

APPENDIX D

Biodiversity Development Assessment Report

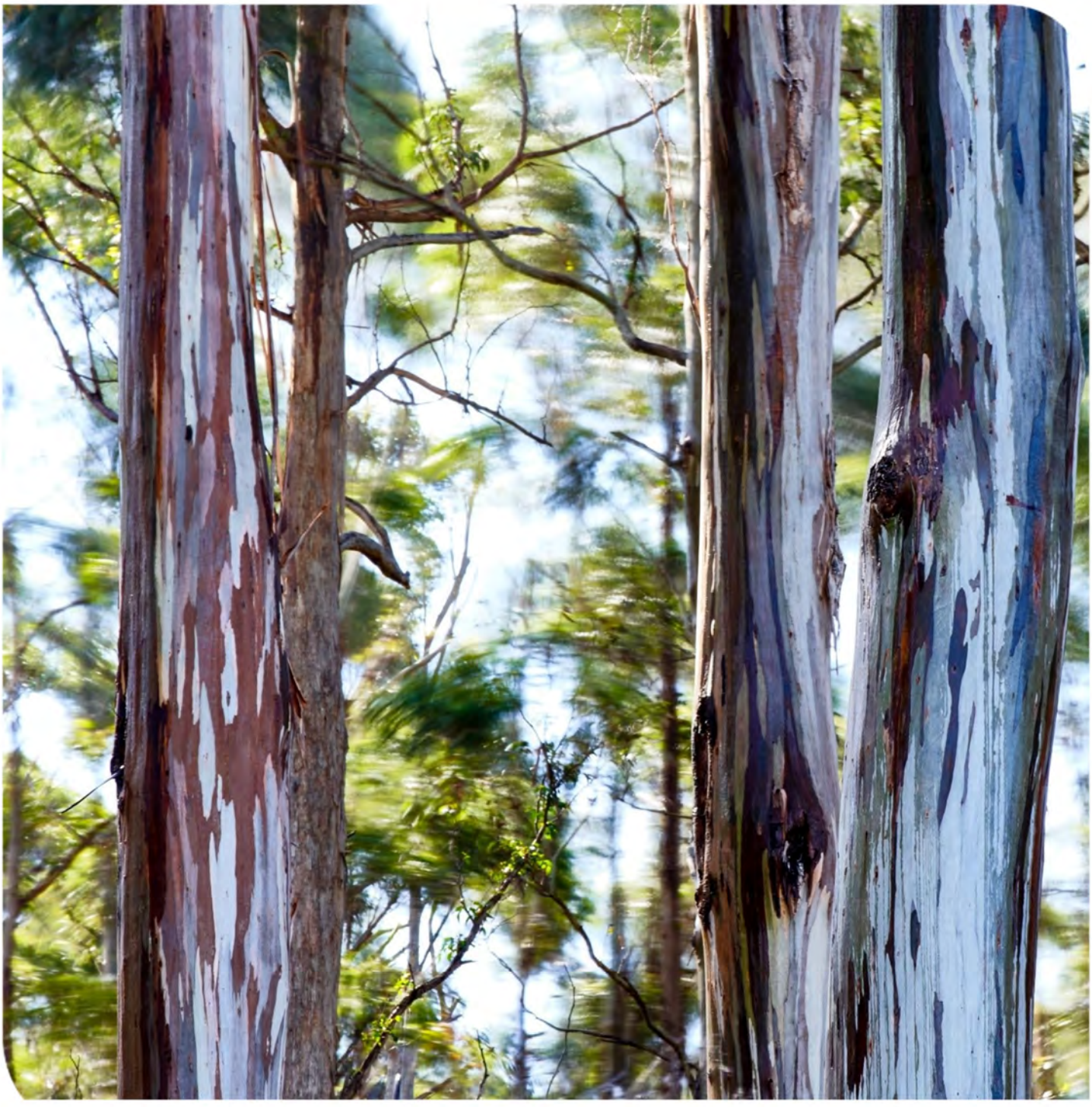
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Dendrobium Mine Extension Project

Biodiversity Development Assessment Report

Prepared for Illawarra Metallurgical Coal | 28 March 2022



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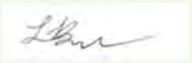
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Project number	Client	Project manager	LGA
6624	Prepared for Illawarra Metallurgical Coal	Simon Tweed & Luke Baker	Wollongong City Council, Wingecarribee Shire Council, Wollondilly Shire Council

Declaration:

This Biodiversity Development Assessment Report has been prepared on the basis of the requirements of (and information provided under) the Biodiversity Assessment Method as certified by BAM Accredited Assessor: Luke Baker (BAAS #BAAS17033) for all threatened flora and BAM-C calculations; and Simon Tweed (BAAS #BAAS17040) for all threatened fauna inputs.

Signature:





Version	Author	Review	Status	Date
Rev1	Luke Baker, Simon Tweed, Jessie Bear, Luke Stone	Resource Strategies	Rev1	28/03/2022

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Executive summary

Context

Background

The Dendrobium Mine is an underground coal mine situated in the Southern Coalfield of New South Wales (NSW) approximately 8 kilometres (km) west of Wollongong.

Illawarra Coal Holdings Pty Ltd (Illawarra Metallurgical Coal [IMC]), a wholly owned subsidiary of South32 Limited (South32), is the owner and operator of the Dendrobium Mine. The Dendrobium Mine, Appin Mine and supporting operations are managed by IMC. Development Consent DA 60-03-2001 for the Dendrobium Mine was granted by the NSW Minister for Urban Affairs and Planning under the NSW Environmental Planning and Assessment Act 1979 (EP&A Act) in November 2001.

The Dendrobium Mine extracts coal from the Wongawilli Seam (also known as the No 3 Seam) within Consolidated Coal Lease (CCL) 768 using underground longwall mining methods. The Dendrobium Mine includes five approved underground mining domains, named Areas 1, 2, 3A, 3B and 3C. Longwall mining is currently being undertaken in Area 3B, with extraction largely complete in Areas 1, 2 and 3A.

The Dendrobium Mine has an approved operational capacity of up to 5.2 million tonnes per annum (Mtpa) of run of mine (ROM) coal until 31 December 2030.

IMC is seeking an Infrastructure Approval for the Dendrobium Mine Extension Project (the Project), which would support the extraction of approximately 31 million tonnes (Mt) of ROM coal from Area 5, within CCL 768. The life of the Project includes longwall mining in Area 5 up to approximately 31 December 2034, and ongoing use of existing surface facilities for handling of Area 3C ROM coal until 2041. The underground mining area will be serviced by associated infrastructure such as the proposed Ventilation Shaft Site, electricity transmission line (ETL) and service boreholes and the existing infrastructure at the existing Dendrobium Mine. Additional personnel will use the Dendrobium Pit Top Carpark Extension and Cordeaux Dam Access Road Construction Carpark.

Aims

Niche Environment and Heritage Pty Ltd (Niche) was commissioned by IMC to prepare a Biodiversity Development Assessment Report (BDAR) in accordance with the *Biodiversity Assessment Method* (BAM) (DPIE 2020a).

The BDAR describes and assesses potential impacts to biodiversity values from the Project, including threatened biodiversity listed under the *NSW Biodiversity Conservation Act 2016* (BC Act) and Matters of National Environmental Significance (MNES) listed on the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). In addition to requirements under the BAM and Commonwealth environmental approvals process, this BDAR addresses specific requirements relating to biodiversity provided in the Secretary's Environmental Assessment Requirements (SEARs) for the State Significant Infrastructure application for the Project.

The assessment has utilised the findings of other specialist studies in preparation of the impact assessment, that of Mine Subsidence Engineering Consultants (MSEC) (2022) in regard to subsidence predictions associated with the Project; and detailed historic analysis completed by Watershed (2021) of Dendrobium Mine Coastal Upland Swamps and swamp piezometer data following longwall mining.

Subject Land

The Subject Land refers to the proposed mining area (Area 5, including the predicted extent of subsidence – 20 millimetre (mm) subsidence contour) as well as areas proposed for surface infrastructure (referred to as the Biodiversity Assessment Development Footprint).

The Subject Land is 922.73 hectares (ha) in size which includes a total of 30.08 ha of the Biodiversity Assessment Development Footprint.

The BDAR has also considered the potential subsidence impacts on features that are potentially sensitive to subsidence within a 600 metre (m) buffer from the proposed longwalls (referred to as the Subsidence Assessment Subject Land).

Surface infrastructure sites - Areas of direct impact

The direct impacts of the Project occur within a 30.08 ha disturbance area to support surface infrastructure with approximately a third of that (10.2 ha) located on previously disturbed land to mitigate impacts. The surface infrastructure, including the area occupied by native vegetation that occurs within each location has been provided in table below:

Surface infrastructure site	Area of Disturbance (ha)	Area of Native Vegetation Impacted (ha)
Ventilation Shaft Site No 5A	15.37	14.64
Ventilation shaft construction – water pumping	0.69	0.69
Ventilation shaft construction - Fire Trail upgrades for construction	0.26	0.21
Dendrobium Pit Top Carpark Extension	0.40	0.17
Electricity Transmission Line (ETL) and pole placement (0.1 ha)	13.05	3.99
Cordeaux Dam Access Road Construction Carpark	0.15	0.15
ETL laydown area nominated near Cordeaux Dam Access Road	0.16	0.00
Total Area	**30.08**	**19.85**

Survey overview

The Subject Land and Subsidence Assessment Subject Land has been the subject of extensive targeted biodiversity surveys since 2016 using relevant State and Commonwealth threatened biodiversity survey guidelines.

The survey effort concentrated on areas that would be directly impacted by the clearing associated with surface infrastructure (Biodiversity Assessment Development Footprint), and natural features that may be susceptible to subsidence related impacts i.e., Coastal Upland Swamps, watercourses, and cliff lines.

The field survey involved the following key tasks:

- Mapping the extent and condition of Plant Community Types (PCTs) within the Subject Land.
- Identification of threatened biodiversity and associated habitat.

- Collection of flora attribute data within the Subject Land using BAM plots.
- Targeted survey for threatened flora species.
- Targeted survey for threatened fauna species that are regarded in the BAM as 'species credit fauna'.

Results

Native vegetation assessment

The field validation of vegetation confirmed that the PCTs present within the Biodiversity Assessment Development Footprint, contained the following PCTs:

- PCT1083 *Red Bloodwood – scribbly gum heathy woodland*.
- PCT1245 *Sydney Blue Gum x Bangalay – Lilly Pilly moist forest.*
- PCT1250 *Sydney Peppermint - Smooth-barked Apple - Red Bloodwood shrubby open forest.*

The field validation confirmed that the Biodiversity Assessment Development Footprint is not located within areas consisting of Coastal Upland Swamps or any other Threatened Ecological Community (TEC).

The field validation of vegetation confirmed the following PCTs are present within the Subject Land:

- PCT978 *Needlebush - banksia wet heath on sandstone plateaus of the Sydney Basin Bioregion.*
- PCT1083 *Red Bloodwood – scribbly gum heathy woodland.*
- PCT1181 *Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion.*
- PCT1245 *Sydney Blue Gum x Bangalay – Lilly Pilly moist forest.*
- PCT1250 *Sydney Peppermint - Smooth-barked Apple - Red Bloodwood shrubby open forest.*
- PCT1804 *Coastal upland wet heath swamp.*
- PCT1395 *Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion.*

Threatened Ecological Communities

Two TECs listed under the BC Act and EPBC Act were recorded in the Subject Land, however none of these are mapped within the Biodiversity Assessment Development Footprint:

- Shale Sandstone Transition Forest of the Sydney Basin Bioregion (91.18 ha within Subject Land); and
- Coastal Upland Swamps of the Sydney Basin Bioregion (7.96 ha within the Subject Land which satisfies the TEC listing).

Threatened flora

Extensive transects and field campaigns were completed within the Biodiversity Assessment Development Footprint and Subject Land. Threatened flora field survey employed the following:

- Flora transects within the Biodiversity Assessment Development Footprint.
- BAM plots within the Biodiversity Assessment Development Footprint and throughout the wider Subject Land.
- Transects along riparian areas.
- Flora transects through centre line of swamp, and where practical, and would not damage ground cover within the swamp.
- BAM plots within swamps, including targeted flora search within the 50 x 20 m quadrat.
- Flora traverses along ridgetop environments.
- Opportunistic flora survey when traversing to BAM plot locations and survey sites.

The surveys did not detect the presence of threatened flora within the Biodiversity Assessment Development Footprint.

Outside of the area directly impacted by the Project, a population of *Acacia bynoeana, Epacris purpurescens var. purpurescens* and *Leucopogon exolasius* were recorded. None of the threatened flora recorded would be directly impacted by the Project. No threatened flora was recorded within habitat types that are sensitive to subsidence (i.e., on the edge of cliffs, within swamps, or within riparian areas).

To avoid damage to Coastal Upland Swamps, and to take on a precautionary approach, this BDAR has also assumed that there may be potential habitat for *Epacris purpurascens var. purpurascens, Cryptostylis hunteriana, Pomaderris brunnea* and *Pultenaea aristata* to have habitat within swamp, or riparian environments. Such habitat features may be subject to indirect impacts as a result of subsidence and have been assessed accordingly for prescribed and indirect impacts in section 4 of the BDAR.

Threatened fauna

A total of 128 fauna species recorded during the survey across the Subject Land and surrounds. Nineteen of the species recorded are listed as threatened under the schedules of the BC Act and/or EPBC Act. Threatened fauna recorded include:

- Large Bent-winged Bat (*Miniopterus schreibersii oceanensis*) (Vulnerable, BC Act) – dual credit species.
- Eastern Cave Bat (*Vespadelus troughtoni*) (Vulnerable, BC Act) – species credit.
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) (Vulnerable, BC Act) – ecosystem credit species.
- Eastern Freetail-bat (*Mormopterus norfolkensis*) (Vulnerable, BC Act) – ecosystem credit species.
- Eastern Pygmy-possum (*Cercartetus nanus*) (Vulnerable, BC Act) – species credit.
- Gang-gang Cockatoo (*Callocephalon fimbriatum*) (Vulnerable, BC Act; Endangered, EPBC Act) – dual credit species.
- Giant Burrowing Frog (*Heleioporus australiacus*) (Vulnerable, BC Act; Vulnerable, EPBC Act) – species credit.
- Golden-tipped Bat (*Kerivoula papuensis*) (Vulnerable, BC Act) – ecosystem credit species.
- Greater Broad-nosed Bat (*Scoteanax rueppellii*) (Vulnerable, BC Act) – ecosystem credit species.
- Greater Glider (*Petauroides volans*) (Vulnerable, EPBC Act) – species credit.
- Grey-headed Flying-fox (*Pteropus poliocephalus*) (Vulnerable, BC Act; Vulnerable, EPBC Act) – dual credit species.
- Koala (*Phascolarctos cinereus*) (Vulnerable, BC Act; Vulnerable[1], EPBC Act) – dual credit species.
- Little Bentwing-bat (*Miniopterus australis*) (Vulnerable, BC Act) – dual credit species.
- Littlejohn's Tree Frog (*Litoria littlejohni*) (Vulnerable, BC Act; Vulnerable[1], EPBC Act) – species credit.
- Rosenberg's Goanna (*Varanus rosenbergi*) (Vulnerable, BC Act) – ecosystem credit species.
- Scarlet Robin (*Petroica boodang*) (Vulnerable, BC Act) – ecosystem credit species.
- Varied Sittella (*Daphoenositta chrysoptera*) (Vulnerable, BC Act) – ecosystem credit species.
- White-bellied Sea-Eagle (*Haliaeetus leucogaster*) (Vulnerable, BC Act) – dual credit species.
- Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*) (Vulnerable, BC Act) – ecosystem credit species.

The BAM categorises threatened fauna as either:

[1] *Listed as 'Vulnerable' under the EPBC Act at the time of the "controlled action" decision (13 January 2022) and therefore assessed as 'Vulnerable' rather than 'Endangered' (refer section 158A of the EPBC Act).*

- ‘ecosystem credit’ fauna - the species is assumed to be present based on the PCTs present, and therefore no targeted survey is required.
- ‘species credit’ fauna – the species is associated with specific habitat requirements, and a survey or expert report is required to confirm the presence/absence of the species.
- Dual credit fauna – the species is regarded as an ‘ecosystem credit’ if specific habitat features (eg. Hollow-bearing trees) are not present. This is guided by the Threatened Biodiversity Data Collection (TBDC).

In total, five threatened fauna (species credit fauna) were recorded or were determined to have habitat within the Biodiversity Assessment Development Footprint. Species include:

- Eastern Pygmy Possum (*Cercartetus nanus*).
- Gang-gang Cockatoo (*Callocephalon fimbriatum*).
- Koala (P*hascolarctos cinereus*).
- Large-eared Pied Bat (*Chalinolobus dwyeri*).
- Southern Myotis (*Myotis aelleni*).

Across the Subject Land, 18 threatened fauna (species credit fauna) were assumed to be present. Species include:

- Gang-gang Cockatoo (*Callocephalon fimbriatum*).
- Glossy Black-Cockatoo (*Calyptorhynchus lathami*).
- Eastern Pygmy-possum (*Cercartetus nanus*).
- Large-eared Pied Bat (*Chalinolobus dwyeri*).
- White-bellied Sea-Eagle (*Haliaeetus leucogaster*).
- Giant Burrowing Frog (*Heleioporus australiacus*).
- Little Eagle (*Hieraaetus morphnoides*).
- Broad-headed Snake (*Hoplocephalus bungaroides*).
- Littlejohn's Tree Frog (*Litoria littlejohni*).
- Square-tailed Kite (*Lophoictinia isura*).
- Southern Myotis (*Myotis Macropus*).
- Powerful Owl (*Ninox strenua*).
- Eastern Osprey (*Pandion cristatus*).
- Giant Dragonfly (*Petalura gigantea*).
- Koala (*Phascolarctos cinereus*).
- Red-crowned Toadlet (*Pseudophryne australis*).
- Masked Owl (*Tyto novaehollandiae*).
- Sooty Owl (*Tyto tenebricosa*).

Impacts

Clearing of native vegetation

The Project would result in direct impact to approximately 19.85 ha of native vegetation associated with clearing for surface infrastructure.

The vegetation that would be directly impacted by surface infrastructure for the Project includes:

- 1.1 ha of PCT1250 *Sydney Peppermint - Smooth-barked Apple - Red Bloodwood shrubby open forest on slopes of moist sandstone gullies, eastern Sydney Basin Bioregion*;

- 18.58 ha of PCT1083 *Red Bloodwood – scribbly gum heathy woodland*; and
- 0.17 ha of PCT1245 *Sydney Blue Gum x Bangalay – Lilly Pilly moist forest.*

An offset for the direct impact to the PCTs has been provided in this BDAR in accordance with the requirements of the BAM.

Indirect impacts - Subsidence related impacts to native vegetation/habitat (non-swamp)

Subsidence from the Project may result in the following impacts to non-swamp native vegetation/habitat:

- Vegetation die-back around strata gas emission/drainage sites within creeks.
- Changes to the floristic composition of vegetation communities immediately adjacent to creeks/ponds where fracturing may result in changes to water flow and water retention periods.
- Destruction/smothering of vegetation/tree fall by rock falls and/or slippage of earth and rocks down steep slopes.

However, based on subsidence predictions by MSEC (2022) and previous experience in the Southern Coalfield, the likelihood for such an event to occur and result in detrimental change to native vegetation is highly unlikely.

Indirect impacts - Subsidence related impacts to Coastal Upland Swamps

MSEC (2022) determined that Coastal Upland Swamps partially or entirely located above the proposed longwalls are expected to experience the full range of predicted subsidence movements, compared to Coastal Upland Swamps located outside the extent of the proposed longwalls which will experience reduced levels of subsidence. It is not expected based on MSEC (2022) that there would be adverse changes in the levels of ponding or scouring of the Coastal Upland Swamps based on the predicted mining induced tilt, or significant changes in the distribution of surface waters due to mining induced tilt or vertical subsidence.

Based on assessments of water levels and recession rates around past mining in Areas 2, 3A and 3B, it was concluded by Watershed (2021) that hydrographs from swamp piezometers directly above or within 60 metres (m) of longwalls exhibit effects from mining, be that through a reduction in the water table to below pre-mining levels and/or increased recession (drainage) rate. Effects on swamp water tables were not reported at distances greater than 60 m from a longwall panel.

Of the 22 Coastal Upland Swamps recorded within the Subsidence Assessment Subject Land, 16 are located above longwalls or occur within 60 m of the proposed longwalls (occupying a total of 8.6 ha of the TEC).

The predicted mining effects at the Coastal Upland Swamps have the potential to result in hydrological changes, which have the potential to result in the following key changes:

1. Reduction in groundwater levels or desaturation of the upland swamp sediments; and/or
2. Transition of the Coastal Upland Swamp to a drier vegetation type; and/or
3. Desaturation of soil particles exposing the swamp to peat desiccation; and/or
4. Exposure to greater bushfire intensity due to loss of inundation; and/or
5. Increased scour and erosion events.

Each of these potential impacts in relation to the Coastal Upland Swamps of the Subsidence Assessment Subject Land has been discussed in an impact assessment provided in Appendix 9.

The remaining Coastal Upland Swamps in the Subsidence Assessment Subject Land (located more than 60 m from the longwalls) are predicted to be unlikely to experience a change in vegetation.

Impacts to threatened flora

No threatened flora species were recorded within the Biodiversity Assessment Development Footprint, and thus no threatened flora would be directly impacted by the Project.

Indirect impacts/prescribed impacts were assessed for threatened flora with habitat potentially impacted by the Project. This included an analysis of the following threatened flora that may have habitat within swamps and watercourses: *Cryptostylis hunteriana, Epacris purpurescens var. purpurescens, Pultenaea aristata* and *Pomaderris brunnea*. Through an analysis of MSEC (2022) subsidence predictions, and analysis of the habitat for threatened flora species in the Subject Land, it was determined that the Project is unlikely to result in a significant or detrimental loss of threatened flora species through potential changes to habitat as a result of subsidence.

Impacts to threatened fauna

Ten species credit fauna were determined to be impacted by the Project, and therefore require offsetting as a result of subsidence related impacts or through vegetation clearing associated with the surface infrastructure.

Species credit fauna determined to be directly impacted by the Project through the loss of 19.85 ha of habitat include:

- Eastern Pygmy Possum (*Cercartetus nanus*).
- Gang-gang Cockatoo (*Callocephalon fimbriatum*).
- Koala (P*hascolarctos cinereus*).
- Large-eared Pied Bat (*Chalinolobus dwyeri*).
- Southern Myotis (*Myotis aelleni*).

Of the 26 species credit fauna that were assessed as having habitat within the Subject Land, ten were assessed having habitat within watercourses, swamps or cliffs that may be subject to indirect/prescribed impacts attributed to subsidence. The species include:

- Broad-headed Snake (*Hoplocephalus bungaroides*).
- Eastern Pygmy-possum (*Cercartetus nanus*).
- Gang-gang Cockatoo (*Callocephalon fimbriatum*).
- Giant Burrowing Frog (*Heleioporus australiacus*).
- Giant Dragonfly (*Petalura gigantea*).
- Koala (*Phascolarctos cinereus*).
- Large-eared Pied Bat (*Chalinolobus dwyeri*).
- Littlejohn's Tree Frog (*Litoria littlejohni*).
- Red-crowned Toadlet (*Pseudophryne australis*).
- Southern Myotis (*Myotis macropus*).

Impacts to Commonwealth threatened biodiversity

The Project SEARs nominated a list of 20 threatened biodiversity communities or species that may be significantly impacted by the Project. This BDAR has completed a thorough literature review to determine a more comprehensive list of subject Commonwealth listed threatened biodiversity for assessment. The

Commonwealth listed entities were assessed in terms of their likelihood for occurrence within the Biodiversity Assessment Development Footprint and Subject Land.

Commonwealth threatened biodiversity were assessed further via Assessments of Significance, that have been included in Appendix 8.

Assessments of Significance were completed for the following threatened biodiversity:

Threatened Ecological Communities:

- Coastal Upland Swamps (*Coastal Upland Swamps in the Sydney Basin Bioregion*)
- Shale Sandstone Transition Forest (*Shale Sandstone Transition Forest of the Sydney Basin Bioregion*).

Threatened flora species:

- Bynoe's Wattle (Acacia bynoeana).
- Leafless Tongue-orchid (*Cryptostylis hunteriana*).
- Woronora Beard-heath (*Leucopogon exolasius*).
- Rufous Pomaderris (*Pomaderris brunnea*).
- Prickly Bush-pea (*Pultenaea aristata*).

Threatened Fauna species:

- Broad-headed Snake (*Hoplocephalus bungaroides*).
- Giant Burrowing Frog (*Heleioporus australiacus*).
- Greater Glider (*Petauroides Volans*).
- Grey-headed Flying Fox (*Pteropus poliocephalus*).
- Koala (*Phascolarctos cinereus*).
- Large-eared Pied Bat (*Halinolobus dwyeri*).
- Littlejohn's Tree Frog (*Litoria littlejohni*).
- White-threatened Needletail (*Hirundapus caudacutus*).
- Swift Parrot (*Lathamus discolor*).

The assessments concluded that the following threatened biodiversity may have a significant impact due to the Project: Littlejohn's Tree Frog, Giant Burrowing Frog, and Coastal Upland Swamps. A significant impact to other threatened biodiversity listed on the EPBC Act is considered unlikely.

A biodiversity offset as per the Biodiversity Offset Scheme, and associated Strategy has been proposed to satisfy the Commonwealth offset liability for the Project.

Impact avoidance, minimisation, and mitigation

Avoidance and minimisation

A number of key constraints and longwall setbacks have been considered in the development of the Project surface infrastructure and underground mining layout, based on previous mining and impact management experience at the Dendrobium Mine, review and analysis of available monitoring data from other operations across the Woronora Plateau.

