Recorders:	GS RP	**Plot ID:**	40	**Date:**	22/05/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Other (OG)	*Glycine spp.*	0.1	15	no	N
Grass & grasslike (GG)	*Eragrostis australasica (Canegrass)*	65	4000	no	N
Other (OG)	*Convolvulus erubescens (Pink Bindweed)*	0.4	350	no	N
	Abutilon grandifolium	10	450	no	E
Forb (FG)	*Glycyrrhiza acanthocarpa (Native Liquorice)*	10	1600	no	N
Forb (FG)	*Erodium crinitum (Blue Crowfoot)*	0.8	200	no	N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.2	50	no	N
	Sonchus oleraceus (Common Sowthistle)	0.4	7	no	E
	Cirsium vulgare (Spear Thistle)	0.4	3	no	E
	Medicago polymorpha (Burr Medic)	1.2	400	no	E
Forb (FG)	*Dysphania pumilio (Small Crumbweed)*	0.2	60	no	N
Grass & grasslike (GG)	*Sporobolus mitchellii (Rat's Tail Couch)*	0.4	145	no	N
	Lactuca serriola (Prickly Lettuce)	0.1	2	no	E
	Conyza bonariensis (Flaxleaf Fleabane)	0.1	7	no	E
Shrub (SG)	*Salsola australis*	0.1	3	no	N
Forb (FG)	*Rumex brownii (Swamp Dock)*	0.1	2	no	N
Forb (FG)	*Senecio gunnii*	0.1	1	no	N

Appendix D

Email correspondence with Dr Colin Bower re: Discussion points for clarification: Austral Pillwort at Lake Cowal

EMM
creating opportunities

Hayden Beck

From: colinbower1948@bigpond.com
Sent: Sunday, 23 October 2022 9:31 AM
To: Hayden Beck
Subject: RE: Discussion points for clarification: Austral Pillwort at Lake Cowal

CAUTION: This email originated outside of the Organisation.

Hi Hayden,

Yes, your understanding of our conversation is correct. I would add that I looked for it along the edge of Lake Cowal at the same time and did not see any sign at all, the habitat being quite different from that in a gilgai. I would also add that I think gilgais represent a unique microhabitat / ecosystem for aquatic plants that is highly threatened.

Kind regards,

Col

Colin C Bower PhD

Address: 37 Kent Avenue, Orange, NSW 2800
Email: colinbower1948@bigpond.com
Landline: 02 6363 1513
Mobile: 0428 263 274

From: Hayden Beck <hbeck@emmconsulting.com.au>
Sent: Monday, 17 October 2022 9:49 AM
To: colinbower1948@bigpond.com
Cc: Steven Ward <sward@emmconsulting.com.au>
Subject: Discussion points for clarification: Austral Pillwort at Lake Cowal

Good morning Colin,

As mentioned last week, BCD have requested a record of our conversation on 5 September 2022 about your observations of Austral Pillwort at Lake Cowal.

My understanding was that in your past studies:

- Austral Pillwort were primarily found in Gilgais on the ridge above the shoreline of Lake Cowal;
- Austral Pillwort were never found in Lake Cowal or along the shoreline of Lake Cowal;
- Austral Pillwort favour gilgai depressions lacking invasive grasses and overgrowth of invasive grasses, which likely explains the reduced population of Austral Pillwort at Lake Cowal (ie lack of recent detections); and
- The species is likely to be much more common than currently understood, as it is small/inconspicuous, highly seasonal and easily overlooked.

More broadly, we discussed the likelihood of Austral Pillwort occurring in Lake Cowal itself, given the lake is currently inundated and so survey is not currently possible. It was my understanding that you thought that given your understanding of Austral Pillwort habitat, you considered it highly unlikely to occur in Lake Cowal itself or along the Lake Cowal shoreline.

Can you please confirm that you agree with the above? If not, please correct me where needed.

Thanks again for your assistance on this matter Colin.

Warm regards,

Hayden

Hayden Beck
Senior Ecologist
Bushfire, Ecology, Heritage and Spatial Solutions Division

T 02 4907 4872

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Appendix E

Bower (1998) Survey of the Cowal Gold Project Area and surrounds for the Austral Pillwort (*Pilularia novae-hollandiae*)

EMM
creating opportunities

SURVEY OF THE COWAL GOLD PROJECT AREA AND SURROUNDS FOR THE AUSTRAL PILLWORT (*PILULARIA NOVAE-HOLLANDIAE*)

C.C.BOWER
ORCHID RESEARCH
PO BOX 300 ORANGE NSW 2800

Introduction

This survey was conducted at the request of Resource Strategies on behalf of North Limited. It aimed to determine the distribution and abundance of the Austral Pillwort (*Pilularia novae-hollandiae*) in the Lake Cowal region of Central Western NSW, including areas likely to be disturbed by the proposed gold mining project.

Pilularia novae-hollandiae is a small aquatic fern which occurs in small temporary pools, bogs and swamp margins. It is listed as an endangered species in Schedule 1, Part 1 of the NSW Threatened Species Conservation Act 1995. According to Clements and Rodd (1995) *P. novae-hollandiae* is known from very few collections from NSW in the National Herbarium, Sydney. They recorded *P. novae-hollandiae* at two locations in a survey conducted in the Lake Cowal district in 1994. These recordings were the first for the Central West Slopes of NSW. Elsewhere in NSW *P. novae-hollandiae* has been recorded on the Central Coast, Southern Tablelands and South Western Slopes (Harden, 1990). Outside NSW, *P. novae-hollandiae* occurs in Victoria, Tasmania and South Australia. It is not listed in the Rare or Threatened Australian Plants database (Briggs and Leigh, 1996) and is therefore not considered to be endangered nationally.

Clements and Rodd (1995) found *P. novae-hollandiae* in the Lake Cowal area in gilgai with free water or recently receded water. One location (Transect 11) was within the Cowal Gold Project area in the vicinity of the proposed access road near the proposed southern waste emplacement. The other (Transect 75) was 13 km to the south east of Transect 11 near Bland Creek.

Pilularia novae-hollandiae

P. novae-hollandiae is a small grass-like perennial fern (family Marsileaceae) that grows in mud when seasonally dry depressions fill with water (Jones and Clemesha, 1981; Harden, 1990). The growth cycle is completed before the depression dries out in summer. *P. novae-hollandiae* consists of a slender creeping rhizome just below the surface from which arise the filiform bright green fronds in groups of two or three at intervals of about 1 cm. The fronds are up to 8 cm long and may form mats in favourable sites. The sporocarps are spherical, buried in the substrate and borne singly at the end of short stalks, or are sessile at the base of the fronds. The fronds may be

distinguished from other vegetatively similar plants by their twisted or flexuose bending (pers. obs.).

Gilgai

A gilgai landscape consists of exaggerated unevenness in the soil surface with irregularly spaced low mounds and shallow depressions (Taylor, 1960). Gilgai forms in high clay content soils subject to periods of extreme wetness and drought. The precise mechanism of formation of gilgai is unknown but may relate to swelling within the B horizon when it is wetted (Clements and Rodd, 1995). This may result in upward pressure and mound formation. There may also be effects related to rapid infiltration of water through cracks after drought causing expansion of the B horizon before the A horizon is fully wetted (Taylor, 1960; Beadle, 1981). Another model proposes that depressions are caused by less easily wet, and hence less plastic, blocks of soil sinking relative to less dense, more easily wet surrounding soil (Beadle, 1981).

Some gilgai depressions are relatively impermeable with a thick sticky grey mud base and form shallow ponds after heavy rain. A variety of perennial and ephemeral aquatic plants complete their life cycles before the ponds dry out. These include sedges (family Cyperaceae), rushes (family Juncaceae), aquatic ferns (family Marsileaceae), joyweed (*Alternanthera* sp. A), waterwort (*Elatine gratioloides*), grey raspwort (*Haloragis glauca*), water-milfoil (*Myriophyllum crispatum),* poison pratia (*Pratia concolor*), mudmats (*Glossostigma diandrum*), lignum (*Muehlenbeckia florulenta*), docks (*Rumex* spp.), large mudwort (*Limosella curdieana*), starfruit (*Damasonium minus*), and some grasses (family Poaceae) (after Clements and Rodd, 1995).

Aims

The aims of the survey and report were to:

- determine the distribution and abundance of the Austral Pillwort (*Pilularia novae-hollandiae*) on areas proposed to be disturbed by the Cowal Gold Project.

- determine the distribution and abundance of *P. novae-hollandiae* in the surrounding district if it is found on the Project area,

- recommend options to ensure the ongoing viability of populations of *P. novae-hollandiae* in the Lake Cowal area.

Methods

Areas sampled and data recorded

The survey focussed on gilgai depressions which occur on red, brown and grey cracking clay soils. The distribution of these soils in the Project area is shown in the attached Figure B-1 from Appendix B (Barker and Wild, 1994) of the Cowal Gold Project Environmental Impact Statement (Resource Strategies, 1998). This figure shows the potential distribution of gilgai and hence the potential distribution of *Pilularia novae-hollandiae* in the Project area. There is also some potential for *P. novae-hollandiae* to occur along the shore of Lake Cowal, so the shoreline in the Project area was also examined.

Gilgai areas outside the Project area were selected using the Department of Defence 1:250 000 Joint Operations Graphic (Forbes - Series 1501, Sheet SI 55-7, Edition 1), which shows major occurrences of gilgai near Lake Cowal. The vegetation map of Clements and Rodd (1995) was also useful for areas close to Lake Cowal. Gilgai were surveyed immediately to the north and south of the Project area and to the north west towards Condobolin.

Individual gilgai in the Project area were surveyed on 2 and 21 November 1998. Surrounding areas were surveyed on 15, 21 and 22 November 1998.

The entire depressed area of each gilgai was visually inspected except where there was free water. Groups of plants suspected of being *P. novae-hollandiae* were sampled by digging 3 or 4 cm^2 of the substrate containing them. The soil or mud was washed from the roots to reveal the sporocarps which were used to confirm the identity of *P. novae-hollandiae*. Voucher specimens of *P. novae-hollandiae* were submitted to the National Herbarium, Sydney for verification of their identity by the specialist on ferns, Dr. Peter Wilson. Attached is an e-mail from Dr. Wilson confirming the identity of the samples submitted.

Data recorded for each depression included a rating for the abundance of *P. novae-hollandiae*, a rating for the size of the depression, and a classification of the moisture level (Table 1). Abundance of *P. novae-hollandiae* in each depression was classified as absent, rare (< 10 plants), moderate (10 - 100 plants), common (101 - 1000 plants), or abundant (> 1000 plants), where a plant is defined as the node on the rhizome with its associated 2 or 3 fronds and sporocarp.

Depression size was classed as small (< 3m diameter), medium (3-5m diameter) or large (> 5m diameter). Not all depressions are circular, many tend to be oval, elongate or crescent shaped. Some have complex shapes with branches and multiple deeper spots. These could be interpreted as several separate but close depressions which have joined. The size of odd shaped depressions was estimated against those of more regular shape.

Moisture level was ascribed to one of three categories; dry (no free water, soil hard), wet (no free water, soft moist soil present) or free water (free water still

present in some part of the depression). The survey was conducted after a very wet winter in which there had been sufficient rainfall to fill Lake Cowal from empty. The gilgai depressions would have filled with water during winter and were drying out when the survey was conducted.

The majority of depressions surveyed on the Project area (nos. 1 to 50 and 65, Table 1) were in the south western part of the proposed open pit, between the existing mining exploration camp buildings and the fence of the game reserve. Thirty gilgai depressions were in the easternmost part of the MLA immediately to the west of the travelling stock route and south of the proposed southern waste emplacement (nos. 66 to 95). A further 5 depressions (nos. 51 to 55) were surveyed in the northern part of the area of the proposed processing plant. These were in the north west corner of the paddock containing the exploration camp. Eight depressions were surveyed to the south west of Cowal West Hill. This area is designated to become a water storage for the Project. One further depression (no. 64) was surveyed in the north western corner of the Mining Lease Application area near the entrance gate marked ‘Thornton’. The lake margin was examined between the game reserve fence and the exploration camp.

Gilgai depressions at nine discrete areas were randomly sampled outside but close to the Project area. Details of these sites are as follows:

1. Travelling stock reserve between 0.2 and 6.6 km north of the Project area, i.e. from the edge of the Project area to the entrance gate of ‘The Glen’ property. Thirty two depressions surveyed.
2. Just inside the gate of a paddock east of travelling stock reserve and 0.9 km north of the northern boundary of the MLA. Ten depressions surveyed.
3. In the same paddock as 2 above, but on the gravelly crest adjacent to the lake and just south of a set of stockyards. Ten depressions.
4. Paddock east of travelling stock reserve and through gate 1.9 km north of northern boundary of the MLA. Ten depressions on rise at the northern end of the paddock.
5. Just inside gate of paddock east of travelling stock route and 3.7 km north of the northern boundary of the MLA. Opposite entrance gate to ‘Coniston’. Eleven depressions.
6. In the same paddock as 5 above, but 0.7 km east towards the lake. Ten depressions.
7. In paddock east of travelling stock route with entrance gate 6.6 km north of the northern boundary of the MLA and just north of the entrance to ‘The Glen’. Ten depressions surveyed 1.8 km into paddock towards the lake.
8. Large gilgai paddock on ‘Lake Cowal’ property, 5.3 km SSE of southern boundary of the MLA, just inside fence adjacent to property access road. Ten depressions.
9. Same paddock as 8 above, but 1.0 km towards the southern shore of the lake. Ten depressions.

A total of twenty five gilgai depressions and swamp margins were sampled in the area between Girral and Condobolin on the main road and side roads at seven separate localities.

Results

The results of the survey are shown in Tables 1 and 2. *Pilularia novae-hollandiae* was found to be widely distributed and relatively abundant in gilgai formations on the Project area (Table 1). It was detected in 52 depressions out of the 95 surveyed or 54.7 percent. It was common or abundant in 25 depressions or 26.3 percent. *P. novae-hollandiae* was present in all areas surveyed; the proposed pit, processing and water storage areas, west of the proposed northern tailings dam and south of the southern waste emplacement.

The results of the survey of gilgai depressions outside the Project area are shown in Table 2. In nine sites close to Lake Cowal *Pilularia novae-hollandiae* occurred in 44 depressions out of 113 surveyed, or 38.9 percent. It was common or abundant in 29 depressions (25.7 percent). Although widespread, the distribution of *P. novae-hollandiae* was patchy. It was absent from some areas (sites 1 and 5 close to Lake Cowal and in 6 out of 7 sites between Girral and Condobolin). The abundance of *P. novae-hollandiae* also varied considerably among sites where it occurred, with between 20 and 100 percent of depressions occupied (Table 2). There were four sites where greater than 50 percent of depressions contained *P. novae-hollandiae* (sites 3,7,8 and 9, Table 2). At these sites *P. novae-hollandiae* also tended to be common or abundant in many depressions.

P. novae-hollandiae was found in depressions of all sizes and moisture levels (Tables 1 and 2). In the drier depressions it tended to be yellowing off and in some cases had dried out completely. In moist depressions the fronds were still bright green. *P. novae-hollandiae* did not grow in the most heavily vegetated depressions; it seemed to prefer relatively open areas among sparse rushes or bare ground where there was high light penetration. It grew most commonly around the outer margins of depressions, but in some cases was found in the centre. *P. novae-hollandiae* occurred either as small widely scattered clusters of fronds, as a more or less continuous marginal band in the depression, or as dense mats up to 25 cm^2 or more in area. It grew most commonly in deep sticky grey mud and was absent from gilgai with friable or stony soils.

In the vicinity of Lake Cowal *P. novae-hollandiae* tended to be most common close to the lake. All sample sites on the ridge above the lake shore supported *P. novae-hollandiae* (pit area, Table 1; sites 3, 4, and 6, Table 2). These sites were on exposed rises and the vegetation was generally sparse with little encroachment of introduced grasses into the depressions. Further away from the lake there was a tendency for depressions to be surrounded and encroached by a dense growth of introduced grasses which appeared to exclude *P. novae-hollandiae*. This was particularly evident along the stock

Table 1 Distribution and abundance of the Austral Pillwort (*Pilularia novae-hollandiae*) in gilgai depressions in the proposed Cowal Gold Project area.

Abundance: 0 = none found, x = rare, xx = moderate numbers, xxx = common, xxxx = abundant (see methods for more explanation).
Size: s = small, m = medium, l = large (see methods for more explanation).
Moisture: d = dry, w = wet soil, f = free water, nr = not recorded (see methods for more explanation).

Depression no.	Location	Abundance	Size	Moisture level
1	Pit	0	m	nr
2	Pit	0	m	w
3	Pit	0	m	w
4	Pit	0	s	nr
5	Pit	0	m	nr
6	Pit	xx	l	f
7	Pit	0	s	nr
8	Pit	0	s	nr
9	Pit	0	s	nr
10	Pit	0	s	nr
11	Pit	0	s	nr
12	Pit	0	s	nr
13	Pit	0	l	nr
14	Pit	0	m	nr
15	Pit	xxxx	m	f
16	Pit	xxxx	l	w
17	Pit	xxxx	l	f
18	Pit	xxxx	m	f
19	Pit	0	s	d
20	Pit	x	s	d
21	Pit	xxx	s	d
22	Pit	xxxx	s	w
23	Pit	0	s	d
24	Pit	x	s	d
25	Pit	xxx	l	f
26	Pit	x	s	w
27	Pit	x	s	d
28	Pit	xx	s	d
29	Pit	x	s	d
30	Pit	xxxx	l	w
31	Pit	xxxx	l	f
32	Pit	xxxx	m	f
33	Pit	xxxx	m	f
34	Pit	0	s	d
35	Pit	xx	l	w
36	Pit	xx	l	f
37	Pit	x	s	d
38	Pit	0	s	d
Depression no.	Location	Abundance	Size	Moisture level
39	Pit	x	s	d
40	Pit	xxxx	s	d
41	Pit	xxx	s	d

42	Pit	xxxx	l	f
43	Pit	xx	s	d
44	Pit	xxxx	l	f
45	Pit	x	l	w
46	Pit	x	l	f
47	Pit	xxxx	l	f
48	Pit	x	l	w
48	Pit	0	m	f
50	Pit	0	m	f
51	Process plant	0	s	f
52	Process plant	0	s	w
53	Process plant	xxx	m	d
54	Process plant	0	m	f
55	Process plant	xxx	s	f
56	Water store	0	l	f
57	Water store	xx	m	w
58	Water store	0	s	d
59	Water store	0	m	d
60	Water store	x	s	d
61	Water store	0	m	d
62	Water store	0	m	d
63	Water store	xx	l	d
64	NW corner of MLA	x	m	w
65	Pit	xxx	s	d
66	East margin	xxxx	m	f
67	East margin	xx	l	w
68	East margin	0	s	d
69	East margin	xxxx	l	f
70	East margin	x	s	d
71	East margin	xxxx	l	w
72	East margin	0	l	f
73	East margin	0	m	d
74	East margin	0	m	w
75	East margin	0	l	f
76	East margin	0	s	w
77	East margin	0	s	d
78	East margin	0	s	d
79	East margin	0	l	d
80	East margin	0	m	w
81	East margin	0	m	d
82	East margin	0	s	d
83	East margin	xxxx	l	f
84	East margin	0	s	d

Depression no.	Location	Abundance	Size	Moisture level
85	East margin	0	s	d
86	East margin	xxx	m	f
87	East margin	x	s	w

88	East margin	xx	m	f
89	East margin	xxxx	l	f
90	East margin	x	s	w
91	East margin	xx	m	w
92	East margin	xx	m	f
93	East margin	0	m	d
94	East margin	0	m	f
95	East margin	xx	l	f
No. with *Pilularia*		52		
%. with *Pilularia*		54.7		

route north of the MLA where no *P. novae-hollandiae* was found despite intensive sampling (site 1, Table 2 - 32 depressions). This trend is reinforced by the results of paired samples in the same paddocks between the lake and the stock route north of the MLA. Samples close to the stock route (sites 2 and 5) had much lower frequencies of *P. novae-hollandiae* than samples adjacent to the lake (sites 3 and 6 respectively). However, *P. novae-hollandiae* was also found in abundance at some sites distant from the lake. These tended to be in paddocks dominated by native grasses with little encroachment of introduced grasses into the depressions (depressions 66-95, Table 1; sites 7, 8 and 9, Table 2).

No *P. novae-hollandiae* was found along the lake shore. The vegetation on the shoreline was found to comprise entirely introduced grasses and weeds, and was highly disturbed by cattle. The original native vegetation appeared to have been completely replaced.

Table 2 Distribution and abundance of the Austral Pillwort (*Pilularia novae-hollandiae*) in gilgai depressions outside but near the proposed Cowal Gold Project area.

Abundance: 0 = none found, x = rare, xx = moderate numbers, xxx = common, xxxx = abundant (see methods for more explanation).
Size: s = small, m = medium, l = large (see methods for more explanation).
Moisture: d = dry, w = wet soil, f = free water, nr = not recorded (see methods for more explanation).
See methods section for details of locations of sample sites

Sample site	Depression no.	Location	Abundance	Size	Moisture level
1	1	Stock Route	0	m	w
1	2	Stock Route	0	s	d
1	3	Stock Route	0	s	d
1	4	Stock Route	0	l	f
1	5	Stock Route	0	s	f
1	6	Stock Route	0	s	d
1	7	Stock Route	0	l	d
1	8	Stock Route	0	m	w
1	9	Stock Route	0	s	d
1	10	Stock Route	0	s	d
1	11	Stock Route	0	m	f
1	12	Stock Route	0	l	f
1	13	Stock Route	0	m	d
1	14	Stock Route	0	s	d
1	15	Stock Route	0	l	f
1	16	Stock Route	0	s	d
1	17	Stock Route	0	s	d
1	18	Stock Route	0	m	f
1	19	Stock Route	0	m	f
1	20	Stock Route	0	m	f
1	21	Stock Route	0	m	d
1	22	Stock Route	0	s	d
1	23	Stock Route	0	m	f
1	24	Stock Route	0	l	f
1	25	Stock Route	0	l	f
1	26	Stock Route	0	l	f
1	27	Stock Route	0	m	w
1	28	Stock Route	0	l	f
1	29	Stock Route	0	l	f
1	30	Stock Route	0	s	d
1	31	Stock Route	0	l	d
1	32	Stock Route	0	l	w
1	No. with *Pilularia*		0		
1	%. with *Pilularia*		0.0		

Sample	Depression	Location	Abundance	Size	Moisture

site	no.				level
2	33	0.9 km N MLA	0	l	d
2	34	0.9 km N MLA	0	m	d
2	35	0.9 km N MLA	xx	m	w
2	36	0.9 km N MLA	0	m	d
2	37	0.9 km N MLA	0	s	d
2	38	0.9 km N MLA	0	s	d
2	39	0.9 km N MLA	xxx	l	d
2	40	0.9 km N MLA	0	l	f
2	41	0.9 km N MLA	0	l	f
2	42	0.9 km N MLA	0	l	d
2	No. with *Pilularia*		2		
2	%. with *Pilularia*		20.0		
3	43	0.9 km N MLA	0	s	d
3	44	0.9 km N MLA	0	l	f
3	45	0.9 km N MLA	x	s	d
3	46	0.9 km N MLA	xxx	l	d
3	47	0.9 km N MLA	x	m	d
3	48	0.9 km N MLA	xxx	m	d
3	49	0.9 km N MLA	xxxx	m	d
3	50	0.9 km N MLA	xxxx	l	w
3	51	0.9 km N MLA	x	l	f
3	52	0.9 km N MLA	0	m	f
3	No. with *Pilularia*		7		
3	%. with *Pilularia*		70.0		
4	53	1.9 km N MLA	0	l	d
4	54	1.9 km N MLA	0	m	d
4	55	1.9 km N MLA	0	s	d
4	56	1.9 km N MLA	0	l	nr
4	57	1.9 km N MLA	0	m	w
4	58	1.9 km N MLA	xx	l	f
4	59	1.9 km N MLA	xxxx	m	w
4	60	1.9 km N MLA	0	m	d
4	61	1.9 km N MLA	xxxx	m	d
4	62	1.9 km N MLA	xxx	m	d
4	63	1.9 km N MLA	xxx	l	f
4	No. with *Pilularia*		5		
4	%. with *Pilularia*		45.5		

Sample site	Depression no.	Location	Abundance	Size	Moisture level

5	64	3.7 km N MLA	0	m	d
5	65	3.7 km N MLA	0	l	d
5	66	3.7 km N MLA	0	s	d
5	67	3.7 km N MLA	0	m	d
5	68	3.7 km N MLA	0	ll	nr
5	69	3.7 km N MLA	0	l	d
5	70	3.7 km N MLA	0	l	d
5	71	3.7 km N MLA	0	m	nr
5	72	3.7 km N MLA	0	l	d
5	73	3.7 km N MLA	0	m	d
5	No. with *Pilularia*		0		
5	%. with *Pilularia*		0.0		
6	74	3.7 km N MLA	0	l	f
6	75	3.7 km N MLA	0	s	d
6	76	3.7 km N MLA	0	m	d
6	77	3.7 km N MLA	xxxx	m	d
6	78	3.7 km N MLA	x	l	d
6	79	3.7 km N MLA	x	m	d
6	80	3.7 km N MLA	xxx	l	d
6	81	3.7 km N MLA	0	l	w
6	82	3.7 km N MLA	x	m	d
6	83	3.7 km N MLA	0	l	f
6	No. with *Pilularia*		5		
6	%. with *Pilularia*		50.0		
7	84	6.6 km N MLA	xxxx	m	d
7	85	6.6 km N MLA	xx	m	d
7	86	6.6 km N MLA	xxxx	s	d
7	87	6.6 km N MLA	0	s	d
7	88	6.6 km N MLA	xxxx	l	f
7	89	6.6 km N MLA	0	s	d
7	90	6.6 km N MLA	0	s	d
7	91	6.6 km N MLA	xxxx	s	d
7	92	6.6 km N MLA	xxxx	m	d
7	93	6.6 km N MLA	xx	l	d
7	No. with *Pilularia*		7		
7	%. with *Pilularia*		70.0		

Sample site	Depression no.	Location	Abundance	Size	Moisture level
8	94	5.3 km SSE MLA	xx	l	w

8	95	5.3 km SSE MLA	xxxx	l	d
8	96	5.3 km SSE MLA	0	m	f
8	97	5.3 km SSE MLA	x	l	f
8	98	5.3 km SSE MLA	0	m	w
8	99	5.3 km SSE MLA	xxxx	l	d
8	100	5.3 km SSE MLA	xxxx	m	d
8	101	5.3 km SSE MLA	xxxx	l	f
8	102	5.3 km SSE MLA	x	m	d
8	103	5.3 km SSE MLA	x	l	f
8	No. with *Pilularia*		8		
8	%. with *Pilularia*		80.0		
9	104	5.3 km SSE MLA	xxxx	l	d
9	105	5.3 km SSE MLA	xxxx	m	d
9	106	5.3 km SSE MLA	xxxx	l	d
9	107	5.3 km SSE MLA	xxxx	l	d
9	108	5.3 km SSE MLA	xxx	l	f
9	109	5.3 km SSE MLA	xxxx	l	f
9	110	5.3 km SSE MLA	xxxx	m	f
9	111	5.3 km SSE MLA	xxxx	l	f
9	112	5.3 km SSE MLA	xxxx	l	w
9	113	5.3 km SSE MLA	x	l	w
9	No. with *Pilularia*		10		
9	%. with *Pilularia*		100.0		
Total	No. with *Pilularia*		44		
Total	%. with *Pilularia*		38.9		

Discussion

From the results it is clear that *Pilularia novae-hollandiae* is widespread and common in gilgai formations in the vicinity of Lake Cowal, including the Project area. All three areas of gilgai on the Project site would be impacted by the development, particularly by the pit, southern waste emplacement, water storage and northern tailings dam.

The data shows that *P. novae-hollandiae* is a relatively common inhabitant of gilgai depressions in the Lake Cowal region, both to the north and south of the Project area. Similar gilgai habitat occurs widely beyond Lake Cowal and it is therefore likely that *P. novae-hollandiae* is widespread in Central Western NSW. This is supported by the finding in this survey that *P. novae-hollandiae* was abundant in a gilgai 12 km south of Condobolin and also the report of Clements and Rodd (1995) of its occurrence in a gilgai 13 km SW of the Project area near Bland Creek.

Given that the area of gilgai proposed to be disturbed by the Project comprises only a very small proportion of that in the surrounding region, the Project will have only a slight impact on the total regional population of *P. novae-hollandiae*. It is therefore reasonable to conclude that the Cowal Gold Project will not significantly affect the long term viability of *P. novae-hollandiae* in the vicinity of Lake Cowal.

The results of this study suggest that *P. novae-hollandiae* is not as uncommon as the paucity of collection records suggests. It is a small inconspicuous species that is easily overlooked. In addition it is absent above the soil surface in dry seasons and for most of the year. Its small size and ephemeral nature probably account for it being under represented in collections.

In my opinion any attempts to rescue populations of *P. novae-hollandiae* from gilgai areas to be disturbed by the Cowal Gold Project with a view to translocating them for re-establishment elsewhere would not be justified. Rather, efforts would be better directed to protecting remaining areas of gilgai in the region in order to maintain viable existing populations in them. In particular, the observations reported here indicate it is important to maintain gilgai areas under native grasses to prevent encroachment of depressions by aggressive introduced species which exclude *P. novae-hollandiae*.

Recommendation

In view of the widespread distribution and commonness of *P. novae-hollandiae* in the Lake Cowal region it is recommended that no special action is undertaken to protect its populations on the Project site or to translocate them to new locations off the site.

References

Barker, P.J. and J.A. Wild (1994). Cowal Gold Project soil survey consultancy report to North Mining Ltd. Appendix B1, *Cowal Gold Project Environmental Impact Statement*. Volume 2, 46 pp. Resource Strategies Pty. Ltd. (1998).

Beadle, N.C.W. (1981). *Vegetation of Australia*. Cambridge University Press.

Briggs, J.D. and J.H.Leigh (1996). *Rare or Threatened Australian Plants*. CSIRO Publishing, Melbourne

Clements, AM. and A.N.Rodd (1995). *Terrestrial Flora Report: Lake Cowal District*. Appendix F, Lake Cowal Gold Project Environmental Impact Statement. NSR Environmental Consultants, Hawthorn.

Harden, G.J. (Ed.) (1990). *Flora of New South Wales*. Vol. 1. University of NSW Press, Sydney.

Jones, D.L. and S.C.Clemesha (1981). *Australian Ferns and Fern Allies*. (revised edition). Reed Books, Frenchs Forest, NSW

Resource Strategies Pty. Ltd. (1998). *Cowal Gold Project Environmental Impact Statement*. 5 Vols.

Taylor, J.K. (1960). Soils. In *The Australian Environment.* Pp. 29-44. CSIRO, Melbourne University Press, Melbourne.

From:	Hayden Beck
To:	Michael.Todd@environment.nsw.gov.au; andrew.fisher@environment.nsw.gov.au
Cc:	Janet Krick; Steven Ward; rog.southwest@environment.nsw.gov.au
Subject:	Attention Michael Todd and Andrew Fisher: Cowal Gold Operations Open Pit Continuation Project (SSD-42917792)
Date:	Wednesday, 30 November 2022 8:07:08 AM
Attachments:	J190417_Austral Pillwort survey timing January 2023_V0.2.pdf

Good morning Michael and Andrew,

Hope you are both well.

Please find attached letters regarding the Cowal Gold Operations Open Pit Continuation Project (SSD-42917792):

1) Response to Biodiversity Conservation Division (BCD) South West Branch's letter (DOC22/717039; 4 October 2022) regarding the minutes of our meeting on 31 August 2022 in relation to EMM's proposed approach to the Biodiversity Development Assessment Report (BDAR). This letter seeks to
to reach agreement with BCD upon an approach to assessing biodiversity values within Lake Cowal, which is still fully inundated. Please find letter here:
https://spaces.hightail.com/receive/OmqAWzGUwJ

2) We seek formal agreement from BCD that, due to recent high rainfall conditions, extending the timing of surveys for the Austral Pillwort (*Pilularia novae-hollandiae*) into January 2023 is justified. Please find letter attached.

Timely advice on these matters would be much appreciated to allow for organisation of fieldwork and preparation of the BDAR.

Warm regards,

Hayden

Dr Hayden Beck
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Memorandum

29 November 2022

To: Michael Todd and Andrew Fisher

From: Hayden Beck (BAAS19000)

Subject: Targeted surveys for Austral Pillwort in January 2023

Dear Michael,

Targeted surveys for Austral Pillwort were undertaken for the Cowal Gold Operations Open Pit Continuation Project (SSD-42917792) on 14 – 18 November, with an additional survey scheduled for 5 – 9 December 2022. The Threatened Biodiversity Database Collection (TBDC) recommends surveys for the Austral Pillwort "in drying mud after inundation", with survey months defined as October to December.

Many of the shallower gilgais surveyed during November 2022 had drying mud, with EMM detecting Austral Pillwort both submerged and emerging from shallow water. However, at least at the time of the November survey, due to recent high rainfalls associated with La nina conditions, water levels were still considerably high within many of the deeper gilgais. Photos of gilgai water levels during the November survey are provided in photographs below.



Photograph 1 High water levels within deeper gilgais during November survey

Based on the high-water levels, these deeper gilgais may still not be sufficiently dried during the December survey. Hence, additional surveys for the Austral Pillwort may be required in these deeper gilgais to assess the presence/absence of this species more accurately once they dry out further. To improve survey representativeness, EMM proposes undertaking surveys in January 2023 to allow water levels to recede, and

thus provide more "drying mud" conditions that support the emergence of this species. EMM believes January 2023 provides a more suitable time to survey for the Austral Pillwort than December 2022 within deeper gilgiais, since more suitable drying mud habitat is likely to occur in those depressions.

Drier conditions, which may allow deeper gilgai to dry out, are expected in January since neutral ENSO conditions are predicted by BoM in early 2023 (ie reducing rainfall; see: http://www.bom.gov.au/climate/enso/outlook/). Moreover, this species should still be expressing in January since the frequencies of records of this species in January are comparable to those in the prescribed survey period of October to December (Figure 1). Hence, the potential for this species to emerge in January should be similar to the period prescribed by the TBDC.

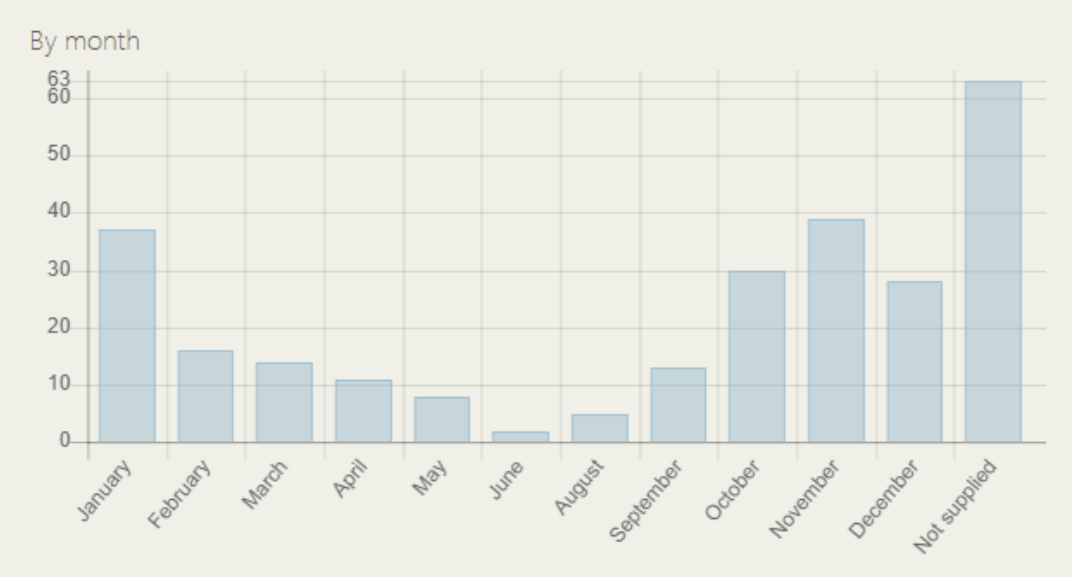


Figure 1 Records of Austral Pillwort by month (source: Australian Virtual Herbarium 2022)

EMM are seeking formal agreement from BCD that the Austral Pillwort can be surveyed for the OPC Project in January 2023. As a requirement under Section 5.3 of BAM (2020), "*If undertaking a species survey the assessor must: a. only survey during the time specified for that species in the TBDC, unless there is clear justification to vary the timing and the reasoning is documented in the BAR*." EMM seeks formal recognition that, due to recent high rainfall conditions, extending the timing of surveys for the Austral Pillwort into January is justified.

Timely advice on this would be much appreciated to allow for organisation of the proposed fieldwork.

Yours sincerely

Dr Hayden Beck
Senior Ecologist
hbeck@emmconsulting.com.au

Department of Planning and Environment

Hayden Beck
Senior Ecologist
EMM Consulting

Our ref: DOC22/717039
Senders ref: J190417

Via email: hbeck@emmconsulting.com.au

14 December 2022

Dear Hayden

Subject: Cowal Gold Operations Open Pit Continuation Project – EMM response to BDAR approach and extended survey season for Austral Pillwort

Thank you for your email dated 30 November 2022 seeking additional feedback for the proposed Biodiversity Development Assessment Report (BDAR) approach from the Biodiversity and Conservation Division (BCD) of the Department of Planning and Environment.

We have reviewed the letter regarding an extension of survey timing for Austral Pillwort (*Pilularia novae-hollandiae*) beyond the nominated months of October to December (in the Threatened Biodiversity Data Collection (TBDC)) into January of 2023.

We agree that given current ongoing weather conditions and the likely drying of suitable habitats on site, that surveys in January 2023 would be acceptable for this species in addition to the surveys already conducted in November 2022 and proposed for December 2022.

We have reviewed the supplied letter document regarding the revised approach to the BDAR surveys relating to the prolonged inundation of Lake Cowal and provide comments for consideration in **Attachment A**.

If you have any questions about this advice, please contact Leigh Maloney, Senior Conservation Planning Officer, via rog.southwest@environment.nsw.gov.au or 02 6983 4911.

Yours sincerely

Andrew Fisher
Senior Team Leader Planning
South West Branch
Biodiversity and Conservation Division
Department of Planning and Environment

ATTACHMENT A – Detailed comments on CGO proposed BDAR approach

ATTACHMENT A Detailed comments on CGO proposed BDAR approach

Table 1: Record of responses to proposed BDAR approach due to Lake Cowal inundation.

Proposed approach (31 August 2022 meeting	BCD Feedback (4 October 2022 letter)	EMM response (28 November letter)	BCD response (this letter)
NOTE (post meeting) – PCT 17 It is unclear how the benchmarks utilised should be approached as BAM plot data has been gathered over multiple years. EMM suggest the "wet" rainfall average year should be applied to all PCTs.	Agree. Is the proposal to review and apply 'wet' benchmarks to all other PCTs on the proposal site? Do the other PCTs have 'wet' benchmarks?	**Application of modified benchmark data.** • All PCTs within the OPC area have dry, average and wet condition benchmarks. • Default benchmarks for all PCTs in the OPC differ in the BAM-C versus the published benchmarks. • VI plots for the OPC undertaken from 2020 to 2022 which include both El Nino (dry conditions) and La Nina (wet conditions). • Propose assigning each VI plot to a dry, wet or average benchmark condition based on rainfall from West Wyalong weather station for the 365 days prior to collection of VI plots. • For each PCT, the benchmark data to be applied in the BAM-C will then be based on the rainfall condition associated with when the most plots were completed.	**Agree** with proposed approach to assign each PCT to a dry, wet or average rainfall condition that the most plots were undertaken in. We recommend that for a PCT with generally even split of plots across wet and dry for a condition, a separate vegetation zone be entered and different condition benchmark values assigned for that PCT.

Proposed approach (31 August 2022 meeting	BCD Feedback (4 October 2022 letter)	EMM response (28 November letter)	BCD response (this letter)
Assessment of PCT 17 Options 1 to 3 for assessing inundated land	Option 1 is supported if an appropriate local site can be found, BCD expect it to be on land owned by Evolution and under the same management, including grazing regime. Option 2 is supported. This approach is most likely to meet requirements of the BAM. This approach would be applied for any other site that is not able to be accessed before the EIS is submitted. Revision of PCTs present, boundaries and vegetation zones may be needed as water recedes.	• Application of benchmark data for PCT 17 for EIS due to inundation. High water levels unlikely to recede prior to EIS lodgement. • Option 2 - Survey vegetation zone for PCT 17 post-approval with survey requirement as part of conditions for PCT 17 will be applied.	**Agree** - Support use of benchmark data of inundated PCT 17. **Agree** - Support post approval survey for PCT 17 (with survey requirement as part of consent conditions) and an agreed mechanism with NSW Planning for resolving the assessment.
Assessment of PCT 17 - Option 4 1. Justification 2. Adopt PCT 53 BAM data for PCT 17 3. Estimate the Lignum cover using aerial photography from 2019, which should represent a high condition state.	BCD do not agree with Option 4 The outcome of applying PCT 53 benchmarks to areas able to be delineated as PCT 17 on aerial photos is unclear. Are there two vegetation zones entered into BAM-C as PCT 53, which then influences the candidate species list, effectively removing species predicted by PCT 17? 1. PCTs 17 and 53 are in different vegetation classes, and the benchmarks are very different. For example: - PCT 53 is described as a low to mid-high sedgeland/grassland with a 'wet' benchmark for Grass/grass like plant cover of 102, and shrub cover of 0.	1. Plot data from PCT 53 will not be used for PCT 17 as previously proposed. As outlined in row 2 (above), benchmark values for PCT 17 will be applied. 2. For PCT 17 benchmark data to be used for VI plots, also propose assigning tree species richness and tree cover to '0' in the BAM-C benchmark VI plot data based on aerial imagery that shows no tree canopy within PCT 17. 3. High condition state will not be represented by benchmark data for PCT 17.	**Noted** – Plot data from PCT 53 for PCT 17 no longer proposed. **Agree** – Assign tree species richness and cover to zero for the benchmark data being used for VI plots in PCT 17 only. Ensure aerial imagery from multiple years (not just 2019) are used to delineate the extent of Lignum within PCT 17.

Proposed approach (31 August 2022 meeting	BCD Feedback (4 October 2022 letter)	EMM response (28 November letter)	BCD response (this letter)
	- PCT17 is open-shrubland usually to 2m high and has a 'wet' benchmark grass and grass-like of 10. Has the presence of other PCTs been considered in the inundated area? - PCT 24 'Canegrass swamp tall grassland wetland of drainage depressions, lakes and pans of the inland plains' - PCT 360 'Gilgai wetland mosaic in the southern NSW South Western Slopes Bioregion' 2. Table 1.1 has average scores but PCT 53 BAM plot data has not been supplied. Without that it is difficult to assess if the result is ecologically meaningful. 3. 2018 and 2019 were very dry years (annual rainfall at West Wyalong of 239 and 250mm), so assumptions about a high condition state may not be correct. Delineation of lignum from photography should represent the boundary of PCT 17. It is not clear if or why this area would not be a separate vegetation zone in BAM-C. Revision of PCTs present, boundaries and vegetation zones may be needed as water recedes.		

Proposed approach (31 August 2022 meeting	BCD Feedback (4 October 2022 letter)	EMM response (28 November letter)	BCD response (this letter)
Targeted threatened flora Options 1 to 4	BCD support assuming presence for species not able to be surveyed, with an appropriate, agreed mechanism for modifying the credit liability based on survey after project approval and before construction. EMM and Evolution must provide evidence in the BDAR that NSW Planning agree to enable this approach through conditions of consent. Option 2 may apply to some species, depending on adequate justification and evidence that micro-habitats are absent. Option 3, re SAII – note that the BDAR provides the data with a description of limitations and assumptions. The recommendation about whether the impact has a serious and irreversible impact is made by the decision maker.	**Targeted threatened flora - Options 1 to 4.** • Assumed presence for inundated areas partially supported as the lake is unlikely to dry out prior to construction commencement to allow post approval surveys to occur. • Exclusion based on expert reports for Spiny Peppercress and Austral Pillwort. • SAII technical data requested for Austral Pillwort	**Noted.** Where a lack of microhabitats and adequate justification for exclusion from inundated areas cannot be provided, this is still the supported approach by BCD. **Noted**. BCD have assessed the expert application and have approved Dr Colin Bower as an expert for these two species for this project. **Disagree**. Without further details within an expert report, at this point BCD do not agree with the exclusion of Austral Pillwort. The EMM memo states it has been recorded but does not specify where in relation to the proposed OPC. **Noted**. SAII technical data to be sought by BCD from internal sources (if available). This will be provided separately to this response (if available).

Proposed approach (31 August 2022 meeting	BCD Feedback (4 October 2022 letter)	EMM response (28 November letter)	BCD response (this letter)
Case for lack of suitable microhabitat for Austral Pillwort (*Pilularia novae-hollandiae*) in Lake Cowal Proposed approach: 1. Focus survey effort on gilgai depressions outside Lake Cowal, where this species has previously been found 2. Seek agreement with BCD to rule out PCT 53 within Lake Cowal based on lack of suitable microhabitat	Successful survey for Austral Pillwort requires very specific timing. Under 'Justification', the description of yellowing plants found in drier depressions may simply indicate that the plant has reached the end of its life cycle following inundation, rather than being in poor health due to lack of habitat. 1. Is there a record of the conversation with Colin Bower? More specific information about the location of the original Austral Pillwort record is needed, given it was recorded as "common in gilgai depressions. Occurred in 38 out of 65 depressions examined. At the time of sampling the ponds were drying out and most had little free water". Also "Gilgai soils - predominantly grey cracking clays. Dominant tree species are *Eucalyptus populnea* and *Casuarina cristata*. Occurs mainly around edges of the gilgai depressions in open areas among short sedges and rushes" 2. Evidence has not yet been provided to demonstrate whether suitable habitat is present on Lake Cowal when the water is receding.	1. Record of conversations with Dr Colin Bower regarding the species location provided in response and supporting Appendix D. 2. Based on Dr Colin Bower's commentary and an apparent lack of gilgais in Lake Cowal, EMM are seeking agreement from BCD that the Austral Pillwort should be excluded from requiring survey effort in Lake Cowal given its low chance of occurring.	**Noted**. **Disagree.** Given that Dr Colin Bower has been approved as an expert for this species and project, we expect to see evidence for exclusion or otherwise of this species in the proposed expert report for this species in PCT 53.

Proposed approach (31 August 2022 meeting	BCD Feedback (4 October 2022 letter)	EMM response (28 November letter)	BCD response (this letter)
Case for lack of suitable microhabitat for *Lepidium aschersonii* (Spiny Peppercress) in Lake Cowal Case for lack of suitable microhabitat for *Austrostipa wakoolica* (A spear-grass) in Lake Cowal	Evidence has not yet been provided to demonstrate whether suitable habitat is present on Lake Cowal when the water is receding. Note that AMBS surveys were limited in scope and not likely to conform to BAM requirements.	Dr. Colin Bower has prepared an application to be listed as an expert for *Lepidium aschersonii* for this project.	**Noted**. Dr Colin Bower has been approved as an expert for *Lepidium aschersonii* for this project. Species will be assumed present as per heading 3 of the EMM response for *Austrostipa wakoolica*.
Case for lack of suitable microhabitat for *Amphibromus fluitans* (Floating Swamp Wallaby-Grass) in Lake Cowal	Transitional vegetation between PCT 17 and PCT 53 may be PCT 24. Evidence has not yet been provided to demonstrate whether suitable habitat is present on Lake Cowal when the water is receding.		Species will be assumed present as per heading 3 of the EMM response for *Amphibromus fluitans*.

From:	Glenn Stuckey
To:	David Hunter
Subject:	RE: Sloane"s Froglet survey advice
Date:	Thursday, 22 July 2021 10:53:00 AM
Attachments:	image002.jpg image003.png image004.png image006.png image007.jpg

Hi Dave,

Thanks for your reply, as previously discussed we have a project where we plan to commence survey soon for Sloane's Froglet, as conditions are currently suitable for survey due to inundation of potential habitat. It would be appreciated if you could indicate if you concur with our proposed approach to the survey, or if you recommend any alterations.

The current guidelines for aural-visual transects seem to be more appropriate for species with linear riparian habitat, whereas in this instance the potential habitat is over a broader area. The guidelines are 120 minutes per 500 m transect, one transect repeated for every 1000 m of potential habitat. For the upcoming survey, the habitat for Sloane's is in three locations: a large area of dense gilgai approximately 700 m x 500 m (area A); an adjacent area with sparse gilgai approximately 600 m x 400 m (area B); a smaller area of moderately dense gilgai approximately 400 m x 150 m (area C).

We are proposing to do one aural-visual transect in each of the three areas (including call playback), repeated over four nights. To maximize habitat coverage we propose to do the transects as broad meanders and extend their length but retain the 120 minutes per transect. Transects for areas A and B would be approximately 850 m, area C approximately 600 m. The aural and call playback component will be completed at equidistance locations along the transect, at least 10 locations per transect. Recordings will be taken at any location where Sloane's is detected or suspected.

George Madani will be leading the survey as a sub-consultant; he has experience working with DPIE on Sloane's.

Happy to receive your comments, or to discuss further.

Thanks,

Glenn Stuckey
Ecologist

Bushfire, Ecology, Heritage and Spatial Solutions team

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M 0467 164 614
www.emmconsulting.com.au

From: David Hunter <David.Hunter@environment.nsw.gov.au>
Sent: Friday, 16 July 2021 1:37 PM
To: Glenn Stuckey <gstuckey@emmconsulting.com.au>
Subject: RE: Sloane's Froglet survey advice

CAUTION: This email originated outside of the Organisation.

Hi Glen – thanks for contacting us about this!

Meandering transects through gilgai areas is definitely a suitable approach. You can usually hear sloane's from quite a distance – but when it becomes difficult is if there are other species calling in the area. And sloane's can be patchy – so getting around as much of the potential habitat is best.

Definitely take recordings of anything you think might be sloanes – we've had a few recent examples of consultants mis-identifying the calls of sloane's (mainly with other crinia).

We generally survey while ever temperatures above 5oC – they seem to be quite cold tolerant – and you can also use the other species as a guide – if everything is still calling strongly – then sloane's will be too.

All the best with your surveys!

Cheers, Dave.

David Hunter
Senior Threatened Species Officer

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The Department of Planning, Industry and Environment acknowledges that it stands on Aboriginal land. We acknowledge the traditional custodians of the land and we show our respect for elders past, present and emerging through thoughtful and collaborative approaches to our work, seeking to demonstrate our ongoing commitment to providing places in which Aboriginal people are included socially, culturally and economically.

From: Glenn Stuckey <gstuckey@emmconsulting.com.au>
Sent: Friday, 16 July 2021 12:47 PM
To: David Hunter <David.Hunter@environment.nsw.gov.au>
Subject: Sloane's Froglet survey advice

Hi David,

We (EMM Consulting) have some Sloane's Froglet surveys in the northern Riverina coming up and I was hoping you could provide some survey advice.

The survey is currently planned for the first week of August. Habitat is an area with a high density of gilgai, primarily surrounded by grazed derived native grassland with scattered Belah. There is some connectivity to smaller patches of gilga scattered over a broad area. Last year we surveyed for Sloane's in parts of this larger area following the older guidelines; species was not detected.

For the up-coming survey we are planning on following the DPIE 2020 Survey Guide for Threatened Frogs, ie aural-visual surveys over 500 m transects, two hours per transect, over four nights. We will

also be recording calls during survey however not planning to set recorders. Given the habitat is not linear (gilgai area is close to a square polygon), we are planning to follow broadly meandering transect lines through the gilgai.

My main query is what are the minimum temperatures that Sloane's Froglet will call in? Given we will have multiple transects and each transect takes quite a while, we need to know what our survey window is for all transects to be completed before it gets too cold in the later evening.

Any other advice for this survey, such as surveying in dense areas of gilgai, would be very welcome.

If you would like to discuss this further feel free to call me on 0467 164 614.

Regards

Glenn Stuckey
Ecologist
Bushfire, Ecology, Heritage and Spatial Solutions team

T 02 9493 9500
M 0467 164 614

Connect with us

SYDNEY | Ground floor, 20 Chandos Street, St Leonards NSW 2065

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PLEASE CONSIDER THE ENVIRONMENT BEFORE PRINTING THIS EMAIL

From:	Farah Naz
To:	Hayden Beck
Subject:	DPE-2098 SAII data requested for Austral Pillwort (Pilularia novae-hollandiae)
Date:	Wednesday, 21 December 2022 12:02:45 PM
Attachments:	jira-generated-image-static-befe21a1-9658-419a-8616-63f6f516bfa6

CAUTION: This email originated outside of the Organisation.

———————

Reply above this line.

Farah Naz commented:

Hi Steven,

Thank you for your enquiry.

The BOS subject matter officer has provided the following response to your enquiry:

The current data that DPE has for Austral Pillwort (Pilularia novae-hollandiae):

Austral Pillwort (Pilularia novae-hollandiae)

Principle 1 SAII = No

Justification = Data Deficient

Principle 2 SAII = No

Population = Data deficient

Extreme fluctuations = No

Principle 3 SAII = No

Number of locations = 4 or more

Estimated AOO = 88 km^2^

Estimated EOO = 120013 km^2^

Source = 2022 Flora review (BioNet, AVH, Species profile).

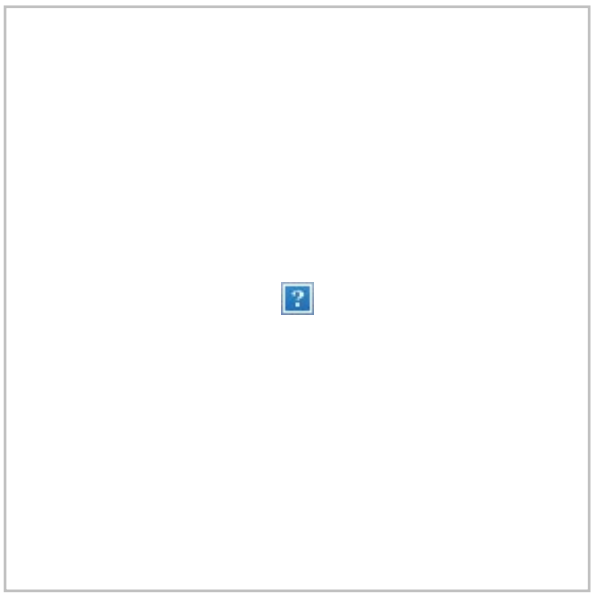
Justification: A number of sightings deleted west of Oolambeyan NP, including 2 records from the 1800s, and all SA records. Record, NSW416437, included from AVH (occurring between Cooma and Nimmitabel).

Supporting information/maps =

Principle 4 SAII = No

Caveat: Where ranges of numbers are given (e.g., in populations or distributions), the lower estimate should be used - this is the conservative or minimum estimate of the number of individuals or distribution of the TEC. Minimum estimates (indicated by ">" e.g., >5 individuals) should be used in a similar way. Calculations of decline made based on these numbers may therefore be considered "worst case scenario". Unfortunately, many estimates of population are maximum estimates (indicated by "<" e.g., "<250"), any calculations of decline based on these numbers are not precautionary, and should be considered a minimum decline, or "best case scenario "of decline.

If you are aware that these data are incorrect/out of date or have more information regarding the extent or population we would appreciate feedback from you, as we welcome all data to strengthen and improve our datasets.



2

Farah Naz resolved this as Done.

View request · Turn off this request's notifications

BOS Help Desk Team

Biodiversity and Conservation Division | Department of Planning and Environment

BOS Help Desk mailbox BOS.helpdesk@environment.nsw.gov.au

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We acknowledge the traditional custodians of the land and we show our respect for elders past, present and emerging.

This is shared with Steven Ward and Hayden Beck.

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From:	Leigh Maloney
To:	Hayden Beck
Cc:	Janet Krick; Steven Ward
Subject:	FW: HPE CM: DPE-2130 SW Regional Team Enquiry - SAII data for Pilularia novae-hollandiae
Date:	Friday, 24 February 2023 2:58:53 PM
Attachments:	~WRD0000.jpg image001.png

CAUTION: This email originated outside of the Organisation.

Hello Hayden,

Please see below some additional advice from the AO regarding Pilularia novae-hollandiae. Apologies if you have this data already and the Helpdesk has said that the data is a little out of date at the moment and will be updated later this year. In the interim, please use the below supplied data.

While I received the reply in mid-January there was some additional information that required clarification that I only received the final reply from this week.

Regards

Leigh Maloney
Senior Conservation Planning Officer – South West

Biodiversity and Conservation | Department of Planning and Environment
T 02 6983 4911 | **M** 0499 708 656 | **E** leigh.maloney@environment.nsw.gov.au
PO Box 5336, 7161 Olympic Highway, Wagga Wagga NSW 2650
www.dpie.nsw.gov.au

-



Contact the South West Planning Team about biodiversity and flood management planning matters by emailing rog.southwest@environment.nsw.gov.au.

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From: Carlie.McClung <jira@boshelpdeskdpensw.atlassian.net>
Sent: Wednesday, 18 January 2023 1:49 PM
To: Leigh Maloney <leigh.maloney@environment.nsw.gov.au>
Subject: HPE CM: DPE-2130 SW Regional Team Enquiry - SAII data for Pilularia novae-hollandiae

---

Reply above this line.

Hi Leigh

Thank you for your enquiry.

The BOS subject matter officer has provided the following response to your enquiry:

Please see this data below - The current data that DPE has for your species is:

Austral pillwort (Pilularia novae-hollandiae)

Principle 1 SAII = No

Justification = Data deficient

Principle 2 SAII = No

Justification = Data deficient

Principle 3 SAII = Yes

Number of locations = 2

Estimated AOO = 8 - 124 km^2^

Estimated EOO = 142,147 km^2^

Principle 4 SAII = No

Caveat: Where ranges of numbers are given (e.g., in populations or distributions), the lower estimate should be used - this is the conservative or minimum estimate of the number of individuals or distribution of the TEC. Minimum estimates (indicated by ">" e.g., >5 individuals) should be used in a similar way. Calculations of decline made based on these numbers may therefore be considered "worst case scenario". Unfortunately, many estimates of population are maximum estimates (indicated by "<" e.g., "<250"), any calculations of decline based on these numbers are not precautionary, and should be considered a minimum decline, or "best case scenario "of decline.

If you are aware that these data are incorrect/out of date or have more information regarding the extent or population we would appreciate feedback from you, as we welcome all data to strengthen and improve our datasets.

Kind regards

The BOS Help Desk Team

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Biodiversity and Conservation Division | Department of Planning and Environment

BOS Help Desk mailbox BOS.helpdesk@environment.nsw.gov.au

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This is shared with Leigh Maloney.

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From:	Leigh Maloney
To:	Hayden Beck
Subject:	FW: DPE-2519 SW Regional Planning Team Enquiry - Clarification re conflicting SAII data for Pilularia novae-hollandiae
Date:	Friday, 3 March 2023 2:38:08 PM
Attachments:	~WRD0000.jpg image001.png

CAUTION: This email originated outside of the Organisation.

Hi Hayden,

Please see below the correct advice for *Pilularia novae-hollandiae*.

As you will see below the caveat, this species is being considered for removal from the SAII list. However, until any new records and information regarding the species is formally reviewed and approved we have been advised to progress the assessment with the existing data provided here.

Please give me a call or send me an email if you would like to discuss further.

Cheers

Leigh Maloney
Senior Conservation Planning Officer – South West

Biodiversity and Conservation | Department of Planning and Environment
T 02 6983 4911 | **M** 0499 708 656 | **E** leigh.maloney@environment.nsw.gov.au
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-



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From: Farah Naz <jira@boshelpdeskdpensw.atlassian.net>
Sent: Friday, 3 March 2023 3:26 PM
To: Leigh Maloney <leigh.maloney@environment.nsw.gov.au>
Subject: DPE-2519 SW Regional Planning Team Enquiry - Clarification re conflicting SAII data for Pilularia novae-hollandiae

———————
Reply above this line.

Farah Naz commented:

Hi Leigh,

The BOS subject matter officer has provided the following response to your enquiry:

Thank you for you enquiry seeking confirmation of the correct SAII data for the Austral Pillwort (*Pilularia novae-hollandiae*).

As per the TBDC, *Pilularia novae-hollandiae* is listed as at risk of SAII for Principle 3. It is considered to be currently observed, estimated, inferred or reasonably suspected to have a very limited geographic distribution due to being known from ≤ 3 locations and/or an AOO < 10km*²* or EOO < 100km*².*

The current data that DPE currently has for *Pilularia novae-hollandiae* is:

Principle 1 SAII = No

Justification = Data Deficient

Principle 2 SAII = No

Population = Data deficient

Extreme fluctuations = No

Principle 3 SAII = **Yes**

Number of locations = 2

Estimated AOO = 8 - 124 km^2^

Estimated EOO = 142,147 km^2^

Principle 4 SAII = No

Caveat: Where ranges of numbers are given (e.g., in populations or distributions), the lower estimate should be used - this is the conservative or minimum estimate of the number of individuals or distribution of the TEC. Minimum estimates (indicated by ">" e.g., >5 individuals) should be used in a similar way. Calculations of decline made based on these numbers may therefore be considered "worst case scenario". Unfortunately, many estimates of population are maximum estimates (indicated by "<" e.g., "<250"), any calculations of decline based on these numbers are not precautionary, and should be considered a minimum decline, or "best case scenario "of decline.

A review of the data in 2022 suggests that *Pilularia novae-hollandiae* should be considered for removal from being listed as at risk of SAII for Principle 3. However, until the data is finalised and reviewed by Conservation Science the SAII listing stands and the above data should be used in a Biodiversity Assessment Report for assessment under the Biodiversity Offset Scheme.

If you have any questions or seek further clarification please contact the BOS Helpdesk BOS.helpdesk@environment.nsw.gov.au

Kind Regards

The BOS Help desk Team

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Appendix E
Category 1 Land Assessment

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1 Background

Evolution is seeking agreement from Biodiversity and Conservation Division (BCD) for the categorisation of category 1-exempt land (category 1 land) within the study area of the Open Cut Continuation (OPC) project. However, this does not include the approved and existing disturbance area as per DA14/98, as these lands already have consent for development activities.

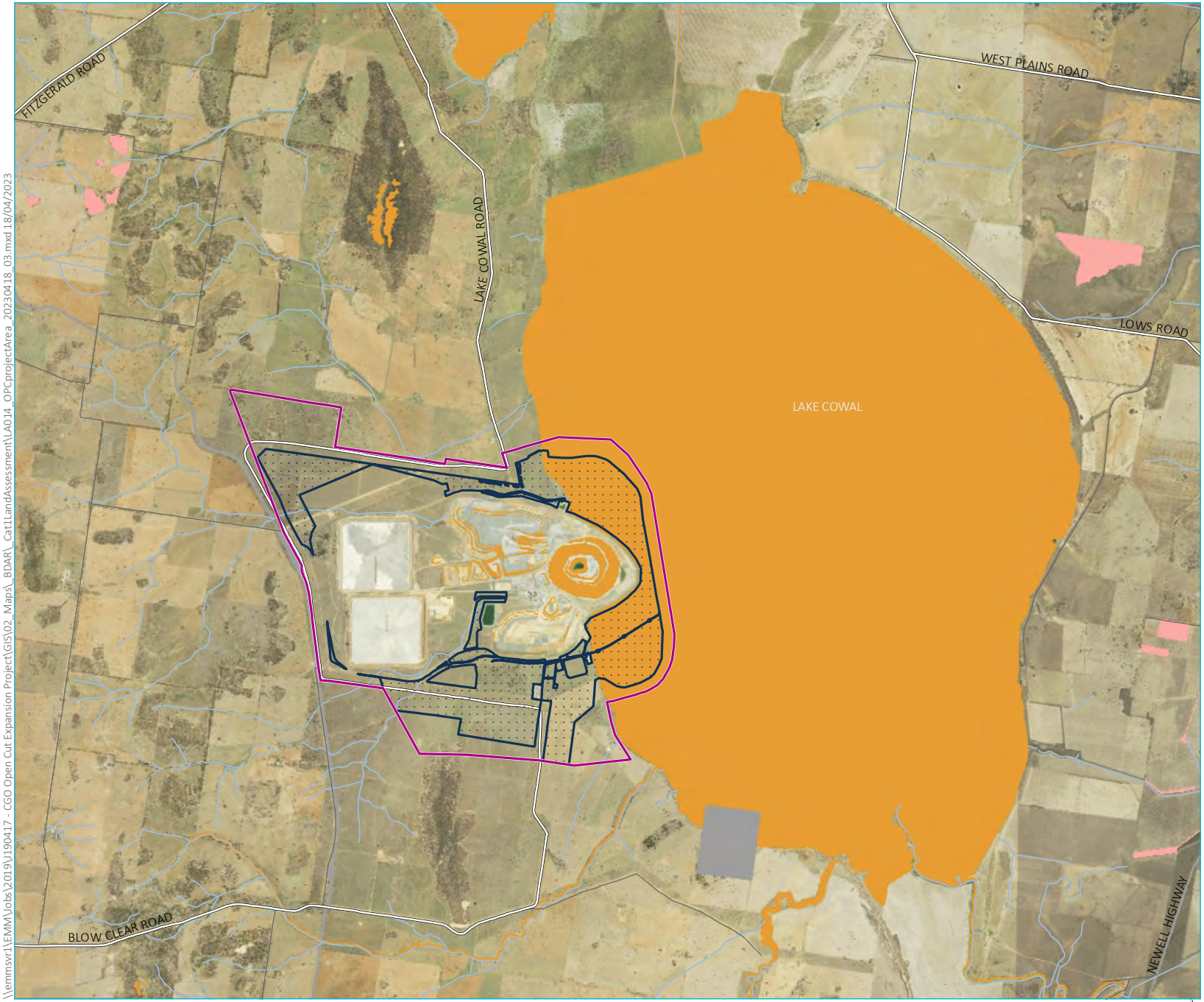
Category 1 lands do not formally require offsets under the *Biodiversity Conservation Act 2016* (BC Act). However, prescribed impacts as outlined in Chapter 6 of the Biodiversity Assessment Method (BAM, DPIE 2020) must still be considered on category 1 land, as well as potential impacts on Matters of National Environmental Significance (MNES) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). As such, prescribed impacts from clearing of non-native vegetation within category 1 lands has been considered in Section 8 of the accompanying Biodiversity Development Assessment Report (BDAR).