The Project proposes the extraction of additional metallurgical coal reserves within the existing CCL 768 for the Dendrobium Mine. The extraction of additional Project metallurgical coal reserves would be supported

by the development of supporting infrastructure and the use and augmentation of existing surface facilities at the Dendrobium Mine. The Project underground mining area would allow for the continuation of the existing approved underground mining operations at the Dendrobium Mine, thereby minimising any new surface disturbance that would otherwise be associated with a separate mine.

The key alternatives considered when locating the proposal have been based on the following key assumptions and constraints:

- All alternative mine designs considered are based on layouts located with IMC's existing tenement (CCL 768).
- Key IMC commitments adopted for the previous application have been retained, namely:
    - No mining beneath reservoirs, with at least 1,000 metre (m) setback from dam walls and 300 m setback from full supply levels (FSLs).
    - No mining beneath named watercourses (i.e. Avon River, Cordeaux River, Wongawilli Creek, Donalds Castle Creek).

Avoidance of key surface features has been incorporated into the design of the Project, and IMC has proposed a Project design that includes the following measures:

- minimum longwall mining setback distance of 1,000 m from dam walls.
- minimum longwall mining setback distance of 300 m from the Full Supply Level of the Avon Dam.
- not longwall mine beneath 3rd, 4th and 5th order (or above) streams.
- set longwall mining at a distance of at least 400 m from named watercourses (i.e. the Avon River, Cordeaux River, Donalds Castle Creek and Wongawilli Creek).
- avoid longwall mining beneath identified key stream features.
- avoid longwall mining beneath "Area 4" swamp cluster.
- use existing infrastructure (namely the Dendrobium Pit Top, Kemira Valley Coal Loading Facility, Kemira Valley Rail Line, Dendrobium CPP, Shaft Sites Nos 1, 2 and 3 and the West Cliff Stage 3 Coal Wash Emplacement) which would reduce the requirement for additional surface disturbance.

Design of the surface infrastructure has been planned to avoid or minimise biodiversity impacts as much as practical by focusing on:

- reducing vegetation clearing by locating surface infrastructure within previously disturbed areas or adjacent to fire trails.
- limiting vegetation clearing only to areas that are considered necessary for construction and operational purposes.
- avoiding clearing of riparian vegetation or TECs.

Mitigation and management

The Project will reduce impacts to biodiversity through a series of mitigation measures as proposed in section 7 of this BDAR.

Credit calculations and offsetting

The BAM identifies the BAM-C as the appropriate tool for quantifying the offsets required in both ecosystem credit and species credit terms. The BAM-C is used to quantify the direct impact to threatened biodiversity and can be used to quantify indirect/prescribed impacts.

The Project would require biodiversity offsets in accordance with the BAM and associated *NSW Addendum to NSW Biodiversity Offsets Policy for Major Projects: Upland swamps impacted by longwall mining subsidence* (Swamps Offset Policy) (OEH 2016a). Biodiversity offsets have been provided for the following:

- Unavoidable direct impacts to native vegetation to be cleared for the surface infrastructure.
- Unavoidable direct impacts to threatened fauna habitat for Eastern Pygmy-possum, Gang-gang Cockatoo, Koala, Large-eared Pied Bat, and Southern Myotis.
- Potential subsidence related impacts to Coastal Upland Swamps of the Sydney Basin Bioregion.
- Potential subsidence related impacts to habitat supporting Broad-headed Snake, Giant Burrowing Frog, Giant Dragonfly, Littlejohn's Tree Frog, Red-crowned Toadlet and Southern Myotis.

The offset credit liability was completed using the BAM Calculator. The number of credits required are as follows:

PCT/Threatened species	Credits required
Direct impact credits	
PCT1250 - Coastal sandstone gully forest	17
PCT1245 Illawarra Escarpment Blue Gum wet forest	2
PCT1083 Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion	346
Callocephalon fimbriatum / Gang-gang Cockatoo	399
Cercartetus nanus / Eastern Pygmy-possum	472
Chalinolobus dwyeri / Large-eared Pied Bat	3
Myotis macropus / Southern Myotis	126
Phascolarctos cinereus / Koala	456
Indirect / prescribed impact credits	
Coastal Upland Swamps (PCT978/1804)	107
Heleioporus australiacus / Giant Burrowing Frog	257
Hoplocephalus bungaroides / Broad-headed Snake	5
Litoria littlejohni / Littlejohn's Tree Frog	343
Myotis macropus / Southern Myotis	123
Petalura gigantea / Giant Dragonfly	186
Pseudophryne australis / Red-crowned Toadlet	68

Offset strategy

IMC has provided an offset strategy to address the maximum offset liability for the Project in section 6 of the BDAR.

The Project would require a biodiversity offset for both BC Act and EPBC Act listed threatened entities. The biodiversity offset entails the formal requirement to retire the biodiversity credit obligation. The Australian Government has also formally endorsed the NSW Biodiversity Offsets Scheme through the Environment Protection and Biodiversity Conservation Act Condition-setting Policy, and as such, this streamlines the options and approvals associated with retiring the Project's biodiversity offsetting obligation for EPBC Act listed entities.

The biodiversity credit obligation can be retired through the purchasing credits available on the market, establishing a Biodiversity Stewardship Site(s), or Payment into the Biodiversity Conservation Fund.

IMC have investigated the following options to formally satisfy the offset obligation for both State and Commonwealth, which include the following:

1. Establish a Biodiversity Stewardship Site(s) with the required biodiversity values and formally retire the credits.
2. Retire credits from existing South32 BioBanking sites – noting that this would only satisfy a portion of Koala credits, and potentially Large-eared Pied Bat and Eastern Pygmy Possum credits.
3. Purchase biodiversity credits from the credit market and formally retire the credits.
4. Payment of the biodiversity offset obligation into the Biodiversity Conservation Fund.

Glossary and list of abbreviations

Term or abbreviation	Definition
Area 5	Dendrobium Area 5
AOBV	Areas of Outstanding Biodiversity Value
BAM	Biodiversity Assessment Method
BAM-C	Biodiversity Assessment Method Credit Calculator
BBAM	BioBanking Assessment Methodology
BC Act	*NSW Biodiversity Conservation Act 2016*
BC Reg	*NSW Biodiversity Conservation Regulation 2017*
BCD	Biodiversity Conservation Division
BCF	Biodiversity Conservation Fund
BCT	Biodiversity Conservation Trust
BDAR	Biodiversity Development Assessment Report
BMP	Biodiversity Management Plan
BOS	NSW Biodiversity Offsets Scheme
CCL	Consolidated Coal Lease
CEEC	Critically Endangered Ecological Community
CEM	Canopy Elevation Model
CHM	Canopy Height Model
cm	Centimetre/s
CPP	Coal Production Plant
DAWE	Commonwealth Department of Agriculture, Water and the Environment
DBH	Diameter at Breast Height
DCP	Development Control Plan
DPIE	NSW Department of Planning, Industry and Environment (formerly DECCW, DECC, DEC, OEH)
EEC	Endangered Ecological Community
EES	Environment, Energy and Science Group
EP&A Act	*NSW Environmental Planning and Assessment Act 1979*
EPBC Act	*Commonwealth Environment Protection and Biodiversity Conservation Act 1999*
ETL	Electricity Transmission Line
FBA	Framework for Biodiversity Assessment – NSW Biodiversity Offsets Policy for Major Projects
FM Act	NSW Fisheries Management Act 1994
FSLs	Full Supply Levels
ha	Hectare/s

Term or abbreviation	Definition
IBRA	Interim Biogeographic Regionalisation for Australia
ISR	Illawarra Subtropical Rainforest in the Sydney Basin Bioregion
km	Kilometre/s
LEP	Local Environment Plan
LGA	Local Government Area
Local population	The population of a particular threatened species that occurs in the locality
Locality	The Subject Land and surrounds, nominally a 10 km radius from the Subject Land
m	Metre/s
MNES	Matters of National Environmental Significance (from the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999*)
MSEC	Mine Subsidence Engineering Consultants
Mt	Million tonnes
Mtpa	Million tonnes per annum
OEH	Office of Environment and Heritage, now BCD
PCT	Plant Community Type
PCT	Plant Community Type
RDP	Rapid Data Point
SAII	Serious and Irreversible Impacts
SEARS	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SLU	Soil landscape units
TBDC	Threatened Biodiversity Database Collection
TEC	Threatened Ecological Community
VI	Vegetation Integrity as calculated by the BAM Calculator
VZ	Vegetation zones
IMC	Illawarra Metallurgical Coal
ROM	Run of mine
CPP	Coal Preparation Plant

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1. Introduction

1.1 Context and objectives

The Dendrobium Mine is an underground coal mine situated in the Southern Coalfield of New South Wales (NSW) approximately 8 kilometres (km) west of Wollongong (Figure 1).

Illawarra Coal Holdings Pty Ltd (Illawarra Metallurgical Coal [IMC]), a wholly owned subsidiary of South32 Limited (South32), is the owner and operator of the Dendrobium Mine. The Dendrobium Mine, Appin Mine and supporting operations are managed by IMC. Development Consent DA 60-03-2001 for the Dendrobium Mine was granted by the NSW Minister for Urban Affairs and Planning under the NSW Environmental Planning and Assessment Act 1979 (EP&A Act) in November 2001.

The Dendrobium Mine extracts coal from the Wongawilli Seam (also known as the No 3 Seam) within Consolidated Coal Lease (CCL) 768 using underground longwall mining methods. The Dendrobium Mine includes five approved underground mining domains, named Areas 1, 2, 3A, 3B and 3C. Longwall mining is currently being undertaken in Area 3B, with extraction largely complete in Areas 1, 2 and 3A (Figure 1; Figure 2).

The Dendrobium Mine has an approved operational capacity of up to 5.2 million tonnes per annum (Mtpa) of run of mine (ROM) coal until 31 December 2030.

IMC is seeking an Infrastructure Approval for the Dendrobium Mine Extension Project (the Project), which would support the extraction of approximately 31 million tonnes (Mt) of ROM coal from Area 5, within CCL 768 (Figure 2). The life of the Project includes longwall mining in Area 5 up to approximately 31 December 2034, and ongoing use of existing surface facilities for handling of Area 3C ROM coal until 2041[2]. The underground mining area will be serviced by associated infrastructure such as the proposed Ventilation Shaft Site, electricity transmission line (ETL) and service boreholes and the existing infrastructure at the existing Dendrobium Mine. Additional personnel will use the Dendrobium Pit Top Carpark Extension and Cordeaux Dam Access Road Construction Carpark.

Niche Environment and Heritage Pty Ltd (Niche) was commissioned by IMC to assess the ecological values and impacts associated with the Project and provide a Biodiversity Development Assessment Report (BDAR). The BDAR has been prepared in accordance with the Biodiversity Assessment Method (BAM) (DPIE 2020a) to address the potential impacts on threatened biodiversity listed under relevant biodiversity legislation, including the NSW *Biodiversity Conservation Act 2016* (BC Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), and to identify and quantify any associated biodiversity offsetting requirements.

This assessment also includes detailed historic analysis completed by Watershed (2021) of Dendrobium Mine Coastal Upland Swamps and swamp piezometer data following longwall mining (Appendix 13).

[2] The Project does not include approved underground mining operations in the Wongawilli Seam in Areas 1, 2, 3A, 3B and 3C at the Dendrobium Mine and associated surface activities (such as monitoring and remediation). These activities will continue to operate in accordance with Development Consent DA 60-03-2001 (as modified).

1.2 The Project

IMC is seeking an Infrastructure Approval for the the Project, which proposes to extend the mine life at the Dendrobium Mine to 31 December 2041 through underground mining operations within Area 5 until approximately 2035 (noting this may change depending on mine sequence), as well as use of the existing Dendrobium Mine surface facilities to 2041 to allow receipt of coal mined in approved Area 3C.

The Project would include the following activities:

- Longwall mining of the Bulli Seam in a new underground mining area (Area 5).
- Development of underground roadways from the existing Dendrobium Mine underground areas (namely Area 3) to Area 5.
- Use of existing Dendrobium Mine underground roadways and drifts for personnel and materials access, ventilation, dewatering and other ancillary activities related to Area 5.
- Development of new surface infrastructure associated with mine ventilation and gas management and abatement, water management and other ancillary infrastructure.
- Handling and processing of up to 5.2 Mtpa of ROM coal (no change from the approved Dendrobium Mine).
- Extension of underground mining operations within Area 5 until approximately 2035.
- Use of the existing Dendrobium Pit Top, Kemira Valley Coal Loading Facility, Dendrobium Coal Preparation Plant (CPP) and Dendrobium Shafts with minor upgrades and extensions until approximately 2041.
- Transport of ROM coal from the Kemira Valley Coal Loading Facility to the Dendrobium CPP via the Kemira Valley Rail Line.
- Handling and processing of coal from the Dendrobium Mine (including the Project) and IMC's Appin Mine (if required) at the Dendrobium CPP to 2041.
- Delivery of coal from the Dendrobium CPP to Port Kembla for domestic use at the Port Kembla Steelworks and Liberty Primary Steel Whyalla Steelworks or export through the Port Kembla Coal Terminal (PKCT).
- Transport of coal wash by road to customers for engineering purposes (e.g. civil construction fill) for other beneficial uses and/or for emplacement at the West Cliff Stage 3 and/or Stage 4 Coal Wash Emplacement.
- Development and rehabilitation of the West Cliff Stage 3 Coal Wash Emplacement (noting that opportunities for beneficial use of coal wash would be maximised).
- Continued use of the Cordeaux Pit Top for mining support activities such as exploration, environmental monitoring, survey, rehabilitation, administration, and other ancillary activities.
- Progressive development of sumps, pumps, pipelines, water storages and other water management infrastructure.
- Controlled release of excess water in accordance with the conditions of Environmental Protection Licence (EPL) 3241 and beneficial use.
- Monitoring, rehabilitation and remediation of subsidence and other mining effects.
- Other associated infrastructure, plant, equipment, and activities.

The Subject Land refers to the proposed mining area (Area 5, including the predicted extent of subsidence – 20 millimetre (mm) subsidence contour) as well as areas proposed for surface infrastructure (referred to as the Biodiversity Assessment Development Footprint) detailed below in Table 1.

Table 1: Summary Comparison of the Approved Dendrobium Mine and the Project

Component	Approved Dendrobium Mine (DA 60-03-2001)	Project
Mine Life	Until 31 December 2030.	Until 31 December 2041.
Mining Method	Underground extraction using longwall mining methods.	No change.
Resource	Mining of the Wongawilli Seam in Areas 1, 2, 3A, 3B and 3C within CCL 768.	Additional mining of the Bulli Seam in Area 5 within CCL 768.
Annual Production	Handling and processing of up to 5.2 Mtpa of ROM coal.	No change.
Coal Handling and Processing	Transport of coal from underground workings to the Kemira Valley Coal Loading Facility via an underground conveyor network. Sizing and stockpiling of coal at the Kemira Valley Coal Loading Facility prior to transport to the Dendrobium CPP via the Kemira Valley Rail Line, in accordance with the approved hours of operation. Processing of up to 5.2 Mtpa of sized ROM coal at the Dendrobium CPP.	No change.
Management of Mining Waste	Transportation of up to approximately 1.1 Mtpa of coal wash by road from the Dendrobium CPP to the West Cliff Stage 3 and Stage 4 Coal Wash Emplacement. Development and rehabilitation of the West Cliff Stage 3 Coal Wash Emplacement. Supply of coal wash to customers for engineering purposes (e.g. civil construction fill) or for other beneficial uses.	No change. No change. No change.
General Infrastructure	Dendrobium Pit Top. Kemira Valley Coal Loading Facility. Kemira Valley Rail Line. Dendrobium CPP. Dendrobium Shafts Nos 1, 2 and 3.	Continued use of existing infrastructure with minor upgrades and extensions. Development of new surface infrastructure associated with mine ventilation and gas management and abatement at Shaft Site No 5A to support underground mining operations in Area 5, and other ancillary infrastructure (including ETL to proposed mine ventilation infrastructure) and minor fire trail upgrades. Development of additional carpark facilities.
Product Transport	Delivery of product coal from the Dendrobium CPP to the BlueScope Port Kembla Steelworks or to PKCT for transport to Liberty Primary Steel Whyalla Steelworks or for export.	No change.

Component	Approved Dendrobium Mine (DA 60-03-2001)	Project
Water Management	Water management infrastructure to separate clean, oily and dirty water. Use of a combination of recycled treated mine water and potable water purchased from Sydney Water in underground and surface operations. Release of water in accordance with the conditions of EPL 3241.	No change (with augmentations and extensions to existing water management infrastructure as required). No change. No change (release volumes and release infrastructure to be modified as required based on Project mine inflow rates). Development of temporary water supply infrastructure for construction water supply for Shaft Site No 5A. Provision of offsets (funding of "indirect" offsets) for predicted surface water take as a result of the Project that would result in a net gain to Metropolitan water supplies.
Workforce	Current workforce of approximately 650 operational personnel.	At full development an additional 50 operational personnel for the Project. Up to approximately 100 personnel would also be required for construction and development activities.
Hours of Operation	Operated on a continuous basis, 24 hours per day, seven days per week. Trains do not travel on the Kemira Valley Rail Line between 11.00 pm and 6.00 am, unless written approval is obtained from the NSW Environment Protection Authority (EPA) for emergency use of the rail line.	No change.

1.3 Subject Land

The Subject Land refers to the proposed mining area (Area 5, including the predicted extent of subsidence – 20 mm subsidence contour) as well as areas proposed for surface infrastructure (referred to as the Biodiversity Assessment Development Footprint) (Figure 3).

The Subject Land covers 922.73 hectares (ha) of which 30.08 ha occurs within the Biodiversity Assessment Development Footprint.

The BDAR has also considered the potential subsidence impacts on features that are potentially sensitive to subsidence within a 600 metres (m) buffer from the proposed longwalls (referred to as the Subsidence Assessment Subject Land).

The Subject Land is located within the WaterNSW Upper Nepean Catchment area almost entirely within Lot 14 DP1233164, with the north-eastern corner extending into Lot 13 DP 1092321. Both lots in the catchment are zoned E2 Environmental Conservation in the Wingecarribee and Wollongong Local Environmental Plans (LEPs) (Figure 3).

The Dendrobium Pit Top Carpark Extension, which is located in Lot 1 DP 1103781 which is zoned E3 Environmental Management in the Wollongong LEP.

1.3.1 Mining Area

The Project involves underground mining of Area 5 and development of underground roadways. The area potentially subject to subsidence effects associated with Area 5 according to MSEC (2022) includes the predicted extent of subsidence – 20 mm subsidence contour). The BDAR has also considered the potential subsidence impacts on features that are potentially sensitive to subsidence within a 600 m buffer from the proposed longwalls (referred to as the Subsidence Assessment Subject Land) (Figure 4).

1.3.2 Biodiversity Assessment Development Footprint

The Biodiversity Assessment Development Footprint (i.e. the area of direct surface impact) encompasses the surface infrastructure associated with the Project which includes mine ventilation site (Ventilation Shaft Site No 5A), and other ancillary infrastructure (including ETL to proposed mine ventilation infrastructure), temporary carpark at Cordeaux Dam Access Road, and the Dendrobium Pit Top Carpark Extension off Cordeaux Road in Kembla Heights (Figure 4).

The size of the Biodiversity Assessment Development Footprint is 30.08 ha, comprising approximately 19.85 ha of direct surface disturbance of native vegetation and 10.23 ha of previously disturbed areas.

Where possible, the areas proposed for surface infrastructure has utilised existing disturbed areas, such as Fire Trail easements, access tracks, and borehole site.

An ETL would be required to service Ventilation Shaft Site No 5A. The proposed ETL easement would follow the existing Fire Trail, along an existing fire break for much of the traverse.

The proposed ETL easement occurs within land that is comprised of:

- Cleared Fire Trail (5.69 ha).
- In-tact native vegetation on the edge of the Fire Trail (3.87 ha).
- Native regeneration that occurs along the existing easement is currently maintained at a low height (typically below 0.5 m) by WaterNSW to act as a fire break (3.41 ha).

The fire break vegetation that is currently maintained by WaterNSW will not be subject to additional vegetation clearing with the exception of a conservative estimate of 0.1 ha of disturbance to account for the disturbance associated with the 100 poles for the ETL, (e.g. 0.1 ha of direct impact assessed as a total loss for the purpose of offsetting).

The in-tact native vegetation (3.87 ha) that will be subject to clearing to widen the ETL, would be cleared to a height of two metres. The vegetation would be maintained/slashed in the same condition as the existing fire break, which amounts to a total area of 3.87 ha that will be modified to accommodate the ETL. We have regarded this impact, whilst only cleared to a height of two metres, as a full loss for the purpose of offsetting in this assessment.

A further 0.21 ha of native vegetation that occurs immediately adjacent to the Fire Trail, may need to be modified/trimmed to allow for truck movement into the site during the construction for the infrastructure. We have regarded this impact, whilst it is temporary, as a full loss for the purpose of offsetting in this assessment.

Water supply for ventilation shaft construction would be provided via one of the following options:

- Development of an underground pumping system and pipeline to supply recycled mine water from the Dendrobium Mine underground workings via a previous borehole site. The pipeline and infrastructure required at the borehole site would be located within existing disturbance areas, where possible. This

option would require 0.69 ha of disturbance of existing native vegetation rehabilitation. The associated pipeline route is on a previous exploration access track, which is approximately 1 km in length that is rehabilitating and would require a machine to move the branches and logs off the track and pull the poly pipe into place, involving trampling of the regrowth and selective secondary clearing in places at a width of 3 m. We have conservatively estimated 0.69 ha of vegetation disturbance. Given the flexibility in pipeline placement, threatened flora impacts can be avoided.

- Development of a temporary pumping station at the Cordeaux River crossing and water supply pipeline along Fire Trail 6 (subject to agreement to purchase water from WaterNSW). The pipeline would be located along existing disturbed corridors and would not require additional vegetation clearing.
- Delivery of potable water via water truck to Shaft Site No 5A along Fire Trail 6. This option would not require any clearance of vegetation and has therefore not been considered further in this BDAR.

To capture biodiversity impacts, we have included the 0.69 ha of potential disturbance for the water supply for the Ventilation Shaft Site No 5A as detailed above.

In total, the area of native vegetation within the Biodiversity Assessment Development Footprint would be 19.85 ha as detailed in Table 2.

Table 2: Biodiversity Assessment Development Footprint disturbance areas

Surface infrastructure site	Biodiversity Assessment Development Footprint (ha)	Area of Native Vegetation (ha)
Ventilation Shaft Site No 5A	15.37	14.64
Ventilation shaft construction – water pumping	0.69	0.69
Ventilation shaft construction - Fire Trail upgrades for construction	0.26	0.21
Dendrobium Pit Top Carpark Extension	0.40	0.17
Electricity Transmission Line (ETL) and pole placement (0.1 ha)	13.05	3.99
Cordeaux Dam Access Road Construction Carpark	0.15	0.15
ETL laydown area nominated near Cordeaux Dam Access Road	0.16	0.00
Total Area	**30.08**	**19.85**

1.4 Approval and assessment process

The following legislation or planning instruments are relevant to the works associated with the Project.

1.4.1 State approval and assessment process – application of the BAM

The *Environmental Planning and Assessment Act 1979* (EP&A Act) and *Environmental Planning and Assessment Regulation 2021* (EP&A Regulation) generally set the framework for planning and environmental assessment in NSW, in concert with the BC Act for the consideration of impacts to biodiversity including threatened biodiversity. Approval for the Project will be sought under the State

Significant Infrastructure (SSI) provisions (i.e. Division 5.2) under Part 5 of the EP&A Act which requires proponents to use the BAM and the NSW Biodiversity Offset Scheme (BOS) to prepare a BDAR under the BC Act.

As the Project has been declared to be SSI and may be carried out without obtaining Development Consent under Part 4 of the EP&A Act, the Project requires assessment and approval under Part 5, Division 5.2 of the EP&A Act.

In accordance with section 5.22(2) of the EP&A Act, Environmental Planning Instruments (EPIs) do not apply to SSI, beyond the declaration of the Project as SSI. Accordingly, the provisions of Part 4 of the EP&A Act do not apply, and the Project is not prohibited under any EPIs.

The purpose of the BDAR is to outline avoidance and mitigation measures as well as offset requirements for all native vegetation clearing and threatened species and/or their habitat regardless of whether significant impacts on threatened biodiversity are likely to occur. This BDAR is prepared in accordance with BAM (DPIE 2020a).

1.4.2 Commonwealth approval and assessment process

The Project was determined to be a controlled action under the EPBC Act on 13 January 2022.

The Project will be assessed under the Bilateral Agreement between New South Wales and the Commonwealth.

The DAWE has provided input in the SEARs in the Amendment to Planning Secretary's Environmental Assessment Requirements, Dendrobium Mine Extension Project (SSI-33143123) (dated 25 January 2022). The additional SEARs include Commonwealth's assessment requirements for the Matters of National Environmental Significance relevant to the Project (Appendix 1). This BDAR has addressed the relevant SEARs from DAWE throughout this assessment.

1.4.3 Secretary's Environmental Assessment Requirements (SEARS)

In preparing this BDAR, the SEARs issued for the Project on 23 December 2021 have been addressed. The key matters raised by the Secretary that are applicable to this BDAR, and the section within this report which addresses each of the SEARs, are outlined in Appendix 1.

1.5 Assessment format

The primary objective of this assessment is to use the guidelines and methodology provided in the BAM to determine the impact the Project will have on biodiversity, to address the SEARs, and to calculate the Project's biodiversity offset requirement. This assessment also considers the NSW Office of Environment and Heritage (OEH) (2016a) *Addendum to NSW Biodiversity Offsets Policy for Major Projects: Upland swamps impacted by longwall mining subsidence* (Swamps Offset Policy) and SEARs for the Project.