Category 2 land (of various types) requires full assessment of impacts and biodiversity offsets, so category 2 land is subject to full survey and impact assessment within the accompanying BDAR.

At the time of preparation of this document, there was no approved Native Vegetation Regulatory map. That is, the study area and Bland local government area are not mapped on the Draft Native Vegetation Regulatory map. The study area is mapped in *Transitional native vegetation regulatory map viewer* (NSW Government 2023) and the results are shown in Figure 1.1. This indicates that all land within Lake Cowal is sensitive (category 2 vulnerable regulated land). Thus, these lands were categorised accordingly within the study area detailed assessment. However, most of the study area is not identified on the NVR Map.

This document identifies the process followed to seek to identify category 1 and category 2 land within the study area for the OPC project. This document includes:

- Section 2: the designated criteria for category 2 and category 1 land as set out in the *Local Land Services Act 2013* (LLS Act) and Local Land Services Regulation 2014 (LLS Regulation)
- Section 3: the methods used to identify and map category 1 and category 2 land within the study area
- Section 4: the results of the assessment of the study area firstly against the category 2 criteria, with remaining land within the study area considered for classification as category 1 land
- Appendix A: historic aerial photographs of the study area used in this assessment
- Appendix B: NSW Landuse 2017 mapping (DPIE 2017) which was a dataset to used identify category 2 land
- Appendix C: the seven steps to identifying category 1 and category 2 land across the study area.



KEY

- Study area
- Additional disturbance footprint
- Major road
- Minor road
- Watercourse/drainage line

Transitional native vegetation regulatory map

- Steep or highly erodible land, protected riparian land or special category land (category 2 vulnerable regulated land)
- Category 2 sensitive regulated land
- Land excluded from LLS Act

\\emmsvr1\EMM\Jobs\2019\J190417 - CGO Open Cut Expansion Project\GIS\02_Maps_BDAR_Cat1LandAssessment\LA014_OPCprojectArea_20230418_03.mxd 18/04/2023

Source: EMM (2023); Evolution (2023); DFSI (2021); DPE (2023)

0 2.5 5 km

GDA 1994 MGA Zone 55

N

Transitional native vegetation regulatory map viewer (NSW Government 2023)

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Category 1 Land Assessment
Figure 1.1

EMM
creating opportunities

2 Criteria for category 2 and category 1 land

Broadly, category 1 land is land where, under s60H of the *Local Land Services Act 2013* (LLS Act), the land was cleared of native vegetation prior to 1 January 1990.

On category 1 land, clearing is not regulated (that is, it does not require approval). Clearing of native vegetation on category 1 land does not require assessment and offsetting under the BC Act under section 1.5(1)(d) of the BAM (DPIE 2020), though prescribed impacts are still assessed under clause 6.1 of the BC Regulation.

Clearing of native vegetation on category 2 land requires authorisation, including clearing under the Land Management (Native Vegetation) Code 2018 (the Clearing Code) and, for the purposes of application of the BC Act to developments, must be assessed in accordance with the BAM (DPIE 2020).

The *Local Land Services Act 2013* (LLS Act) and Local Land Services Regulation 2014 (LLS Regulation) designates the following criteria for category 2 and category 1 land (see Table 2.1 and Table 2.2 below, respectively).

2.1 Category 2 land criteria

Land within the category 1 and 2 land assessment area was firstly assessed against the LLS Act criteria to determine whether category 2 land is present. The criteria for the classification of category 2-regulated land are provided in Table 2.1.

Table 2.1 Criteria for classification of category 2-regulated land

Reference	Criteria
Section 60I(1)(a) LLS Act	The land was not cleared of native vegetation as of 1 January 1990. However, the land is not to be designated as category 2-regulated land if section 60H (2) or (3) requires the land to be designated as category 1-exempt land (see Table 2.2).
Section 60I(1)(b) LLS Act	The land was unlawfully cleared of native vegetation after 1 January 1990. However, the land is not to be designated as category 2-regulated land if section 60H (2) or (3) requires the land to be designated as category 1-exempt land (See Table 2.2).
Section 60I(2)(a) LLS Act	The land contains native vegetation that was grown or preserved with the assistance of public funds (other than funds for forestry purposes).
Section 60I(2)(b) LLS Act	The land is eligible for designation as category 2-vulnerable regulated land.
Section 60I(2)(c) LLS Act	The land is subject to a private land conservation agreement under the *Biodiversity Conservation Act 2016*.
Section 60I(2)(d) LLS Act	The land is subject to be set aside under a requirement made in accordance with a land management (native vegetation) code under this Part.
Section 60I(2)(e) LLS Act Clause 113(1)(g) LLS Regulation	The land contains grasslands that are not low conservation value grasslands. The land contains low conservation grasslands beneath the canopy or drip line of woody vegetation (being woody vegetation that satisfies the criteria for classification of the land as category 2-regulated land).
Section 60I(2)(f) LLS Act	The land is or was subject to a requirement to take remedial action to restore or protect the biodiversity values of the land under this Part or the *Biodiversity Conservation Act 2016* or under the *Native Vegetation Act 2003* or the *National Parks and Wildlife Act 1974*.
Section 60I(2)(g) LLS Act	The land is subject to an approved conservation measure that was the basis for other land being biodiversity certified under Part 8 of the *Biodiversity Conservation Act 2016* or under any Act repealed by that Act.

Table 2.1 Criteria for classification of category 2-regulated land

Reference	Criteria
Section 60I(2)(h) LLS Act	The land is an offset under a property vegetation plan under the *Native Vegetation Act 2003* or is a set aside under a Ministerial order under Division 3 of Part 6 of the Native Vegetation Regulation 2013.
Section 60I(2)(i) LLS Act	The land is in the coastal wetlands and littoral rainforests area of the coastal zone referred to in the *Coastal Management Act 2016*.
Clause 108(5) LLS Regulation	The land is identified as "proximity area for coastal wetlands" or "proximity area for littoral rainforest" by State Environmental Planning Policy (Coastal Management) 2018 if that land is in the coastal wetlands and littoral rainforests area of the coastal zone referred to in the *Coastal Management Act 2016.*
Section 60I(2)(j) LLS Act	The land is identified as koala habitat (of a kind prescribed by the regulations) in a plan of management made under State Environmental Planning Policy No 44 — Koala Habitat Protection.
Clause 111 LLS regulation	Koala habitat that is to be designated as category 2-regulated land is land identified as koala habitat under a plan of management approved under State Environmental Planning Policy No 44 — Koala Habitat Protection, being land that in the opinion of the Environment Agency Head is core koala habitat.
Section 60I(2)(k) LLS Act	The land is a declared Ramsar wetland within the meaning of the *Environment Protection and Biodiversity Conservation Act 1999* of the Commonwealth.
Section 60I(2)(l) LLS Act	The land has (subject to the regulations) been mapped by the Environment Agency Head as land containing critically endangered species of plants under the *Biodiversity Conservation Act 2016.*
Clause 112 LLS Act	Land may be mapped by the Environment Agency Head as category 2-regulated land because it contains critically endangered species of plants under the *Biodiversity Conservation Act 2016* only if it is land around the location of particular plants of that species (being a location identified in the records of the Environment Agency Head).
Section 60I(2)(m) LLS Act	The land has been mapped by the Environment Agency Head as land containing a critically endangered ecological community under the Biodiversity Conservation Act 2016.
Section 60I(2)(n) LLS Act	The land is of a kind prescribed by the regulations as category 2-regulated land.
Clause 113(1)(a) LLS Regulation	The land is (or was previously) subject to a private native forestry plan approved under Part 5B of the LLS Act, to a private native forestry plan that was approved under Part 5C of the *Forestry Act 2012* before its repeal or to a property vegetation plan that was approved under the *Native Vegetation Act 2003* before its repeal and that authorised the clearing of native vegetation for the purposes of forestry operations.
Clause 113(1)(c) LLS Regulation	The land was, immediately before the repeal of the *Native Vegetation Act 2003*, subject to a conservation property vegetation plan or an incentive property vegetation plan (being land that was required to be conserved or in respect of which public funding was provided to improve biodiversity). Note, land that continues to be subject to a plan described above is classified as category 2-sensitive regulated land (Clause 108(2)(e)).
Clause 113(1)(l) LLS Regulation	The land is a travelling stock reserve (TSR) (unless the land is in the Western Division of the State).

2.2 Category 1 land criteria

The criteria for defining category 1 land are provided in Table 2.2 below.

Table 2.2 Criteria for classification of category 1-exempt land

Reference	Criteria
Section 60H(1)(a) LLS Act	The land was cleared of native vegetation as of 1 January 1990. However, the land is not to be designated as category 1-exempt land if the land was unlawfully cleared of native vegetation after 1 January 1990 (LLS Act, section 60H(4)(b)).
Section 60H(1)(b) LLS Act Section 60J(2) LLS Act	The land was lawfully cleared of native vegetation between 1 January 1990 and the commencement of Part 5A of the LLS Act (25 August 2017). Note, native vegetation that comprises grasslands or other non-woody vegetation is taken to have been significantly disturbed or modified (and therefore cleared) between 1 January 1990 and date of commencement of Part 5A of the Act (25 August 2017).
Section 60H(2)(a) LLS Act Clause 109(1) LLS Regulation	The land contains low conservation value grasslands. However, land is not to be designated as category 1-exempt land if the land was unlawfully cleared of native vegetation after 1 January 1990. The land contains only low conservation value groundcover (not being grasslands).
Section 60H(2)(b) LLS Act	The land contains native vegetation that was identified as regrowth in a property vegetation plan referred to in section 9 (2) (b) of the *Native Vegetation Act 2003*.
Section 60H(3) LLS Act	The land is biodiversity certified under Part 8 of the BC Act or under any Act repealed by that Act.
Section 60K(3) LLS Act	The land is authorised to be re-categorised to category 1 - exempt land.

3 Methods

3.1 Consultation of the native vegetation regulatory (NVR) map

The land categorisation approach that was undertaken for the study area follows the guidance in the native vegetation regulatory (NVR) map method statement and appendices (the NVR Map Method, OEH 2017).

In making an assessment of category 2 land and category 1 land within the OPC Additional disturbance footprint, EMM first sought to identify whether the site is a Rural Area to which the clearing provisions of the LLS Act applies (section 60A of the LLS Act). The entirety of the study area is zoned RU1 as per the Bland Shire Council Local Environmental Plan (2011), and thus the clearing provisions of the LLS Act applies.

EMM then sought to identify whether the site, or portions of the site, are mapped on the transitional Native Vegetation Regulatory Map (NVR Map) as one of the following:

- "Excluded land", which is land to which the LLS Act does not apply. Clearing of native vegetation on excluded land would still need to be assessed under the BC Act.
- "Category 2 vulnerable regulated land", which is steep or highly erodible lands, protected riparian land or special category land.
- "Category 2- sensitive regulated land", which is land designated as environmentally sensitive.

3.2 Detailed assessment of category 1 and 2 land in the study area

It is recommended in BAM training material that land meeting criteria for category 2 land is identified first, prior to category 1 land identification (Greencap 2022). As such, the assessment is structured to firstly identify category 2 land, prior to refining the potential extent of category 1 land.

Section 3.2.1 details the information used in determining category 2 and category 1 land. The method used for addressing the criteria for and then mapping category 2 and category 1 land is provided in Section 3.2.2.

3.2.1 Data sources

The following data sources were utilised in making a reasonable assessment of land category:

- NVR Map (NSW Government 2022) to check for category 2-sensitive regulated, category 2-vulnerable regulated [also referred to as the Vulnerable Lands dataset (BCD 2022)], and excluded land that may be present on the site
- published data layers to facilitate the identification of existing and historical land use since 1 January 1990:
    - NSW Landuse 2017 mapping (DPIE 2017) – used to identify and map existing and historical agricultural land use in NSW under the ALUM classification
- Travelling Stock Reserves – State Classification Map (LLS 2023)
- RVEP areas as supplied by Evolution (2023)

- available historical aerial imagery (NSW Government Spatial Services 2023) to identify land that was cleared of native vegetation before 1 January 1990, comprising:
    - 1973
    - 1983
    - 1989
    - 1993
    - 1997
    - 2010
    - 2015
    - 2021.

3.2.2 Assessment approach

i Addressing category 1 and 2 criteria

The first step is to identify category 2 land prior to category 1, as provided in Table 2.1 and Table 2.2. This step allowed an initial pass to firstly identify category 2 land. The remaining land, not considered consistent with category 2 land, was then assessed in suitability for being categorised with category 1 land.

ii Mapping category 2 and category 1 land

The following steps were undertaken in making a reasonable approximation of category 2 and category 1 land on the site. These steps were taken in sequence in the order as presented below:

1. Identify the land identified in NVR as category 2 land (as per Section 3.1).
2. Apply category 2 land to substantially natural environments vegetation within NSW Land Use 2017 data layer.
3. Apply category 2 land to areas of Cropping (ALUM code 3.3.0) considered “not low conservation value grassland” as per Section 60I(2)(e) LLS Act.
4. Apply category 2 land to TSRs.
5. Apply category 2 land to areas identified as Remnant Vegetation Enhancement Program (RVEP), which are lands containing remnant vegetation and/or Lake Cowal wetland in accordance with Cowal Gold Mine’s Flora and Fauna Management Plan (FFMP) to conserve and enhance remnant vegetation and wildlife values around Lake Cowal.
6. For areas not yet mapped as category 2 land, apply category 2 land to woody vegetation extant prior to 1990 by mapping trees present in the 1989 aerial imagery (the latest imagery available before 1990).
7. For areas not yet mapped as category 2 land, apply category 1 land to cropped areas identified within the time series aerial photography as cropped prior to 1990.

Figure C.1 to Figure C.7 shows the steps taken to map category 1 and 2 land.

4 Results

4.1 Detailed assessment of category 1 and 2 land in the study area

i Addressing category 2 criteria

Table 4.1 Assessment of category 2 land as per LLS Act criteria

Criteria	Assessment of site
The land was not cleared of native vegetation as of 1 January 1990. However, the land is not to be designated as category 2-regulated land if section 60H (2) or (3) requires the land to be designated as category 1-exempt land (see Table 2.2).	**Yes** There are areas within the study area not cleared of native vegetation as of 1 January 1990. These areas have been categorised as category 2 land. **See step 6 of mapping category 2 and category 1 land (see Section 3.2.2ii below).**
The land was unlawfully cleared of native vegetation after 1 January 1990. However, the land is not to be designated as category 2-regulated land if section 60H (2) or (3) requires the land to be designated as category 1-exempt land (See Table 2.2).	No
The land contains native vegetation that was grown or preserved with the assistance of public funds (other than funds for forestry purposes).	No
The land is eligible for designation as category 2-vulnerable regulated land.	**Yes** The NVR identifies Lake Cowal as category 2-vulnerable regulated land. Also, much of the study area is also consistent with the definition of category 2-vulnerable regulated land. **See steps 1 to 6 of mapping category 2 and category 1 land (see Section ii below).**
The land is subject to a private land conservation agreement under the *Biodiversity Conservation Act 2016.*	No
The land is subject to be set aside under a requirement made in accordance with a land management (native vegetation) code under this Part.	**Yes** There is a parcel of land set aside as a Remnant Vegetation Enhancement Protection (RVEP) area to the south-east of the Study Area. Apart from the RVEP, there no other land is subject to be set aside under a requirement made in accordance with a land management (native vegetation) code under this Part. **See step 5 of mapping category 2 and category 1 land (see Section ii below).**

Table 4.1 Assessment of category 2 land as per LLS Act criteria

Criteria	Assessment of site
The land contains grasslands that are not low conservation value grasslands.	**Yes** Areas within the ALUM mapping identified as Grazing native vegetation (ALUM code 2.1.0); Grazing modified pastures (ALUM code 3.2.0); and Lake (ALUM code 6.1.0) were verified through flora surveys for the BDAR as having a greater proportion of native groundcover than exotic species, so were considered grasslands that are not low conservation value grasslands. There are also two areas mapped as cropped within the ALUM mapping in the study area, within Lot 64 DP 753083 and Lot 38 DP 39733. Both areas have historically been disturbed through cropping and grazing, which pre-dates the earliest available photograph provided in 1973 (see Appendix A). Despite an intermittent history of grazing/cropping in Lot 64 DP 753083 (see note 1 in Figure C.3), on-ground assessments of this area indicated a relatively high native groundcover, so were considered grasslands that are medium conservation value grasslands. Other areas of ALUM mapping, which are classified as cropping or mining (but outside of the existing and approved disturbance footprint) but considered as not low conservation value grasslands after field inspections, were also considered category 2 land (see notes 4 and 5 in Figure C.3). In contrast, land cropped in Lot 38 DP 39733 (note 2 in Figure C.3), is much more disturbed owing to an ongoing three-year crop/rest rotation. The land was last cropped in 2021, with harvest stretched out to early 2022. As such, this land is highly disturbed with a high exotic groundcover. It was considered that the grasslands are of low conservation value. Examples of the disturbed state of cropping areas in Lot 38 DP 39733 are shown in Table 4.13 of the BDAR. **See steps 2 and 3 of mapping category 2 and category 1 land (see Section 3.2.2ii below).**
The land is or was subject to a requirement to take remedial action to restore or protect the biodiversity values of the land under this Part or the Biodiversity Conservation Act 2016 or under the *Native Vegetation Act 2003* or the *National Parks and Wildlife Act 1974*.	No
The land is subject to an approved conservation measure that was the basis for other land being biodiversity certified under Part 8 of the *Biodiversity Conservation Act 2016* or under any Act repealed by that Act.	No
The land is an offset under a property vegetation plan under the *Native Vegetation Act 2003* or is a set aside under a Ministerial order under Division 3 of Part 6 of the Native Vegetation Regulation 2013.	**Yes** There is a parcel of land set aside as a Remnant Vegetation Enhancement Protection (RVEP) area to the south-east of the Study Area. Apart from the RVEP, there no other land is subject to be set aside under a requirement made in accordance with a land management (native vegetation) code under this Part. **See step 5 of mapping category 2 and category 1 land (Section 3.2.2ii below).**
The land is in the coastal wetlands and littoral rainforests area of the coastal zone referred to in the *Coastal Management Act 2016*.	No

Table 4.1 Assessment of category 2 land as per LLS Act criteria

Criteria	Assessment of site
The land is identified as koala habitat (of a kind prescribed by the regulations) in a plan of management made understate Environmental Planning Policy No 44—Koala Habitat Protection.	No
The land is a declared Ramsar wetland within the meaning of the *Environment Protection and Biodiversity Conservation Act 1999* of the Commonwealth.	No
The land has (subject to the regulations) been mapped by the Environment Agency Head as land containing critically endangered species of plants under the *Biodiversity Conservation Act 2016*.	No
The land has been mapped by the Environment Agency Head as land containing a critically endangered ecological community under the *Biodiversity Conservation Act 2016*.	No
The land is of a kind prescribed by the regulations as category 2-regulated land.	No
The land is (or was previously) subject to a private native forestry plan approved under Part 5B of the LLS Act, to a private native forestry plan that was approved under Part 5C of the *Forestry Act 2012* before its repeal or to a property vegetation plan that was approved under the *Native Vegetation Act 2003* before its repeal and that authorised the clearing of native vegetation for the purposes of forestry operations.	No
The land was, immediately before the repeal of the *Native Vegetation Act 2003*, subject to a conservation property vegetation plan or an incentive property vegetation plan (being land that was required to be conserved or in respect of which public funding was provided to improve biodiversity).	No
The land is a travelling stock reserve (TSR) (unless the land is in the Western Division of the State).	**Yes** There are areas of TSR within the study area and it is outside of the Western Division of LLS. TSRs within the study area have been categorised as category 2 land. **See step 4 of mapping category 2 and category 1 land (Section 3.2.2ii below).**

ii Mapping category 2 and category 1 land

The results of the seven steps taken to map category 2 then category 1 land within the study area are presented below. Appendix C shows the maps following each of these steps. Figure 4.1 shows the proposed category 1 land mapping.

1. Identify category 2 land from NVR.

RESULT: Land within Lake Cowal was identified in the NVR as category 2 vulnerable regulated land. This land was identified in the map as category 2, as shown in

Figure C.1.

2. **Apply category 2 land to substantially natural environments vegetation within NSW Land Use 2017 data layer.**

RESULT: Areas identified as substantially natural environments from DPIE (2017) and so classified as category 2 land were:

- Grazing native vegetation (ALUM code 2.1.0)
- Grazing modified pastures (ALUM code 3.2.0)
- Lake (ALUM code 6.1.0).

These areas captured the native vegetation mapped and considered as category 2 land for the purpose of the BDAR. After classification of the above ALUM land classes to category 2 land, there were only two areas remaining, which were both classified as Cropping (ALUM code 3.3.0).

Areas identified as substantially natural environments across the study area, as indicated by the following ALUM classes, and so allocated to category 2 land, are shown in Figure C.2.

3. **Apply category 2 land to areas of Cropping (ALUM code 3.3.0) or Mining (ALUM code 5.8.0) outside of the Approved disturbed Area considered "not low conservation value grassland" as per Section 60I(2)(e) LLS Act.**

RESULT: Following site visits to these areas identified by ALUM mapping as Cropping (ALUM code 3.3.0), out of the two land parcels in the study area, it was considered that groundcover in Lot 64 DP 753083 (note 1 in Figure C.3) was better classified as Grazing modified pastures (ALUM code 3.2.0). This was because there was typically a greater proportion of native groundcover than exotic species in that area. As such, despite being mapped as Cropping (ALUM code 3.3.0), Lot 64 DP 753083 was considered as Grazing modified pastures, and so was classified as category 2 land. These areas of Cropping (ALUM code 3.3.0) were considered to be medium conservation value grassland (or "not low conservation value grassland") following field verification, and so allocated to category 2 land, are shown on Figure C.3.

In contrast, the land parcel mapped as Cropping (ALUM code 3.3.0) in Lot 38 DP 39733 (note 2 in Figure C.3) has experienced a much more intense cropping regime than Lot 64 DP 753083, which has led to a highly disturbed groundcover. Photographs of the disturbed state of the understory on this land parcel are provided in Table 4.13 of the BDAR. This disturbance has arisen from an ongoing three-year crop/rest rotation cycle. The land was last cropped in 2021, with harvest stretched out to early 2022. Hence, land considered in this mapping process as potential category 1 land was wholly within Lot 38 DP39733.

Note that a small adjustment to the extent of Cropping (ALUM code 3.3.0) in Lot 38 DP 39733 was made to the northern perimeter of this polygon. This adjustment was made to capture a small area that was cropped but incorrectly identified as Grazing modified pastures (ALUM code 3.2.0) by DPIE (2017) (see note 3 in Figure C.3). This area was identified in the ALUM mapping as Grazing modified pastures (ALUM code 3.2.0) but was historically cropped and subject to the same history as other areas mapped as Cropping (ALUM code 3.3.0). As such, this small area was classified as Cropping (ALUM code 3.3.0) in further steps.

There were also 8.98 ha (17 areas) of the study area mapped as Mining (ALUM code 5.8.0) that are outside of the Existing and approved disturbance area. Following site visits, groundcover in these areas (note 4 in Figure C.3) was found to be mostly derived native grasslands, so better classified as Grazing modified pastures (ALUM code 3.2.0) or Grazing native vegetation (ALUM code 2.1.0). Hence, these areas were also allocated to category 2 land.

Finally, there was a small area mapped as Cropping (ALUM code 3.3.0) to the southwest of the study area (note 5 in Figure C.3). As there was insufficient field data to confirm this land-use, this area was assigned as category 2 land on a precautionary basis. This area is outside of the Additional disturbance footprint, so will not be directly impacted.

4. Apply category 2 land to TSRs.

RESULT: There were several areas of mapped TSR located in the study area. All areas of TSR were already captured as category 2 land within steps 1–3.

The location of TSRs, as already classified as category 2 land, are shown on Figure C.4.

5. Apply category 2 land to areas identified as Remnant Vegetation Enhancement Program (RVEP).

RESULT: There is a strip of RVEP area to the south-east of the study area. This RVEP is outside of the Additional disturbance footprint.

Areas identified as RVEP, and so allocated to category 2 land, are shown in Figure C.5.

6. For areas not yet mapped as category 2 land, apply category 2 land to woody vegetation extent prior to 1990 by mapping trees present in the 1989 aerial imagery (the latest imagery available before 1990).

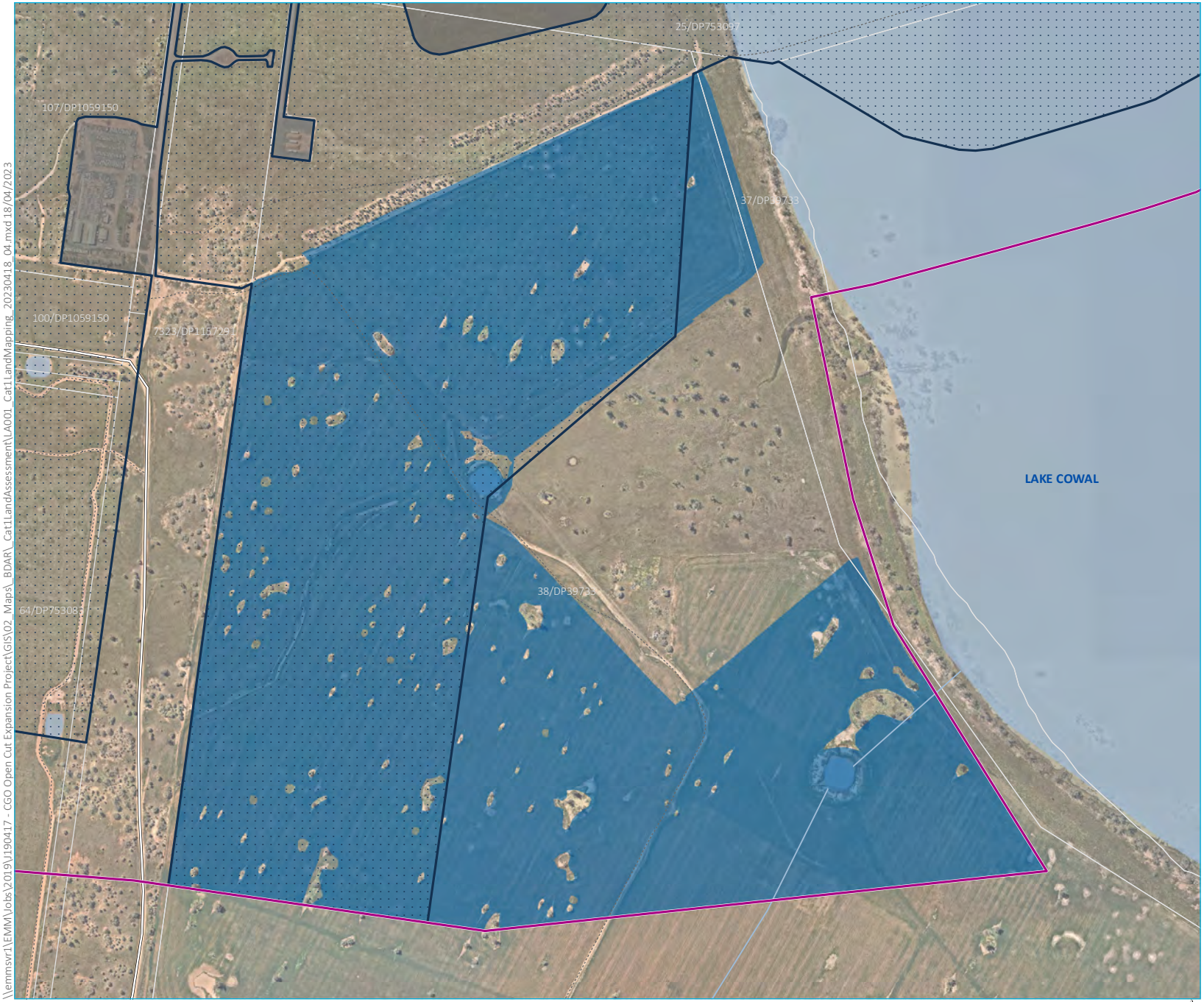
RESULT: Lot 38 DP39733 was the remaining land parcel not yet mapped as category 2 land. Woody vegetation on this property in the 1989 aerial imagery was paddock trees only and appeared to be largely consistent with those currently remaining. The mature paddock trees (that were extant prior to 1990 and which persist to the current day) were mapped as category 2 land during this stage and were identified during fieldwork for the BDAR as Wilga, Western Rosewood, and Belah.

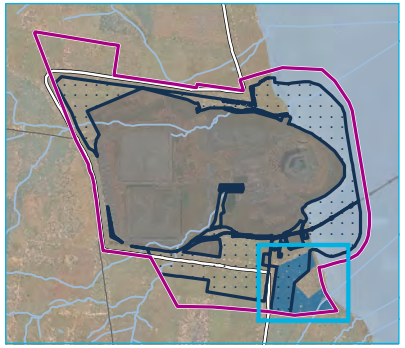
Areas identified as woody vegetation within Lot 38 DP39733, and so allocated to category 2 land, are shown in Figure C.6.

7. For areas not yet mapped as category 2 land, apply category 1 land to grassland areas identified within the time series aerial photography as cropped prior to 1990.

RESULT: All areas not classified as category 2 land were entirely within Lot 38 DP39733. Here, active cropping has occurred since prior to 1990, as evidenced by 1989 aerial imagery. After classifying woody vegetation in Lot 38 DP39733 as category 2 land in step 5, the remaining areas were categorised as category 1.

After undertaking steps 1 to 6, the remaining areas were classified as category 1 land, as shown in Figure C.7.





KEY

- Proposed category 1 land
- Study area
- Additional disturbance footprint
- DA14/98 approved surface disturbance
- Major road
- Minor road
- Vehicular track
- Watercourse/drainage line
- Waterbody
- Cadastral boundary

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Source: EMM (2023); Evolution (2023); DFSI (2021); Nearmap (2021)

0 250 500 m

GDA 1994 MGA Zone 55

N

Proposed category 1 land mapping

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Category 1 Land Assessment
Figure 4.1

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5 Key findings

Land within the category 1 and 2 land assessment area was assessed against the LLS Act criteria to firstly determine where category 2 land is present. The assessment concluded that category 2 land is present in areas where there were lands with some natural environments as per ALUM mapping (DPIE 2017; Grazing native vegetation, Grazing modified pastures, and Lake ALUM classes), areas identified as Cropping as per ALUM mapping (code 3.3.0) but considered "not low conservation value grassland", TSRs, Remnant Vegetation Enhancement Program (RVEP) and woody native vegetation not cleared prior to 1990.

Following categorisation of land within the study area as category 2 land as outlined in Section 3.2.2, it was considered that Lot 38 DP39733 was the only land parcel where active cropping has occurred to the extent that a portion of the land was consistent with the criteria for category 1 land (as detailed in Table 2.2). The full mapping of category 1 and 2 vegetation is shown in Figure C.7. The mapping of category 1 land on Lot 38 DP39733 is presented in Figure 4.1.

The areas of category 1 land identified on the site is, in EMM's view, appropriate and clearly supported by time series photography (presented in Appendix A), which demonstrates that there has been a long and consistent use of the site for agriculture, including cropping, pasture improvement, and stock grazing.

Historical imagery (see Appendix A) of Lot 38 DP 39733 shows cropping and grazing regimes were already established across the site by the time the earliest imagery was collected in 1973. Subsequent imagery shows that the only changes since 1973 have been a gradual decline in tree cover. The decline in tree cover is consistent with a combination of dieback and an absence of seedling recruitment, likely driven by a combination of unsuitable environmental factors (for example, drought) and land management practices (for example, grazing and cropping). Nevertheless, current tree cover on Lot 38 DP39733 is largely consistent with the earliest imagery of 1973.

Much of the contemporary agriculture on site represents continued use of Lot 38 DP 39733 for cropping and cattle grazing. This long agricultural land use history is recognised and supported by the mapping of extensive areas of ALUM classes "3.3.0 Cropping" across that land parcel (Appendix B), which is treated as category 1 land in the *Native vegetation regulatory map: method statement* (OEH 2017). Additionally, the cycle of cropping and cattle grazing continues to occur to the present day, as indicated by correspondence with the owners.

Based on historic aerial imagery and information from the landowners, much of Lot 38 DP 39733 has been cultivated in the past and continues to be farmed at the present, and therefore meets the criteria for category 1 land.

References

DPIE 2020, *Biodiversity Assessment Method*, Department of Planning, Industry and Environment, Sydney

DPIE 2017, *NSW Land Use 2017 v1.2*, Department of Planning, Industry and Environment, Sydney

Greencap 2022, *BAM Assessor Accreditation Renewal Course Companion*.

LLS 2023, Travelling Stock Reserves – State Classification Map from Local Land Services, from https://trade.maps.arcgis.com/apps/webappviewer/index.html?id=dd585551cd5c4320bfcd2d671d8f2364, accessed March 2023

NSW Government 2023, *Transitional native vegetation regulatory map viewer*, from https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=NVRMap, accessed January 2023

NSW Government Spatial Services 2023, *Historical Imagery Viewer*, https://www.spatial.nsw.gov.au/products_and_services/aerial_and_historical_imagery, accessed January 2023

OEH 2017, *Native vegetation regulatory map: method statement*, Office of Environment and Heritage, Sydney

Appendix A

Historic imagery sequency (1973 - 2021)

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KEY

- Study area
- Additional disturbance footprint
- Major road
- Minor road
- Vehicular track
- Watercourse/drainage line
- Waterbody
- Cadastral boundary

\\emmsvr1\EMM\Jobs\2019\190417 - CGO Open Cut Expansion Project\GIS\02_Maps_BDAR_Cat1LandAssessment\LA002_1973AerialImagery_20230418_04.mxd 18/04/2023

Source: EMM (2023); Evolution (2023); DFSI (2021); NSW Spatial Services (2023)

0 1 2 km

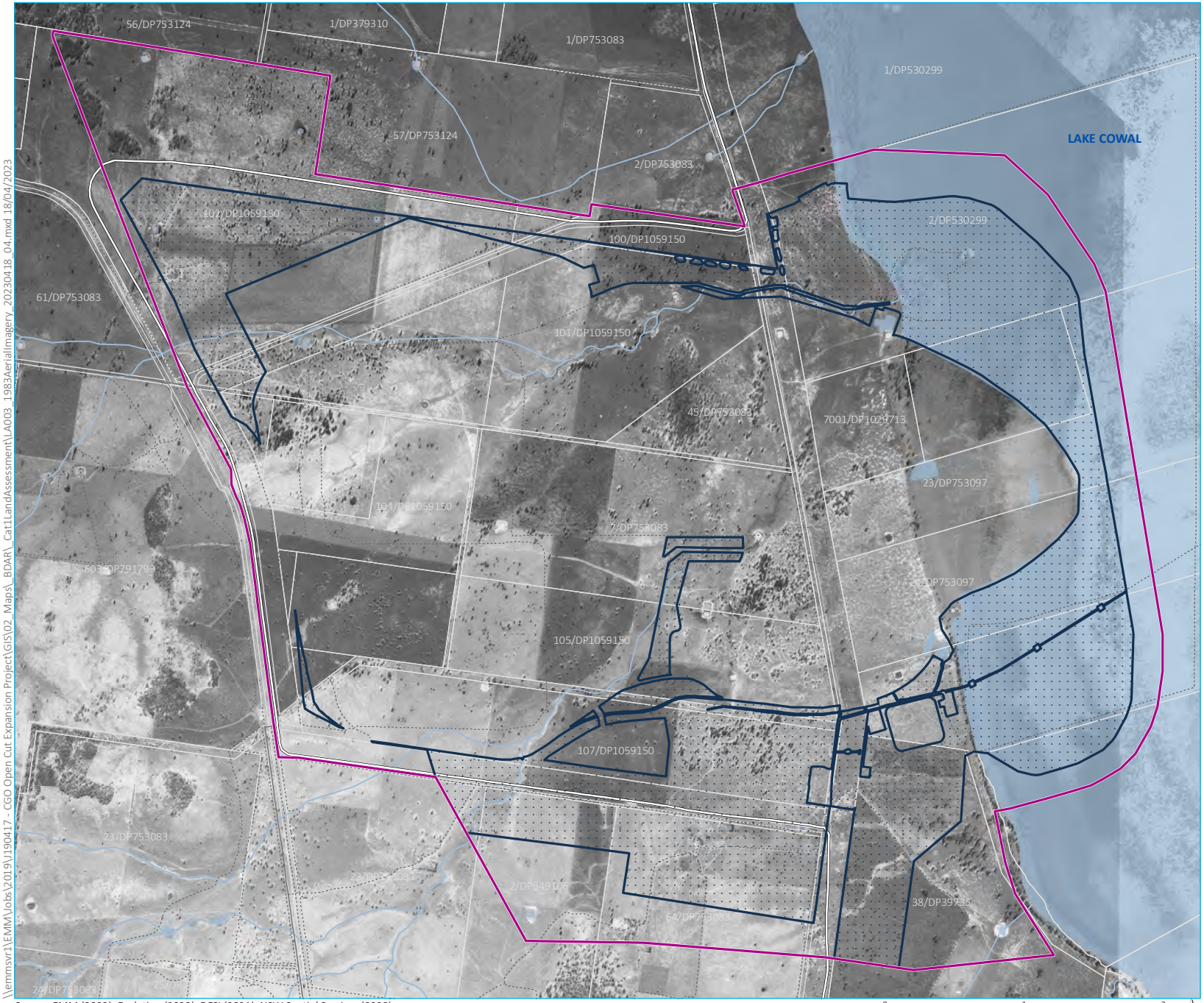
GDA 1994 MGA Zone 55

N

1973 Aerial imagery

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Category 1 Land Assessment
Figure A.1

EMM
creating opportunities



KEY

- Study area
- Additional disturbance footprint
- Major road
- Minor road
- Vehicular track
- Watercourse/drainage line
- Waterbody
- Cadastral boundary

Source: EMM (2023); Evolution (2023); DFSI (2021); NSW Spatial Services (2023)

0 1 2 km

GDA 1994 MGA Zone 55

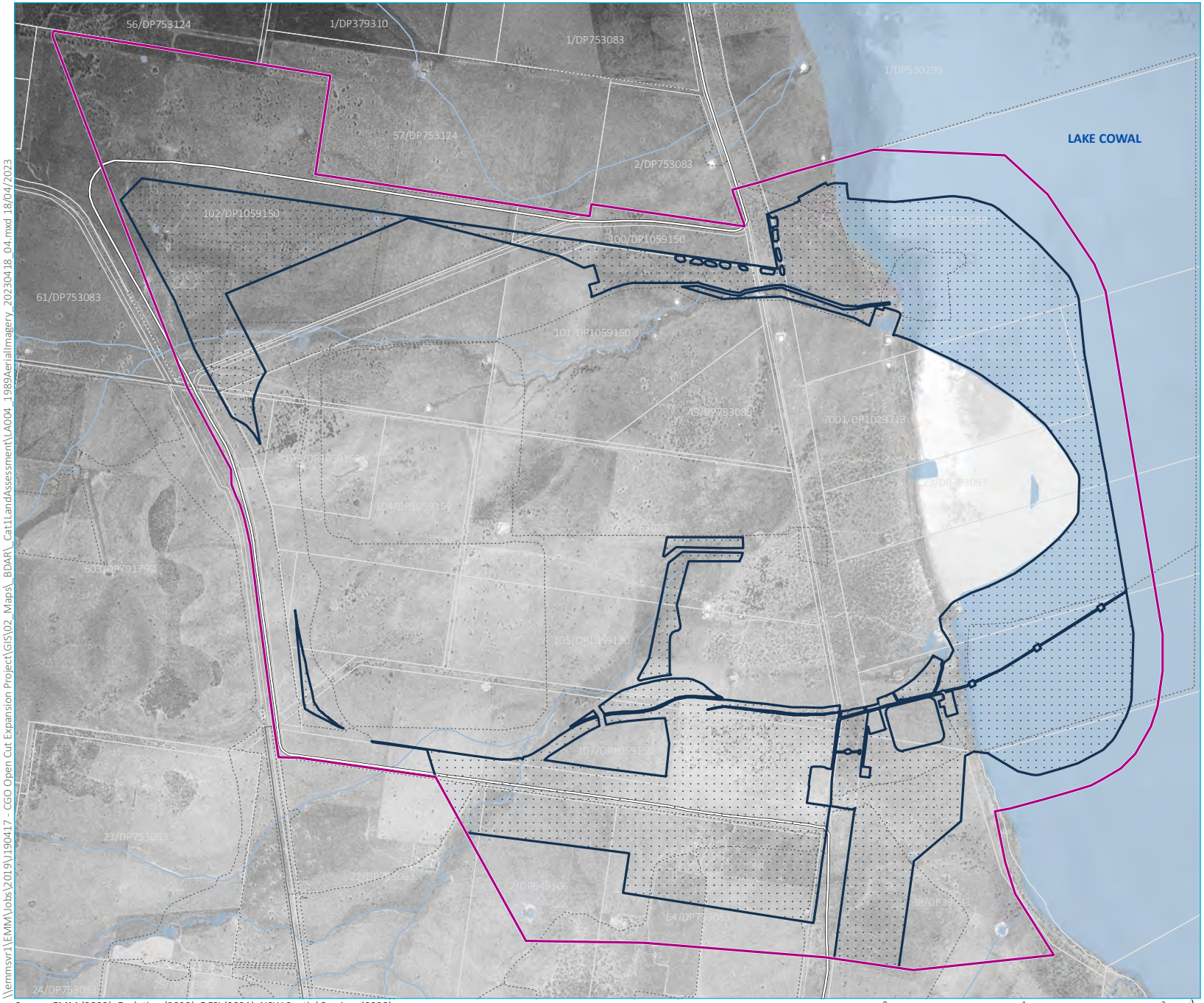
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\\emmsvr1\EMM\Jobs\2019\1190417 - CGO Open Cut Expansion Project\GIS\02_Maps_BDAR_Cat1LandAssessment\LA003_1983AerialImagery_20230418_04.mxd 18/04/2023

1983 Aerial imagery

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Category 1 Land Assessment
Figure A.2

EMM
creating opportunities



KEY

- Study area
- Additional disturbance footprint
- Major road
- Minor road
- Vehicular track
- Watercourse/drainage line
- Waterbody
- Cadastral boundary

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Source: EMM (2023); Evolution (2023); DFSI (2021); NSW Spatial Services (2023)

0 1 2 km

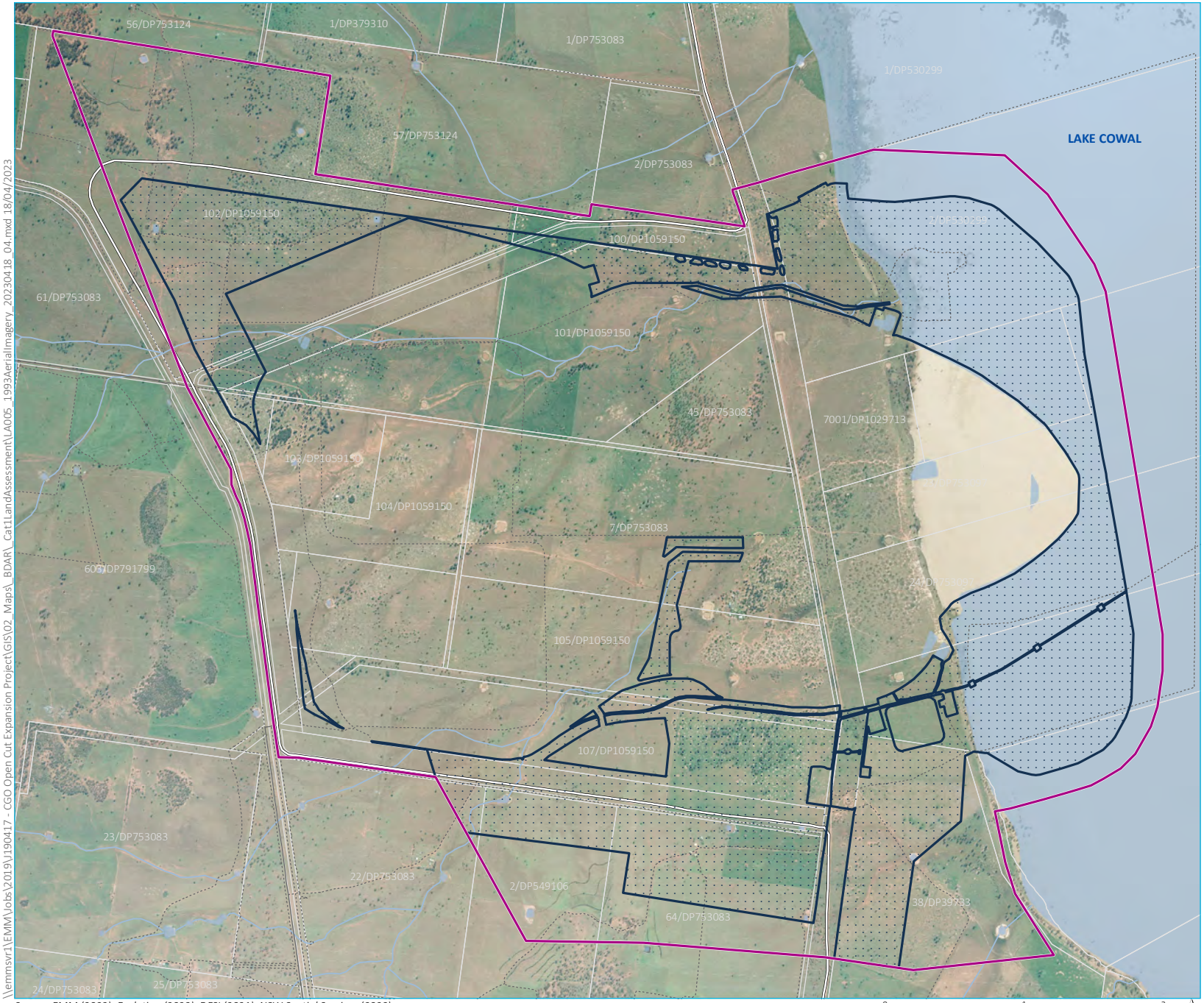
GDA 1994 MGA Zone 55

N

1989 Aerial imagery

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Category 1 Land Assessment
Figure A.3

EMM
creating opportunities



KEY

- Study area
- Additional disturbance footprint
- Major road
- Minor road
- Vehicular track
- Watercourse/drainage line
- Waterbody
- Cadastral boundary

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Source: EMM (2023); Evolution (2023); DFSI (2021); NSW Spatial Services (2023)

0 1 2 km

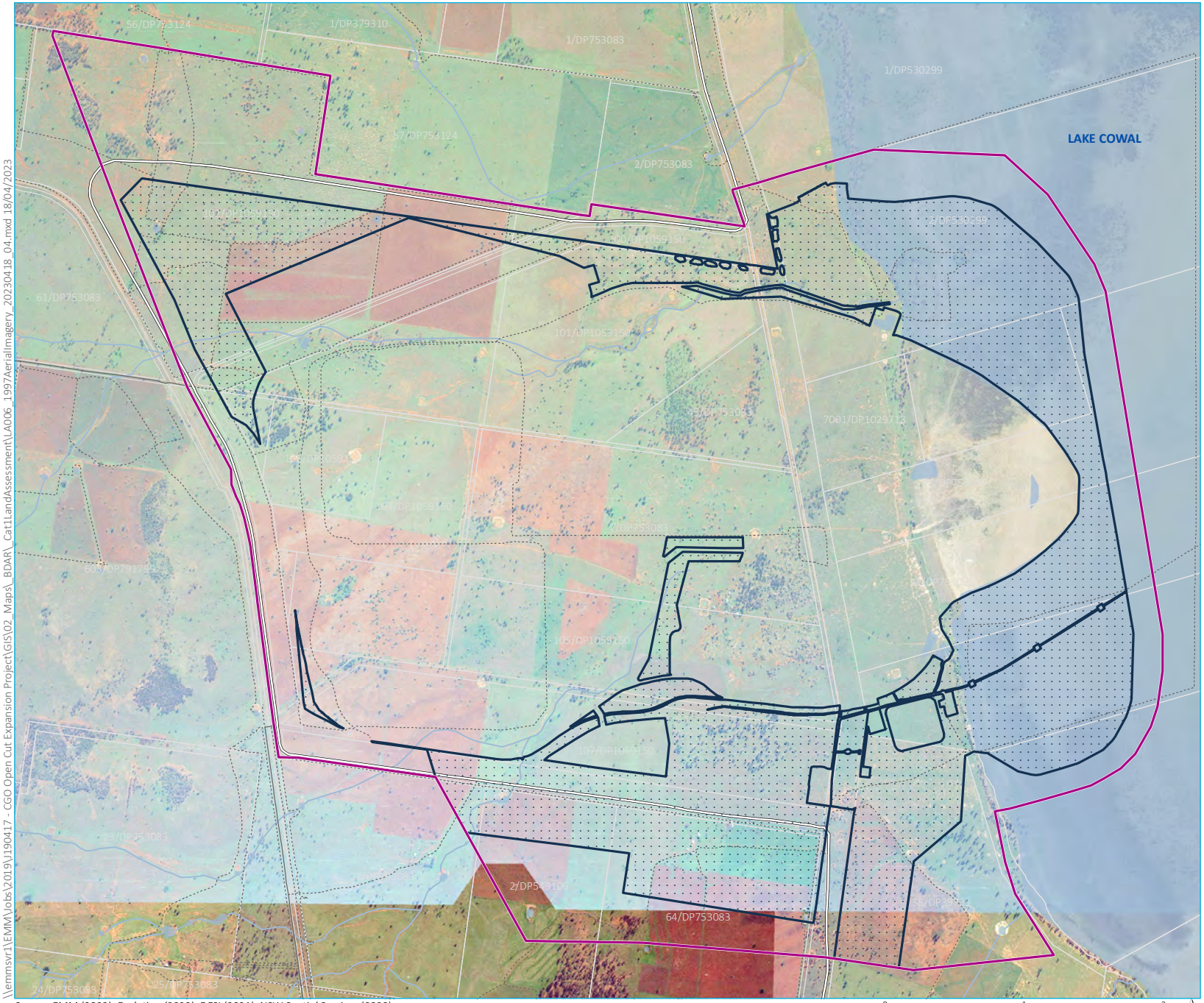
GDA 1994 MGA Zone 55

N

1993 Aerial imagery

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Category 1 Land Assessment
Figure A.4

EMM
creating opportunities



KEY

- Study area
- Additional disturbance footprint
- Major road
- Minor road
- Vehicular track
- Watercourse/drainage line
- Waterbody
- Cadastral boundary

\\emmsvr1\EMM\Jobs\2019\190417 - CGO Open Cut Expansion Project\GIS\02_Maps_BDAR_Cat1LandAssessment\LA006_1997AerialImagery_20230418_04.mxd 18/04/2023

Source: EMM (2023); Evolution (2023); DFSI (2021); NSW Spatial Services (2023)

1997 Aerial imagery

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Category 1 Land Assessment
Figure A.5

EMM
creating opportunities



KEY

- Study area
- Additional disturbance footprint
- Major road
- Minor road
- Vehicular track
- Watercourse/drainage line
- Waterbody
- Cadastral boundary

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Source: EMM (2023); Evolution (2023); DFSI (2021)

0 1 2 km

GDA 1994 MGA Zone 55

N

2010 Aerial imagery

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Category 1 Land Assessment
Figure A.6

EMM
creating opportunities



KEY

- Study area
- Additional disturbance footprint
- Major road
- Minor road
- Vehicular track
- Watercourse/drainage line
- Waterbody
- Cadastral boundary

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Source: EMM (2023); Evolution (2023); DFSI (2021)

0 1 2 km

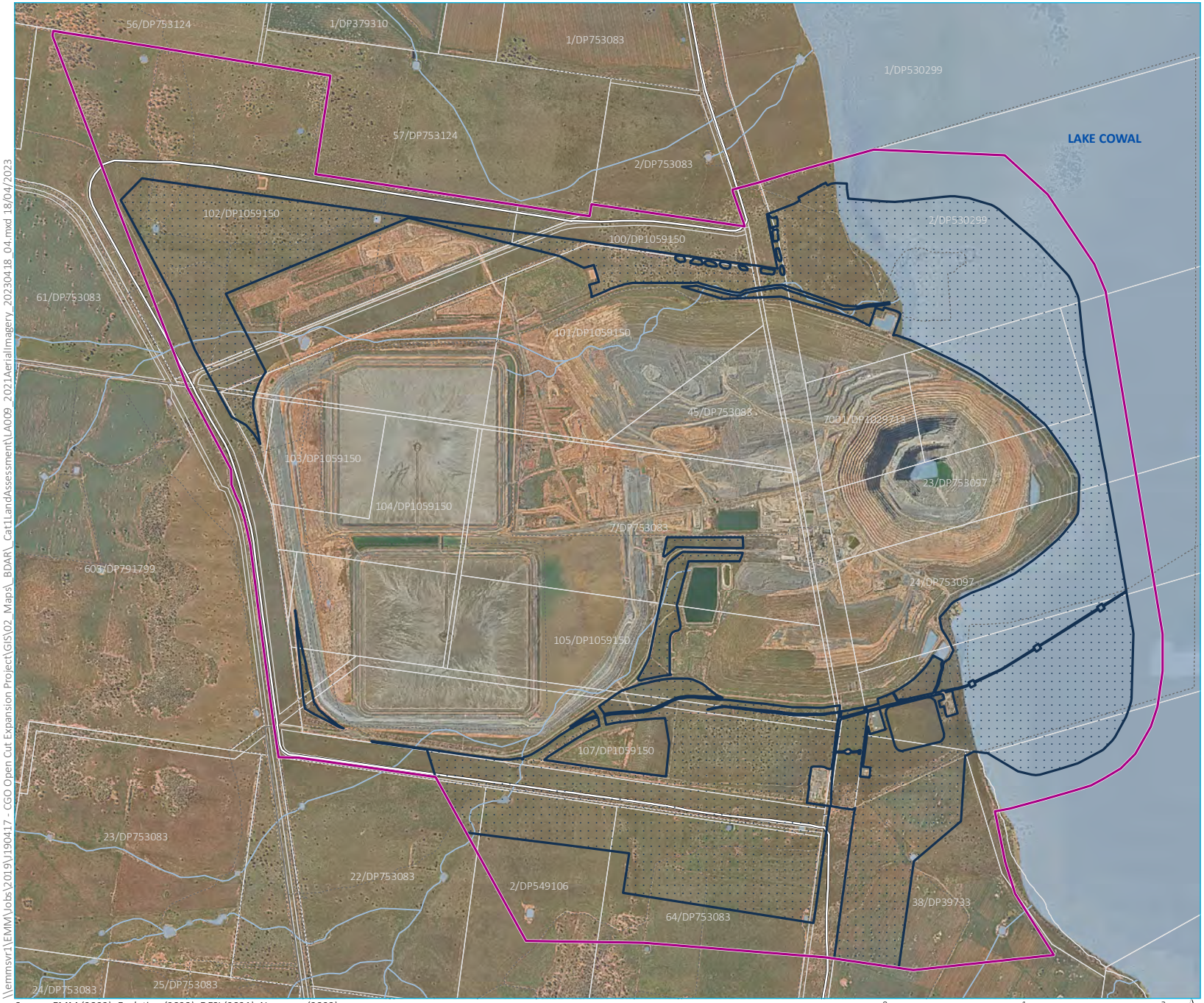
GDA 1994 MGA Zone 55

N

2015 Aerial imagery

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Category 1 Land Assessment
Figure A.7

EMM
creating opportunities



KEY

- Study area
- Additional disturbance footprint
- Major road
- Minor road
- Vehicular track
- Watercourse/drainage line
- Waterbody
- Cadastral boundary

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Source: EMM (2023); Evolution (2023); DFSI (2021); Nearmap (2023)

0 1 2 km

GDA 1994 MGA Zone 55

N

2021 Aerial imagery

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Category 1 Land Assessment
Figure A.8

EMM
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Appendix B

ALUM classes on site (from NSW land use map; DPIE 2017)

EMM
creating opportunities



KEY

- Study area
- Additional disturbance footprint
- Major road
- Minor road
- Vehicular track
- Watercourse/drainage line
- Cadastral boundary

Land use

- 2.1.0 Grazing native vegetation
- 3.2.0 Grazing modified pastures
- 3.3.0 Cropping
- 5.4.0 Residential and farm infrastructure
- 5.8.0 Mining
- 6.1.0 Lake
- 6.2.0 Reservoir/dam

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Source: EMM (2023); Evolution (2023); DFSI (2021); DPIE (2020); Nearmap (2021)

0 0.5 1 km

GDA 1994 MGA Zone 55

N

ALUM classes on the study area

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Category 1 Land Assessment
Figure B.1

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Appendix C

Category-2 land mapping steps

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C.1 Category 2 land mapping steps

This appendix provides a visual display of the steps taken to map category 1 land. This involved firstly identifying category 2 land in steps 1 to 6, with step 7 identifying category 1 land in the final stage. These steps are as below:

1. Identify category 2 land from NVR.

2. Apply category 2 land to substantially natural environments vegetation as per NSW Land Use 2017 data layer (classes 2.1.0, 3.2.0 or 6.1.0).

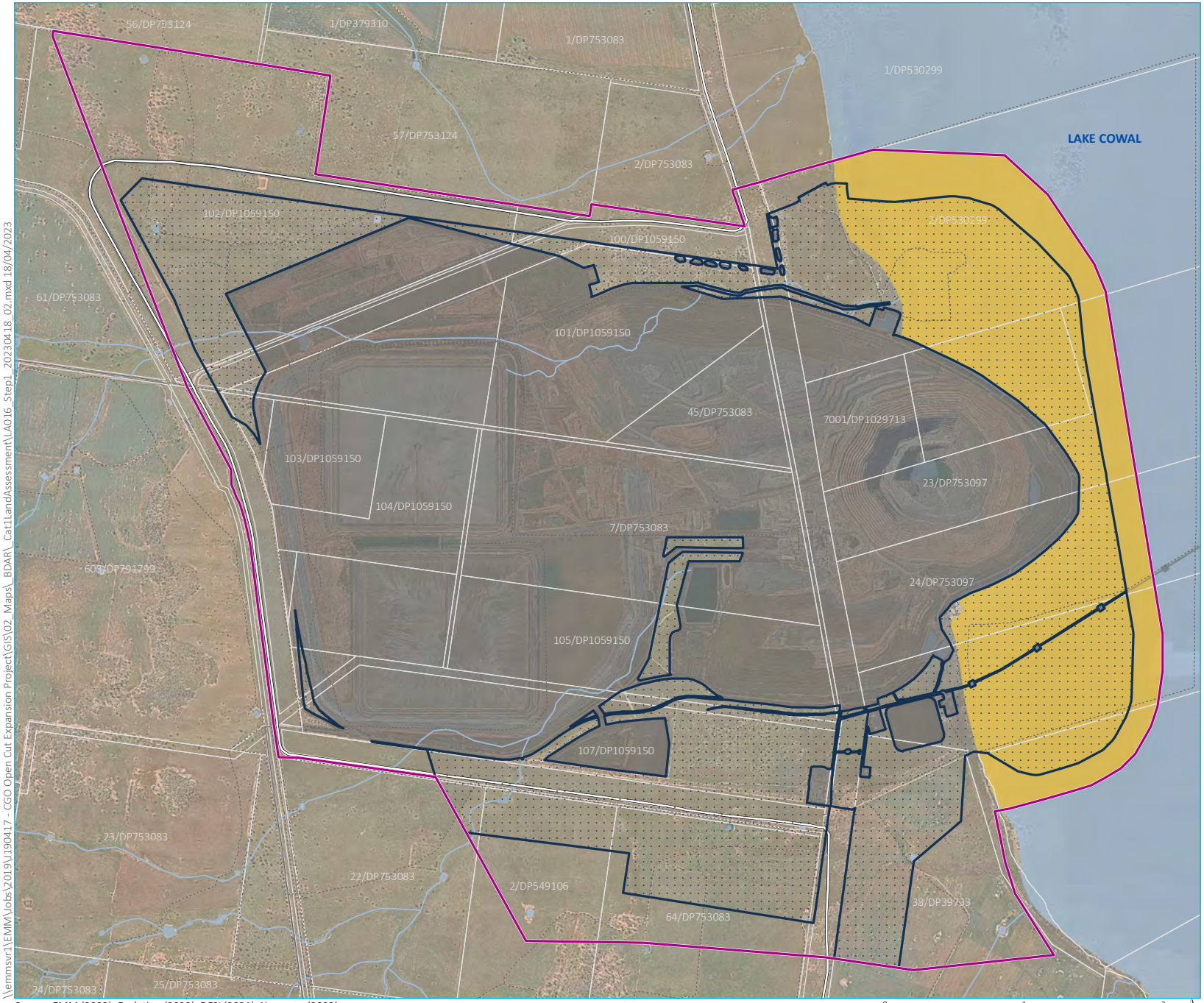
3. Apply category 2 land to areas of Cropping (ALUM code 3.3.0) or Mining (ALUM code 5.8.0) outside of the Approved disturbed Area considered “not low conservation value grassland” as per Section 60I(2)(e) LLS Act.

4. Apply category 2 land to Travelling Stock Reserves (TSRs).

5. Apply category 2 land to areas identified as Remnant Vegetation Enhancement Program (RVEP).

6. For areas not yet mapped as category 2 land, apply category 2 land to woody vegetation extant prior to 1990 by mapping trees present in the 1989 aerial imagery (the latest imagery available before 1990).

7. For areas not yet mapped as category 2 land, apply category 1 land to grassland areas identified within the time series aerial photography as cropped prior to 1990.



KEY

- Additional proposed category 2 land
- Study area
- Additional disturbance footprint
- DA14/98 approved surface disturbance
- Major road
- Minor road
- Vehicular track
- Watercourse/drainage line
- Waterbody
- Cadastral boundary

Step 1. Identification of category 2 land from NVR

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Source: EMM (2023); Evolution (2023); DFSI (2021); Nearmap (2023)

0 1 2 km

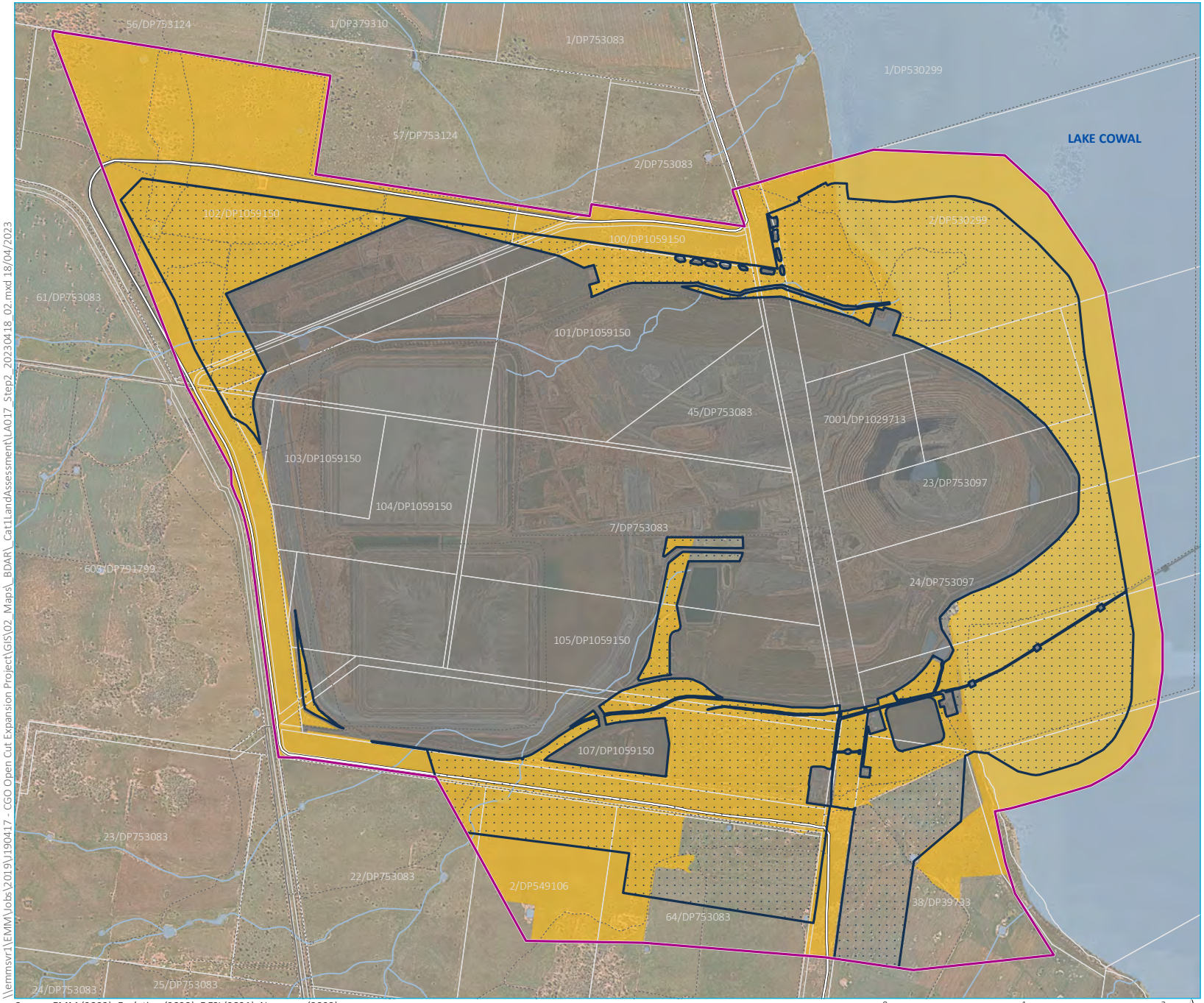
GDA 1994 MGA Zone 55

N

Land category mapping procedure
Step 1

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Category 1 Land Assessment
Figure C.1

EMM
creating opportunities



KEY

- Additional proposed category 2 land
- Study area
- Additional disturbance footprint
- DA14/98 approved surface disturbance
- Major road
- Minor road
- Vehicular track
- Watercourse/drainage line
- Waterbody
- Cadastral boundary

Step 2. Category 2 land was applied to substantially natural environments vegetation as per NSW Land Use 2017 data layer (classes 2.1.0, 3.2.0 or 6.1.0)

Source: EMM (2023); Evolution (2023); DFSI (2021); Nearmap (2023)

0 1 2 km

GDA 1994 MGA Zone 55

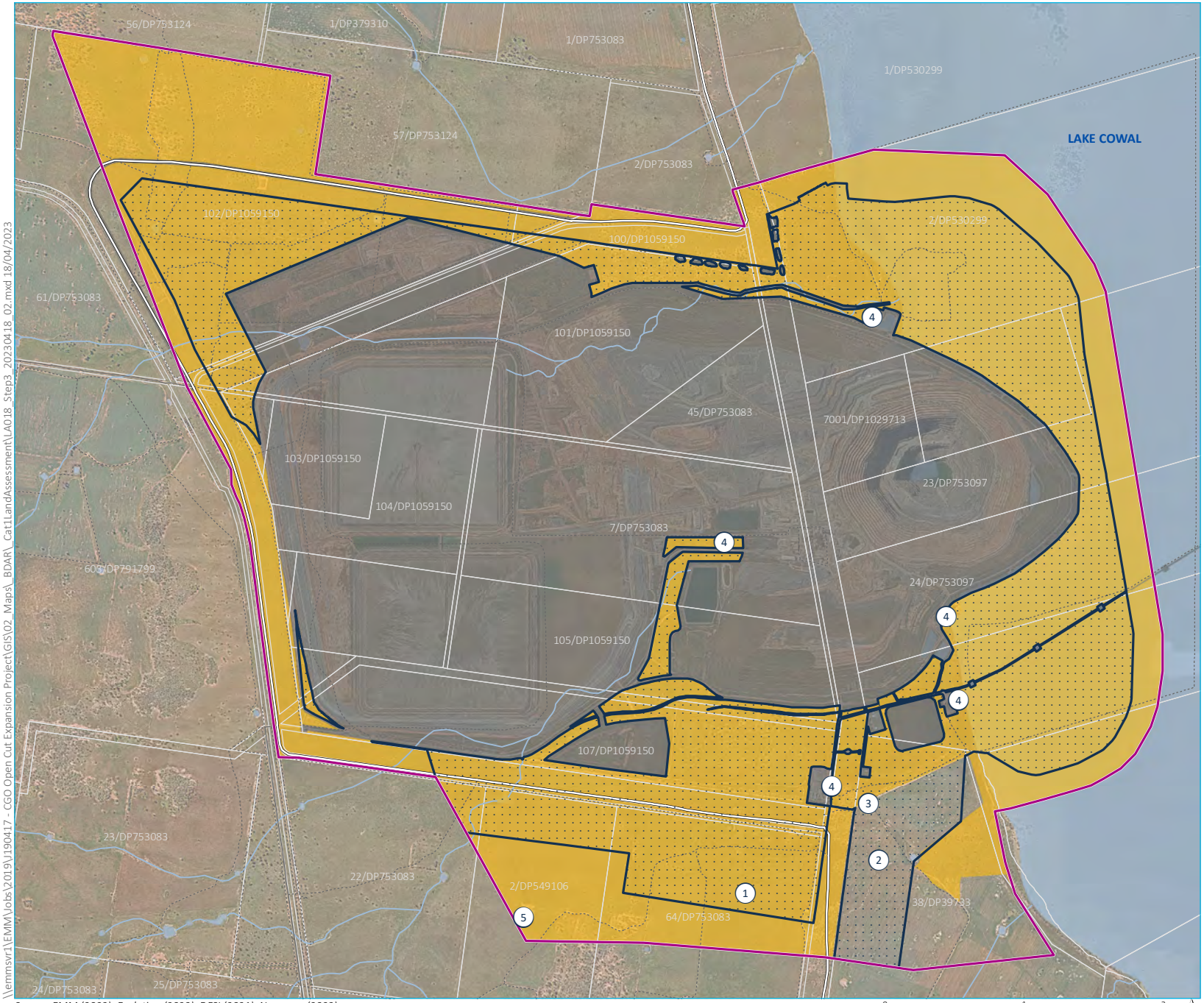
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Land category mapping procedure
Step 2

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Category 1 Land Assessment
Figure C.2

EMM
creating opportunities



KEY

- Additional proposed category 2 land
- Study area
- Additional disturbance footprint
- DA14/98 approved surface disturbance
- Major road
- Minor road
- Vehicular track
- Watercourse/drainage line
- Waterbody
- Cadastral boundary

Step 3 notes

1. No on-ground evidence of recent cropping and considerable proportion of native species cover
2. Intense cropping regime has led to highly disturbed groundcover
3. Small adjustment to the extent of Cropping (ALUM code 3.3.0) required
4. Area mapped as Mining (ALUM code 5.8.0) that is outside of the Existing and approved disturbance area and best classified as Grazing modified pastures (ALUM code 3.2.0)
5. Insufficient field data to confirm cropping land-use, so this area was considered as category 2 land

Step 3. Category 2 land applied to areas of Cropping (ALUM code 3.3.0) considered "not low conservation value grassland" as per Section 60I(2)(e) LLS Act

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Source: EMM (2023); Evolution (2023); DFSI (2021); Nearmap (2023)

0 1 2 km

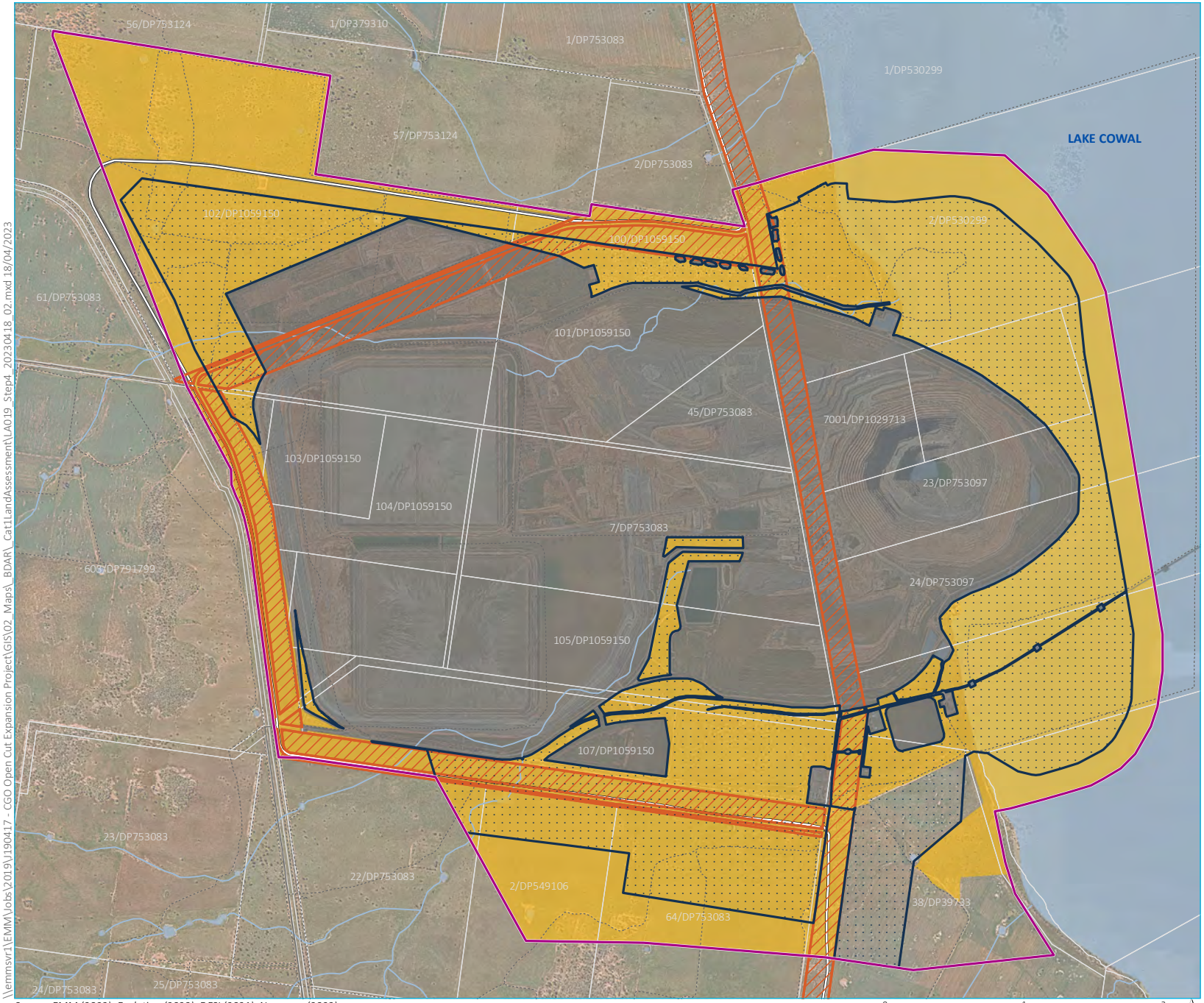
GDA 1994 MGA Zone 55

N

Land category mapping procedure
Step 3

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Category 1 Land Assessment
Figure C.3

EMM
creating opportunities



KEY

- Additional proposed category 2 land
- Study area
- Additional disturbance footprint
- DA14/98 approved surface disturbance
- Major road
- Minor road
- Vehicular track
- Watercourse/drainage line
- Waterbody
- Cadastral boundary
- Travelling Stock Reserve (TSR)

Step 4. Category 2 land was applied to Travelling Stock Reserves (TSRs)

\\emmsvr1\EMM\Jobs\2019\190417 - CGO Open Cut Expansion Project\GIS\02_Maps_BDAR_Cat1LandAssessment\LA019_Step4_20230418_02.mxd 18/04/2023

Source: EMM (2023); Evolution (2023); DFSI (2021); Nearmap (2023)

0 1 2 km

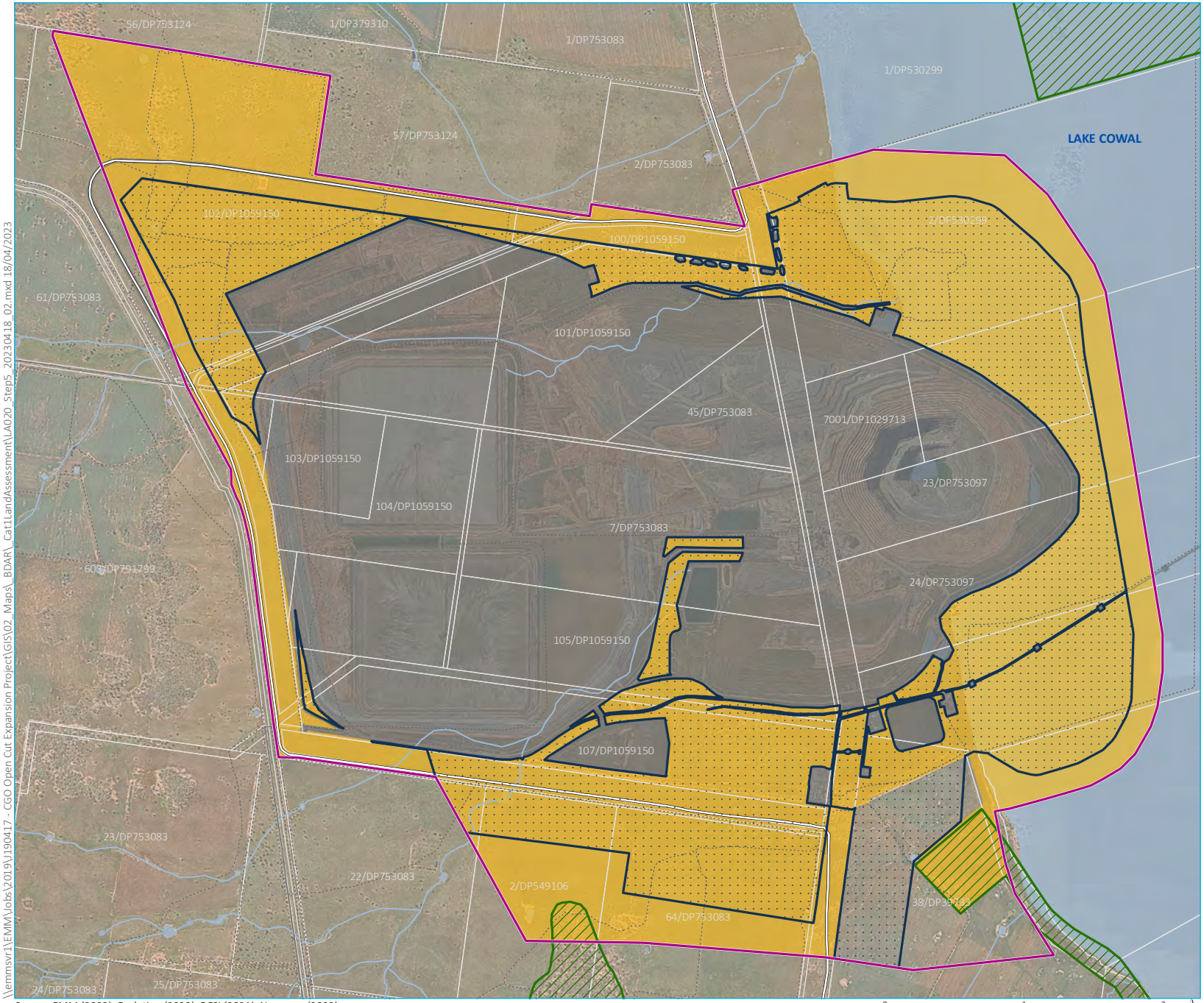
GDA 1994 MGA Zone 55

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Land category mapping procedure
Step 4

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Category 1 Land Assessment
Figure C.4

EMM
creating opportunities



KEY

- Additional proposed category 2 land
- Study area
- Additional disturbance footprint
- DA14/98 approved surface disturbance
- Major road
- Minor road
- Vehicular track
- Watercourse/drainage line
- Waterbody
- Cadastral boundary
- Remnant Vegetation Enhancement Program

Step 5. Category 2 land was applied to areas identified as Remnant Vegetation Enhancement Program (RVEP)

\\emmsvr1\EMM\Jobs\2019\190417 - CGO Open Cut Expansion Project\GIS\02_Maps_BDAR_Cat1LandAssessment\LA020_Step5_20230418_02.mxd 18/04/2023

Source: EMM (2023); Evolution (2023); DFSI (2021); Nearmap (2023)

0 1 2 km

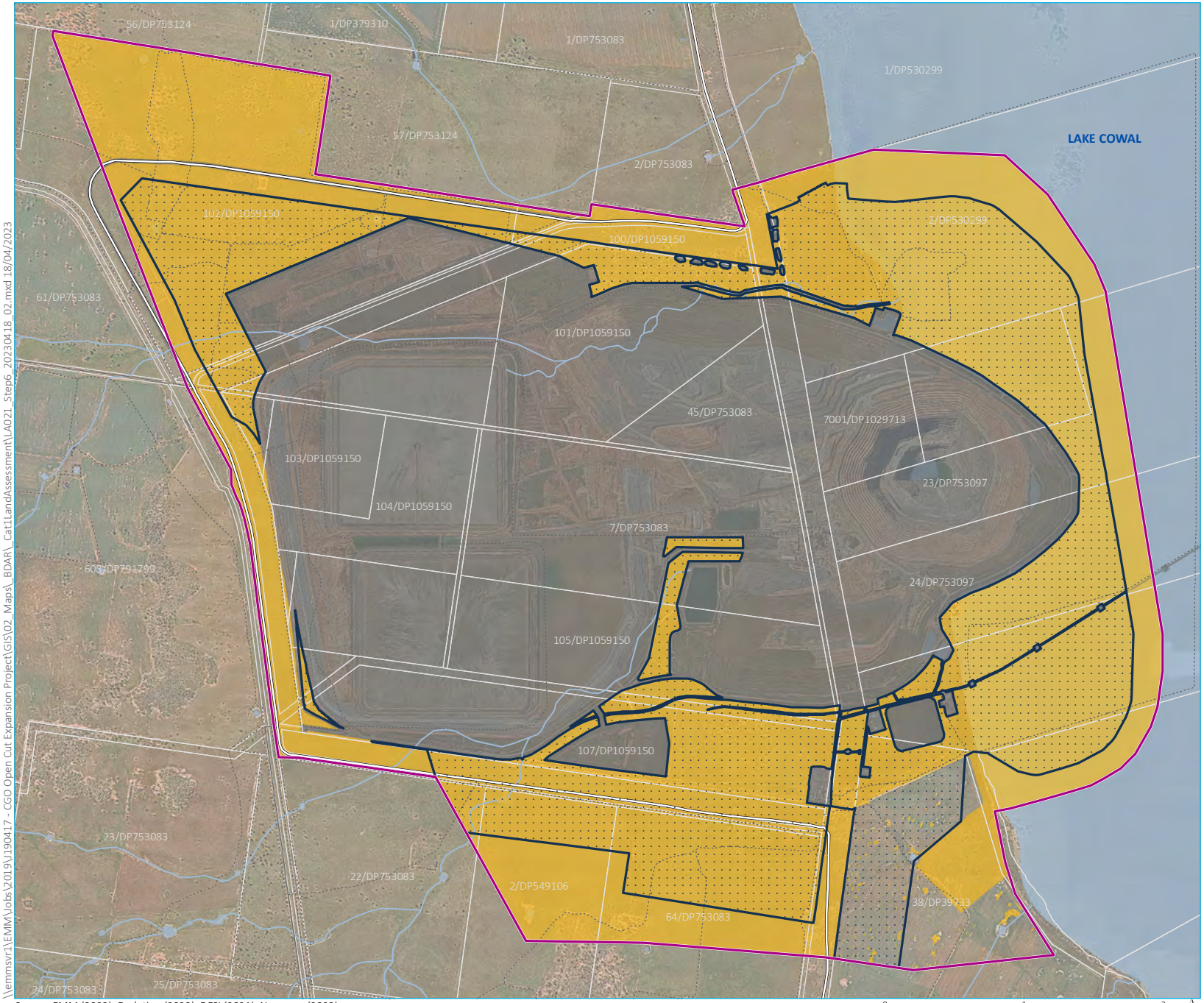
GDA 1994 MGA Zone 55

N

Land category mapping procedure
Step 5

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Category 1 Land Assessment
Figure C.5

EMM
creating opportunities



KEY

- Additional proposed category 2 land
- Study area
- Additional disturbance footprint
- DA14/98 approved surface disturbance
- Major road
- Minor road
- Vehicular track
- Watercourse/drainage line
- Waterbody
- Cadastral boundary

Step 6. For areas not yet mapped as Category 2 land, Category 2 land was applied to woody vegetation extent prior to 1990 by mapping trees present in the 1989 aerial imagery (the latest imagery available before 1990)

\\emmsvr1\EMM\Jobs\2019\190417 - CGO Open Cut Expansion Project\GIS\02_Maps_BDAR_Cat1LandAssessment\LA021_Step6_20230418_02.mxd 18/04/2023

Source: EMM (2023); Evolution (2023); DFSI (2021); Nearmap (2023)

0 1 2 km

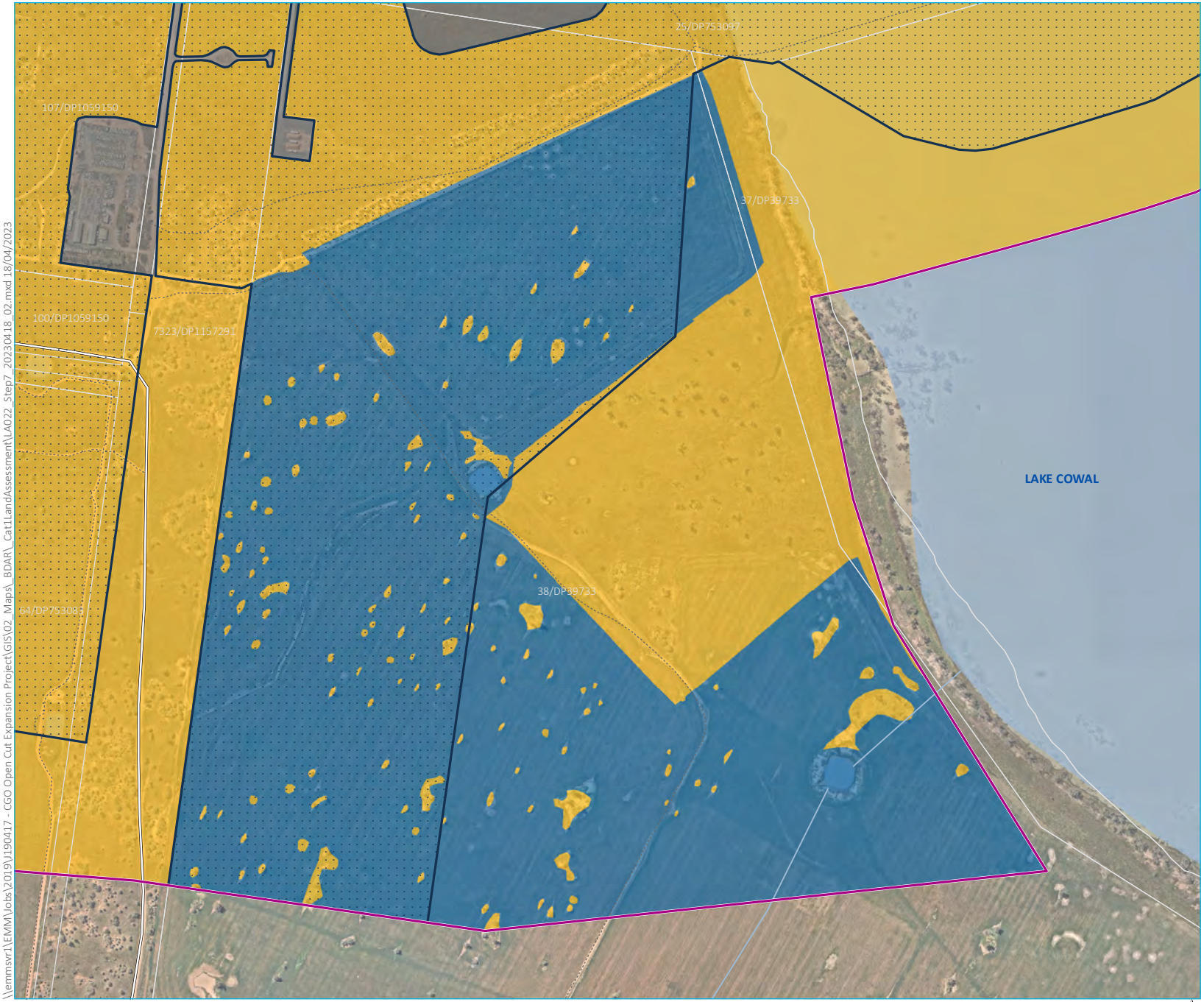
GDA 1994 MGA Zone 55

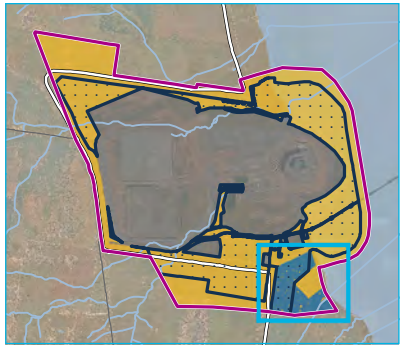
N

Land category mapping procedure
Step 6

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Category 1 Land Assessment
Figure C.6

EMM
creating opportunities





KEY

- Proposed category 1 land
- Proposed category 2 land
- Study area
- Additional disturbance footprint
- DA14/98 approved surface disturbance
- Major road
- Minor road
- Vehicular track
- Watercourse/drainage line
- Waterbody
- Cadastral boundary

Step 7. For areas not yet mapped as Category 2 land, Category 1 land was applied to grassland areas identified within the time series aerial photography as cropped prior to 1990

\\emmsvr1\EMM\Jobs\2019\190417 - CGO Open Cut Expansion Project\GIS\02_Maps_BDAR_Cat1LandAssessment\LA022_Step7_20230418_02.mxd 18/04/2023

Source: EMM (2023); Evolution (2023); DFSI (2021); Nearmap (2023)

0 250 500 m

GDA 1994 MGA Zone 55

N

Land category mapping procedure
Step 7

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Category 1 Land Assessment
Figure C.7

EMM
creating opportunities

Appendix F
Hollow-bearing trees

EMM
creating opportunities

Tree Species	DBH (cm)	Hollows <5 cm	Hollows 5 - 20 cm	Hollows > 20 cm	Vegetation Zone
A.oleifolius	35	1	0	0	PCT82 - Poor
A.oleifolius	40	0	1	0	PCT82 - Medium
A.oleifolius	15	1	0	0	PCT55 - Poor
A.oleifolius	60	1	0	0	PCT55 - Poor
A.oleifolius	40	2	0	0	PCT82 - Poor
A.oleifolius	40	1	0	0	Cleared
A.oleifolius	40	1	0	0	PCT55 - Medium
A.oleifolius	35	0	1	0	PCT26 - Planted
A.oleifolius	50	0	1	0	Cropped
A.oleifolius	50	0	1	0	Cropped
A.oleifolius	0	2	1	0	PCT55 - Poor
A.oleifolius	35	0	1	0	PCT26 - Poor
A.oleifolius	45	0	1	0	PCT26 - Poor
A.oleifolius	50	0	1	0	PCT26 - Poor
A.oleifolius	35	1	3	0	PCT55 - Poor
A.oleifolius	60	1	2	0	PCT26 - Medium
A.oleifolius	55	0	2	0	PCT55 - Medium
A.oleifolius	0	0	1	0	PCT55 - Medium
A.oleifolius	0	1	0	0	PCT55 - Poor
A.oleifolius	0	1	0	0	PCT55 - Medium
A.oleifolius	0	0	1	0	PCT55 - Medium
A.oleifolius	0	1	0	0	PCT55 - Medium
A.oleifolius	0	0	1	0	PCT55 - Medium
A.oleifolius	60	1	0	0	PCT55 - Medium
A.oleifolius	50	2	0	0	PCT55 - Medium
A.oleifolius subsp. *canescens*	70	0	1	0	PCT55 - Medium
A.oleifolius subsp. *canescens*	70	2	0	0	PCT55 - Medium
A.pendula	55	0	1	0	PCT55 - Medium
A.pendula	50	0	2	0	PCT55 - Medium
A.pendula	65	0	1	0	PCT55 - Medium
A.pendula	60	3	0	0	PCT55 - Medium
A.pendula	50	0	1	0	PCT55 - Poor
A.pendula	55	1	0	0	PCT55 - Medium
A.pendula	75	0	0	1	PCT55 - Poor
A.pendula	40	0	1	0	PCT55 - Medium
Acacia sp.	25	0	1	0	Cleared
Acacia sp.	40	1	0	0	PCT249 - Medium
Acacia sp.	75	2	0	0	PCT26 - Medium
Alectryon sp.	100	1	0	0	PCT55 - Medium
Alectryon sp.	50	0	1	0	PCT55 - Medium
Alectryon sp.	80	0	2	0	PCT55 - DNG
Alectryon sp.	100	1	0	0	PCT55 - Medium
Alectryon sp.	100	1	1	0	PCT55 - Medium

Tree Species	DBH (cm)	Hollows <5 cm	Hollows 5 - 20 cm	Hollows > 20 cm	Vegetation Zone
Alectryon sp.	100	2	0	0	PCT55 - Medium
Alectryon sp.	100	2	0	0	PCT55 - Medium
Allocasuarina sp.	50	0	1	0	Cleared
Allocasuarina sp.	70	2	0	0	PCT82 - Poor
Allocasuarina sp.	100	2	0	0	PCT55 - DNG
Allocasuarina sp.	100	0	0	0	PCT55 - Poor
Allocasuarina sp.	90	1	0	0	PCT55 - DNG
Casuarina sp.	75	3	1	0	PCT55 - Poor
Casuarina sp.	0	0	1	0	PCT55 - Poor
C.cristata	0	2	0	0	PCT55 - Poor
C.cristata	0	1	2	0	PCT55 - Poor
C.cristata	70	1	1	0	PCT26 - High
C.cristata	35	2	0	0	PCT26 - Medium
C.cristata	0	2	0	0	PCT55 - Poor
C.cristata	0	0	0	1	PCT55 - Poor
C.cristata	40	1	0	0	PCT26 - Medium
C.cristata	35	2	0	0	PCT26 - Poor
C.cristata	45	1	0	0	PCT26 - Medium
C.cristata	70	0	0	1	PCT55 - DNG
C.cristata	100	2	1	0	Cleared
C.cristata	0	0	2	0	PCT55 - Poor
C.cristata	60	1	0	0	PCT55 - Medium
C.cristata	0	0	1	0	PCT55 - Medium
C.cristata	80	1	0	0	PCT55 - Medium
C.cristata	75	0	2	0	PCT55 - Medium
C.cristata	70	1	0	0	PCT55 - Medium
C.cristata	0	0	3	0	PCT55 - Medium
C.cristata	0	0	1	0	PCT55 - Medium
C.cristata	0	1	0	0	PCT55 - Medium
C.cristata	65	1	0	0	PCT55 - Medium
C.cristata	55	0	1	0	PCT55 - Medium
C.cristata	55	1	0	0	PCT55 - Medium
C.cristata	60	2	0	0	PCT55 - Medium
C.cristata	0	2	0	0	PCT82 - DNG
C.cristata	75	0	1	0	PCT55 - Medium
C.cristata	70	2	0	0	PCT55 - Medium
C.cristata	80	1	1	0	PCT55 - Medium
C.cristata	45	1	0	0	PCT55 - Medium
C.cristata	45	1	0	0	PCT55 - Medium
C.cristata	80	1	2	0	PCT244 - Poor
C.cristata	200	2	2	0	PCT244 - Medium
C.cristata	90	2	0	0	PCT244 - DNG
C.cristata	90	2	0	0	PCT244 - Poor

Tree Species	DBH (cm)	Hollows <5 cm	Hollows 5 - 20 cm	Hollows > 20 cm	Vegetation Zone
C.cristata	120	0	3	0	PCT244 - Medium
C.cristata	50	2	0	0	PCT244 - Medium
C.cristata	70	0	2	0	PCT244 - Medium
C.cristata	160	6	1	0	PCT244 - Medium
C.cristata	50	2	0	1	PCT244 - Medium
C.cristata	140	5	1	0	PCT244 - Medium
C.cristata	100	1	1	1	PCT244 - Medium
C.cristata	80	2	2	0	PCT244 - Medium
C.cristata	90	1	3	0	PCT244 - Medium
C.cristata	60	2	0	0	PCT244 - Medium
C.cristata	60	0	1	0	PCT244 - Medium
C.cristata	80	0	2	0	PCT244 - Medium
C.cristata	60	0	1	0	PCT244 - Medium
C.cristata	70	2	2	0	PCT244 - Medium
C.cristata	70	2	0	0	PCT244 - Medium
C.cristata	70	0	1	0	PCT244 - Medium
C.cristata	60	2	0	0	PCT244 - Medium
C.cristata	60	1	1	0	PCT244 - Medium
C.cristata	70	2	1	0	PCT244 - Medium
C.cristata	60	0	1	0	PCT244 - Medium
C.cristata	80	1	0	0	PCT55 - Medium
C.cristata	50	1	1	0	PCT244 - Medium
C.cristata	60	0	1	0	PCT244 - Medium
C.cristata	50	2	0	0	PCT244 - Medium
C.cristata	60	2	0	0	PCT244 - Medium
C.cristata	60	2	0	0	PCT244 - Medium
C.cristata	50	3	0	0	PCT244 - Medium
C.cristata	60	3	1	0	PCT244 - Medium
C.cristata	45	1	0	0	PCT55 - Medium
C.cristata	70	1	1	0	PCT26 - DNG
C.cristata	80	1	0	0	PCT55 - Medium
C.cristata	70	0	2	0	PCT55 - Medium
C.cristata	75	1	0	0	PCT55 - Medium
C.cristata	60	1	0	0	PCT55 - Poor
C.cristata	80	2	0	0	PCT55 - Medium
C.cristata	50	1	0	0	PCT55 - Medium
C.cristata	30	1	0	0	PCT55 - Poor
C.cristata	40	4	0	0	PCT55 - Poor
C.cristata	10	0	0	0	PCT55 - Medium
C.cristata	65	1	1	0	PCT55 - Medium
C.cristata	80	1	0	0	PCT55 - Medium
C.cristata	0	2	0	0	PCT55 - Medium
C.cristata	80	1	0	0	PCT55 - Medium

Tree Species	DBH (cm)	Hollows <5 cm	Hollows 5 - 20 cm	Hollows > 20 cm	Vegetation Zone
C.cristata	80	1	0	0	PCT55 - Medium
C.cristata	90	1	1	0	PCT55 - Medium
C.cristata	70	3	1	0	PCT55 - Medium
C.cristata	70	0	2	0	PCT55 - Medium
C.cristata	70	0	2	1	PCT55 - Medium
C.cristata	0	1	1	0	PCT55 - Medium
Casuarina sp.	70	0	0	0	PCT55 - DNG
Casuarina sp.	70	0	0	0	PCT55 - Medium
Casuarina sp.	80	3	1	0	PCT249 - Medium
E.blakelyi	40	1	1	0	PCT185 - Medium
E.blakelyi	70	0	0	0	PCT185 - High
E.blakelyi	50	1	0	0	PCT185 - High
E.blakelyi	80	2	0	0	PCT185 - High
E.blakelyi	90	1	1	0	PCT185 - High
E.blakelyi	20	1	0	0	PCT185 - High
E.blakelyi	0	0	0	0	PCT185 - High
E.blakelyi	20	1	0	0	PCT185 - High
E.camaldulensis	80	0	2	0	PCT249 - Medium
E.camaldulensis	80	1	3	2	PCT249 - Medium
E.camaldulensis	90	0	2	5	PCT249 - Medium
E.camaldulensis	100	1	2	0	PCT249 - Medium
E.camaldulensis	50	1	0	0	PCT249 - Medium
E.camaldulensis	80	1	0	0	PCT249 - Medium
E.camaldulensis	70	0	4	0	PCT249 - Medium
E.camaldulensis	90	0	3	1	PCT249 - Medium
E.camaldulensis	80	2	0	0	PCT249 - Medium
E.camaldulensis	90	0	4	3	PCT249 - Medium
E.camaldulensis	50	0	2	0	PCT249 - Medium
E.camaldulensis	70	2	2	0	PCT249 - Medium
E.camaldulensis	80	4	3	2	PCT249 - Medium
E.camaldulensis	90	0	5	2	PCT249 - Medium
E.camaldulensis	30	1	0	0	PCT249 - Medium
E.camaldulensis	70	1	1	1	PCT249 - Medium
E.camaldulensis	60	0	2	1	PCT249 - Medium
E.camaldulensis	70	0	2	1	PCT249 - Medium
E.camaldulensis	70	0	1	2	PCT249 - Medium
E.camaldulensis	0	6	3	0	PCT249 - Medium
E.camaldulensis	100	1	1	1	PCT249 - Medium
E.camaldulensis	70	0	0	1	PCT249 - Medium
E.camaldulensis	90	0	0	2	PCT249 - Medium
E.camaldulensis	60	0	1	0	PCT249 - Medium
E.camaldulensis	60	1	1	0	PCT249 - Medium
E.camaldulensis	100	0	1	1	PCT249 - Medium

Tree Species	DBH (cm)	Hollows <5 cm	Hollows 5 - 20 cm	Hollows > 20 cm	Vegetation Zone
E.camaldulensis	100	2	4	1	PCT249 - Medium
E.camaldulensis	60	0	0	3	PCT249 - Medium
E.camaldulensis	110	0	8	1	PCT249 - Medium
E.camaldulensis	70	1	4	1	PCT249 - Medium
E.camaldulensis	90	3	1	1	PCT249 - Medium
E.camaldulensis	70	1	4	1	PCT249 - Medium
E.camaldulensis	70	2	2	0	PCT249 - Medium
E.camaldulensis	70	1	0	2	PCT249 - Medium
E.camaldulensis	70	1	1	1	PCT249 - Medium
E.camaldulensis	100	0	0	2	PCT249 - Medium
E.camaldulensis	80	0	2	2	PCT249 - Medium
E.camaldulensis	70	1	2	3	PCT249 - Medium
E.camaldulensis	80	0	0	2	PCT249 - Medium
E.camaldulensis	40	1	0	0	PCT249 - Medium
E.camaldulensis	70	0	1	0	PCT249 - Medium
E.camaldulensis	80	0	1	1	PCT249 - Medium
E.camaldulensis	100	0	2	0	PCT249 - Medium
E.camaldulensis	150	0	0	2	PCT249 - Medium
E.camaldulensis	80	0	2	0	PCT249 - Medium
E.camaldulensis	70	1	0	0	PCT249 - Medium
E.camaldulensis	80	2	0	0	PCT249 - Medium
E.camaldulensis	130	0	0	1	PCT249 - Medium
E.camaldulensis	80	1	0	0	PCT249 - Medium
E.camaldulensis	90	0	2	0	PCT249 - Medium
E.camaldulensis	80	0	2	0	PCT249 - Medium
E.camaldulensis	60	0	0	2	PCT249 - Medium
E.camaldulensis	80	3	0	0	PCT249 - Medium
E.camaldulensis	80	1	0	1	PCT249 - Medium
E.camaldulensis	0	0	0	1	PCT249 - Medium
E.camaldulensis	60	2	0	0	PCT249 - Medium
E.camaldulensis	90	0	0	3	PCT249 - Medium
E.camaldulensis	120	2	0	0	PCT249 - Medium
E.camaldulensis	80	0	2	0	PCT249 - Medium
E.camaldulensis	80	1	3	0	PCT53 - Medium
E.camaldulensis	90	3	0	0	PCT249 - Medium
E.camaldulensis	100	1	3	1	PCT53 - Medium
E.camaldulensis	90	2	1	0	PCT249 - Regenerating
E.camaldulensis	150	6	0	0	PCT249 - Medium
E.camaldulensis	80	1	0	0	PCT249 - Medium
E.camaldulensis	120	0	0	3	PCT249 - Medium
E.camaldulensis	80	0	2	0	PCT249 - Medium
E.camaldulensis	0	0	3	0	PCT249 - Medium
E.camaldulensis	100	0	3	0	PCT249 - Medium

Tree Species	DBH (cm)	Hollows <5 cm	Hollows 5 - 20 cm	Hollows > 20 cm	Vegetation Zone
E.camaldulensis	150	0	0	2	PCT249 - Medium
E.camaldulensis	100	2	1	0	PCT249 - Medium
E.camaldulensis	120	1	1	1	PCT249 - Medium
E.camaldulensis	70	0	1	0	PCT249 - Medium
E.camaldulensis	100	0	0	1	PCT249 - Medium
E.camaldulensis	70	2	3	1	PCT249 - Regenerating
E.camaldulensis	60	0	2	0	PCT249 - Medium
E.camaldulensis	200	4	7	0	PCT249 - Medium
E.camaldulensis	200	5	1	0	PCT249 - Medium
E.camaldulensis	110	2	0	0	PCT249 - Medium
E.camaldulensis	80	2	3	5	PCT249 - Regenerating
E.camaldulensis	110	3	0	0	PCT249 - Medium
E.camaldulensis	110	0	0	1	PCT53 - Medium
E.camaldulensis	150	5	0	0	PCT249 - Medium
E.camaldulensis	80	2	0	0	PCT249 - Medium
E.camaldulensis	300	2	0	2	PCT249 - Medium
E.camaldulensis	150	0	1	0	PCT249 - Medium
E.camaldulensis	110	3	3	0	PCT249 - Medium
E.camaldulensis	60	2	1	0	PCT249 - Medium
E.camaldulensis	120	2	1	0	PCT249 - Medium
E.camaldulensis	200	0	2	0	PCT249 - Medium
E.camaldulensis	120	0	2	0	PCT249 - Medium
E.camaldulensis	80	1	4	0	PCT249 - Medium
E.camaldulensis	70	0	1	0	PCT249 - Medium
E.camaldulensis	100	0	2	0	PCT249 - Medium
E.camaldulensis	100	2	0	2	PCT249 - Medium
E.camaldulensis	90	0	2	0	PCT249 - Medium
E.camaldulensis	200	0	0	1	PCT249 - Medium
E.camaldulensis	80	0	1	0	PCT249 - Medium
E.camaldulensis	70	0	1	0	PCT249 - Medium
E.camaldulensis	120	3	0	0	PCT249 - Medium
E.camaldulensis	90	0	2	1	PCT249 - Medium
E.camaldulensis	80	1	1	0	PCT249 - Medium
E.camaldulensis	70	0	2	0	PCT249 - Medium
E.camaldulensis	60	0	1	0	PCT249 - Medium
E.camaldulensis	70	0	3	0	PCT249 - Medium
E.camaldulensis	80	0	1	0	PCT249 - Medium
E.camaldulensis	100	2	0	0	PCT249 - Medium
E.camaldulensis	70	1	3	0	PCT249 - Medium
E.camaldulensis	120	0	0	1	PCT249 - Medium
E.camaldulensis	60	0	2	0	PCT249 - Medium
E.camaldulensis	70	1	1	0	PCT249 - Medium
E.camaldulensis	80	0	1	0	PCT249 - Medium

Tree Species	DBH (cm)	Hollows <5 cm	Hollows 5 - 20 cm	Hollows > 20 cm	Vegetation Zone
E.camaldulensis	110	3	0	0	PCT249 - Medium
E.camaldulensis	250	2	1	0	PCT249 - Medium
E.camaldulensis	70	0	2	0	PCT249 - Medium
E.camaldulensis	60	0	1	0	PCT249 - Medium
E.camaldulensis	90	0	1	0	PCT249 - Medium
E.camaldulensis	90	2	0	0	PCT249 - Medium
E.camaldulensis	90	0	2	0	PCT249 - Medium
E.camaldulensis	80	0	2	0	PCT249 - Medium
E.camaldulensis	160	0	1	1	PCT249 - Medium
E.camaldulensis	70	0	1	0	PCT249 - Regenerating
E.camaldulensis	40	0	1	0	PCT249 - Regenerating
E.camaldulensis	120	0	1	1	PCT249 - Medium
E.camaldulensis	70	1	2	0	PCT249 - Medium
E.camaldulensis	130	2	4	1	PCT249 - Medium
E.camaldulensis	60	0	1	0	PCT249 - Medium
E.camaldulensis	70	0	5	0	PCT249 - Medium
E.camaldulensis	100	1	1	1	PCT249 - Medium
E.camaldulensis	80	0	3	2	PCT249 - Medium
E.camaldulensis	90	1	2	0	PCT249 - Medium
E.camaldulensis	80	2	3	0	PCT249 - Medium
E.camaldulensis	100	0	0	1	PCT249 - Medium
E.camaldulensis	120	0	0	3	PCT249 - Medium
E.camaldulensis	80	0	1	0	PCT249 - Medium
E.camaldulensis	50	2	3	0	PCT249 - Medium
E.camaldulensis	240	0	4	0	PCT249 - Regenerating
E.camaldulensis	100	0	6	0	PCT249 - Medium
E.camaldulensis	80	4	5	0	PCT249 - Medium
E.camaldulensis	90	0	2	0	PCT249 - Medium
E.camaldulensis	110	1	0	0	PCT249 - Medium
E.camaldulensis	90	0	2	0	PCT249 - Medium
E.camaldulensis	90	2	1	0	PCT249 - Medium
E.camaldulensis	160	3	4	2	PCT249 - Medium
E.camaldulensis	130	0	3	0	PCT249 - Medium
E.camaldulensis	70	0	3	0	PCT249 - Medium
E.camaldulensis	70	0	1	0	PCT249 - Medium
E.camaldulensis	120	3	4	0	PCT249 - Medium
E.camaldulensis	70	0	1	0	PCT249 - Medium
E.camaldulensis	80	0	0	1	PCT249 - Medium
E.camaldulensis	80	0	0	1	PCT249 - Regenerating
E.camaldulensis	60	3	2	0	PCT249 - Medium
E.camaldulensis	70	0	1	1	PCT249 - Medium
E.camaldulensis	60	0	2	0	PCT249 - Medium
E.camaldulensis	90	0	2	1	PCT249 - Regenerating

Tree Species	DBH (cm)	Hollows <5 cm	Hollows 5 - 20 cm	Hollows > 20 cm	Vegetation Zone
E.camaldulensis	90	0	0	1	PCT249 - Regenerating
E.camaldulensis	140	0	2	1	PCT249 - Medium
E.camaldulensis	90	0	1	1	PCT249 - Medium
E.camaldulensis	90	0	0	3	PCT249 - Regenerating
E.camaldulensis	80	2	4	0	PCT249 - Medium
E.camaldulensis	50	0	1	0	PCT249 - Medium
E.camaldulensis	60	0	2	0	PCT249 - Medium
E.camaldulensis	70	0	1	0	PCT249 - Medium
E.camaldulensis	70	0	2	0	PCT249 - Medium
E.camaldulensis	90	0	1	0	PCT249 - Medium
E.camaldulensis	70	0	1	2	PCT249 - Medium
E.camaldulensis	70	0	4	4	PCT249 - Medium
E.camaldulensis	50	2	1	0	PCT249 - Regenerating
E.camaldulensis	110	1	1	1	PCT249 - Medium
E.camaldulensis	60	0	4	0	PCT249 - Regenerating
E.camaldulensis	70	2	4	1	PCT249 - Regenerating
E.camaldulensis	95	1	0	0	PCT249 - Medium
E.camaldulensis	95	2	2	0	PCT249 - Medium
E.camaldulensis	80	0	6	0	PCT249 - Medium
E.camaldulensis	180	0	3	2	PCT249 - Medium
E.camaldulensis	100	1	3	2	PCT249 - Medium
E.camaldulensis	90	0	2	0	PCT249 - Medium
E.camaldulensis	90	0	1	0	PCT249 - Medium
E.camaldulensis	90	1	0	0	PCT249 - Medium
E.camaldulensis	100	0	2	4	PCT249 - Medium
E.camaldulensis	100	3	2	2	PCT53 - Medium
E.camaldulensis	80	0	2	1	PCT249 - Medium
E.camaldulensis	70	0	0	1	PCT53 - Medium
E.camaldulensis	90	1	1	0	PCT249 - Medium
E.camaldulensis	90	0	3	1	PCT249 - Medium
E.camaldulensis	140	0	9	0	PCT249 - Medium
E.camaldulensis	50	0	1	0	PCT249 - Medium
E.camaldulensis	55	1	1	0	PCT249 - Medium
E.camaldulensis	110	0	2	1	PCT249 - Medium
E.camaldulensis	70	1	1	1	PCT249 - Medium
E.camaldulensis	80	1	3	0	PCT249 - Medium
E.camaldulensis	100	0	0	2	PCT53 - Medium
E.camaldulensis	60	0	0	3	PCT249 - Medium
E.camaldulensis	75	0	5	0	PCT249 - Medium
E.camaldulensis	40	0	2	0	PCT249 - Medium
E.camaldulensis	130	5	4	0	PCT249 - Medium
E.camaldulensis	70	1	0	2	PCT249 - Medium
E.camaldulensis	70	1	3	0	PCT249 - Medium

Tree Species	DBH (cm)	Hollows <5 cm	Hollows 5 - 20 cm	Hollows > 20 cm	Vegetation Zone
E.camaldulensis	85	1	6	0	PCT249 - Medium
E.camaldulensis	65	0	0	1	PCT249 - Medium
E.camaldulensis	60	0	1	0	PCT249 - Medium
E.camaldulensis	65	0	2	0	PCT249 - Medium
E.camaldulensis	180	1	2	3	PCT249 - Medium
E.camaldulensis	90	0	0	3	PCT249 - Medium
E.camaldulensis	90	2	1	0	PCT249 - Medium
E.camaldulensis	50	1	4	1	PCT249 - Medium
E.camaldulensis	110	2	2	1	PCT249 - Medium
E.camaldulensis	90	0	3	3	PCT249 - Medium
E.camaldulensis	70	0	1	4	PCT249 - Medium
E.camaldulensis	50	1	3	0	PCT249 - Medium
E.camaldulensis	70	0	2	1	PCT249 - Medium
E.camaldulensis	70	1	1	0	PCT249 - Medium
E.camaldulensis	110	1	3	0	PCT249 - Medium
E.camaldulensis	65	3	1	1	PCT249 - Medium
E.camaldulensis	100	1	3	2	PCT249 - Medium
E.camaldulensis	70	0	0	1	PCT249 - Medium
E.camaldulensis	70	1	2	2	PCT249 - Medium
E.camaldulensis	80	1	2	0	PCT249 - Medium
E.camaldulensis	70	1	0	2	PCT249 - Medium
E.camaldulensis	60	2	0	0	PCT249 - Medium
E.camaldulensis	90	1	3	1	PCT249 - Medium
E.camaldulensis	80	0	1	2	PCT249 - Medium
E.camaldulensis	90	2	1	2	PCT249 - Medium
E.camaldulensis	80	1	0	2	PCT249 - Medium
E.camaldulensis	110	0	1	4	PCT249 - Medium
E.camaldulensis	70	1	4	1	PCT249 - Medium
E.camaldulensis	40	0	0	1	PCT249 - Medium
E.camaldulensis	110	0	2	3	PCT249 - Medium
E.camaldulensis	60	1	1	1	PCT249 - Medium
E.camaldulensis	150	1	1	1	PCT249 - Medium
E.camaldulensis	150	2	0	0	PCT249 - Medium
E.camaldulensis	40	0	1	1	PCT249 - Medium
E.camaldulensis (stag)	90	0	2	1	PCT249 - Medium
E.camaldulensis (stag)	50	0	1	0	PCT249 - Medium
E.camaldulensis (stag)	25	0	0	1	PCT249 - Medium
E.camaldulensis (stag)	0	0	1	0	PCT249 - Medium
E.camaldulensis (stag)	60	0	0	2	PCT249 - Medium
E.camaldulensis (stag)	80	0	2	0	PCT249 - Medium
E.camaldulensis (stag)	80	0	2	0	PCT249 - Medium
E.camaldulensis (stag)	50	0	3	0	PCT249 - Medium
E.camaldulensis (stag)	70	0	0	2	PCT249 - Medium

Tree Species	DBH (cm)	Hollows <5 cm	Hollows 5 - 20 cm	Hollows > 20 cm	Vegetation Zone
E.camaldulensis (stag)	40	0	4	0	PCT249 - Medium
E.camaldulensis (stag)	100	0	1	0	PCT249 - Medium
E.camaldulensis (stag)	80	0	2	0	PCT249 - Medium
E.camaldulensis (stag)	100	3	0	0	PCT249 - Medium
E.camaldulensis (stag)	0	0	3	0	PCT249 - Medium
E.camaldulensis (stag)	60	1	0	1	PCT249 - Medium
E.camaldulensis (stag)	70	2	0	1	PCT249 - Medium
E.camaldulensis (stag)	60	4	0	0	PCT249 - Medium
E.camaldulensis (stag)	80	6	3	0	PCT249 - Medium
E.camaldulensis (stag)	80	0	3	0	PCT249 - Medium
E.camaldulensis (stag)	60	6	0	0	PCT249 - Medium
E.camaldulensis (stag)	120	0	5	0	PCT249 - Medium
E.camaldulensis (stag)	100	12	0	0	PCT249 - Medium
E.camaldulensis (stag)	100	0	3	0	PCT249 - Medium
E.camaldulensis (stag)	60	0	4	0	PCT249 - Medium
E.camaldulensis (stag)	90	2	3	0	PCT249 - Medium
E.camaldulensis (stag)	70	2	0	0	PCT249 - Medium
E.camaldulensis (stag)	100	2	4	0	PCT249 - Medium
E.camaldulensis (stag)	120	0	0	2	PCT249 - Medium
E.camaldulensis (stag)	60	0	0	1	PCT249 - Medium
E.camaldulensis (stag)	60	4	0	0	PCT53 - Medium
E.camaldulensis (stag)	70	2	2	2	PCT53 - Medium
E.camaldulensis (stag)	0	0	0	3	PCT249 - Medium
E.camaldulensis (stag)	80	5	0	0	PCT53 - Medium
E.camaldulensis (stag)	70	4	0	0	PCT53 - Medium
E.camaldulensis (stag)	80	2	3	0	PCT53 - Medium
E.camaldulensis (stag)	180	2	1	0	PCT249 - Medium
E.camaldulensis (stag)	80	2	0	1	PCT249 - Medium
E.camaldulensis (stag)	100	2	1	0	PCT249 - Medium
E.camaldulensis (stag)	100	2	0	0	PCT249 - Medium
E.camaldulensis (stag)	100	1	0	24	PCT249 - Medium
E.camaldulensis (stag)	60	0	2	0	PCT249 - Medium
E.camaldulensis (stag)	120	0	0	4	PCT249 - Medium
E.camaldulensis (stag)	80	6	2	0	PCT53 - Medium
E.camaldulensis (stag)	0	1	2	0	PCT53 - Medium
E.camaldulensis (stag)	0	0	5	0	PCT53 - Medium
E.camaldulensis (stag)	70	1	0	0	PCT53 - Medium
E.camaldulensis (stag)	90	3	0	0	PCT53 - Medium
E.camaldulensis (stag)	80	2	0	0	PCT53 - Medium
E.camaldulensis (stag)	110	3	0	2	PCT249 - Regenerating
E.camaldulensis (stag)	80	3	2	0	PCT249 - Regenerating
E.camaldulensis (stag)	0	2	0	2	PCT249 - Medium
E.camaldulensis (stag)	60	1	0	0	PCT249 - Medium

Tree Species	DBH (cm)	Hollows <5 cm	Hollows 5 - 20 cm	Hollows > 20 cm	Vegetation Zone
E.camaldulensis (stag)	120	0	3	2	PCT249 - Medium
E.camaldulensis (stag)	70	0	5	0	PCT249 - Regenerating
E.camaldulensis (stag)	80	1	4	0	PCT249 - Regenerating
E.camaldulensis (stag)	50	2	2	0	PCT249 - Medium
E.camaldulensis (stag)	50	0	0	1	PCT249 - Medium
E.camaldulensis (stag)	65	0	0	1	PCT249 - Medium
E.camaldulensis (stag)	90	2	2	0	PCT249 - Medium
E.camaldulensis (stag)	110	2	3	1	PCT249 - Medium
E.camaldulensis (stag)	65	2	1	3	PCT249 - Medium
E.camaldulensis (stag)	30	2	1	0	PCT249 - Medium
E.camaldulensis (stag)	55	0	2	0	PCT249 - Medium
E.camaldulensis (stag)	90	1	1	0	PCT249 - Medium
E.camaldulensis (stag)	25	0	1	1	PCT249 - Medium
E.camaldulensis (stag)	100	1	0	2	PCT249 - Medium
E.camaldulensis (stag)	30	8	3	0	PCT249 - Regenerating
E.camaldulensis (stag)	60	1	1	0	PCT249 - Medium
E.camaldulensis (stag)	45	2	6	0	PCT249 - Regenerating
E.dwyeri	130	1	0	0	PCT185 - Medium
E.dwyeri	150	0	1	0	PCT185 - Medium
E.dwyeri	110	1	0	0	PCT82 - Poor
E.microcarpa	150	4	2	0	PCT82 - Medium
E.microcarpa	70	4	1	0	PCT82 - Medium
E.microcarpa	70	1	0	0	PCT82 - Medium
E.microcarpa	60	3	0	0	PCT82 - Medium
E.microcarpa	60	2	0	0	PCT55 - Medium
E.microcarpa	90	5	1	0	PCT82 - Medium
E.microcarpa	80	2	0	0	Cleared
E.microcarpa	60	1	0	0	PCT82 - Medium
E.microcarpa	90	2	0	0	PCT185 - Medium
E.microcarpa	0	1	2	0	PCT82 - Medium
E.microcarpa	80	1	0	0	PCT55 - Poor
E.sideroxylon	120	3	3	0	PCT185 - High
E.sideroxylon	120	2	0	0	PCT185 - High
E.sideroxylon	0	0	0	0	PCT185 - High
E.sideroxylon	130	1	0	0	PCT185 - High
E.sideroxylon	110	0	2	0	PCT185 - High
E.sideroxylon	140	1	0	0	PCT185 - High
E.sideroxylon	110	0	0	0	PCT185 - High
E.sideroxylon	110	1	1	0	PCT185 - High
E.sideroxylon	35	1	0	0	PCT185 - High
E.sideroxylon	80	1	0	0	PCT185 - High
E.sideroxylon	70	2	0	0	PCT185 - High
E.sideroxylon	60	1	0	0	PCT185 - High

Tree Species	DBH (cm)	Hollows <5 cm	Hollows 5 - 20 cm	Hollows > 20 cm	Vegetation Zone
E.sideroxylon	60	0	1	0	PCT185 - High
Eremophila mitchelli	30	2	0	0	PCT26 - Medium
Eucalyptus sp.	75	0	0	0	PCT55 - Planted
Eucalyptus sp.	75	0	0	0	PCT55 - DNG
Eucalyptus sp.	0	0	0	0	PCT185 - High
G.parviflora (Wilga)	50	3	1	0	PCT55 - DNG
G.parviflora (Wilga)	45	1	1	0	PCT55 - Poor
G.parviflora (Wilga)	45	2	1	0	PCT55 - Poor
G.parviflora (Wilga)	70	6	0	0	PCT55 - Poor
G.parviflora (Wilga)	60	1	0	0	PCT55 - Medium
G.parviflora (Wilga)	75	1	0	0	PCT55 - Medium
G.parviflora (Wilga)	100	1	0	0	PCT55 - Medium
G.parviflora (Wilga)	40	2	0	0	PCT55 - Medium
G.parviflora (Wilga)	45	3	0	0	PCT55 - Medium
G.parviflora (Wilga)	35	4	0	0	PCT55 - Medium
G.parviflora (Wilga)	40	2	1	0	PCT55 - Medium
G.parviflora (Wilga)	30	1	0	0	PCT55 - Medium
G.parviflora (Wilga)	50	2	0	0	PCT55 - Medium
G.parviflora (Wilga)	40	2	0	0	PCT55 - Medium
G.parviflora (Wilga)	35	1	0	0	PCT26 - Medium
G.parviflora (Wilga)	60	1	0	0	PCT26 - Poor
G.parviflora (Wilga)	60	1	0	0	PCT26 - Poor
G.parviflora (Wilga)	35	2	0	0	PCT26 - Poor
G.parviflora (Wilga)	45	1	0	0	PCT26 - DNG
G.parviflora (Wilga)	45	1	0	0	PCT26 - Poor
G.parviflora (Wilga)	35	0	2	0	PCT26 - Medium
G.parviflora (Wilga)	65	3	1	0	PCT26 - DNG
G.parviflora (Wilga)	30	2	1	0	PCT26 - Poor
G.parviflora (Wilga)	20	0	1	0	PCT26 - Medium
G.parviflora (Wilga)	30	1	0	0	PCT26 - Poor
G.parviflora (Wilga)	30	2	0	0	PCT26 - Poor
G.parviflora (Wilga)	30	2	0	0	PCT26 - Poor
G.parviflora (Wilga)	30	2	0	0	PCT26 - Poor
G.parviflora (Wilga)	45	1	2	0	PCT55 - Poor
G.parviflora (Wilga)	35	2	0	0	PCT26 - Poor
G.parviflora (Wilga)	65	0	1	0	PCT26 - Poor
G.parviflora (Wilga)	70	0	0	1	PCT26 - Medium
G.parviflora (Wilga)	70	0	1	0	PCT26 - Medium
G.parviflora (Wilga)	0	1	0	0	PCT55 - Medium
G.parviflora (Wilga)	0	0	1	0	PCT55 - Medium
G.parviflora (Wilga)	50	0	1	0	PCT82 - DNG
G.parviflora (Wilga)	40	0	0	1	PCT55 - Medium
G.parviflora (Wilga)	45	1	0	0	PCT55 - Medium

Tree Species	DBH (cm)	Hollows <5 cm	Hollows 5 - 20 cm	Hollows > 20 cm	Vegetation Zone
G.parviflora (Wilga)	50	1	0	0	PCT55 - DNG
G.parviflora (Wilga)	80	2	3	0	PCT26 - Poor
G.parviflora (Wilga)	80	3	1	0	PCT26 - Medium
G.parviflora (Wilga)	80	1	2	0	PCT55 - Medium
G.parviflora (Wilga)	50	1	0	0	PCT55 - Planted
G.parviflora (Wilga)	35	1	0	0	PCT55 - Planted
G.parviflora (Wilga)	50	1	0	0	PCT55 - Medium
Geijera sp.	40	1	0	0	Cleared
Geijera sp.	60	0	0	0	PCT55 - Medium
Stag	50	3	1	0	Cleared
Stag	40	3	0	0	PCT185 - Medium
Stag	40	0	1	0	PCT26 - Poor
Stag	40	3	1	0	PCT26 - DNG
Stag	70	0	4	0	PCT55 - DNG
Stag	60	0	0	1	PCT249 - Medium
Stag	80	0	5	2	PCT249 - Medium
Stag	80	0	0	1	PCT249 - Medium
Stag	80	0	1	1	PCT249 - Medium
Stag	90	2	1	1	PCT249 - Medium
Stag	60	0	1	2	PCT249 - Medium
Stag	70	1	3	0	PCT249 - Medium
Stag	60	3	3	1	PCT53 - Medium
Stag	70	5	3	0	PCT53 - Medium
Stag	50	1	2	0	PCT53 - Medium
Stag	110	2	0	3	PCT249 - Regenerating
Stag	70	3	2	1	PCT244 - Medium
Stag	0	0	4	0	PCT244 - Medium
Stag	70	0	3	0	PCT53 - Medium
Stag	80	0	2	2	PCT53 - Medium
Stag	100	0	2	1	PCT53 - Medium
Stag	3	3	0	0	PCT249 - Medium
Stag	80	0	3	2	PCT53 - Medium
Stag	100	0	0	3	PCT53 - Medium
Stag	70	0	2	0	PCT53 - Medium
Stag	80	0	3	0	PCT249 - Medium
Stag	80	0	2	4	PCT53 - Medium
Stag	60	2	3	0	PCT249 - Medium
Stag	80	0	2	0	PCT249 - Medium
Stag	60	0	2	0	PCT249 - Medium
Stag	70	0	4	1	PCT249 - Medium
Stag	0	2	3	0	PCT55 - Medium
Stag	80	1	4	0	PCT53 - Medium
Stag	110	2	3	1	PCT249 - Medium

Tree Species	DBH (cm)	Hollows <5 cm	Hollows 5 - 20 cm	Hollows > 20 cm	Vegetation Zone
Stag	100	0	2	3	PCT249 - Medium
Stag	70	0	1	0	PCT55 - Medium
Stag	80	0	3	0	PCT249 - Medium
Stag	80	1	3	0	PCT53 - Medium
Stag	90	2	6	1	PCT53 - Medium
Stag	90	0	2	4	PCT53 - Medium
Stag	60	3	1	0	PCT53 - Medium
Stag	90	0	2	4	PCT53 - Medium
Stag	80	0	2	2	PCT53 - Medium
Stag	70	0	4	3	PCT53 - Medium
Stag	90	0	0	5	PCT249 - Medium
Stag	70	0	0	4	PCT249 - Medium
Stag	60	0	2	3	PCT249 - Medium
Stag	60	0	1	2	PCT249 - Regenerating
Stag	70	0	2	0	PCT53 - Medium
Stag	70	0	1	3	PCT249 - Medium
Stag	70	0	2	1	PCT249 - Medium
Stag	80	0	4	0	PCT53 - Medium
Stag	45	0	2	0	PCT55 - Medium
Stag	80	0	3	0	PCT53 - Medium
Stag	0	0	4	0	PCT249 - Medium
Stag	70	2	1	2	PCT249 - Medium
Stag	50	0	1	2	PCT249 - Medium
Stag	80	0	1	4	PCT249 - Medium
Stag	70	0	0	2	PCT53 - Medium
Stag	40	3	0	1	PCT53 - Medium
Stag	60	2	2	1	PCT53 - Medium
Stag	80	0	46	2	PCT53 - Medium
Stag	40	2	6	0	PCT53 - Medium
Stag	40	0	2	0	PCT53 - Medium
Stag	40	0	3	0	PCT53 - Medium
Stag	40	0	0	2	PCT53 - Medium
Stag	60	1	6	0	PCT53 - Medium
Stag	45	6	6	1	PCT53 - Medium
Stag	40	0	4	0	PCT53 - Medium
Stag	50	3	2	0	PCT53 - Medium
Stag	70	2	2	0	PCT53 - Medium
Stag	50	3	2	1	PCT53 - Medium
Stag	60	0	4	0	PCT53 - Medium
Stag	60	0	2	0	PCT53 - Medium
Stag	50	2	2	3	PCT53 - Medium
Stag	80	2	2	5	PCT53 - Medium
Stag	40	3	3	1	PCT53 - Medium

Tree Species	DBH (cm)	Hollows <5 cm	Hollows 5 - 20 cm	Hollows > 20 cm	Vegetation Zone
Stag	50	5	6	0	PCT53 - Medium
Stag	40	3	4	0	PCT53 - Medium
Stag	50	2	2	3	PCT53 - Medium
Stag	60	2	2	3	PCT53 - Medium
Stag	50	0	1	1	PCT53 - Medium
Stag	60	2	3	1	PCT53 - Medium
Stag	40	0	1	2	PCT53 - Medium
Stag	70	2	3	2	PCT53 - Medium
Stag	60	0	0	1	PCT53 - Medium
Stag	30	0	2	1	PCT53 - Medium
Stag	50	0	0	2	PCT53 - Medium
Stag	50	0	1	3	PCT53 - Medium
Stag	50	2	1	1	PCT53 - Medium
Stag	30	2	3	0	PCT53 - Medium
Stag	70	0	2	2	PCT53 - Medium
Stag	50	1	2	2	PCT53 - Medium
Stag	30	0	1	0	PCT185 - High
Stag	0	0	0	0	PCT185 - High
Stag	0	0	0	0	PCT185 - High
Stag	25	1	2	0	PCT185 - High
Stag	70	0	1	0	PCT55 - Poor
Stag	35	0	0	1	PCT26 - High
Unidentified	40	1	4	0	PCT26 - Poor
Unidentified	0	0	0	1	PCT82 - DNG
Unidentified	70	0	1	0	Cleared
Unidentified	100	0	3	0	PCT53 - Medium
Unidentified	40	0	1	0	PCT249 - Regenerating
Unidentified	0	1	0	1	PCT55 - Medium
Unidentified	45	2	1	0	PCT55 - Planted
Unidentified	70	0	1	0	PCT249 - Medium
Unidentified	0	1	0	0	PCT55 - Medium
Unidentified	0	0	0	0	PCT185 - High
Unidentified	0	0	0	0	PCT185 - High
Unidentified	0	0	0	0	PCT185 - High
Unidentified	0	0	0	0	PCT185 - High
Unidentified	0	0	0	0	PCT185 - High
Unidentified	0	0	0	0	PCT185 - High
Unidentified	0	1	2	3	PCT185 - DNG
Unidentified	0	1	1	0	PCT185 - High
Unidentified	0	0	0	0	PCT185 - High
Unidentified	0	0	1	0	PCT185 - High
Unidentified	0	2	3	1	PCT185 - High
Unidentified	0	0	0	0	PCT185 - High

Tree Species	DBH (cm)	Hollows <5 cm	Hollows 5 - 20 cm	Hollows > 20 cm	Vegetation Zone
Unidentified	0	0	2	1	PCT185 - High
Unidentified	0	2	0	0	PCT185 - High
Unidentified	0	0	2	0	PCT185 - High
Unidentified	0	0	0	0	PCT185 - High
Unidentified	0	0	0	0	PCT185 - High

Appendix G
Fauna specialist reports

EMM
creating opportunities

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Lake Cowal Gold Mine – Drone Surveys for Koalas 04 – 06, 18, and 19/10/2022

Author: Dr. Chad T. Beranek

Hayden Beck
Project Officer – EMM Consulting
M: 0421 440 518, E: hbeck@emmconsulting.com.au

Dear Hayden,
RE: Lake Cowal Gold Mine – Drone Surveys for Koalas 04 – 06, 18, and 19/10/2022

Conservation Leaders were contracted by EMM Consulting to conduct drone surveys for koalas (*Phascolarctos cinereus*) as a part of the approval process for the Lake Cowal Evolution Gold Mine expansion.