This BDAR has two stages consistent with the BAM:

Stage 1 – Biodiversity Assessment

- assessment of landscape features.
- assessment of native vegetation.
- assessment of threatened species and populations.

Stage 2 – Impact Assessment

- avoid and minimise impacts on biodiversity values.

- consider impact and offset thresholds.
- determine and calculate offset requirements.

To address the SEARs, this BDAR also includes a biodiversity offset strategy.

1.6 Assessment resources and assessor qualifications

This BDAR has been prepared by the accredited personnel and support staff identified in Table 3. Resources and survey guidelines used in the development of this BDAR are detailed in Table 4.

Table 3: Assessor and support staff qualifications and resources

Personnel	Role	Qualifications	Tasks carried out
Luke Baker	Discipline Manager – Flora Biodiversity Lead; BAM Accredited Assessor	BAppSc Accredited Biodiversity Assessor (BAAS17033)	BAM plots, targeted threatened flora searches, credit calculations, review of credit calculations, report preparation and quality assurance.
Simon Tweed	Senior Ecologist – Fauna Biodiversity Lead; BAM Accredited Assessor	BEnvSc (Hons) Accredited Biodiversity Assessor (BAAS 18088)	Targeted threatened fauna searches; data management, review of credit calculations, fauna species polygons, report preparation and quality assurance.
Alex Christie	Senior Ecologist	BEnvSc Accredited Biodiversity Assessor (BAAS18131)	BAM plots, threatened flora surveys.
Sian Griffiths	Senior Associate – Ecology	BEnvSc (Hons) Accredited Biodiversity Assessor (BAAS 17066)	BAM plots, threatened flora surveys, report preparation.
Freya Gordon	Senior Consultant - Ecology	BSc (Hons)	Targeted fauna surveys, report preparation.
Sarah Hart	Experienced Consultant - Ecology	BSc, MSc, GradDip EnvMgmt	BAM plots, targeted threatened flora searches and data management.
Yogesh Nair	Experienced Consultant - Ecology	BSc, Accredited Biodiversity Assessor (BAAS18144)	BAM plots, targeted threatened flora searches and data management.
Nathan Browne	Ecologist	BSc (Hons)	Targeted threatened flora and fauna surveys, data management.
Christie Chapman	Environmental Consultant	BSc	Threatened flora and fauna surveys, data management.
Jessie Bear	Consultant - Ecology	BNatSc (Advanced)(EnvMgt)	Report preparation and GIS analysis.
Yin Hua	GIS Consultant	-	GIS support and figure preparation.

Table 4: Assessment resources and guidelines used

Assessment resources/guideline	
Assessment guidelines	• Biodiversity Assessment Method (BAM) (DPIE 2020a). • BAM Operational Manual – Stage 1 (DPIE 2020b). • BAM Operational Manual – Stage 2 (DPIE 2019). • BAM Calculator User Guide (DPIE 2018).
Survey guidelines	• Surveying threatened plants and their habitats NSW survey guide for the Biodiversity Assessment Method (DPIE 2020c). • 'Species credit' threatened bats and their habitats, NSW survey guide for the Biodiversity Assessment Method (OEH 2018). • Species specific survey requirements in the Threatened Biodiversity Database Collection (DPIE 2021). In the absence of specific survey guidelines issued at the state level, Commonwealth survey guidelines were adapted: • Survey guidelines for Australia's threatened mammals (DSEWPC 2011a). • Survey guidelines for Australia's threatened reptiles (DSEWPC 2011b). • Survey guidelines for Australia's threatened birds (DEWHA 2010a). • Survey guidelines for Australia's threatened frogs (DEWHA 2010b). • Survey guidelines for Australia's threatened bats (DEWHA 2010c). • Draft survey guidelines for Australia's threatened orchids (DOE 2013).
Resources	• This assessment has used the BAM Calculator (BAM-C) (version 1.3.0.00). • NSW BioNet Atlas Database for spatial records of threatened flora listed under the BC Act within a 10 km radius of the Subject Land (DPIE 2021). • EPBC Act Protected Matters Search Tool (PMST) for threatened entities identified as MNES known from or with potential habitat within a 10 km radius of the Subject Land (DAWE 2021). • Vegetation mapping used for the Project was The Native Vegetation of the Woronora OHares and Sydney Metropolitan Catchments (NPWS 2003a) VISID 2387. Other publications and guidelines used have been referenced within the text and included in the References section.

2. Biodiversity Assessment

2.1 Landscape features

Section 3 of the BAM details the landscape assessment requirements for a BDAR.

An assessment of landscape features as per the BAM, includes the assessment of a number of factors including:

- Native vegetation cover.
- Rivers, streams and estuaries.
- Areas of geological significance.
- Habitat connectivity.

For each factor the current state of the landscape is assessed then compared with the state of the landscape if the Project were to proceed.

The landscape features that are required to be addressed as per the BAM, have been described in Table 5, along with the associated Figure references.

Table 5: Landscape features

Landscape features	Description	Figure reference
Interim Biogeographic Regionalisation for Australia (IBRA) bioregion/subregion	The Project is located within the Sydney Basin IBRA bioregion. The majority of the Subject Land is located within the Sydney Cataract IBRA subregion. The Dendrobium Pit Top Carpark Extension (approximately 0.2 ha in area) is located in the Illawarra IBRA subregion. Given the majority of the Subject Land is within the Sydney Basin IBRA bioregion and the Sydney Cataract IBRA subregion, this has been used in the Biodiversity Credit Calculator (BAM-C). However, we have also added the list of predicted species to the assessment (sections 2.5.1 and 2.6.1) to account for the Dendrobium Pit Top Carpark Extension that occurs within the Illawarra IBRA subregion.	Figure 5
NSW (Mitchell) Landscapes	The majority of the Subject Land (Area 5 and the majority of the surface infrastructure) is located within the Woronora Plateau, and Upper Nepean Gorges NSW (Mitchell) Landscape. The Dendrobium Pit Top Carpark Extension, which is 0.2 ha in size, is located in the Bulli Coastal Escarpment NSW (Mitchell) Landscape. Given the majority of the Subject Land is located within the Woronora Plateau NSW (Mitchell) Landscape, this has been selected in the BAM-C.	Figure 5
Topography	The Project underground mining area is located to the west of Wollongong on the southern Woronora Plateau, which is characterised by undulating topography and naturally vegetated landscapes, with elevations generally higher than the Project surface facilities located east of the Illawarra Escarpment and proximal to Wollongong. Topography in the vicinity of the Project area varies, with elevations in Area 5 varying from approximately 335 m AHD to 440 m AHD.	Figure 6
Rivers, streams and estuaries and Strahler stream order	Watercourses that occur within the Subject Land are shown on Figure 5. Of particular note, the Avon River lies to the west of Area 5 and is a 5th order stream near the Subject Land. First, second and third order streams within the Subject Land flow into the Avon River.	Figure 5

Landscape features	Description	Figure reference
	Donalds Castle Creek and Wongawilli Creek are also situated on the perimeter of the Subject Land. First, second and third order streams within the Subject Land also flow into both watercourses.	
Wetlands within and adjacent to development/Subject Land	There are no Coastal Wetlands in the Subject Land according to the State Environmental Planning Policy (SEPP) (Coastal Management) 2018. Coastal Upland Swamps occur in the Subject Land and are described in section 2.2.4 and shown on Figure 9.	Figure 9
Connectivity features	The Subject Land is within contiguous habitat that connects the Southeast and Tablelands Regional Plan Corridor and the Illawarra Shoalhaven Regional Plan Corridor. This habitat links the Woronora Plateau in the east to the Nattai Plateau in the west. The Project would not affect the utility of this corridor, which has been addressed in section 4.6.3.	Figure 5
Buffer area (percent native vegetation cover)	A 1,500 m buffer was applied to the Subject Land, which include one buffer around the Project within the Sydney Cataract Subregion, and one in the Illawarra IBRA subregion. This resulted in an overall buffer area of 7,511 ha. ***Native vegetation cover*** The native vegetation extent and cover of woody vegetation was determined via aerial photography interpretation based on canopy cover, local vegetation mapping (DPIE 2016) and knowledge of the Subject Land. For **woody vegetation** 92 percent of the buffer area was determined to support native woody vegetation with canopy cover (6,847 ha). For **non-woody vegetation (grassland)** 0.3 percent of the buffer area was determined to support native woody vegetation with canopy cover (24 ha). ***Total native vegetation cover*** The total of native vegetation cover is 91 percent of the buffer area which was entered within the BAM-C.	Figure 5
Cleared Areas	As detailed above, the area of non-native vegetation or cleared land/existing infrastructure within the locality is about 640 ha. A detailed assessment of cleared areas (non-native vegetation) within the Subject Land is provided in Table 7.	Figure 5
Karst, caves, crevices, cliffs, rocks and other geological features of significance	The geology of the Subject Land mainly comprises sedimentary sandstones, shales and claystones of the Permian and Triassic Periods which have been intruded by igneous sills. The dominant lithology of the Subject Land generally comprises Hawkesbury Sandstone, with localised areas of Quaternary Alluvium (MSEC 2022). Different geological influences are further discussed within vegetation community descriptions (Appendix 3). Cliffs and minor cliffs within the Subsidence Assessment Subject Land have been identified from the LiDAR surface level contours and from field investigations (MSEC 2022). There are approximately 12 cliffs (10-20 m in height) above the proposed longwalls, and 32 cliffs (10-25 m in height) outside the proposed longwalls and within the 35° angle of draw (MSEC 2022). Further detail regarding rock as fauna habitat is discussed in section 2.7.	Figure 6
Areas of Outstanding Biodiversity Value (AOBVs)	The Register of Declared Areas of Outstanding Biodiversity Value has information about declared AOBV in NSW. AOBV declarations in NSW include the following: • Gould's Petrel – critical habitat declaration. • Little penguin population in Sydney's North Harbour – critical habitat declaration.	-

Landscape features	Description	Figure reference
	• Mitchell's Rainforest Snail in Stotts Island Nature Reserve – critical habitat declaration. • Wollemi Pine – critical habitat declaration. AOBVs are declared under the BC Act for to identify, highlight and effectively manage sites that make significant contributions to the persistence of biodiversity in NSW, Australia and globally. No registered AOBVs occur within the Subject Land or surrounds. None of the AOBVs that are listed above would be impacted by the Project, given none are located within the Subject land or the Subsidence Assessment Subject Land	
Additional landscape features identified in SEARs	The SEARs suggest an assessment of potential impacts on adjacent conservation areas. The Subject Land is located adjacent to the Upper Nepean State Conservation Area (approximately 500 m to the north, and 500 m to the west) and Illawarra Escarpment State Conservation Area (approximately 1 km from the Dendrobium Pit Top Carpark). An assessment of the adjacent conservation areas and the land managed by WaterNSW has been completed in section 4.8. The assessment concludes that there is a low likelihood for far reaching impacts to local threatened biodiversity populations outside of what has already been assessed in this BDAR.	Figure 5

2.2 Native vegetation

This section describes the survey effort, identification associated with mapping the extent of Plant Community Types (PCTs) occurring across the Subject Land.

2.2.1 Desktop data review – vegetation and flora

A review of relevant literature, databases and existing vegetation mapping was undertaken to identify vegetation, threatened flora and Threatened Ecological Communities (TECs) that are listed under both NSW and Commonwealth legislation, with potential to occur at the Subject Land. The literature review was undertaken prior to the field survey to inform field survey requirements.

A likelihood of occurrence analysis (Appendix 2) was then undertaken for each threatened species/TEC, based on suitability of habitat present within the Subject Land.

The following databases were used for this purpose:

- NSW BioNet Atlas Database (DPIE 2021) for:
  - spatial records of threatened flora listed under the BC Act within a 10 km radius of the Subject Land
  - Threatened biodiversity database collection information.
- PMST (DAWE 2021) for threatened flora and ecological communities identified as MNES known from or with potential habitat within a 10 km radius of the Subject Land (Appendix 14).
- BAM-C tool (using benchmark condition for previously mapped PCTs) to identify candidate species credit species and predicted ecosystem credit species known or predicted to occur within the IBRA subregion – BAM-C output from 2021.
- Existing vegetation mapping: The Native Vegetation of the Woronora O'Hares and Sydney Metropolitan Catchments (NPWS 2003a) VISID 2387 was examined prior to the field survey to determine the vegetation communities likely to be present in the Subject Land.
- Records of Woronora Beard Heath (*Leucopogon exolasius*) at Donalds Castle Creek recorded by Biosis (Biosis 2016a).

2.2.2 Methods - Vegetation zone mapping

The Subject Land and surrounds have been subject to extensive biodiversity survey and monitoring over the past decade. In particular, the Subject Land was subject to a detailed survey to support the Niche (2019) Biodiversity Assessment Report for the '*Dendrobium Plan for the Future Project: Coal for Steelmaking'* (the previous application) which was submitted to DPIE in 2019, and the Niche (2020) Supplementary Biodiversity Assessment Report for the previous application.

The survey effort associated with both Biodiversity Assessment Reports for the previous application (Niche 2019;2020) is of relevance to this BDAR given the Subject Land encompasses the area previously assessed.

The survey effort to support the Biodiversity Assessment Reports for the previous application (Niche 2019; 2020) concentrated on searches for threatened flora that occur within habitat that may be impacted by the surface infrastructure, subsidence impacts, and the validation of the National Parks and Wildlife Service (NPWS, 2003) vegetation mapping for PCTs and Biometric Vegetation Types (BVTs) likely to be impacted by subsidence or impacted by surface infrastructure.

The validation of the PCTs for the Biodiversity Assessment Reports for the previous application (Niche 2019;2020) was achieved by completing the required number of floristic plots consistent with the methods specified in the OEH (2014a) *Framework for Biodiversity Assessment Methodology* (FBA), with additional information recorded (abundance, structure etc.) on the basis of best practice flora survey guidelines for assessment of a large site (at that time), particularly OEH's Working Draft *Threatened Biodiversity Survey and Assessment – Guidelines for Developments and Activities* (DEC 2004a) and OEH (2016b) *NSW Guide to Surveying Threatened Plants*.

The Biodiversity Assessment Reports for the previous application (Niche 2019;2020) included the collection of over 50 FBA Plots across the Subject Land and immediate surrounds, Coastal Upland Swamps, and within riparian area to support the assessment, and inform a detailed vegetation map. BAM attribute data was also collected at some of the FBA plot locations. The flora plots were further supported by a series of transects throughout the Coastal Upland Swamps and watercourses.

As part of this BDAR, the data previously collected was utilised to support the vegetation mapping of the Subject Land, and the threatened flora survey effort.

Additional field work was completed as part of this BDAR to supplement the previous threatened flora transects, and the collection of additional BAM plot data to meet the minimum plot requirements of the BAM. Specifically, the updated field survey included the:

- Collection of required number of BAM plots within the area proposed for surface infrastructure to meet the BAM plot requirements specified in the BAM.
- Collection of BAM plots within Coastal Upland Swamps within Area 5.
- Threatened flora transects within each Upland Swamp of Area 5.
- Threatened flora transects within the watercourses of Area 5.
- Threatened flora transects within the areas proposed for surface infrastructure.

The survey effort associated with the above are shown on Figure 7[3], with further details regarding the validation of vegetation provided below.

[3] Only BAM plots relevant to this BDAR are displayed on the figure. FBA plots completed as part of Biodiversity Assessment Reports for the previous application (Niche 2019;2020) have not been included as they have not been used in the Biodiversity credit calculations.

Table 6: Vegetation and flora field survey effort

Date	Methodology	Summary
24 - 27 October 2016	FBA	PCT validation and threatened flora species survey
31 October - 2 November 2016	FBA	PCT validation and threatened flora species survey
4 November 2016	FBA	PCT validation and threatened flora species survey
10 November 2016	FBA	PCT validation and threatened flora species survey
17 - 18 November 2016	FBA	PCT validation and threatened flora species survey
10 - 13 May 2017	FBA	PCT validation and threatened flora species survey
16 - 18 May 2018	FBA	PCT validation and threatened flora species survey
1 June 2018	FBA	PCT validation and threatened flora species survey
10 July 2019	FBA & BAM	BAM plots, PCT validation
13-15 May 2020	FBA & BAM	BAM plot, PCT validation in the ETL
19 May 2020	FBA & BAM	BAM plot, PCT validation in the ETL
21 May 2020	FBA & BAM	PCT validation in the ETL
23 - 24 June 2020	FBA & BAM	BAM plots in impact swamps and threatened flora species survey
13 - 16, 18, 21 - 23 July 2021	BAM	BAM plots, PCT validation
3 – 4, 6, 9 August 2021	BAM	BAM plots in impact swamps and threatened flora species survey
6 – 9 September 2021	BAM	BAM plots in surface infrastructure and threatened flora species survey
8, 20, 21, 22 December 2021	BAM	BAM plots within Subject Land

2.2.3 Methods – Coastal Upland Swamp mapping

For the mapping of Coastal Upland Swamps, separate vegetation zones were attributed to swamp sub-communities. The mapping completed by Niche has ground-truthed and revised all the NPWS (2003a) Coastal Upland Swamps boundaries and sub-vegetation types (Tea-Tree Thicket, Sedgeland-Heath Complex (including Sedgeland, Restioid Heath and Cyperoid Heath), Banksia Thicket, Fringing Eucalypt Woodland) using the methods described below.

2.2.3.1 Pre-processing

Prior to undertaking the validation of Coastal Upland Swamp mapping, the following data was obtained from IMC and overlayed in ARCGIS:

- LiDAR data was supplied in the form of LAS files covering the majority of the Subject Land.
- Aerial imagery (2009, 2015).
- Preliminary swamp boundaries derived from Woronora vegetation mapping (NPWS 2003a) and modified by IMC where there were obvious discrepancies.

Inspection of the existing mapped swamp boundaries (i.e. the Woronora vegetation and related vector data) indicated that those swamp polygons were either displaced from the boundaries clearly distinguishable on orthophotography, did not capture the sensible extent of the swamp, or extended into non-swamp woodland.

A consequent first step was to roughly re-align the swamp boundaries to better represent swamp dimension in order to:

- guide first approximation of the swamp extent for Canopy Height Model (CHM) editing (described below); and
- provide a representative swamp extent for internal swamp vegetation community delineation.

2.2.3.2 Data development

LAS files were converted to raster surfaces using ArcGIS for Desktop v10.4 software using the <LAS Dataset to Raster> command. Command parameters for point to raster interpolation are as follows:

- Binning (bare earth DEM) – cell assignment is average, void fill method is natural neighbour.
- Binning (canopy elevation model - CEM) – cell assignment is maximum, void fill method is none.
- Floating decimal point output and 1 m cell size (for both DEM and CEM).

A CHM was then generated by subtracting the DEM from the CEM.

2.2.3.3 Swamp delineation

Height stratification of the CHM to represent swamp boundaries was determined by trial and error. This was required as there are in-swamp features, later identified typically as Banksia Thicket, that were greater than 5 m elevation, so a low elevation as used by Jenkins and Frazier (2010) was not applicable. A 10 m stratification, on visual examination, captured the full extent of swamps, however also captured many instances of inter-connected tree canopy gaps. Consequently, a manual editing effort was required to restrict the 'swamp' CHM to a margin adjacent to swamps.

Manual editing involved visual comparison of aerial imagery (typically 2009) with the CHM stratified (> 10 m) dataset. For editing purposes, the CHM raster was converted to vector, without polygon simplification (i.e. all 1 m 'step-wise' boundaries were retained).

In the first instance, edits to eliminate non-swamp polygons were undertaken at the polygon narrowest gap, which was usually one to two pixels wide. Edits were constructed to form north to south, or east to west boundaries, in order to preserve the pixel dimensions for future comparison.

Discrimination of swamp versus non-swamp vegetation was taken on characteristic swamp vegetation texture and colour, along with absence of on-ground woody vegetation typical of eucalypt woodland. In general, a fringe of woodland was retained (later classified as Upland Swamp: Fringing Eucalypt Woodland) in order to accurately delineate the swamp boundary.

No attempt to delineate the extent of Coastal Upland Swamp: Fringing Eucalypt Woodland was made using GIS. Field validation of the boundary was difficult given that Coastal Upland Swamps: Fringing Eucalypt Woodland transitions gradually with the surrounding PCT 1083 Red Bloodwood - scribbly gum heathy woodland on sandstone plateaus, and/or PCT1181 Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion. Edits to boundaries where no narrow polygon gap was available were also constructed using east to west, or north to south boundaries where possible, except in locations where this would clearly not represent a sensible boundary. In the latter case, boundaries are typically a minimum of 20 m in length and are clearly discernible against the 'pixel dimension' background.

In many locations, scattered trees are present and surrounded by swamp vegetation. Individual trees or clusters of a small number of trees were retained as a non-threatened community ('in-swamp tree') in

order to avoid data discontinuities. Separation of scattered 'in-swamp' trees and Coastal Upland Swamps: Fringing Eucalypt Woodland was based on an approximate 30% canopy cover cut off.

The final product resulted in a Coastal Upland Swamp detailed vegetation mapping layer, that has been incorporated into the final vegetation mapping for the Subject Land.

2.2.4 Results - Vegetation zone mapping

A total of seven PCTs (split into 10 vegetation zones based on condition and/or sub-community type) were identified in the Subject Land, occupying a total area of 922.77 (Table 7). Each PCT is described in Appendix 3, and location shown on Figure 7.

Different condition classes were assigned to PCTs where they were different in cover / abundance / weed incursion.

Within the Biodiversity Assessment Development Footprint (ie. the area proposed for surface infrastructure (direct impacts), three PCTs were recorded (Table 7):

- PCT1083 *Red Bloodwood - scribbly gum heathy woodland.*
- PCT1245 *Sydney Blue Gum x Bangalay - Lilly Pilly moist forest.*
- PCT1250 *Sydney Peppermint - Smooth-barked Apple - Red Bloodwood shrubby open forest.*

The location of the PCTs within the Biodiversity Assessment Development Footprint, in respect to each surface infrastructure areas, has been described below:

Ventilation Shaft Site No. 5A

The PCT located within the proposed Ventilation Shaft Site location is PCT1083 *Red Bloodwood - scribbly gum heathy woodland,* which is the dominant vegetation community of the sandstone plateaus within the Metropolitan Water Catchment. Two separate vegetation zones (VZs) were established for PCT1083 within the area proposed for the Ventilation Shaft Site, which reflect differences in condition or structure (described in Appendix 3). The VZs were mapped separately, and the required number of plots were surveyed for each VZ as required by the BAM (Table 8).

Ventilation shaft construction – water pumping

The PCT located at the area proposed for the associated pipeline and infrastructure, has been previously cleared to support a borehole (now decommissioned) and access track. The area that was cleared to support the access track and borehole site, is in a regenerating condition, with juvenile species ranging in height from 0.1 to 2 m in areas.

The pipeline would be positioned along the rehabilitating access track. Given the flexibility in pipeline placement, areas of well-established regenerating vegetation can largely be preferentially avoided during machinery movement for construction of the water pumping infrastructure.

The infrastructure is proposed to be located at the historic borehole site, is also situated predominately within an area of regenerating PCT1083 *Red Bloodwood - scribbly gum heathy woodland*, with some intact condition on the edges of the site.

Ventilation shaft construction – Fire Trail Upgrades

The areas of vegetation along the existing Fire Trail that would need to be trimmed/modified to facilitate road upgrades are shown on Figure 7. The PCT to be impacted consists of PCT1083 *Red Bloodwood - scribbly gum heathy woodland,* which occurs immediately adjacent to the Fire Trail.

Cordeaux Dam Access Road Construction Carpark

The PCT located at the Cordeaux Dam Access Road Construction Carpark location consists of is PCT1083 *Red Bloodwood - scribbly gum heathy woodland* which is in a regenerating condition and is regularly maintained (slashed/mown) for the purposes of a road easement.

Dendrobium Pit Top Carpark Extension

The native vegetation at the Dendrobium Pit Top Carpark Extension area consists of PCT1245 *Sydney Blue Gum x Bangalay - Lilly Pilly moist forest*. A single VZ identified as being in low condition was present, with vegetation being highly modified (i.e., isolated native shrubs and a mix of introduced ground cover).

Electricity Transmission Line Easement and temporary slashing along Fire Trail

Based on the field survey results, two PCTs occur in areas subject to direct impact (i.e., vegetation clearing) for the development of the ETL easement (Table 8) (Appendix 3). Each PCT within the ETL is comprised of two VZs which represent a relatively intact condition, and a condition that has previously been cleared. The VZs were mapped separately, and the required number of plots were surveyed for each VZ as required by the BAM (Table 8).

The PCTs to be impacted by the ETL are:

- PCT1083 *Red Bloodwood - scribbly gum heathy woodland* – which comprises of an intact condition class (good) and a modified condition class (low). The modified condition class is reflective of the fire break which the PCT resides within. The fire break/easement along the Fire Trail requires slashing as routine maintenance, and as such is low in height (approx. 0.5 m to 1 m high).
- PCT1250 *Sydney Peppermint - Smooth-barked Apple - Red Bloodwood shrubby open forest* – which comprises of an intact condition class (good) and a modified condition class (low). The modified condition class (approximately 0.43 ha) is reflective of the fire break which the PCT resides within. The fire break/easement along the Fire Trail requires slashing as routine maintenance, and as such is low in height (approx. 0.5 m to 1 m high).

The low condition vegetation zones are currently maintained as a fire break and will not be modified to facilitate the Project, except for a conservative estimate of 0.1 ha to accommodate the ETL poles within PCT 1083 as previously noted section 1.3.2.

ETL construction laydown area near Cordeaux Dam

The laydown area is located within an area that is ‘cleared’ land – and thus no PCT would be impacted.