Surveys were conducted on the 4th, 5th, 6th, 18th, and 19th October 2022 using a Mavic 2 Enterprise Advanced (M2EA) according to the BAM assessment guidelines and Beranek et al. (2020) and Witt et al. (2020). The M2EA has a 9 mm sensor and hence flight height was conducted at 65 m AGL with a speed of 8 m/s. Potential koala detections were validated via drone in real-time with the use of the axillary light to illuminate the detection to allow identification via RBG camera. Survey areas were repeated a minimum of two nights (Table 1 for flight summary). The flight paths were created to overlap vegetation communities that constitute potential habitat for koalas (see Figure 1 for map of flight paths).

Table 1. Summary of flight conducted

Flight area	Repeat	Date	Fight times
F6	1	04/10/2022	19:45 – 20:34
F7	1	04/10/2022	20:34 – 21:11
F5	1	04/10/2022	21:20 – 21:48
F7	2	04/10/2022	21:51 – 22:11
F5	2	04/10/2022	22:11 - 22:35
F6	2	04/10/2022	22:42 – 23:07
F1	1	05/10/2022	21:01 – 21:49, 23:33 - 00:02
F2	1	05/10/2022	21:59 – 22:24
F3	1	05/10/2022	22:27 – 22:57
F4	1	05/10/2022	23:09 – 23:28
F1	2	06/10/2022	18:57 – 20:11
F2	2	06/10/2022	20:27 – 21:01
F3	2	06/10/2022	21:30 – 21:53
F4	2	06/10/2022	22:04 – 23:00

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F6	3	18/10/2022	18:50 – 19:21
F5	3	19/10/2022	18:50 – 19:14
F7	3	19/10/2022	19:14 – 19:37

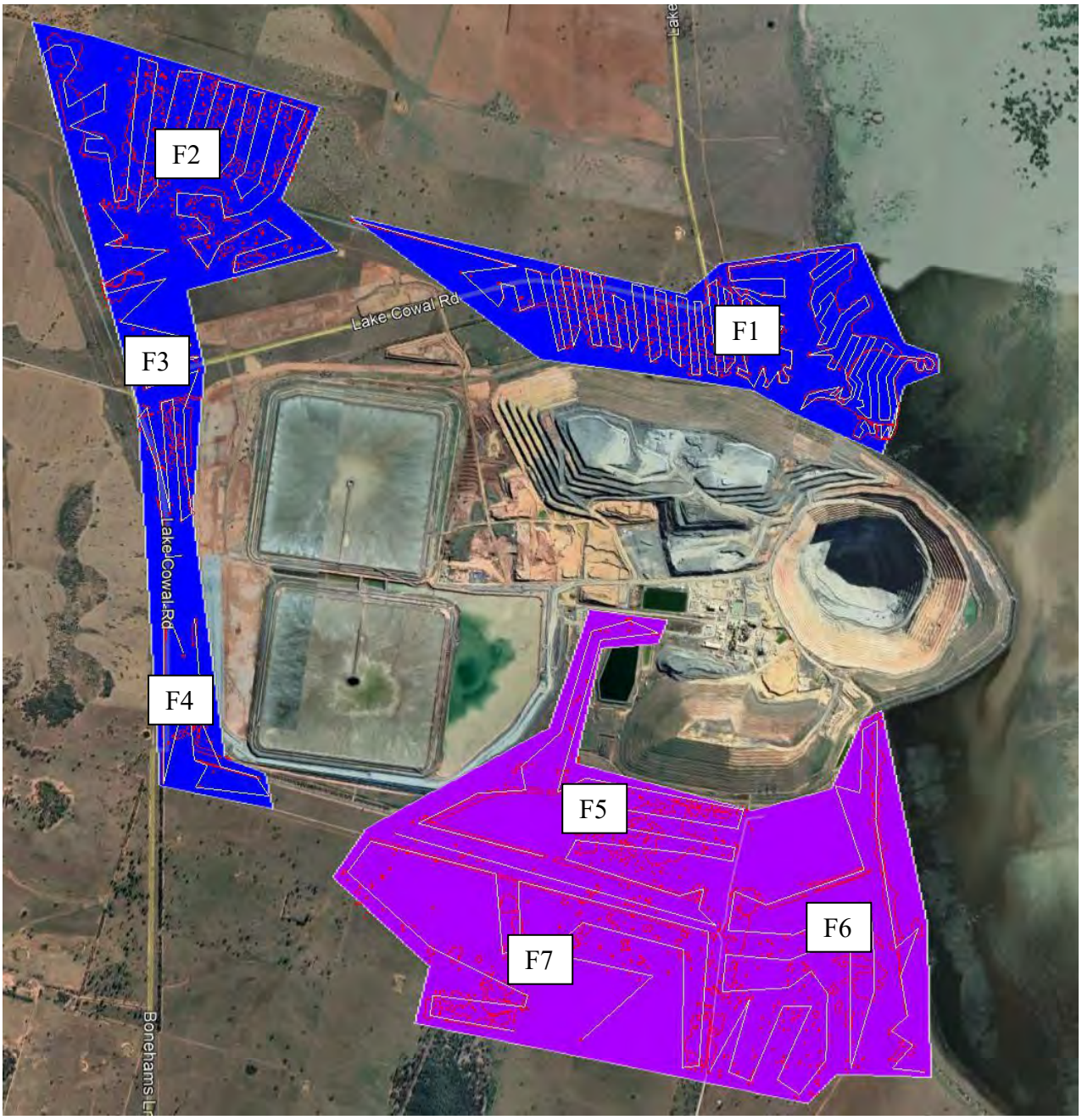


Figure 1. Map of flight paths. Red lines indicate areas of potential suitable koala habitat. White lines indicate the flight path of the drone. Blue polygons indicate the northern survey area, and the purple polygon indicates the southern survey area.

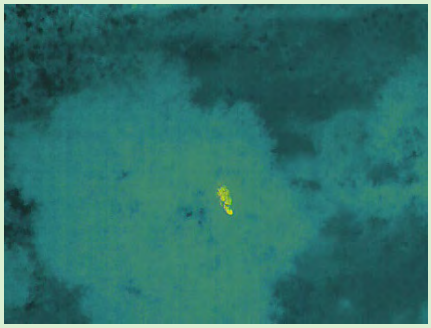
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Results

Numerous detections were made, most did not appear to match a koala thermal signature. There were some that were considered a low probability koala detection, and all these were validated for their identity by either gaining inference via thermal camera with behavioural cues or if still uncertain, getting close enough to use the axillary light to enable RBG validation. The validated detections were brush-tailed possums (*Trichosurus vulpecula*), white-faced egret (*Egretta novaehollandiae*) nest and a white-winged chough (*Corcorax melanorhamphos*) nocturnal roost. Additional detections of co-occurring fauna occurred and were opportunistically tabulated. Co-occurring species detected via drone included emu (*Dromais novaehollandiae*), European hare (*Lepus europaeus*), and kangaroos (*Macropus* spp.).

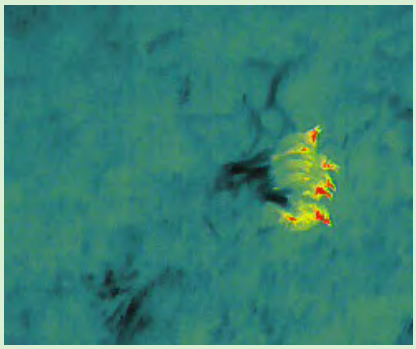
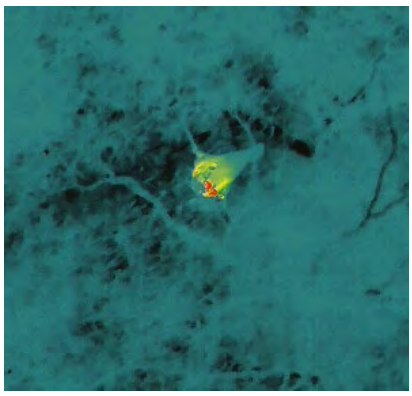
The habitat appeared too sparse and fragmented to support a population of koalas. There were only scattered trees available in most habitats, and many areas which were mapped as potential koala habitat contained no feed trees and consisted of scattered semi-arid shrubs such as western rosewood (*Alectryon oleifolius*) and wilga (*Geijera parviflora*). Furthermore, the foreshore areas which support river red gums (*Eucalyptus camaldulensis*, which are a known feed tree for koalas) were entirely flooded which would likely lead to unsuitable access.

Table 2. Summary of detections investigated.

Species	GPS	Thermal	RBG
Brush-tailed possum F1 repeat 1 21:24 05/10/2022	-33.62386, 147.38728		
White-faced egret (sitting on nest) F3 repeat 1 22:45 05/10/2022	-33.633025, 147.353506		

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White-winged chough F2 repeat 2 06/10/2022 20:51	-33.61116, 147.35606		
Corvid F2 repeat 2 20:55 06/10/2022	-33.6148, 147.34279		

Conclusion

After conducting two repeat surveys across the areas containing potential koala habitat with no detections of koalas. In addition, considering the poor habitat quality and the lack of connectivity, according to the BAM methods, it can be deemed that a koala population does not persist at the site.

References

Beranek, C. T., Roff, A., Denholm, B., Howell, L. G., & Witt, R. R. (2020). Trialling a real-time drone detection and validation protocol for the koala (*Phascolarctos cinereus*). Australian Mammalogy, 43(2), 260-264.

Witt, R. R., Beranek, C. T., Howell, L. G., Ryan, S. A., Clulow, J., Jordan, N. R., & Roff, A. (2020). Real-time drone derived thermal imagery outperforms traditional survey methods for an arboreal forest mammal. *PLoS One*, *15*(11), e0242204.



CORYMBIA ECOLOGY

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BAT CALL ANALYSIS RESULTS

EMM – Lake Cowal, near West Wyalong 14-26 November 2022

Species	A1	A2	A2-2	A3	A4	A5	A6	Comments
Austronomus australis	D				D	D	D	Flat to curved pulse characteristic frequency at 10-15khz
Saccolaimus flaviventris						D		Curved consistent pulses with characteristic frequency between 17 and 23khz. Dominant second harmonic around 20khz, 1st harmonic around 10 and 3rd harmonic around 30. During attack phase characteristic frequency stays fairly consistent.
Chalinolobus gouldii	D	D	Po	D	D	D	D	Usually curved, upright pulses with a prominent foot with no tail. May sometimes downsweep and be flatter at the lower frequencies in more open areas. Alternation is present in many passes which distinguish the species from others calling at the same frequency (i.e. *Scotorepens balstoni* and *Ozimops* sp)
Chalinolobus morio	Pr		Pr	D	Pr	D		Curved upright call with a downsweeping tail. Characteristic frequency at 46.5-53khz
Chalinolobus picatus		Po		Po	Pr			Curved pulses with fairly prominent foot with no tail. Characteristic frequency between 38 and 43khz. When alternating passes are not confused with other species. When not

Species	A1	A2	A2-2	A3	A4	A5	A6	Comments
								alternating can be confused with other species that call in the same frequency range with overlapping call characteristics (e.g. *Scotorepens greyii, Scotorepens sp*.)
Ozimops Petersi	D						D	One pass only. Characteristic frequency 31-36khz. Flat to curved. Calls becoming steeper in attack phase and may be confused with non-alternating *Chalinolobus gouldi* or *Scotorepens balstoni.* Lower frequency passes overlap with *Ozimops ridei* and higher frequency passes of *Ozimops planiceps*, where distributions overlap.
Ozimops planiceps	D		D	D	D	D	D	Characteristic frequency 26-30.5khz. Flat to curved pulses. This pulse is dominant harmonic, with second between 53-60. Can differentiate from non-alternating cruise phase *Chalinolobus gouldii* if the pass contains harmonics as *C. gouldii* does not appear to display harmonics. May be confused with *Ozimops petersi* and *Ozimops ridei* at the higher frequencies where there is overlap in call characteristics and overlap in distribution.
Oimops ridei / O. petersi	E	E(Pr)	E	E	E	E	E	*Ozimops ridei*- Characteristic frequency 28.5 to 31khz. Usually flat pulses, but also curved in attack phase. During attack phase this species can produce pulses that may be confused with other species calling in the same frequency range. Where distribution overlap this species may be confused with *Ozimops petersi* and *Ozimops planiceps.* Passes within the overlap between these two species have been allocated to the species group.
Scotorepens balstoni	Pr		Pr		Pr	Po	Po	Characteristic frequency 28-34khz. Curved pulse with a

Species	A1	A2	A2-2	A3	A4	A5	A6	Comments
								variable tail (absent or down-sweep, but also can up-sweep). Sometimes difficult to distinguish between non-alternating *Chalinolobus gouldii* at lower frequencies and other *scotorepens* species at the higher frequencies. Also can be confused with *Falsistrellus tasmaniensis* and *Scoteanax rueppellii.*
Scotorepens greyii	D	Pr		Pr	Pr	Pr	Pr	Currently indistinguishable on call characteristics and therefore grouped. Characteristic frequency 35-40kh. Curved pulse shape, usually with upsweeping tail. May also have down sweeping or absent tail and when this occurs it is difficult to separate from *Scotorepens orion*. Also overlaps with *Chalinolobus nigrogriseus*, non-alternating *Chalinolobus picatus* and possible *Falsistrellus tasmaniensis* where distributions overlap.
Nyctophilus geoffroyi / Nyctophilus gouldi and Nyctophilus corbeni	E		E	E	E	E		Near vertical pulse shape. Nyctophilus species currently indistinguishable on call characteristics
Nyctophilus / Myotis macropus			E					**Only two passes.** *Myotis macropus* calls are very similar to *Nyctophilus* species and often cannot be distinguished. Good Myotis passes are often longer and stronger than *Nyctophilus* with a varying slope between consecutive pulses and often occur at a slightly lower frequency than *Nyctophilus*. A few passes contained characteristics that were in the overlap between *Myotis* and *Nyctophilus* species. When recordings are positioned in a significant foraging area, there are usually a reasonable number of passes with characteristic features identifiable in the passes.
Vespadelus regulus / V. vulturnus	E			E	E	E	E	Characteristic frequency for V. regulus 40-55khz, where this

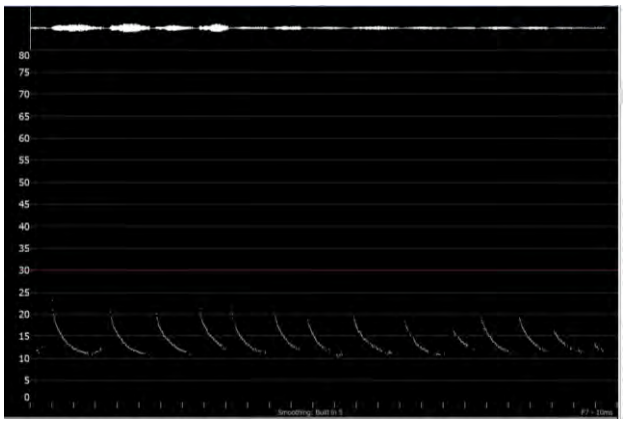
Species	A1	A2	A2-2	A3	A4	A5	A6	Comments
								frequency and call shape varies geographically. Characteristic frequency for *V. vulturnus* 42.5-53khz, where this frequency varies geographically. For *V. vulturnus*, the characteristic frequency of consecutive pulses often varies within a sequence, whereas consecutive pulses for V. regulus tend to be more consistent. Calls of both species likely recorded, due to significant overlap in call frequencies and characteristics, these species were grouped for analysis.

Note: only calls identified a definite should be entered in Bionet

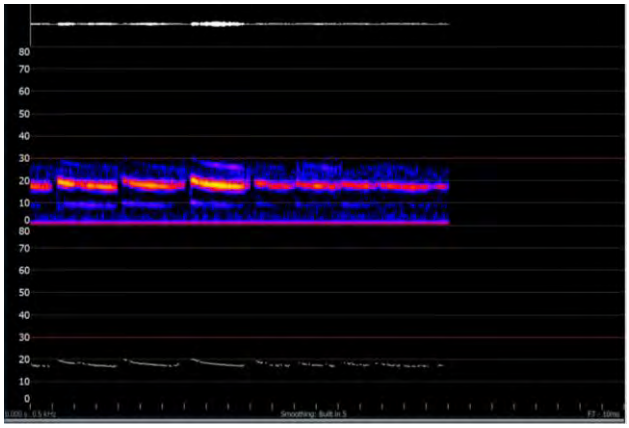
- D – definite; Pr – probable; Po – possible; E-either/both
- Calls were analysed using Anabat Insight.
- Example calls presented below are displayed in this report at F7.
- Analysis was completed on the 19 December 2022.
- Activity levels are in relation to overall activity at the site.
- The following resources were consulted during analysis:
    - Pennay M., Law B., and Reinhold L. (2004) Bat Calls of NSW. DEC of NSW.
    - Corben C. (2009) Anabat Techniques Workshop, Titley Scientific.
    - Personal experience analysing calls and collection of reference calls in NSW
    - Anabat Insight Workshop (2019), Titley Scientific and Balance Environmental.
    - Australasian Bat Society - BatMap. http://ausbats.org.au/batmap. Accessed 10/12/2022.

Examples of calls for definite and probable identified species

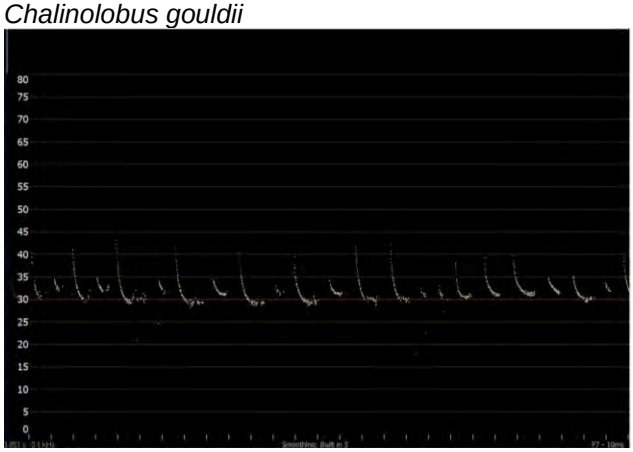
Austronomus australis



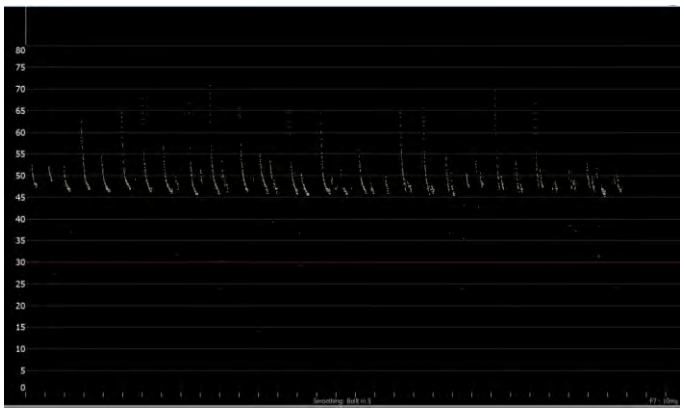
Saccolaimus flaviventris



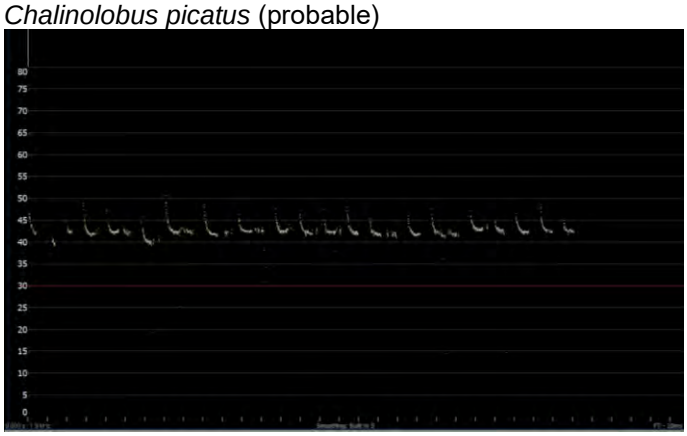
Chalinolobus gouldii



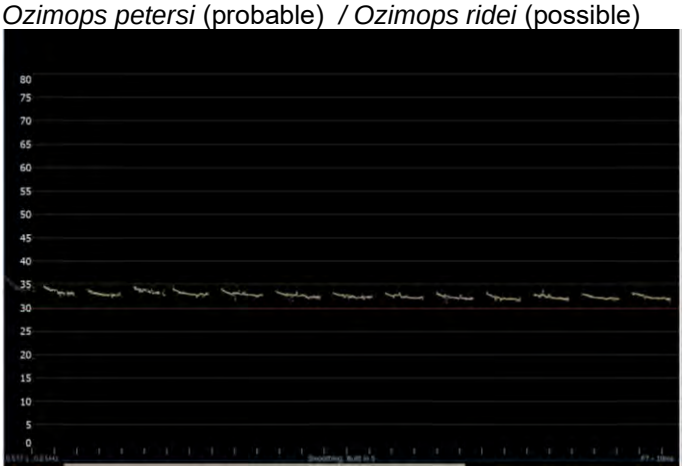
Chalinolobus morio



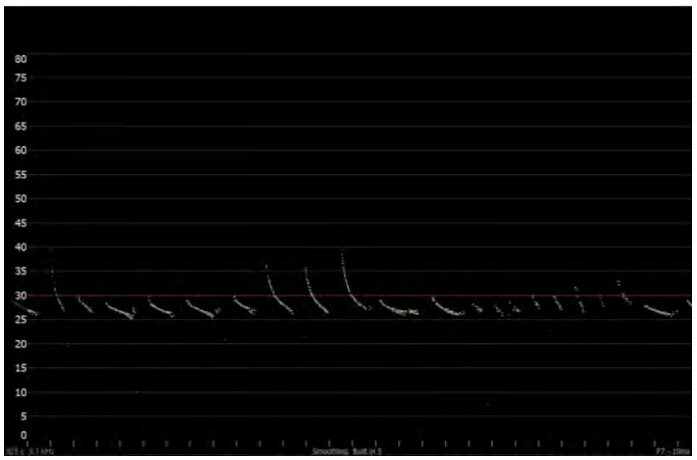
Chalinolobus picatus (probable)



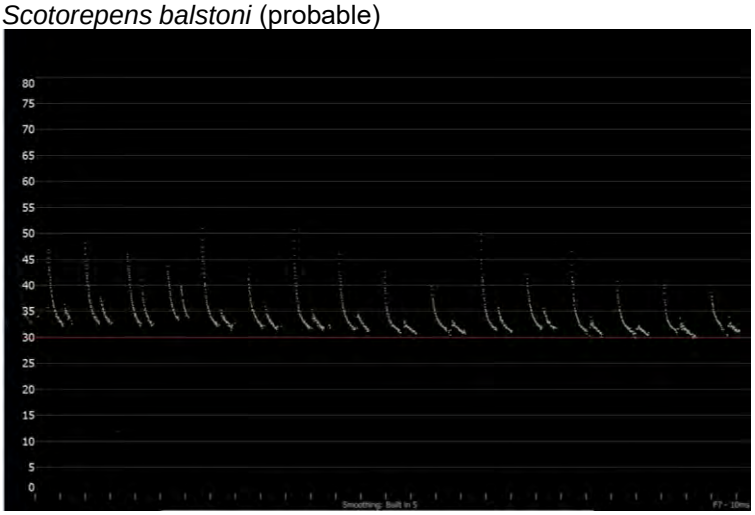
Ozimops petersi (probable) */ Ozimops ridei* (possible)



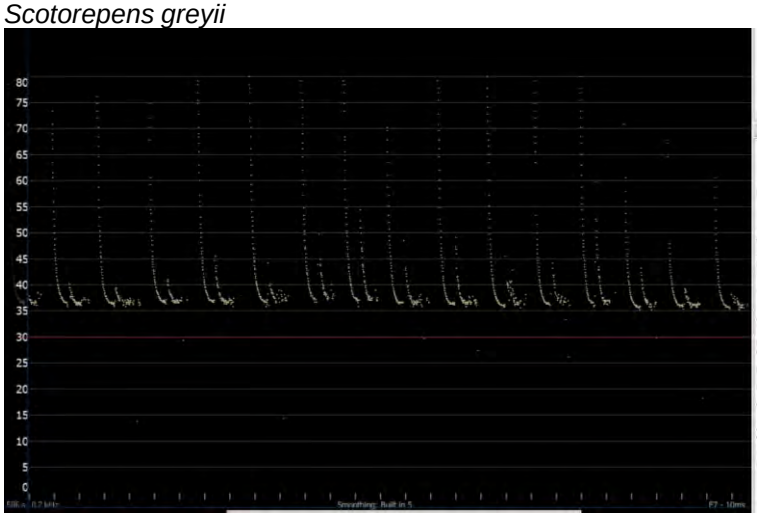
Ozimops planiceps



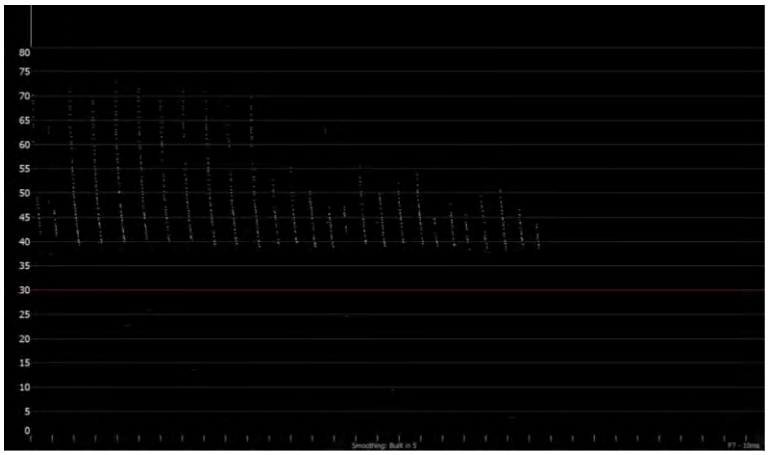
Scotorepens balstoni (probable)



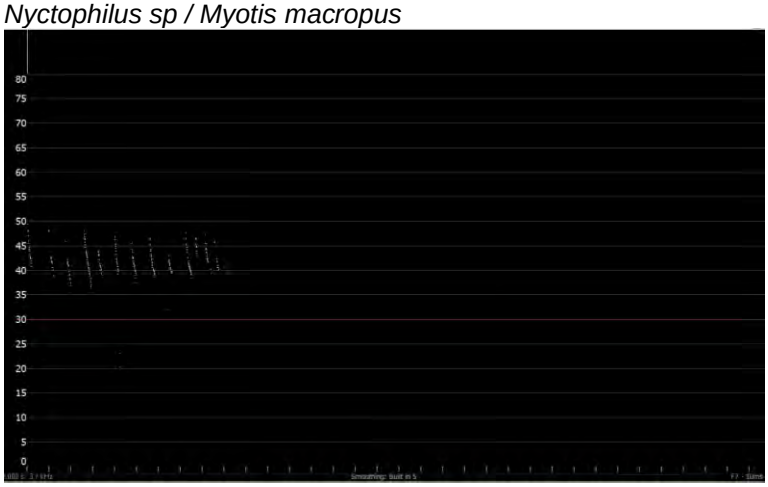
Scotorepens greyii



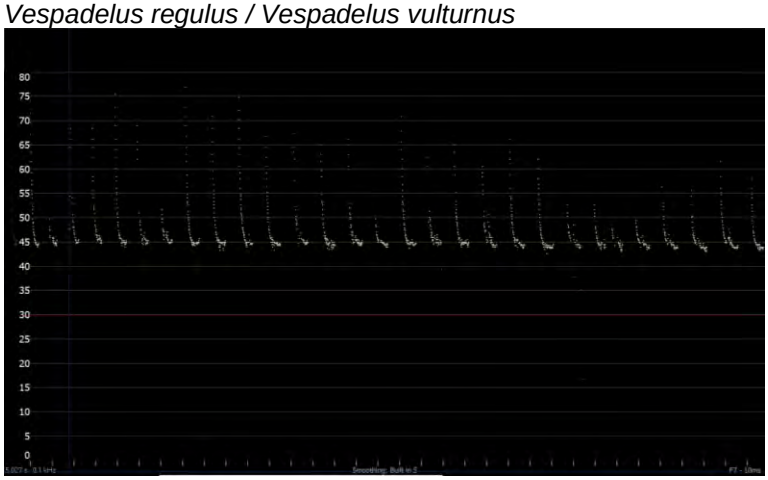
Nyctophilus geoffroyi / Nyctophilus gouldi / Nyctophilus corbeni



Nyctophilus sp / Myotis macropus



Vespadelus regulus / Vespadelus vulturnus



From:	amy@corymbiaecology.com.au
To:	Benjamin Parkin
Cc:	Hayden Beck
Subject:	RE: Anabat analysis
Date:	Monday, 19 December 2022 4:01:36 AM
Attachments:	image001.png image002.png image003.png Corymbia_Ecology_BCA-EMM_LakeCowal_Nov22.pdf 224_Corymbia Ecology INV-EMM.pdf

CAUTION: This email originated outside of the Organisation.

Hi Ben,

Here are the results. Most of the data was reviewed to cover these two species, so these results are for the entire dataset.
There were two passes which I could not distinguish between Nyctophilus and Myotis. When you get a good Myotis foraging area, you tend to get quite a few passes and get some characteristic features amongst them, so it is likely that if these passes were Myotis activity level is low or passing individual/s. I would rate this as only a possible Myotis.

Nyctophilus passes were recorded of which may be attributed to corbeni.

Let me know if you have any questions. Invoice is attached.

Regards,
Amy

Amy Rowles
CORYMBIA ECOLOGY
415 Parishs Rd, Hilldale, NSW, 2420
Mob: 0418451488

Amy is a Practising Member of the Ecological Consultants Association of NSW

From: Benjamin Parkin <bparkin@emmconsulting.com.au>
Sent: Friday, 2 December 2022 9:55 AM
To: Amy Rowles <amy@corymbiaecology.com.au>
Cc: Hayden Beck <hbeck@emmconsulting.com.au>
Subject: RE: Anabat analysis

Hi Amy,

For the moment we'll just ask you to screen for Myotis macropus and also Nyctophilus corbenii. We will revisit the need for a broader analysis in a few weeks.

80% of the recordings are in zca format (from Anabat express) and the rest in WAV. The total data size is 10GB, small enough for a dropbox transfer? Let me know and I'll either send you a link or post off a device today.

Thanks,

Ben Parkin
Ecologist

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M 0490 959 418
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From: Amy Rowles <amy@corymbiaecology.com.au>
Sent: Thursday, 1 December 2022 10:18 PM
To: Benjamin Parkin <bparkin@emmconsulting.com.au>
Cc: Hayden Beck <hbeck@emmconsulting.com.au>
Subject: Re: Anabat analysis

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Hi Ben,
It is a big data set. I doubt I would get through it all within 2 weeks. I should be able to search for Myotis first and let you know within 2 weeks of receiving the data, then another 2-3 weeks to do the rest. So including the Christmas/New Years break we are looking at early Jan to complete.

Also if the data is recorded in wav format can you please post on a memory device as downloading large datasets is often problematic.

Thanks,
Amy

Get Outlook for Android

From: Benjamin Parkin <bparkin@emmconsulting.com.au>
Sent: Thursday, 1 December 2022, 2:29 pm
To: amy@corymbiaecology.com.au <amy@corymbiaecology.com.au>
Cc: Hayden Beck <hbeck@emmconsulting.com.au>
Subject: Anabat analysis

Hi Amy,

Thanks for offering to help out with Anabat analysis.

We have approximately 39 detection nights worth of recordings from Lake Cowal (near West Wyalong) that require analysis. While we're interested in having these scanned for all possible threatened species, our main priority is checking for Southern Myotis, as a detection might require us to carry out further surveys on site in upcoming weeks.

We were ideally hoping to have the recordings scanned for southern myotis ASAP, ideally within 2 weeks or so. Would this be a feasible timeframe for you? I appreciate it's a pretty substantial bank of recordings to get through. If 2 weeks isn't viable, could you let us know roughly how long this could take?

Thanks,

Ben Parkin
Ecologist



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M 0490 959 418

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Animal Training Enterprises.

EVOLUTION MINING – LAKE COWAL – KOALA DETECTION DOG SURVEY SUMMARY.

Detection Dog Survey Dates

10th January 2023
11th January 2023
30th January 2023
31st January 2023
1st February 2023
2nd February 2023

Methodology

As per the 2022 Koala BAM survey guidelines each transect (selected by EMM consulting) was walked up and back with a detection dog checking all suitable trees within the transects on multiple wind directions. Due to the easy access, flat terrain, no ground cover and low volume of trees (and often absence of any feed trees) in the transects they were often done faster than the average time of 30-40 minutes – which is based upon surveys in dense coastal forests.

The transects were thoroughly assessed on the ground prior to running the dogs, to ensure the most appropriate trees were selected and the staff could always have feedback from their colleagues prior to attempting the survey.

The staff used a georeferenced PDF map of the site on Avenza to keep themselves close to the suggested transects and ran a Garmin Alpha 100 with a T5 Collar on each of the dogs. The staff would either record their own tracks on Avenza or colour in the transect once completed and immediately share with their colleagues to ensure no transects were missed. All of the dog track logs in GPX format have been sent onto EMM.

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Animal Training Enterprises.

EVOLUTION MINING – LAKE COWAL – KOALA DETECTION DOG SURVEY SUMMARY.

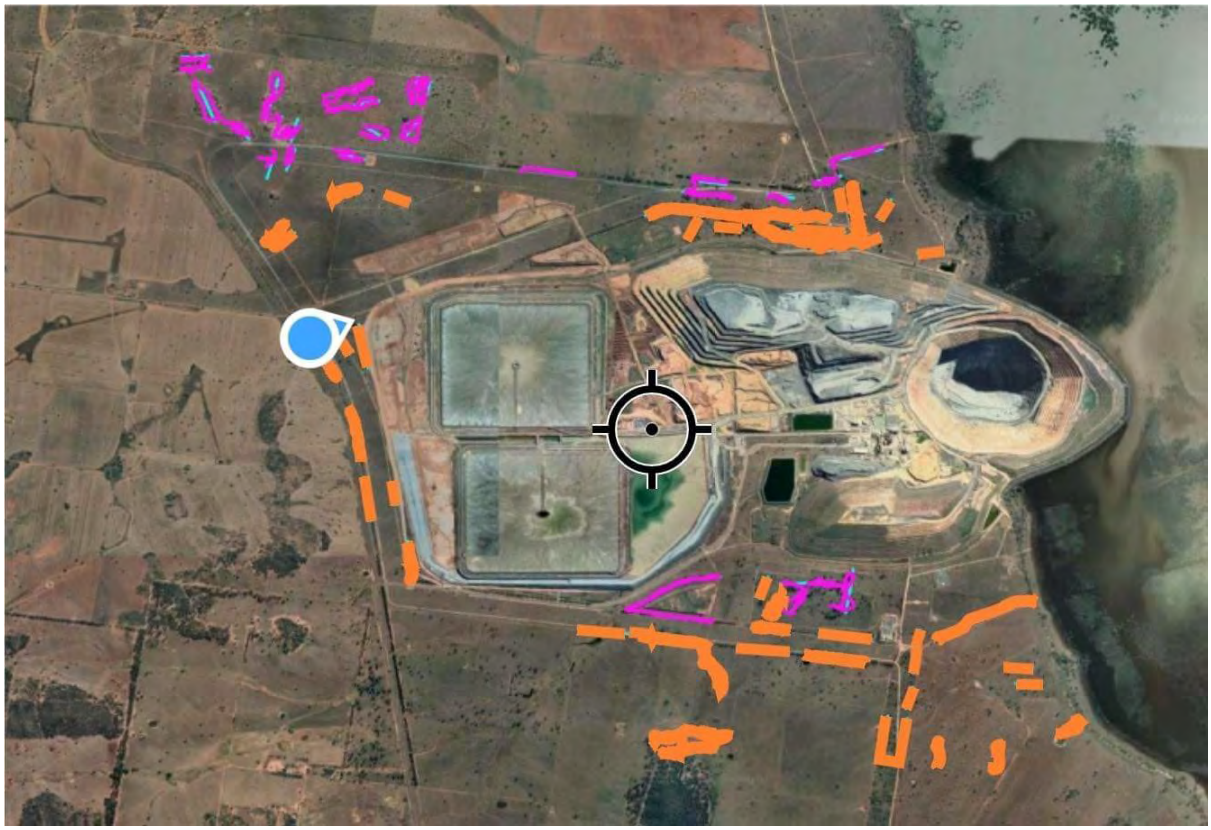


Image 1. The survey area with all transects coloured in.

The surveys were always conducted during weather conducive to successful detection of Koala scats.

As per our internal procedures if the dogs went more than 3 transects without a find, they were tested by our handlers putting our a target scent (usually an aged Koala scat) somewhere in the transect – all training materials were collected.

Dog Handlers

Even without the use of detection dogs the staff on the job are incredibly experienced in looking for Koalas, Koala feed trees, Scats and Scat Identification. All staff have worked for NSW NPWS conducting Koala surveys with detector dogs, as well as many local government agencies and ecological consultancies.

Ryan Tate
19 years relevant experience to Koalas and native animals. 8 years full time detector dog handling. - Bachelor of science, Zookeeping Certificate.

Claire Chiotti
18 years relevant wildlife experience. 7 years full time handling Detector dogs. Bachelors degree in Animal Behaviour.

Simone popp

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Animal Training Enterprises.

EVOLUTION MINING – LAKE COWAL – KOALA DETECTION DOG SURVEY SUMMARY.

15 years experience with Koalas and native Mammals. 10 years dog handling experience. Bachelor of Science.

Stephen Dalleywater - 13 years experience with native Mammals including koalas. 10 years dog training and handling experience. Zookeeping Certificate and dog training qualifications.

Koala Detection Dogs

The detection dogs used are all professionally trained and handled and are rigorously tested and undergo regular third-party assessment by other industry professionals including Stephen Austin and Craig Faulkner. At any stage if we thought habitat looked more suitable, we would run two dogs over it briefly to be extra sure. As mentioned previously, we did not get any interest from the dogs, and they all passed their in-situ training tests.

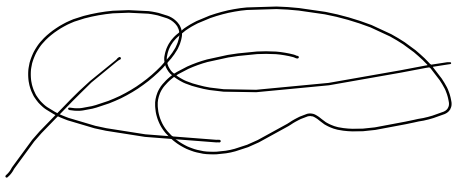
Primary Detector Dogs on the job:
Taylor - 6 years Koala surveys for NPWS
Dash – 2.5 years Koala surveys for NPWS
Rafa - 5 years Koala surveys for DPI and RMS

Secondary and back up dogs:
Becky - 6 years Koala surveys
Darcie - 1 year Koala surveys
Winnie - 1 year Koala surveys.

Results

Not a single bit of evidence of Koalas were detected throughout the entirety of the surveys. Not even a slight bit of interest from the dogs, or any scratch marks or similar scats that could be mistaken. We are absolutely confident that the transects we surveyed have not been used by Koalas in the last 3 months or likely a few years.

Ryan Tate – Managing Director Tate Animal Training Enterprises



EMM Targeted Frog Surveys - species detected							
Transect	**Date**	***L.tasmaniensis***	***L.interioris***	***L.latopalmata***	***C.parinsignifera***	***L.peronii***	***N.sudellae***
Sloane's Froglet Surveys (X = presence, - = absence)							
Site 1	1/08/2021	X	-	-	X	-	X
	2/08/2021	X	-	-	X	-	-
	3/08/2021	X	-	-	X	-	-
	4/08/2021	X	-	-	X	-	-
Site 2	1/08/2021	X	-	-	X	-	X
	2/08/2021	X	-	-	X	-	X
	3/08/2021	X	-	-	X	-	X
	4/08/2021	X	-	-	X	-	-
Site 3	1/08/2021	X	-	-	X	-	-
	2/08/2021	X	-	-	X	-	-
	3/08/2021	X	-	-	X	-	X
	4/08/2021	X	-	-	X	-	-
Transect 1	27/08/2021	X	-	-	X	-	-
	29/08/2021	X	-	-	X	-	-
Transect 2	26/08/2021	X	-	-	X	-	-
	28/08/2021	X	-	-	X	-	-
Transect 3	26/08/2021	X	-	-	X	-	-
	28/08/2021	X	-	-	X	-	-
Transect 4	27/08/2021	X	-	-	X	-	-
	29/08/2021	X	-	-	X	-	-

EMM Targeted Frog Surveys - species detected							
Transect	**Date**	***L.tasmaniensis***	***L.interioris***	***L.latopalmata***	***C.parinsignifera***	***L.peronii***	***N.sudellae***
		Southern Bell Frog Surveys (numbers refer to counts)					
T1A+B	5/10/2022	10	1	-	5	-	-
T1A	23/11/2022	10+	-	-	-	1	-
	23/11/2022	50+	-	2	5	2	-
	24/11/2022	5	-	5	-	-	-
T1B	23/11/2022	50+	-	2	20+	-	-
	23/11/2022	75+	-	25+	15+	8	-
	24/11/2022	100+	-	15+	3	5-10	-
	-	-	-	-	-	-	-
T2	22/11/2022	10+	-	-	3	1	-
	23/11/2022	15+	-	-	4	5	-
	24/11/2022	50+	2	6	1	5	1
	25/11/2022	30+	2	5	-	5+	1
T3	22/11/2022	100+	5+ Calling >1 km away	-	30+	-	-
	23/11/2022	100+	5+ Calling >1 km away	-	30+		
	24/11/2022	25+	5+ Calling >1 km away	5-10	-	10+	-
	25/11/2022	50+	5+ Calling >1 km away	10+	5+	10+	-
T4	22/11/2022	2	-	-	-	-	-
	23/11/2022	3	-	-	-	-	-
	24/11/2022	5	-	-	-	-	-
	25/11/2022						
DAM 1	24/11/2022	2	-	-	-	-	-
	24/11/2022	3	-	-	-	-	-
	25/11/2022	3	-	-	-	-	-

EMM Targeted Frog Surveys - species detected							
Transect	**Date**	***L.tasmaniensis***	***L.interioris***	***L.latopalmata***	***C.parinsignifera***	***L.peronii***	***N.sudellae***
DAM 2	24/11/2022	30+	-	-	2	2	-
	24/11/2022	30+	-	-	-	5	-
	25/11/2022	-	-	-	-	-	-
DAM 3	23/22/22	40+	-	10+	20	2	-
	24/11/2022	No data	No data	No data	No data	No data	No data
	25/11/2022	20+	-	-	2	5+	-

Appendix H
Plant identification

EMM
creating opportunities

The Royal
BOTANIC GARDENS
& Domain Trust

National Herbarium of New South Wales

Paul ROSSINGTON
EMM
10 Amaroo Avenue
Blaxland, NSW 2774

BIS Enquiry No: 22115
Botanical.Is@botanicgardens.nsw.gov.au
Ph. No: (02) 4631 5135
Date: 25 November 2022

Dear Paul,

Re: specimen identification – *Amphibromus* from near Lake Cowal

Thank you for your enquiry of 24-Nov-22.

Your specimen has been determined as:

Amphibromus nervosus (Hook.f.) Baill. – det. A.E. Orme, 25th Nov 2022.

We have retained the specimen for the herbarium collection – NSW1123991.

Thank you for your enquiry.

Yours sincerely,

Andrew Orme
Identifications Snr Technical Officer
Botanical Identification Service

From:	Paul Rossington
To:	Hayden Beck
Subject:	FW: Amphibromus ~ BIS 22115
Date:	Monday, 28 November 2022 8:17:27 AM
Attachments:	BIS 22115.pdf

FYI

From: Andrew Orme <Andrew.Orme@botanicgardens.nsw.gov.au>
Sent: Friday, 25 November 2022 2:45 PM
To: Paul Rossington <prossington@emmconsulting.com.au>
Subject: Amphibromus ~ BIS 22115

CAUTION: This email originated outside of the Organisation.

Hi Paul,
Here is the reply letter for your Amphibromus,
cheers,
Andrew

Andrew Orme
Identifications Snr Technical Officer
Botanical Identification Service

National Herbarium of New South Wales
Australian Institute of Botanical Science
Royal Botanic Gardens and Domain Trust
(02) 4631 5136 | 0410 025 101
andrew.orme@botanicgardens.nsw.gov.au
Locked Bag 6002, Mount Annan, NSW, 2567, Australia

The Royal
BOTANIC GARDENS
& Domain Trust

National Herbarium of New South Wales

Dr Hayden BECK
RPS Australia East Pty Ltd
Unit 2a,
45 Fitzroy St
Carrington, NSW 2294

BIS Enquiry No: 22122
Botanical.Is@botanicgardens.nsw.gov.au
Ph. No: (02) 4631 5135
Date: 30 November 2022

Dear Dr BECK,

Re: *Pilularia novae-hollandiae* from Lake Cowal, NSW

We are happy to povide the following identifications:

GPS #15/16 *Pilularia novae-hollandiae* Conf. SF McCune 30 Nov 2022 - retained

GPS #17 *Pilularia novae-hollandiae* Conf. SF McCune 30 Nov 2022 - retained

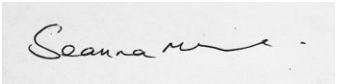
GPS #019 Probably *Pilularia novae-hollandiae* - sterile material with slight coiling of young frond tips Det. SF McCune 30 Nov 2022

GPS #20 *Pilularia novae-hollandiae* Conf. SF McCune 30 Nov 2022 - retained

You have not been charged for these determinations.

Thank you for your enquiry.

Yours sincerely,



Seanna McCune
Identification Senior Technical Officer
Botanical Identification Service

From:	Seanna Mccune
To:	Hayden Beck
Subject:	Plant ID BIS 22122: Pilularia novae-hollandiae (Austral Pillwort)
Date:	Wednesday, 30 November 2022 1:38:33 PM
Attachments:	image001.jpg image002.jpg BIS 22122.pdf

CAUTION: This email originated outside of the Organisation.

Hi Hayden,

Please find attached our response to your enquiry dated 24 November 2022.

Warm regards, Seanna

Seanna McCune
Senior Technical Officer
Botanical Identification Service
(work days Monday to Wednesday)

National Herbarium of New South Wales
Australian Institute of Botanical Science
Royal Botanic Gardens and Domain Trust
T (02) 4631 5135
E seanna.mccune@botanicgardens.nsw.gov.au
Locked Bag 6002, Mount Annan, NSW 2567

Botanical Identification Service enquiries botanical.is@botanicgardens.nsw.gov.au
W rbgsyd.nsw.gov.au/Science/Plant-ID-Disease-Diagnostic-Services/Botanical-Identification-Service



Timeline Description automatically generated



We pay respect to the First Peoples of this nation and their custodianship of the land, sea and sky. This place always was and always will be Aboriginal land.

From: Hayden Beck <hbeck@emmconsulting.com.au>
Sent: Tuesday, 2 August 2022 3:25 PM
To: Seanna Mccune <Seanna.Mccune@botanicgardens.nsw.gov.au>

Subject: Seeking expert: Pilularia novae-hollandiae (Austral Pillwort)

Good afternoon Seanna,

Hope you are well!

We are currently undertaking an impact assessment and need an expert to provide guidance on habitat for *Pilularia novae-hollandiae* (Austral Pillwort).

We were wondering if there was someone you knew who could assist us?

Any guidance would be much appreciated.

Warm regards,

Hayden (note – I used to work at RPS and now at EMM)

Hayden Beck
Senior Ecologist
Bushfire, Ecology, Heritage and Spatial Solutions Division

T 02 4907 4872

M 0421 440 518

www.emmconsulting.com.au

The Royal
BOTANIC GARDENS
& Domain Trust

National Herbarium of New South Wales

Dr Donna JOHNSTON
DnA Environmental
417 Mandurama Rd
Mandurama, NSW 2792
AUSTRALIA

BIS Enquiry No: 22157
Botanical.Is@botanicgardens.nsw.gov.au
Ph. No: (02) 4631 5135
Date: 25 January 2023

Dear Dr JOHNSTON,

Re: grass from "Gumridge"

We are happy to provide the following information:

The ligule morphology and scattered tubercle-based hairs on leaves are consistent with *Bothriochloa biloba*, but this determination can't be confirmed without fertile material.

Re: 7 specimens from Cowal Gold Operations, Lake Cowal, West Wyalong

42 *Pilularia novae-hollandiae* Det. S McCune 23 Jan 2023 – listed as Endangered (BCA)

43 *Pilularia novae-hollandiae* Det. S McCune 23 Jan 2023 - retained for the Herbarium collection

44 *Pilularia novae-hollandiae* Det. S McCune 23 Jan 2023

45 *Pilularia novae-hollandiae* Det. S McCune 23 Jan 2023

46 *Pilularia novae-hollandiae* Det. S McCune 23 Jan 2023

47 no specimen

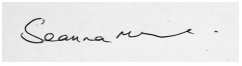
48 *Pilularia novae-hollandiae* Det. S McCune 23 Jan 2023 - retained for the Herbarium collection

49 *Pilularia novae-hollandiae* Det. S McCune 23 Jan 2023

An invoice for $55.00 (incl. GST) will be forwarded to you separately by our finance section to cover cost of identification.

Thank you for your enquiry.

Yours sincerely,



Seanna McCune
Identification Senior technical Officer
Botanical Identification Service

From: Albrecht, Dave (NCMI, Black Mountain)
To: Hayden Beck
Subject: Your plant IDs
Date: Monday, 5 December 2022 1:36:01 PM

CAUTION: This email originated outside of the Organisation.

Hello Hayden,

The three specimens that you submitted recently have been identified as Amphibromus nervosus. The awns were bent and twisted when dry, which rules out A.fluitans.

All the best,

Dave

David Albrecht
Plant Identification and Liaison Officer | Australian National Herbarium
Centre for Australian National Biodiversity Research
National Research Collections Australia
CSIRO
E dave.albrecht@csiro.au
GPO Box 1700, Canberra, ACT 2601, AUSTRALIA

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Appendix I
GDE Assessment – raw data

EMM
creating opportunities

Table AI.1 Current groundwater levels for PCTs in groundwater study area

PCTID	PCTName	vegForm	vegClass	Area_ha	GWmbgl
2	River Red Gum-sedge dominated very tall open forest in frequently flooded forest wetland along maior rivers and floodplains in south-western NSW	Forested Wetlands	Inland Riverine Forests	732.36	> 5
5	River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the eastern Riverina Bioregion.	Forested Wetlands	Inland Riverine Forests	0.15	2 - 5
5	River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the eastern Riverina Bioregion.	Forested Wetlands	Inland Riverine Forests	478.88	> 5
9	River Red Gum - wallaby grass tall woodland wetland on the outer River Red Gum zone mainly in the Riverina Bioregion	Forested Wetlands	Inland Riverine Forests	1.44	2 - 5
9	River Red Gum - wallaby grass tall woodland wetland on the outer River Red Gum zone mainly in the Riverina Bioregion	Forested Wetlands	Inland Riverine Forests	897.05	> 5
9	River Red Gum - wallaby grass tall woodland wetland on the outer River Red Gum zone mainly in the Riverina Bioregion	Forested Wetlands	Inland Riverine Forests	7.71	0 - 0.5
9	River Red Gum - wallaby grass tall woodland wetland on the outer River Red Gum zone mainly in the Riverina Bioregion	Forested Wetlands	Inland Riverine Forests	5.51	0.5 - 2
10	River Red Gum - Black Box woodland wetland of the semi-arid (warm) climatic zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Forested Wetlands	Inland Riverine Forests	1.63	> 5
10	River Red Gum - Black Box woodland wetland of the semi-arid (warm) climatic zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Forested Wetlands	Inland Riverine Forests	1.49	0 - 0.5
10	River Red Gum - Black Box woodland wetland of the semi-arid (warm) climatic zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Forested Wetlands	Inland Riverine Forests	14.14	0.5 - 2
11	River Red Gum - Lignum very tall open forest or woodland wetland on floodplains of semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Forested Wetlands	Inland Riverine Forests	55.74	2 - 5
11	River Red Gum - Lignum very tall open forest or woodland wetland on floodplains of semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Forested Wetlands	Inland Riverine Forests	183.43	> 5
11	River Red Gum - Lignum very tall open forest or woodland wetland on floodplains of semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Forested Wetlands	Inland Riverine Forests	12.94	0.5 - 2
13	Black Box - Lignum woodland wetland of the inner floodplains in the semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Semi-arid Woodlands (Grassy sub-formation)	Inland Floodplain Woodlands	0.78	> 5
15	Black Box open woodland wetland with chenopod understorey mainly on the outer floodplains in south-western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Semi-arid Woodlands (Grassy sub-formation)	Inland Floodplain Woodlands	1.92	0 - 0.5
17	Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Freshwater Wetlands	Inland Floodplain Shrublands	1.04	0 - 0.5
24	Canegrass swamp tall grassland wetland of drainage depressions, lakes and pans of the inland plains	Freshwater Wetlands	Inland Floodplain Shrublands	111.69	2 - 5
24	Canegrass swamp tall grassland wetland of drainage depressions, lakes and pans of the inland plains	Freshwater Wetlands	Inland Floodplain Shrublands	68.31	> 5
24	Canegrass swamp tall grassland wetland of drainage depressions, lakes and pans of the inland plains	Freshwater Wetlands	Inland Floodplain Shrublands	2.05	0 - 0.5
26	Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	Semi-arid Woodlands (Grassy sub-formation)	Riverine Plain Woodlands	40.60	2 - 5
26	Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	Semi-arid Woodlands (Grassy sub-formation)	Riverine Plain Woodlands	608.94	> 5
26	Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	Semi-arid Woodlands (Grassy sub-formation)	Riverine Plain Woodlands	142.82	0 - 0.5
26	Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	Semi-arid Woodlands (Grassy sub-formation)	Riverine Plain Woodlands	6.45	0.5 - 2
27	Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	Semi-arid Woodlands (Grassy sub-formation)	Riverine Plain Woodlands	2.60	> 5
45	Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion	Grasslands	Riverine Plain Grasslands	2381.41	2 - 5
45	Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion	Grasslands	Riverine Plain Grasslands	########	> 5
45	Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion	Grasslands	Riverine Plain Grasslands	1939.13	0 - 0.5
45	Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion	Grasslands	Riverine Plain Grasslands	395.66	0.5 - 2
53	Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains	Freshwater Wetlands	Inland Floodplain Swamps	838.88	2 - 5
53	Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains	Freshwater Wetlands	Inland Floodplain Swamps	4986.08	> 5
53	Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains	Freshwater Wetlands	Inland Floodplain Swamps	1313.03	0 - 0.5
53	Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains	Freshwater Wetlands	Inland Floodplain Swamps	80.37	0.5 - 2
54	Bulokе - White Cypress Pine woodland in the NSW South Western Slopes Bioregion	Dry Sclerophyll Forests (Shrubby sub-formation)	Western Slopes Dry Sclerophyll Forests	2.65	> 5
55	Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.	Semi-arid Woodlands (Grassy sub-formation)	North-west Floodplain Woodlands	441.61	2 - 5
55	Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.	Semi-arid Woodlands (Grassy sub-formation)	North-west Floodplain Woodlands	7637.41	> 5
55	Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.	Semi-arid Woodlands (Grassy sub-formation)	North-west Floodplain Woodlands	223.49	0 - 0.5
55	Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.	Semi-arid Woodlands (Grassy sub-formation)	North-west Floodplain Woodlands	67.06	0.5 - 2
56	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW	Grassy Woodlands	Floodplain Transition Woodlands	13.17	2 - 5
56	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW	Grassy Woodlands	Floodplain Transition Woodlands	64.79	> 5
56	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW	Grassy Woodlands	Floodplain Transition Woodlands	15.14	0 - 0.5
56	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW	Grassy Woodlands	Floodplain Transition Woodlands	0.92	0.5 - 2
70	White Cypress Pine woodland on sandy loams in central NSW wheatbelt	Grassy Woodlands	Floodplain Transition Woodlands	542.99	2 - 5
70	White Cypress Pine woodland on sandy loams in central NSW wheatbelt	Grassy Woodlands	Floodplain Transition Woodlands	3151.93	> 5
70	White Cypress Pine woodland on sandy loams in central NSW wheatbelt	Grassy Woodlands	Floodplain Transition Woodlands	195.60	0 - 0.5
70	White Cypress Pine woodland on sandy loams in central NSW wheatbelt	Grassy Woodlands	Floodplain Transition Woodlands	152.93	0.5 - 2
72	White Cypress Pine - Poplar Box woodland on footslopes and peneplains mainly in the Cobar Peneplain Bioregion	Semi-arid Woodlands (Shrubby sub-formation)	Western Peneplain Woodlands	8.88	2 - 5
72	White Cypress Pine - Poplar Box woodland on footslopes and peneplains mainly in the Cobar Peneplain Bioregion	Semi-arid Woodlands (Shrubby sub-formation)	Western Peneplain Woodlands	63.22	> 5
74	Yellow Box - River Red Gum tall grassy riverine woodland of NSW South Western Slopes Bioregion and Riverina Bioregion	Grassy Woodlands	Floodplain Transition Woodlands	2.74	> 5
75	Yellow Box - White Cypress Pine grassy woodland on deep sandy-loam alluvial soils of the eastern Riverina Bioregion and western NSW South Western Slopes Bioregion	Semi-arid Woodlands (Shrubby sub-formation)	Riverine Sandhill Woodlands	6.52	2 - 5
75	Yellow Box - White Cypress Pine grassy woodland on deep sandy-loam alluvial soils of the eastern Riverina Bioregion and western NSW South Western Slopes Bioregion	Semi-arid Woodlands (Shrubby sub-formation)	Riverine Sandhill Woodlands	0.35	> 5
76	Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions	Grassy Woodlands	Floodplain Transition Woodlands	2015.63	2 - 5
76	Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions	Grassy Woodlands	Floodplain Transition Woodlands	########	> 5
76	Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions	Grassy Woodlands	Floodplain Transition Woodlands	97.37	0 - 0.5
76	Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions	Grassy Woodlands	Floodplain Transition Woodlands	52.91	0.5 - 2
77	Yarran shrubland of the NSW central to northern slopes and plains	Arid Shrublands (Acacia sub-formation)	North-west Plain Shrublands	255.32	2 - 5
77	Yarran shrubland of the NSW central to northern slopes and plains	Arid Shrublands (Acacia sub-formation)	North-west Plain Shrublands	906.82	> 5
77	Yarran shrubland of the NSW central to northern slopes and plains	Arid Shrublands (Acacia sub-formation)	North-west Plain Shrublands	0.67	0 - 0.5
80	Western Grey Box - White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion	Grassy Woodlands	Floodplain Transition Woodlands	1008.51	2 - 5
80	Western Grey Box - White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion	Grassy Woodlands	Floodplain Transition Woodlands	7413.40	> 5
80	Western Grey Box - White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion	Grassy Woodlands	Floodplain Transition Woodlands	230.44	0 - 0.5
80	Western Grey Box - White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion	Grassy Woodlands	Floodplain Transition Woodlands	106.79	0.5 - 2
81	Western Grey Box - cypress pine shrub grass shrub tall woodland in the Brigalow Belt South Bioregion	Grassy Woodlands	Floodplain Transition Woodlands	3.75	> 5
82	Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	Grassy Woodlands	Floodplain Transition Woodlands	4.71	2 - 5
82	Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	Grassy Woodlands	Floodplain Transition Woodlands	95.47	> 5
82	Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	Grassy Woodlands	Floodplain Transition Woodlands	73.69	0 - 0.5
82	Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	Grassy Woodlands	Floodplain Transition Woodlands	4.48	0.5 - 2
104	Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion	Semi-arid Woodlands (Shrubby sub-formation)	Inland Rocky Hill Woodlands	4.42	> 5
105	Poplar Box grassy woodland on flats mainly in the Cobar Peneplain Bioregion and Murray Darling Depression Bioregion	Semi-arid Woodlands (Shrubby sub-formation)	Western Peneplain Woodlands	11.30	2 - 5
105	Poplar Box grassy woodland on flats mainly in the Cobar Peneplain Bioregion and Murray Darling Depression Bioregion	Semi-arid Woodlands (Shrubby sub-formation)	Western Peneplain Woodlands	0.98	> 5
110	Western Grey Box - Cypress Pine shrubby woodland on stony footslopes in the NSW South Western Slopes Bioregion and Riverina Bioregion	Dry Sclerophyll Forests (Shrubby sub-formation)	Western Slopes Dry Sclerophyll Forests	428.24	> 5
173	Sandplain mallee of central NSW	Semi-arid Woodlands (Shrubby sub-formation)	Sand Plain Mallee Woodlands	5.55	> 5
176	Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion	Semi-arid Woodlands (Shrubby sub-formation)	Inland Rocky Hill Woodlands	48.28	2 - 5
176	Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion	Semi-arid Woodlands (Shrubby sub-formation)	Inland Rocky Hill Woodlands	99.38	> 5
177	Blue Mallee - Bull Mallee - Green Mallee very tall mallee shrubland of the West Wyalong region, NSW South Western Slopes Bioregion	Semi-arid Woodlands (Shrubby sub-formation)	Inland Rocky Hill Woodlands	90.72	> 5
182	Cumbungi rushland wetland of shallow semi-permanent water bodies and inland watercourses	Freshwater Wetlands	Inland Floodplain Swamps	2.48	> 5
182	Cumbungi rushland wetland of shallow semi-permanent water bodies and inland watercourses	Freshwater Wetlands	Inland Floodplain Swamps	7.16	0 - 0.5
184	Dwyers Red Gum - White Cypress Pine - Currawang low shrub-grass woodland of the Cobar Peneplain Bioregion	Semi-arid Woodlands (Shrubby sub-formation)	Inland Rocky Hill Woodlands	13.63	2 - 5
184	Dwyers Red Gum - White Cypress Pine - Currawang low shrub-grass woodland of the Cobar Peneplain Bioregion	Semi-arid Woodlands (Shrubby sub-formation)	Inland Rocky Hill Woodlands	0.63	> 5
184	Dwyers Red Gum - White Cypress Pine - Currawang low shrub-grass woodland of the Cobar Peneplain Bioregion	Semi-arid Woodlands (Shrubby sub-formation)	Inland Rocky Hill Woodlands	0.04	0.5 - 2
185	Dwyers Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion	Semi-arid Woodlands (Shrubby sub-formation)	Inland Rocky Hill Woodlands	934.12	2 - 5
185	Dwyers Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion	Semi-arid Woodlands (Shrubby sub-formation)	Inland Rocky Hill Woodlands	5076.92	> 5
185	Dwyers Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion	Semi-arid Woodlands (Shrubby sub-formation)	Inland Rocky Hill Woodlands	295.66	0 - 0.5
185	Dwyers Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion	Semi-arid Woodlands (Shrubby sub-formation)	Inland Rocky Hill Woodlands	129.86	0.5 - 2
186	Dwyers Red Gum - Black Cypress Pine - Currawang shrubby low woodland on rocky hills mainly in the NSW South Western Slopes Bioregion	Semi-arid Woodlands (Shrubby sub-formation)	Inland Rocky Hill Woodlands	730.35	> 5
186	Dwyers Red Gum - Black Cypress Pine - Currawang shrubby low woodland on rocky hills mainly in the NSW South Western Slopes Bioregion	Semi-arid Woodlands (Shrubby sub-formation)	Inland Rocky Hill Woodlands	20.14	0 - 0.5
201	Fuzzy Box Woodland on alluvial brown loam soils mainly in the NSW South Western Slopes Bioregion	Grassy Woodlands	Western Slopes Grassy Woodlands	56.86	> 5
217	Mugga Ironbark - Western Grey Box - cypress pine tall woodland on footslopes of low hills in the NSW South Western Slopes Bioregion	Dry Sclerophyll Forests (Shrubby sub-formation)	Western Slopes Dry Sclerophyll Forests	176.47	2 - 5
217	Mugga Ironbark - Western Grey Box - cypress pine tall woodland on footslopes of low hills in the NSW South Western Slopes Bioregion	Dry Sclerophyll Forests (Shrubby sub-formation)	Western Slopes Dry Sclerophyll Forests	3224.63	> 5
217	Mugga Ironbark - Western Grey Box - cypress pine tall woodland on footslopes of low hills in the NSW South Western Slopes Bioregion	Dry Sclerophyll Forests (Shrubby sub-formation)	Western Slopes Dry Sclerophyll Forests	142.59	0 - 0.5
217	Mugga Ironbark - Western Grey Box - cypress pine tall woodland on footslopes of low hills in the NSW South Western Slopes Bioregion	Dry Sclerophyll Forests (Shrubby sub-formation)	Western Slopes Dry Sclerophyll Forests	3.49	0.5 - 2
244	Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).	Grassy Woodlands	Floodplain Transition Woodlands	16.93	2 - 5
244	Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).	Grassy Woodlands	Floodplain Transition Woodlands	47.58	> 5
244	Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).	Grassy Woodlands	Floodplain Transition Woodlands	2.38	0 - 0.5
244	Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).	Grassy Woodlands	Floodplain Transition Woodlands	0.45	0.5 - 2
248	Mixed box eucalypt woodland on low sandy-loam rises on alluvial plains in central western NSW	Grassy Woodlands	Floodplain Transition Woodlands	4.27	2 - 5
248	Mixed box eucalypt woodland on low sandy-loam rises on alluvial plains in central western NSW	Grassy Woodlands	Floodplain Transition Woodlands	175.71	> 5
248	Mixed box eucalypt woodland on low sandy-loam rises on alluvial plains in central western NSW	Grassy Woodlands	Floodplain Transition Woodlands	63.36	0 - 0.5
248	Mixed box eucalypt woodland on low sandy-loam rises on alluvial plains in central western NSW	Grassy Woodlands	Floodplain Transition Woodlands	7.14	0.5 - 2
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	202.33	2 - 5
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	2527.84	> 5
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	3781.11	0 - 0.5
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	271.86	0.5 - 2
251	Mixed Eucalypt woodlands of floodplains in the southern-eastern Cobar Peneplain Bioregion	Grassy Woodlands	Floodplain Transition Woodlands	24.70	2 - 5
251	Mixed Eucalypt woodlands of floodplains in the southern-eastern Cobar Peneplain Bioregion	Grassy Woodlands	Floodplain Transition Woodlands	280.47	> 5
251	Mixed Eucalypt woodlands of floodplains in the southern-eastern Cobar Peneplain Bioregion	Grassy Woodlands	Floodplain Transition Woodlands	0.39	0 - 0.5
251	Mixed Eucalypt woodlands of floodplains in the southern-eastern Cobar Peneplain Bioregion	Grassy Woodlands	Floodplain Transition Woodlands	7.21	0.5 - 2
257	Dwyers Red Gum - Currawang grassy low woodland of the central western plains of NSW	Semi-arid Woodlands (Shrubby sub-formation)	Inland Rocky Hill Woodlands	1.12	2 - 5
257	Dwyers Red Gum - Currawang grassy low woodland of the central western plains of NSW	Semi-arid Woodlands (Shrubby sub-formation)	Inland Rocky Hill Woodlands	16.32	> 5
257	Dwyers Red Gum - Currawang grassy low woodland of the central western plains of NSW	Semi-arid Woodlands (Shrubby sub-formation)	Inland Rocky Hill Woodlands	3.93	0.5 - 2
267	White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland in the NSW South Western Slopes Bioregion	Grassy Woodlands	Western Slopes Grassy Woodlands	12.49	> 5
276	Yellow Box grassy tall woodland on alluvium or parna loams and clays on flats in NSW South Western Slopes Bioregion	Grassy Woodlands	Western Slopes Grassy Woodlands	86.46	> 5
277	Blakelys Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion	Grassy Woodlands	Western Slopes Grassy Woodlands	48.11	> 5
278	Riparian Blakelys Red Gum - box - shrub - sedge - grass tall open forest of the central NSW South Western Slopes Bioregion	Grassy Woodlands	Western Slopes Grassy Woodlands	16.73	> 5
279	Blakelys Red Gum - White Cypress Pine woodland on footslopes of hills in central part of the NSW South Western Slopes Bioregion	Grassy Woodlands	Western Slopes Grassy Woodlands	1.54	2 - 5
292	She oak - Fringe Myrtle heathland on rocky ranges in the NSW South Western Slopes Bioregion	Semi-arid Woodlands (Shrubby sub-formation)	Inland Rocky Hill Woodlands	872.27	> 5
332	Tumbledown Red Gum - Black Cypress Pine - Red Stringybark woodland on rocky hills in the NSW central western slopes	Semi-arid Woodlands (Shrubby sub-formation)	Inland Rocky Hill Woodlands	13.62	> 5
356	Blakelys Red Gum x Dirty Gum - White Cypress Pine tall riparian woodland, NSW South Western Slopes Bioregion	Forested Wetlands	Inland Riverine Forests	3.98	> 5