Table 7: PCTs, Keith formations, Keith classes and vegetation zones within the Subject Land and Subsidence Assessment Subject Land

PCT ID	PCT Name	Keith Formation	Keith Class	Condition	% Cleared	Corresponding TEC	Subject Land (ha)	Subsidence Assessment Subject Land (ha)
978	Needlebush - banksia wet heath on sandstone plateaus of the Sydney Basin Bioregion (Banksia Thicket)	Freshwater Wetlands	Coastal Heath Swamps	Good	48	Coastal Upland Swamps of the Sydney basin bioregion (BC Act and EPBC Act)	0.16	0.16
	Needlebush - banksia wet heath on sandstone plateaus of the Sydney Basin Bioregion (Restioid Heath)	Freshwater Wetlands	Coastal Heath Swamps	Good	48	Coastal Upland Swamps of the Sydney basin bioregion (BC Act and EPBC Act)	7.62	11.32
	Needlebush - banksia wet heath on sandstone plateaus of the Sydney Basin Bioregion (Eucalypt Fringing Woodland)	Freshwater Wetlands	Coastal Heath Swamps	Good	48	Not listed	8.42	11.38
1804	Coastal upland wet heath swamp	Freshwater Wetlands	Coastal Heath Swamps	Good	0.1	Coastal Upland Swamps of the Sydney basin bioregion (BC Act and EPBC Act)	0.18	1.8
1083	Red Bloodwood - scribbly gum heathy woodland on sandstone plateaus, Sydney Basin	Dry Sclerophyll Forests (Shrubby sub-formation)	Sydney Coastal Dry Sclerophyll Forests	Good	17	Not listed	607.59	1182.93
				Low	17	Not listed	4.94	4.95
1181	Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion	Dry Sclerophyll Forests (Shrubby sub-formation)	Sydney Coastal Dry Sclerophyll Forests	Good	20	Not listed	109.06	420.38

PCT ID	PCT Name	Keith Formation	Keith Class	Condition	% Cleared	Corresponding TEC	Subject Land (ha)	Subsidence Assessment Subject Land (ha)
1250	Sydney Peppermint - Smooth-barked Apple - Red Bloodwood shrubby open forest on slopes of moist sandstone gullies, eastern Sydney Basin Bioregion	Dry Sclerophyll Forests (Shrubby sub-formation)	Sydney Coastal Dry Sclerophyll Forests	Good	30	Not listed	63.02	150.35
				Low	30	Not listed	0.43	0.43
1395	Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	Grassy Woodland	Coastal Valley Grassy Woodlands	Good	80	Shale Sandstone Transition Forest (BC Act and EPBC Act)	91.18	127.57
1245	Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion	Wet Sclerophyll Forests (Shrubby sub-formation)	North Coast Wet Sclerophyll Forests	Moderate	43	Not listed	0.17	0.17
-	Cleared	-	-	-	-	-	29.99	78.47
Total area							**922.73**	**1,989.91**
Total area of native vegetation							**891.77**	**1,911.44**

2.2.5 Vegetation Integrity

A total of 66 BAM plots were collected throughout the Subject Land as shown on Figure 7.

The minimum number of plots collected within the Biodiversity Assessment Development Footprint are compliant with the number specified in the BAM (Table 8).

Two BAM-C cases were created to determine the VI score for the Biodiversity Assessment Development Footprint, and that of the wider Subject Land.

The VI score for the Biodiversity Assessment Development Footprint was obtained by entering BAM plot data collected only within the direct impact area into the BAM-C cases. Whilst the VI score for the Subject Land was obtained from all BAM plots collected (Table 9).

The data provides quantitative measures of composition, structure, and function for each vegetation zone (Appendix 4). The BAM-C compares the values recorded in each VZ on the Subject Land with the benchmark for the PCT described in the BioNET Vegetation Classification database (DPIE 2021) to provide the VI score. This score represents the overall condition, health and function of the vegetation compared to the benchmark value (out of 100).

Patch size for all vegetation zones was given the highest score in the BAM-C (>100 ha), as the native vegetation in the Subject Land is directly connected to other large areas of native vegetation (as can be seen on Figure 5).

Table 8: BAM plots and vegetation integrity scores of vegetation zones within the Biodiversity Assessment Development Footprint

PCT Code	PCT Name	Corresponding TEC	Condition	Vegetation integrity	Biodiversity Assessment Development Footprint (ha)							Total Area (ha)	BAM Plots required – as per BAM	BAM Plots completed
					Ventilation Shaft Site No 5A	Ventilation construction – water shaft and pipeline	Ventilation construction – Fire Trail Upgrade	ETL	Dendrobium Pit Top Carpark Extension	ETL set down area	Cordeaux Dam Access Road Construction Carpark			
Surface infrastructure														
1250	Sydney Peppermint - Smooth-barked Apple - Red Bloodwood shrubby open forest on slopes of moist sandstone gullies, eastern Sydney Basin Bioregion	Not listed	Good	42.4	0	0	0.10	1.00	0	0	0	1.1	1	6
			Low	24	0	0	0	0.43	0	0	0	0.43	1	1
1083	Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux, Sydney Basin Bioregion	Not listed	Good	52.5	13.38	0.14	0.11	2.89	0	0	0	16.52	3	7
			Low	26	1.26	0.55	0	2.98	0	0	0.15	4.95	3	4
1245	Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion	Not listed	Low	26.2	0	0	0	0	0.17	0	0	0.17	1	1
0	Cleared land	Not listed	Cleared	-	0.73	0	0.05	5.75	0.22	0.16	0	6.91	-	-
Total												30.07	9	19

Table 9. BAM plots and vegetation integrity scores for vegetation zones within the Subject Land (not subject to Direct Impacts)

PCT Code	PCT Name	Corresponding TEC	Condition	Vegetation integrity	Total Area (ha)	BAM Plots completed
978	Needlebush - banksia wet heath on sandstone plateaux of the Sydney Basin Bioregion - Banksia	Coastal Upland Swamps of the Sydney Basin Bioregion (BC Act and EPBC Act)	Good	78.6	0.16	1
978	Needlebush - banksia wet heath on sandstone plateaux of the Sydney Basin Bioregion – Restioid	Coastal Upland Swamps of the Sydney Basin Bioregion (BC Act and EPBC Act)	Good	67.3	7.62	4
978	Needlebush - banksia wet heath on sandstone plateaux of the Sydney Basin Bioregion – Eucalypt Fringing Woodland	Not Listed	Good	62.6	8.42	3
1804	Needlebush - Banksia wet heath swamps on coastal sandstone plateaus of the Sydney Basin (Tea Tree Thicket)	Coastal Upland Swamps of the Sydney Basin Bioregion (BC Act and EPBC Act)	Good	52.8	0.18	1
1083	Red Bloodwood - scribbly gum heathy woodland on sandstone plateaus of the Sydney Basin Bioregion	Not Listed	Good	51.8	607.59	25
			Low	43.8	4.94	4
1250	Sydney Peppermint - Smooth-barked Apple - Red Bloodwood shrubby open forest on slopes of moist sandstone gullies, eastern Sydney Basin Bioregion	Not Listed	Good	68.7	63.02	6
			Low	9.9	0.43	1
1181	Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion	Not listed	Good	68.7	109.06	2
1395	Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	Shale Sandstone Transition Forest (BC Act and EPBC Act)	Good	67.9	91.18	1 & 5 in low condition
1245	Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion	Not listed	Low	43.6	0.17	1
Total					981.11	54

2.3 Threatened ecological communities

Details relating to the characteristics and potential occurrence of the TECs generated from the desktop review (section 2.2.1) and the SEARs have been provided in Appendix 1.

Based on the background analysis, and result of the field survey, only two TECs are known to be associated with the PCTs recorded within the Subject Land (Table 7; Figure 8):

- Shale Sandstone Transition Forest, which is listed as Critically Endangered under the BC Act and EPBC Act; and
- Coastal Upland Swamps, which is listed as Endangered under the BC Act and EPBC Act.

Neither of the TECs occur within the Biodiversity Assessment Development Footprint.

The occurrence within the Subject Land for both TECs are discussed below.

2.3.1 Shale Sandstone Transition Forest

Shale Sandstone Transition Forest TEC is listed as Critically Endangered under the BC Act and EPBC Act. The TEC has been identified by DAWE as a subject threatened entity for the Project, as '*Longwall mining is listed as a threatening process, disrupting natural groundwater regimes and discharge patterns associated with mining* (Appendix 1).

The State listing and description for the TEC is described in NSW Scientific Committee (2014a) *Final Determination - Shale Sandstone Transition in the Sydney Basin Bioregion*, whilst the Commonwealth listing and description is detailed in DoE (2014a) *Approved Conservation Advice (including listing advice) for Shale Sandstone Transition Forest of the Sydney Basin Bioregion*.

Both documents describe the community in the same manner, however Shale Sandstone Transition Forest is only listed as Critically Endangered under the EPBC Act if it meets the condition classes/condition thresholds provided in DoE (2014a).

PCT1395 *Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion* within the Subject Land (Figure 7; Figure 8) aligns to both the State and Commonwealth listing for Shale Sandstone Transition Forest TEC due to the following:

- Characteristic species listed under both the NSW Scientific Committee (2014) and DoE (2014a) which occur within Transitional Shale Dry Ironbark Forest and Transitional Shale Stringybark Forest include *Eucalyptus punctata, Eucalyptus globoidea, Eucalyptus eugenioides,* and *Eucalyptus crebra.*
- The Subject Land occurs within the known distribution for the TEC.
- The shrub layer of both Transitional Shale Dry Ironbark Forest and Transitional Shale Stringybark Forest are consistent with the NSW Scientific Committee (2014) and DoE (2014a) descriptions. Both communities contained diverse, shrub layer consisting of *Kunzea ambigua, Persoonia linearis* and *Bursaria spinosa,* and ground layer dominated by *Austrostipa pubescens, Entolasia stricta, Themeda australis, Lepidosperma laterale, Aristida vagans* and *Pomax umbellata.*
- Under the DoE (2014a) condition classes/condition thresholds, both Transitional Shale Dry Ironbark Forest and Transitional Shale Stringybark Forest would be classified as 'high condition' given the vegetation communities are part of an extensive patch of native vegetation. As such, Transitional Shale Dry Ironbark Forest and Transitional Shale Stringybark Forest are regarded as the TEC under the EPBC Act.
- The vegetation descriptions for both Transitional Shale Dry Ironbark Forest and Transitional Shale Stringybark Forest in NPWS (2003a) state that both communities 'form a component of Shale Sandstone Transition Forest listed on Part 3 of Schedule 1 of the BC Act'.

In total, 91.18 ha of the Shale Sandstone Transition Forest TEC has been mapped within the Subject Land (Table 7; Figure 8).

2.3.2 Coastal Upland Swamps

Coastal Upland Swamps are listed as TECs under the BC Act and EPBC Act. The TEC has been identified by DAWE as a subject threatened entity for the Project, as '*subsidence events associated with the proposed action may reduce the extent of the ecological community and adversely affect critical habitat*' (Appendix 1).

The State listing and description for the TEC is described in NSW Scientific Committee (2012) *Final Determination – Coastal Upland Swamps in the Sydney Basin Bioregion*, whilst the Commonwealth listing and description is detailed in DoE (2014a) *Approved Conservation Advice (including listing advice) for Coastal Upland Swamps of the Sydney Basin Bioregion*.

Both documents provide similar descriptions for Coastal Upland Swamps and list the following NPWS (2003a) mapping units as aligning to the TEC:

- Coastal Upland Swamps Banksia Thicket (MU42);
- Coastal Upland Swamps Tea-tree Thicket (MU43); and
- Coastal Upland Swamps Sedgeland-Heath Complex (MU44).

Both MU42 and MU44 mapping units align to PCT978 *Needlebush - banksia wet heath on sandstone plateaux of the Sydney Basin Bioregion*. Mapping unit MU43 aligns to PCT1804 *Needlebush - Banksia wet heath swamps on coastal sandstone plateaus of the Sydney Basin*.

A total of 18 Coastal Upland Swamps were mapped by Niche within the Subject Land, and 22 within the Subsidence Assessment Subject Land (Figure 9).

Each Coastal Upland Swamp is generally a mosaic of more than one of the following sub-units of Upland Swamp vegetation:

- Coastal Upland Swamps Banksia Thicket' (MU42);
- Coastal Upland Swamps Tea-tree Thicket' (MU43);
- Coastal Upland Swamps Sedgeland-Heath Complex' (MU44[4]); and
- 'Coastal Upland Swamps Eucalypt Fringing Woodland' (MU45).

The vegetation description for each of the Coastal Upland Swamp sub-units is provided in Appendix 3. 'Coastal Upland Swamps Eucalypt Fringing Woodland' (MU45) is not listed on either the Scientific Committee (2012) or DoE (2014b) as a vegetation mapping unit aligning to the TEC.

Therefore, 18 of the Coastal Upland Swamps recorded within Subject Land and 22 Coastal Upland Swamps within the Subsidence Assessment Subject Land contain the mapping units equivalent to the TEC listing, and therefore would be regarded as Endangered Ecological Community (EEC) under the BC Act and EPBC Act (Table 10). These Coastal Upland Swamps (excluding the non-threatened MU45) are shown on Figure 9.

These Coastal Upland Swamps in the Subject Land also meet the NSW Scientific Committee (2012) and DoE (2014b) Determination for the following reasons:

[4] Coastal Upland Swamps Sedgeland-Heath Complex (MU44) is composed of three sub-units reflecting vegetation sub structure including MU44a, MU44b and MU44c. Reference to MU44 may refer to any one of these sub-units or a composite.

- The Coastal Upland Swamps in the Subject Land occur on Hawkesbury sandstone plateaus.
- The Coastal Upland Swamps are within the known distribution for Coastal Upland Swamps TEC.
- The Subject Land is within the Woronora plateau, which according to NSW Scientific Committee (2012) 'represents the greatest extent and one of the oldest recorded occurrences of upland wetlands on the Australian mainland'.
- The following characteristic species as detailed in both the NSW Scientific Committee (2012) and DoE (2014b) determination listing were recorded during the field survey across the majority of Coastal Upland Swamps: *Actinotus minor, Baeckea imbricata, Baeckea linifolia, Banksia ericifolia, Banksia robur, Bauera microphylla, Boronia parviflora, Cassytha glabella, Dampiera stricta, Dillwynia floribunda, Drosera binata, Drosera spathulata, Empodisma minus, Entolasia stricta, Epacris microphylla, Epacris obtusifolia, Lepidosperma limicola, Leptocarpus tenax, Leptospermum juniperinum, Leptospermum squarrosum, Lepyrodia scariosa, Ptilothrix deusta, Schoenus brevifolius, Selaginella uliginosa* and *Sprengelia incarnata.*

The Coastal Upland Swamps in the Subject Land comprise two fundamental geomorphic types:

1. Headwater Swamps are the majority of the Coastal Upland Swamps within the Woronora Plateau, and are generally situated in areas near catchment divides where plateau incision is weak and topographic grades are shallow.
2. Valley Infill Swamps form as isolated pockets blanketing the floor of incised second or third order stream valleys and therefore tend to be elongated downstream (Tomkins and Humphreys 2006). They are believed to be initiated by rapid transportation of sediment material downstream and equally rapid deposition possibly as a result of channel profile-restriction. Once initiated, the swamps are probably self-reinforcing, trapping more sediment, raising the water table and fostering the growth of organics and formation of peat (Tomkins and Humphreys 2006).

The identification of Valley Infill Swamps and Headwater Swamps for each Coastal Upland Swamp recorded in the Subject Land was completed using GIS analysis. Headwater Swamps were attributed to those swamps that did not occur within creek lines, or were elevated above first order streams on relatively flat terrain. Valley Infill Swamps were attributed to incised depressions with clearly identified drainage lines. The alignment of each Coastal Upland Swamp is provided in Table 10.

Table 10: Coastal Upland Swamps within the Subject Land and Subsidence Subject Land

Swamp	Type	Present within Subject Land	Area (ha)					
			MU42 – Banksia Thicket	MU43 – Tea-tree Thicket	MU44b – Restioid Heath	MU45 – Eucalypt Fringing Woodland	Swamp Area	Total TEC
Den100	Headwater	Present	0	0	0.46	0.38	0.84	0.46
Den101	Headwater	Present	0	0	0.4	0.41	0.81	0.4
Den102	Headwater	Present	0	0	0.27	0.24	0.51	0.27
Den103	Headwater	Present	0	0	0.53	0.63	1.16	0.53
Den104	Valley In-fill	Absent	0	0	0.16	0.34	0.5	0.16
Den105	Headwater	Absent	0	0	0.16	0.23	0.39	0.16
Den106	Headwater	Present	0	0	0.66	0.42	1.08	0.66
Den107	Headwater	Present	0	0	0	0.54	0.54	0
Den108	Valley In-fill	Present	0.11	0	0	0.3	0.41	0.11
Den109	Headwater	Present	0.04	0	0.37	0.55	0.96	0.41
Den110	Headwater	Present	0	0.18	0.07	0.24	0.49	0.25
Den111	Valley In-fill	Present	0	0	0.17	0.19	0.36	0.17
Den114	Headwater	Present	0	0	0	0.61	0.61	0
Den120	Headwater	Present	0	0	0.61	0.34	0.95	0.61
Den121	Valley In-fill	Present	0	0	0.46	0.73	1.19	0.46
Den122	Headwater	Present	0	0	0.35	0.26	0.61	0.35
Den123	Headwater	Present	0	0	0.13	0.27	0.4	0.13
Den85	Headwater	Absent	0	0	2.1	0.67	2.77	2.1
Den86	Headwater	Present	0	0	2.37	2.29	4.66	2.37
Den97	Headwater	Present	0	1.03	0	0.36	1.39	1.03
Den98	Valley In-fill	Absent	0	0.59	0	0.21	0.8	0.59
Den99	Headwater	Present	0	0	2.03	1.18	3.21	2.03
Total			**0.15**	**1.8**	**11.3**	**11.39**	**24.64**	**13.25**

2.3.3 Upland Swamp Environmental Assessment

To assist in the environmental assessment process in regard to Coastal Upland Swamps, Environment, Energy and Science Group (EES) has provided the following guideline - *Upland Swamp Environmental Assessment Guidelines – Guidance for the underground mining industry operating in the Southern Coalfield* (OEH 2012a).

The guideline was designed to provide proponents with a step-by-step method to undertake environmental assessment and impact mitigation. The guideline provides a list of criteria to be used to assess Coastal Upland Swamps in terms of 'significance'.

Coastal Upland Swamps that are deemed to be of 'special significance' are considered by OEH to be of greater biological and ecological value which may require further avoidance, mitigation and monitoring measures.

To determine if an Upland Swamp in the Subject Land is of 'special significance' the Upland Swamp must satisfy three of the criteria from OEH (2012a), provided in Table 11.

Niche has undertaken an independent assessment for each Coastal Upland Swamp against the criteria, as the NPWS (2003a) mapping was further refined by Niche for this assessment.

Table 11. Coastal Upland Swamp Significance criteria

Significance Criteria	Significance Criteria Descriptions OEH (2012a) Upland Swamp Environmental Assessment Guidelines Guidance for the Underground Mining Industry Operating in the Southern Coalfield
Statutory thresholds, indicated by the presence of TECs or threatened species	A swamp is significant under criterion 2.3 of OEH (2012a) if it is determined to be of National and/or State significance. If using the OEH assessment, all Coastal Upland Swamps on the Woronora Plateau with the vegetation types MU42, MU43 or MU44 in the regional vegetation map (NPWS 2003a) are of State significance under this criterion. If using an independent assessment, the vegetation types within swamps would need to be sampled, then assessed against the criteria in the State listing for Coastal Upland Swamp TEC. If using an independent assessment, the swamp is of State significance if it contains habitat for any recorded threatened species. A swamp is of National significance if the relevant Commonwealth authority makes such a determination.
Substantial size	A swamp is significant under criterion 2.4 of OEH (2012a) if its size is greater than 7.4 ha. 10% of swamps in the region exceed this threshold. If using the OEH assessment, all swamps from the regional vegetation mapping (NPWS 2003a) that are larger than this threshold have been identified in Map 3 in Appendix 1 of OEH (2012a). If using an independent assessment, the boundary of individual swamps can be verified by field assessment, and their area calculated by methods such as GIS. The threshold remains 7.4 ha in either instance.

Significance Criteria	Significance Criteria Descriptions OEH (2012a) Upland Swamp Environmental Assessment Guidelines Guidance for the Underground Mining Industry Operating in the Southern Coalfield
Unusual complexity	A swamp is significant under criterion 2.5 of OEH (2012a) if it contains the full range of regionally occurring swamp vegetation communities. If using the OEH assessment, a significant swamp is indicated by the presence of Tea-Tree Thicket (MU 43) in the regional vegetation map (NPWS 2003a). Swamps with MU43 have been identified in Map 4 in Appendix 1 of OEH (2012a). This approach should apply if this vegetation mapping is used without field verification. If using an independent assessment to identify the vegetation types within a swamp by field assessment, a significant swamp is indicated by the presence of all of MU42, MU43 and MU44.
Closely proximate habitat	A swamp is significant under criterion 2.6 of OEH (2012a) if it occurs in one of the four key clusters of swamps shown in Map 5 in Appendix 1 of OEH (2012a), including: • Maddens Plains (O'Hares and Cataract catchments). • Wallandoola Creek (Cataract catchment). • North Pole (southern Avon catchment). • Stockyard (southern Nepean catchment). The assessment of significance for this criterion is the same regardless of whether the OEH assessment or an independent assessment is used.
Scientific research importance	A swamp is significant under criterion 2.7 of OEH (2012a) if it is a site of scientific research importance. Significant swamps include • The swamps in Map 6; and • Reference swamps with no mining beneath that have been paired with a swamp(s) that is subject to underground mining. The assessment of significance for this criterion is the same regardless of whether the OEH assessment or an independent assessment is used.

An assessment of each Coastal Upland Swamp recorded in the Subject Land in relation to the significance criteria is provided in Table 12. Based on the results, Den98 is regarded as a swamp that meets the special significance criteria. Potential impacts to Den98 have been avoided as discussed in section 3.

Table 12: Coastal Upland Swamps in Subject Land compared to Significance Criteria

Swamp	Significant criteria					Does swamp meet three of the significant criteria, and is therefore regarded as of special significance?
	Statutory thresholds[1]	Substantial size	Unusual complexity	Closely proximate habitat	Scientific research importance	
Den85	Yes	No	No	No	No	No
Den86	Yes	No	No	No	No	No
Den97	Yes	No	No	No	No	No
Den98	Yes	No	Yes	Yes	No	Yes
Den99	Yes	No	No	No	No	No
Den100	Yes	No	No	No	No	No
Den101	Yes	No	No	No	No	No
Den102	Yes	No	No	No	No	No
Den103	Yes	No	No	No	No	No
Den104	Yes	No	No	No	No	No
Den105	Yes	No	No	No	No	No
Den106	Yes	No	No	No	No	No
Den107	Yes	No	No	No	No	No
Den108	Yes	No	No	No	No	No
Den109	Yes	No	No	No	No	No
Den110	Yes	No	No	No	No	No
Den111	Yes	No	No	No	No	No
Den114	Yes	No	No	No	No	No
Den120	Yes	No	No	No	No	No
Den121	Yes	No	No	No	No	No
Den122	Yes	No	No	No	Yes	No
Den123	Yes	No	No	No	No	No

1 All swamps have been included based on the potential for threatened species habitat.

2.4 Threatened species

2.4.1 Assessing the habitat suitability for threatened species

In accordance with the BAM, assessing habitat suitability for an ecosystem credit species involves the following steps:

Step 1: Identify ecosystem credit species for assessment.

Step 2: Assess the habitat constraints and vagrant species.

The list of predicted species (ecosystem credit species) generated via the BAM-C is for the Subject Land displayed in Table 13 below. The predicted species list also includes those predicted species to occur within the small portion of the site that occurs within the Illawarra IBRA subregion.

For the purpose of this assessment, it is assumed that all predicted species may have potential habitat in the Subject Land.

Table 13. List of predicted species (ecosystem credit species) as determined by BAM-C

Scientific Name	Common name	BC Act /EPBC Act Status*	Associated with PCTs within the Biodiversity Assessment Development Footprint	Associated PCTs within the Subject Land
Anthochaera phrygia	Regent Honeyeater	CE BC Act / CE EPBC Act	1250, 1083, 1245	1250, 1083, 1181, 1395, 1804, 1245
Artamus cyanopterus	Dusky Woodswallow	V BC Act	1250, 1083, 1245	1250, 978, 1083, 1181, 1395, 1804, 1245
Callocephalon fimbriatum	Gang-gang Cockatoo	V BC Act / E EPBC Act	1250, 1083, 1245	PCT 1250, 1083, 1181, 1395, 1804, 1245
Calyptorhynchus lathami	Glossy Black Cockatoo	V BC Act	1250, 1083, 1245	1250, 1083, 1181, 1395, 1245
Circus assimilis	Spotted Harrier	V BC Act	Not associated	1804
Daphoenositta chrysoptera	Varied Sittella	V BC Act	1250, 1083, 1245	1250, 1083, 1181, 1395, 1804, 1245
Dasyurus maculatus	Spotted-tailed Quoll	V BC Act/ E EPBC Act	1250, 1083, 1245	1250, 978, 1083, 1181, 1395, 1804, 1245
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V BC Act	1250, 1083, 1245	PCT 1250, 1083, 1181, 1395, 1245
Glossopsitta pusilla	Little Lorikeet	V BC Act	1250, 1083, 1245	PCT1083, 1181, 1250, 1804, 1245, 1245
Haliaeetus leucogaster	White-bellied Sea-Eagle	V BC Act	1250, 1083, 1245	1250, 978, 1083, 1181, 1395, 1804, 1245
Hieraaetus morphnoides	Little Eagle	V BC Act	1250, 1083, 1245	978, 1083, 1181, 1395, 1804
Hirundapus caudacutus	White-throated Needletail	V EPBC Act	1250, 1083, 1245	1250, 978, 1083, 1181, 1395, 1804, 1245
Hoplocephalus bungaroides	Broad-headed Snake	E BC Act/ V EPBC Act	1250, 1083, 1245	PCT 1250, 978, 1083, 1181, 1804, 1245
Ixobrychus flavicollis	Black Bittern	V BC Act	1250, 1083, 1245	PCT 1250
Lathamus discolor	Swift Parrot	E BC Act/ CE EPBC Act	1250, 1083, 1245	1250, 1083, 1181, 1395, 1804, 1245
Lophoictinia isura	Square-tailed Kite	V BC Act	1250, 1083, 1245	1250, 1083, 1181, 1395, 1804
Melithreptus gularis	Black-chinned Honeyeater (eastern subspecies)	V BC Act	1083	PCT 1083, PCT 1395
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	V BC Act	1250, 1083, 1245	PCT 1250, 978, 1083, 1181, 1395, 1804, 1245
Miniopterus australis	Little Bent-winged Bat	V BC Act	1250, 1083	1250, 978, 1083, 1181, 1395, 1804

Scientific Name	Common name	BC Act /EPBC Act Status*	Associated with PCTs within the Biodiversity Assessment Development Footprint	Associated PCTs within the Subject Land
Miniopterus orianae oceanensis	Large Bent-winged Bat	V BC Act	1250, 1083, 1245	1250, 978, 1083, 1181, 1395, 1804
Neophema pulchella	Turquoise Parrot	V BC Act	1250, 1083	1250, 1083, 1395, 1804
Ninox strenua	Powerful Owl	V BC Act	1250, 1083, 1245	1250, 1083, 1181, 1395, 1245
Pachycephala olivacea	Olive Whistler	V BC Act	1245	1245
Pandion cristatus	Eastern Osprey	V BC Act	1250, 1083,	1250, 978, 1083
Petaurus australis	Yellow-bellied Glider	V BC Act	1250, 1083, 1245	1250, 1083, 1181, 1395, 1245
Petroica boodang	Scarlet Robin	V BC Act	1250, 1083, 1245	1250, 1083, 1181, 1395, 1804
Petroica phoenicea	Flame Robin	V BC Act	1250	PCT 1250, 1395
Phascolarctos cinereus	Koala	V BC Act / V EPBC Act[5]	1250, 1083, 1245	1250, 1083, 1181, 1395, 1804, 1245
Phoniscus papuensis	Golden-tipped Bat	V BC Act	1250, 1083, 1245	1250, 1083, 1181, 1395, 1245
Pseudomys novaehollandiae	New Holland Mouse	V EPBC Act	1250, 1083, 1245	1250, 978, 1083, 1181, 1804
Pteropus poliocephalus	Grey-headed Flying-fox	V BC Act / V EPBC Act	1250, 1083, 1245	1250,0978, 1083, 1181, 1395, 1804, 1245
Ptilinopus regina	Rose-crowned Fruit-Dove	V BC Act	1245	1245
Ptilinopus superbus	Superb Fruit-Dove	V BC Act	1245	1245
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V BC Act	1250, 1083, 1245	1250, 978, 1083, 1181, 1395, 1245
Scoteanax rueppellii	Greater Broad-nosed Bat	V BC Act	1250, 1083, 1245	1250, 978, 1083, 1181, 1395, 1804, 1245
Tyto longimembris	Eastern Grass Owl	V BC Act	Not associated	PCT 978, 1804
Tyto novaehollandiae	Masked Owl	V BC Act	1250, 1083, 1245	1250, 1083, 1181, 1395, 1245

[5] *Listed as 'Vulnerable' under the EPBC Act at the time of the "controlled action" decision (13 January 2022) and therefore assessed as 'Vulnerable' rather than 'Endangered' (refer section 158A of the EPBC Act).*

Scientific Name	Common name	BC Act /EPBC Act Status*	Associated with PCTs within the Biodiversity Assessment Development Footprint	Associated PCTs within the Subject Land
Tyto tenebricosa	Sooty Owl	V BC Act	1250, 1245	1250, 1395, 1245
Varanus rosenbergi	Rosenberg's Goanna	V BC Act	1250, 1083	1250, 978, 1083, 1181, 1395, 1804

Assessing habitat suitability for a species credit species involves the following steps:

Step 1: Identify species credit species for assessment.

Step 2: Assess the habitat constraints and vagrant species for species credit species on the biodiversity assessment development footprint.

Step 3: Further assessment of candidate species credit species.

Step 4: Determine the presence of a candidate species credit species.

Step 5: Determine the area or count, and location of suitable habitat for a species credit species (a species polygon).

Step 6: Determine the habitat condition within the species polygon for species assessed by area.

The list of candidate species (species credit species) generated via the BAM-C is provided in section 2.5 (flora) and section 2.6 (fauna). The candidate species list also includes those species from the Illawarra subregion. Threatened flora and fauna species identified as having a moderate or higher likelihood of occurrence in the Subject Land (via database searches or the PMST), which were not in the list generated by BAM-C, were added to the candidate species list for further assessment.

2.5 Threatened flora (species credit species)

This section of this BDAR details the survey effort used to detect the presence/absence of threatened flora and their habitats within the portions of the Subject Land that may be impacted by the Project. Threatened flora determined to have potential habitat likely to be impacted by the Project, are further detailed further in the impact assessment (section 4).

The BAM regards all threatened flora species as 'species credit' species. Targeted surveys or an expert report are required for those species identified by BAM-C, or for species deemed to have a high potential or known occurrence from database searches. The species are referred to as 'candidate species'.

A total of 41 threatened flora species (candidate species) with potential habitat within the Subject Land were identified in the BAM-C, which are provided in Table 17.

2.5.1 Methods - Threatened flora survey

The Biodiversity Assessment Development Footprint, Subject Land, and Subsidence Assessment Subject Land has been subject to extensive threatened flora surveys associated with the Project over the past five years. In particular, the Subject Land was subject to threatened flora surveys to support the Niche (2019) Biodiversity Assessment Report for the previous applicationwhich was submitted to DPIE in 2019, and the Niche (2020) Supplementary Biodiversity Assessment Report for the previous application. The survey effort associated with both Niche Biodiversity Assessment Reports is of relevance to this BDAR given the Subject Land encompasses the area previously assessed. The targeted flora surveys associated with both assessments have been incorporated into this BDAR where relevant, along with supplementary surveys.

The survey effort associated with the Biodiversity Assessment Development Footprint, and that of the wider Subject Land has been discussed below.

The survey effort was completed by ecologists from Niche with suitable relevant experience as summarised in Table 14. Specifics of the field survey within the Biodiversity Assessment Development Footprint, wider Subject Land and the Subsidence Subject Land are detailed in the sections below.

Table 14. Identity, role and experience of ecologists relevant to the targeted threatened flora species surveys

Consultant name	Role	Accreditation	Experience	Survey target	Location of survey	Date of surveys
Luke Baker	Discipline Manager – Flora Biodiversity Lead; BAM Accredited Assessor	BAppSc Accredited Biodiversity Assessor (BAAS17033)	BAM plots, targeted threatened flora searches, credit calculations, review of credit calculations, report preparation and quality assurance.	All threatened flora	Ventilation Shaft Site No 5A; Coastal Upland Swamps; ETL; Riparian areas; ridgeline environments.	2016 and 2017 field survey
Alex Christie	Senior Ecologist	BEnvSc Accredited Biodiversity Assessor (BAAS18131)	BAM plots, threatened flora surveys.	All threatened flora	Ventilation Shaft Site No 5A; Coastal Upland Swamps; ETL; Riparian areas; ridgeline environments, water pipeline access.	2016 and 2017 field survey
Sian Griffiths	Senior Associate – Ecology	BEnvSc (Hons) Accredited Biodiversity Assessor (BAAS 17066)	BAM plots, threatened flora surveys, report preparation.	All threatened flora	Ventilation Shaft Site No 5A; Coastal Upland Swamps; ETL; Riparian areas; ridgeline environments.	2020 and 2021 survey
Sarah Hart	Experienced Consultant - Ecology	BSc, MSc, GradDip EnvMgmt	BAM plots, targeted threatened flora searches and data management.	All threatened flora	Ventilation Shaft Site No 5A; Coastal Upland Swamps; ETL; Riparian areas; ridgeline environments.	2020 and 2021 survey
Stephen Bloomfield	Senior Associate – Ecology	BAppSc (Coastal Mgmt), Accredited BAM Assessor (BAAS18054)	Threatened flora survey. Reference population survey for Genoplesium baueri	All threatened flora including Genoplesium baueri	Ventilation shaft site	2022 survey
Nathan Browne	Ecologist	BSc (Hons)	Targeted threatened flora and fauna surveys, data management.	All threatened flora	Ventilation Shaft Site No 5A; Coastal Upland Swamps; ETL; Riparian areas; ridgeline environments.	2021 survey

Consultant name	Role	Accreditation	Experience	Survey target	Location of survey	Date of surveys
Yogesh Nair	Ecologist	Cert III CLM (Natural Area Restoration), AdvDipEnvMgnt, BEnvSci, MSc Biodiversity Conservation Accredited Biodiversity Assessor (BAAS18144)	Targeted threatened flora and fauna surveys, data management.	All threatened flora	Ventilation Shaft Site No 5A; ETL;	2021 survey
Christie Chapman	Environment Consultant	BEnvSc	Targeted threatened flora and fauna surveys, data management.	All threatened flora	ETL; Water pipeline	2021 survey
David Wilkinson	Ecologist	BSci	Targeted threatened flora and fauna surveys, data management.	All threatened flora	Ventilation Shaft Site No 5A; Coastal Upland Swamps; ETL; Riparian areas; ridgeline environments.	2021 survey
Amy Legge	Ecologist	BSci	Targeted threatened flora and fauna surveys, data management.	All threatened flora	Ventilation Shaft Site No 5A	2021 survey

2.5.1.1 Biodiversity Assessment Development Footprint

Threatened flora survey completed within the Biodiversity Assessment Development Footprint comprised of transects as details in Table 15. In summary, the targeted flora survey included the following:

- Flora transects using parallel 10-20 m transect widths as per the *Surveying threatened plants and their habitats NSW survey guide for the Biodiversity Assessment Method* (DPIE 2020c)., were completed within the Ventilation Shaft Site within the months of February, May, July and November which covered the correct survey season for all candidate threatened flora listed in Table 17. The February survey specifically targeted *Genoplesium baueri* and was undertaken on the 22nd of February 2022 after confirming that the local population (at Helensburgh NSW) was flowering.
- The ETL, Fire Trail upgrade and water pipeline route were traversed during May, August and November. The survey months did not cover all the survey seasons for all the threatened flora, however the disturbance within these areas has the flexibility to avoid any threatened flora (section 3). For example:
    - Powerline poles can be installed in areas of bare earth or avoid threatened flora.
    - The water pipe that is placed on the ground surface can be moved aside to avoid threatened flora.
    - All vegetation disturbance works within the ETL, Fire Trail upgrade and water pipeline route would be supervised by an ecologist as a safeguard against impacts to any threatened flora.
    - Trimming of any overhanging branches will not impact threatened flora.
- Flora transects covering the entire area (approximately 0.17 ha of native vegetation) of the Dendrobium Pit Top Carpark Extension during the months of August and May. We deemed this sufficient effort given the site has been highly impacted by historic clearing, with thick ground-cover

grasses occupying the ground layer which we have aligned to native vegetation due to the overstorey cover. The introduced ground layer is highly likely to impede the occurrence of threatened flora.

- Cordeaux Dam Access Road Construction Carpark (approximately 0.15 ha of native vegetation) is part of a mown area of native grass within an existing fire trail easement. The entire area was easily traversed in August. We deem this as sufficient to cover off on threatened flora given it is a patch of grass that has been regularly mown for many decades.

Details of the flora survey within the Biodiversity Assessment Development Footprint has been provided in Table 15, and track extent shown on Figure 10.

Table 15. Threatened flora survey effort

Area	Dates surveyed	Ecologists	Details	Estimate of hours
Ventilation Shaft Site No 5A	17 and 18 November 2016; 5 to 6 of May 2020; 7 May 2020; 13 May 2020; 15 May 2020; 16 July 2021, 22 February 2022.	Luke Baker (2016-survey); Alex Christie (2016-survey); Sarah Hart Sian Griffiths Nathan Browne David Wilkinson Amy Legg Yogesh Nair	Parallel traverses across the site by two ecologists. 10 m intervals in closed-well vegetated areas; and approximately 20 m where the ground layer did not impede visibility. See Figure 10 which shows the extent of transects.	Approximately 118 hours of survey.
ETL, Fire Trail upgrade	7 May 2020; 15 and 19 May 2020; 26 August 2021 3 November 2021	Sarah Hart Sian Griffiths Nathan Browne David Wilkinson Amy Legg Christie Chapman	Traverses by two ecologists across the entire ETL easement. Visibility was good given the ground layer is generally maintained to a height of 0.5 m. Note that all threatened flora can be avoided given the flexibility in pole placement, and the vegetation is maintained at a specific height. Pre-construction surveys would also be undertaken to avoid impacts to any threatened flora. Traverse by an ecologist within the area that may require vegetation modification (slashing) to allow for truck movement during construction. Note that the slashing/trimming/impact would be temporary during construction and any native ground cover would not require clearing, thus avoiding impacts to threatened flora (section 3).	Approximately 18 hours (2 days in May 2020) was spent with two ecologists completing transverse and plot surveys over the area of proposed clearing for the ETL. Approximately 4 hours over 1 day (3 November 2021).

Area	Dates surveyed	Ecologists	Details	Estimate of hours
Dendrobium Pit Top Carpark Extension	26 August 2021 19 May 2019	Sarah Hart (2021) Luke Baker (2019)	Traverses by an ecologist within the disturbance area. The traverse was 10 m wide width during both August and May surveys. Traverses were also undertaken during the fauna survey effort of the site. The site was very small and could easily be covered. The ground cover consisted predominately of non-native vegetation. Highly unlikely for threatened flora. BAM plot collected at the site.	Approximately 1.5 hours each.
Cordeaux Dam Access Road Construction Carpark	26 August 2021	Sarah Hart	Traverse by an ecologist within the disturbance area. Very small area (0.15 ha) easily covered by a traverse. The site is regularly mown/slashed and thus threatened flora habitat is minimal.	Approximately 1 hour
Ventilation shaft water pump and pipeline	8 August 2018; 18 November 2021	Alex Christie; Christie Chapman	Traverse by an ecologist within the area that may require vegetation impact.	Approximately 4 hours over 1 day.

2.5.1.2 Subject land & Subsidence Subject Land

The BAM is not prescriptive in its survey effort requirements for indirect impacts and prescribed impact areas (Appendix 15). To approach the survey of the areas outside of the Biodiversity Assessment Development Footprint, a threatened flora survey was completed within the Subsidence Assessment Subject Land with a focus on features that may be exposed to indirect and subsidence-related impacts as identified in MSEC (2022). Potential subsidence related impacts are associated in the BAM as 'prescribed impacts' (prescribed impacts – section 2.7). The features that Niche surveyed include habitat within the following:

- Coastal Upland Swamps.
- Watercourses.
- Ridgetop environments.

Extensive surveys within woodland/forest environments that occur outside of these areas, were not completed, as such environments are unlikely to be impacted by indirect impact or subsidence related impacts. In accordance with the BAM, we had to therefore assume the presence of threatened flora in the absence of surveys and expert reports in these areas.

The survey approach was similar to the Niche (2019) Biodiversity Assessment Report for the previous application which was submitted to DPIE in 2019, and the Niche (2020) Supplementary Biodiversity Assessment Report for the previous application.

Both Biodiversity Assessment Reports for the previous application (Niche 2019; 2020) entailed threatened flora surveys within the Subsidence Assessment Subject Land. The effort associated with both the Biodiversity Assessment Reports for the previous application (Niche 2019; 2020) have been summarised in Table 16 and shown on Figure 10.

Further supplementary flora field survey was undertaken in July, August and December 2021, and February 2022 to support this BDAR. The flora survey included additional surveys within Coastal Upland Swamps, along watercourses, and within each of the PCTs of the Subsidence Subject Land. General traverses throughout the woodland/forest environments were also carried out.

The extent of the combined survey effort from 2016 to date has been compiled and shown on Figure 10. Further detail of the hours and the approach has been tabulated in Table 16 with additional information about the experience of the ecologists in Table 14.

A limitation of the surveys within the Subsidence Assessment Subject Land was that the flora transects as per the Plant Survey Guidelines (ie. ~10 m parallel transects) could not be practically completed in some areas. For example, parallel transects across multiple months within Coastal Upland Swamps would damage the swamp ground layer. And portions of a watercourse that could not be traversed due to rocky terrain, were observed where practical.

To approach the limitations, we have assessed each of the candidate species based on the survey completed, previous records, and the habitat types that the species is associated. Species were assumed to be present as a precaution if habitat preferences were present and survey was insufficient, and further assessed accordingly for prescribed and indirect impacts.

Table 16. Threatened flora survey effort within the Subsidence Assessment Subject Land

Area	Dates surveyed	Ecologists	Details	Estimate of hours
Survey within Subject Land				
Area 5 – General traverses	24 to 27 October 2016; 31 to 2 November 2016; 4 November 2016; 10 November 2016; 17 to 18 November 2016; 10 to 13 May 2017; 16 to 18 May 2018; 1 June 2018; 7 May 2020; 13th May 2020; 15th May 2020; 19th and 21st May 2020; 16 to 18th June 2021; 21st to 23rd of June 2021; 13th to 16th of July 2021; 22nd to 23rd July 2021; 26th August 2021; 18 November 2021.	Luke Baker (2016-2017 survey); Alex Christie (2016-2017 survey); Yogesh Nair; Sian Griffiths; Sarah Hart, Nathan Browne, David Wilkinson.	General traverses between vegetation types, BAM Plots, Survey locations. No specific distance between traverses as the survey was to understand condition and vegetation types present and look for threatened flora and fauna habitat/sightings.	>100 hours of threatened flora surveys
Riparian areas	24 to 27 October 2016; 4 November 2016; 10 November 2016; 17 to 18 November 2016; 13 to 16 of July 2021; 22 to 23 July 2021.	Luke Baker (2016-2017 survey); Alex Christie (2016-2017 survey); Yogesh Nair; Sian Griffiths; Sarah Hart, Nathan Browne, David Wilkinson.	Traverses by two ecologists along the edge of riparian areas within the Subject Land.	Approximately 55 hours were spent by two ecologists completing threatened flora transects between riparian vegetation plot surveys in 2016. Approximately 30 hours were spent by two ecologists completing traverse and plot surveys throughout the riparian vegetation in the Subject Land in 2021.
Ridgeline habitat types	In combination with the dates above.	Luke Baker (2016-2017 survey); Alex Christie (2016-2017 survey); Yogesh Nair; Sian Griffiths; Sarah Hart, Nathan Browne, David Wilkinson.	Traverses by two ecologists within ridgeline habitat within the Subject Land.	Approximately 80 hours of transects were completed throughout ridgetop/woodland and forest habitat whilst traversing to riparian habitat sites and Upland Swamp locations.
Coastal Upland Swamps	4 November 2016; 10 November 2016; 17 to 18 November 2016; 13 to 16 of July 2021; 22 to 23 July 2021; 26 August 2021;	Luke Baker (2016-2017 survey); Alex Christie (2016-2017 survey); Sian Griffiths; Sarah Hart and David Wilkinson.	Traverses across the middle of the swamps; Traverses between plot locations; Observations throughout swamps to avoid impacting the swamps via foot.	Approximately 32 hours were spent by two ecologists completing traverse and plot surveys throughout all the Coastal Upland Swamps in the Subject Land in 2016. Approximately 25 hours were spent by two ecologists completing

Area	Dates surveyed	Ecologists	Details	Estimate of hours
				traverse and plot surveys throughout the Coastal Upland Swamps in 2021.

2.5.2 Threatened flora candidate species analysis

The potential for the candidate threatened flora to occur within the Biodiversity Assessment Development Footprint (direct impact), and an assessment of threatened flora to occur within the wider Subject Land, is provided in Table 17.

Table 17. Candidate flora species analysis - Biodiversity Assessment Development Footprint

Scientific name	Common name	BC Act Status	EPBC Act Status	Required months of survey	SAII Status	Associated PCTs	Geographic limitations specified in BAM-C	Assessment of threatened flora – Biodiversity Assessment Development Footprint		Assessment of threatened flora within Subject Land	
								Biodiversity Assessment Development Footprint - Habitat assessment and targeted survey results and justification	Species polygon required?	Assessment of threatened flora within the wider Subject Land - Habitat assessment and targeted survey results and justification	Species polygon required?
Acacia baueri subsp. *aspera*	*Acacia baueri* subsp. *aspera*	V	-	January; February; March; April; September; October; November; December	No	978; 1083	-	The species was not detected during survey. Survey completed during recommended survey time - conspicuous species that is unlikely to remain undetected during field survey within the area proposed for surface infrastructure. The species has not been recorded within the locality. The closest known record is over 11 km to the east of the Subject Land which was recorded in 1969 associated with Mount Kiera Road upgrades. Highly unlikely to occur within the area proposed for surface infrastructure.	No	The species needs to be assumed to be present as targeted survey not completed across the wider Subject Land.	Yes – assumed to be present within PCT978 and 1083 of the Subject Land.
Acacia bynoeana	Bynoe's Wattle	E	V	January; February; March; April; May; June; July; August; September; October; November; December	No	1083; 1181; 1250; 1395	-	The species was recorded within the vicinity of the proposed ETL during targeted survey. The species was not recorded within the vicinity of any other areas proposed for surface infrastructure. All records would be avoided by the Project. Surveys were completed during recommended survey time. The species is conspicuous that is unlikely to remain undetected during field survey within the area proposed for surface infrastructure.	No	The species needs to be assumed to be present as targeted survey not completed across the wider Subject Land.	Yes – assumed to be present within PCT1083, PCT1181, PCT1250 and PCT1385 of the Subject Land.
Acacia prominens - endangered population Gosford Wattle, Hurstville and Kogarah Local Government Area	Acacia prominens - endangered population Gosford Wattle, Hurstville and Kogarah Local Government Area	EP	-	-		-	LGAs listed in the Determination (inclusive of Georges River LGA))	Subject Land is not located with applicable LGAs.	No	Subject Land is not located with applicable LGAs.	No
Acacia pubescens	Downy Wattle	V	V	January; February; March; April; May; June; July; August; September; October; November; December	No	1083; 1181; 1395	-	The species was not detected during targeted survey. Survey completed during recommended survey time - conspicuous species that is unlikely to remain undetected during field survey within the area proposed for surface infrastructure. The species has not been recorded within the locality. The closest known record is over 30 km to the north of the Subject Land. Unlikely to occur within the area proposed for surface infrastructure.	No	The species needs to be assumed to be present as targeted survey not completed across the wider Subject Land.	Yes – assumed to be present within PCT1083, PCT1181 and PCT1395 of the Subject Land.
Allocasuarina diminuta subsp. *mimica - endangered population*	*Allocasuarina diminuta subsp. mimica population in the Sutherland Shire and Liverpool City local government areas*	EP	-	-		-	LGAs listed in the Determination	Subject Land is not located with applicable LGAs.	No	Subject Land is not located with applicable LGAs.	No
Astrotricha crassifolia	*Thick-leaf Star-hair*	V	V	July, August September; October; November December	No	1083; 1181; 1250; 1395	-	The species was not detected during targeted survey. Survey completed during recommended survey time.	No	The species needs to be assumed to be present as targeted survey not completed across the wider Subject Land.	Yes – assumed to be present within PCT 1083, 1181, 1250 and PCT1395 of the Subject Land.

Scientific name	Common name	BC Act Status	EPBC Act Status	Required months of survey	SAII Status	Associated PCTs	Geographic limitations specified in BAM-C	Assessment of threatened flora – Biodiversity Assessment Development Footprint		Assessment of threatened flora within Subject Land	
								Biodiversity Assessment Development Footprint - Habitat assessment and targeted survey results and justification	Species polygon required?	Assessment of threatened flora within the wider Subject Land - Habitat assessment and targeted survey results and justification	Species polygon required?
Caesia parviflora var. *minor*	Small Pale Grass-lily	E	-	January; February; October; November; December	No	1083; 1395	-	The species was not detected during targeted survey. Survey completed during recommended survey time. The closest known record is over 40 km to the north of the Subject Land. Highly unlikely to occur within the area of surface infrastructure.	No	The species needs to be assumed to be present as targeted survey not completed across the wider Subject Land.	Yes – assumed to be present within PCT1083 and PCT1395 of the Subject Land.
Caladenia tessellata	Thick Lip Spider Orchid	E	V	September; October	Yes	1083; 1181; 1250; 1395	-	The TBDC (2021) notes that 'Flowers appear between September and November'. The survey was completed during November. The survey did not record the species. As per the TBCD (2021), the species has records from the Sydney area (old records), Wyong, Ulladulla and Braidwood in NSW. Populations in Kiama and Queanbeyan are presumed extinct. No known records for the species occur near the Subject Land. Furthermore, in New South Wales, the species is generally found in grassy dry sclerophyll woodland on clay loam or sandy soils, less commonly in heathland on sandy loam soils. The area proposed for surface infrastructure is not of a grassy dry sclerophyll formation and does not occur on clay soil. Unlikely to be present within the area proposed for surface infrastructure.	No	The species needs to be assumed to be present as targeted survey not completed across the wider Subject Land.	Yes – assumed to be present within PCT1083, PCT1181, PCT1250 and PCT1395 of the Subject Land.
Callistemon linearifolius	Netted Bottle Brush	V	-	January; October; November; December	No	1083; 1181; 1395	-	The species was not detected during targeted survey. Survey completed during recommended survey time - conspicuous species that is unlikely to remain undetected during field survey within the area proposed for surface infrastructure.	No	The species needs to be assumed to be present as targeted survey not completed across the wider Subject Land.	Yes – assumed to be present within PCT1083; 1181; 1250; 1395 of the Subject Land.
Cryptostylis hunteriana	Leafless Tongue Orchid	V	V	January; November; December	No	978; 1083	-	The species was not detected during targeted survey. Survey completed during recommended survey time.	No	The species needs to be assumed to be present as targeted survey not completed across the wider Subject Land.	Yes – assumed to be present within PCT978; 1083 of the Subject Land.
Daphnandra johnsonii	Illawarra Socketwood[6]	E	E	January; February; March; April; May; June; July; August; September; October; November; December	No	1250	-	The species was not detected during targeted survey. Survey completed during recommended survey time.	No	The species was not recorded at the Dendrobium Pit Top Carpark.	No
Deyeuxia appressa	Deyeuxia appressa	E	E	December	Yes	1083	-	A highly restricted NSW endemic known only from two pre-1942 records in the Sydney area. Was first collected in 1930 at Herne Bay, Saltpan Creek, off the Georges River, south of Bankstown. Was then collected in 1941 from Killara, near Hornsby. Has not been collected since and may now be extinct in the wild due to the level of habitat loss and development that has occurred within these areas. Given that D. appressa hasn't been seen in over 60 years, almost nothing is known of the species' habitat and ecology. The species has not been recorded during the field campaigns associated with the Project, or historic and current monitoring campaigns and exploration programs. Furthermore, the species has not been detected in the locality despite the significant amount of biodiversity assessments completed in the region. Therefore, we deem the species unlikely to occur.	No	The species needs to be assumed to be present as targeted survey not completed across the wider Subject Land.	Yes – assumed to be present within PCT 1083 of the Subject Land.