Table AI.2 Incremental drawdown for potential GDEs

PCTID	PCTName	vegForm	vegClass	Area_ha	HEVAE_HP	GDE_cat	Approved	PostMining	Drawdown
10	River Red Gum - Black Box woodland wetland of the semi-arid (warm) climatic zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Forested Wetlands	Inland Riverine Forests	1.63	HEVAE high priority GDE	Entirely/obligate	5 - 10	5 - 10	0 - 2
10	River Red Gum - Black Box woodland wetland of the semi-arid (warm) climatic zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Forested Wetlands	Inland Riverine Forests	0.06	HEVAE high priority GDE	Entirely/obligate	5 - 10	5 - 10	0 - 2
10	River Red Gum - Black Box woodland wetland of the semi-arid (warm) climatic zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Forested Wetlands	Inland Riverine Forests	0.75	HEVAE high priority GDE	Entirely/obligate	5 - 10	10 - 20	5 - 10
10	River Red Gum - Black Box woodland wetland of the semi-arid (warm) climatic zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Forested Wetlands	Inland Riverine Forests	0.69	HEVAE high priority GDE	Entirely/obligate	10 - 20	10 - 20	5 - 10
10	River Red Gum - Black Box woodland wetland of the semi-arid (warm) climatic zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Forested Wetlands	Inland Riverine Forests	8.70	HEVAE high priority GDE	Entirely/obligate	5 - 10	5 - 10	0 - 2
10	River Red Gum - Black Box woodland wetland of the semi-arid (warm) climatic zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Forested Wetlands	Inland Riverine Forests	0.67	HEVAE high priority GDE	Entirely/obligate	5 - 10	10 - 20	0 - 2
10	River Red Gum - Black Box woodland wetland of the semi-arid (warm) climatic zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Forested Wetlands	Inland Riverine Forests	4.49	HEVAE high priority GDE	Entirely/obligate	5 - 10	10 - 20	2 - 5
10	River Red Gum - Black Box woodland wetland of the semi-arid (warm) climatic zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Forested Wetlands	Inland Riverine Forests	0.07	HEVAE high priority GDE	Entirely/obligate	5 - 10	10 - 20	5 - 10
10	River Red Gum - Black Box woodland wetland of the semi-arid (warm) climatic zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Forested Wetlands	Inland Riverine Forests	0.21	HEVAE high priority GDE	Entirely/obligate	10 - 20	10 - 20	2 - 5
15	Black Box open woodland wetland with chenopod understorey mainly on the outer floodplains in south-western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Semi-arid Woodlands (Grassy sub-formation)	Inland Floodplain Woodlands	1.92		Entirely/obligate	5 - 10	5 - 10	0 - 2
17	Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Freshwater Wetlands	Inland Floodplain Shrublands	0.10		Entirely/obligate	5 - 10	5 - 10	0 - 2
17	Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Freshwater Wetlands	Inland Floodplain Shrublands	0.94		Entirely/obligate	5 - 10	10 - 20	0 - 2
24	Canegrass swamp tall grassland wetland of drainage depressions, lakes and pans of the inland plains	Freshwater Wetlands	Inland Floodplain Shrublands	25.57		Facultative - opportunistic	20+	20+	0 - 2
24	Canegrass swamp tall grassland wetland of drainage depressions, lakes and pans of the inland plains	Freshwater Wetlands	Inland Floodplain Shrublands	39.49		Facultative - opportunistic	5 - 10	5 - 10	0 - 2
24	Canegrass swamp tall grassland wetland of drainage depressions, lakes and pans of the inland plains	Freshwater Wetlands	Inland Floodplain Shrublands	3.21		Facultative - opportunistic	10 - 20	10 - 20	0 - 2
24	Canegrass swamp tall grassland wetland of drainage depressions, lakes and pans of the inland plains	Freshwater Wetlands	Inland Floodplain Shrublands	111.60		Facultative - opportunistic	2 - 5	2 - 5	0 - 2
24	Canegrass swamp tall grassland wetland of drainage depressions, lakes and pans of the inland plains	Freshwater Wetlands	Inland Floodplain Shrublands	2.10		Facultative - opportunistic	5 - 10	5 - 10	0 - 2
75	Yellow Box - White Cypress Pine grassy woodland on deep sandy-loam alluvial soils of the eastern Riverina Bioregion and western NSW South Western Slopes Bioregion	Semi-arid Woodlands (Shrubby sub-formation)	Riverine Sandhill Woodlands	0.35		Facultative - proportional	5 - 10	5 - 10	0 - 2
75	Yellow Box - White Cypress Pine grassy woodland on deep sandy-loam alluvial soils of the eastern Riverina Bioregion and western NSW South Western Slopes Bioregion	Semi-arid Woodlands (Shrubby sub-formation)	Riverine Sandhill Woodlands	5.23		Facultative - proportional	2 - 5	2 - 5	0 - 2
75	Yellow Box - White Cypress Pine grassy woodland on deep sandy-loam alluvial soils of the eastern Riverina Bioregion and western NSW South Western Slopes Bioregion	Semi-arid Woodlands (Shrubby sub-formation)	Riverine Sandhill Woodlands	1.29		Facultative - proportional	5 - 10	5 - 10	0 - 2
105	Poplar Box grassy woodland on flats mainly in the Cobar Peneplain Bioregion and Murray Darling Depression Bioregion	Semi-arid Woodlands (Shrubby sub-formation)	Western Peneplain Woodlands	0.98		Facultative - proportional	20+	20+	0 - 2
105	Poplar Box grassy woodland on flats mainly in the Cobar Peneplain Bioregion and Murray Darling Depression Bioregion	Semi-arid Woodlands (Shrubby sub-formation)	Western Peneplain Woodlands	11.30		Facultative - proportional	5 - 10	5 - 10	0 - 2
182	Cumbungi rushland wetland of shallow semi-permanent water bodies and inland watercourses	Freshwater Wetlands	Inland Floodplain Swamps	2.48		Entirely/obligate	2 - 5	2 - 5	0 - 2
182	Cumbungi rushland wetland of shallow semi-permanent water bodies and inland watercourses	Freshwater Wetlands	Inland Floodplain Swamps	3.32		Entirely/obligate	5 - 10	5 - 10	0 - 2
182	Cumbungi rushland wetland of shallow semi-permanent water bodies and inland watercourses	Freshwater Wetlands	Inland Floodplain Swamps	3.84		Entirely/obligate	5 - 10	10 - 20	0 - 2
184	Dwyers Red Gum - White Cypress Pine - Currawang low shrub-grass woodland of the Cobar Peneplain Bioregion	Semi-arid Woodlands (Shrubby sub-formation)	Inland Rocky Hill Woodlands	0.63		Facultative - proportional	10 - 20	10 - 20	0 - 2
184	Dwyers Red Gum - White Cypress Pine - Currawang low shrub-grass woodland of the Cobar Peneplain Bioregion	Semi-arid Woodlands (Shrubby sub-formation)	Inland Rocky Hill Woodlands	0.95		Facultative - proportional	2 - 5	2 - 5	0 - 2
184	Dwyers Red Gum - White Cypress Pine - Currawang low shrub-grass woodland of the Cobar Peneplain Bioregion	Semi-arid Woodlands (Shrubby sub-formation)	Inland Rocky Hill Woodlands	4.23		Facultative - proportional	2 - 5	5 - 10	0 - 2
184	Dwyers Red Gum - White Cypress Pine - Currawang low shrub-grass woodland of the Cobar Peneplain Bioregion	Semi-arid Woodlands (Shrubby sub-formation)	Inland Rocky Hill Woodlands	8.44		Facultative - proportional	5 - 10	5 - 10	0 - 2
184	Dwyers Red Gum - White Cypress Pine - Currawang low shrub-grass woodland of the Cobar Peneplain Bioregion	Semi-arid Woodlands (Shrubby sub-formation)	Inland Rocky Hill Woodlands	0.03		Facultative - proportional	5 - 10	10 - 20	0 - 2
184	Dwyers Red Gum - White Cypress Pine - Currawang low shrub-grass woodland of the Cobar Peneplain Bioregion	Semi-arid Woodlands (Shrubby sub-formation)	Inland Rocky Hill Woodlands	0.00		Facultative - proportional	10 - 20	10 - 20	0 - 2
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	1615.30	HEVAE high priority GDE	Entirely/obligate	20+	20+	0 - 2
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	2.30	HEVAE high priority GDE	Entirely/obligate	2 - 5	2 - 5	0 - 2
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	1.40	HEVAE high priority GDE	Entirely/obligate	2 - 5	5 - 10	0 - 2
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	2.40	HEVAE high priority GDE	Entirely/obligate	2 - 5	10 - 20	5 - 10
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	0.67	HEVAE high priority GDE	Entirely/obligate	2 - 5	10 - 20	10 - 20
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	0.02	HEVAE high priority GDE	Entirely/obligate	2 - 5	20+	10 - 20
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	95.60	HEVAE high priority GDE	Entirely/obligate	5 - 10	5 - 10	0 - 2
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	1.53	HEVAE high priority GDE	Entirely/obligate	5 - 10	10 - 20	0 - 2
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	0.38	HEVAE high priority GDE	Entirely/obligate	5 - 10	5 - 10	2 - 5
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	0.28	HEVAE high priority GDE	Entirely/obligate	5 - 10	10 - 20	2 - 5
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	2.02	HEVAE high priority GDE	Entirely/obligate	5 - 10	10 - 20	5 - 10
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	4.42	HEVAE high priority GDE	Entirely/obligate	5 - 10	10 - 20	10 - 20
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	6.27	HEVAE high priority GDE	Entirely/obligate	5 - 10	20+	10 - 20
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	0.28	HEVAE high priority GDE	Entirely/obligate	5 - 10	20+	20+
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	777.72	HEVAE high priority GDE	Entirely/obligate	10 - 20	10 - 20	0 - 2
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	16.16	HEVAE high priority GDE	Entirely/obligate	10 - 20	20+	0 - 2
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	13.60	HEVAE high priority GDE	Entirely/obligate	2 - 5	2 - 5	0 - 2
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	6.56	HEVAE high priority GDE	Entirely/obligate	2 - 5	5 - 10	0 - 2
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	28.71	HEVAE high priority GDE	Entirely/obligate	5 - 10	5 - 10	0 - 2
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	0.55	HEVAE high priority GDE	Entirely/obligate	5 - 10	10 - 20	0 - 2
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	0.57	HEVAE high priority GDE	Entirely/obligate	5 - 10	10 - 20	5 - 10
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	1.31	HEVAE high priority GDE	Entirely/obligate	5 - 10	10 - 20	10 - 20
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	4.94	HEVAE high priority GDE	Entirely/obligate	5 - 10	20+	10 - 20
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	146.10	HEVAE high priority GDE	Entirely/obligate	10 - 20	10 - 20	0 - 2
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	0.09	HEVAE high priority GDE	Entirely/obligate	20+	20+	0 - 2
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	1.54	HEVAE high priority GDE	Entirely/obligate	2 - 5	2 - 5	0 - 2
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	302.07	HEVAE high priority GDE	Entirely/obligate	2 - 5	5 - 10	0 - 2
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	333.87	HEVAE high priority GDE	Entirely/obligate	2 - 5	5 - 10	2 - 5
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	42.82	HEVAE high priority GDE	Entirely/obligate	2 - 5	5 - 10	5 - 10
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	0.25	HEVAE high priority GDE	Entirely/obligate	2 - 5	10 - 20	5 - 10
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	926.77	HEVAE high priority GDE	Entirely/obligate	5 - 10	5 - 10	0 - 2
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	68.64	HEVAE high priority GDE	Entirely/obligate	5 - 10	10 - 20	0 - 2
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	536.62	HEVAE high priority GDE	Entirely/obligate	5 - 10	5 - 10	2 - 5
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	219.10	HEVAE high priority GDE	Entirely/obligate	5 - 10	10 - 20	2 - 5
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	1196.81	HEVAE high priority GDE	Entirely/obligate	5 - 10	10 - 20	5 - 10
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	0.18	HEVAE high priority GDE	Entirely/obligate	5 - 10	10 - 20	10 - 20
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	0.67	HEVAE high priority GDE	Entirely/obligate	5 - 10	20+	10 - 20
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	131.12	HEVAE high priority GDE	Entirely/obligate	10 - 20	10 - 20	0 - 2
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	0.00	HEVAE high priority GDE	Entirely/obligate	10 - 20	20+	0 - 2
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	5.51	HEVAE high priority GDE	Entirely/obligate	10 - 20	10 - 20	2 - 5
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	15.05	HEVAE high priority GDE	Entirely/obligate	10 - 20	10 - 20	5 - 10
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	3.56	HEVAE high priority GDE	Entirely/obligate	2 - 5	2 - 5	0 - 2
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	6.56	HEVAE high priority GDE	Entirely/obligate	2 - 5	5 - 10	0 - 2
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	176.41	HEVAE high priority GDE	Entirely/obligate	5 - 10	5 - 10	0 - 2
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	14.33	HEVAE high priority GDE	Entirely/obligate	5 - 10	10 - 20	0 - 2
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	0.37	HEVAE high priority GDE	Entirely/obligate	5 - 10	5 - 10	2 - 5
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	9.89	HEVAE high priority GDE	Entirely/obligate	5 - 10	10 - 20	2 - 5
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	1.61	HEVAE high priority GDE	Entirely/obligate	5 - 10	10 - 20	5 - 10
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	1.06	HEVAE high priority GDE	Entirely/obligate	5 - 10	10 - 20	10 - 20
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	0.88	HEVAE high priority GDE	Entirely/obligate	5 - 10	20+	10 - 20
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	54.70	HEVAE high priority GDE	Entirely/obligate	10 - 20	10 - 20	0 - 2
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	0.57	HEVAE high priority GDE	Entirely/obligate	10 - 20	10 - 20	2 - 5
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Forested Wetlands	Inland Riverine Forests	1.91	HEVAE high priority GDE	Entirely/obligate	10 - 20	10 - 20	5 - 10
279	Blakelys Red Gum - White Cypress Pine woodland on footslopes of hills in central part of the NSW South Western Slopes Bioregion	Grassy Woodlands	Western Slopes Grassy Woodlan	1.54		Facultative - proportional	5 - 10	5 - 10	0 - 2

Appendix J

Waterbird monitoring data (1989 to present)

EMM
creating opportunities

Lake Cowal Waterbird Transect Monitoring Data: 1989-2022

***Note** : All numbers refer to bird counts. Number following month refers to transect number (e.g. Jan-01 = January, Transect 1). Transects are numbered 1,2,7,8*
***Data source:** 1989-2012 Data sourced from Australian Musuem Business Services (2013). 2013-22 compiled from Evolution Monitoring reports (see Gell 2013-2022)*

	1989	1989	1989	1989	1989	1989	1989	1989	1990	1990	1990	1990	1991	1991	1991	1991	1991	1991	1991	1991	1992	1992	1992	1992	1992	1992	1992	1992	1992	1992	1993	1993
Species / Year, Month & Transect	**Aug-01**	**Aug-02**	**Aug-07**	**Aug-08**	**Oct-01**	**Oct-02**	**Oct-07**	**Oct-08**	**Jan-01**	**Jan-02**	**Jan-07**	**Jan-08**	**Aug-01**	**Aug-02**	**Aug-07**	**Aug-08**	**Oct-01**	**Oct-02**	**Oct-07**	**Oct-08**	**Jan-01**	**Jan-02**	**Jan-07**	**Jan-08**	**Aug-01**	**Aug-02**	**Aug-07**	**Aug-08**	**Oct-01**	**Oct-02**	**Oct-08**	**Jan-01**	**Jan-02**
Australasian Bittern	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Australasian Darter	0	1	0	0	2	0	0	0	3	4	0	2	2	1	3	4	18	8	0	10	8	2	0	12	1	3	0	0	2	6	5	1	1
Australasian Grebe	6	10	0	0	0	8	1	0	15	30	16	0	0	0	0	0	0	0	0	0	0	0	0	0	13	6	0	5	0	0	0	0	0
Australasian Shoveler	3	6	8	4	14	6	12	2	0	0	53	2	2	0	0	0	0	0	0	0	0	0	54	0	51	0	0	4	0	0	2	0	0
Australian Pelican	0	0	0	8	58	0	175	3	5	10	500	3	0	0	3	8	33	37	16	2	608	137	32	212	136	120	0	13	135	105	45	128	55
Australian Pratincole	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Australian Shelduck	0	0	6	2	20	1	2	3	1	0	17	0	0	0	3	0	0	0	7	8	0	0	35	24	1	2	0	11	2	0	0	2	0
Australian Spotted Crake	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Australian White Ibis	1	3	0	0	15	9	17	1	1	7	7	4	0	5	0	0	2	1	11	1	3	0	9	0	0	11	0	1	0	0	0	0	1
Australian Wood Duck	0	2	10	3	129	4	55	35	60	118	123	31	1	118	0	3	2	14	32	19	111	0	0	8	0	23	0	1	0	0	11	0	0
Banded Lapwing	0	0	0	0	0	0	0	0	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Black Swan	57	3	24	0	9	2	4	9	70	169	27	25	0	0	8	12	0	1	10	32	2	0	68	0	216	100	0	25	8	24	68	1	0
Black-fronted Dotterel	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	1	2	0	7	22	1	0	0	0	0	4	1	1	0	0	0
Black-tailed Native-hen	0	0	0	0	0	0	0	0	0	0	4	0	0	0	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Black-winged Stilt	0	0	0	0	4	12	18	0	92	48	178	14	4	9	0	0	2	0	0	0	83	43	183	16	18	19	0	11	0	3	1	28	0
Blue-billed Duck	0	0	0	0	0	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brolga	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Buff-banded Rail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caspian Tern	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	0
Cattle Egret	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chestnut Teal	0	5	4	6	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0
Common Greenshank	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	1	2	37	0	0	0	82	0	0	42	0
Curlew Sandpiper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Double-banded Plover	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dusky Moorhen	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eastern Great Egret	0	0	0	0	1	0	0	0	6	5	1	2	41	28	11	40	10	10	18	3	41	28	1	81	32	5	0	19	14	35	14	0	0
Eurasian Coot	0	0	0	0	7	2	5	16	77	165	84	204	974	108	23	0	31	2	260	38	96	17	0	20	0	210	0	3	66	41	286	173	0
Franklin's Gull	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Freckled Duck	0	0	0	0	0	0	4	0	0	0	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glossy Ibis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	42	0	0	0	0	1	5	2	0	0	0	0	0	46	0	0	0
Great Cormorant	0	0	0	0	1	2	1	0	1	8	0	5	15	0	0	6	3	5	4	3	10	3	0	288	20	67	0	16	1	4	24	1	0
Great Crested Grebe	0	12	0	0	0	1	0	0	6	23	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Grey Teal	94	85	154	139	375	278	277	297	258	1056	3605	137	46	58	0	7	57	2	9	0	322	291	934	102	1284	594	0	423	315	239	133	360	24
Gull-billed Tern	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	2	0	0	0	0	1	0	1	0	3	0	0	4	0	0	0	0	0
Hardhead	13	8	8	0	3	31	15	28	2	0	1	2	0	0	0	0	0	0	0	0	0	0	5	10	0	0	0	0	4	0	0	4	0
Hoary-headed Grebe	4	0	1	2	6	2	5	0	36	52	154	29	6	4	5	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intermediate Egret	0	0	0	0	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Latham's Snipe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
Little Black Cormorant	17	0	0	0	5	10	4	0	15	6	0	1	88	28	5	39	2	96	17	39	223	418	1	190	130	2	0	30	15	11	14	7	0
Little Curlew	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little Egret	0	0	0	0	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0
Little Pied Cormorant	16	34	0	0	0	3	23	0	13	61	0	35	16	5	2	1	2	5	3	0	10	0	0	38	2	1	0	37	1	0	2	0	0
Magpie goose	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Marsh Sandpiper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	39	0	0	0	0	0	0	32	9	0	1	2
Masked Lapwing	7	6	7	5	12	11	45	20	34	20	42	13	4	1	0	1	4	2	2	3	31	11	8	23	2	1	0	3	14	8	2	17	2
Musk Duck	0	0	0	0	0	2	0	0	1	6	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nankeen Night-Heron	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pacific Black Duck	7	8	14	7	33	48	54	25	1	2	225	17	11	10	24	11	20	9	9	6	58	19	59	11	60	8	0	48	26	35	20	50	15
Pacific Golden Plover	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pectoral Sandpiper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
Pied Cormorant	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	3	12	2	1	0	0	0	1	0	0	0	1	1	0	0	3	0
Pink-eared Duck	0	0	0	0	2	0	6	0	4	0	84	15	0	0	0	0	0	0	4	0	0	1	0	0	211	2	0	13	0	0	0	0	2
Plumed Whistling-duck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Purple Swamphen	0	0	0	0	0	1	0	0	5	44	0	0	0	0	17	0	0	0	0	0	0	0	0	0	1	0	0	1	4	4	1	0	5
Red-capped Plover	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	2	0	0	0	8	2	0	0	0
Red-kneed Dotterel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	13	0	0	0	0	0
Red-necked Avocet	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0
Red-necked Stint	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Royal Spoonbill	0	0	0	0	0	15	6	2	4	0	0	1	1	2	5	0	5	1	4	0	0	6	0	1	1	3	0	1	8	3	3	0	1
Sharp-tailed Sandpiper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	13	0	5	0	0	0	6	0	0	0	0
Silver Gull	63	20	0	1	36	1	44	17	1	0	21	1	10	4	7	1	3	0	0	0	256	10	6	8	16	2	0	17	24	2	6	29	3
Straw-necked Ibis	9	4	2	1	4	3	17	0	0	1	4	1	0	0	0	0	0	0	0	0	0	0	32	0	0	0	0	0	0	0	65	2	0
Wandering Whistling-duck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Whiskered Tern	0	0	0	0	53	10	2	0	103	59	31	46	31	2	10	3	0	4	0	0	0	15	0	6	0	0	0	0	100	12	0	35	40
White-faced Heron	2	1	1	2	8	18	15	1	21	11	7	2	4	2	1	0	2	1	0	0	7	3	3	0	1	0	0	0	0	2	2	13	4
White-necked Heron	0	0	1	0	2	7	18	1	4	2	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0
White-winged Black Tern	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yellow-billed Spoonbill	0	3	0	1	0	10	4	3	3	0	0	5	0	1	12	0	3	0	23	0	9	1	20	1	9	42	0	7	14	0	8	0	0

Lake Cowal Waterbird Transect Monitoring Data: 1989-2022

***Note** : All numbers refer to bird counts. Number following month refers to transect number (e.g. Jan-01 = January, Transect 1). Transects are numbered 1,2,7,8*
***Data source:** 1989-2012 Data sourced from Australian Musuem Business Services (2013). 2013-22 compiled from Evolution Monitoring reports (see Gell 2013-2022)*

	1993	1993	1993	1993	1993	1993	1993	1993	1993	1993	1994	1994	1994	1994	1994	1994	1994	1994	1995	1995	1995	1995	1995	1995	1995	1995	1995	1995	1995	1996	1996	1996
Species / Year, Month & Transect	**Jan-07**	**Jan-08**	**Aug-01**	**Aug-02**	**Aug-07**	**Aug-08**	**Oct-01**	**Oct-02**	**Oct-07**	**Oct-08**	**Aug-01**	**Aug-02**	**Aug-07**	**Aug-08**	**Oct-01**	**Oct-02**	**Oct-07**	**Oct-08**	**Jan-01**	**Jan-02**	**Jan-07**	**Jan-08**	**Aug-01**	**Aug-02**	**Aug-07**	**Aug-08**	**Oct-01**	**Oct-02**	**Oct-07**	**Oct-08**	**Jan-01**	**Jan-02**	**Jan-07**
Australasian Bittern	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Australasian Darter	0	0	4	3	4	2	0	3	1	1	11	14	0	12	24	21	12	10	10	6	0	31	2	5	0	9	3	4	0	12	6	4	1
Australasian Grebe	0	0	4	2	0	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	4	1	0	0	0	0	0	0	0
Australasian Shoveler	0	0	0	0	27	2	0	1	0	0	2	1	0	0	3	0	0	0	14	138	7	0	0	16	0	0	1	37	0	0	2	178
Australian Pelican	0	58	48	79	1	8	6	3	6	38	28	48	2	77	63	90	38	51	206	579	54	224	93	23	31	20	148	575	355	106	330	101	0
Australian Pratincole	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Australian Shelduck	0	0	1	0	5	0	0	0	0	0	10	0	12	9	4	0	4	10	0	0	21	0	9	0	13	3	4	0	17	1	2	2	2
Australian Spotted Crake	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Australian White Ibis	0	0	2	0	3	0	0	0	0	0	0	0	0	1	0	2	19	0	1	4	10	0	0	0	0	0	1	0	2	1	1	0	5
Australian Wood Duck	0	0	0	0	1	7	8	9	2	2	3	27	2	84	11	15	54	23	4	32	22	35	14	16	2	6	40	0	59	8	68	12	2
Banded Lapwing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Black Swan	0	12	0	4	41	45	0	0	7	8	10	6	24	44	28	13	12	46	2	13	325	4	20	34	20	17	4	29	55	38	15	0	54
Black-fronted Dotterel	0	0	0	1	0	0	0	0	0	0	2	2	1	0	1	8	0	0	1	0	0	0	2	0	0	0	0	2	0	0	0	3	0
Black-tailed Native-hen	0	0	0	0	2	0	0	0	0	0	0	0	29	0	3	0	52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Black-winged Stilt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	66	190	24	5	0	0	0	23	0	1	4	0	2	7
Blue-billed Duck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brolga	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Buff-banded Rail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caspian Tern	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0
Cattle Egret	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chestnut Teal	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	0	1	8	0	0	2	2	0	0	0
Common Greenshank	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	4	0	0	0	0	0	0	0	0	0	0	3	0
Curlew Sandpiper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Double-banded Plover	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dusky Moorhen	0	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Eastern Great Egret	0	4	0	6	4	0	0	2	0	0	1	7	5	3	1	1	6	0	3	12	1	8	1	2	0	2	5	2	1	1	0	8	0
Eurasian Coot	0	158	16	0	180	558	0	0	0	0	152	376	0	48	404	270	6	145	162	0	255	266	235	729	62	220	250	530	1579	270	175	168	0
Franklin's Gull	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Freckled Duck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	10	1	2	0	0	0	0	0	0	0	0	0	0	0
Glossy Ibis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	33	72	0	0	5	3	3	0	0	0	26	0	0	3	0	0	7	23
Great Cormorant	0	0	0	1	0	0	0	1	0	2	0	42	0	0	2	3	1	59	39	21	0	9	3	0	0	25	2	391	0	8	5	3	0
Great Crested Grebe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grey Teal	0	60	38	21	124	110	10	29	43	16	134	432	0	34	221	256	27	39	77	189	1235	188	44	30	57	123	66	25	371	56	36	70	384
Gull-billed Tern	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hardhead	0	0	0	0	2	0	0	0	0	0	0	2	0	0	0	10	0	0	0	0	0	0	0	10	0	9	0	0	2	0	0	0	0
Hoary-headed Grebe	0	0	7	24	1	14	0	0	0	0	14	36	18	17	13	9	1	2	0	0	0	0	8	8	13	24	0	20	0	0	0	0	0
Intermediate Egret	0	0	3	0	0	1	0	0	0	0	0	0	0	0	1	6	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Latham's Snipe	0	0	0	2	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	14	0
Little Black Cormorant	0	3	0	44	4	2	2	11	0	0	0	4	1	0	3	3	1	1	8	24	3	166	0	18	3	10	2	11	0	4	1	6	0
Little Curlew	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little Egret	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	3	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
Little Pied Cormorant	0	0	1	1	0	0	0	0	0	0	0	0	0	2	0	0	2	0	1	2	3	12	0	0	0	1	0	0	0	0	0	1	0
Magpie goose	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Marsh Sandpiper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	1	0
Masked Lapwing	0	4	0	0	6	0	0	0	0	0	1	0	1	3	7	4	3	5	20	36	26	15	4	2	4	2	7	5	8	12	23	27	16
Musk Duck	0	0	1	2	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	4	0	1	0	2	0	0	0	1	0
Nankeen Night-Heron	0	0	0	2	0	0	0	5	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Pacific Black Duck	0	37	16	15	27	19	0	13	14	14	51	57	4	24	43	68	11	30	41	107	14	71	2	12	2	15	5	10	13	10	19	23	178
Pacific Golden Plover	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pectoral Sandpiper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pied Cormorant	0	0	0	0	0	0	0	0	1	0	2	1	0	1	0	5	0	2	2	0	0	0	1	1	0	1	0	3	0	0	4	0	0
Pink-eared Duck	0	0	0	0	0	1	0	0	2	0	22	58	0	0	2	86	2	0	2	6	44	26	0	0	5	8	0	2	9	0	0	0	0
Plumed Whistling-duck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Purple Swamphen	0	5	155	129	3	121	0	17	0	1	406	46	0	110	284	34	0	20	75	9	0	32	275	0	0	3	65	11	0	43	1	17	0
Red-capped Plover	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red-kneed Dotterel	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Red-necked Avocet	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Red-necked Stint	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Royal Spoonbill	0	0	3	0	4	1	0	0	0	1	0	4	0	1	0	0	1	3	9	3	4	15	4	0	0	0	12	0	4	2	2	3	0
Sharp-tailed Sandpiper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Silver Gull	0	4	6	10	4	0	0	0	1	5	14	4	7	22	4	4	2	2	16	41	2	1	5	4	0	0	2	4	0	0	32	24	7
Straw-necked Ibis	0	12	7	10	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	163
Wandering Whistling-duck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Whiskered Tern	0	18	14	0	0	0	0	0	0	0	0	0	0	0	2	0	17	0	87	112	0	1	0	0	0	1	0	91	4	28	0	0	2
White-faced Heron	0	1	0	0	0	0	1	0	0	4	0	1	3	1	2	0	5	0	0	1	6	1	0	1	0	1	1	1	1	2	0	3	2
White-necked Heron	0	0	0	0	0	0	1	0	0	1	0	0	1	0	0	0	3	1	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0
White-winged Black Tern	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yellow-billed Spoonbill	0	0	4	0	3	0	0	0	0	0	0	0	9	0	3	1	22	2	5	0	13	1	6	0	0	0	13	0	7	2	5	0	10

Lake Cowal Waterbird Transect Monitoring Data: 1989-2022

***Note** : All numbers refer to bird counts. Number following month refers to transect number (e.g. Jan-01 = January, Transect 1). Transects are numbered 1,2,7,8*
***Data source:** 1989-2012 Data sourced from Australian Musuem Business Services (2013). 2013-22 compiled from Evolution Monitoring reports (see Gell 2013-2022)*

	1996	1996	1996	1996	1996	1996	1996	1996	1996	1997	1997	1997	1997	1997	1997	1997	1997	1997	1997	1997	1997	1998	1998	1998	1998	1998	1998	1998	1998	1999	1999	1999	1999
Species / Year, Month & Transect	**Jan-08**	**Aug-01**	**Aug-02**	**Aug-07**	**Aug-08**	**Oct-01**	**Oct-02**	**Oct-07**	**Oct-08**	**Jan-01**	**Jan-02**	**Jan-07**	**Jan-08**	**Aug-01**	**Aug-02**	**Aug-07**	**Aug-08**	**Oct-01**	**Oct-02**	**Oct-07**	**Oct-08**	**Jan-01**	**Jan-02**	**Jan-07**	**Jan-08**	**Oct-01**	**Oct-02**	**Oct-07**	**Oct-08**	**Jan-01**	**Jan-02**	**Jan-07**	**Jan-08**
Australasian Bittern	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Australasian Darter	26	3	3	0	5	3	14	0	10	0	4	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	16	4	5	4
Australasian Grebe	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	2
Australasian Shoveler	10	9	28	1	1	0	0	6	0	20	5	0	6	18	25	0	2	0	0	0	101	0	0	0	0	2	2	15	1	1	0	0	1
Australian Pelican	97	2	12	0	31	134	54	41	25	36	123	0	74	0	0	0	0	10	21	0	37	0	0	0	0	2	3	14	18	28	0	0	0
Australian Pratincole	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Australian Shelduck	24	21	2	10	5	8	0	43	12	4	2	0	106	9	6	0	2	13	2	0	6	0	0	0	8	33	12	68	9	0	0	7	4
Australian Spotted Crake	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Australian White Ibis	1	0	0	2	0	0	0	0	1	5	15	0	1	1	7	0	1	1	3	0	1	0	0	0	1	3	0	19	2	1	0	7	0
Australian Wood Duck	28	0	3	0	6	4	3	0	4	2	10	0	6	0	0	0	18	0	0	0	0	0	0	0	23	74	22	9	13	93	21	12	55
Banded Lapwing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Black Swan	44	62	30	168	45	122	18	284	34	6	0	0	38	1	9	0	4	24	47	0	6	0	0	0	0	7	7	114	8	23	11	17	55
Black-fronted Dotterel	0	13	7	0	2	0	5	1	0	3	3	0	3	0	83	0	0	2	0	0	0	0	0	0	0	1	1	1	0	2	3	0	0
Black-tailed Native-hen	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0
Black-winged Stilt	2	0	0	28	0	0	0	0	0	131	180	0	24	18	50	0	0	223	660	0	447	0	0	0	0	0	0	2	0	54	8	3	10
Blue-billed Duck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brolga	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Buff-banded Rail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caspian Tern	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cattle Egret	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chestnut Teal	0	2	0	0	0	0	0	0	0	8	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	2	14	12	2	0	0	0	0
Common Greenshank	0	0	0	0	0	0	1	0	0	2	46	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Curlew Sandpiper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Double-banded Plover	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dusky Moorhen	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	1
Eastern Great Egret	1	3	0	0	1	3	3	0	2	7	18	0	6	0	0	0	0	0	5	0	1	0	0	0	1	0	0	1	0	1	4	11	3
Eurasian Coot	243	2040	0	0	60	0	0	0	0	0	0	0	197	0	0	0	0	0	810	0	0	0	0	0	0	4	0	18	0	27	54	145	217
Franklin's Gull	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Freckled Duck	0	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glossy Ibis	1	0	0	0	0	12	0	0	0	19	4	0	0	0	0	0	0	8	27	0	100	0	0	0	0	0	0	0	0	0	0	0	0
Great Cormorant	2	0	0	0	4	0	1	0	3	0	1	0	8	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	3	1	1	1
Great Crested Grebe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	11	5	0	13	23	7	2
Grey Teal	52	18	23	305	29	34	13	261	60	209	259	0	384	629	798	0	260	402	726	0	954	0	0	0	34	118	88	350	91	71	30	74	63
Gull-billed Tern	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hardhead	0	10	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	22	8	1	0	0	8
Hoary-headed Grebe	0	6	1	0	1	0	0	0	4	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	44	0	7	7	6	15
Intermediate Egret	2	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	2	0
Latham's Snipe	0	0	0	0	0	0	0	0	0	3	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little Black Cormorant	44	3	1	0	12	1	3	0	21	0	6	0	21	0	0	0	0	0	0	0	4	0	0	0	0	6	11	17	0	0	2	0	0
Little Curlew	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little Egret	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little Pied Cormorant	2	0	0	0	5	0	0	0	2	4	30	0	45	0	0	0	0	0	0	0	0	0	0	0	1	0	0	12	1	12	30	2	1
Magpie goose	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Marsh Sandpiper	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Masked Lapwing	11	2	0	8	2	7	10	15	3	17	18	0	8	44	19	0	0	65	8	0	6	0	0	0	1	8	2	8	5	11	3	4	6
Musk Duck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	1	4	1	4
Nankeen Night-Heron	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
Pacific Black Duck	68	9	7	2	7	15	13	10	21	28	29	0	40	0	53	0	2	22	5	0	126	0	0	0	36	35	18	97	18	37	47	61	69
Pacific Golden Plover	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pectoral Sandpiper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pied Cormorant	2	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pink-eared Duck	0	23	8	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	9	0	0	0	0	5	2	19	26	22	1	4	13
Plumed Whistling-duck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Purple Swamphen	4	24	37	0	19	21	49	0	37	8	22	0	13	0	50	0	125	10	435	0	174	0	0	0	0	5	0	13	2	48	11	14	15
Red-capped Plover	0	0	0	10	0	0	0	5	0	0	0	0	0	71	6	0	4	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Red-kneed Dotterel	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red-necked Avocet	0	0	0	49	0	0	0	107	0	0	0	0	0	0	0	0	0	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red-necked Stint	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Royal Spoonbill	0	5	0	0	1	14	2	0	1	7	2	0	15	0	6	0	8	2	3	0	13	0	0	0	0	1	0	13	1	1	1	0	11
Sharp-tailed Sandpiper	0	0	0	0	0	0	0	2	0	201	0	0	0	0	0	0	0	117	49	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Silver Gull	1	9	3	46	1	0	0	0	0	3	17	0	15	2	3	0	0	3	13	0	2	0	0	0	0	1	2	3	5	26	1	18	1
Straw-necked Ibis	0	0	0	0	0	0	0	0	34	0	0	0	0	0	4	0	0	0	0	0	25	0	0	0	12	13	0	8	2	0	0	1	0
Wandering Whistling-duck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Whiskered Tern	0	0	0	0	0	0	0	119	0	95	600	0	4	0	0	0	0	210	346	0	315	0	0	0	0	0	0	0	0	18	20	0	7
White-faced Heron	3	0	0	0	0	0	1	2	1	0	6	0	2	4	27	0	0	0	0	0	0	0	0	0	1	1	0	2	1	0	0	30	0
White-necked Heron	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	1	3	20	0	0	1
White-winged Black Tern	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yellow-billed Spoonbill	1	7	0	2	3	3	0	6	0	22	1	0	10	0	35	0	8	2	0	0	8	0	0	0	0	0	2	2	0	12	4	0	0

Lake Cowal Waterbird Transect Monitoring Data: 1989-2022

***Note** : All numbers refer to bird counts. Number following month refers to transect number (e.g. Jan-01 = January, Transect 1). Transects are numbered 1,2,7,8*
***Data source:** 1989-2012 Data sourced from Australian Musuem Business Services (2013). 2013-22 compiled from Evolution Monitoring reports (see Gell 2013-2022)*

	1999	1999	1999	1999	1999	1999	1999	1999	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2002-2010
Species / Year, Month & Transect	**Aug-01**	**Aug-02**	**Aug-07**	**Aug-08**	**Oct-01**	**Oct-02**	**Oct-07**	**Oct-08**	**Jan-01**	**Jan-02**	**Jan-07**	**Jan-08**	**Aug-01**	**Aug-02**	**Aug-07**	**Aug-08**	**Oct-01**	**Oct-02**	**Oct-07**	**Oct-08**	**Jan-01**	**Jan-02**	**Jan-07**	**Jan-08**	**Aug-01**	**Aug-02**	**Aug-07**	**Aug-08**	**Oct-01**	**Oct-02**	**Oct-07**	**Oct-08**	**Jan-Jan**
Australasian Bittern	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Australasian Darter	9	1	0	0	11	4	0	2	22	26	5	8	0	2	0	1	17	28	1	24	0	7	2	4	0	0	0	0	1	1	0	0	0
Australasian Grebe	5	7	0	1	6	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Australasian Shoveler	154	320	120	11	40	18	349	93	34	6	587	51	5	0	7	4	30	3	67	9	36	2	1375	32	18	40	0	4	18	337	0	48	0
Australian Pelican	73	11	60	38	242	18	36	81	257	50	0	50	245	127	0	15	287	69	21	124	71	76	2	213	44	1770	0	100	18	21	0	70	0
Australian Pratincole	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Australian Shelduck	3	2	70	5	10	10	51	6	8	0	305	13	11	45	38	19	0	0	53	0	22	0	22	2	7	22	0	0	31	107	0	6	0
Australian Spotted Crake	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
Australian White Ibis	1	0	0	0	0	0	0	1	2	0	6	1	0	0	0	0	1	1	10	3	39	1	15	4	0	0	0	1	0	1	0	2	0
Australian Wood Duck	58	48	1	8	38	82	38	30	24	0	15	24	15	27	7	7	84	24	0	65	30	110	0	91	0	0	0	40	0	0	0	7	0
Banded Lapwing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Black Swan	118	102	685	126	52	20	205	71	10	29	159	28	82	14	102	16	53	20	10	16	58	16	29	28	31	44	0	108	3	11	0	2	0
Black-fronted Dotterel	2	9	1	0	3	1	0	2	10	9	0	0	0	4	3	1	13	2	1	1	6	3	0	2	15	0	0	0	0	0	0	0	0
Black-tailed Native-hen	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Black-winged Stilt	0	4	10	0	71	88	210	6	0	2	47	0	0	2	2	0	1	0	0	0	30	0	167	7	4	10	0	33	201	538	0	0	0
Blue-billed Duck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brolga	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Buff-banded Rail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caspian Tern	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cattle Egret	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chestnut Teal	0	0	12	0	0	0	82	0	0	0	4	0	4	0	2	4	0	0	1	4	0	0	0	0	4	0	0	0	0	0	0	0	0
Common Greenshank	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	3	4	1	0	0	1	0	0	0	2	0	7	0
Curlew Sandpiper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	0	0
Double-banded Plover	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0
Dusky Moorhen	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eastern Great Egret	0	1	0	0	7	3	0	2	0	1	3	0	3	8	0	2	4	9	0	2	1	1	0	0	0	0	0	0	0	2	0	1	0
Eurasian Coot	269	600	0	226	1385	677	2684	1398	228	227	97	113	0	22	0	160	72	5	0	310	1	1	0	1	0	0	0	0	0	0	0	0	0
Franklin's Gull	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Freckled Duck	0	0	0	0	0	0	2	19	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glossy Ibis	0	0	0	0	0	0	0	20	0	0	1	0	0	0	0	0	0	0	0	0	10	0	12	2	0	0	0	0	0	40	0	14	0
Great Cormorant	1	21	0	68	11	26	4	31	2	0	1	18	3	0	7	2	4	6	0	127	0	0	0	1	0	10	0	0	0	0	0	0	0
Great Crested Grebe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grey Teal	398	660	3215	208	457	681	3504	457	166	352	1942	196	427	111	3400	405	401	44	2576	240	357	68	2039	249	1825	264	0	754	1720	856	0	300	0
Gull-billed Tern	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hardhead	32	19	11	1	0	0	122	14	0	0	0	0	6	0	0	2	7	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0
Hoary-headed Grebe	1	19	0	25	62	88	72	128	64	11	385	0	12	22	0	11	1	1	0	6	0	0	1	0	0	0	0	0	1	0	0	0	0
Intermediate Egret	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Latham's Snipe	0	0	0	0	0	0	0	1	0	5	0	0	0	4	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Little Black Cormorant	80	3	0	5	14	2	1	1	4	0	2	0	0	1	0	11	6	3	0	23	0	4	0	2	0	14	0	0	0	0	0	0	0
Little Curlew	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little Egret	0	0	0	0	0	0	0	1	0	0	3	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Little Pied Cormorant	5	18	2	2	5	2	4	4	4	1	2	0	0	0	0	0	7	0	0	1	0	3	0	6	0	1	0	0	0	0	0	0	0
Magpie goose	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Marsh Sandpiper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	5	82	43	0	12	0
Masked Lapwing	11	4	4	2	12	18	26	9	14	20	38	3	3	0	22	2	11	3	4	4	27	4	12	7	56	23	0	0	45	8	0	4	0
Musk Duck	1	1	0	0	0	2	0	1	0	4	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nankeen Night-Heron	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pacific Black Duck	17	79	65	14	4	20	27	2	2	84	260	69	4	7	8	29	36	24	10	43	40	100	45	88	0	17	0	68	6	238	0	50	0
Pacific Golden Plover	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pectoral Sandpiper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pied Cormorant	0	1	0	0	3	0	0	0	0	0	0	0	3	7	0	3	2	7	0	3	0	1	0	0	0	1	0	0	0	0	0	0	0
Pink-eared Duck	0	926	321	4	214	160	879	182	128	17	591	32	0	0	50	0	0	1	283	0	2	0	896	0	12	0	0	14	106	309	0	0	0
Plumed Whistling-duck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Purple Swamphen	41	45	0	153	74	40	0	175	20	10	0	68	3	15	0	7	5	20	0	21	2	14	0	1	80	286	0	47	35	104	0	195	0
Red-capped Plover	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32	2	0	0	3	0	0	0	0
Red-kneed Dotterel	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	0	3	0	0	0	0	0
Red-necked Avocet	0	0	0	1	0	0	0	0	0	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	290	0	0	0	98	0	0	0	0
Red-necked Stint	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	20	0	0	0	0
Royal Spoonbill	4	0	0	0	5	13	4	1	3	1	1	3	9	8	0	3	1	6	0	6	20	1	36	4	0	2	0	3	0	0	0	18	0
Sharp-tailed Sandpiper	0	0	0	0	0	0	0	0	0	4	0	0	0	5	0	0	5	0	2	0	0	0	0	0	47	2	0	1	1445	2	0	0	0
Silver Gull	3	0	11	5	8	17	2	11	22	3	6	5	15	1	3	16	69	4	3	17	15	7	58	12	76	1	0	3	28	10	0	20	0
Straw-necked Ibis	0	0	0	2	1	0	7	1	0	2	380	0	0	0	0	0	2	2	18	0	22	0	0	0	0	0	0	0	0	0	0	0	0
Wandering Whistling-duck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Whiskered Tern	0	0	0	0	132	55	115	4	0	0	0	0	9	0	0	0	151	112	32	44	0	70	0	0	0	0	0	2	248	132	0	132	0
White-faced Heron	0	1	1	1	0	0	2	1	0	2	31	1	0	1	1	0	1	1	6	2	2	5	0	0	1	1	0	0	0	0	0	0	0
White-necked Heron	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
White-winged Black Tern	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Yellow-billed Spoonbill	1	0	2	0	5	2	13	3	10	3	8	9	20	4	3	4	7	5	5	5	41	1	61	1	9	50	0	8	4	10	0	28	0

Lake Cowal Waterbird Transect Monitoring Data: 1989-2022

***Note** : All numbers refer to bird counts. Number following month refers to transect number (e.g. Jan-01 = January, Transect 1). Transects are numbered 1,2,7,8*
***Data source:** 1989-2012 Data sourced from Australian Musuem Business Services (2013). 2013-22 compiled from Evolution Monitoring reports (see Gell 2013-2022)*

	2010	2010	2010	2010	2010	2010	2010	2010	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011	2012	2012	2012	2012	2012	2012	2012	2012	2013	2013	2013	2013	2013
Species / Year, Month & Transect	**Aug-01**	**Aug-02**	**Aug-07**	**Aug-08**	**Oct-01**	**Oct-02**	**Oct-07**	**Oct-08**	**Jan-01**	**Jan-02**	**Jan-07**	**Jan-08**	**Aug-01**	**Aug-02**	**Aug-07**	**Aug-08**	**Oct-01**	**Oct-02**	**Oct-07**	**Oct-08**	**Jan-01**	**Jan-02**	**Jan-07**	**Jan-08**	**Aug-01**	**Aug-02**	**Aug-07**	**Aug-08**	**Jan-01**	**Jan-02**	**Jan-07**	**Jan-08**	**Aug-01**
Australasian Bittern	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Australasian Darter	0	0	0	0	0	1	0	0	0	8	2	1	2	0	0	0	5	40	2	12	19	28	10	7	2	0	0	0	0	2	0	9	0
Australasian Grebe	0	0	0	0	27	4	0	4	5	3	0	1	1	6	141	0	31	123	129	1	279	155	79	32	35	4	5	0	0	0	5	0	0
Australasian Shoveler	0	0	0	10	8	11	0	18	0	25	7	20	0	38	50	4	0	0	22	0	0	0	6	0	0	0	0	0	0	0	0	0	0
Australian Pelican	0	0	0	0	0	0	0	0	0	0	197	0	0	1	0	0	0	5	0	0	0	1	0	17	0	31	1	0	32	4	11	3	4
Australian Pratincole	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Australian Shelduck	0	0	0	0	1	12	0	12	0	0	4	10	1	0	7	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1
Australian Spotted Crake	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Australian White Ibis	0	0	0	5	3	19	0	2	37	5	5	7	0	6	0	3	18	10	0	10	14	4	8	3	4	2	0	0	8	5	5	0	0
Australian Wood Duck	0	0	0	135	0	0	0	57	7	47	8	50	6	16	18	62	7	64	122	37	4	0	21	49	16	23	34	80	29	0	26	105	4
Banded Lapwing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Black Swan	0	0	0	5	6	35	0	11	0	7	59	21	2	18	3	6	7	43	8	8	0	1	0	0	0	0	0	0	0	0	0	3	0
Black-fronted Dotterel	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	5	0	0	0	0
Black-tailed Native-hen	0	0	0	0	0	0	0	0	0	0	3	0	3	0	20	3	2	0	47	13	1	0	37	0	0	4	95	1	3	6	414	6	0
Black-winged Stilt	0	0	0	175	2	0	0	0	0	0	107	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Blue-billed Duck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brolga	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Buff-banded Rail	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0
Caspian Tern	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cattle Egret	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chestnut Teal	0	0	0	0	2	0	0	0	0	2	0	2	0	0	0	2	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
Common Greenshank	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Curlew Sandpiper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Double-banded Plover	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dusky Moorhen	0	0	0	0	0	0	0	0	0	1	0	0	7	9	36	16	1	51	19	2	9	9	3	0	8	5	10	0	0	0	0	0	0
Eastern Great Egret	0	0	0	8	39	5	0	2	0	0	0	0	0	0	0	0	3	1	2	2	0	101	6	40	5	1	4	2	1	3	2	1	0
Eurasian Coot	0	0	0	0	150	184	0	160	917	432	53	218	411	1041	207	326	796	1800	382	378	128	268	156	118	178	168	318	219	52	30	66	60	205
Franklin's Gull	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Freckled Duck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glossy Ibis	0	0	0	4	4	0	0	0	0	0	0	0	0	0	0	0	36	7	8	0	0	1	2	1	0	0	0	0	0	0	8	0	0
Great Cormorant	0	0	0	0	0	1	0	1	1	8	0	0	13	1	1	0	6	0	0	0	11	56	2	52	3	0	0	1	4	0	0	1	0
Great Crested Grebe	0	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grey Teal	0	0	0	33	90	130	0	392	89	318	355	357	51	263	244	353	188	492	411	250	163	79	231	136	72	23	315	80	24	18	71	71	59
Gull-billed Tern	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Hardhead	0	0	0	0	14	36	0	88	43	78	79	36	21	28	96	87	52	266	87	13	28	49	1	0	63	0	2	0	0	0	1	0	0
Hoary-headed Grebe	0	0	0	0	97	51	0	31	376	290	97	210	255	168	44	117	166	11	29	25	749	163	94	92	412	314	31	24	3	0	0	0	6
Intermediate Egret	0	0	0	0	2	0	0	0	0	0	0	0	1	0	0	1	12	3	3	10	0	0	0	0	2	0	1	0	0	0	0	0	0
Latham's Snipe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little Black Cormorant	0	0	0	0	0	0	0	0	1	6	0	1	0	1	0	0	9	182	1	0	78	147	1	34	17	0	0	2	0	0	1	0	0
Little Curlew	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little Egret	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little Pied Cormorant	0	0	0	0	28	2	0	1	3	22	4	0	10	4	1	1	11	6	3	2	55	92	32	83	13	1	0	0	0	0	1	1	1
Magpie goose	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Marsh Sandpiper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Masked Lapwing	0	0	0	12	4	1	0	18	2	0	9	22	1	0	5	10	5	0	6	14	0	2	2	2	2	1	1	6	5	5	4	10	2
Musk Duck	0	0	0	0	1	0	0	0	2	1	0	0	1	0	1	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0
Nankeen Night-Heron	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	13	5	4	0	0	0	0	0	0	0	8	2	0	0	0
Pacific Black Duck	0	0	0	20	16	23	0	65	71	128	29	30	50	133	107	100	57	292	96	65	20	19	38	23	48	6	65	22	20	6	2	0	4
Pacific Golden Plover	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pectoral Sandpiper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pied Cormorant	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	2	0	0	0	0	0	0	0	0	0
Pink-eared Duck	0	0	0	0	0	0	0	15	0	9	53	63	0	1	47	35	0	0	12	11	16	0	16	0	0	0	4	3	0	0	0	0	0
Plumed Whistling-duck	0	0	0	0	0	0	0	350	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Purple Swamphen	0	0	0	12	5	13	0	0	8	19	0	0	0	3	21	2	39	50	18	12	11	0	4	0	0	0	0	0	4	0	7	0	0
Red-capped Plover	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red-kneed Dotterel	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
Red-necked Avocet	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red-necked Stint	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Royal Spoonbill	0	0	0	0	2	1	0	2	0	7	4	1	0	0	0	5	1	0	4	0	0	0	0	0	0	1	0	0	1	3	3	1	0
Sharp-tailed Sandpiper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Silver Gull	0	0	0	6	0	0	0	0	1	2	2	162	53	0	7	3	6	6	8	5	6	0	2	38	1	4	0	6	34	0	0	3	3
Straw-necked Ibis	0	0	0	58	23	2	0	8	18	37	9	51	0	0	0	0	0	4	3	0	6	8	6	2	0	0	0	0	0	1	0	0	0
Wandering Whistling-duck	0	0	0	0	18	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0
Whiskered Tern	0	0	0	0	216	383	0	39	18	180	49	119	64	50	1	0	165	113	118	0	54	1	37	2	0	184	0	0	25	2	29	23	0
White-faced Heron	0	0	0	24	3	4	0	2	1	7	5	6	1	3	12	9	4	9	1	5	1	4	3	5	4	3	4	1	8	5	1	1	1
White-necked Heron	0	0	0	9	7	4	0	0	0	0	5	9	0	0	0	13	1	1	2	6	10	15	1	5	1	1	2	2	2	0	0	0	0
White-winged Black Tern	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yellow-billed Spoonbill	0	0	0	0	0	0	0	0	0	0	9	5	0	0	0	1	0	0	0	0	0	0	0	0	0	20	1	0	5	0	7	0	3

Lake Cowal Waterbird Transect Monitoring Data: 1989-2022

***Note** : All numbers refer to bird counts. Number following month refers to transect number (e.g. Jan-01 = January, Transect 1). Transects are numbered 1,2,7,8*
***Data source:** 1989-2012 Data sourced from Australian Musuem Business Services (2013). 2013-22 compiled from Evolution Monitoring reports (see Gell 2013-2022)*

	2013	2013	2013	2013	2013	2013	2013	2014	2014	2014	2014	2014	2014	2014	2014	2014	2014	2014	2014	2016	2016	2016	2016	2016	2016	2016	2016	2017	2017	2017	2017	2017	2017
Species / Year, Month & Transect	**Aug-02**	**Aug-07**	**Aug-08**	**Oct-01**	**Oct-02**	**Oct-07**	**Oct-08**	**Jan-01**	**Jan-02**	**Jan-07**	**Jan-08**	**Aug-01**	**Aug-02**	**Aug-07**	**Aug-08**	**Oct-01**	**Oct-02**	**Oct-07**	**Oct-08**	**Aug-01**	**Aug-02**	**Aug-07**	**Aug-08**	**Nov-01**	**Nov-02**	**Nov-07**	**Nov-08**	**Jan-01**	**Jan-02**	**Jan-07**	**Jan-08**	**Aug-01**	**Aug-02**
Australasian Bittern	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Australasian Darter	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	4	1	2	1	2	2	1	1
Australasian Grebe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Australasian Shoveler	0	0	0	0	0	2	0	0	0	3	0	0	15	0	2	0	0	0	2	4	2	3	4	2	1	0	0	0	0	0	2	0	0
Australian Pelican	57	53	12	18	56	86	1	110	222	0	78	6	0	0	2	0	52	0	38	0	0	0	3	0	0	0	0	0	75	2	1	11	0
Australian Pratincole	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Australian Shelduck	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Australian Spotted Crake	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Australian White Ibis	0	0	0	0	0	0	2	3	0	8	0	0	0	0	0	0	2	0	0	0	0	0	0	8	2	3	5	48	24	31	42	0	0
Australian Wood Duck	28	214	46	20	59	443	153	8	0	119	69	0	0	0	27	0	0	0	0	0	3	6	22	39	50	28	80	0	37	55	394	3	38
Banded Lapwing	0	0	0	0	0	0	0	0	0	19	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	0	0	0
Black Swan	0	0	0	5	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	6	8	2	0	1	0	0	0	0	0	0	2
Black-fronted Dotterel	4	2	0	0	4	0	0	2	15	1	0	0	4	0	2	0	0	0	0	0	0	0	0	0	2	2	1	0	1	2	3	0	0
Black-tailed Native-hen	0	5	0	0	0	187	0	0	0	0	53	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	1	0
Black-winged Stilt	0	0	0	3	0	0	0	2	6	74	0	1	350	0	0	235	300	0	140	0	0	15	30	0	0	2	0	0	0	6	0	0	0
Blue-billed Duck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brolga	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Buff-banded Rail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caspian Tern	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cattle Egret	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chestnut Teal	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	2	0	0	0	0	0	0
Common Greenshank	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Curlew Sandpiper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Double-banded Plover	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dusky Moorhen	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	5	0	6	0	5	0	0	0
Eastern Great Egret	0	0	0	0	1	0	0	0	9	0	0	0	1	0	0	0	5	0	0	1	0	0	0	0	0	0	0	10	5	5	6	5	1
Eurasian Coot	387	351	97	62	70	74	113	9	19	0	8	0	0	0	0	0	0	0	0	116	53	417	279	38	2	21	0	214	56	112	99	20	120
Franklin's Gull	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Freckled Duck	0	0	0	0	0	8	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	2	0	0	0	1	0	0	0
Glossy Ibis	0	4	0	0	0	0	0	2	0	3	0	0	0	0	0	0	32	0	0	0	0	0	0	0	0	9	0	6	34	29	27	0	0
Great Cormorant	0	0	0	0	0	0	1	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	3	1	0	0
Great Crested Grebe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Grey Teal	69	721	73	62	111	419	198	112	24	4195	113	511	1490	0	539	215	245	0	534	79	117	165	152	132	206	317	252	9	19	26	83	41	87
Gull-billed Tern	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Hardhead	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	76	126	114	201	2	0	1	0	2	0	0	2	0	0
Hoary-headed Grebe	4	0	0	2	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	40	44	126	23	0	0	0	0	8	0	2	0	11	7
Intermediate Egret	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	2	4	0	0
Latham's Snipe	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	9	2	0	0	1	2	4	0	0
Little Black Cormorant	0	0	0	3	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	6	1	0	7	0	0
Little Curlew	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little Egret	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little Pied Cormorant	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	15	0	0	0	34	2	1	4	7	0
Magpie goose	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	1	0	1	77	0	0
Marsh Sandpiper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Masked Lapwing	0	7	0	3	9	19	6	7	0	43	6	4	9	0	0	16	109	0	10	1	6	5	8	0	1	0	3	1	10	4	3	3	0
Musk Duck	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3	1	0	0	0	0
Nankeen Night-Heron	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	25	1	12	0	1	0
Pacific Black Duck	0	4	0	15	0	0	11	26	6	8	4	0	0	0	4	0	0	0	6	16	4	0	8	33	4	23	5	9	2	19	4	11	0
Pacific Golden Plover	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pectoral Sandpiper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pied Cormorant	0	0	3	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	3	0	0	0	0	0	0	0	10	0
Pink-eared Duck	0	21	0	0	0	155	0	0	0	2502	3	4	25	0	434	0	202	0	674	42	6	88	94	16	5	34	13	2	0	17	12	0	0
Plumed Whistling-duck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	363	0	0	7	0	24	0	0	0	0	0	0	0
Purple Swamphen	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	5	0	0	2	5	0	0	0	3	0	0	0	0	0
Red-capped Plover	0	0	0	0	0	0	0	0	0	8	0	0	2	0	1	14	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red-kneed Dotterel	0	0	0	0	2	0	0	4	12	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Red-necked Avocet	0	0	0	0	0	0	0	1	0	56	0	0	81	0	14	416	1	0	6	0	0	7	0	0	0	0	0	0	0	0	0	0	0
Red-necked Stint	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Royal Spoonbill	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	2	0	0	0	4	3	1	0
Sharp-tailed Sandpiper	0	0	0	0	0	0	0	0	5	5	0	0	0	0	0	500	288	0	77	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Silver Gull	0	26	2	4	4	8	2	5	16	5	6	14	2	0	0	6	0	0	3	0	0	0	1	0	0	0	6	16	38	10	43	0	4
Straw-necked Ibis	0	0	0	0	0	41	0	3	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	5	1	1	9	11	7	0	0
Wandering Whistling-duck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	45	0	2	0	0	0	0	0	0	0	0	0	0
Whiskered Tern	0	0	0	14	260	95	0	12	133	70	0	0	0	0	0	1008	295	0	515	0	0	0	0	0	0	29	14	15	99	12	12	0	0
White-faced Heron	1	1	0	1	0	0	0	5	8	4	1	0	0	0	0	0	1	0	0	4	2	1	0	2	5	2	6	0	5	6	1	3	0
White-necked Heron	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	13	5	5	8	31	63	42	26	0	0
White-winged Black Tern	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yellow-billed Spoonbill	4	3	9	3	8	6	5	44	2	0	28	0	41	0	25	112	25	0	58	0	0	0	0	0	2	0	2	0	3	2	5	7	3

Lake Cowal Waterbird Transect Monitoring Data: 1989-2022

***Note** : All numbers refer to bird counts. Number following month refers to transect number (e.g. Jan-01 = January, Transect 1). Transects are numbered 1,2,7,8*
***Data source:** 1989-2012 Data sourced from Australian Musuem Business Services (2013). 2013-22 compiled from Evolution Monitoring reports (see Gell 2013-2022)*

	2017	2017	2017	2017	2017	2017	2018	2018	2018	2018	2018	2018	2018	2018	2019	2019	2019	2019	2021	2021	2021	2021	2022	2022	2022	2022	2022	2022	2022	2022
Species / Year, Month & Transect	**Aug-07**	**Aug-08**	**Oct-01**	**Oct-02**	**Oct-07**	**Oct-08**	**Jan-01**	**Jan-02**	**Jan-07**	**Jan-08**	**Oct-01**	**Oct-02**	**Oct-07**	**Oct-08**	**Jan-01**	**Jan-02**	**Jan-07**	**Jan-08**	**Oct-01**	**Oct-02**	**Oct-07**	**Oct-08**	**Jan-01**	**Jan-02**	**Jan-07**	**Jan-08**	**Aug-01**	**Aug-02**	**Aug-07**	**Aug-08**
Australasian Bittern	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Australasian Darter	0	2	1	5	3	2	13	0	10	6	5	4	0	2	0	0	0	0	0	1	2	0	0	1	2	0	0	0	0	0
Australasian Grebe	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	5	0	1	0	3	2	1	11	0	0	0
Australasian Shoveler	14	0	0	0	10	0	0	0	0	0	0	0	0	0	8	0	0	0	16	29	6	13	0	0	16	8	1	0	0	0
Australian Pelican	0	1	32	3	2	3	49	68	57	15	147	331	0	155	14	19	0	0	1	0	1	0	0	0	0	0	2	18	21	0
Australian Pratincole	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Australian Shelduck	15	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Australian Spotted Crake	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Australian White Ibis	0	0	7	0	2	0	5	0	5	1	1	0	0	3	2	1	0	0	8	8	4	4	148	53	16	18	0	1	0	0
Australian Wood Duck	71	44	5	7	194	50	5	7	40	10	6	0	0	204	0	0	0	0	0	47	32	3	7	21	22	7	1	16	4	15
Banded Lapwing	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Black Swan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	4	0	0	4	4	0	0	2	0
Black-fronted Dotterel	0	2	0	0	0	3	2	1	0	0	6	0	0	2	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Black-tailed Native-hen	58	0	1	0	50	0	5	0	56	0	2	0	0	0	0	0	0	0	13	23	0	153	0	4	11	0	16	4	47	2
Black-winged Stilt	0	0	0	0	1	0	0	0	0	0	63	61	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0
Blue-billed Duck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	2	3	8	0	2	1	1	1	0	0	0
Brolga	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Buff-banded Rail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Caspian Tern	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Cattle Egret	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Chestnut Teal	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	8	0	0	0	0	0	0	0	0	0
Common Greenshank	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Curlew Sandpiper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Double-banded Plover	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dusky Moorhen	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	9	0	5	0	13	0	4	0	2	0	0	0
Eastern Great Egret	2	1	0	0	4	0	7	1	6	2	3	2	0	0	0	63	0	0	0	1	1	2	4	2	2	12	1	1	0	0
Eurasian Coot	65	90	21	0	6	0	26	1	40	19	0	0	0	0	0	0	0	0	126	96	88	153	38	15	106	64	35	5	55	0
Franklin's Gull	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Freckled Duck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	1	0	0	0	4	0
Glossy Ibis	0	0	0	0	0	3	0	0	1	0	0	2	0	0	21	34	0	0	0	0	2	28	0	0	38	17	0	0	0	0
Great Cormorant	0	0	1	1	2	0	0	1	1	5	1	25	0	0	0	0	0	0	0	0	0	0	0	8	3	0	0	0	0	0
Great Crested Grebe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28	0	2	0	37	7	5	0	0	0	0
Grey Teal	162	18	10	60	128	20	68	21	71	57	164	37	0	1485	7290	24	0	0	102	138	409	277	17	52	73	222	0	31	46	59
Gull-billed Tern	0	0	0	1	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hardhead	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	46	30	40	16	2	2	4	2	0	2	4	0
Hoary-headed Grebe	0	0	0	0	0	0	0	0	0	0	7	8	0	0	0	0	0	0	83	462	561	176	0	41	18	29	9	34	10	10
Intermediate Egret	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	1	0	5	9	0	0	0	0
Latham's Snipe	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0
Little Black Cormorant	0	0	0	0	0	2	3	0	1	0	1	0	0	1	0	0	0	0	0	0	0	1	0	6	0	24	0	0	0	0
Little Curlew	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little Egret	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
Little Pied Cormorant	0	0	4	1	0	0	1	3	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	11	9	31	0	0	1	0
Magpie goose	0	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0	4	22	0	0	0	0	0	0	0	0
Marsh Sandpiper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Masked Lapwing	0	2	0	0	6	0	0	0	0	0	5	15	0	11	206	2	0	0	0	0	4	0	0	0	0	0	0	0	0	0
Musk Duck	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	3	0	0	5	5	0	0	0	0
Nankeen Night-Heron	0	0	1	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	38	32	48	0	0	0	0
Pacific Black Duck	8	0	26	0	22	5	28	15	47	2	8	2	0	60	8	0	0	0	7	12	13	13	0	23	14	9	4	14	6	31
Pacific Golden Plover	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pectoral Sandpiper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pied Cormorant	0	0	2	23	1	3	26	7	5	3	1	5	0	0	0	0	0	0	0	0	0	0	2	1	10	20	0	0	0	1
Pink-eared Duck	110	25	0	0	0	0	2	2	0	0	267	5	0	241	327	0	0	0	79	158	242	16	1	2	22	23	0	0	4	2
Plumed Whistling-duck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
Purple Swamphen	0	0	0	0	2	0	0	0	15	0	0	0	0	0	0	0	0	0	17	13	4	23	2	0	6	0	3	0	0	0
Red-capped Plover	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red-kneed Dotterel	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red-necked Avocet	0	0	0	0	0	0	0	0	0	0	10	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red-necked Stint	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Royal Spoonbill	0	2	0	1	4	0	2	0	5	2	0	0	0	0	0	0	0	0	1	0	2	1	0	0	1	2	0	6	1	0
Sharp-tailed Sandpiper	1	0	0	0	0	0	0	0	0	0	56	73	0	0	92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Silver Gull	0	1	0	0	0	5	0	2	0	5	4	7	0	0	38	0	0	0	1	0	14	3	4	1	0	20	0	7	0	0
Straw-necked Ibis	0	0	0	0	22	0	5	1	0	14	0	0	0	0	0	0	0	0	2	3	6	46	18	6	57	5	0	0	4	0
Wandering Whistling-duck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Whiskered Tern	0	0	0	4	73	249	12	30	0	0	31	74	0	18	33	8	0	0	91	55	150	120	5	13	1	48	0	0	0	0
White-faced Heron	2	1	0	0	1	0	3	1	0	3	1	3	0	1	1	2	0	0	4	1	2	0	1	19	6	5	0	1	0	0
White-necked Heron	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	1	0	9	14	6	1	18	25	0	2	0	3
White-winged Black Tern	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yellow-billed Spoonbill	7	2	0	0	9	1	0	0	0	1	0	0	0	115	188	45	0	0	0	0	0	1	0	3	0	1	0	0	0	0

Lake Cowal Breeding Bird Data by Month (1989-2012)

Note: *Bird numbers represent count of nests or breeding birds observed (* = number unknown)*

Data sourced from Australian Museum Business Services (2013)

Species/Month & Year	1989 Aug	1989 Oct	1990 Jan	1991 Jan	1991 Aug	1991 Oct	1992 Jan	1992 Aug	1992 Oct	1993 Jan	1993 Aug	1993 Oct	1994 Jan	1994 Aug	1994 Oct	1995 Jan	1995 Aug	1995 Oct	1996 Jan	1996 Aug
Musk Duck		*	*																	
Freckled Duck																				
Black Swan	*	*	*					1	2	7		3	2				5			21
Australian Shelduck	*														2					
Australian Wood Duck	*							1					5					1		
Pink-eared Duck	*	*	*																	
Grey Teal	*	*	*									2	5						1	
Chestnut Teal																				
Pacific Black Duck	*											1							1	
Hardhead	*	*	*																	
Blue-billed Duck		*	*																	
Australasian Grebe			*																	
Hoary-headed Grebe		*	*																	
Great Crested Grebe			*																	
Australasian Darter		30	50	162		133	21			3			80		10	50		19	20	
Little Pied Cormorant		100	350			3						6						10	20	
Great Cormorant			*	40		1							6							
Little Black Cormorant		150	300	474		214	164			8		55	1000					60	30	
Pied Cormorant			*	15		8	1						10					10	30	
White-necked Heron		*	*	1								1								
Eastern Great Egret			*	1																
Intermediate Egret			7	1																
White-faced Heron	*		*									1								
Little Egret																				
Nankeen Night Heron			200	28																
Glossy Ibis			20							100										
Australian White Ibis		120	120	24		5				500		191	50					51	10	
Straw-necked Ibis		4000	*							1500		3734	2500					350	4000	
Royal Spoonbill		15	45	36		1				30		14	100						40	
Yellow-billed Spoonbill		*	*	12		1							20							
White-bellied Sea-eagle																				1
Purple Swamphen													1							
Black-tailed Native Hen																				
Dusky Moorhen																				
Eurasian Coot	*	*	*																	
Black-winged Stilt		*	*																	
Black -fronted Dotterel																				
Red-kneed Dotterel			*																	
Masked Lapwing		*																		
Gull-billed Tern			2																	
Whiskered Tern		1000	500										15							
Silver Gull					10	10						6						6		

Lake Cowal Breeding Bird Data by Month (1989-2012)

Note: *Bird numbers represent count of nests or breeding birds observed (* = number unknown)*

Data sourced from Australian Museum Business Services (2013)

	1996	1997	1997	1997	1998	1998	1999	1999	1999	2000	2000	2000	2001	2001-2010	2010	2011	2011	2011	2012	2012
Species/Month & Year	**Oct**	**Jan**	**Aug**	**Oct**	**Jan**	**Oct**	**Jan**	**Aug**	**Oct**	**Jan**	**Aug**	**Oct**	**Jan**	**Aug**	**Oct**	**Jan**	**Aug**	**Oct**	**Jan**	**Aug**
Musk Duck																				
Freckled Duck																				
Black Swan	20					45	2	1	7	2		1	1		1	11		1		
Australian Shelduck	3					8			1		1	1								
Australian Wood Duck				1		6			1				1		2	1		6		
Pink-eared Duck						3	1									6		1		
Grey Teal						15	1						5		9	12			8	
Chestnut Teal						1														
Pacific Black Duck						2						1	2		1	4				
Hardhead															1					
Blue-billed Duck																				
Australasian Grebe																				
Hoary-headed Grebe						1	1									1				
Great Crested Grebe							5													
Australasian Darter		12				10	87		63	182		4						56	80	
Little Pied Cormorant						40	50		119							220			57	
Great Cormorant							341													
Little Black Cormorant						80	3500		388	70								1	180	
Pied Cormorant		10																		
White-necked Heron							0													
Eastern Great Egret							15												20	
Intermediate Egret																				
White-faced Heron							1													
Little Egret																10				
Nankeen Night Heron							5													
Glossy Ibis																			110	
Australian White Ibis		18				1200	50		28	405		200	300						30	
Straw-necked Ibis		1500				10100			18000	1650		10000	2000			2030			2500	
Royal Spoonbill						40	80			250		2				46		10	18	
Yellow-billed Spoonbill							16													
White-bellied Sea-eagle	1																			
Purple Swamphen							1						2			1				
Black-tailed Native Hen							1													
Dusky Moorhen							1													
Eurasian Coot							10								3	27				
Black-winged Stilt							10													
Black -fronted Dotterel										1										
Red-kneed Dotterel																				
Masked Lapwing																				
Gull-billed Tern																				
Whiskered Tern							5													
Silver Gull							*					4								

Lake Cowal Colonial Breeding Bird Data: 1989-October 2010

Key: *I = Open water with scattered Red Gum, II = Lignum, III = Scattered River Red Gum with Lignum, IV = Clumps of River Red Gum, V = Open water with Isolated Trees, VI = Cane Grass, ^ = nymber reported is total of 2 or more areas*

Note: *Numbers refer to maximum number of nests for that season. Years refer to surveys in August and October of the listed year and January of the following year (e.g. 2012 = August 2012, October 2012, January 2013).*

Data sourced from Australian Museum Business Services (2013)

Species/Site	Preferred Habitat	T1	T8	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	Area 8
Habitat Types				**I, IV**	**II, III, IV**	**I**	**II, III, IV**	**II, III, IV**	**II, III, IV**	**V**
Australasian Darter	I, III, IV					1989-4	1989-9	1989-30		
				1990–37	1990-35	1990-45	1990-20	1990-25		
					1991-26	1991-91		1991-13		
						1992-3		1993-58		
				1993-10	1993-10	1993-10				
						1994-50				
								1995-20		1995-1
								1996-12		
		1998-97^			1998-97^	1998-97^		1998-97^		
								1999-245		
						2000-1		2000-3		
Little Pied Cormorant	IV				1989-30	1989-22	1989-30	1989-200		
								1993-6		
								1995-20		
								1998-90		
								1999-119		
Pied Cormorant	I, IV						1990-11	1990-4		
						1991-8				
								1993-7		
								1995-30		
								1996-10		
Little Black Cormorant	I				1989-45			1989-250		
								1990-474		
							1991-40	1991-174		
							1992-8			
								1993-1000		
								1995-60		
								1998-3580		
								1999-458		
Great Cormorant	I, III, IV				1989-3					
				1990-19		1990-5	1990-16			
						1991-1				
				1993-1		1993-5				
		1998-341^				1998-341^				
Eastern Great Egret	I, IV, V				1989-1 1990-120 1991-27			1998-15		
Intermediate Egret	IV				1989-7 1990-1					
Nankeen Night Heron	III, IV				1989-200			1989-10		
					1990-28			1995-1?		
								1998-5?		
								1999-?		
Glossy Ibis	II				1989-20		1992-100			
Australian White Ibis	II				1989-20		1989-20	1989-18	1989-60	
					1990-10			1990-11	1990-3	
									1991-6	
							1992-500			
									1993-100	
								1995-20	1995-31	
									1996-18	
								1998-1250^	1998-1250^	
							1999-20	1999-28	1999-385	
									2000-500	
Straw-necked Ibis	II				1989-3500			1989-45		
							1992-1500			
					1993-800			1993-4500	1993-234	
								1995-4000	1996-1500	
								1998-10100^	1998-10100^	
								1999-~18000	1999-1650	
									2000-12000	

Lake Cowal Colonial Breeding Bird Data: 1989-October 2010

Key: *I = Open water with scattered Red Gum, II = Lignum, III = Scattered River Red Gum with Lignum, IV = Clumps of River Red Gum, V = Open water with Isolated Trees, VI = Cane Grass, ^ = nymber reported is total of 2 or more areas*

Note: *Numbers refer to maximum number of nests for that season. Years refer to surveys in August and October of the listed year and January of the following year (e.g. 2012 = August 2012, October 2012, January 2013).*

Data sourced from Australian Museum Business Services (2013)

Species/Site	Preferred Habitat	T1	T8	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	Area 8
Habitat Types				**I, IV**	**II, III, IV**	**I**	**II, III, IV**	**II, III, IV**	**II, III, IV**	**V**
Royal Spoonbill	II				1989-20		1989-2	1989-20		
							1990-2	1990-33		
								1991-1		
							1992-30			
									1993-191	
									1995-40	
									1996-9	
									1998-120	
							1999-30		1999-220	
									2000-2	
Yellow-billed Spoonbill	I, IV			1990-11	1989-4	1989-6 1990-1				
		1998-16^		1993-20		1991-3				1998-16^
						1991-7				1991-3
										1993-6
Silver Gull	V					1995-6				
						1998-?				1998-?
			2000-4							

Lake Cowal Colonial Breeding Bird Data: 2011-2012

***Key** : I = Open water with scattered Red Gum, II = Lignum, III = Scattered River Red Gum with Lignum, IV = Clumps of River Red Gum, V = Open water with Isolated Trees, VI = Cane Grass, ^ = number reported is total of 2 or more areas*

***Key (Cont'd):** cl = no. clutches, j = young, n = nests, e = eggs, A = breeding adults*

***Note:** Years refer to surveys in August and October of the listed year and January of the following year (e.g. 2012 = August 2012, October 2012, January 2013).*

Data sourced from Australian Museum Business Services (2013)

Species/Site	Preferred Habitat	T1	T2	T7	T8	West	North	North-east	North-west	Central
Australasian Darter	I, III, IV						2011-75n	2011-5n	2011-56n	
Little Pied Cormorant	IV						2011-57			
Pied Cormorant	I, IV									
Little Black Cormorant	I						2011-130n	2011-50n	2011-1n/4j	
Great Cormorant	I, III, IV									
Eastern Great Egret	I, IV, V							2011-20n		
Intermediate Egret	IV									
Nankeen Night Heron	III, IV									
Glossy Ibis	II						2011-50n	2011-60n		
Australian White Ibis	II					2010-200n	2010-100p/100j 2011-30n	2010-25n		
Straw-necked Ibis	II					2010-1800n/150 0p/4500j	2010-30n/300p/300j 2011-~2000n	2010-200n 2011-500n		
Royal Spoonbill	II					2010-10n	2010-1n/2j 2011-16n	2010-30n 2011-2n	2011-10n	2010-5n
Yellow-billed Spoonbill	I, IV									
Silver Gull	V				2010-21j					

Lake Cowal Incidental Breeding Records: August 1989 to October 2010

***Key** : cg = canegrass, l = lignum, h = tree hollows, b = branches, t = terrestrial habitat, f = floarting vegetation on water*
***Key Cont'd** : * = unspecified number, ^ = number reported is total of 2 or more areas, ? = uncertaity in numbers or observation*
***Note** : Numbers refer to maximum number of nests for that season. Years refer to surveys in August and October of the listed year plus January of the following year (e.g. 2012 = August 2012, October 2012, January 2013), however year 2010 refers only to August and October of that year due to a change in the reporting of breeding bird numbers*
Data sourced from Australian Museum Business Services (2013)

Species	Preferred Habitat	Unspecified Location	T1	T2	T7	T8	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	Area 7	Area 8
Blue-billed Duck	l	1989-*												
Musk Duck	l	1989-*												
Freckled Duck	t										1999-40?			
Black Swan	cg, l	1989-*				1991-1					1993-1	1993-2	1993-1	
		1992-9												
		1995-5												
		1996-10	1996-8	1996-3	1996-4	1996-9								
				1998-47^	1998-47^			1998-47^	1998-47^	1998-47^	1998-47^	1998-47^	1998-47^	
			1999-1	1999-1	1999-5						1999-2			
			2000-1									2000-1		
					2010-3	2010-4								
Australian Shelduck	h	1989-*			1996-3	1994-1								
			1998-8^	1998-8^	1998-8^	1998-8^								
					1999-1									
						2000-1						2000-1		
Australian Wood Duck	h	1989-*	1998-6^	1998-6^	1991-1	1998-6^			1995-1					
		1992-1												
		1993-5												
		1997-1												
			1999-1											
						2000-1								
						2010-2								
Pacific Black Duck	h, l	1989-*	1995-1	1995-1	1998-2						2000-1			
Grey Teal	h	1989-*												
		1993-5			1993-2									
		1995-1				1995-1								
			1998-16^	1998-16^	1998-16^	1998-16^			1998-16^					
					2000-2	2000-3								
			2010-2	2010-8										
Chestnut Teal	cg, h			1998-1										
Pink-eared Duck	h	1989-*			1998-4^	1998-4^		1989-2	1998-4^					
Hardhead	h, l	1989-*		2010-1										
Australasian	cg, l	1989-*												
Hoary-headed	cg, l	1989-*		2010-1	1998-2			1989-1						
Great-crested	cg, l	1989-*	1998-5^	1998-5^	1998-5^									
White-faced	b	1989-*			1998-1									1993-1
White-necked	b, l	1989-*					32874	1989-2	1989-3					1998-2
Purple	l		1998-1	2000-2										
Black-tailed	cg, l				1998-1									
Dusky Moorhen	f				1998-1									
		1989-*						1989-5		1989-1				
Eurasian Coot	cg, l		1998-10?											
			2010-1	2010-2										
Black-winged Stilt	t	1989-*	1998-10?^		1998-10?^	1998-10?^								
Black-fronted Dotterel	t			1999-1										
Red-kneed Dotterel	t	1989-*												

Lake Cowal Incidental Breeding Records: August 1989 to October 2010

***Key** : cg = canegrass, l = lignum, h = tree hollows, b = branches, t = terrestrial habitat, f = floarting vegetation on water*
***Key Cont'd** : * = unspecified number, ^ = number reported is total of 2 or more areas, ? = uncertaity in numbers or observation*
***Note** : Numbers refer to maximum number of nests for that season. Years refer to surveys in August and October of the listed year plus January of the following year (e.g. 2012 = August 2012, October 2012, January 2013), however year 2010 refers only to August and October of that year due to a change in the reporting of breeding bird numbers*
Data sourced from Australian Museum Business Services (2013)

Species	Preferred Habitat	Unspecified Location	T1	T2	T7	T8	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	Area 7	Area 8
Masked Lapwing	t	1989-*												
Gull-billed Tern	cg												1989-3	
Whiskered Tern	cg	1989-*	1998-5?^						1989-900			1991-?	1989-500	1998-5?^

Lake Cowal Incidental Breeding Records: January 2011-August 2012

Key *: cg = canegrass, l = lignum, h = tree hollows, b = branches, t = terrestrial habitat, f = floarting vegetation on water, * = unspecified number, ^ = number reported is total of 2 or more areas, ? = uncertaity in numbers or observation*
Key Cont'd *: cl = no. clutches, j = young, n = nests, e = eggs, A = breeding adults*

Note: *Years refer to surveys in August and October of the listed year and January of the following year (e.g. 2012 = August 2012, October 2012, January 2013).*
Data sourced from Australian Museum Business Services (2013)

Species	Preferred Habitat	Unspecified Location	T1	T2	T7	T8	West	North	North-east	North-west	Centre
Blue-billed Duck	l										
Musk Duck	l										
Freckled Duck	t										
Black Swan	cg, l		2011-1p/5j	2011-1p/6j	2010-3n/13J 2011-1p/6j	2010-3n/15j 2011-2p/4j	2010-4n/19j 2011-2p/18j	2011-1p/3j	2010-1n		
Australian Shelduck	h										
Australian Wood Duck	h		2010-1p/5j	2011-3p/28j	2011-2p/13j	2011-1p/14j					
Pacific Black Duck	h, l		2010-1p/8j 2011-1p/6j	2010-1p/5j 2011-1p/4j	2010-1p/1j		2010-1p/8j				
Grey Teal	h		2010-4p/38j	2010-5p/35j 2011-3p/8j	2010-1p/1j 2011-1p/2j	2010-2p/9j 2011-4p/32j					
Chestnut Teal	cg, h										
Pink-eared Duck	h			2010-1p/5j	2010-2p/12j 2011-1p/5j	2010-2p/15j	2010-1p/6j			2011-2p/6j	
Hardhead	h, l										
Australasian Grebe	cg, l		2011-9j	2010-1j							
Hoary-headed Grebe	cg, l	2011-?j	2010-143j 2011-1p/1j	2010-1n/250j	2010-90j	2010-140j					
Great-crested Grebe	cg, l										
White-necked Heron	b, l										
White-faced Heron	b										
Little Egret	b								2010-10n		
Purple Swamphen	l		2010-1n/2j	2010-3j							
Dusky Moorhen	f		2011-2j					2010-2j			
Eurasian Coot	cg, l	2011-?j	2010-10n/290j	2010-15n/300j		2010-90j			2010-2n		
Black-winged Stilt	t				2010-50j	2010-6j					
Black-fronted Dotterel	t										
Red-kneed Dotterel	t										
Masked Lapwing	t										
Gull-billed Tern	cg										
Whiskered Tern	cg			2010-250j	2010-35j	2010-25j					

Lake Cowal Colonial and Incidental Breeding Records: 2012-22

Key *: cl = no. clutches, j = young, n = nests, e = eggs, A = breeding adults*

Note *: Years refer to surveys in August and October of the listed year and January of the following year (e.g. 2012 = August 2012, October 2012, January 2013). Data compiled from Gell (2013-2022).*

Species	No location given	T1	T2	T7	T8	North-east section of Breeding Areas	Western shore	Central Lignum	Isolated Trees	Redgum Forest	B2 (Coniston Lake)	B4 (Lignum West)	B5 (Lignum East)	B8 (North)
Australasian Darter						2012-2n	2017-2n		2017-22n		2021-21P/34N/71J		2021-26A/31N/53J	2021-6P/16N/24J
Australasian Grebe													2021-2A/2J	
Australasian Shoveler				2021-2P/2y										
Australian Pelican						2022-80A								
Australian White Ibis						2012-2n 2017-25n	2016-10n			2016-1n 2017-25n	2021-2P/14N		2021-500P/515N	
Australian Wood Duck		2012-5y 2016-36y,3cl 2022-2N	2013-4y 2016.12y,2cl	2016-8y 2021-2P/14y	2016-8y 2017-9y		2016-10n		2016-1n	2016-1n				
Black Swan					2021-12y	2022-2A	2016-1y				2021-2P/8J			
Black-fronted Dotterell		2012-3j												
Black-tailed Nativehen		2022-1J												
Cattle Egret													2021-3P/4N/3J	
Chestnut-breasted Shelduck				2017-16y										
Dusky Moorhen		2021-8P/13J												
Eastern Great Egret											2021-6P/6N/11J		2021-9P/11N/7J	
Eurasian Coot		2021-3P/4J 2016-?j	2021-2P/4J	2021-3P/5J	2021-1P/3J									
Glossy Ibis													2021-300P/450N	
Great Cormorant									2016-32n				2021-7A/6N/11J	2021-1P/4N/8J
Great Crested Grebe											2021-8A/14J			2021-6A/9J
Grey Teal		2016-7cl 54y 2021-13Y	2016-6cl 51y	2016-3cl/21y 2017-6y 2021-4P/19y 2022-6J	2016-6y 2021-4P/10y						2021-120P/120N		2021-5N	2021-3P/18N/12J
Hoary-headed Grebe			2021-4P/7J	2021-1P/2J	2021-4P/8J									
Intermediate Egret													2021-12A/7N/9J	
Little Black Cormorant							2016-100n					2021-600P/618N/1200J	2021-14A/26J	2021-3P/13N/37J
Little Pied Cormorant										2017-1n				
Magpie Goose	2017-6y				2016-41y			2016-1n,3e			2021-4N	2021-3N	2021-5N	
Masked Lapwing		2018-1y												
Nankeen Night Heron		2021-1P/1J		2021-2J		2022-6A					2021-11P/9N/8J		2021-150P/150N/120J	2021-3N
Pacific Black Duck			2021-2P/4J;		2021-2P/12y									
Pied Cormorant									2016-1n 2017-3n					2021-6P/16N/24J
Pink-eared Duck		2016-2cl, 2y	2016-1cl, 3y		2016-5y									

Lake Cowal Colonial and Incidental Breeding Records: 2012-22

***Key** : cl = no. clutches, j = young, n = nests, e = eggs, A = breeding adults*

***Note** : Years refer to surveys in August and October of the listed year and January of the following year (e.g. 2012 = August 2012, October 2012, January 2013). Data compiled from Gell (2013-2022).*

Species	No location given	T1	T2	T7	T8	North-east section of Breeding Areas	Western shore	Central Lignum	Isolated Trees	Redgum Forest	B2 (Coniston Lake)	B4 (Lignum West)	B5 (Lignum East)	B8 (North)
Royal Spoonbill						2012-5n				2012-1n 2016-Nest-building	2021-2P/7N	2021-17P/28N	2021-200P/320N	
Silver Gull										2016-1n				
Straw-necked Ibis										2016-8n			2021-12500P/13700N	
Whiskered Tern							2016-Large flock preparing nests							
White-faced Heron					2021-2N									2021-1N
White-necked Heron				2021-6P/7J	2022-1N		2016-16n, 6y				2021-6P/6N/15J			2021-2P/5N/9J
Yellow-billed Spoonbill						2021-1N 2022-2A	2016-1n 2017-1n				2021-2N			2021-6P/9N/7J

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	16/11/2010			15/11/2011			7/11/2012			5/11/2013		
Species	**Bird Count**	**Nest Count**	**Brood Count**	**Bird Count**	**Nest Count**	**Brood Count**	**Bird Count**	**Nest Count**	**Brood Count**	**Bird Count**	**Nest Count**	**Brood Count**
Australasian shoveler	3	0	0	194	0	0	0	0	0	6	0	0
Australian Shelduck (Mountain Duck)	0	0	0	2	0	0	0	0	0	9	0	0
Banded Stilt	0	0	0	0	0	0	0	0	0	0	0	0
Black Swan	109	30	3	316	0	7	2	0	0	0	0	0
Black-tailed Native-hen	0	0	0	240	0	0	6	0	0	7	0	0
Black-winged Stilt	70	0	0	1346	0	0	35	0	0	66	0	0
Brolga	0	0	0	0	0	0	0	0	0	0	0	0
Caspian Tern	0	0	0	11	0	0	0	0	0	0	0	0
Darter	0	0	0	98	0	0	2	0	0	2	0	0
Egrets	2	0	0	242	0	0	98	0	0	3	0	0
Eurasian Coot	195	42	0	8256	0	0	322	0	0	20	0	0
Freckled duck	2	0	0	82	0	0	17	0	0	0	0	0
Glossy Ibis	0	0	0	268	0	0	0	0	0	17	0	0
Great cormorant	0	0	0	32	0	0	0	0	0	16	0	0
Great crested grebe	0	0	0	5	0	0	0	0	0	0	0	0
Great egret	0	0	0	58	0	0	24	0	0	0	0	0
Grey teal	851	140	0	6918	0	0	1740	0	0	1929	0	0
Gull-billed tern	0	0	0	55	0	0	0	0	0	1	0	0
Hardhead	83	6	0	1058	0	0	37	0	0	0	0	0
Little (Australasian) Grebe	0	0	0	1	0	0	0	0	0	0	0	0
Little black cormorant	2	0	0	223	0	0	1	0	0	0	0	0
Little pied cormorant	0	0	0	145	0	0	13	0	0	0	0	0
Magpie Goose	0	0	0	0	0	0	0	0	0	0	0	0
Masked lapwing	5	2	0	201	0	0	2	0	0	3	0	0
Musk Duck	0	0	0	1	0	0	0	0	0	0	0	0
Nankeen (Rufous) Night Heron	1	1	0	11	0	0	19	0	0	0	0	0
Pacific (White-necked) Heron	0	0	0	13	0	0	0	0	0	0	0	0
Pacific black Duck	101	6	0	1107	0	0	588	0	0	163	0	0
Pelican	0	0	0	97	0	0	1043	0	0	1481	0	0
Pied Cormorant	0	0	0	3	0	0	1	0	0	0	0	0
Pink-eared Duck	8	0	0	105	0	0	83	0	0	47	0	0
Plumed whistling-duck	0	0	0	0	0	0	0	0	0	0	0	0
Purple swamphen	23	0	0	103	0	0	8	0	0	0	0	0
Red-necked Avocet	0	0	0	0	0	0	0	0	0	57	0	0
Royal Spoonbill	12	12	0	17	3	0	14	2	0	49	0	0
Silver Gull	7	0	0	13	0	0	6	0	0	45	0	0
Small Grebes	0	0	0	0	0	0	1	0	0	0	0	0
Small Waders	0	0	0	0	0	0	0	0	0	58	0	0
Straw-necked Ibis	8895	8659	0	98	0	0	1	0	0	681	667	0
Unidentified Tern	0	0	0	0	0	0	0	0	0	150	0	0
Wandering Whistling Duck	31	31	0	0	0	0	0	0	0	0	0	0
Whiskered (Marsh) Tern	5101	2333	0	40	0	0	163	0	0	721	0	0
White (Sacred) Ibis	464	294	0	48	17	0	11	0	0	33	0	0
White-faced Heron	35	10	0	231	0	0	1	0	0	4	0	0
Wood (Maned) Duck	5	0	0	871	0	0	217	0	0	730	0	0
Yellow-billed Spoonbill	2	0	0	170	0	0	587	0	0	807	0	0
Zero Count	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	16007	11566	3	22679	20	7	5042	2	0	7105	667	0

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	17/11/2014			9/11/2015			10/11/2016			7/11/2017		
Species	**Bird Count**	**Nest Count**	**Brood Count**	**Bird Count**	**Nest Count**	**Brood Count**	**Bird Count**	**Nest Count**	**Brood Count**	**Bird Count**	**Nest Count**	**Brood Count**
Australasian shoveler	0	0	0	11	0	0	88	0	0	0	0	0
Australian Shelduck (Mountain Duck)	20	0	0	0	0	0	90	0	0	0	0	0
Banded Stilt	0	0	0	0	0	0	0	0	0	0	0	0
Black Swan	0	0	0	1	0	0	123	0	0	4	0	0
Black-tailed Native-hen	0	0	0	0	0	0	0	0	0	0	0	0
Black-winged Stilt	1033	0	0	4969	0	0	184	0	0	603	0	0
Brolga	0	0	0	1	0	0	0	0	0	0	0	0
Caspian Tern	0	0	0	0	0	0	0	0	0	0	0	0
Darter	0	0	0	0	0	0	0	0	0	11	0	0
Egrets	3	0	0	705	0	0	29	0	0	9	0	0
Eurasian Coot	0	0	0	833	0	0	44	0	0	606	0	0
Freckled duck	240	0	0	189	0	0	0	0	0	11	0	0
Glossy Ibis	50	0	0	556	0	0	0	0	0	11	0	0
Great cormorant	0	0	0	0	0	0	60	0	0	13	0	0
Great crested grebe	0	0	0	0	0	0	0	0	0	0	0	0
Great egret	0	0	0	2	0	0	1	0	0	9	0	0
Grey teal	8411	0	0	20111	0	0	6206	0	2	4269	0	0
Gull-billed tern	0	0	0	1	0	0	0	0	0	6	0	0
Hardhead	0	0	0	969	0	0	244	0	0	3	0	0
Little (Australasian) Grebe	0	0	0	0	0	0	0	0	0	0	0	0
Little black cormorant	0	0	0	0	0	0	19	0	0	1	0	0
Little pied cormorant	0	0	0	0	0	0	1	0	0	0	0	0
Magpie Goose	0	0	0	0	0	0	17	3	0	3	0	0
Masked lapwing	74	0	0	0	0	0	18	0	0	26	0	0
Musk Duck	0	0	0	0	0	0	1	0	0	1	0	0
Nankeen (Rufous) Night Heron	0	0	0	0	0	0	0	0	0	0	0	0
Pacific (White-necked) Heron	0	0	0	156	0	0	16	0	0	0	0	0
Pacific black Duck	82	0	0	71	0	0	305	0	0	95	0	0
Pelican	1192	0	0	456	0	0	33	0	0	1064	0	0
Pied Cormorant	0	0	0	0	0	0	20	0	0	43	0	0
Pink-eared Duck	530	0	0	6144	0	0	247	0	0	384	0	0
Plumed whistling-duck	0	0	0	0	0	0	26	0	0	0	0	0
Purple swamphen	0	0	0	0	0	0	0	0	0	0	0	0
Red-necked Avocet	1716	0	0	0	0	0	0	0	0	44	0	0
Royal Spoonbill	0	0	0	0	0	0	17	17	0	17	0	0
Silver Gull	202	0	0	111	0	0	1	0	0	49	0	0
Small Grebes	0	0	0	44	0	0	6	0	0	0	0	0
Small Waders	512	0	0	833	0	0	0	0	0	27	0	0
Straw-necked Ibis	0	0	0	4570	0	0	86	0	0	335	167	0
Unidentified Tern	1	0	0	216	0	0	0	0	0	0	0	0
Wandering Whistling Duck	0	0	0	0	0	0	0	0	0	0	0	0
Whiskered (Marsh) Tern	1637	0	0	506	0	0	309	166	0	1419	0	0
White (Sacred) Ibis	36	0	0	22	0	0	18	10	0	40	0	0
White-faced Heron	0	0	0	2	0	0	27	0	0	13	0	0
Wood (Maned) Duck	0	0	0	0	0	0	358	0	0	467	0	0
Yellow-billed Spoonbill	1079	0	0	813	0	0	5	0	0	398	0	0
Zero Count	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	16818	0	0	42292	0	0	8599	196	2	9981	167	0

Lake Cowal Waterbird Data - University of New South Wales

	6/11/2018			15/10/2020		
Species	**Bird Count**	**Nest Count**	**Brood Count**	**Bird Count**	**Nest Count**	**Brood Count**
Australasian shoveler	2	0	0	520	0	0
Australian Shelduck (Mountain Duck)	0	0	0	25	0	1
Banded Stilt	5	0	0	0	0	0
Black Swan	0	0	0	382	0	7
Black-tailed Native-hen	0	0	0	0	0	0
Black-winged Stilt	794	0	0	4298	0	0
Brolga	0	0	0	0	0	0
Caspian Tern	8	0	0	0	0	0
Darter	1	0	0	1	0	0
Egrets	18	0	0	359	0	0
Eurasian Coot	258	0	0	6071	0	0
Freckled duck	80	0	0	7	0	0
Glossy Ibis	26	0	0	362	0	0
Great cormorant	77	0	0	10	0	0
Great crested grebe	0	0	0	0	0	0
Great egret	15	0	0	6	0	0
Grey teal	4453	0	0	22742	0	0
Gull-billed tern	0	0	0	2	0	0
Hardhead	0	0	0	986	0	0
Little (Australasian) Grebe	0	0	0	0	0	0
Little black cormorant	19	0	0	10	0	0
Little pied cormorant	2	0	0	3	0	0
Magpie Goose	0	0	0	20	0	0
Masked lapwing	49	0	0	0	0	0
Musk Duck	0	0	0	0	0	0
Nankeen (Rufous) Night Heron	0	0	0	0	0	0
Pacific (White-necked) Heron	0	0	0	1109	0	0
Pacific black Duck	437	0	0	1626	0	0
Pelican	2559	0	0	268	0	0
Pied Cormorant	3	0	0	40	0	0
Pink-eared Duck	1104	0	0	5491	0	0
Plumed whistling-duck	0	0	0	67	0	0
Purple swamphen	0	0	0	40	0	0
Red-necked Avocet	490	0	0	2	0	0
Royal Spoonbill	20	0	0	46	0	0
Silver Gull	50	0	0	30	0	0
Small Grebes	0	0	0	0	0	0
Small Waders	5833	0	0	300	0	0
Straw-necked Ibis	0	0	0	1386	0	0
Unidentified Tern	0	0	0	0	0	0
Wandering Whistling Duck	0	0	0	0	0	0
Whiskered (Marsh) Tern	217	0	0	3522	333	0
White (Sacred) Ibis	113	0	0	55	0	0
White-faced Heron	1	0	0	0	0	0
Wood (Maned) Duck	19	0	0	162	0	0
Yellow-billed Spoonbill	162	0	0	250	0	0
Zero Count	0	0	0	0	0	0
Grand Total	16815	0	0	50198	333	8

Appendix K
Species Expert Reports

EMM
creating opportunities

Cover letter

To whom it may concern,

The views and conclusions presented within this expert report, regarding the likelihood for the Austral Pillwort to occur in habitats that could not be surveyed for the Lake Cowal Gold Mine Continuation Project, are my own.

Under my guidance, this expert report was prepared with the assistance of EMM during the initial drafting phase and preparation of figures.

Warm regards,

Dr Colin Bower



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1 Introduction

1.1 Project Background

Evolution Mining (Cowal) Pty Limited (Evolution) is the owner and operator of Cowal Gold Operations (CGO), an existing open pit and underground gold mine approximately 38 kilometres (km) north-east of West Wyalong, NSW. CGO is located on the traditional lands of the Wiradjuri People and is immediately adjacent to the western foreshore of Lake Cowal, which is an ephemeral waterbody and one of the largest inland lakes in NSW.

Evolution is seeking approval for further open pit mining operations at CGO through the Open Pit Continuation Project (the Project), which will involve further development of the existing E42 Pit and the development of open pit mining in three new and adjacent orebodies.

In pursuit of approval for the Project, Evolution engaged EMM consulting to prepare a Biodiversity Development Assessment Report (BDAR; hereafter referred to as EMM 2023). In accordance with the BAM (DPIE 2020), EMM undertook a candidate species assessment to determine the likely presence of threatened species on the area surveyed for ecological values for the BDAR (hereafter study area). The Austral Pillwort (*Pilularia novae-hollandiae*) was identified as a species requiring further assessment due to the presence of potentially associated vegetation communities, appropriate microhabitats and historical records at Lake Cowal.

1.2 Need for Expert Report

In accordance with section 5.2.4(b) of the BAM, initial targeted surveys for Austral Pillwort were undertaken by EMM within the study area across 2020. However, due to heavy rainfall through 2021 and 2022 associated with a La Nina Southern Oscillation Cycle, areas of potentially associated PCTs within Lake Cowal could not be surveyed in their entirety. Subsequent surveys by EMM in 2022 allowed for completion of surveys within the extent of the study area outside of Lake Cowal, however survey could not be completed within Lake Cowal given it was inundated at the time. In accordance with section 5.2.4(c) of BAM (2020), an expert report is required to determine if the Austral Pillwort is likely to be present within the un-surveyed extent of Lake Cowal. Accordingly, this expert report was undertaken to determine the potential for Austral Pillwort occurring in the unsurveyed extent of Lake Cowal, as well as defining the species polygon where the species was found within the study area.

1.3 Study Area Characteristics

The Study area is approximately 3,441.91 hectares (ha) in size, with 1,030.68 ha expected to be directly impacted by the project (referred to as Additional disturbance footprint). Within the additional disturbance footprint, 928.67 ha has been mapped by EMM as native vegetation, although much of this vegetation has been highly disturbed due to historical grazing.

According to information held in the Department of Planning and Environment's (DPE) Threatened Biodiversity Database Collection (hereafter DPE TBDC 2023), the Austral Pillwort may associate with three of eight PCTs present on site, which include:

- PCT 26 – Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion;
- PCT 53 – Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains; and
- PCT 249 – River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW.

The study area is also host to areas of shallow, ephemeral depressions known as gilgai, which the species has been shown to associate with during prior surveys at Lake Cowal (Clements & Rodd 1995, Bower 1998). A map of the site showing possible PCTs associated with the Austral Pillwort, along with approximate mapping of gilgai areas, is displayed in Figure 1.1.



KEY

- Subject land
- Additional disturbance area
- Existing and approved disturbance area
- Major road
- Broad gilgai area

PCTs associated with Austral Pillwort

PCT 26 | Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion

- High
- Medium
- Poor
- Planted
- DNG

PCT 53 | Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains

- Medium

PCT 249 | River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW

- Medium
- Regenerating
- DNG

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Source: EMM (2023); Evolution (2023); DFSI (2017); Nearmap (2021)

0 1 2 km

GDA 1994 MGA Zone 55

N

Austral Pillwort PCT associations and gilgai mapping

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Species Expert Report for Austral Pillwort (*Pilularia novae-hollandiae*)
Figure 1.1

1.4 Area Requiring Assessment by the Species Expert

This expert report covers the full extent of the BDAR study area. While 497.36 ha of the study area was surveyed by EMM, approximately 271.52 ha within Lake Cowal could not be surveyed due to inundation during 2021/2022. This unsurveyed area is depicted in Figure 1.2 and falls entirely in the vegetation zone medium condition PCT 53 - *Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains*.



KEY

- Subject land
- Additional disturbance area
- Existing and approved disturbance area
- Major road
- Broad gilgai area
- Associated vegetation communities
- Area unable to be surveyed

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Source: EMM (2023); Evolution (2023); DFSI (2017); Nearmap (2021)

0 1 2 km

GDA 1994 MGA Zone 55

N

Areas not surveyed by EMM due to inundation in 2021/2022

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Species Expert Report for Austral Pillwort (*Pilularia novae-hollandiae*)
Figure 1.2

1.5 Aims of the Expert Report

This expert report aims to:

- define suitable habitat for the Austral Pillwort based on a review of literature, previous records and local studies undertaken by the species expert;
- determine the likelihood of occurrence of the Austral Pillwort within unsurveyed areas of the study area; and
- identify an appropriate species polygon for the Austral Pillwort in areas of the study area where the species was recorded.

1.6 Expert Status of Species Expert

Dr Colin Bower has been approved by the DPE as a species expert for the Austral Pillwort in accordance with section 5.3 (Box 3) of the Biodiversity Assessment Method. This recognition applies exclusively to the Lake Cowal Open Cut Continuation project within the Bland Local Government Area. The approval letter is provided in Appendix A.

1.7 Identification of the Austral Pillwort

The Austral Pillwort is a small, grass-like perennial fern that grows in mud when seasonally dry depressions fill with water (Jones & Clemesha 1981, Harden 1990). The plant consists of a slender, creeping rhizome growing just below the surface, from which arise filiform bright green fronds about 8 cm long at intervals of about 1 cm. The sporocarps are spherical, buried in the substrate and borne singly at the end of short stalks or are sessile at the base of fronds. The fronds may be distinguished from other vegetatively similar plants by their twisted or flexuose bending. The growth cycle is completed before depressions dry out in summer.

Examples of the Austral Pillwort detected by EMM on the study area in 2022 are displayed in Photograph 1.1 and Photograph 1.2. Samples collected by the author and EMM (2023) were positively identified by the NSW herbarium as the Austral Pillwort.



Photograph 1.1 **Austral Pillwort specimen detected on the study area (photograph by EMM)**



Photograph 1.2 **Austral Pillwort growing out of a drying gilgai depression on the study area (photograph by EMM)**

1.8 Geographic Distribution

The Austral Pillwort is a widely, yet patchily, distributed species. In NSW, it has been recorded in Sydney, Khancoban, the Riverina region between Albury and Urana, Oolambeyan National Park and Lake Cowal (DPE 2022). Beyond NSW, it is also known from sites in Victoria, ACT, South Australia, Western Australia, and Tasmania.

Nearby Lake Cowal, Bower (1998) found the species at various sites in proximity to the western edge of the lake, however observations were also made across the wider area, including nearly 50 km to the north-east of the CGO. Recent surveys by EMM also located the species in large numbers approximately 16 km south-east of Lake Cowal and 25 km south-east of the CGO, as reported in EMM (2023).

Despite the paucity of records, these detections suggest the species is widespread around Lake Cowal and the broader central west region of NSW where suitable gilgai habitat occurs.

1.9 Habitat Associations of the Austral Pillwort

1.9.1 Habitat Across Australia

Across Australia, the Austral Pillwort has been detected most frequently in gilgai and other shallow depressions, although observations have also been made in other aquatic habitats.

According to 176 records of the species sourced from the Australian Virtual Herbarium database (AVH 2023), the species can also occur along the margins of waterbodies such as swamps, lagoons, dams, and rivers. While one record from Tasmania is attributed to Lake Leake, this lake is an artificially dammed reservoir in an area originally hosting a wetland or cluster of lagoons.

A complete breakdown of observations by habitat and state is provided in Table 1.1. Note, only records containing habitat or descriptions of locality were included.

Table 1.1 Austral Pillwort records by state and aquatic habitat type

State	Aquatic Habitat
NSW	• Gilgai/shallow depressions • Margins of rivers, swamps • Claypans • Roadside ditches, drains, pools
Victoria	• Gilgai/shallow depressions • Margins of rivers, swamps
ACT	• Shallow depressions • Pools within wet herbfield-heath
South Australia	• Shallow depressions • Margins of swamp, rivers, dams, lagoons • Roadside pools and depressions
Western Australia	• Shallow depressions • Claypans • Margins of swamps, rivers
Tasmania	• Shallow depressions • Margin of dams, rivers, lagoons, creeks • Margin of retreating lake/dam

1.9.2 Habitat Across NSW

Within DPE TBDC (2023), habitat for Austral Pillwort is defined as shallow swamps and waterways, often among grasses and sedges. It is most often recorded in drying mud as this is when it is most conspicuous. It also describes the species as probably ephemeral (especially in the drier parts of its range), appearing when soils are moistened by rain. A review of DPE BioNet Atlas (2023) records revealed little information on habitats where Austral Pillwort has been recorded outside Lake Cowal. For the two records where the aquatic habitat is described outside of Lake Cowal, both were in small depressions, partly submerged or with intermediate wetness. Only one references the adjacent vegetation, which mentions Grey Box vegetation with Eleocharis and Juncus dominant. One record refers to the geology, noting quaternary floodplains of black and red clayey silt, sand, and gravel. Threats identified that may pertain to the Lake Cowal population, and hence impact the habitat suitability for Austral Pillwort, include drainage of swamps, difficulty surveying due to seasonal constraints, and Rye grass and other grasses outcompeting the species and stock, possibly threatening gilgai habitat, particularly in wet periods (DPE 2022).

1.9.3 Habitat at Lake Cowal

The Austral Pillwort has been previously recorded by Clements and Rodd (1995) and Bower (1998) across the Lake Cowal region. In these studies, the Austral Pillwort was only observed within gilgais and shallow depressions on grey, cracking soils. This is despite efforts to locate the species in more diverse habitats, including the margins of swamps, creeks, and Lake Cowal itself.

In 1994, Clements and Rodd (1995) recorded the Austral Pillwort within the current CGO footprint and nearby at Bland Creek, approximately 13 km to the southeast of the CGO. At both sites, the species was observed in gilgai containing standing or recently receded water. These records of Austral Pillwort were the first for Lake Cowal and more broadly the South Western Slopes IBRA subregion.

Bower (1998), the author of this report, undertook a targeted survey for the Austral Pillwort to determine the distribution and abundance of this species to be disturbed by the initial Cowal Gold Project. Those surveys documented habitat where Austral Pillwort was found within and nearby the current CGO footprint, including seven more distant locations between Girral and Condobolin. These surveys represent the most detailed account of habitat for the Austral Pillwort, prior to the EMM (2023) study.

Despite surveying a range of aquatic habitats at Lake Cowal, which included gilgais, swamp margins, and Lake Cowal foreshore, Bower (1998) only found Austral Pillwort in gilgai depressions, with most records occurring in gilgai nearby the lake. During these surveys, the Austral Pillwort was detected in 52 out of 95 (54.7%) depressions within the CGO footprint, 44 out of 113 depressions (25.7%) outside the initial Cowal Gold project area, and at 1 out of 7 (14%) of sites between Girral and Condobolin. At no point was the Austral Pillwort detected along the Lake Cowal foreshore.

Bower (1998) attempted to further characterise the microhabitat where the Austral Pillwort was found by recording depression sizes and moisture level where the species was detected. Bower (1998) concluded that Austral Pillwort was found in depressions of all sizes and moisture levels. Further, it was found not to grow in the most heavily vegetated depressions, seeming to prefer relatively open areas among sparse rushes or bare ground where there was high light penetration, particularly around the outer margins of depressions. It was also observed that the Austral Pillwort grew most commonly in deep sticky grey mud and was absent from gilgai with friable or stony soils.

Since detection of the Austral Pillwort at Lake Cowal by Bower (1998), DnA Environmental has attempted to monitor retained populations within gilgai nearby CGO. However, annual surveys conducted since 2006 have failed to locate Austral Pillwort in the Lake Cowal area despite extensive and targeted searches (DnA Environmental 2022). Reduced populations of Austral Pillwort were attributed to high densities of ground cover, which compete with Austral Pillwort, and inappropriate rainfall activity prior to surveys.

2 Methods

2.1 Targeted Surveys

2.1.1 Broader Lake Cowal Vicinity

To understand the spatial extent of Austral Pillwort populations across the Lake Cowal area, broad-scale surveys for this species were undertaken by EMM and DnA Environmental across Evolution's broader land-holdings, as well as other accessible land (i.e. crown-land, road reserves, and a nearby biodiversity stewardship site). The primary aim of these broader surveys was to inform the assessment of the potential for a Serious and Irreversible Impact (SAII) impact on the species, as it is considered an SAII species in the DPE TBDC (2023).

Broad-scale surveys were undertaken across December 2022 and January 2023. In total, 11 days of survey were undertaken by EMM and DnA Environmental. The effort and extent of these surveys is displayed in Figure 2.1. Various samples of Austral Pillwort collected by EMM throughout both the Broader Lake Cowal Vicinity and BDAR Study Area had their identity confirmed by the NSW Royal Botanic Gardens herbarium in Sydney.



KEY

- Subject land
- Additional disturbance area
- Existing and approved disturbance area
- Major road
- Broad gilgai area
- Austral Pillwort survey tracks

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Source: EMM (2023); Evolution (2023); DFSI (2017)

0 2.5 5 km

GDA 1994 MGA Zone 55

N

EMM and DnA Environmental survey effort for the Austral Pillwort across the broader Lake Cowal area

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Species Expert Report for Austral Pillwort (*Pilularia novae-hollandiae*)
Figure 2.1

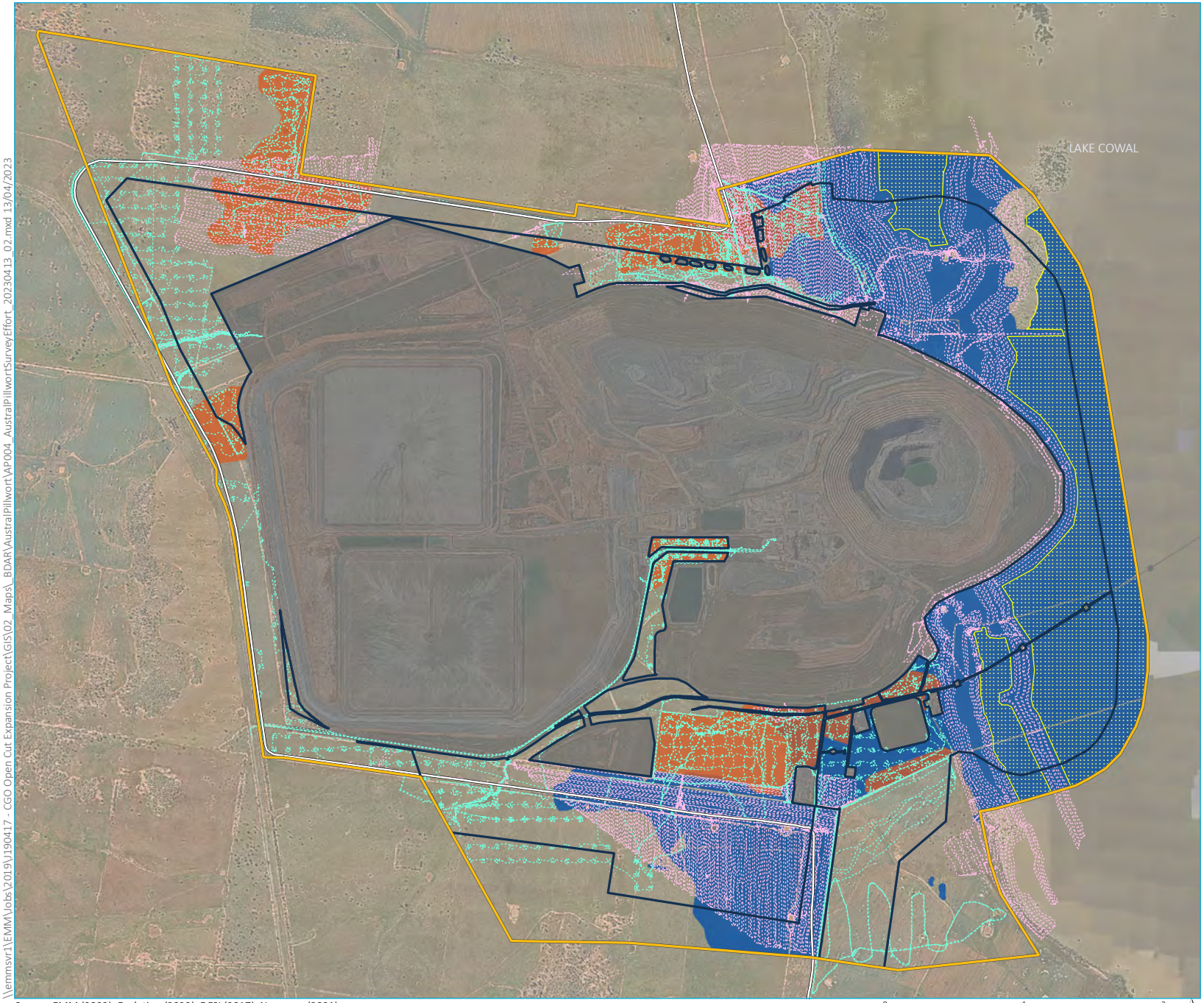
2.1.2 BDAR Study Area

EMM undertook five survey campaigns for the Austral Pillwort to inform assessment of the species within the BDAR. These targeted surveys were undertaken during November 2020, December 2020, November 2022, December 2022, and January 2023 in accordance with DPIE (2020). These surveys were within the recommended survey window identified by the DPE TBDC (2023). The only exception was January 2023, however DPE provided formal support to undertake survey for the Austral Pillwort during this month due to extensive rainfall (and hence extent of inundation) prior to and during that spring/summer period.

Surveys conducted by EMM were directed towards PCTs associated with the species (i.e. PCTs 26, 53, and 249). Rather than pertaining exclusively to these potentially associated PCTs, however, survey was also directed towards vegetation zones containing potential gilgai habitat; particularly throughout PCT 55. In addition to surveying gilgais, EMM also directed survey effort to sample any other shallow, ephemeral habitat within the Study Area including drainage lines and the margins of streams and dams.

In 2022, when Austral Pillwort was detectable, EMM undertook three survey campaigns across November, December, and January in order to encompass a range of hydrological conditions within the study area. Conducted across a full wetting-drying cycle, surveys sought to capture a representative sample of depressions at varying levels of inundation. For example, surveys in November 2022 were the earliest Austral Pillwort could be surveyed for as per the TBDC, when heavy rainfall over winter and spring led to filling of even the most shallow depressions. Surveys in December 2022 aimed to capture the period when most shallow gilgias had begun drying out, whilst deeper gilgais were still holding considerable water. Finally, the January 2023 survey was primarily undertaken to detect the Austral Pillwort in deeper depressions as water levels receded. Nevertheless, Austral Pillwort was still identifiable in the January 2023 period in shallower depressions, even though they were starting to yellow off (due to drying out).

These targeted surveys were representative of 497.36 ha of the study area. However, approximately 271.52 ha within Lake Cowal could not be surveyed due to inundation during 2021/2022. This unsurveyed area falls exclusively in the vegetation zone PCT 53 - *Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains* in medium condition (Figure 2.2).



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Source: EMM (2023); Evolution (2023); DFSI (2017); Nearmap (2021)

EMM survey effort for the Austral Pillwort within the study area

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Species Expert Report for Austral Pillwort (*Pilularia novae-hollandiae*)
Figure 2.2

2.1.3 Microhabitat Study

The adjacent vegetation community was recorded where all records of Austral Pillwort were made by EMM, including the tree species nearest to the Austral Pillwort record. To better define microhabitat requirements of Austral Pillwort in the study area, so that a species polygon could be accurately defined, EMM also undertook observations of microhabitats across a subset of 335 gilgais, including those where the Austral Pillwort was found. Data collected during those surveys included gilgai size, water fullness and estimates of the proportion of cover by grasses and sedges within each microhabitat surveyed.

2.2 Habitat Matching

To assess the likelihood of the species occurring in unsurveyed areas of Lake Cowal (i.e. PCT 53 medium condition zone), the character of this habitat was compared to known habitat that the Austral Pillwort associates with at Lake Cowal. Based on the habitat description for Austral Pillwort at Lake Cowal, as provided in Section 1.9.3, suitable habitat was considered:

- gilgais on the ridge above the lake shore;
- relatively open areas among sparse rushes or bare ground where there was high light penetration;
- depressions with a low density of introduced grasses (which appeared to exclude Austral Pillwort); and
- depressions consisting of deep sticky grey mud (excluding gilgai with friable or stony soils).

Additional observations made during the EMM (2023) surveys regarding associated vegetation communities were also used to inform the assessment of the likelihood of Austral Pillwort occurring within the unsurveyed extent of Lake Cowal. Based on observations by EMM (2023), it was considered that vegetation communities with an overstorey cover of Weeping Myall or Belah, or open paddocks nearby Weeping Myall or Belah woodlands where grass and sedge cover, particularly exotic species, is low, may provide suitable habitat for the Austral Pillwort (see Section 3).

2.3 Species Polygon

Based on the known habitat associations described above (Section 2.2), and the lack of Austral Pillwort observed in areas lacking these habitat characteristics (DnA Environmental 2006-2021; EMM 2023), it is considered that not all gilgais in the study area represent suitable habitat for Austral Pillwort (see Section 3.2). As Austral Pillwort is an area-based species per the DPE TBDC (2023), EMM (2023) attempted to refine the area for allocating the species polygon. However, the features important for predicting the occurrence of this species vary at such fine spatial scales that they cannot be mapped with confidence. That is, based on my observations (Bower 1998) and those by EMM (2023), the Austral Pillwort appears to respond to fine-scale spatiotemporal variation in hydrology, soils, and competition by grasses/sedges. As such, it is considered that the most pragmatic way to map the species polygon for Austral Pillwort should be based on where it actually occurs, given the comprehensive survey effort across the study area. Hence, a 30 m buffer was applied around the outside of these records following the approach recommended in section 5.2.5 of the BAM for count-based species.

3 Results and discussion

3.1 Targeted Surveys

3.1.1 Broader Lake Cowal Vicinity

Surveys by EMM and DnA Environmental detected the Austral Pillwort in 28 locations across the broader Lake Cowal area. Twelve of these occurred within 5–10 km of the CGO site, with six occurring to the north and six to the south. Interestingly, the species was also detected in 12 locations on a property approximately 16 km to the southeast of the CGO site. Locations of these records are displayed in Figure 3.1.

As with Bower (1998), no Austral Pillwort was detected along the Lake Cowal foreshore or within PCT 249 by EMM. Most records of Austral Pillwort detected by EMM and DnA Environmental in EMM (2023) were located adjacent to, but inland from the Lake Cowal foreshore, which is also consistent with Bower (1998). Nevertheless, it does not appear that Lake Cowal itself has any association with Austral Pillwort since this species was found in gilgai habitat 16 km away from Lake Cowal. Hence, it appears that this specie associates with alluvial plains, regardless of whether they are adjacent to a lake or not. This is corroborated by observations of Austral Pillwort in many areas across Australia in small ephemeral waterbodies, rather than associating with waterbodies such as lakes (see Table 1.1).