[6] Only listed as a candidate species for the 0.2 ha associated with the Dendrobium Pit Top carpark.

Scientific name	Common name	BC Act Status	EPBC Act Status	Required months of survey	SAII Status	Associated PCTs	Geographic limitations specified in BAM-C	Assessment of threatened flora – Biodiversity Assessment Development Footprint		Assessment of threatened flora within Subject Land	
								Biodiversity Assessment Development Footprint - Habitat assessment and targeted survey results and justification	Species polygon required?	Assessment of threatened flora within the wider Subject Land - Habitat assessment and targeted survey results and justification	Species polygon required?
Dillwynia tenuifolia	Dillwynia tenuifolia	V	-	August; September	No	1081; 1395	-	Conspicuous species that can be identified regardless of time of year. The core distribution is the Cumberland Plain from Windsor and Penrith east to Dean Park near Colebee. Other populations in western Sydney are recorded from Voyager Point and Kemps Creek in the Liverpool LGA, Luddenham in the Penrith LGA and South Maroota in the Baulkham Hills Shire. Disjunct localities outside the Cumberland Plain include the Bulga Mountains at Yengo in the north, and Kurrajong Heights and Woodford in the Lower Blue Mountains.	No	The Subject Land is not within known distribution.	No
Epacris purpurascens var. *purpurascens*	*Epacris purpurascens* var. *purpurascens*	V	-	September; October	No	1083; 1181; 1395	-	The species was recorded during the ETL survey. Two individuals were recorded within the existing Fire Trail easement, and individuals were also recorded outside of Subject Land as shown on Figure 10. The recorded individuals would not be impacted by the Project. Survey completed during recommended survey time. Conspicuous species regardless of the survey time. Team highly experienced with this species.	No	The species needs to be assumed to be present as targeted survey not completed across the wider Subject Land.	Yes – assumed to be present within PCT1083; 1181; 1395 of the Subject Land.
Eucalyptus camfieldii	Camfield's Stringybark	V	V	January; February; March; April; May; June; July; August; September; October; November; December	No	1083; 1183; 1250	-	The species was not detected during targeted survey. Survey completed during recommended survey time. Conspicuous species regardless of the survey time.	No	The species needs to be assumed to be present as targeted survey not completed across the wider Subject Land.	Yes – assumed to be present within PCT1083; 1183; 1250 of the Subject Land.
Genoplesium baueri	Bauer's Midge Orchid	E	E	February; March	Yes	1083	-	The TBCD (2021) notes that the survey requirements for this species includes: *Feb - Mar, 6 weeks after significant rain*'. A targeted field survey was undertaken in February by two ecologists during the recommended time, and after a period of 5-6 weeks following rainfall in December and January. The team also confirmed that the Helensburgh population was flowering prior to the survey. The species was not detected during the survey which covered the majority of the ventilation shaft site. Furthermore, the species has not been recorded during all other survey activities for the Project, and has not been recorded historically during other biodiversity monitoring/impacts assessments for the Project. No records for the species occur within the wider locality, with the closest population at Helensburgh. The transmission line easement would not require the clearing of the ground layer, so if the species was to occur, it is highly unlikely the species would be impacted. The species does not have habitat within the Dendrobium Pit Top Carpark site.	No	The species needs to be assumed to be present as targeted survey not completed across the wider Subject Land.	Yes – assumed to be present within PCT 1083 of the Subject Land.
Grevillea parviflora subsp. *parviflora*	Small-flower Grevillea	V	V	August; September; October; November	No	978; 1083; 1395	-	The species was not detected during targeted survey. Survey completed during recommended survey time. Conspicuous species regardless of the survey time.	No	The species needs to be assumed to be present as targeted survey not completed across the wider Subject Land.	Yes – assumed to be present within PCT978; 1083; 1395 of the Subject Land.
Grevillea raybrownii	*Grevillea raybrownii*	V	V	October; November; December	No	1083; 1181	-	The species was not detected during targeted survey. Survey completed during recommended survey time. Conspicuous species regardless of the survey time.	No	The species needs to be assumed to be present as targeted survey not completed across the wider Subject Land.	Yes – assumed to be present within PCT1083; 1181 of the Subject Land.
Helichrysum calvertianum	*Helichrysum calvertianum*	V	-	January; February; August;	No	1083; 1181	-	The species was not detected during targeted survey. Survey completed during recommended survey time.	No	The species needs to be assumed to be present as targeted survey not completed across the wider Subject Land.	Yes – assumed to be present within

Scientific name	Common name	BC Act Status	EPBC Act Status	Required months of survey	SAII Status	Associated PCTs	Geographic limitations specified in BAM-C	Assessment of threatened flora – Biodiversity Assessment Development Footprint		Assessment of threatened flora within Subject Land	
								Biodiversity Assessment Development Footprint - Habitat assessment and targeted survey results and justification	Species polygon required?	Assessment of threatened flora within the wider Subject Land - Habitat assessment and targeted survey results and justification	Species polygon required?
				September; October; November; December							PCT1083; 1181 of the Subject Land.
Hibbertia puberula	*Hibbertia pube rula*	E	-	October; November; December	No	978; 1083; 1181; 1250; 1395	-	The species was not detected during targeted survey. Survey completed during recommended survey time. No known populations within 10 km of the Subject Land.	No	The species needs to be assumed to be present as targeted survey not completed across the wider Subject Land.	Yes – assumed to be present within PCT978; 1083; 1181; 1250; 1395 of the Subject Land.
Hibbertia stricta subsp. *furcatula*	*Hibbertia stricta* subsp. *furcatul a*	E	-	January; October; November; December	No	1083; 1181; 1250	-	The species was not detected during targeted survey. Survey completed during recommended survey time.	No	The species needs to be assumed to be present as targeted survey not completed across the wider Subject Land.	Yes – assumed to be present within PCT1083; 1181; 1250; of the Subject Land.
Hygrocybe anomala var. *ianthinomar ginata* [7]	*Hygrocybe ano mala* var. *ianth inomarginata*	V	-	May; June	Yes	1083; 1245; 1250	-	A survey was completed in May. However, the TBCD (2021) notes that this species is '*weather dependent and must be surveyed 7 - 10 days after at least 40 mm rain over 2 weeks when soil moisture levels are high, during May - Jun. May also be present at other times of the year after suitable rain*.'. This survey requirement is not practical to achieve given the short window of opportunity. As such, Niche has considered the following into an assessment of likelihood to occur: - The species is only known from Lane Cove Bushland Park, Lane Cove, Royal National Park, Chatswood, Castle Hill and the Blue Mountains (Springwood). The location of Subject Land is not within close proximity to known populations. - Occurs in gallery warm temperate forests dominated by Lilly Pilly (*Acmena smithii*), Grey Myrtle (*Backhousia myrtifolia*), Cheese Tree (*Glochidion ferdinandi*) and Sweet Pittosporum (*Pittosporum undulatum*). Warm temperate forests do not occur within Subject Land. - Occur as individuals or in groups, terrestrial rarely on wood and only if extremely rotten; substrates include soil, humus, or moss. The proposed Ventilation Shaft Site did have termite impacted logs which contained some moss which is typical of all fallen timber across Dry Sclerophyll Forest areas. Areas of thick moss and humus were not recorded. The other surface infrastructure areas ie. carpark locations, water pipeline and ETL also do not support sufficient habitat. - Subject Land contains Dry Sclerophyll Forest which has a relatively open canopy, which is reasonable to suggest that it would not create a shaded environment to which the species is known to occur within. Based on the above, we regard the species to have a low likelihood to occur within the Biodiversity Assessment Development Footprint.	No	No – unlikely to be present at the Dendrobium Pit Top Carpark as described adjacent	No
Irenepharsus trypherus	Illawarra Irene[8]	E	E	January; February; March; April; December	No	1245	-	The targeted survey confirmed that the species does not occur within the areas proposed for surface infrastructure. It is a conspicuous species regardless of the survey time.		The targeted survey confirmed that the species does not occur within the areas proposed for surface infrastructure. It is a conspicuous species regardless of the survey time.	No

[7] Only listed as a candidate species for the 0.2 ha associated with the Dendrobium Pit Top carpark.

[8] Only listed as a candidate species for the 0.2 ha associated with the Dendrobium Pit Top carpark.

Scientific name	Common name	BC Act Status	EPBC Act Status	Required months of survey	SAII Status	Associated PCTs	Geographic limitations specified in BAM-C	Assessment of threatened flora – Biodiversity Assessment Development Footprint		Assessment of threatened flora within Subject Land	
								Biodiversity Assessment Development Footprint - Habitat assessment and targeted survey results and justification	Species polygon required?	Assessment of threatened flora within the wider Subject Land - Habitat assessment and targeted survey results and justification	Species polygon required?
Leucopogon exolasius	Woronora Beard-heath	V	V	August; September	No	1083; 1181; 1250	-	The species was recorded during the field survey; however it was not recorded within the Biodiversity Assessment Development Footprint. The targeted survey confirmed that the species does not occur within the areas proposed for surface infrastructure. It is a conspicuous species regardless of the survey time.	No	The species needs to be assumed to be present as targeted survey not completed across the wider Subject Land. The species has already been recorded within the Subject Land.	Yes – assumed to be present within PCT1083; 1181; 1250 of the Subject Land.
Leucopogon fletcheri subsp. *fletcheri*	*Leucopogon fletcheri* subsp. *fletcheri*	E	-	August; September	No	1083; 1181; 1395	-	The targeted survey confirmed that the species does not occur within the development site. It is a conspicuous species regardless of the survey time.	No	The species needs to be assumed to be present as targeted survey not completed across the wider Subject Land.	Yes – assumed to be present within PCT1083; 1181; 1395 of the Subject Land.
Melaleuca deanei	Deane's Paperbark	V	V	January; February; March; April; May; June; July; August; September; October; November; December	Yes	1083; 1181; 1250; 1395	-	The targeted survey did not record the species within the development site. It is a conspicuous species regardless of the survey time. Furthermore, as noted in the TBCD (2021), the species occurs in two distinct areas, in the Ku-ring-gai/Berowra and Holsworthy/Wedderburn areas respectively. There are also more isolated occurrences at Springwood (in the Blue Mountains), Wollemi National Park, Yalwal (west of Nowra) and Central Coast (Hawkesbury River) areas.	No	The species needs to be assumed to be present as targeted survey not completed across the wider Subject Land.	Yes – assumed to be present within PCT1083; 1181; 1250; 1395 of the Subject Land.
Persoonia acerosa	Needle Geebung	V	V	January; February; March; April; May; June; July; August; September; October; November; December	No	1083; 1181	-	The targeted survey did not record the species within the development site. It is a conspicuous species regardless of the survey time.	No	The species needs to be assumed to be present as targeted survey not completed across the wider Subject Land.	Yes – assumed to be present within PCT1083; 1181 of the Subject Land.
Persoonia bargoensis	Bargo Geebung	E	V	January; February; March; April; May; June; July; August; September; October; November; December	No	1083; 1181; 1250; 1395	-	The targeted survey did not record the species within the development site. It is a conspicuous species regardless of the survey time.	No	The species needs to be assumed to be present as targeted survey not completed across the wider Subject Land.	Yes – assumed to be present within PCT1083; 1181; 1250; 1395 of the Subject Land.
Persoonia hirsuta	Hairy Geebung	E	E	January; February; March; April; May; June; July; August; September; October; November; December	Yes	1083; 1181; 1250; 1395	-	The targeted survey did not record the species within the development site. It is a conspicuous species regardless of the survey time.	No	The species needs to be assumed to be present as targeted survey not completed across the wider Subject Land.	Yes – assumed to be present within PCT1083; 1181; 1250; 1395 of the Subject Land.
Pomaderris adnata	Sublime Point Pomaderris	E	-	January; February; March; April; May; June; July; August; September; October; November; December	Yes	1083	-	The targeted survey did not record the species within the development site. It is a conspicuous species regardless of the survey time.	No	The species needs to be assumed to be present as targeted survey not completed across the wider Subject Land.	Yes – assumed to be present within PCT 1083 of the Subject Land.

Scientific name	Common name	BC Act Status	EPBC Act Status	Required months of survey	SAII Status	Associated PCTs	Geographic limitations specified in BAM-C	Assessment of threatened flora – Biodiversity Assessment Development Footprint		Assessment of threatened flora within Subject Land	
								Biodiversity Assessment Development Footprint - Habitat assessment and targeted survey results and justification	Species polygon required?	Assessment of threatened flora within the wider Subject Land - Habitat assessment and targeted survey results and justification	Species polygon required?
Prostanthera densa	Villous Mint-bush	V	V	January; February; March; April; May; June; July; August; September; October; November; December	No	1083; 1181; 1250	-	The targeted survey confirmed that the species does not occur within the area proposed for surface infrastructure. It is a conspicuous species regardless of the survey time.	No	The species needs to be assumed to be present as targeted survey not completed across the wider Subject Land.	Yes – assumed to be present within PCT1083; 1181; 1250 of the Subject Land.
Pterostylis saxicola	Sydney Plains Greenhood	E	E	October	No	1083; 1181; 1250; 1395	-	Survey was not undertaken in October, however, was undertaken in November when the species is known to flower. Regardless, the surface infrastructure is not located within suitable habitat as described in the TBCD (2021) ie: the surface infrastructure does not occur in 'depressions on sandstone rock shelves above cliff lines'. Furthermore, the soil type which the species occurs within is associated with shale/sandstone transition soils or shale soils, which do not occur within the surface infrastructure locations. As such, we deem the survey adequate based on the location constraints the species is associated with.	No	The species needs to be assumed to be present as targeted survey not completed across the wider Subject Land.	Yes – assumed to be present within PCT1083; 1181; 1250; 1395 of the Subject Land.
Pterostylis sp. Botany Bay	Botany Bay Bearded Orchid	E	E	September	Yes	1083	-	The species is restricted to the Sydney region where it is known from a small number of sites within Botany Bay National Park on the Kurnell Peninsula. The Subject Land does not occur within the restricted range.	No	The species is restricted to the Sydney region where it is known from a small number of sites within Botany Bay National Park on the Kurnell Peninsula. The Subject Land does not occur within the restricted range.	No
Pultenaea aristata	Prickly Bush-pea	V	V	January; February; March; April; May; June; July; August; September; October; November; December	No	978; 1083; 1804	-	The targeted survey did not record the species within the areas proposed for surface infrastructure. It is a conspicuous species regardless of the survey time.	No	The species needs to be assumed to be present as targeted survey not completed across the wider Subject Land.	Yes – assumed to be present within PCT978; 1083; 1804 of the Subject Land.
Rhodamnia rubescens	Scrub Turpentine	CE	CE	January; February; March; April; May; June; July; August; September; October; November; December	Yes	1245	-	The targeted survey did not record the species within the areas proposed for surface infrastructure. It is a conspicuous species regardless of the survey time.	No	The targeted survey did not record the species within the areas proposed for the Pit Top Carpark. It is a conspicuous species regardless of the survey time.	No
Syzygium paniculatum	Magenta Lilly Pilly	E	V	April; May; June	No	1245	-	The targeted survey did not record the species within the areas proposed for the Pit Top Carpark. It is a conspicuous species regardless of the survey time.	No	The targeted survey did not record the species within the areas proposed for Dendrobium Pit Top Carpark. It is a conspicuous species regardless of the survey time.	No
Thelymitra kangaloonica[9]	Kangaloon Sun Orchid	CE	CE	October; November	Yes	None within the Subject Land	-	Thelymitra kangaloonica (Thelymitra sp. Kangaloon) is only known to occur on the southern tablelands of NSW in the Moss Vale / Kangaloon / Fitzroy Falls area at 550-700 m above sea level. It is known to occur at three swamps that are above the Kangaloon Aquifer. These swamps are a part of the ecological community "Coastal Upland Swamp" which is listed under the BC	No	The species is unlikely to occur based on the habitat descriptions in the TBDC. The species is not associated with the PCTs of the Subject Land.	No

[9] Species only identified in the SEARs. It was not identified in the PMST Search nor the BAM-C as a candidate species.

Scientific name	Common name	BC Act Status	EPBC Act Status	Required months of survey	SAII Status	Associated PCTs	Geographic limitations specified in BAM-C	Assessment of threatened flora – Biodiversity Assessment Development Footprint		Assessment of threatened flora within Subject Land	
								Biodiversity Assessment Development Footprint - Habitat assessment and targeted survey results and justification	Species polygon required?	Assessment of threatened flora within the wider Subject Land - Habitat assessment and targeted survey results and justification	Species polygon required?
								Act as an EEC, also known as "Temperate Highland Peat Swamps on Sandstone" which is listed under the Environment Protection and Biodiversity Conservation Act 1999. It is found in swamps in sedgelands over grey silty grey loam soils. The habitat and distribution of the species does not occur within the Project.			
Zieria granulata[10]	Illawarra Zieria	E	E	All year	No	1245	-	The targeted survey did not record the species within the area proposed for surface infrastructure. It is a conspicuous species regardless of the survey time.	No	The targeted survey did not record the species within the area proposed for surface infrastructure. It is a conspicuous species regardless of the survey time.	No

[10] Only listed as a candidate species for the 0.2 ha associated with the Dendrobium Pit Top carpark.

2.5.3 Results –threatened flora survey with Biodiversity Assessment Development Footprint

A summary of the results of the threatened flora survey for each portion of the Biodiversity Assessment Development Footprint has been provided in Table 18.

Table 18. Summary of threatened flora results in relation to the Biodiversity Assessment Development Footprint

Surface infrastructure	Area of native vegetation directly impacted	Survey/Candidate analysis result
Ventilation Shaft Site No 5A	14.64	No threatened flora detected during survey transects. Based on results of survey and candidate species analysis, no threatened flora likely to occur (Table 17).
Ventilation shaft construction – water pumping	0.69	No threatened flora recorded within the area proposed for surface infrastructure. Furthermore, the activity will have safeguards to avoid impacts to any threatened flora (section 5).
Dendrobium Pit Top Carpark Extension	0.17	No threatened flora detected during survey. Based on result of survey, no threatened flora likely to occur (Table 17).
ETL and pole placement (0.1ha)	3.99	*Acacia bynoeana* and *Epacris purpurescens* var *purpurescens* (described below and shown on Figure 10 , were recorded during the ETL and pole placement survey). All threatened flora that recorded, can be avoided. Furthermore, the activity will have safeguards to avoid impacts to any threatened flora (section 5).
Cordeaux Dam Access Road Construction Carpark	0.15	No threatened flora detected during survey transects. Based on results of survey and candidate species analysis, no threatened flora likely to occur (Table 17).
ETL laydown area nominated near Cordeaux Dam	0.00	No habitat for threatened flora.
Ventilation shaft construction - Fire Trail upgrades for construction	0.21	No threatened flora recorded. Furthermore, the activity will not impact the ground cover as the vegetation to be slashed/trimmed/partially cleared.
Area of native vegetation	**19.85**	

The field survey of the Subject Land resulted in the detection of one threatened flora – *Acacia bynoeana* within the Biodiversity Assessment Development Footprint. All individuals of *Acacia bynoeana* would not be impacted by the Project as described below:

- *Acacia bynoeana* (listed as endangered under the BC Act and Vulnerable under the EPBC Act): A total of 86 plants were recorded within the existing easement along Fire Trail 6 (Figure 10). The population occurred within slashed/maintained vegetation (mapped as PCT1081) within the existing Fire Trail 6

easement. This area is managed by WaterNSW on a periodic basis to ensure that the height of the vegetation remains below approximately 0.5 m, and thus acts as a fire break. The existing management practices may have attributed to the plant's establishment given the species is known to prefer disturbed sites such as trail margins (NSW Scientific Committee 1999). None of the records of Acacia bynoeana would need to be cleared for the Project, and thus all individuals would be retained.

The field survey detected two other threatened flora – *Epacris purpursecens* var. *purpurescens* and *Leucopogon exolasius* within the Subject Land, however both species were not recorded within the area proposed for direct impact (Biodiversity Assessment Development Footprint):

- *Epacris purpurascens* var. *purpurascens* (listed as vulnerable under the BC Act): Three plants were recorded outside of the Biodiversity Assessment Development Footprint within an existing easement (mapped as a low condition class of PCT1081) as shown on Figure 10. All of the recorded plants occur within an existing Transgrid easement that consists of low shrubs and native ground cover. This easement is currently managed by Transgrid for an existing transmission line. None of the plants would be impacted by the Project.
- *Leucopogon exolasius* (listed as vulnerable under the BC Act and EPBC Act): Recorded by Niche within woodland habitat (mapped as PCT1081) towards the south-west of the Subject Land as shown on Figure 10. All of the recorded plants do not occur within the watercourse or the bank, Coastal Upland Swamps or ridgeline habitat. *Leucopogon exolasius* was also recorded by Biosis Research (2016a) adjacent to Donalds Castle Creek outside of the far north-east corner of Area 5. Niche undertook a survey in this section of the creek in November 2016 however were unable to find the location of the plants due to this portion of the creek containing steep rocky outcrops along the banks and dense vegetation along the edges of the creekline. Regardless, none of these records would be directly impacted by the Project.

The location of the above threatened flora is shown on Figure 10.

As stated above, none of the recorded threatened flora would be directly impacted by the Project, and safeguards have been implemented into the Project design to minimise potential for impacts to threatened flora as summarised in section 5.

2.5.4 Threatened flora species polygons

As detailed in Table 17, species polygons are required for the 28 threatened flora species assumed to be present within the Subject Land, which is largely based on the inability to meet the requirements of the Plant Survey Guidelines given the extensive area.

The species polygon for all threatened flora species have been derived from the associated PCTs (as specified in Table 17.

The threatened flora survey and candidate species analysis confirmed the absence of threatened flora within the Biodiversity Assessment Development Footprint (Table 17). As such, the species polygon does not extend into the Biodiversity Assessment Development Footprint for any threatened flora.

The species polygons for the threatened flora species listed in Table 19 are provided in Figure 11 map series.