KEY

- Subject land
- Additional disturbance area
- Existing and approved disturbance area
- Major road
- Austral Pillwort record

\\emnsvr1\EMM\Jobs\2019\1190417 - CGO Open Cut Expansion Project\GIS\02_Maps_BDAR\AustralPillwort\AP005_AustralPillwortRecordsBroaderLakeCowal_20230413_02.mxd 13/04/2023

Source: EMM (2023); Evolution (2023); DFSI (2017)

0 2.5 5 km

GDA 1994 MGA Zone 55

N

Austral Pillwort records across the broader Lake Cowal survey area

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Species Expert Report for Austral Pillwort (*Pilularia novae-hollandiae*)
Figure 3.1

3.1.2 BDAR Study Area

EMM recorded Austral Pillwort 15 locations across the study area in 2022 and 2023. Whilst most records were concentrated within a small area to the north of the mine, a single detection was made in a paddock to the south. Locations of these records are displayed in Figure 3.2.



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Source: EMM (2023); Evolution (2023); DFSI (2017); Nearmap (2021)

Austral pillwort records within the OPC study area

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Species Expert Report for Austral Pillwort (*Pilularia novae-hollandiae*)
Figure 3.2

3.1.3 Microhabitat Study

Vegetation type was a good predictor of where Austral Pillwort may occur, with all Austral Pillwort recorded within Belah and Weeping Myall woodland containing gilgais with a grey cracking clay substrate, or within ephemeral depressions where these woodlands would have once occurred. However, not all gilgais in these vegetation communities offer suitable habitat for Austral Pillwort. As with Bower (1998), EMM (2023) observed that grass cover and availability of free mud also appeared to be important in determining fine-scale variation in distribution of the species. Such factors may vary spatially on scales of metres or less. Due to this fine-scale variance in the hydrology and availability of suitable mud substrate for Austral Pillwort through space and time, it is considered not possible to accurately map these factors across the study area to generate a suitable species polygon.

Patterns of microhabitat factors that appear to influence Austral Pillwort distribution, as observed by EMM (2023) are presented below, and include vegetation associations, hydrology, geology, and grass/sedge cover. Microhabitat where Austral Pillwort was found during EMM (2023) surveys are presented in Appendix B.

i Vegetation Associations

Across all targeted surveys for Austral Pillwort, most individuals were found near or surrounded by Belah (*Casuarina cristata*) associated with PCT 55 (88.37%). Although, some Austral Pillwort were detected adjacent to planted Weeping Myall (*Acacia pendula*) and Grey Box (*Eucalyptus macrocarpa*). There were also two records of Austral Pillwort in depressions in paddocks cleared of mature trees, presumably where Belah and/or Weeping Myall once occurred.

Vegetation communities this species has been found to associate with are largely unreported during previous studies, including Bower (1998).

Vegetation located adjacent to Austral Pillwort records is displayed in Table 3.1.

Table 3.1 Austral Pillwort records by vegetation community

Nearby Vegetation	Number of Records	Percentage of records
Belah (*Casuarina cristata*)	38	88.37%
Weeping Myall (*Acacia pendula*) and Grey Box (*Eucalyptus microcarpa*), (planted tubestock, 2003)	3	6.98%
Open Paddock	2	4.65%

ii Hydrology and Geology

On all occasions within the BDAR study area and broader Lake Cowal vicinity, the Austral Pillwort was observed in shallow or recently dried out depressions (i.e. typically 10–20 cm deep when the depression is full). This was despite surveys covering inundated areas along the margins of streams, the Lake Cowal foreshore, and a wide range of gilgais with varying hydrological characteristics (i.e. shapes, sizes, depth and volume). For instance, of 335 gilgais where their hydrological nature was recorded in the study area, ranging from less than 1 cm to over >1 m deep and 2 to 20 m wide when full, the Austral Pillwort was observed to strictly occur in shallow gilgais that were typically 10–20 cm deep when full and appeared to be capable of holding standing water for several weeks. In no case was Austral Pillwort located where there was flowing water. Association of Austral Pillwort with shallow ephemeral depressions with standing water were also observed by Bower (1998), although water depths were not noted in that study.

The geology of substrate was also consistent across the depressions where Austral Pillwort was found. That is, in all cases where EMM (2023) recorded Austral Pillwort, grey cracking clays were present. This is consistent with Bower (1998), who found it also grew most commonly in deep sticky grey mud when detected in 1998.

An example of suitable shallow depression with grey clays where the Austral Pillwort was detected by EMM (2023) is shown in Photograph 3.1.



Photograph 3.1 Shallow depression surrounded by Belah (*Casuarina cristata*) hosting a population of Austral Pillwort (photograph by EMM)

Such observations of Austral Pillwort associating with shallow ephemeral depressions is supported by Daoud-Bouattour et al (2014), who showed that *Pilularia minuta*, a closely-related Pilularia species from the Mediterranean region, grows optimally in pools with a maximum water depth between 5–10 cm. Their studies also highlighted the importance of sustained inundation, demonstrating that *P. minuta* required inundation for at least 2, and ideally 7, weeks to reach maximum population development.

While comparable data to Daoud-Bouattour et al (2014) is not available for the Austral Pillwort, similar hydrological requirements of the Austral Pillwort may explain this species ephemerality. That is, the Austral Pillwort may only express vegetatively in years where winter and spring rainfall is sufficient to provide suitable hydrological conditions for the species across gilgais and shallow depressions. This may also explain the difficulty of DnA Environmental failing to detect the Austral Pillwort at Lake Cowal from 2006 to 2021 despite extensive search efforts.

iii Grass/sedge and debris cover

During surveys by EMM (2023), the Austral Pillwort was primarily found in ephemeral depressions with a low cover of grasses and sedges, including introduced grasses. That is, an area of free mud was available where most of the Austral Pillwort recorded by EMM (2023). Typically, this was toward the edge of the depression where it was not smothered by grasses/sedges or vegetative debris. In many cases, the Austral Pillwort was recorded were located immediately adjacent or nearby to Belah or Weeping Myall, where shading from the tree canopy appeared to have reduced encroachment by grasses and sedges. However, EMM (2023) also observed Austral Pillwort in shallow depressions with low grass/sedge cover in paddocks. Hence, it appears that competition by grasses and sedges could limit the availability of free space for Austral Pillwort and may restrict its distribution.

Examples of suitable shallow depressions with substantial free water/mud and a low cover of grasses are displayed in Photograph 3.2 and Photograph 3.3. Austral Pillwort was detected by EMM in each of these depressions.



Photograph 3.2 **Shallow depression where Austral Pillwort was detected by EMM. Note the free water/mud and low cover of introduced grasses (photograph by EMM)**



Photograph 3.3 **Dry, shallow depressions with a low cover of sedges/grasses. Austral Pillwort was detected in a desiccated state here in January 2023 (photograph by EMM)**

3.2 Habitat Matching

It is in my expert opinion that the Austral Pillwort is unlikely to occur within Lake Cowal for the following reasons:

- The Austral Pillwort has never been detected within Lake Cowal despite survey efforts occurring during suitable years when the species was widely detectable (i.e. Clements and Rodd 1995; Bower 1998; EMM 2023).
- Gilgai and shallow depressions do not typically occur within the footprint of the lake. The species is only known to occur within such depressions nearby Lake Cowal, and the majority of records across Australia have been made within these shallow ephemeral microhabitats and not large lakes.
- The lake is unlikely to provide the appropriate hydrological conditions for the Austral Pillwort. The species appears to require a specific water depth to persist, as well as appropriately timed wetting and drying cycles. Lake Cowal inundates to a depth of up to 2.5 m and stays full for up to three years, which is too great a water depth for too long to support the species based on the shallow ephemeral habitat in which it has been historically observed.
- PCT 53 on the study area lacks woodland that the Austral Pillwort is known to associate with. While there are sparse mature River Red Gums (*Eucalyptus camaldulensis*) present, the Austral Pillwort has not been recorded associating with River Red Gum.

3.3 Species Polygon

The species polygon for the Austral Pillwort in the study area is shown in Figure 3.3. The species polygon for the Austral Pillwort within the wider Lake Cowal vicinity is shown in Figure 3.4.



KEY

- Subject land
- Additional disturbance area
- Existing and approved disturbance area
- Major road
- Austral Pillwort species polygon

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Source: EMM (2023); Evolution (2023); DFSI (2017); Nearmap (2021)

0 1 2 km

GDA 1994 MGA Zone 55

N

Austral Pillwort species polygon

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Species Expert Report for Austral Pillwort
(*Pilularia novae-hollandiae*)
Figure 3.3



KEY

- Subject land
- Additional disturbance area
- Existing and approved disturbance area
- Major road
- Austral Pillwort species polygon

\\emnsvr1\EMM\Jobs\2019\1190417 - CGO Open Cut Expansion Project\GIS\02_Maps_BDAR\AustralPillwort\AP008_AustralPillwortSpeciesPolygonBroaderLakeCowal_20230413_02.mxd 13/04/2023

Source: EMM (2023); Evolution (2023); DFSI (2017); Nearmap (2021)

0 2.5 5 km

GDA 1994 MGA Zone 55

N

Species Polygon for the Austral Pillwort across the broader Lake Cowal vicinity

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Species Expert Report for Austral Pillwort (*Pilularia novae-hollandiae*)
Figure 3.4

4 Conclusions and Recommendations

4.1 Suitability of Unsurveyed Areas for the Austral Pillwort

It is my opinion that the Austral Pillwort is unlikely to occur within currently inundated, unsurveyed areas of Lake Cowal. Based on my understanding of the habitat this species occupies, it is considered unlikely that the lake provides suitable habitat for this species. This is supported by failure to detect this species within Lake Cowal despite extensive prior surveys, including years when the species was detectable (i.e. Clements and Rodd 1995; Bower 1998; EMM 2023).

Accordingly, in this case, I consider there no requirement for a species polygon for the Austral Pillwort within the unsurveyed extent of Lake Cowal.

4.2 Species Polygon for the Austral Pillwort

For areas where the Austral Pillwort has been detected during recent surveys by EMM, I endorse the preparation of a species polygon based on locations where the species was recorded by EMM (2023). This polygon consists of a 30 m buffer around these locations.

Signed:



Dr Colin Bower

27 February 2023

References

AVH 2023a, *Occurrence records – Pilularia novae-hollandiae*, Australian Virtual Herbarium, accessed 1 February 2023, https://avh.ala.org.au/occurrences/search?q=taxa%3A%22austral+pillwort%22#tab_mapView

Bower C 1998, *Survey of the Cowal Project Area and surrounds for the Austral Pillwort (Pilularia novae-hollandiae),* report prepared by Orchid Research for North Limited.

Clements A & Rodd, A 1995*, Terrestrial Flora Report: Lake Cowal District. Appendix F, Lake Cowal Gold Project Environmental Impact Statement*, NSR Environmental Consultants, Hawthorn.

Daoud-Bouattour A, Bottollier-Curtet M, Jamaa H.F.B., Ghrabi-Gammar Z, Saad-Limam S.B., Rhazi L & Muller, SD, 2014, Effects of hydrology on recruitment of Pilularia minuta Durieu (Marsileaceae), an endangered plant of Mediterranean temporary pools, *Aquatic botany* 112, pp.76-83.

DPIE 2020a, *Biodiversity Assessment Method*, Department of Planning, Industry and Environment.

DPE 2022, *Austral Pillwort – profile*, Department of Planning and Environment, accessed 10 December 2022, https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10628#:~:text=Austral%20Pillwort%20is%20a%20semiaquatic%20fern%2C%20resembling%20a,pills%20that%20form%20at%20the%20base%20of%20fronds.

DPE Bionet Atlas 2023, *Species sightings search*, Department of Planning and Environment, accessed 4 Feb 2023, https://www.environment.nsw.gov.au/atlaspublicapp/UI_Modules/ATLAS_/AtlasSearch.aspx?who=f79a4868-ab11-446b-a618-fb4012d9f84e

DPE TBDC 2023, *BioNet Threatened Biodiversity Database Collection – Ecological data: Austral Pillwort*, Department of Planning and Environment, accessed 4 Feb 2023, https://www.environment.nsw.gov.au/AtlasApp/UI_Modules/TSM_/ProfileEdit.aspx?pId=10628&pType=SpeciesCode

DnA Environmental 2022, *2021 Austral Pillwort Survey*, report prepared for Evolution Mining (Cowal) Pty Ltd.

EMM 2023, *Cowal Gold Operations Open Cut Continuation Project Biodiversity Development Assessment Report*, prepared for Evolution Mining (Cowal) Pty Limited.

Harden G (Ed.) 1990, *Flora of New South Wales*, Vol. 1, University of NSW Press, Sydney.

Jones D & Clemesha, S 1981, *Australian Ferns and Fern Allies (revised edition),* Reed Books, Frenchs Forest, NSW

Appendix A

Dr Colin Bower – Approval Letter as Expert for the Austral Pillwort (*Pilularia novae-hollandiae*)

Department of Planning and Environment

Dr Colin Bower
37 Kent Avenue
Orange NSW 2800
colinbower1948@bigpond.com

Our ref: DOC22/1099847
Sender's ref: BE 22 11

13 December 2022

Dear Dr Bower

Approval as an expert for Austral Pillwort (*Pilularia novae-hollandiae*)

Thank you for your application dated 14 November 2022 to the Biodiversity Conservation Division (BCD) of the Department of Planning and Environment.

BCD has reviewed the information provided in support of this request and is satisfied that you meet the definition of a species expert for Austral Pillwort (*Pilularia novae-hollandiae*) in accordance with section 5.3 (Box 3) of the Biodiversity Assessment Method.

Please note that this formal recognition of you as an expert only applies to the Lake Cowal Open Pit Continuation project within the Bland Local Government Area.

If you require any further information regarding this matter, please contact Andrew Fisher, Senior Team Leader Planning, via rog.southwest@environment.nsw.gov.au or 02 6022 6023.

Yours sincerely



Adam Vey
Director
South West Branch
Biodiversity and Conservation Division
Department of Planning and Environment

Appendix B

Austral Pillwort Habitat Photos

B.1 Warrakimbo Biodiversity Stewardship Site (16 km Southeast of Cowal Gold Mine)

B.1.1 Site 1



B.1.2 Site 2



B.1.3 Site 3



B.1.4 Site 4



B.1.5 Site 5



B.1.6 Site 6



B.1.7 Site 7



B.1.8 Site 8



B.2 Travelling Stock Route North (9 km North of the Cowal Gold Mine)

B.2.1 Site 1



B.3 DnA Environmental Records – North and South of Cowal Gold Mine

B.3.1 Site 1



B.3.2 Site 2



B.3.3 Site 3



B.3.4 Site 4



B.3.5 Site 5



B.3.6 Site 6



B.4 OPC Study Area – North

B.4.1 Site 1



B.4.2 Site 2



B.4.3 Site 3



B.4.4 Site 4



B.4.5 Site 5



B.4.6 Site 6



B.4.7 Site 7



B.4.8 Site 8



B.5 OPC Study Area – South



Cover Letter

To whom it may concern,

The views and conclusions presented within this expert report, regarding the likelihood for *Eleocharis obicis* to occur in habitats that could not be surveyed for the Lake Cowal Gold Mine Continuation Project, are my own.

Under my guidance, this expert report was prepared with the assistance of EMM during the initial drafting phase and preparation of figures.

Sincerely,



Neville Walsh

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1 Introduction

1.1 Project Background

Evolution Mining (Cowal) Pty Limited (Evolution) is the owner and operator of Cowal Gold Operations (CGO), an existing open pit and underground gold mine approximately 38 kilometres (km) north-east of West Wyalong, NSW. CGO is located on the traditional lands of the Wiradjuri People and is immediately adjacent to the western foreshore of Lake Cowal, which is an ephemeral waterbody and the largest inland lake in NSW.

Evolution is seeking approval for further open pit mining operations at CGO through the Open Pit Continuation (OPC) Project, which will involve further development of the existing E42 Pit and the development of open pit mining in three new and adjacent orebodies.

In pursuit of approval for the Project, Evolution engaged EMM Consulting to prepare a Biodiversity Development Assessment Report (BDAR). In accordance with the Biodiversity Assessment Method (BAM; DPIE 2020), EMM undertook a candidate species assessment to determine the likely presence of threatened species within the study area. Due to the presence of several associated vegetation communities, *Eleocharis obicis* was identified as a species requiring further assessment.

1.2 Need for Expert Report

In accordance with Section 5.2.4(b) of the BAM, targeted surveys for *Eleocharis obicis* were undertaken by EMM within the study area (the area where ecological surveys were focused) throughout 2020. However, due to heavy rainfall through 2021 and 2022, associated with a La Nina Southern Oscillation Cycle, areas of associated PCTs within Lake Cowal could not be surveyed in their entirety. Subsequent surveys allowed for completion of surveys outside of Lake Cowal. However, in accordance with Section 5.2.4(c) of BAM (DPIE 2020), an expert report is required to determine if the *Eleocharis obicis* is likely to be present within the unsurveyed extent of Lake Cowal.

In addition to areas within Lake Cowal, this expert report also assesses the likelihood of *Eleocharis obicis* occurring within the highly disturbed, cropped areas of the study area that were not surveyed by EMM.

1.3 Study Area Characteristics

The Study area is approximately 3,441.91 hectares (ha) in size, with 1,030.68 ha expected to be directly impacted by the project (referred to as the additional disturbance footprint). Within the additional disturbance footprint, approximately 928.6 ha has been mapped by EMM as native vegetation, although much of this vegetation has been highly disturbed due to historical grazing.

According to information held in the Department of Planning and Environment's (DPE) Threatened Biodiversity Database Collection (hereafter DPE TBDC 2023), *Eleocharis obicis* may be associated with three of eight PCTs present on site, which include:

- PCT 17 – Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion).
- PCT 53 – Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains.
- PCT 244 – Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)

A map of the site showing PCT's considered by DPE to be associated with *Eleocharis obicis* is displayed in Figure 1.1.



KEY

- Study area
- Additional disturbance area
- Existing and approved disturbance area
- Major road
- Broad gilgai area

Associated vegetation communities

PCT 17 - Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)

- Medium

PCT 53 | Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains

- Medium

PCT 244 | Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate climate zone of central NSW

- Medium
- Poor
- DNG

PCTs considered to be associated with the *Eleocharis obicis* (per DPE TBDC 2023)

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Species expert report for *Eleocharis obicis*
Figure 1.1

\\emmsvr1\EMM\Jobs\2019\I190417 - CGO Open Cut Expansion Project\GIS\02_Maps_BDAR\EleocharisObicis\EO001_EleocharisObicisSurveys_20230512_01.mxd 12/05/2023

Source: EMM (2023); Evolution (2023); DFSI (2017); Nearmap (2021)

0 1 2 km

GDA 1994 MGA Zone 55

N

EMM creating opportunities

1.4 Aims of the Expert Report

This expert report aims to:

- define suitable habitat for the *Eleocharis obicis* based on a literature review and analysis of previous records;
- identify areas within the study area (if any) which might be considered potential habitat for the species; and
- determine the likelihood of occurrence of the *Eleocharis obicis* within non-surveyed areas of the Study area.

1.5 Expert Status of Species Expert

I, Neville Walsh, have been approved by the NSW Department of Planning and Environment as a species expert for *Eleocharis obicis* in accordance with Section 5.3 (Box 3) of the Biodiversity Assessment Method. This recognition applies exclusively to the Lake Cowal Open Cut Continuation project within the Bland Local Government Area. The approval letter is provided in Appendix A.

1.6 Identification of Eleocharis obicis

Eleocharis obicis is a leafless, tufted or very shortly rhizomatous sedge to c. 50 cm high. Stems (culms) are cylindrical, longitudinally lined by the 6–8 pale nerves, rather soft-textured and c. 1 mm diam. The basal sheaths are membranous, to c. 5 cm long and terminate in an oblique orifice with a terminal point of c. 90 degrees. The inflorescence is terminal, cylindrical, c. 2–3 cm long and c. 2.5 mm diameter, consisting of c. 15–30 overlapping scales (glumes), rounded at their apices and each c. 4-5 mm long and 2 mm wide, with a fairly prominent green to straw-coloured midrib and broad membranous margins that are usually tinged red-brown. Glumes cover a single flower with 2–7 unequal bristles at the base that are up half as long as the mature nut. There are 3 stamens and the style is shortly 3-branched. The nut is obovoid, c. 1.5 mm long, 1.2 mm wide, with 3 angles (the dorsal one broader than the laterals), narrowed to a distinct neck, pale yellow to dark brown, shallowly pitted with approximately hexagonal cells in longitudinal rows (15–20 rows on the broader face of the nut). The conical style-base is about one-third as long as and one-third as wide as nut. Flowering occurs spring–summer (Johnson & Evans 1968; PlantNet 2023; VicFlora 2023).

While generally described as a perennial, there appear to be no perennating organs (e.g. a substantial persistent rhizome, or tubers, as in some species of *Eleocharis* ('Water Chestnuts' are the tubers of *E. dulcis*)). Its overall structure and, particularly its habitat (see below), rather indicate that the species is more likely an annual, or in instances where the habitat remains wet for extended periods, a short-lived perennial (pers. obs.; Stables 2023, see Section 1.8 for discussion of habitat associations).

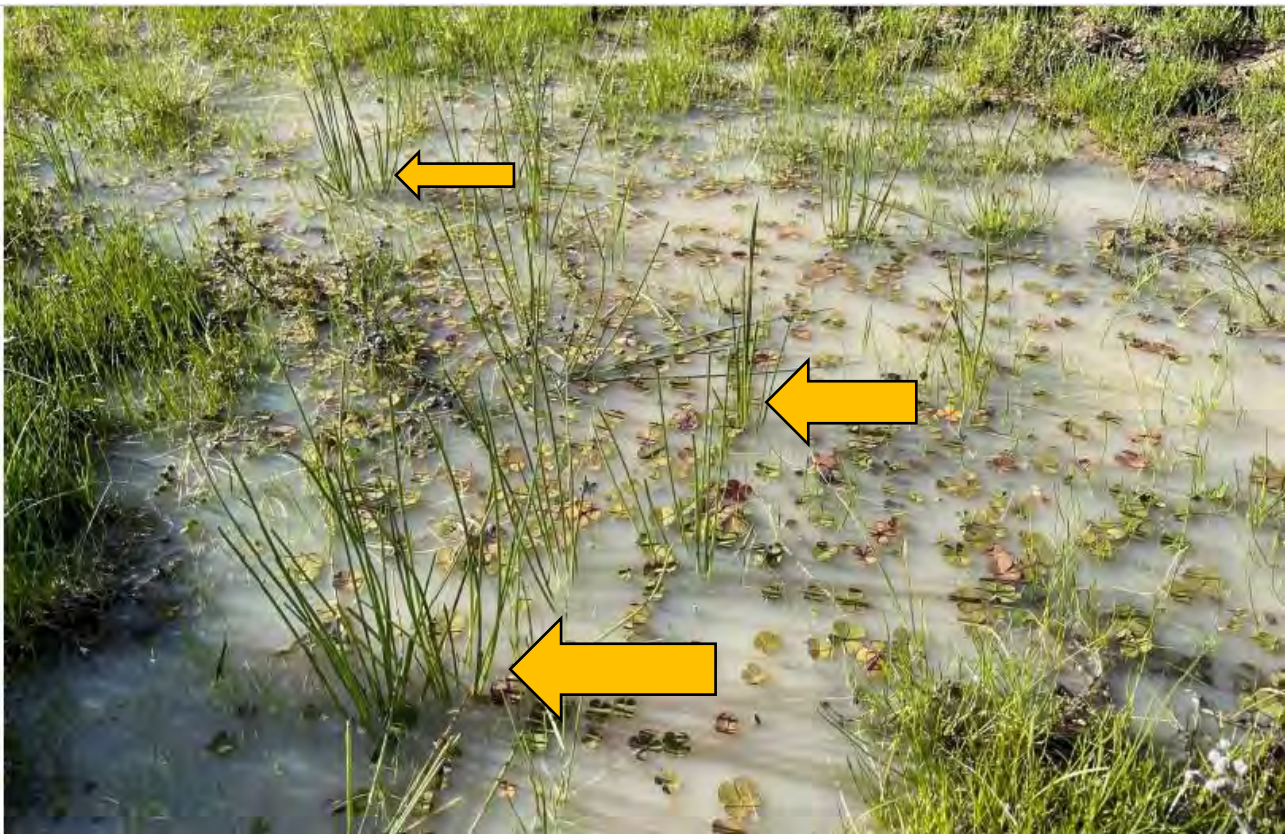


Figure 1.1 *Eleocharis obicis* growing in a shallow inundated gilgai, Moulamein area; arrows indicate selected plants (Photo M. Stables). Arrows indicate *E. obicis* individuals.



Figure 1.2 Pointed apex of leaf sheath of *Eleocharis obicis* (Photo M. Stables)

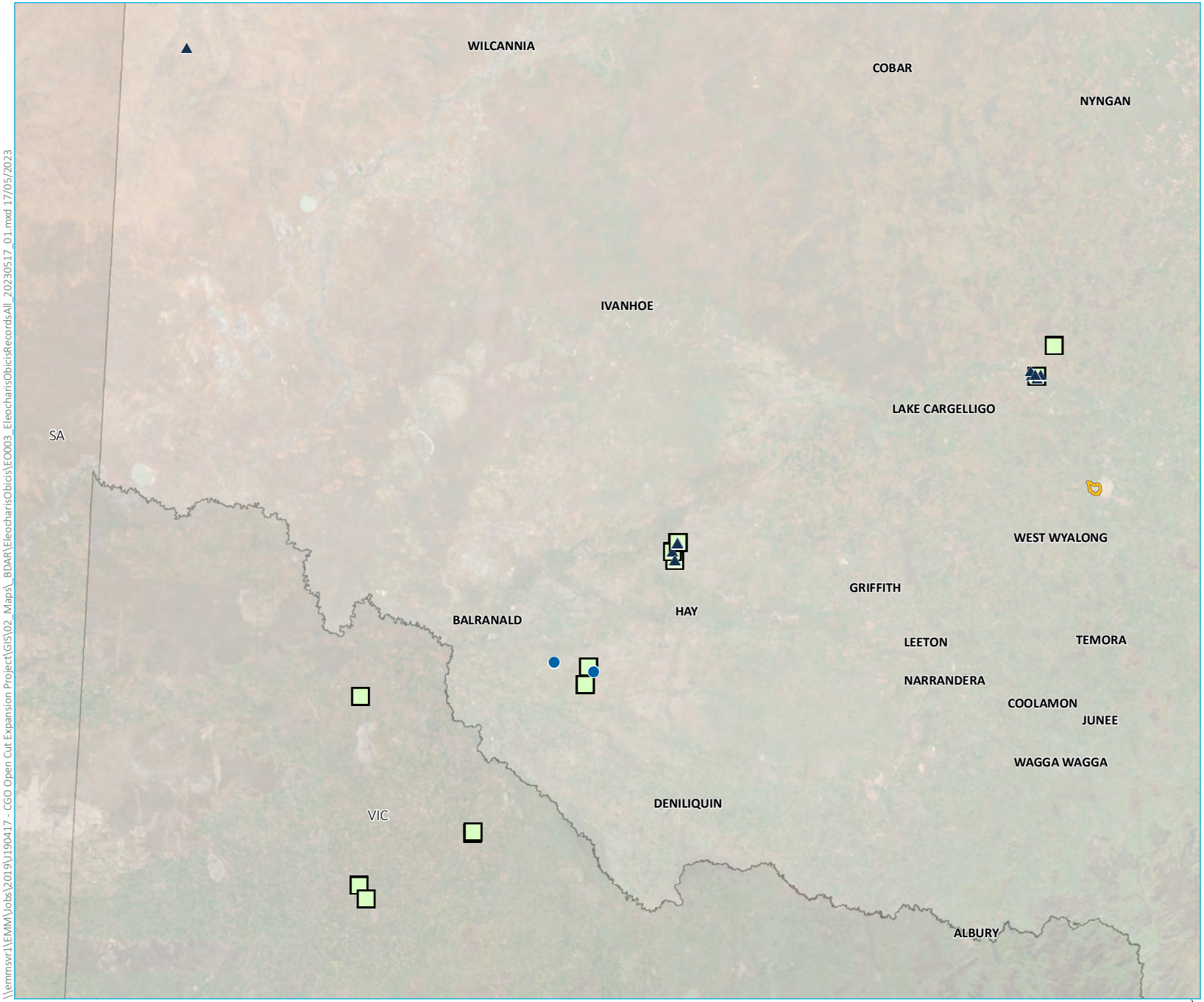


Figure 1.3 Inflorescences of *Eleocharis obicis* (photo Karen L Wilson ©The Royal Botanic Gardens & Domain Trust)

1.7 Geographic Distribution

With only about 15 locality records of the species known, it appears to be a species of very restricted distribution, albeit sometimes locally common – a study in the Moulamein area detected an estimated 500-1000 plants in a few gilgai systems near Moulamein (Stables 2023). *Eleocharis obicis* is currently known from a narrow band between Condobolin area in New South Wales south-west to Wycheproof area in Victoria. The nearest known occurrence of *Eleocharis obicis* to Lake Cowal is between Condobolin and Kiacatoo, some 75 km to the north-west.

The type collection (1885) was described as being from the 'Barrier Range' which is conventionally interpreted as near Broken Hill, well beyond the current known distribution. The collector of the type, Edwin Ramsay, made only one other plant collection labelled 'Barrier Range', but there is no record of him having visited the Broken Hill area. It appears likely that Ramsay's 'Barrier Range' was nearer Cobar or Dubbo – there exist numerous plant collections made by him in that general area (AVH 2023) and the environmental conditions there are more similar to those of the currently known range of *E. obicis*. The Australian Virtual Herbarium (AVH 2023) records 29 herbarium collections of *E. obicis*, representing 17 individual collections (12 of these records are of duplicates held in more than one herbarium). Of these, at least four collections are from essentially the same locality (within c. 2 km of each other). Some earlier collections have only very vague locality information so cannot be accurately located. A further four sites are known from the Moulamein area (within the known range), but currently not represented by herbarium specimens (M. Stables 2023).



KEY

- Study area
- *Eleocharis obicis* record
- AVH
- BioNet
- M. Stables (2022)

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Source: EMM (2023); ESRI (2023); AVH (2023); DPE (2023)

0 50 100 km

GDA 1994 Geoscience Australia Lambert

N

Records of *Eleocharis obicis* from the Australian Virtual Herbarium (AVH 2023) and NSW BioNet (DPE TBDC 2023)

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Species expert report for *Eleocharis obicis*
Figure 1.4

1.8 Habitat Associations of *Eleocharis obicis*

The common habitat feature for *E. obicis* throughout its range, based on collections that provide detailed habitat notes, is the presence of gilgais or other seasonally wet (winter-spring) depressions, including roadside drains (see Table 1.1). There are no collections from lakes or other extensive water bodies that are likely to hold water for extensive periods (1 year or more), nor are there collections from relatively deep (> ca. 30 cm), impermanent water bodies. Numerus lake systems, both natural and modified, and permanent and impermanent, exist within the known range of *E. obicis* (e.g. Lake Cargelligo, Lake Tara, Ita Lake, Lake Tyrell, Lake Charm, Lake Lalbert, Reedy Lake), and most, if not all, of these have received considerable botanical attention over the years. It would appear that the longer-term flooding and drying regimes of such systems provide unsuitable conditions for *E. obicis.* Lake depth is an obvious factor (but shallow edges will be present in most cases), but perhaps more likely is the inability of the seed of *E. obicis* to remain viable after long periods of submersion. Most gilgais hold water for a few months – long enough for the plant to complete its life cycle, but not long enough to be lethal to seed. It's likely, as in many other hard-coated seed of aquatic or semi-aquatic species, that the seed is highly drought-tolerant rather than flood-tolerant, well adapted to a system of short periods of wetness, albeit prone to consecutive seasons of dry conditions.

1.8.1 Vegetation Communities

i NSW Habitats

While projected potential occurrences for *Eleocharis obicis* in PCTs 17, 53 and/or 244 were the spur for the need of a report on the likelihood of occurrence for it in the Lake Cowal area, data from site occurrence records and other literature (e.g. Species Profile for *Eleocharis obicis* (BCS 2022)) suggests that these three PCTs correspond only weakly to known habitat for the species. These PCTs include numerous aquatic and semi-aquatic species, sometimes within a broader shrubby (PCT 17) or woodland (PCT 244) context. However, these PCTs comprise few species indicative of ephemeral wetlands (with possible exceptions perhaps of *Ranunculus undosus*, *Fimbristylis dichotoma* (PCT 53), *Centipeda thespidioides* (PCT 244) and *Marsilea drummondii* (PCTs 17, 53 and 244). Of these, the rather ubiquitous *Marsilea drummondii* is the only one having been recorded as occurring with *E. obicis* to date (BCS 2022; AVH 2023; Stables (2023); pers. obs.), and suggest that the apparently critical gilgais are either not a feature of these communities and/or other environmental features (e.g. edaphic, hydrological) are not suitable for *E. obicis*. Information from previous vegetation sampling to date indicates that gilgais are not present on the bed of Lake Cowal, consistent with the characterisation of PCTs 17, 53 and 244 that inhabit the lake bed.

Given the apparent reliance of *E. obicis* on relatively small features of the broad landscape (i.e. shallow gilgais and/or other shallow depressions that hold water for short periods only, drying in late spring/summer), broad vegetation descriptions will almost invariably include surrounding species that exist more or less independently of the ephemeral wetlands. The scale of the microtopographic features militates against their constituent 'niche' vegetation to be described as a distinct entity at the scale of most broadly recognised vegetation types or communities as typically applied in statewide vegetation descriptions (e.g. Plant Community Types (PCTs) in NSW and Environmental Vegetation Classes (EVCs) in Victoria).

Species noted to be closely associated with *E. obicis* in New South Wales include the slightly woody plants, *Eragrostis australasica, Sclerolaena* tricuspis and low herbaceous species *Alternanthera angustifolia, A. nana, Calocephalus sonderi, Goodenia sp, Marsilea drummondii. Minuria integerrima, Myriocephalus rhizocephalus, Pilularia novae-hollandiae*, *Rhodanthe corymbiflora* and *Swainsona procumbens*. Species recorded from taller vegetation surrounding the ephemeral wetlands include the 'saltbush' species *Atriplex nummularia, A. vesicaria,* and *Maireana aphylla* (AVH 2023; Stables 2023). The Species Profile for *Eleocharis obicis* (BCS 2022) records one occurrence (near Condobolin) as a shallow open ditch on a low ridge with *Eucalyptus populnea* in red sandy soil over clay. This appears to be an unusual occurrence, or possibly, refers to the broad rather than proximate vegetation type. An example of typical habitat of *E. obicis* (i.e. gilgais within a broader shrubland/grassland context, in this case, PCT 164 Cotton bush (*Mairena aphylla*) open-shrubland) is shown in Figure 1.5.



Figure 1.5 Gilgai within stand of PCT 164 near Moulamein. *Eleocharis obicis* is the dominant plant within the gilgiai/wet depression. (photo M. Stables)

ii Victorian Habitats

In Victoria, *E. obicis* has been recorded from EVC 956, Herb-rich Gilgai Wetland, described as a 'herbland of small, seasonally wet gilgai depressions on heavy soil plains, occurring as part of a mosaic within drier woodland and grassland formations. Where present, surrounding trees can include *Eucalyptus camaldulensis*, *Eucalyptus largiflorens*, *Eucalyptus microcarpa* and/or *Allocasuarina luehmannii'*. The community is considered to have been 'Formerly widespread in lowland plains areas of northern and western Victoria, but now very rare as a consequence of agricultural practices' (DELWP 2022).

Species recorded as close associates in herbarium records of *Eleocharis obicis* in Victoria are *Eleocharis pallens, E. plana, Amphibromus* sp. (most likely *A. nervosus*), *Rytidosperma* sp. (most likely *R. duttonianum*), *Eryngium paludosum, Swainsona procumbens, Chrysocephalum apiculatum* and *Craspedia paludicola* (AVH 2023).

1.8.2 Responses to Disturbance

Responses of *E. obicis* to disturbance are largely unknown, but from its apparent restriction to small shallow depressions prone to cyclic inundation and drying, any disruption to local topography and/or drainage patterns is likely to reduce available habitat for the species. The Species Profile for *E. obicis* (BCS 2022) lists threats as:

- Habitat clearing and modification (for agriculture and sheep grazing).
- Grazing, trampling and pugging (stock particularly sheep).
- Weed invasion and competition.
- Feral animals (pigs, rabbits).
- Insufficient understanding of distribution.
- Insufficient understanding of threats.

In Victoria, EVC 956, *E. obicis* is considered to have been 'Formerly widespread in lowland plains areas of northern and western Victoria, but now very rare as a consequence of agricultural practices' (DELWP 2022). Gilgai-producing soils (vertisols) have been extensively utilised for cropping. They comprise some of the most important cropping areas of the east Wimmera in Victoria (Agriculture Victoria 1996-2023). A specimen of *E. obicis* in the National Herbarium of Victoria (Specimen no MEL 2269866A, *P. Foreman 371*, collected 2004, see Table 1.1) notes 'Very very sparse as scalded by past drought and over grazing.' It is axiomatic that much of the former habitat for *E. obicis* will have been destroyed or highly modified by agriculture throughout its range.

Table 1.1 Summary of locality and site information from herbarium records (AVH 2023)

Collector	Year	State	Generalised locality	Habitat and associated native species/notes
Robertson, G.	2016	NSW	Hay area	Flat plain, grey clay soil. *Eragrostis australasica*, *Eleocharis acuta*, *Atriplex vesicaria*.
Wilson, K.L.	2010	NSW	Moulamein area	Plain with mixed, low chenopods and grasses; some bare claypan areas. Lower-lying areas near road filled with water (good rain about 2 weeks before), with *Eragrostis australasica* and *Marsilea drummondii*. Soil grey clay (very sticky when wet, hard when dry). Found on drier margins of shallow depression filled with water and dominated by *Eleocharis acuta*.
Cunningham, G.M.	1973	NSW	Condobolin area	Heavy clay. Swamp, ditch in TC soil.
Robertson, G.	2016	NSW	Hay area	Flat plain, grey clay soil. On drier margin (no standing water) of creek which is still flooded. *Eragrostis australasica*, *Eleocharis acuta*, *Cotula bipinnata*, *Rhodanthe corymbiflora*, *Sclerolaena tricuspis*, *Goodenia* sp.
Robertson, G.	2016	NSW	Hay area	Flat plain, grey clay soil. *Eragrostis australasica*, *Sclerolaena tricuspis*, *Minuria integerrima*, *Swainsona procumbens*.
Wilson, K.L.	2010	NSW	Moulamein area	Plain with mixed, low chenopods and grasses. Grey clay soil. Occasional small clumps on drier margins of elongated depression parallel to road and about 15 m west of it, with *Eragrostis australasica*. Also *Eleocharis acuta* and *E. pallens*. Clumps not deeply rooted but mud/soil very sticky/hard.
Wilson, K.L.	1983	NSW	Moulamein area	A couple of small shallow rooted tussocks in low lying part of claypan near (E. of) irrigation channel.
Foreman, P. Garner, S.	2004	Vic	Quambatook area	Ephemeral wetland (small) in open, species rich riverine grassland vegetation dominated by perennial native grasses, salt bushes and annual forbs. Like *E. pallens* and *E. plana*, this species occupies a few small depressions full of water following Nov/Dec storms. Very very sparse as scalded by past drought and over grazing.
O'Brien, E.	2009	Vic	Quambatook area	Low open grassland/herbfield. Reddish clay loam soil.
Garner, S.	1995	Vic	Birchip-Watchem area	Growing in wet grassland dominated by *Amphibromus* sp., *Rytidosperma* sp., *Austrostipa* sp., *Eryngium plantagineum* and *Swainsona procumbens*.
O'Brien, E.	2009	Vic	Birchip-Watchem area	Slightly saline ground, parts prone to inundation.

Table 1.1 Summary of locality and site information from herbarium records (AVH 2023)

Collector	Year	State	Generalised locality	Habitat and associated native species/notes
Garner, S.	1995	Vic	Sea Lake area	Growing in grassland/herbfield with gilgai hollows. Dominant species include: *Chrysocephalum apiculatum*, *Swainsona procumbens*, *Eryngium plantagineum*, *Craspedia paludicola*.

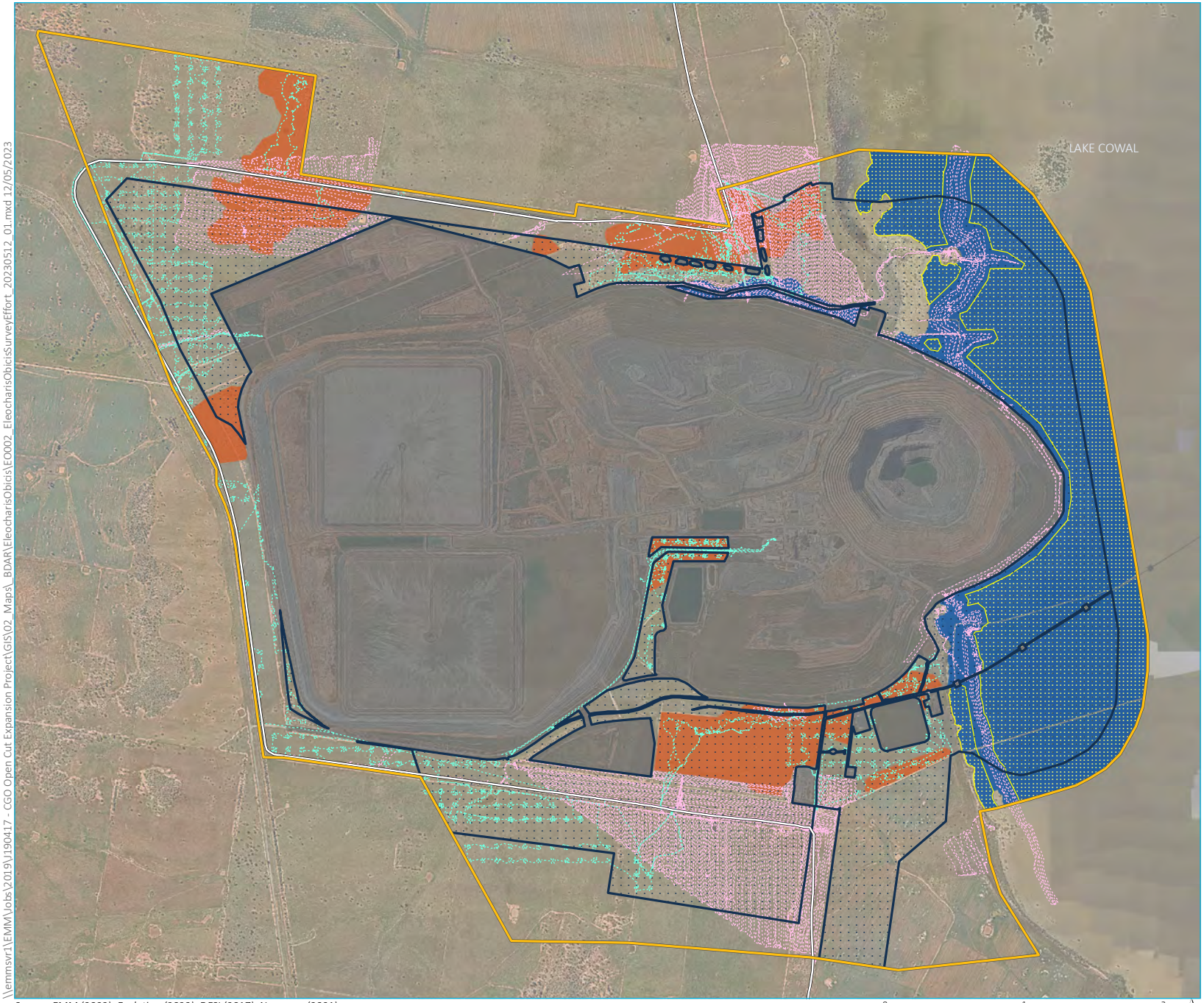
2 Methods

2.1 Targeted Surveys

The occurrence of *E. obicis* in potential habitat outside of Lake Cowal has been ruled out by targeted surveys by EMM. EMM undertook three survey campaigns for the species during November 2020 and November 2022. Surveys were directed towards PCTs associated with the *E. obicis* (primarily PCT 53), however opportunistic surveys were also undertaken in association with other flora surveys, including 111 BAM plots and 23 Rapid Vegetation Assessments (RVAs). Targeted surveys were completed during the optimal survey period for the species (October-November) as per the DPE TBDC (2023).

As shown in Figure 2.1, despite comprehensive surveys by EMM, approximately 239.64 ha within Lake Cowal could not be surveyed due to inundation in 2021/2022. This area falls within two vegetation zones PCT 53 - *Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains* in medium condition and PCT 17 – *Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)* in medium condition. This unsurveyed extent of Lake Cowal is the subject of this expert report.

Furthermore, an area of cropped land to the south of the mine was also considered in this assessment (see Figure 2.1). This area was not surveyed for *Eleocharis obicis* by EMM as it is considered to be Category 1 land within EMM (2023), owing to an extensive history of cropping and grazing.



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Source: EMM (2023); Evolution (2023); DFSI (2017); Nearmap (2021)

EMM survey effort for the
Eleocharis obicis
(figure supplied by EMM)

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Species expert report for *Eleocharis obicis*
Figure 2.1

2.2 Habitat Matching

To assess the likelihood of the species occurring in non-surveyed areas of Lake Cowal (i.e. PCT 17 and PCT 53 medium condition zones) and cropped land to the south of the mine, the character of these areas was compared to known habitat that *Eleocharis obicis* associates with in NSW. Based on the habitat description for the species in NSW, as provided in Section 1.8, suitable habitat for *Eleocharis obicis* in NSW is considered to be:

- Natural gilgais or other shallow depressions (e.g. drainage lines) functioning as ephemeral freshwater to slightly saline wetlands, likely to fill to a depth of <30 cm and to hold water in most seasons for no longer than a few months. The gilgais/depressions may remain dry in drought years.
- Areas primarily with low levels of disruption to hydrology or vegetation composition.
- Areas with grey clay or reddish clay or clay loam soil.
- Areas containing at least of some of the following species within the gilgais/depressions: *Alternanthera angustifolia*, *A. nana*, *Calocephalus sonderi*, *Goodenia* sp, *Marsilea drummondii*. *Minuria integerrima*, *Myriocephalus rhizocephalus*, *Pilularia novae-hollandiae*, *Rhodanthe corymbiflora*, *Sclerolaena tricuspis*, and *Swainsona procumbens*. Associated shrubland/tall grassland communities are likely to include the following species as major structural components: *Eragrostis australasica*, *Atriplex vesicaria*, *A. nummularia* and *Maireana aphylla*.

It is noteworthy that a previous study (Bower 2023) related to the proposed development by Evolution Mining at Lake Cowal sought for and detected populations of the Austral Pillwort, *Pilularia novae-hollandiae*, noted as a threatened species in NSW. In surveys by Bower (1998), the Austral Pillwort was found to be confined to gilgais, to the north and south of the current mine site and above the shore of the lake. As noted above, Austral Pillwort has been recorded as an associated gilgai species with *Eleocharis obicis* near Moulamein. The description of the sites for Austral Pillwort given in Bower (2023) is very similar to that proposed for *Eleocharis obicis* in the present study so is worth repeating here: '*…shallow or recently dried out depressions (i.e. typically 10–20 cm deep when the depression is full). This was despite surveys covering inundated areas along the margins of streams, the Lake Cowal foreshore, and a wide range of gilgais with varying hydrological characteristics (i.e. shapes, sizes, depth and volume). For instance, of 335 gilgais where their hydrological nature was recorded in the study area, ranging from less than 1 cm to over >1 m deep and 2 to 20 m wide when full, the Austral Pillwort was observed to strictly occur in shallow gilgais that were typically 10–20 cm deep when full and appeared to be capable of holding standing water for several weeks.*'

A conclusion from that report was that Austral Pillwort was unlikely to occur within Lake Cowal due to the physiognomy of the lake bed, in particular the absence of shallow depressions capable of functioning as ephemeral wetlands.

3 Results and Discussion

3.1 Targeted Survey Results

Despite EMM undertaking extensive targeted surveys for *E. obicis* across the study area, *E. obicis* was not detected (Figure 2.1). Moreover, *E. obicis* has not been observed in or nearby the mine lease during any of the targeted flora surveys that date back to 1969, nor within ongoing flora monitoring programs by Evolution, including monitoring programs for Remnant Vegetation Enhancement Program, Compensatory Wetland and rehabilitation areas in Lake Cowal itself (undertaken annually since 2008). In addition to targeted surveys by EMM, flora surveys targeting threatened flora in or near Evolution's mine lease are summarised in Table 3.1.

Table 3.1 Previous threatened flora surveys within and nearby Project Area

Surveys	Period	Method	Reference
Flora surveys within ML 1565 and surrounds prior to operation	1969 and 2003	Quadrat sampling, random meander search and targeted searches within aquatic/semi-aquatic habitat	Vestjens (1977) Anne Clements and Associates (1995) Charles Sturt University (1997) Bower (1997; 1998a-b; 2003a-b).
Flora surveys for the Cowal Gold Mine E42 Modification Environmental Assessment	2008	Quadrat sampling and random meander search	FloraSearch (2008).
Opportunistic threatened flora surveys undertaken during annual monitoring for Remnant Vegetation Enhancement Program, Compensatory Wetland, rehabilitation areas and Biodiversity offsets.	2008 to present	Quadrat sampling and random meander search	DnA Environmental (2011a-2022a, 2011b-2022b; 2018d-2022d).
Austral Pillwort annual monitoring	2006 to present	Annual monitoring for the Austral Pillwort within ML 1535 and surrounds	DnA Environmental (2011c-2022c).
Targeted threatened flora surveys within and surrounding ML 1535 within Evolution-owned lands	2011 to 2012	Targeted searches for threatened flora at floristic survey sites and incidental searches	Australian Museum Business Services (2012) FloraSearch (2013) Resource Strategies Pty Ltd (2013)
Targeted threatened flora surveys for MOD 14	August, September and November 2017	Targeted searches for threatened flora in accordance with OEH (2014), DEC (2004) and OEH (2016)	AMBS Ecology & Heritage (2018)

3.2 Habitat Matching Results

It is my expert opinion that the *E. obicis* is unlikely to occur within Lake Cowal since:

- The species has never been recorded from the Lake or nearby areas despite extensive survey.
- The Lake lacks natural gilgais or other shallow depressions believed to be critical habitat for the species.
- No other occurrences of *E. obicis* have been from lake systems.
- The species composition of plant communities surveyed on the lake bed is not a good match for known associated species in occurrences of *E. obicis*.

Furthermore, the occurrence of *E. obicis* within cropped areas is also considered unlikely since:

- Evidence suggests that *E. obicis* is unable to tolerate cropping regimes due to the disruption of smaller-scale surface features in the cropping process and alteration of the chemical composition of the soil (through application of fertilisers etc.). All known occurrences of the species have been in remnant native vegetation. While some tolerance has been exhibited towards grazing, the species has never been observed within land that has been cultivated for cropping etc.

4 Conclusions and recommendations

It is my opinion that *Eleocharis obicis* is unlikely to occur within Lake Cowal or the cropped land to the south of the mine. While some areas in the Study area may possess potential habitat for *E. obicis*, particularly gilgais associated with PCT 55 Belah woodland, these areas were surveyed extensively by EMM without detecting this species. A lack of suitable habitat in these areas for *E. obicis*, combined with a lack of records of this species within or nearby the Additional disturbance area during surveys for the BDAR, and historically for Evolution, suggests that the potential occurrence of the *E. obicis* in either of these areas is low.

Accordingly, in this case, no species polygon is considered necessary for the *E. obicis* within the BDAR being prepared for Evolution's Open Pit Continuation Project.

Signed:



Date: 10 May 2023

References

AVH 2023, The Australasian Virtual Herbarium, Council of Heads of Australasian Herbaria, <https://avh.chah.org.au>, accessed 10 May 2023.

Agriculture Victoria 1996-2023, Victoria Resources Online, Wimmera https://vro.agriculture.vic.gov.au/dpi/vro/wimregn.nsf/pages/natres_soil_eastwimm_agric (accessed 10 May 2023).

Australian Museum Business Services 2012, *Cowal Gold Mine and Surrounds Flora Survey*, report prepared for Barrick (Australia Pacific) Limited.

AMBS Ecology & Heritage 2018, *Cowal Gold Operations Processing Rate Modification – Biodiversity Assessment Report and Biodiversity Offset Strategy*, report prepared for Evolution Mining (Cowal) Pty Limited.

BCS 2022, NSW Biodiversity, Conservation and Science. Species profile for *Eleocharis obicis* https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10264 (accessed 10 May 2023).

Bower C 1998a, *Survey of the Cowal Project Area and surrounds for the Austral Pillwort (Pilularia novae-hollandiae),* report prepared by Orchid Research for North Limited.

Bower C 1998b, *Survey for the Endangered Peppercress, Lepidium Hyssopifolium Desv. (Brassicaceae), on the Proposed Cowal Gold Project Site and the Route of the Borefield Pipeline,* unpublished report by Orchid Research for North Limited.

Bower C 2003a*, Vegetation Community Mapping along the Pipeline/Borefield Route.*

Bower C 2003b, *Vegetation Community Mapping along the Access Road*.

Bower C 2023, Species Expert Report for the Austral Pillwort, *Pilularia novae-hollandiae*. EMM

Charles Sturt University 1997, *Cowal Gold Project Area Botanical Survey*, report prepared for North Limited.

DELWP 2022. Benchmarks for wetland Ecological Vegetation Classes in Victoria, August 2022 update. https://iwc.vic.gov.au/docs/IWC%20Wetland%20EVC%20benchmarks%20-%20August%202022.pdf (accessed 10 May 2023).

DnA Environmental 2011a, *2010 Compensatory Wetland Regeneration Monitoring Results*, report prepared for Cowal Gold Mine.

DnA Environmental 2011b, *2010 Rehabilitation Monitoring Report*, prepared for Cowal Gold Mine.

DnA Environmental 2012a, *2011 Compensatory Wetland Regeneration Monitoring Results*, prepared for Cowal Gold Mine.

DnA Environmental 2012b, *2011 Rehabilitation Monitoring Report*, prepared for Cowal Gold Mine.

DnA Environmental 2012c, *2011 Austral Pillwort Survey*, report prepared for Cowal Gold Mine.

DnA Environmental 2013a, *2012 Compensatory Wetland Regeneration Monitoring Results*, report prepared for Cowal Gold Mine.

DnA Environmental 2013b, *2012 Rehabilitation Monitoring Report*, prepared for Cowal Gold Mine.

DnA Environmental 2013c, *2012 Austral Pillwort Survey*, prepared for Cowal Gold Mine.

DnA Environmental 2014a*, 2013 Compensatory Wetland Regeneration Monitoring Results*, report prepared for Cowal Gold Mine.

DnA Environmental 2014b, *2013 Rehabilitation Monitoring Report*, prepared for Cowal Gold Mine.

DnA Environmental 2014c, *2013 Austral Pillwort Survey*, prepared for Cowal Gold Mine.

DnA Environmental 2015a, *2015 Compensatory Wetland Regeneration Monitoring Report*, prepared for Evolution Cowal Limited.

DnA Environmental 2015b, *2014 Rehabilitation Monitoring Report*, prepared for Evolution Cowal Limited.

DnA Environmental 2015c, *2014 Austral Pillwort Survey*, prepared for Evolution Cowal Limited.

DnA Environmental 2016b, *2015 Rehabilitation Monitoring Report*, prepared for Evolution Cowal Limited.

DnA Environmental 2016c, *2015 Austral Pillwort Survey*, report prepared for Evolution Cowal Limited.

DnA Environmental 2017a, *2016 Compensatory Wetland Regeneration Monitoring Report*, prepared for Evolution Cowal Limited.

DnA Environmental 2017b, *2016 Rehabilitation Monitoring Report*, prepared for Evolution Cowal Limited.

DnA Environmental 2017c, *2016 Austral Pillwort Survey*, report prepared for Evolution Cowal Limited.

DnA Environmental 2018a, *2017 Compensatory Wetland Regeneration Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2018b, *2018 Rehabilitation Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2018c, *2017 Austral Pillwort Survey*, report prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2018d, *2017 Biodiversity Offset Areas Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2019a, *2018 Compensatory Wetland Regeneration Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2019b, *2018 Rehabilitation Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2019c, *2018 Austral Pillwort Survey*, report prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2019d, *2018 Biodiversity Offset Areas Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2020a, *2019 Compensatory Wetland Regeneration Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2020b, *2019 Rehabilitation Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2020c, *2019 Austral Pillwort Survey*, report prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2020d, *2019 Biodiversity Offset Areas Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2021a, *2020 Compensatory Wetland Regeneration Monitoring Report*, report prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2021b, *2020 Rehabilitation Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2021c, *2020 Austral Pillwort Survey*, report prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2021d, *2020 Biodiversity Offset Areas Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2022a, *2021 Compensatory Wetland Regeneration Monitoring Report*, report prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2022b, *2021 Rehabilitation Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2022c, *2021 Austral Pillwort Survey*, report prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2022d*, 2021 Biodiversity Offset Areas Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

DPE TBDC 2023, *BioNet Threatened Biodiversity Database Collection – Ecological data: Austral Pillwort*, Department of Planning and Environment, accessed 4 Feb 2023, https://www.environment.nsw.gov.au/AtlasApp/UI_Modules/TSM_/ProfileEdit.aspx?pId=10628&pType=SpeciesCode

DPIE 2020, *Biodiversity Assessment Method*, Department of Planning, Industry and Environment.

EMM 2023, *Cowal Gold Operations Open Cut Continuation Project Biodiversity Development Assessment Report*, prepared for Evolution Mining (Cowal) Pty Limited.

FloraSearch 2013, *Cowal Gold Mine Modification - Proposed Pump Station: Impact on Flora*, report to Barrick Australia Ltd.

Johnson, L.A.S. & Evans, O.D. 1968, New species in Eleocharis. *Contributions from the New South Wales National Herbarium* 4(2): 71.

PlantNET 2023, The NSW Plant Information Network System. Royal Botanic Gardens and Domain Trust, Sydney. https://plantnet.rbgsyd.nsw.gov.au (accessed 10 May 2023).

Resource Strategies Pty. Ltd. 2013, *Cowal Gold Mine Extension Modification Threatened Species Assessment*, report prepared for Barrick Australia Ltd.

Stables, M. 2023, Brief notes on the occurrence of *Eleocharis obicis* near Dry Lake, Moulamein (unpublished report).

Vestjens W 1977, *Status, habitats and food of vertebrates at Lake Cowal, NSW,* Division of Wildlife Research Technical Memorandum No. 12 Commonwealth Scientific and Industrial Research Organisation, Canberra.

VicFlora 2023, Flora of Victoria, Royal Botanic Gardens Victoria. Available online: https://vicflora.rbg.vic.gov.au (accessed 10 May 2023).

Appendix A Approval Letter

Department of Planning and Environment

Mr Neville Walsh
neville.walsh@rbg.vic.gov.au

Our ref: SF23/32703
Sender's ref: BE 23 04

30 March 2023

Dear Mr Walsh

Approval of Neville Walsh as an expert for *Eleocharis obicis*

Thank you for your application dated 9 March 2023 to the Biodiversity and Conservation Division (BCD) of the Department of Planning and Environment.

BCD has reviewed the information provided in support of this request and is satisfied that you meet the definition of a species expert for *Eleocharis obicis* in accordance with section 5.3 (Box 3) of the Biodiversity Assessment Method.

Please note that this formal recognition of you as an expert only applies to the Lake Cowal Open Pit Continuation project within the Bland Local Government Area.

If you require any further information regarding this matter, please contact Andrew Fisher, Senior Team Leader Planning, South West via rog.southwest@environment.nsw.gov.au or 02 6022 6023.

Yours sincerely

Adam Vey
Director South West
Biodiversity and Conservation Division
Department of Planning and Environment

Cover Letter

To whom it may concern,

The views and conclusions presented within this expert report, regarding the likelihood for the Spiny Peppercress to occur in habitats that could not be surveyed for the Lake Cowal Gold Mine Continuation Project, are my own.

Under my guidance, this expert report was prepared with the assistance of EMM during the initial drafting phase and preparation of figures.

Warm regards,
Dr Colin Bower



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1 Introduction

1.1 Project Background

Evolution Mining (Cowal) Pty Limited (Evolution) is the owner and operator of Cowal Gold Operations (CGO), an existing open pit and underground gold mine approximately 38 kilometres (km) north-east of West Wyalong, NSW. CGO is located on the traditional lands of the Wiradjuri People and is immediately adjacent to the western foreshore of Lake Cowal, which is an ephemeral waterbody and the largest inland lake in NSW.

Evolution is seeking approval for further open pit mining operations at CGO through the Open Pit Continuation Project, which will involve further development of the existing E42 Pit and the development of open pit mining in three new and adjacent orebodies.

In pursuit of approval for the Project, Evolution engaged EMM Consulting to prepare a Biodiversity Development Assessment Report (BDAR). In accordance with the BAM (DPIE 2020), EMM undertook a candidate species assessment to determine the likely presence of threatened species within the study area. Due to the presence of several associated vegetation communities, the Spiny Peppercress (*Lepidium aschersonii*) was identified as a species requiring further assessment.

1.2 Need for Expert Report

In accordance with Section 5.2.4(b) of the BAM, targeted surveys for Spiny Peppercress were undertaken by EMM within the study area (the area where ecological surveys were focused) throughout 2020. However, due to heavy rainfall through 2021 and 2022, associated with a La Nina Southern Oscillation Cycle, areas of associated PCTs within Lake Cowal could not be surveyed in their entirety. Subsequent surveys allowed for completion of surveys outside of Lake Cowal. However, in accordance with Section 5.2.4(c) of BAM (DPIE 2020), an expert report is required to determine if the Spiny Peppercress is likely to be present within the unsurveyed extent of Lake Cowal.

In addition to areas within Lake Cowal, this expert report will assess the likelihood of the Spiny Peppercress occurring within the highly disturbed, cropped areas of the study area that were not surveyed by EMM.

1.3 Study Area Characteristics

The Study area is approximately 3,441.91 hectares (ha) in size, with 1,030.68 ha expected to be directly impacted by the project (referred to as the additional disturbance footprint). Within the additional disturbance footprint, approximately 928.6 ha has been mapped by EMM as native vegetation, although much of this vegetation has been highly disturbed due to historical grazing.

According to information held in the Department of Planning and Environment's (DPE) Threatened Biodiversity Database Collection (herafter DPE TBDC 2023), the Austral Pillwort may be associated with three of eight PCTs present on site, which include:

- PCT 53 – Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains;
- PCT 55 – Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions; and
- PCT 249 – River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW.

A map of the site showing PCT's considered by DPE to be associated with the Spiny Peppercress is displayed in Figure 1.1.



KEY

- Subject land
- Additional disturbance area
- Existing and approved disturbance area
- Major road

PCTs associated with Spiny Peppercress

PCT 53 | Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains

- Medium

PCT 55 | Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions

- Medium
- Poor
- Planted
- DNG

PCT 249 | River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW

- Medium
- Regenerating
- DNG

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Source: EMM (2023); Evolution (2023); DFSI (2017); Nearmap (2021)

0 1 2 km

GDA 1994 MGA Zone 55

N

Spiny Peppercress PCT associations

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Species Expert Report for Spiny Peppercress (*Lepidium aschersonii*)
Figure 1.1

1.4 Aims of the Expert Report

This expert report aims to:

- define suitable habitat for the Spiny Peppercress in NSW based on a literature review and analysis of previous records;
- identify areas within the study area (if any) which might be considered potential habitat for the species; and
- determine the likelihood of occurrence of the Spiny Peppercress within non-surveyed areas of the Study area.

1.5 Expert Status of Species Expert

I (Dr Colin Bower) have been approved by the NSW Department of Planning and Environment as a species expert for the Spiny Peppercress in accordance with Section 5.3 (Box 3) of the Biodiversity Assessment Method. This recognition applies exclusively to the Lake Cowal Open Cut Continuation project within the Bland Local Government Area. The approval letter is provided in Appendix A.

1.6 Identification of the Spiny Peppercress

The Spiny Peppercress is an erect, perennial herb with hairy and intricate branches. Growing to 30 cm tall, its basal leaves are lobed and reduce in size moving up the stem (DPE 2019). It has small flowers borne in elongated clusters and its fruit is a 2-celled, flattened circular pod on a spreading stalk. It is most readily distinguished from other species in the *Lepidium* genus by inflorescences that terminate in tiny spines, a feature that provides mature plants with an intricate appearance.

In-situ specimens observed at a reference site near Barmedman, approximately 50 km south of the project area, are shown in Photograph 1.1 and Photograph 1.2. This reference site was also recently visited by EMM, who detected the Spiny Peppercress here during the height of floodwaters (November 2022). Located well above floodwaters, this site displayed only occasional ponding when visited by EMM (EMM, pers.comm 2023). Photograph 1.3 displays a Spiny Peppercress specimen detected here by EMM, while Photograph 1.4 demonstrates the Belah (*Casuarina cristata*) woodland in which this reference population occurs.



Photograph 1.1 **Spiny Peppercress specimen at the West Wyalong-Barmedman reference site (photograph by Colin Bower)**



Photograph 1.2 **Spiny Peppercress specimen at the West Wyalong-Barmedman reference site (photograph by Colin Bower)**



Photograph 1.3 **Spiny Peppercress specimen at the time of surveys at the West Wyalong-Barmedman reference site (photograph by EMM)**



Photograph 1.4 **Belah (Casuarina cristata) (PCT 55) woodland at the West Wyalong-Barmedman Spiny Peppercress reference site (photograph by EMM)**

1.7 Geographic Distribution

The Spiny Peppercress is a patchily distributed species. It is known in NSW, Victoria, and Western Australia.

In NSW, it occurs in the marginal central-western slopes and north-western plains region. Here, it mainly occurs at two sites: in the vicinity of West Wyalong and Narrabri.