Table 19. Threatened flora species polygons

Candidate flora species	Species polygon requirements	Figure reference
Acacia baueri subsp. *aspera*	Polygon formed from the entire extent of associated PCT978 and 1083 of the Subject Land, except for the Biodiversity Assessment Development Footprint given the species was not detected during targeted survey.	Figure 11a
Acacia bynoeana	Polygon formed from the entire extent of associated PCT1083, PCT1181, PCT1250 and PCT1385 of the Subject Land, except for the Biodiversity Assessment Development Footprint given the species was not detected during targeted survey.	Figure 11b
Acacia pubescens	Polygon formed from the entire extent of associated PCT1083, PCT1181 and PCT1395 of the Subject Land, except for the Biodiversity Assessment Development Footprint given the species was not detected during targeted survey.	Figure 11c
Astrotricha crassifolia	Polygon formed from the entire extent of associated PCT 1083, 1181, 1250 and PCT1395 of the Subject Land, except for the Biodiversity Assessment Development Footprint given the species was not detected during targeted survey.	Figure 11d
Caesia parviflora var. *minor*	Polygon formed from the entire extent of associated PCT1083 and PCT1395 of the Subject Land, except for the Biodiversity Assessment Development Footprint given the species was not detected during targeted survey.	Figure 11e
Caladenia tessellata	Polygon formed from the entire extent of associated PCT1083, PCT1181, PCT1250 and PCT1395 of the Subject Land, except for the Biodiversity Assessment Development Footprint given the species was not detected during targeted survey.	Figure 11d
Callistemon linearifolius	Polygon formed from the entire extent of associated PCT1083, 1181, 1250, 1395 of the Subject Land, except for the Biodiversity Assessment Development Footprint given the species was not detected during targeted survey.	Figure 11d
Cryptostylis hunteriana	Polygon formed from the entire extent of associated PCT978, 1083 of the Subject Land, except for the Biodiversity Assessment Development Footprint given the species was not detected during targeted survey.	Figure 11f
Deyeuxia appressa	Polygon formed from the entire extent of associated PCT 1083 of the Subject Land, except for the Biodiversity Assessment Development Footprint given the species was not detected during targeted survey.	Figure 11g
Epacris purpurascens var. *purpurascens*	Polygon formed from the entire extent of associated PCT1083, 1181, 1395 of the Subject Land, except for the Biodiversity Assessment Development Footprint given the species was not detected during targeted survey.	Figure 11h
Eucalyptus camfieldii	Polygon formed from the entire extent of associated PCT1083, 1183, 1250 of the Subject Land, except for the Biodiversity Assessment Development Footprint given the species was not detected during targeted survey.	Figure 11i
Genoplesium baueri	Polygon formed from the entire extent of associated PCT 1083 of the Subject Land, except for the Biodiversity Assessment Development Footprint given the species was not detected during targeted survey.	Figure 11g
Grevillea parviflora subsp. *parviflora*	Polygon formed from the entire extent of associated PCT978; 1083; 1395 of the Subject Land, except for the Biodiversity Assessment Development Footprint given the species was not detected during targeted survey.	Figure 11j

Candidate flora species	Species polygon requirements	Figure reference
Grevillea raybrownii	Polygon formed from the entire extent of associated PCT1083; 1181; of the Subject Land, except for the Biodiversity Assessment Development Footprint given the species was not detected during targeted survey.	Figure 11k
Helichrysum calvertianum	Polygon formed from the entire extent of associated PCT1083; 1181 of the Subject Land, except for the Biodiversity Assessment Development Footprint given the species was not detected during targeted survey.	Figure 11k
Hibbertia puberula	Polygon formed from the entire extent of associated PCT978; 1083; 1181; 1250; 1395; of the Subject Land, except for the Biodiversity Assessment Development Footprint given the species was not detected during targeted survey.	Figure 11l
Hibbertia stricta subsp. *furcatula*	Polygon formed from the entire extent of associated PCT1083; 1181; 1250; of the Subject Land, except for the Biodiversity Assessment Development Footprint given the species was not detected during targeted survey.	Figure 11m
Leucopogon exolasius	Polygon formed from the entire extent of associated PCT1083; 1181; 1250 of the Subject Land, except for the Biodiversity Assessment Development Footprint given the species was not detected during targeted survey.	Figure 11n
Leucopogon fletcheri subsp. *fletcheri*	Polygon formed from the entire extent of associated PCT1083; 1181; 1395 of the Subject Land, except for the Biodiversity Assessment Development Footprint given the species was not detected during targeted survey.	Figure 11c
Melaleuca deanei	Polygon formed from the entire extent of associated PCT1083; 1181; 1250; 1395 of the Subject Land, except for the Biodiversity Assessment Development Footprint given the species was not detected during targeted survey.	Figure 11d
Persoonia acerosa	Polygon formed from the entire extent of associated PCT1083; 1181 of the Subject Land, except for the Biodiversity Assessment Development Footprint given the species was not detected during targeted survey.	Figure 11k
Persoonia bargoensis	Polygon formed from the entire extent of associated PCT1083; 1181; 1250; 1395 of the Subject Land, except for the Biodiversity Assessment Development Footprint given the species was not detected during targeted survey.	Figure 11d
Persoonia hirsuta	Polygon formed from the entire extent of associated PCT1083; 1181; 1250; 1395 of the Subject Land, except for the Biodiversity Assessment Development Footprint given the species was not detected during targeted survey.	Figure 11d
Pomaderris adnata	Polygon formed from the entire extent of associated PCT 1083 of the Subject Land, except for the Biodiversity Assessment Development Footprint given the species was not detected during targeted survey.	Figure 11g
Pomaderris brunnea	Polygon formed from the entire extent of associated PCT 1181 and 1395 of the Subject Land, with the exception of the Biodiversity Assessment Development Footprint given the species was not detected during targeted survey.	Figure 11o
Prostanthera densa	Polygon formed from the entire extent of associated PCT1083; 1181; 1250; of the Subject Land, except for the Biodiversity Assessment Development Footprint given the species was not detected during targeted survey.	Figure 11m

Candidate flora species	Species polygon requirements	Figure reference
Pterostylis saxicola	Polygon formed from the entire extent of associated PCT1083; 1181; 1250; 1395 of the Subject Land, except for the Biodiversity Assessment Development Footprint given the species was not detected during targeted survey.	Figure 11d
Pultenaea aristata	Polygon formed from the entire extent of associated PCT 978; 1083; 1804 of the Subject Land, except for the Biodiversity Assessment Development Footprint given the species was not detected during targeted survey.	Figure 11p

2.5.5 Matters of National Environmental Significance - flora

A total of 30 threatened flora were generated by the PMST search for the Subject Land (Appendix 8).

Each of the species from the EPBC Act Protected Matters Search Tool (PMST) have been assessed in terms of their likelihood to occur within the Subject Land (Appendix 2) and incorporated to the candidate species list for assessment where there is a high or known likelihood to occur.

Threatened flora specifically identified in the SEARs include: *Pomaderris brunnea, Leucopogon exolasius, Persoonia bargoensis, Grevillea parviflora subsp. parviflora, Thelymitra kangaloonica, Pultenea aristata, Melaleuca deanei, Persoonia hirsuta,* and *Rhodamnia rubescensa*. These species have also been addressed in the candidate species list (Table 17) and threatened species likelihood assessment provided in Appendix 2.

The field survey detected the presence of two Vulnerable EPBC Act listed threatened flora within parts of the Subject Land or within proximity: *Acacia bynoeana* and *Leucopogon exolasius*. The location of the records associated with both species are described in section 2.5.3, and location shown on Figure 10.

As identified Table 17, no EPBC Act listed threatened flora were recorded within the Biodiversity Assessment Development Footprint.

As detailed in Table 17, Niche has had to assume the presence of threatened flora within areas that could not be adequately surveyed as per Plant Survey Guidelines. As such, we have assumed that 22 threatened flora listed on the EPBC Act have habitat within the Subject Land (excluding the Biodiversity Assessment Development Footprint): A*cacia bynoeana, Acacia pubescens, Astrotricha crassifolia, Caladenia tessellata, Cryptostylis hunteriana, Deyeuxia appressa, Dillwynia tenuifolia, Eucalyptus camfieldii, Genoplesium baueri, Grevillea parviflora subsp. parviflora, Grevillea raybrownii, Leucopogon exolasius, Melaleuca deanei, Persoonia acerosa, Persoonia bargoensis, Persoonia hirsuta, Prostanthera densa, Pterostylis saxicola, Pterostylis sp. Botany Bay, Pultenaea aristate, Rhodamnia rubescens,* and *Syzygium paniculatum.*

These species have been considered further in regard to indirect/prescribed impacts (subsidence related impacts) in sections 2.7 and the impact assessment (section 4).

2.6 Threatened fauna and habitat

This section of the BDAR details the survey effort used to detect the presence/absence of threatened fauna and their habitat within the Biodiversity Assessment Development Footprint, and within the Subject Land. Threatened fauna determined to have habitat likely to be impacted by the Project, are assessed further in section 4.

Unlike threatened flora, the BAM categorises threatened fauna as either:

- 'ecosystem credit' fauna - the species is assumed to be present based on the PCTs, and therefore no targeted survey is required.
- 'species credit' fauna – the species is associated with specific habitat requirements, and a survey or expert report is required to confirm the presence/absence of the species.
- Dual credit fauna – the species is regarded as an 'ecosystem credit' if specific habitat features (eg. Hollow-bearing trees) are not present. This is guided by the TBDC.

Targeted surveys or an expert report, is required for those species identified by BAM-C, or for species deemed to have a high potential or known occurrence to occur based on database searches. These species are referred to as 'candidate species'.

The following databases were used for this purpose of generating the 'candidate species':

- NSW BioNet Atlas Database (DPIE 2021) for:
  - spatial records of threatened fauna listed under the BC Act/EPBC Act within a 10 km radius of the Subject Land.
  - Threatened biodiversity database collection information.
- PMST (DAWE 2021) for threatened fauna identified as MNES known from or with potential habitat within a 10 km radius of the Subject Land.
- BAM-C tool (using benchmark condition for previously mapped PCTs) to identify candidate species, species credit species and predicted ecosystem credit species, that are known or predicted to occur within the IBRA subregion – BAM-C output from 2021.

A total of 33 threatened fauna species (candidate species) were identified as having potential habitat within the Subject Land. The candidate species list is provided in Table 25.

The following section describes the surveys undertaken to identify threatened fauna species and fauna habitat constraints within the Subject Land, and the subsequent creation of species polygons for threatened species confirmed or assumed present.

2.6.1 Methods – Threatened fauna survey

The fauna field survey focussed on the two main areas based upon the pathways of potential impacts associated with the Project, which are:

1. The area proposed for surface infrastructure (area of direct impact) referred to as the Biodiversity Assessment Development Footprint (Figure 3).
2. Habitat types that are sensitive to indirect impacts and prescribed impacts, which are predominately associated with subsidence. Features that are sensitive to subsidence are identified in MSEC (2022) and include specific habitats such as waterbodies (swamps and watercourses), cliffs, caves and rock outcrops which fauna may utilise (Figure 6 and Figure 12). Such habitat features encompass portions of the Subject Land, and a wider area referred to as the Subsidence Assessment Subject Land.

Survey methods were selected to detect the target species identified during desktop research (i.e. threatened species with the potential to be impacted by the Project), as well as to employ a broad range of survey techniques that allowed for the detection of a variety of fauna species groups.

Relevant threatened species guidelines and the TBCD were consulted to assist in determining the survey methods, effort and timing.

The following guidelines or documentation were consulted to assist with establishing the survey plan:

- BAM and associated Modules.
- 'Species credit' threatened bats and their habitats, NSW survey guide for the Biodiversity Assessment Method (OEH 2018).
- Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Working Draft) (DEC 2004a).
- NSW Survey Guide for Threatened Frogs: a Guide for the Survey of Threatened Frogs and their Habitats for the Biodiversity Assessment Method (DPIE 2020d).
- Fauna specific information available in the TBDC.

In the absence of specific survey guidelines issued at the state level, the following Commonwealth survey guidelines were adopted:

- *Survey guidelines for Australia's threatened mammals* (DSEWPC 2011a).
- *Survey guidelines for Australia's threatened reptiles* (DSEWPC 2011b).
- *Survey guidelines for Australia's threatened birds* (DEWHA 2010a).
- *Survey guidelines for Australia's threatened frogs* (DEWHA 2010b).
- *Survey guidelines for Australia's threatened bats* (DEWHA 2010c).
- Relevant Significant Impact Guidelines and Referral Guidelines for EPBC Act listed species.

The guidelines are primarily concerned with establishing the presence of the species within the Subject Land and determining the area of suitable habitat present to calculate species credits.

Most of the candidate species identified, do not have specific targeted survey recommendations included in the available guidelines. As such, the survey design has been informed by the available guidelines and Niche's extensive experience undertaking surveys for threatened species throughout the Metropolitan Special Areas. The design incorporates best-practice repeatable methods that align with the general methods relevant to fauna groups (e.g. arboreal mammals) described in the available guidelines.

The survey design incorporates multiple detection methods for the candidate species and emerging technologies such as drone survey, with methods specific to the candidate species and Project being adopted that recognise the landscape context and the scale of assessment. Through this approach, the survey design is considered suitable to inform the assessment of the species for the BDAR and achieve the overarching aims of the relevant guidelines.

Descriptions of the survey methods employed are provided in the following sections with specific information associated to candidate species provided in Table 22 and Table 23. Where specific targeted survey guidelines for candidate species have been provided, an assessment of the survey method utilised against these guidelines has been provided in Table 24.

In addition to consideration of targeted threatened species, it was also desired that non-target species be detected within the Subject Land, particularly within areas prone to subsidence or clearing impacts. The

suite of methods used to detect target threatened species was sufficient to detect a large proportion of non-target vertebrate fauna species.

The Biodiversity Assessment Development Footprint, Subject Land, and Subsidence Assessment Subject Land has been subject to extensive threatened fauna surveys associated with the Project over the past five years. In particular, the Subject Land was subject to threatened fauna surveys to support the Niche (2019) Biodiversity Assessment Report for the previous application which was submitted to DPIE in 2019, and the Niche (2020) Supplementary Biodiversity Assessment Report for the previous application. The survey effort associated with both Niche Biodiversity Assessment Reports is of relevance to this BDAR given the Subject Land encompasses the area previously assessed. The targeted fauna surveys associated with both assessments have been incorporated into this BDAR where relevant, along with supplementary surveys.

Supplementary surveys were completed during 2021 in response to design and regulatory changes and to obtain new data given some of the field survey was collected in 2016. The extent of the combined survey effort from 2016 to date has been compiled and shown on Figure 12, with details regarding the methods personnel, dates and methods provided in Tables 20, 21 and 22.

Table 20. Identity, role and experience of ecologists relevant to the targeted threatened species surveys

Consultant name and qualifications	Role	Experience	Survey target	Targeted survey activity
Simon Tweed BEnvSc (Hons) Accredited Biodiversity Assessor (BAAS 18088)	Ecology Team Leader	Simon is a BAM accredited assessor with 15 years of experience as an ecologist.	Fauna survey lead	Field survey, planning and reporting
Chelsea Hankin BEnvSc (Hons)	Ecologist	Chelsea worked as an ecologist with Niche with over 6 years of experience.	Fauna survey	Field survey, data collation
Matthew Stanton BAppSc (Coastal Management), MSc (Zoology)	Research Ecologist	Matthew worked as an ecologist with Niche and has over 25 years of experience.	Fauna survey	Field survey, Anabat analysis
Christie Chapman BEnvSc (Hons)	Environmental Approvals Consultant	Christie is an environmental consultant with Niche and has 2 years of experience	Threatened fauna survey	Field survey, data collation
Sarah Hart BSc, MSc, Grad Dip	Ecologist	Chelsea worked as an ecologist with Niche and has 4 years of experience.	Fauna survey	Field survey, data collation

Consultant name and qualifications	Role	Experience	Survey target	Targeted survey activity
Yogesh Nair MSc, BEnvSci, AdvDipEnvMgnt, Cert III CLM	Ecologist	Yogesh is an ecology consultant and a BAM accredited assessor with Niche and has over 10 years in ecological restoration for private institutions and 4 years ecological consulting.	Fauna and flora survey	Field survey, data collation
David Wilkinson BSc	Ecologist	David is an ecologist with 4 years' experience in laboratory work and ecological field survey and assessment	Fauna survey	Field survey, data collation
Freya Gordon BSc (Hons)	Senior Ecologist	Freya worked as a senior ecologist with Niche and has over 15 years of experience in academic research and ecological consulting.	Fauna survey	Field survey, data collation
Nathan Browne BSc (Cons Bio), BSc (Hons)	Graduate Ecologist	Nathan has 3 years' experience in environmental compliancy and field surveys.	Fauna and flora survey	Field survey, data collation
Amy Legg BSc (Cons Bio)	Graduate Ecologist	Amy is an ecologist with Niche and has 4 years of experience in the environmental field.	Fauna and flora survey	Field survey, data collation

Table 21: Dates of field survey and field team for the targeted species surveys

Date of survey	Field Team
2016	
4 – 7 October 2016	Simon Tweed, Chelsea Hankin
11 – 14 October 2016	Simon Tweed, Matthew Stanton, Chelsea Hankin
31 October – 3 November 2016	Simon Tweed, Chelsea Hankin
22 – 25 November 2016	Simon Tweed, Chelsea Hankin
1 – 2 December 2016	Simon Tweed, Chelsea Hankin
22 December 2016	Simon Tweed, Chelsea Hankin
2017	
3 – 4 July 2017	Simon Tweed, Alex Christie
2018	
25 May 2018	Simon Tweed, Alex Christie
28 May 2018	Simon Tweed, Alex Christie
31 May 2018	Simon Tweed, Luke Baker
12 June 2018	Simon Tweed, Lucy Porter
2020	
28 – 30 April 2020	Christie Chapman, David Wilkinson, Sarah Hart, Yogesh Nair
4 May 2020	Christie Chapman, David Wilkinson, Sarah Hart, Yogesh Nair
7 – 8 May 2020	Christie Chapman, David Wilkinson, Sarah Hart, Yogesh Nair
11 May 2020	Christie Chapman, David Wilkinson, Sarah Hart, Yogesh Nair
13 – 15 May 2020	Christie Chapman, David Wilkinson, Sarah Hart, Yogesh Nair
29 May 2020	David Wilkinson, Christie Chapman
30 June 2020	Sarah Hart, David Wilkinson
1 July 2020	Simon Tweed, David Wilkinson
2021	
22 – 25 February 2021	Christie Chapman, Kai Whitaker
1 July 2021	Freya Gordon, Nathan Browne
5 July 2021	Freya Gordon, Nathan Browne
6 July 2021	Nathan Browne, Kai Whitaker
13 July 2021	Freya Gordon, David Wilkinson
21 July 2021	Freya Gordon, David Wilkinson
22 July 2021	Freya Gordon, David Wilkinson
29 July 2021	Freya Gordon, David Wilkinson
3 August 2021	Sarah Hart, David Wilkinson
5 – 6 August 2021	Freya Gordon, Nathan Browne
11 August 2021	Freya Gordon, Nathan Browne
12 August 2021	Sarah Hart, Kayla McGregor
13 August 2021	Freya Gordon, Nathan Browne
18 August 2021	Freya Gordon, Nathan Browne
7 September 2021	Sarah Hart, Amy Legge
12 September 2021	Freya Gordon, Nathan Browne

Table 22. Fauna methodology and survey effort (Figure 12)

Method	Biodiversity Assessment Development Footprint survey effort (2016-2019)	Biodiversity Assessment Development Footprint survey effort for 2020-2021	Subsidence Assessment Subject Land	Target species	Habitat surveyed and other notes	Relevant legend item (Figure 12)
Adult frog and tadpole diurnal habitat search and call playback	2 hours at 2 sites over 2 days	No additional survey required or completed	32 hours at 17 sites over 13 days	Primarily Giant Burrowing Frog and Littlejohn's Tree Frog (tadpole search) and Red-crowned Toadlet (call playback)	Primarily targeting tadpoles of difficult to detect threatened species as adults. Incorporated call playback survey for Red-crowned Toadlet. Note that there was very little aquatic habitat within Biodiversity Assessment Development Footprint. Some of the survey effort associated with subsidence areas is relevant for potential direct impacts from surface infrastructure areas.	• Tadpole survey (Jul-Aug 2021) • Diurnal frog and reptile search, call playback (Oct-Dec 2016) • Threatened fauna diurnal transect
Adult frog and tadpole nocturnal habitat search	1 hour over 3 nights at or adjacent to the proposed Ventilation Shaft Site	1 hour	19 hours at 13 sites over 10 nights.	Primarily Giant Burrowing Frog and Littlejohn's Tree Frog	Swamps with pools and creeks. Note that there was very little aquatic habitat within the Biodiversity Assessment Development Footprint.	• Threatened fauna diurnal transect • Nocturnal search, spotlight, call playback -Frogs and Birds (Oct-Dec 2016)
Frog nocturnal call playback	3 call playback surveys over 3 nights	No additional survey required or completed	13 call playback surveys at 13 sites over 10 nights	Primarily Giant Burrowing Frog, Littlejohn's Tree Frog and Red-crowned Toadlet	Incorporated into nocturnal habitat and watercourse searches. Diurnal call playback incorporated into day frog and tadpole habitat searches.	• Nocturnal Search, spotlight, call playback -Frogs and Birds (Oct-Dec 2016) Call Playback - Frogs and Birds (Oct-Dec 2016) • Call playback Frogs, Birds, Koala (Oct-Dec 2016)
Adult frog and tadpole nocturnal watercourse search	3 hours over 3 nights at or adjacent to the proposed Ventilation Shaft Site	No additional survey required or completed	42 hours at 17 sites over 12 nights	All candidate frog species, recognising limitations around detection of Giant Burrowing Frog outside of heavy rain periods	Supplemented with day habitat surveys to enable tadpole identification of cryptic species.	• Spotlighting and call playback -Frogs and Birds (Oct-Dec 2016) • Threatened fauna nocturnal transect
Reptile habitat search	4 hours within the proposed Ventilation Shaft Site (Oct-Dec 2016)	Incidental survey only	36 hours along creek lines, swamps and ridgelines but concentrating on ridgelines	Broad-headed Snake	Surveys of swamp and riparian habitat conducted in conjunction with frog habitat surveys. Additional surveys of rocky outcrops to locate Broad-headed Snake throughout the Biodiversity Assessment Development Footprint if habitat present and within wider Subject Land.	• Diurnal frog and reptile search, call playback (Oct-Dec 2016). • Threatened fauna diurnal transect
Hollow checking and mapping	Conducted during the bird area searches and day habitat searches	20 hours over 10 days	Not completed	Candidate owl and cockatoo species	Checking for whitewash, pellets and other signs of use.	• Hollow-bearing trees shown on Figure 12
Diurnal bird survey	The proposed Ventilation Shaft Site with an average of 75 minutes of survey at each site. Total 150 minutes. (Oct-Dec 2016)	Incidental survey only	26 sites receiving an average of 50 minutes of survey. Total 22 hours. (Jul-Aug 2021)	All candidate bird species with a focus on hollow dwelling bird species within proposed clearing areas	Birds are generally unlikely to be impacted by subsidence however, surveys were completed to gather baseline data. Standard 20 min 2 ha bird surveys were extended at most sites to a minimum of 30 minutes. Selected swamps had surveys of 60 minutes for Eastern Ground Parrot and Eastern Bristlebird.	• Diurnal bird survey other (Jul-Aug 2021) • Diurnal bird survey (June 2018)

Method	Biodiversity Assessment Development Footprint survey effort (2016-2019)	Biodiversity Assessment Development Footprint survey effort for 2020-2021	Subsidence Assessment Subject Land	Target species	Habitat surveyed and other notes	Relevant legend item (Figure 12)
Dusk bird survey and call playback	None	Approximately 55 person hours listening for calls of target species before sunset. Survey duration approximately 1 hour.	5 swamps each receiving an average of 110 minutes of survey. Total 530 minutes.	Eastern Bristlebird Eastern Ground Parrot Candidate owl and cockatoo species	Targeted to Eastern Bristlebird and Eastern Ground Parrot habitat to add certainty around the absence of these species within the Subject Land. Targeted to cockatoos and owls within the surface infrastructure areas.	• Call playback – Owls, Koala • Nocturnal search, spotlight, call playback – Frogs and Birds (Oct-Dec 2016)
Nocturnal bird call playback	Call playback for potentially occurring owl species was done at Ventilation Shaft Site No 5A. Total 40 minutes. (Oct-Dec 2016)	2021: 6 sites, 30 minutes. Total 3 hours. Jul 2021: Total 40 minutes at the proposed Ventilation Shaft Site	Some call playback for potentially occurring owls was completed throughout Area 5.	Candidate owls and Koala	Target species unlikely to be impacted by subsidence so survey was limited within proposed mining area. No roosting habitat within the proposed Ventilation Shaft Site identified, foraging habitat assumed present.	• Call playback – Owls, Koala • Nocturnal search, spotlight, call playback – Frogs and Birds (Oct-Dec 2016)
Dusk drone surveys	5-minute drone surveys above the proposed Ventilation Shaft Site canopy over successive evenings at dusk. Total 40 minutes.	2021: 6 drone flights, 30 minutes.	30 minutes over 3 sites over 2 days	Glossy Black Cockatoo Gang-gang Cockatoo	Target species unlikely to be impacted by subsidence so limited survey was performed within Subsidence Assessment Subject Land. Drone survey undertaken in attempt to observe the direction of flight from passing cockatoo species to identify roosting areas if they occur within the broader habitat of the proposed Ventilation Shaft Site.	• Drone and diurnal bird survey (Jul-Aug 2021)
Nest boxes – small arboreal mammals	Three hollow nest boxes installed at the proposed Ventilation Shaft Site. Total of 672 trap nights. (Oct 2016)	None	None	Eastern Pygmy Possum	Threatened arboreal species are unlikely to be impacted by subsidence so this method was not performed within proposed mining area. Cameras were found to be a more effective method for target species so this was discontinued.	• Nest box (October 2016)
Infrared cameras medium to large mammals	10 sites. 227 nights. (Oct-Dec 2016, May 2018)	8 sites, 168 nights, (Apr-May 2020)	36 camera sites. 1471 nights. (Oct-Dec 2016, Apr-May 2020)	Eastern Pygmy Possum	Target species included the Spotted-tail Quoll and Rosenberg's Goanna. Cameras were used in preference to cage traps and Elliot traps due to their greater efficiency.	• Remote camera (Oct-Dec 2016) • Remote camera (May 2018) • Remote camera (Apr - May 2020)
Spotlighting surveys – foot arboreal and terrestrial mammals	10 hours in total – 2.5 hours at the proposed Ventilation Shaft Site.	80 hours total. In 2021: 20 person hours over 10 nights In 2020: 30 person hours spotlighting for Koala in February 2021, and approximately 30 hours over 4 nights in April – May 2020.	Performed intermittently with other nocturnal survey components. Targeted spotlighting within Sandstone Transition Forest in Area 5 to highlight Koala presence. (Feb 2021)	Koala Candidate owl species Greater Glider	Target species unlikely to be impacted by subsidence so survey was limited in the proposed mining area.	• Spotlighting/stag-watch (Jul-Aug 2021) • Spotlighting (Apr-May 2020) • Threatened fauna nocturnal transect
Spotlighting surveys – vehicle arboreal and terrestrial mammals	Approximately 1 km of vehicle spotlighting performed at the proposed Ventilation Shaft Site No 5A and along Fire trail 6. Additional vehicle spotlighting not applicable due to limited vehicle access.	5 hours	Performed intermittently between other nocturnal survey components.	All relevant candidate species	Target species unlikely to be impacted by subsidence so survey was limited to surface infrastructure areas.	• Threatened fauna nocturnal transect