According to the DPE BioNet Atlas database (2023), the closest record of Spiny Peppercress to the study area is approximately 18 km to the south of the CGO. This observation was made in 2004 during surveys for the Temora-Cowal electricity transmission line by the author of this expert report (Bower 2004). The species was also recently recorded in 2022 around 50 km to the south-west of the CGO, near the township of Aleena (DPE BioNet Atlas 2023).

1.8 Habitat Associations of the Spiny Peppercress

1.8.1 Vegetation Communities

The habitat where Spiny Peppercress has been recorded differs between NSW and Victoria.

i NSW Habitats

In NSW, the Spiny Peppercress has almost exclusively been detected in association with woodland habitats. For example, in northern NSW near Narrabri, where the largest populations of the species have been detected, Spiny Peppercress has been observed within Brigalow (*Acacia harporylla*), Belah (*Casuarina cristata*) and Brigalow-Belah communities on grey cracking soils that are deep and moist (Hunter 2006). This is corroborated in the habitat description by DPE (2019), which describes Spiny Peppercress habitat as "Found on ridges of gilgai clays dominated by Brigalow (*Acacia harpophylla*), Belah (*Casuarina cristata*), Buloke (*Allocasuarina luehmanii*) and Grey Box (*Eucalyptus microcarpa*)".

Similarly, in the West Wyalong-Barmedman area nearby the project, Spiny Peppercress has mostly been detected in Belah woodlands on gilgai soils (Bower 2004). However, the species was also found in mallee communities dominated by Bull Mallee (*Eucalyptus behriana*), along with a Grey Box (*Eucalyptus microcarpa*) / Bull-Oak (*Allocasuarina luehmanii*) woodland.

A summary of the habitats where Spiny Peppercress was recorded in NSW is provided in Table 1.1. These records were sourced from the Australian Virtual Herbarium database (AVH 2023) and Bower (2004).

Table 1.1 Habitat Associations of the Spiny Peppercress - NSW

Vegetation Community	Number of records	Percentage of records
Casuarina cristata woodland	11	32.35%
Acacia harpophylla woodland	11	32.35%
Eucalyptus behriana (Bull Mallee) woodland	2	5.88%
Green Mallee (*Eucalyptus viridis*?) woodland[1]	1	2.94%
Eucalyptus microcarpa / *Allocasuarina luehmanii* woodland	1	2.94%
Eucalyptus albens / *Eucalyptus pilligaensis* woodland	1	2.94%
No habitat description	7	20.59%

[1]Question mark carried over from database record. Identification of vegetation community probably uncertain.

ii Victoria Habitats

In contrast to NSW, Spiny Peppercress has mostly been found in Victoria in "saline situations bordering lakes or in salt marshes" (Leigh, Boden and Briggs 1984), and on "heavy black or clay soil" in areas experiencing "seasonal waterlogging or inundation" (DSE 2009). These descriptions are supported by records from the AVH database (2023), with most of the AVH records occurring in or nearby lakes, swamps, and saline areas (Table 1.2). Note, only records with habitat descriptions were included in this analysis.

Table 1.2 Habitat Associations of the Spiny Peppercress - Victoria

Date of Record	Habitat description	Location
1875	Basaltic Ridge	Lake Corangamite
1961	Heavy, black clay flat. Private property	Balintore (near Lake Colac)
1978	On heavy, perhaps salty, ground. Soil types are basalt barriers with heavy clay flats between. Also, aeolian deposits overlying basalt.	North Cundare
1981	Black, cracking clay on shores of Lake Beeac.	Lake Beeac
1981	Saline areas.	Lake Omeo, Benambra
1982	Growing on hard set clay in disturbed area with introduced grasses.	Roadside at Lake Omeo
1982	On Coxiella beach deposits, primary succession.	Lake Corangamite
1983	Growing in littoral zone around fringe of heavy black clay saltpan containing only *Wilsonia rotundifolia*	Lake Beeac
1983	Heavy black clay depressions in paddock nearby salt lake.	North Cundare
1983	On bare black cracking clay, on banks above Coxiella shell beach.	Lake Corangamite
1983	Area close to swamp and grows in heavy black soil and close to water channels.	Derrinallum
1983	Heavy clay flats. Growing in pasture of clover, rye grass and cape wee	Mortlake
1984	In dense *Agrostis avenacea* on grey silt soil of dry lake-bed.	Lake Omeo
1988	Waterlogged area along a drain, Black peaty soils	Ondit (8km NNE of Colac)
2001	{*Coxiella*} shells over heavy grey clay.	Shores of Lake Corangamite
2009	Floodplain. Growing with *Hordeum* sp., *Spergularia marina*, *Sarcocornia quinqueflora*.	Marshall, Geelong

Given the ample number of records, observed differences in habitat association between NSW and Victoria are unlikely to be a result of sampling bias or low sampling intensity. Rather, they are most likely reflective of a genuine difference in habitat preference across the range of the Spiny Peppercress. With no records around lake edges and lake beds in NSW to date, it appears that the Spiny Peppercress tends to avoid inundation in the northerly extents of its range. Accordingly, it is my view that the Spiny Peppercress is unlikely to occur in lacustrine areas in NSW.

1.8.2 Responses to Disturbance

Analysis of Spiny Peppercress records demonstrate that the species persists primarily in remnant, native vegetation, with most records in NSW occurring in mature or regenerating woodland. Importantly, no records to date have been made of the species within areas disturbed by cropping, strongly suggesting the species is unable to tolerate intensive cropping regimes. However, the Spiny Peppercress does appear to tolerate grazing, as it has been observed persisting in remnant patches of vegetation within paddocks heavily grazed by sheep (Bower 2004). Such tolerance of Spiny Peppercress to grazing may be limited to NSW occurrences, as grazing has been attributed to considerable population declines of the species in Victoria (DSE 2009).

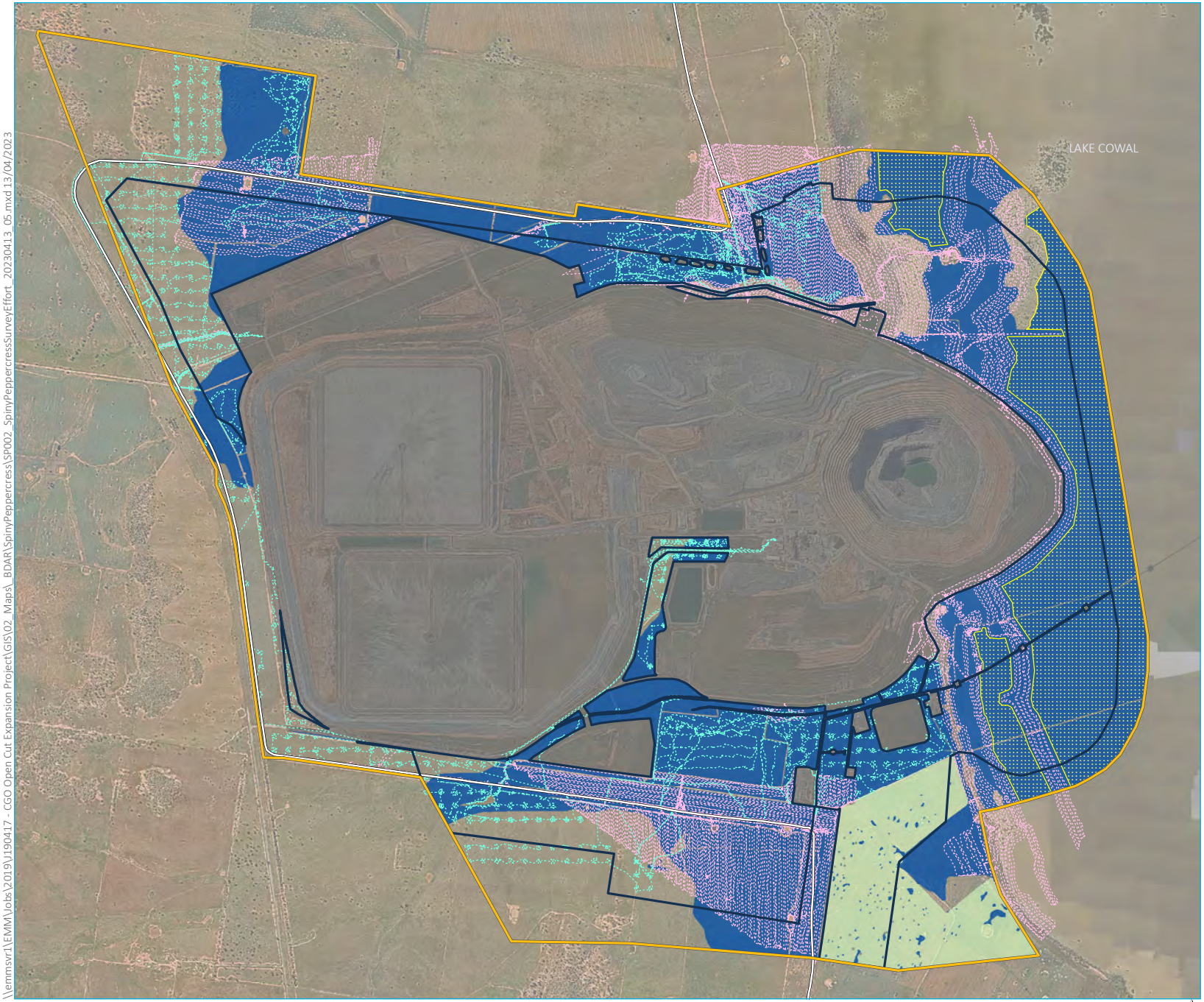
2 Methods

2.1 Targeted Surveys

The occurrence of Spiny Peppercress in potential habitat outside of Lake Cowal has been ruled out by targeted surveys by EMM. EMM undertook five survey campaigns during November 2020, December 2020, April 2022, and November 2022. These surveys were directed towards PCTs associated with the Spiny Peppercress. Opportunistic surveys for Spiny Peppercress were also undertaken by EMM in association with other flora surveys, including 147 BAM plots and 111 Rapid Vegetation Plots. Targeted surveys were completed during the optimal survey period for the species (November-April) as per the DPE TBDC (2023).

As shown in Figure 2.1, despite comprehensive surveys by EMM, approximately 271.52 ha within Lake Cowal could not be surveyed due to inundation in 2021/2022. The entirety of this area falls in the vegetation zone PCT 53 - *Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains* in medium condition. This unsurveyed extent of Lake Cowal is the subject of this expert report.

Furthermore, an area of cropped land to the south of the mine was also considered in this assessment (see Figure 2.1). This area was not surveyed for Spiny Peppercress by EMM as it is considered to be Category 1 land within EMM (2023), owing to an extensive history of cropping and grazing.



KEY

- Subject land
- Additional disturbance area
- Existing and approved disturbance area
- Major road
- Associated vegetation communities
- Cropped land
- Area unable to be surveyed

Survey tracks (year)

- 2020
- 2022

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Source: EMM (2023); Evolution (2023); DFSI (2017); Nearmap (2021)

0 1 2 km

GDA 1994 MGA Zone 55

N

Spiny Peppercress survey effort

Evolution Mining
Cowal Gold Operations
Open Pit Continuation Project
Species Expert Report for Spiny Peppercress (*Lepidium aschersonii*)
Figure 2.1

2.2 Habitat Matching

To assess the likelihood of the species occurring in non-surveyed areas of Lake Cowal (i.e. PCT 53 medium condition zone) and cropped land to the south of the mine, the character of this habitat was compared to known habitat that the Spiny Peppercress associates with in NSW. Based on the habitat description for the species in NSW, as provided in Section 1.8.1.1, suitable habitat for the Spiny Peppercress in NSW is considered to be:

- mature, regenerating or previously cleared woodland;
- where dominant tree species are (or historically were) Belah, Brigalow, Bull Mallee, Grey Box, or White Box; or
- where the habitat is higher ground around a gilgai depression, and not in the inundated areas of this habitat. That is, gilgais are thought to be formed by shrinking and swelling of the soil, causing some areas to sink and the immediate surrounds to rise, forming a raised ring around the gilgai. The Spiny Peppercress tends to occur along this raised ring.

3 Results and Discussion

3.1 Targeted Survey Results

Despite EMM undertaking extensive targeted surveys for the Spiny Peppercress across 804.49 ha of the study area, Spiny Peppercress was not detected. Moreover, Spiny Peppercress has not been observed in or nearby the mine lease during any of the targeted flora surveys that date back to 1969, nor within ongoing flora monitoring programs by Evolution, including monitoring programs for Remnant Vegetation Enhancement Program, Compensatory Wetland and rehabilitation areas in Lake Cowal itself (undertaken annually since 2008). In addition to targeted surveys by EMM, flora surveys targeting threatened flora in or near Evolution's mine lease are summarised in Table 3.1.

Table 3.1 Previous threatened flora surveys within and nearby Project Area

Surveys	Period	Method	Reference
Flora surveys within ML 1565 and surrounds prior to operation	1969 and 2003	Quadrat sampling, random meander search and targeted searches within aquatic/semi-aquatic habitat	Vestjens (1977) Anne Clements and Associates (1995) Charles Sturt University (1997) Bower (1997; 1998a-b; 2003a-b).
Flora surveys for the Cowal Gold Mine E42 Modification Environmental Assessment	2008	Quadrat sampling and random meander search	FloraSearch (2008).
Opportunistic threatened flora surveys undertaken during annual monitoring for Remnant Vegetation Enhancement Program, Compensatory Wetland, rehabilitation areas and Biodiversity offsets.	2008 to present	Quadrat sampling and random meander search	DnA Environmental (2011a-2022a, 2011b-2022b; 2018d-2022d).
Austral Pillwort annual monitoring	2006 to present	Annual monitoring for the Austral Pillwort within ML 1535 and surrounds	DnA Environmental (2011c-2022c).
Targeted threatened flora surveys within and surrounding ML 1535 within Evolution-owned lands	2011 to 2012	Targeted searches for threatened flora at floristic survey sites and incidental searches	Australian Museum Business Services (2012) FloraSearch (2013) Resource Strategies Pty Ltd (2013)
Targeted threatened flora surveys for MOD 14	August, September and November 2017	Targeted searches for threatened flora in accordance with OEH (2014), DEC (2004) and OEH (2016)	AMBS Ecology & Heritage (2018)

3.2 Habitat Matching Results

It is my expert opinion that the Spiny Peppercress is unlikely to occur within Lake Cowal since:

- PCT 53 is a grassland/sedgeland community, with a sparse to non-existent scattering of mature trees. In NSW, including near West Wyalong, the Spiny Peppercress is known to primarily associate with Belah woodland, and has never been documented associating with a grassland/sedgeland in NSW;
- PCT 53 lacks woodland that Spiny Peppercress is known to associate with. While there are sparse mature River Red Gums (*Eucalyptus camaldulensis*) present, the Spiny Peppercress has not been recorded associating with River Red Gum; and
- Spiny Peppercress has never been detected in lacustrine habitats within NSW and it is considered unlikely that it would inhabit such areas in this northern extent of its range.

Furthermore, the occurrence of Spiny Peppercress within cropped areas is also considered unlikely since:

- evidence suggests the Spiny Peppercress is unable to tolerate cropping regimes. All known occurrences of the species have been in remnant native vegetation, particularly mature woodland. While some tolerance has been exhibited towards grazing, the species has never been observed within cropped land.

Moreover, based on the known habitat association of Spiny Peppercress in NSW, PCT 55 within the additional disturbance area presents the highest potential habitat for Spiny Peppercress, particularly in wooded areas. Nevertheless, the Spiny Peppercress was not found in these areas.

4 Conclusions and recommendations

It is my opinion that the Spiny Peppercress is unlikely to occur within Lake Cowal or the cropped land to the south of the mine. While some areas in the Study area do possess potential habitat for Spiny Peppercress, particularly PCT 55 Belah woodland, these areas were surveyed extensively by EMM without detecting this species. A lack of suitable habitat in these areas for Spiny Peppercress, combined with a lack of records of this species within or nearby the Additional disturbance area during surveys for the BDAR and historically for Evolution, suggests that the potential occurrence of the Spiny Peppercress in either of these areas is low.
Accordingly, in this case, no species polygon is considered necessary for the Spiny Peppercress within the BDAR being prepared for Evolution's Open Pit Continuation Project.

Signed:



Name: Dr Colin Bower
Date: 23 February 2023

References

Anne Clements and Associates 1995, *Terrestrial Flora Report: Lake Cowal District*, Appendix F of NSR Environmental Consultants 1995, Lake Cowal Gold Project Environmental Impact Statement.

Australian Museum Business Services 2012, *Cowal Gold Mine and Surrounds Flora Survey*, report prepared for Barrick (Australia Pacific) Limited.

AMBS Ecology & Heritage 2018, *Cowal Gold Operations Processing Rate Modification – Biodiversity Assessment Report and Biodiversity Offset Strategy*, report prepared for Evolution Mining (Cowal) Pty Limited.

AVH (Australian Virtual Herbarium), 2023, *Occurrence records*, data accessed 10 January 2023 https://avh.ala.org.au/occurrences/search?q=taxa%3A%22Lepidium+aschersonii%22#tab_mapView

Bower C 1998a, *Survey of the Cowal Project Area and surrounds for the Austral Pillwort (Pilularia novae-hollandiae),* report prepared by Orchid Research for North Limited.

Bower C 1998b, *Survey for the Endangered Peppercress, Lepidium Hyssopifolium Desv. (Brassicaceae), on the Proposed Cowal Gold Project Site and the Route of the Borefield Pipeline,* unpublished report by Orchid Research for North Limited.

Bower C 2003a*, Vegetation Community Mapping along the Pipeline/Borefield Route.*

Bower C 2003b, *Vegetation Community Mapping along the Access Road*.

Bower C 2004, *Occurrence of the Spiny Peppercress (Lepidium aschersonii) on the Temora-Cowal Electricity Transmission Line,* report prepared for Country Energy.

Charles Sturt University 1997, *Cowal Gold Project Area Botanical Survey*, report prepared for North Limited.

DPE 2019, *Spiny Peppercress - profile*, Department of Planning and Environment, viewed 12 January 2023, https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10461

DPE BioNet Atlas 2023, *Bionet Atlas Species sightings search*, Department of Planning and Environment, accessed 4 Feb 2023, https://www.environment.nsw.gov.au/atlaspublicapp/UI_Modules/ATLAS_/AtlasSearch.aspx?who=f79a4868-ab11-446b-a618-fb4012d9f84e

DPE TBDC 2023, *BioNet Threatened Biodiversity Database Collection – Ecological data: Austral Pillwort*, Department of Planning and Environment, accessed 4 Feb 2023, https://www.environment.nsw.gov.au/AtlasApp/UI_Modules/TSM_/ProfileEdit.aspx?pId=10628&pType=SpeciesCode

DPIE 2020a, *Biodiversity Assessment Method*, Department of Planning, Industry and Environment.

DSE 2009, *Flora and Fauna Guarantee Action Statement No 111 (Revised in 2009): Spiny Peppercress Lepidium aschersonii,* Department of Sustainability and Environment, Victoria.

DnA Environmental 2011a, *2010 Compensatory Wetland Regeneration Monitoring Results*, report prepared for Cowal Gold Mine.

DnA Environmental 2011b, *2010 Rehabilitation Monitoring Report*, prepared for Cowal Gold Mine.

DnA Environmental 2012a, *2011 Compensatory Wetland Regeneration Monitoring Results*, prepared for Cowal Gold Mine.

DnA Environmental 2012b, *2011 Rehabilitation Monitoring Report*, prepared for Cowal Gold Mine.

DnA Environmental 2012c, *2011 Austral Pillwort Survey*, report prepared for Cowal Gold Mine.

DnA Environmental 2013a, *2012 Compensatory Wetland Regeneration Monitoring Results*, report prepared for Cowal Gold Mine.

DnA Environmental 2013b, *2012 Rehabilitation Monitoring Report*, prepared for Cowal Gold Mine.

DnA Environmental 2013c, *2012 Austral Pillwort Survey*, prepared for Cowal Gold Mine.

DnA Environmental 2014a*, 2013 Compensatory Wetland Regeneration Monitoring Results*, report prepared for Cowal Gold Mine.

DnA Environmental 2014b, *2013 Rehabilitation Monitoring Report*, prepared for Cowal Gold Mine.

DnA Environmental 2014c, *2013 Austral Pillwort Survey*, prepared for Cowal Gold Mine.

DnA Environmental 2015a, *2015 Compensatory Wetland Regeneration Monitoring Report*, prepared for Evolution Cowal Limited.

DnA Environmental 2015b, *2014 Rehabilitation Monitoring Report*, prepared for Evolution Cowal Limited.

DnA Environmental 2015c, *2014 Austral Pillwort Survey*, prepared for Evolution Cowal Limited.

DnA Environmental 2016b, *2015 Rehabilitation Monitoring Report*, prepared for Evolution Cowal Limited.

DnA Environmental 2016c, *2015 Austral Pillwort Survey*, report prepared for Evolution Cowal Limited.

DnA Environmental 2017a, *2016 Compensatory Wetland Regeneration Monitoring Report*, prepared for Evolution Cowal Limited.

DnA Environmental 2017b, *2016 Rehabilitation Monitoring Report*, prepared for Evolution Cowal Limited.

DnA Environmental 2017c, *2016 Austral Pillwort Survey*, report prepared for Evolution Cowal Limited.

DnA Environmental 2018a, *2017 Compensatory Wetland Regeneration Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2018b, *2018 Rehabilitation Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2018c, *2017 Austral Pillwort Survey*, report prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2018d, *2017 Biodiversity Offset Areas Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2019a, *2018 Compensatory Wetland Regeneration Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2019b, *2018 Rehabilitation Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2019c, *2018 Austral Pillwort Survey*, report prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2019d, *2018 Biodiversity Offset Areas Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2020a, *2019 Compensatory Wetland Regeneration Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2020b, *2019 Rehabilitation Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2020c, *2019 Austral Pillwort Survey*, report prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2020d, *2019 Biodiversity Offset Areas Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2021a, *2020 Compensatory Wetland Regeneration Monitoring Report*, report prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2021b, *2020 Rehabilitation Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2021c, *2020 Austral Pillwort Survey*, report prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2021d, *2020 Biodiversity Offset Areas Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2022a, *2021 Compensatory Wetland Regeneration Monitoring Report*, report prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2022b, *2021 Rehabilitation Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2022c, *2021 Austral Pillwort Survey*, report prepared for Evolution Mining (Cowal) Pty Ltd.

DnA Environmental 2022d*, 2021 Biodiversity Offset Areas Monitoring Report*, prepared for Evolution Mining (Cowal) Pty Ltd.

EMM 2023, *Cowal Gold Operations Open Cut Continuation Project Biodiversity Development Assessment Report*, prepared for Evolution Mining (Cowal) Pty Limited.

FloraSearch 2013, *Cowal Gold Mine Modification - Proposed Pump Station: Impact on Flora*, report to Barrick Australia Ltd.

Hunter J 2006, *Vegetation and floristics of Brigalow Park and Claremont Nature Reserves*, report to NSW National Parks and Wildlife Service, Narrabri Area.

Leigh J, Boden R & Briggs, J 1984, *Extinct and Endangered Plants of Australia*, MacMillan, South Melbourne.

Resource Strategies Pty. Ltd. 2013, *Cowal Gold Mine Extension Modification Threatened Species Assessment*, report prepared for Barrick Australia Ltd.

Vestjens W 1977, *Status, habitats and food of vertebrates at Lake Cowal, NSW,* Division of Wildlife Research Technical Memorandum No. 12 Commonwealth Scientific and Industrial Research Organisation, Canberra.

Appendix A Approval Letter

Department of Planning and Environment

Dr Colin Bower
37 Kent Avenue
Orange NSW 2800
colinbower1948@bigpond.com

Our ref: DOC22/1099850
Sender's ref: BE 22 12

13 December 2022

Dear Dr Bower

Approval as an expert for Spiny Peppercress (*Lepidium aschersonii*)

Thank you for your application dated 14 November 2022 to the Biodiversity Conservation Division (BCD) of the Department of Planning and Environment.

BCD has reviewed the information provided in support of this request and is satisfied that you meet the definition of a species expert for Spiny Peppercress (*Lepidium aschersonii*) in accordance with section 5.3 (Box 3) of the Biodiversity Assessment Method.

Please note that this formal recognition of you as an expert only applies to the Lake Cowal Open Pit Continuation project within the Bland Local Government Area.

If you require any further information regarding this matter, please contact Andrew Fisher, Senior Team Leader Planning, via rog.southwest@environment.nsw.gov.au or 02 6022 6023.

Yours sincerely



Adam Vey
Director
South West Branch
Biodiversity and Conservation Division
Department of Planning and Environment

Appendix L
BAM Calculator Report

EMM
creating opportunities

BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id
00036405/BAAS19000/22/00036406

Proposal Name
Lake Cowal OPC

BAM data last updated *
14/04/2023

Assessor Name
Hayden John Beck

Assessor Number
BAAS19000

BAM Data version *
58

Proponent Names

Report Created
26/05/2023

BAM Case Status
Finalised

Assessment Revision
4

Assessment Type
Major Projects

Date Finalised
26/05/2023

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Potential Serious and Irreversible Impacts

Name of threatened ecological community	Listing status	Name of Plant Community Type/ID
Nil		

Species
Pilularia novae-hollandiae / Austral Pillwort

Additional Information for Approval

PCT Outside Ibra Added

None added

PCTs With Customized Benchmarks

PCT
26-Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
53-Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains
55-Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.
82-Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion
185-Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).
249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW

Predicted Threatened Species Not On Site

Name
Hylacola cautus / Shy Heathwren
Climacteris picumnus victoriae / Brown Treecreeper (eastern subspecies)

Ecosystem Credit Summary (Number and class of biodiversity credits to be retired)

BAM Biodiversity Credit Report (Like for like)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	HBT Cr	No HBT Cr	Total credits to be retired
17-Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Not a TEC	12.0	0	512	512
26-Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions	200.8	142	2335	2477
53-Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains	Not a TEC	311.1	0	9609	9609
55-Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.	Not a TEC	215.2	1579	2025	3604
82-Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions	120.2	0	2207	2207
185-Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion	Not a TEC	5.1	39	0	39
244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).	Poplar Box Grassy Woodland on Alluvial Plains	12.3	78	112	190

249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Not a TEC	52.0	939	469	1408

17-Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)

Like-for-like credit retirement options

Class	Trading group	Zone	HBT	Credits	IBRA region
Inland Floodplain Shrublands This includes PCT's: 17, 115, 161, 241, 247, 375	Inland Floodplain Shrublands >=50% and <70%	17_Medium	No	512	Lower Slopes, Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

26-Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion

Like-for-like credit retirement options

Name of offset trading group	Trading group	Zone	HBT	Credits	IBRA region

	Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions This includes PCT's: 26, 27, 37, 43, 49, 55, 145, 159, 1766	-	26_DNG	No	1614	Lower Slopes, Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions This includes PCT's: 26, 27, 37, 43, 49, 55, 145, 159, 1766	-	26_Poor	Yes	142	Lower Slopes, Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions This includes PCT's: 26, 27, 37, 43, 49, 55, 145, 159, 1766	-	26_Planted	No	422	Lower Slopes, Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions This includes PCT's: 26, 27, 37, 43, 49, 55, 145, 159, 1766	-	26_Medium	No	93	Lower Slopes, Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions This includes PCT's: 26, 27, 37, 43, 49, 55, 145, 159, 1766	-	26_High	No	206	Lower Slopes, Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
53-Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains	**Like-for-like credit retirement options**					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	Inland Floodplain Swamps This includes PCT's: 47, 53, 66, 204, 205, 238, 335, 336, 360, 361, 416, 447, 465, 1291	Inland Floodplain Swamps >=50% and <70%	53_Medium	No	9609	Lower Slopes, Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

53-Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains

55-Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.

Like-for-like credit retirement options

Class	Trading group	Zone	HBT	Credits	IBRA region
North-west Floodplain Woodlands This includes PCT's: 55	North-west Floodplain Woodlands >=70% and <90%	55_DNG	No	1695	Lower Slopes, Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
North-west Floodplain Woodlands This includes PCT's: 55	North-west Floodplain Woodlands >=70% and <90%	55_Poor	Yes	160	Lower Slopes, Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	North-west Floodplain Woodlands This includes PCT's: 55	North-west Floodplain Woodlands >=70% and <90%	55_Planted	No	330	Lower Slopes, Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	North-west Floodplain Woodlands This includes PCT's: 55	North-west Floodplain Woodlands >=70% and <90%	55_Medium	Yes	1419	Lower Slopes, Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
82-Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	**Like-for-like credit retirement options**					
	Name of offset trading group	Trading group	Zone	HBT	Credits	IBRA region

	Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions This includes PCT's: 76, 80, 81, 82, 101, 110, 237, 248, 3405	-	82_DNG	No	2024	Lower Slopes, Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions This includes PCT's: 76, 80, 81, 82, 101, 110, 237, 248, 3405	-	82_Poor	No	23	Lower Slopes, Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions This includes PCT's: 76, 80, 81, 82, 101, 110, 237, 248, 3405	-	82_Planted	No	5	Lower Slopes, Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions This includes PCT's: 76, 80, 81, 82, 101, 110, 237, 248, 3405	-	82_Regen	No	132	Lower Slopes, Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions This includes PCT's: 76, 80, 81, 82, 101, 110, 237, 248, 3405	-	82_Medium	No	23	Lower Slopes, Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

185-Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion	**Like-for-like credit retirement options**					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	Inland Rocky Hill Woodlands This includes PCT's: 104, 106, 122, 175, 176, 177, 178, 180, 184, 185, 186, 188, 218, 239, 256, 257, 258, 292, 317, 318, 319, 328, 329, 332, 334, 357, 424, 427, 439	Inland Rocky Hill Woodlands <50%	185_DNG	No	0	Lower Slopes, Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	Inland Rocky Hill Woodlands This includes PCT's: 104, 106, 122, 175, 176, 177, 178, 180, 184, 185, 186, 188, 218, 239, 256, 257, 258, 292, 317, 318, 319, 328, 329, 332, 334, 357, 424, 427, 439	Inland Rocky Hill Woodlands <50%	185_Medium	Yes	39	Lower Slopes, Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).	**Like-for-like credit retirement options**					
	Name of offset trading group	Trading group	Zone	HBT	Credits	IBRA region
	Poplar Box Grassy Woodland on Alluvial Plains This includes PCT's: 56, 87, 88, 101, 244	-	244_DNG	No	109	Lower Slopes, Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	Poplar Box Grassy Woodland on Alluvial Plains This includes PCT's: 56, 87, 88, 101, 244	-	244_Poor	No	3	Lower Slopes, Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Poplar Box Grassy Woodland on Alluvial Plains This includes PCT's: 56, 87, 88, 101, 244	-	244_Medium	Yes	78	Lower Slopes, Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	**Like-for-like credit retirement options**					
	Class	Trading group	Zone	HBT	Credits	IBRA region

	Inland Riverine Forests This includes PCT's: 9, 36, 78, 79, 112, 249, 356, 362, 4088, 4089	Inland Riverine Forests >=50% and <70%	249_DNG	No	120	Lower Slopes, Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Inland Riverine Forests This includes PCT's: 9, 36, 78, 79, 112, 249, 356, 362, 4088, 4089	Inland Riverine Forests >=50% and <70%	249_Regen	No	349	Lower Slopes, Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Inland Riverine Forests This includes PCT's: 9, 36, 78, 79, 112, 249, 356, 362, 4088, 4089	Inland Riverine Forests >=50% and <70%	249_Medium	Yes	939	Lower Slopes, Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

BAM Biodiversity Credit Report (Like for like)

Species Credit Summary

Species	Vegetation Zone/s	Area / Count	Credits
Pilularia novae-hollandiae / Austral Pillwort	**55_DNG, 55_Medium, 55_Planted, 55_Poor**	0.8	39.00

Credit Retirement Options

Like-for-like credit retirement options

	Spp	IBRA subregion
Pilularia novae-hollandiae / Austral Pillwort	**Pilularia novae-hollandiae /** Austral Pillwort	Any in NSW

BAM Candidate Species Report

Proposal Details

Assessment Id 00036405/BAAS19000/22/00036406	Proposal Name Lake Cowal OPC	BAM data last updated * 14/04/2023
Assessor Name Hayden John Beck	Report Created 26/05/2023	BAM Data version * 58
Assessor Number BAAS19000	Assessment Type Major Projects	BAM Case Status Finalised
Assessment Revision 4	Date Finalised 26/05/2023	

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List of Species Requiring Survey

Name	Presence	Survey Months
Amphibromus fluitans Floating Swamp Wallaby-grass	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☑ Dec ☐ Survey month outside the specified months?
Austrostipa metatoris A spear-grass	No (surveyed) *Survey months are outside of the months specified in Bionet.	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☑ Dec ☑ Survey month outside the specified months?
Austrostipa wakoolica A spear-grass	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☑ Dec ☐ Survey month outside the specified months?

Burhinus grallarius Bush Stone-curlew	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☑ Oct ☑ Nov ☐ Dec ☐ Survey month outside the specified months?
Calyptorhynchus lathami Glossy Black-Cockatoo	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Crinia sloanei Sloane's Froglet	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Cullen parvum Small Scurf-pea	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☑ Dec ☐ Survey month outside the specified months?
Diuris tricolor Pine Donkey Orchid	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☑ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Eleocharis obicis Spike-Rush	No (expert report)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?

Haliaeetus leucogaster White-bellied Sea-Eagle	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Hamirostra melanosternon Black-breasted Buzzard	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Hieraaetus morphnoides Little Eagle	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Lepidium aschersonii Spiny Peppercress	No (expert report)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Lepidium monoplocoides Winged Peppercress	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☑ Sep ☐ Oct ☑ Nov ☑ Dec ☐ Survey month outside the specified months?
Litoria raniformis Southern Bell Frog	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☐ Dec ☐ Survey month outside the specified months?

Lophochroa leadbeateri Major Mitchell's Cockatoo	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Lophoictinia isura Square-tailed Kite	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Myotis macropus Southern Myotis	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☐ Dec ☐ Survey month outside the specified months?
Ninox connivens Barking Owl	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Petaurus norfolcensis Squirrel Glider	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Phascolarctos cinereus Koala	No (surveyed)	☑ Jan ☑ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?

Pilularia novae-hollandiae Austral Pillwort	Yes (surveyed) *Survey months are outside of the months specified in Bionet.	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☑ Dec ☑ Survey month outside the specified months?
Polytelis swainsonii Superb Parrot	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Senecio garlandii Woolly Ragwort	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☑ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☑ Sep ☐ Oct ☑ Nov ☑ Dec ☐ Survey month outside the specified months?
Swainsona murrayana Slender Darling Pea	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☑ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Swainsona sericea Silky Swainson-pea	No (surveyed) *Survey months are outside of the months specified in Bionet.	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☑ Sep ☐ Oct ☑ Nov ☑ Dec ☑ Survey month outside the specified months?
Tyto novaehollandiae Masked Owl	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?

BAM Candidate Species Report

Threatened species Manually Added

None added

Threatened species assessed as not on site

Refer to BAR for detailed justification

Common name	Scientific name	Justification in the BAM-C
Black-tailed Godwit	Limosa limosa	Habitat constraints
Curlew Sandpiper	Calidris ferruginea	Habitat constraints
Eastern Pygmy-possum	Cercartetus nanus	Species is vagrant
Glossy Black-Cockatoo, Riverina population	Calyptorhynchus lathami - endangered population	Refer to BAR
Grey-headed Flying-fox	Pteropus poliocephalus	Habitat constraints
Lanky Buttons	Leptorhynchos orientalis	Refer to BAR
Squirrel Glider in the Wagga Wagga Local Government Area	Petaurus norfolcensis - endangered population	Species is vagrant
Swift Parrot	Lathamus discolor	Habitat constraints
White-browed Treecreeper population in Carrathool local government area south of the Lachlan River and Griffith local government area	Climacteris affinis - endangered population	Species is vagrant

BAM Predicted Species Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00036405/BAAS19000/22/00036406	Lake Cowal OPC	14/04/2023
Assessor Name	Report Created	BAM Data version *
Hayden John Beck	26/05/2023	58
Assessor Number	Assessment Type	BAM Case Status
BAAS19000	Major Projects	Finalised
Assessment Revision		Date Finalised
4		26/05/2023

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Threatened species reliably predicted to utilise the site. No surveys are required for these species. Ecosystem credits apply to these species.

Common Name	Scientific Name	Vegetation Types(s)
Australasian Bittern	Botaurus poiciloptilus	17-Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)
		53-Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains
		249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW
Australian Painted Snipe	Rostratula australis	17-Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)
		53-Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains
		249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW
Barking Owl	Ninox connivens	53-Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains
		55-Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.
		82-Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion

Barking Owl	Ninox connivens	244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).
		249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW
Black Falcon	Falco subniger	17-Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)
		26-Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
		53-Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains
		55-Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.
		82-Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion
		185-Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
		244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).
Black-breasted Buzzard	Hamirostra melanosternon	17-Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)
		55-Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.
Black-chinned Honeyeater (eastern subspecies)	Melithreptus gularis gularis	244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).
		249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW
Black-tailed Godwit	Limosa limosa	53-Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains
Blue-billed Duck	Oxyura australis	17-Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)
		53-Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains

Brolga	Grus rubicunda	17-Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)
		26-Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
		53-Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains
		82-Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion
		249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW
Corben's Long-eared Bat	Nyctophilus corbeni	55-Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.
		82-Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion
		185-Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
		244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).
		249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW
Curlew Sandpiper	Calidris ferruginea	53-Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains
Diamond Firetail	Stagonopleura guttata	26-Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
		55-Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.
		82-Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion
		185-Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
		244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).

Diamond Firetail	Stagonopleura guttata	249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW
Dusky Woodswallow	Artamus cyanopterus cyanopterus	17-Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)
		26-Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
		53-Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains
		55-Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.
		82-Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion
		185-Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
		244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).
		249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW
Flame Robin	Petroica phoenicea	82-Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion
		185-Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
		249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW
Freckled Duck	Stictonetta naevosa	17-Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)
		53-Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains
		249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW
Gilbert's Whistler	Pachycephala inornata	17-Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)

Gilbert's Whistler	Pachycephala inornata	185-Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
Glossy Black-Cockatoo	Calyptorhynchus lathami	55-Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.
		82-Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion
		185-Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
Grey Falcon	Falco hypoleucos	17-Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)
		26-Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
		53-Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains
		55-Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.
		82-Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion
		244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).
		249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW
Grey-crowned Babbler (eastern subspecies)	Pomatostomus temporalis temporalis	26-Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
		55-Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.
		82-Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion
		185-Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
		244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).

Grey-crowned Babbler (eastern subspecies)	Pomatostomus temporalis temporalis	249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW
Grey-headed Flying-fox	Pteropus poliocephalus	55-Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.
		244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).
Hooded Robin (south-eastern form)	Melanodryas cucullata cucullata	26-Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
		55-Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.
		82-Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion
		185-Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
		244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).
		249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW
Little Eagle	Hieraaetus morphnoides	17-Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)
		26-Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
		53-Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains
		55-Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.
		82-Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion
		185-Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
		244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).

Little Eagle	Hieraaetus morphnoides	249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW
Little Pied Bat	Chalinolobus picatus	17-Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)
		26-Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
		53-Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains
		55-Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.
		82-Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion
		185-Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
		244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).
		249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW
Magpie Goose	Anseranas semipalmata	53-Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains
		249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW
Major Mitchell's Cockatoo	Lophochroa leadbeateri	26-Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
		55-Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.
		82-Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion
		185-Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
		244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).

Major Mitchell's Cockatoo	Lophochroa leadbeateri	249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW
Malleefowl	Leipoa ocellata	185-Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
Masked Owl	Tyto novaehollandiae	26-Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
		53-Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains
		55-Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.
		82-Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion
		244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).
		249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW
Painted Honeyeater	Grantiella picta	26-Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
		55-Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.
		82-Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion
		185-Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
		244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).
		249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW
Pied Honeyeater	Certhionyx variegatus	26-Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
		55-Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.

Pied Honeyeater	Certhionyx variegatus	82-Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion
		185-Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
		244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).
		249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW
Purple-crowned Lorikeet	Glossopsitta porphyrocephala	249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW
Scarlet Robin	Petroica boodang	26-Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
		82-Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion
		185-Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
		244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).
		249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW
Speckled Warbler	Chthonicola sagittata	55-Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.
		82-Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion
		185-Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
		244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).
		249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW

Spotted Harrier	Circus assimilis	17-Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)
		26-Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
		53-Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains
		55-Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.
		82-Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion
		244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).
		249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW
Spotted-tailed Quoll	Dasyurus maculatus	249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW
Square-tailed Kite	Lophoictinia isura	26-Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
		55-Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.
		244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).
		249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW
Stripe-faced Dunnart	Sminthopsis macroura	55-Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.
		244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).
		249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW
Superb Parrot	Polytelis swainsonii	26-Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
		55-Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.

Superb Parrot	Polytelis swainsonii	82-Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion
		244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).
		249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW
Swift Parrot	Lathamus discolor	26-Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
		55-Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.
		82-Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion
		185-Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
		244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).
		249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW
Turquoise Parrot	Neophema pulchella	82-Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion
		185-Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
		244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).
		249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW
Varied Sittella	Daphoenositta chrysoptera	26-Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
		55-Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.
		82-Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion

Varied Sittella	Daphoenositta chrysoptera	185-Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
		244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).
		249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW
White-bellied Sea-Eagle	Haliaeetus leucogaster	17-Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)
		26-Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
		53-Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains
		55-Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.
		82-Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion
		185-Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
		244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).
		249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW
White-fronted Chat	Epthianura albifrons	17-Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)
		53-Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains
White-throated Needletail	Hirundapus caudacutus	17-Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)
		26-Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
		53-Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains

White-throated Needletail	Hirundapus caudacutus	55-Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.
		82-Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion
		185-Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
		244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).
		249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW
Yellow-bellied Sheathtail-bat	Saccolaimus flaviventris	17-Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)
		26-Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
		53-Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains
		55-Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.
		82-Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion
		185-Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
		244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).
		249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW

Threatened species Manually Added

None added

Threatened species assessed as not within the vegetation zone(s) for the PCT(s)

Common Name	Scientific Name	Plant Community Type(s)
Brown Treecreeper (eastern subspecies)	Climacteris picumnus victoriae	244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).
		249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW
Glossy Black-Cockatoo	Calyptorhynchus lathami	244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).
Shy Heathwren	Hylacola cautus	185-Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion

Threatened species assessed as not within the vegetation zone(s) for the PCT(s)

Refer to BAR for detailed justification

Common Name	Scientific Name	Justification in the BAM-C
Brown Treecreeper (eastern subspecies)	Climacteris picumnus victoriae	Refer to BAR
Shy Heathwren	Hylacola cautus	Refer to BAR

BAM Vegetation Zones Report

Proposal Details

Assessment Id
00036405/BAAS19000/22/00036406

Assessment name
Lake Cowal OPC

BAM data last updated *
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Assessor Name
Hayden John Beck

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26/05/2023

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Major Projects

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Finalised

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4

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* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Vegetation Zones

#	Name	PCT	Condition	Area	Minimum number of plots	Management zones
1	17_Medium	17-Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Medium	12.04	3	

2	26_DNG	26-Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	DNG	179.14	6	
3	26_Poor	26-Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	Poor	4.04	2	
4	26_Planted	26-Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	Planted	10.57	3	
5	26_Medium	26-Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	Medium	2.58	2	
6	26_High	26-Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	High	4.49	2	
7	53_Medium	53-Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains	Medium	311.08	7	
8	55_DNG	55-Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.	DNG	166.34	6	
9	55_Poor	55-Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.	Poor	6.14	3	

10	55_Planted	55-Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.	Planted	8.83	3	
11	55_Medium	55-Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.	Medium	33.87	4	
12	82_DNG	82-Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	DNG	113.02	6	
13	82_Poor	82-Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	Poor	0.94	1	
14	82_Planted	82-Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	Planted	0.37	1	
15	82_Regen	82-Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	Regen	5.23	3	
16	82_Medium	82-Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	Medium	0.62	1	

17	185_DNG	185-Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion	DNG	3.56	2	
18	185_Medium	185-Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion	Medium	1.5	1	
19	244_DNG	244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).	DNG	10.33	3	
20	244_Poor	244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).	Poor	0.21	1	
21	244_Medium	244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).	Medium	1.75	1	
22	249_DNG	249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	DNG	6.85	3	
23	249_Regen	249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Regen	16.53	3	

24	249_Medium	249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Medium	28.58	4	

BAM Credit Summary Report

Proposal Details

Assessment Id
00036405/BAAS19000/22/00036406

Proposal Name
Lake Cowal OPC

BAM data last updated *
14/04/2023

Assessor Name
Hayden John Beck

Report Created
26/05/2023

BAM Data version *
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Assessor Number
BAAS19000

BAM Case Status
Finalised

Date Finalised
26/05/2023

Assessment Revision
4

Assessment Type
Major Projects

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	Sensitivity to loss (Justification)	Species sensitivity to gain class	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAII	Ecosystem credits
Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.												
8	55_DNG	Not a TEC	20.4	20.4	166.3	PCT Cleared - 83%	High Sensitivity to Gain			2.00		1695

9	55_Poor	Not a TEC	52.1	52.1	6.1	PCT Cleared - 83%	High Sensitivity to Gain			2.00		160
10	55_Planted	Not a TEC	74.7	74.7	8.8	PCT Cleared - 83%	High Sensitivity to Gain			2.00		330
11	55_Medium	Not a TEC	83.8	83.8	33.9	PCT Cleared - 83%	High Sensitivity to Gain			2.00		1419
											Subtotal	**3604**
Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion												
17	185_DNG	Not a TEC	11.9	11.9	3.6	PCT Cleared - 20%	High Sensitivity to Gain			1.50		0
18	185_Medium	Not a TEC	68.5	68.5	1.5	PCT Cleared - 20%	High Sensitivity to Gain			1.50		39
											Subtotal	**39**
Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)												
1	17_Medium	Not a TEC	97.2	97.2	12	PCT Cleared - 63%	High Sensitivity to Gain			1.75		512
											Subtotal	**512**

Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).												
19	244_DNG	Poplar Box Grassy Woodland on Alluvial Plains	21	21.0	10.3	Environment Protection and Conservation Act listing status	High Sensitivity to Gain	Not Listed	Endangered	2.00		109
20	244_Poor	Poplar Box Grassy Woodland on Alluvial Plains	31.7	31.7	0.21	Environment Protection and Conservation Act listing status	High Sensitivity to Gain	Not Listed	Endangered	2.00		3
21	244_Medium	Poplar Box Grassy Woodland on Alluvial Plains	89.5	89.5	1.8	Environment Protection and Conservation Act listing status	High Sensitivity to Gain	Not Listed	Endangered	2.00		78
											Subtotal	**190**
River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW												
22	249_DNG	Not a TEC	40.1	40.1	6.8	PCT Cleared - 50%	High Sensitivity to Gain			1.75		120
23	249_Regen	Not a TEC	48.2	48.2	16.5	PCT Cleared - 50%	High Sensitivity to Gain			1.75		349

24	249_Medium	Not a TEC	75.1	75.1	28.6	PCT Cleared - 50%	High Sensitivity to Gain			1.75		939
											Subtotal	**1408**
Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains												
7	53_Medium	Not a TEC	70.6	70.6	311.1	PCT Cleared - 67%	High Sensitivity to Gain			1.75		9609
											Subtotal	**9609**
Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion												
2	26_DNG	Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions	18	18.0	179.1	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00		1614

3	26_Poor	Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions	70.1	70.1	4	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00		142
4	26_Planted	Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions	79.8	79.8	10.6	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00		422

5	26_Medium	Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions	72	72.0	2.6	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00		93
6	26_High	Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions	91.6	91.6	4.5	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00		206
											Subtotal	**2477**

Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion												
12	82_DNG	Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions	35.8	35.8	113	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00		2024
13	82_Poor	Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions	49.7	49.7	0.94	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00		23
14	82_Planted	Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions	24.7	24.7	0.37	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00		5

15	82_Regen	Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions	50.4	50.4	5.2	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00	132
16	82_Medium	Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions	75.3	75.3	0.62	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00	23
										Subtotal	**2207**
										Total	**20046**

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	Sensitivity to loss (Justification)	Sensitivity to gain (Justification)	BC Act Listing status	EPBC Act listing status	Potential SAII	Species credits

Pilularia novae-hollandiae / Austral Pillwort (Flora)									
55_DNG	20.4	20.4	0.25	Geographic Distribution	Ecology or response to management is poorly known	Endangered	Not Listed	True	4
55_Medium	83.8	83.8	0.3	Geographic Distribution	Ecology or response to management is poorly known	Endangered	Not Listed	True	19
55_Planted	74.7	74.7	0.27	Geographic Distribution	Ecology or response to management is poorly known	Endangered	Not Listed	True	15
55_Poor	52.1	52.1	0.01	Geographic Distribution	Ecology or response to management is poorly known	Endangered	Not Listed	True	1
								Subtotal	**39**

BAM Biodiversity Credit Report (Variations)

Proposal Details

Assessment Id
00036405/BAAS19000/22/00036406

Proposal Name
Lake Cowal OPC

BAM data last updated *
14/04/2023

Assessor Name
Hayden John Beck

Assessor Number
BAAS19000

BAM Data version *
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Proponent Name(s)

Report Created
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BAM Case Status
Finalised

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Assessment Type
Major Projects

Date Finalised
26/05/2023

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Potential Serious and Irreversible Impacts

Name of threatened ecological community	Listing status	Name of Plant Community Type/ID
Nil		

Species
Pilularia novae-hollandiae / Austral Pillwort

Additional Information for Approval

PCT Outside Ibra Added

None added

PCTs With Customized Benchmarks

PCT
26-Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
53-Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains
55-Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.
82-Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion
185-Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).
249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW

Predicted Threatened Species Not On Site

Name
Hylacola cautus / Shy Heathwren
Climacteris picumnus victoriae / Brown Treecreeper (eastern subspecies)

Ecosystem Credit Summary (Number and class of biodiversity credits to be retired)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	HBT Cr	No HBT Cr	Total credits to be retired
17-Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Not a TEC	12.0	0	512	512.00
26-Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions	200.8	142	2335	2477.00
53-Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains	Not a TEC	311.1	0	9609	9609.00

55-Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.	Not a TEC	215.2	1579	2025	3604.00
82-Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions	120.2	0	2207	2207.00
185-Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion	Not a TEC	5.1	39	0	39.00
244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).	Poplar Box Grassy Woodland on Alluvial Plains	12.3	78	112	190.00
249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	Not a TEC	52.0	939	469	1408.00

17-Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)

Like-for-like credit retirement options

Class	Trading group	Zone	HBT	Credits	IBRA region
Inland Floodplain Shrublands This includes PCT's: 17, 115, 161, 241, 247, 375	Inland Floodplain Shrublands >=50% and <70%	17_Medium	No	512	Lower Slopes,Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Variation options

Formation	Trading group	Zone	HBT	Credits	IBRA region

	Freshwater Wetlands	Tier 3 or higher threat status	17_Medium	No	512	IBRA Region: NSW South Western Slopes, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

26-Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion

Like-for-like credit retirement options

Class	Trading group	Zone	HBT	Credits	IBRA region
Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions This includes PCT's: 26, 27, 37, 43, 49, 55, 145, 159, 1766	-	26_DNG	No	1614	Lower Slopes,Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions This includes PCT's: 26, 27, 37, 43, 49, 55, 145, 159, 1766	-	26_Poor	Yes	142	Lower Slopes,Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions This includes PCT's: 26, 27, 37, 43, 49, 55, 145, 159, 1766	-	26_Planted	No	422	Lower Slopes,Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions This includes PCT's: 26, 27, 37, 43, 49, 55, 145, 159, 1766	-	26_Medium	No	93	Lower Slopes,Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions This includes PCT's: 26, 27, 37, 43, 49, 55, 145, 159, 1766	-	26_High	No	206	Lower Slopes,Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Variation options

Formation	Trading group	Zone	HBT	Credits	IBRA region
Semi-arid Woodlands (Grassy sub-formation)	Tier 1	26_DNG	No	1614	IBRA Region: NSW South Western Slopes, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	Semi-arid Woodlands (Grassy sub-formation)	Tier 1	26_Poor	Yes (including artificial)	142	IBRA Region: NSW South Western Slopes, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Semi-arid Woodlands (Grassy sub-formation)	Tier 1	26_Planted	No	422	IBRA Region: NSW South Western Slopes, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Semi-arid Woodlands (Grassy sub-formation)	Tier 1	26_Medium	No	93	IBRA Region: NSW South Western Slopes, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Semi-arid Woodlands (Grassy sub-formation)	Tier 1	26_High	No	206	IBRA Region: NSW South Western Slopes, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
53-Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains	**Like-for-like credit retirement options**					
	Class	Trading group	Zone	HBT	Credits	IBRA region

	Inland Floodplain Swamps This includes PCT's: 47, 53, 66, 204, 205, 238, 335, 336, 360, 361, 416, 447, 465, 1291	Inland Floodplain Swamps >=50% and <70%	53_Medium	No	9609	Lower Slopes,Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Variation options					
	Formation	Trading group	Zone	HBT	Credits	IBRA region
	Freshwater Wetlands	Tier 3 or higher threat status	53_Medium	No	9609	IBRA Region: NSW South Western Slopes, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
55-Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.	**Like-for-like credit retirement options**					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	North-west Floodplain Woodlands This includes PCT's: 55	North-west Floodplain Woodlands >=70% and <90%	55_DNG	No	1695	Lower Slopes,Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

North-west Floodplain Woodlands This includes PCT's: 55	North-west Floodplain Woodlands >=70% and <90%	55_Poor	Yes	160	Lower Slopes,Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
North-west Floodplain Woodlands This includes PCT's: 55	North-west Floodplain Woodlands >=70% and <90%	55_Planted	No	330	Lower Slopes,Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
North-west Floodplain Woodlands This includes PCT's: 55	North-west Floodplain Woodlands >=70% and <90%	55_Medium	Yes	1419	Lower Slopes,Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Variation options

Formation	Trading group	Zone	HBT	Credits	IBRA region
Semi-arid Woodlands (Grassy sub-formation)	Tier 2 or higher threat status	55_DNG	No	1695	IBRA Region: NSW South Western Slopes, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	Semi-arid Woodlands (Grassy sub-formation)	Tier 2 or higher threat status	55_Poor	Yes (including artificial)	160	IBRA Region: NSW South Western Slopes, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Semi-arid Woodlands (Grassy sub-formation)	Tier 2 or higher threat status	55_Planted	No	330	IBRA Region: NSW South Western Slopes, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Semi-arid Woodlands (Grassy sub-formation)	Tier 2 or higher threat status	55_Medium	Yes (including artificial)	1419	IBRA Region: NSW South Western Slopes, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
82-Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	**Like-for-like credit retirement options**					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions This includes PCT's: 76, 80, 81, 82, 101, 110, 237, 248, 3405	-	82_DNG	No	2024	Lower Slopes,Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions This includes PCT's: 76, 80, 81, 82, 101, 110, 237, 248, 3405	-	82_Poor	No	23	Lower Slopes,Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions This includes PCT's: 76, 80, 81, 82, 101, 110, 237, 248, 3405	-	82_Planted	No	5	Lower Slopes,Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions This includes PCT's: 76, 80, 81, 82, 101, 110, 237, 248, 3405	-	82_Regen	No	132	Lower Slopes,Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions This includes PCT's: 76, 80, 81, 82, 101, 110, 237, 248, 3405	-	82_Medium	No	23	Lower Slopes,Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Variation options

Formation	Trading group	Zone	HBT	Credits	IBRA region
Grassy Woodlands	Tier 3 or higher threat status	82_DNG	No	2024	IBRA Region: NSW South Western Slopes, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Grassy Woodlands	Tier 3 or higher threat status	82_Poor	No	23	IBRA Region: NSW South Western Slopes, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Grassy Woodlands	Tier 3 or higher threat status	82_Planted	No	5	IBRA Region: NSW South Western Slopes, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	Grassy Woodlands	Tier 3 or higher threat status	82_Regen	No	132	IBRA Region: NSW South Western Slopes, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Grassy Woodlands	Tier 3 or higher threat status	82_Medium	No	23	IBRA Region: NSW South Western Slopes, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
185-Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion	**Like-for-like credit retirement options**					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	Inland Rocky Hill Woodlands This includes PCT's: 104, 106, 122, 175, 176, 177, 178, 180, 184, 185, 186, 188, 218, 239, 256, 257, 258, 292, 317, 318, 319, 328, 329, 332, 334, 357, 424, 427, 439	Inland Rocky Hill Woodlands <50%	185_DNG	No	0	Lower Slopes,Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	Inland Rocky Hill Woodlands This includes PCT's: 104, 106, 122, 175, 176, 177, 178, 180, 184, 185, 186, 188, 218, 239, 256, 257, 258, 292, 317, 318, 319, 328, 329, 332, 334, 357, 424, 427, 439	Inland Rocky Hill Woodlands <50%	185_Medium	Yes	39	Lower Slopes,Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Variation options					
	Formation	Trading group	Zone	HBT	Credits	IBRA region
	Semi-arid Woodlands (Shrubby sub-formation)	Tier 4 or higher threat status	185_DNG	No	0	IBRA Region: NSW South Western Slopes, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Semi-arid Woodlands (Shrubby sub-formation)	Tier 4 or higher threat status	185_Medium	Yes (including artificial)	39	IBRA Region: NSW South Western Slopes, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
244-Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).	**Like-for-like credit retirement options**					
	Class	Trading group	Zone	HBT	Credits	IBRA region

Poplar Box Grassy Woodland on Alluvial Plains This includes PCT's: 56, 87, 88, 101, 244	-	244_DNG	No	109	Lower Slopes,Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Poplar Box Grassy Woodland on Alluvial Plains This includes PCT's: 56, 87, 88, 101, 244	-	244_Poor	No	3	Lower Slopes,Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Poplar Box Grassy Woodland on Alluvial Plains This includes PCT's: 56, 87, 88, 101, 244	-	244_Medium	Yes	78	Lower Slopes,Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Variation options

Formation	Trading group	Zone	HBT	Credits	IBRA region
Grassy Woodlands	Tier 2 or higher threat status	244_DNG	No	109	IBRA Region: NSW South Western Slopes, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	Grassy Woodlands	Tier 2 or higher threat status	244_Poor	No	3	IBRA Region: NSW South Western Slopes, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Grassy Woodlands	Tier 2 or higher threat status	244_Medium	Yes (including artificial)	78	IBRA Region: NSW South Western Slopes, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
249-River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	**Like-for-like credit retirement options**					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	Inland Riverine Forests This includes PCT's: 9, 36, 78, 79, 112, 249, 356, 362, 4088, 4089	Inland Riverine Forests >=50% and <70%	249_DNG	No	120	Lower Slopes,Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Inland Riverine Forests This includes PCT's: 9, 36, 78, 79, 112, 249, 356, 362, 4088, 4089	Inland Riverine Forests >=50% and <70%	249_Regen	No	349	Lower Slopes,Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Inland Riverine Forests This includes PCT's: 9, 36, 78, 79, 112, 249, 356, 362, 4088, 4089	Inland Riverine Forests >=50% and <70%	249_Medium	Yes	939	Lower Slopes,Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Variation options

Formation	Trading group	Zone	HBT	Credits	IBRA region
Forested Wetlands	Tier 3 or higher threat status	249_DNG	No	120	IBRA Region: NSW South Western Slopes, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Forested Wetlands	Tier 3 or higher threat status	249_Regen	No	349	IBRA Region: NSW South Western Slopes, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Forested Wetlands	Tier 3 or higher threat status	249_Medium	Yes (including artificial)	939	IBRA Region: NSW South Western Slopes, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

Species	Vegetation Zone/s	Area / Count	Credits
Pilularia novae-hollandiae / Austral Pillwort	**55_DNG, 55_Medium, 55_Planted, 55_Poor**	0.8	39.00

Credit Retirement Options

Like-for-like options

Pilularia novae-hollandiae/ Austral Pillwort	Spp	IBRA region	
	Pilularia novae-hollandiae/Austral Pillwort	Any in NSW	
	Variation options		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region
	Flora	Endangered	Lower Slopes, Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Appendix M
Protected Matters Search

EMM
creating opportunities

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 07-Feb-2023

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	4
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	4
Listed Threatened Species:	29
Listed Migratory Species:	13

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	20
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	None
Regional Forest Agreements:	None
Nationally Important Wetlands:	1
EPBC Act Referrals:	7
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar Wetlands)		[Resource Information]
Ramsar Site Name	Proximity	Buffer Status
Banrock station wetland complex	600 - 700km upstream from Ramsar site	In feature area
Hattah-kulkyne lakes	400 - 500km upstream from Ramsar site	In feature area
Riverland	500 - 600km upstream from Ramsar site	In feature area
The coorong, and lakes alexandrina and albert wetland	700 - 800km upstream from Ramsar site	In feature area

Listed Threatened Ecological Communities			[Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text	Buffer Status
Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	Endangered	Community likely to occur within area	In feature area
Poplar Box Grassy Woodland on Alluvial Plains	Endangered	Community likely to occur within area	In feature area
Weeping Myall Woodlands	Endangered	Community likely to occur within area	In feature area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area	In feature area

Listed Threatened Species			[Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			

Scientific Name	Threatened Category	Presence Text	Buffer Status
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Calyptorhynchus lathami lathami South-eastern Glossy Black-Cockatoo [67036]	Vulnerable	Species or species habitat may occur within area	In feature area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat known to occur within area	In feature area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat known to occur within area	In feature area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat may occur within area	In feature area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area	In feature area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat known to occur within area	In feature area
Limosa lapponica baueri Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat may occur within area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Pezoporus occidentalis](#) Night Parrot [59350]	Endangered	Species or species habitat may occur within area	In buffer area only
[Polytelis swainsonii](#) Superb Parrot [738]	Vulnerable	Species or species habitat known to occur within area	In feature area
[Rostratula australis](#) Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area	In feature area
FISH			
[Maccullochella macquariensis](#) Trout Cod [26171]	Endangered	Species or species habitat may occur within area	In buffer area only
[Macquaria australasica](#) Macquarie Perch [66632]	Endangered	Species or species habitat may occur within area	In feature area
FROG			
[Crinia sloanei](#) Sloane's Froglet [59151]	Endangered	Species or species habitat may occur within area	In feature area
MAMMAL			
[Dasyurus maculatus maculatus (SE mainland population)](#) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area	In buffer area only
[Nyctophilus corbeni](#) Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat known to occur within area	In feature area
[Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)](#) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Endangered	Species or species habitat likely to occur within area	In feature area
[Pteropus poliocephalus](#) Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour may occur within area	In feature area
PLANT			

Scientific Name	Threatened Category	Presence Text	Buffer Status
Austrostipa metatoris [66704]	Vulnerable	Species or species habitat may occur within area	In feature area
Austrostipa wakoolica [66623]	Endangered	Species or species habitat known to occur within area	In feature area
Lepidium aschersonii Spiny Pepper-cress [10976]	Vulnerable	Species or species habitat may occur within area	In feature area
Lepidium monoplocoides Winged Pepper-cress [9190]	Endangered	Species or species habitat may occur within area	In feature area
Swainsona murrayana Slender Darling-pea, Slender Swainson, Murray Swainson-pea [6765]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Vincetoxicum forsteri listed as Tylophora linearis [92384]	Endangered	Species or species habitat may occur within area	In feature area
REPTILE			
Aprasia parapulchella Pink-tailed Worm-lizard, Pink-tailed Legless Lizard [1665]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Hemiaspis damelii Grey Snake [1179]	Endangered	Species or species habitat likely to occur within area	In feature area

Listed Migratory Species			[Resource Information]
Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
Migratory Terrestrial Species			
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Motacilla flava](#) Yellow Wagtail [644]		Species or species habitat may occur within area	In feature area
[Myiagra cyanoleuca](#) Satin Flycatcher [612]		Species or species habitat may occur within area	In feature area
[Rhipidura rufifrons](#) Rufous Fantail [592]		Species or species habitat known to occur within area	In buffer area only
Migratory Wetlands Species			
[Actitis hypoleucos](#) Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
[Calidris acuminata](#) Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area	In feature area
[Calidris ferruginea](#) Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area	In feature area
[Calidris melanotos](#) Pectoral Sandpiper [858]		Species or species habitat known to occur within area	In feature area
[Gallinago hardwickii](#) Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area	In feature area
[Limosa lapponica](#) Bar-tailed Godwit [844]		Species or species habitat known to occur within area	In feature area
[Numenius madagascariensis](#) Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area
[Tringa nebularia](#) Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area	In buffer area only

Other Matters Protected by the EPBC Act

Listed Marine Species			[Resource Information]
Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
Bubulcus ibis as Ardea ibis Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area overfly marine area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area overfly marine area	In feature area
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat likely to occur within area overfly marine area	In feature area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area overfly marine area	In feature area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat may occur within area overfly marine area	In feature area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area overfly marine area	In feature area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area	In feature area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area	In feature area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat may occur within area overfly marine area	In feature area
Neophema chrysostoma Blue-winged Parrot [726]		Species or species habitat likely to occur within area overfly marine area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area overfly marine area	In buffer area only
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Tringa nebularia			
Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area overfly marine area	In buffer area only

Extra Information

Nationally Important Wetlands		[Resource Information]
Wetland Name	State	Buffer Status
Lake Cowal/Wilbertroy Wetlands	NSW	In feature area

EPBC Act Referrals				[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Cowal Gold Operations Open Pit Continuation Project	2022/09223		Assessment	In feature area
Controlled action				
Cowal Gold Operations increased processing rate, Lake Cowal, NSW	2017/7989	Controlled Action	Post-Approval	In feature area
Not controlled action				
Cowal Gold Operations Underground Development	2019/8512	Not Controlled Action	Completed	In feature area
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In feature area
INDIGO Central Submarine Telecommunications Cable	2017/8127	Not Controlled Action	Completed	In feature area
The Cowal Gold Project	2001/421	Not Controlled Action	Completed	In feature area
Not controlled action (particular manner)				
INDIGO Marine Cable Route Survey (INDIGO)	2017/7996	Not Controlled Action (Particular Manner)	Post-Approval	In feature area

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

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