Method	Biodiversity Assessment Development Footprint survey effort (2016-2019)	Biodiversity Assessment Development Footprint survey effort for 2020-2021	Subsidence Assessment Subject Land	Target species	Habitat surveyed and other notes	Relevant legend item (Figure 12)
Call-playback surveys– Koala	Call playback at 4 sites over 3 nights – 9 surveys in total.	None	Two to three hours performed within Sandstone Transition Forest in Area 5 to highlight Koala presence. (Feb 2021)	Koala	Target species unlikely to be impacted by subsidence so limited survey was performed within the proposed mining area.	• Koala call playback (Feb 2021) • Call playback – Frogs, birds, Koala (Oct-Dec 2016)
Search for scats and signs – all mammals	Incorporated into all survey activities.	Incorporated into all survey activities.	Incorporated into all survey activities.	All relevant candidate species	Incorporated into all survey activities.	-
Harp trapping (Oct-Mar) – bats	8 nights (in total) from 4 sites. (Oct-Dec 2016)	None	24 nights from 7 sites. (Oct-Dec 2016)	Microchiropteran bats	Trapping targeted to riparian areas or cliff lines within the proposed mining area.	• Harp Traps (Oct-Dec 2016)
Ultrasonic (Song Meter) call recording (Oct-Mar) – bats	12 trap nights (1 site x 12 nights).	None	24 nights at 6 sites. (Oct-Nov 2016)	Microchiropteran bats	Cliff line habitat and riparian habitat in the proposed mining area.	• Bat Echolocation Recording (Oct-Nov 2016)
Spot Assessment Technique (SAT) – Koalas	3 SAT plots were conducted in the proposed Ventilation Shaft Site within 500 m to 1 km of core Koala habitat. However, no preferred tree species were present within the proposed Ventilation Shaft Site. (May 2021, Feb 2021)	29 SAT plots (May 2021, Feb 2021)	3 SAT plots were conducted in areas where feed tree species were present, to assist with determining usage by Koalas. (May 2021, Feb 2021)	Koala	Koala known to be present and unlikely to be impacted by subsidence, so survey not performed extensively in proposed mining area. Survey performed in accordance with SAT guidelines (Phillips & Callaghan 2011).	• Koala SAT plot (May 2020) • Koala scat search (Jul-Aug 2021) • Koala scat search (May 2018)
Stag watch – all hollow-dependant species	16 nights at Area 5A (Jul-Aug 2021)	20 hours at 20 trees (Jul-Aug 2021)	-	Candidate Cockatoos, Owls and the Greater Glider	Stag watches at hollow-bearing trees with hollows over 20 cm, 2 person hours at dusk over 10 nights. From approximately 30 mins before sunset to 30 mins after sunset.	• Spotlighting/Stag-watch (Jul-Aug 2021)

Table 23: Fauna survey types and detailed methods

Survey type	Methods
Frog and Tadpole Surveys (day)	Diurnal frog and tadpole surveys were conducted along creeks, swamps, and rivers of the Subject Land, with a focus on collecting tadpoles of cryptic threatened frog species. Call playback for threatened species was conducted during the survey, particularly for the Red-crowned Toadlet which is known to be particularly responsive to this survey method (e.g. DPIE 2020d). Tadpole specimens were collected with a dip net, stored live and later identified by a tadpole specialist (Marion Anstis). These surveys have been informed by the *Survey guidelines for Australia's threatened frogs* (DEWHA 2010b) and *NSW Survey Guide for Threatened Frogs: a Guide for the Survey of Threatened Frogs and their Habitats for the Biodiversity Assessment Method* (DPIE 2020d).
Frog and Tadpole Surveys (night)	Nocturnal frog surveys were conducted along creeks, swamps, and rivers of the Subject Land. The survey involved listening for frog calls, active searching of frog habitat such as under rocks and logs, as well as streamside searches using torchlight to detect eye-shine and movement of frogs. Frog species were identified using local knowledge supported by various guides and phone applications. Call playback for threatened species was conducted during survey. These surveys have been informed by the *Survey guidelines for Australia's threatened frogs* (DEWHA 2010b) and *NSW Survey Guide for Threatened Frogs: a Guide for the Survey of Threatened Frogs and their Habitats for the Biodiversity Assessment Method* (DPIE 2020d).
Reptile Surveys	Reptile surveys were conducted throughout the Subject Land, particularly where rocky outcrops were identified, with a preference for a north or westerly facing aspect (i.e., habitat for Broad-headed Snake). The survey involved checking under rock plates and partially embedded rocks. The survey for Rosenberg's Goanna was supported using infrared cameras. These surveys have been informed by the *survey guidelines for Australia's threatened reptiles* (DSEWPC 2011b).
Bird Survey	Bird surveys using binoculars (10 x 40) were conducted across the Subject Land targeting swamp and riparian habitats as well as at the proposed Ventilation Shaft Site. Two-hectare bird surveys were conducted at 24 sites, with survey duration ranging from 20 – 60 minutes depending on the level of bird activity. Surveys were generally conducted soon after sunrise until an hour prior to midday. Surveys targeting the Eastern Bristlebird and Eastern Ground Parrot were conducted at dusk for at least an hour where potential habitat occurred. The location of bird surveys was biased towards upland swamp and adjacent creeks as well as proposed Ventilation Shaft Site as these have been identified as potential impact areas. Calls of target threatened species were played during bird surveys, particularly in potential habitat for Eastern Bristlebird and Eastern Ground Parrot. Call identification was aided by cross checking with a call reference library in the field. In addition to ground-based bird surveys, 5-minute drone surveys were undertaken for Glossy Black Cockatoos and Gang-Gang Cockatoos. 3 flights were repeated on dusk along one edge of the proposed Ventilation Shaft Site to cover the area of interest. This process was repeated over several evenings during the breeding season. Further bird observations (outside of targeted bird survey periods) were recorded throughout the course of the survey if previously unobserved or uncommonly observed birds were encountered. These surveys have been informed by the *Survey guidelines for Australia's threatened birds* (DEWHA 2010a).

Survey type	Methods
Nocturnal call playback (mammals and owls)	Nocturnal call playback was carried out adjacent to the proposed Ventilation Shaft Site and areas of potential Koala habitat (as identified by presence of preferred feed tree species). Calls of targeted species (Koala, Powerful Owl, Masked Owl and Barking Owl) were broadcast for up to five minutes followed by five minutes of listening time. This process was repeated several times for each survey. These surveys have been informed by the *Survey guidelines for Australia's threatened birds* (DEWHA 2010a).
Nest boxes	Nest boxes made of hollow branches approximately 150 mm in diameter and 400 mm long with tin capping and inserted bedding material were affixed to trees adjacent to flowering shrubs (e.g., *Lambertia formosa)* within the proposed Ventilation Shaft Site. Nest boxes were checked twice throughout their deployment and remain in place for future monitoring as needed. These surveys have been informed by the *Survey guidelines for Australia's threatened mammals* (DSEWPC 2011a)
Spotlighting	Spotlighting on foot was carried out during nocturnal survey activities and within the proposed Ventilation Shaft Site. Each spotlighting session lasted for approximately one hour. Each session consisted of a traverse through the site on existing tracks sampling the identified habitats using LED torches. Spotlighting by vehicle was conducted along Fire Trail 6 from the proposed Ventilation Shaft Site heading east. Each driving transects lasted approximately 30 minutes. These surveys have been informed by the *Survey guidelines for Australia's threatened mammals* (DSEWPC 2011a).
Stag watching	Stag watching at hollow-bearing trees with at least one hollow greater than 20 cm was conducted within the proposed Ventilation Shaft Site. A total of 16 trees were observed for around 30 minutes before and after sunset. These surveys have been informed by the *Survey guidelines for Australia's threatened mammals* (DSEWPC 2011a).
Infrared cameras	Infrared cameras were deployed throughout the Subject Land with a focus on swamps, riparian habitat, cliff lines and the proposed Ventilation Shaft Site. Cameras were placed on identified tracks and left unbaited or baited with sardines or honey. These surveys have been informed by the *Survey guidelines for Australia's threatened mammals* (DSEWPC 2011a).
Ultrasonic call recording	Ultrasonic bat detectors (SM2+) recorders were set along identified flyways or creeks. The detectors were placed on the ground or elevated up to 1 m where possible and, pointed upwards at approximately a 45° angle and programmed to record from sunset. Recorded calls were later analysed by computer using Kaleidoscope software. These surveys have been informed by the *Survey guidelines for Australia's threatened bats* (DEWHA 2010c) and *'Species credit' threatened bats and their habitats, NSW survey guide for the Biodiversity Assessment Method* (OEH 2018).
Harp traps	Harp traps were set at riparian sites and along flyways where there was nearby cliff (and potential cave) habitat or within the proposed Ventilation Shaft Site. Two adjacent harp traps were set at each site to fill identified flyways. Traps were checked daily with bats identified on site. These surveys have been informed by the *Survey guidelines for Australia's threatened bats* (DEWHA 2010c) and *'Species credit' threatened bats and their habitats, NSW survey guide for the Biodiversity Assessment Method* (OEH 2018).

Survey type	Methods
Koala SAT Surveys	Koala scats were searched for by targeting preferred feed trees consisting of primary feed trees (in subsidence areas with potential Koala habitat) or supplementary feed tree species where primary feed trees were absent (i.e., within the proposed Ventilation Shaft Site). The bases (0 to 2 m from the trunk) of twenty such trees were searched for evidence of Koala scat by first circling around the tree looking for scats without disturbing the leaf litter (approximately 1 minute), then by raking through the leaf litter for scats (approximately 1 additional minute). Following the method detailed by Phillips and Callaghan (2011). These surveys have been informed by the *Survey guidelines for Australia's threatened mammals* (DSEWPC 2011a).
Limitations to fauna surveys	Breeding events and heightened activity for frogs (such as the Giant Burrowing Frog) in response to heavy rain, generally coincide with access restrictions within the Sydney Catchment Special Areas, thus reducing detectability of adults. This limitation was addressed by focussing on tadpole surveys which have been considered a more effective method of detection for the Giant Burrowing Frog (DECC 2009) and have shown to be reliable in assessing presence of Littlejohn's Tree Frog within streams adjacent to the Subject Land which are part of long-term monitoring programs (Biosis 2016). Attempts were made to stagger frog survey over a number of months and to include at least some nights when conditions were relatively warm and humid. Survey limitations have been considered in conducting the likelihood of occurrence analysis. Therefore, despite some threatened species not being detected during survey, they have been presumed present (or having a high likelihood of occurrence) where they are cryptic species and where there is a reasonable basis to assume they are likely to be present due to past records. For safety reasons the survey was also limited by site constraints such as steepness of terrain and accessibility.

Specific targeted survey guidelines have been described for only a limited number of the candidate species. The survey guidelines are identified in Table 24, which includes and assessment of the survey design against these guidelines, as relevant to the target species and their habitats within the Biodiversity Assessment Development Footprint and Subsidence Assessment Subject Land.

Table 24: Assessment of survey effort against available guidelines for targeted fauna survey

Method	Biodiversity Assessment Development Footprint survey effort		Subsidence Assessment Subject Land (Prescribed impacts)	Habitat surveyed and other notes	NSW survey guidelines summary	Commonwealth survey guidelines summary
	2016-2021	2020-2021				
Giant Burrowing Frog					**DPIE (2020d)**	**DEWHA (2010)**
Adult frog and tadpole diurnal habitat search and call playback	2 hours at 2 sites over 2 days	No additional survey required or completed	32 hours at 17 sites over 13 days	Primarily targeting tadpoles, given adults are difficult to detect.	<u>Aural-visual surveys:</u> • Survey period September – May. • 960 minutes of survey effort for a 500 m transect. run through areas of native vegetation located within 300 metres of suitable breeding habitat. • 8 repeat surveys. <u>Tadpole searches:</u> • Survey period February – May. • 10 minutes/50 m^2 of surface area. • 8 repeat surveys. • Within areas of identified suitable	• Under optimum weather conditions (within 1 week of heavy rainfall). • At time of peak activity for the species (September – March). • Spotlight surveys on foot and by road. Best results during and immediately after rainfall. • Accompanied by habitat assessment by appropriately experienced personnel. • A minimum of four nights under ideal conditions. • In the study site, spotlight surveys on foot should cover several square kilometres of track in suitable habitat.
Adult frog and tadpole nocturnal habitat search	1 hour over 3 nights at or adjacent to the proposed Ventilation Shaft Site	1 hour	19 hours at 13 sites over 10 nights.	Targeting swamps with pools and creeks.		
Frog nocturnal call playback	3 call playback surveys over 3 nights	No additional survey required or completed	13 call playback surveys at 13 sites over 10 nights	Incorporated into nocturnal habitat and watercourse searches.		
Adult frog and tadpole nocturnal watercourse search	3 hours over 3 nights at or adjacent to the proposed	No additional survey required or completed	42 hours at 17 sites over 12 nights	Supplemented with day habitat surveys to enable tadpole identification of cryptic species.		

Method	Biodiversity Assessment Development Footprint survey effort		Subsidence Assessment Subject Land (Prescribed impacts)	Habitat surveyed and other notes	NSW survey guidelines summary	Commonwealth survey guidelines summary
	2016-2021	2020-2021				
	Ventilation Shaft Site				breeding waterbodies, at night when tadpoles are most active	
Assessment:	The survey method has used a combination of Aural-visual surveys and tadpole searches targeting suitable habitat as recommended by the guidelines. The specific use of transects has not been utilised given the disjunct occurrence of pools within the landscape. The number of hours of survey completed and use of complementary survey methods are considered sufficient to inform the assessment of the species for the BDAR and achieve the overarching aims of the survey guidelines.					
Littlejohn's Tree Frog					**DPIE (2020d)**	**DEWHA (2010)**
Adult frog and tadpole diurnal habitat search and call playback	2 hours at 2 sites over 2 days	No additional survey required or completed	32 hours at 17 sites over 13 days	Primarily targeting tadpoles, given adults are difficult to detect.	<u>Aural-visual surveys:</u> • July – Nov. • 480 mins / 500 m transect along areas of potential breeding habitat. • 4 repeat surveys. <u>Tadpole searches:</u> • 10 mins/50 m^2 of surface area. • Up to 2 repeat surveys. • Target areas of open water in potential breeding habitat.	• Survey under optimum weather conditions at time of peak activity (autumn through winter months, within three days of heavy rainfall). • Spotlight and call detection, accompanied by habitat assessment. • A minimum of four nights under ideal conditions, covering a range of stream structure. • Stream transect of a minimum of 200 m. Isolated pools in headwaters of streams and occasionally on ridges.
Adult frog and tadpole nocturnal habitat search	1 hour over 3 nights at or adjacent to the proposed Ventilation Shaft Site	1 hour	19 hours at 13 sites over 10 nights.	Targeting swamps with pools and creeks.		
Frog nocturnal call playback	3 call playback surveys over 3 nights	No additional survey required or completed	13 call playback surveys at 13 sites over 10 nights	Incorporated into nocturnal habitat and watercourse searches.		
Adult frog and tadpole nocturnal watercourse search	3 hours over 3 nights at or adjacent to the proposed	No additional survey required or completed	42 hours at 17 sites over 12 nights	Supplemented with day habitat surveys to enable tadpole identification of cryptic species.		

Method	Biodiversity Assessment Development Footprint survey effort		Subsidence Assessment Subject Land (Prescribed impacts)	Habitat surveyed and other notes	NSW survey guidelines summary	Commonwealth survey guidelines summary
	2016-2021	2020-2021				
	Ventilation Shaft Site					• Also occurs in ponds in forested habitats. • Local area study should include reference sites where feasible.
Assessment:	The survey method has used a combination of aural-visual surveys and tadpole searches targeting suitable habitat as recommended by the guidelines. The specific use of transects has not been utilised given the disjunct occurrence of pools within the landscape. The number of hours of survey completed and use of complementary survey methods are considered sufficient to inform the assessment of the species for the BDAR and achieve the overarching aims of the survey guidelines.					
Green and Golden Bell Frog					**DPIE (2020d)**	**DEWHA (2010)**
Adult frog and tadpole diurnal habitat search and call playback	2 hours at 2 sites over 2 days	No additional survey required or completed	32 hours at 17 sites over 13 days		Aural-visual surveys: • Nov– March. • 480 mins / 500 m transect. • 4 repeat surveys. Tadpole search: • Nov– March. • 10 mins/50 m2 of surface area. • Up to 2 repeat surveys.	• Under optimum weather conditions (warm and windless, following rainfall). • At time of peak activity for the species (September–March). • Using a combination of call detection, call playback and spotlight surveys. • Larvae can be collected by dip netting or trapping. • Accompanied by habitat assessment by appropriately experienced personnel. • A minimum of four nights under ideal conditions.
Adult frog and tadpole nocturnal habitat search	1 hour over 3 nights at or adjacent to the proposed Ventilation Shaft Site	1 hour	19 hours at 13 sites over 10 nights.	Targeting swamps with pools and creeks.		
Frog nocturnal call playback	3 call playback surveys over 3 nights	No additional survey required or completed	13 call playback surveys at 13 sites over 10 nights	Incorporated into nocturnal habitat and watercourse searches.		
Adult frog and tadpole nocturnal	3 hours over 3 nights at or adjacent to the proposed	No additional survey required or completed	42 hours at 17 sites over 12 nights	Supplemented with day habitat surveys to enable tadpole		

Method	Biodiversity Assessment Development Footprint survey effort		Subsidence Assessment Subject Land (Prescribed impacts)	Habitat surveyed and other notes	NSW survey guidelines summary	Commonwealth survey guidelines summary
	2016-2021	2020-2021				
watercourse search	Ventilation Shaft Site			identification of cryptic species.		• Small wetlands (<50 metres at greatest length) at the study site should be covered in a period of about one hour. Larger wetlands (>50 metres) should be searched by sampling multiple units in a systematic manner.
Assessment:	The survey method has used a combination of aural-visual surveys and tadpole searches targeting suitable habitat as recommended by the guidelines. The specific use of transects has not been utilised given the disjunct occurrence of habitat within the landscape. The number of hours of survey completed and use of complementary survey methods are considered sufficient to inform the assessment of the species for the BDAR and achieve the overarching aims of the survey guidelines.					
Red-crowned Toadlet					**DPIE (2020d)**	**DEWHA (2010)**
Adult frog and tadpole diurnal habitat search and call playback	2 hours at 2 sites over 2 days	No additional survey required or completed	32 hours at 17 sites over 13 days		<u>Aural-visual surveys:</u> • Year round (following sufficient rainfall to stimulate activity). • 480 mins / 500 m transect. • 4 repeat surveys. • Surveys should not be conducted if three significant rain events (>50 mm of rain in 24 hours) have occurred in the previous two	• Guidelines specific to the Red-crowned Toadlet have not been published.
Adult frog and tadpole nocturnal habitat search	1 hour over 3 nights at or adjacent to the proposed Ventilation Shaft Site	1 hour	19 hours at 13 sites over 10 nights.	Targeting swamps with pools and creeks.		
Frog nocturnal call playback	3 call playback surveys over 3 nights	No additional survey required or completed	13 call playback surveys at 13 sites over 10 nights	Incorporated into nocturnal habitat and watercourse searches.		

Method	Biodiversity Assessment Development Footprint survey effort		Subsidence Assessment Subject Land (Prescribed impacts)	Habitat surveyed and other notes	NSW survey guidelines summary	Commonwealth survey guidelines summary
	2016-2021	2020-2021				
Adult frog and tadpole nocturnal watercourse search	3 hours over 3 nights at or adjacent to the proposed Ventilation Shaft Site	No additional survey required or completed	42 hours at 17 sites over 12 nights	Supplemented with day habitat surveys to enable tadpole identification of cryptic species.	months, nor during periods of heavy rainfall.	
Assessment:	The survey method has used a combination of aural-visual surveys targeting suitable habitat as recommended by the guidelines. The specific use of transects has not been utilised given the disjunct occurrence of habitat within the landscape. The number of hours of survey completed and use of complementary survey methods are considered sufficient to inform the assessment of the species for the BDAR and achieve the overarching aims of the survey guidelines.					
Stuttering Frog					**DPIE (2020d)**	**DEWHA (2010)**
Adult frog and tadpole diurnal habitat search and call playback	2 hours at 2 sites over 2 days	No additional survey required or completed	32 hours at 17 sites over 13 days		<u>Aural-visual surveys:</u> • Sept. – March. • 480 mins / 500 m transect. • 4 repeat surveys.	• Under optimum weather conditions (substrate and leaf litter wet). • At time of peak activity for the species (September–March). • Not during heavy rainfall or stream flow. One week after heavy rainfall. • Call playback and spotlighting while walking transect along stream or creek.
Adult frog and tadpole nocturnal habitat search	1 hour over 3 nights at or adjacent to the proposed Ventilation Shaft Site	1 hour	19 hours at 13 sites over 10 nights.	Targeting swamps with pools and creeks.		
Frog nocturnal call playback	3 call playback surveys over 3 nights	No additional survey required or completed	13 call playback surveys at 13 sites over 10 nights	Incorporated into nocturnal habitat and watercourse searches.		

Method	Biodiversity Assessment Development Footprint survey effort		Subsidence Assessment Subject Land (Prescribed impacts)	Habitat surveyed and other notes	NSW survey guidelines summary	Commonwealth survey guidelines summary
	2016-2021	2020-2021				
Adult frog and tadpole nocturnal watercourse search	3 hours over 3 nights at or adjacent to the proposed Ventilation Shaft Site	No additional survey required or completed	42 hours at 17 sites over 12 nights	Supplemented with day habitat surveys to enable tadpole identification of cryptic species.		• Detection by larvae presence. • Road transects are effective after heavy rain. • Larvae are distinctive and can be collected by dip netting. • A minimum of two nights under ideal conditions. Should be repeated on at least four separate occasions in activity period. • Stream transect of a minimum of 200 m.
Assessment:	The survey method has used a combination of aural-visual surveys targeting suitable habitat as recommended by the guidelines. The specific use of transects has not been utilised given the disjunct occurrence of habitat within the landscape. The number of hours of survey completed and use of complementary survey methods are considered sufficient to inform the assessment of the species for the BDAR and achieve the overarching aims of the survey guidelines.					
Broad-headed Snake					**DEC (2004a)**	**DSEWPC (2011b)**
Reptile habitat search	4 hours within the proposed Ventilation Shaft Site	Incidental survey only	36 hours along creek lines, swamps and ridgelines but concentrating on ridgelines	Surveys of swamp and riparian habitat conducted in conjunction with frog habitat surveys. Additional surveys of rocky outcrops to locate Broad-headed	• Guidelines specific to the Broad-headed Snake have not been published. • The *Working Draft Threatened Species Survey and Assessment Guidelines* (DEC 2004a)	• Searching suitable sheltering sites (under rocks or in crevices) on westerly-facing sandstone cliffs by day during winter. • Searching appropriate sheltering sites with torches during winter to detect the

Method	Biodiversity Assessment Development Footprint survey effort		Subsidence Assessment Subject Land (Prescribed impacts)	Habitat surveyed and other notes	NSW survey guidelines summary	Commonwealth survey guidelines summary
	2016-2021	2020-2021				
				Snake throughout infrastructure areas if habitat present and within wider Subject Land.	provide guidance for general reptile community survey only.	presence of the species in an area is recommended.
Assessment:	Survey was not conducted during the optimal season for the species according to the BBCC TBCD (August-September), however it was conducted during the period of greatest activity for the species, late spring through to mid-summer (DSEWPC 2011b), as well as March and July when the species would be expected to occupy winter sheltering habitats. The survey undertaken is considered to align with the methods detailed in the available survey guidelines, are suitable to inform the assessment of the species for the BDAR and achieve the overarching aims of the guidelines.					
Large-eared Pied Bat					**OEH (2018)**	**DEWHA (2010c)**
Harp trapping (Oct-Mar) - bats	8 nights (in total) from 4 sites. (Oct-Dec 2016)	None	24 nights from 7 sites. (Oct-Dec 2016)	Trapping targeted to riparian areas or cliff lines within the proposed mining area.	Potential breeding habitat≤ 50 ha: Mid Nov.- end Jan. Total effort: 16 Minimum number of nights: 4	Oct – March Harp traps can be used to confirm presence. Set in forest flyways, near scarps and cliffs and in riparian zones. 16 trap nights (<50 ha), minimum of 4 nights) A combination of techniques is recommended.
Ultrasonic (Song Meter) call recording (Oct-Mar) - bats	12 trap nights (1 site x 12 nights).	None	24 nights at 6 sites. (Oct-Nov 2016)	Cliff line habitat and riparian habitat in the proposed mining area.	Potential breeding habitat≤ 50 ha: Mid Nov.- end Jan. Total effort: 16. Minimum number of nights: 4.	Oct – March Electronic bat detectors can be set in the vicinity of rocky outcrops, vegetation corridors and flyways, over watercourses,

Method	Biodiversity Assessment Development Footprint survey effort		Subsidence Assessment Subject Land (Prescribed impacts)	Habitat surveyed and other notes	NSW survey guidelines summary	Commonwealth survey guidelines summary
	2016-2021	2020-2021				
						isolated waterholes and representative vegetation types. 16 detector nights (<50 ha), minimum of 4 nights)
Assessment:	The survey undertaken is considered to align with the methods detailed in the available survey guidelines, are suitable to inform the assessment of the species for the BDAR and achieve the overarching aims of the guidelines.					
Southern Myotis					**OEH (2018)**	**DEWHA (2010c)**
Harp trapping (Oct-Mar) - bats	8 nights (in total) from 4 sites. (Oct-Dec 2016)	None	24 nights from 7 sites. (Oct-Dec 2016)	Trapping targeted to riparian areas or cliff lines within the proposed mining area.	Potential habitat is <2.5 km riparian length Oct – March Total effort: 16. Minimum number of nights: 4.	N/A
Ultrasonic (Song Meter) call recording (Oct-Mar) - bats	12 trap nights (1 site x 12 nights).	None	24 nights at 6 sites. (Oct-Nov 2016)	Cliff line habitat and riparian habitat in the proposed mining area.	Potential habitat is <2.5 km riparian length Oct – March Total effort: 16. Minimum number of nights: 4.	N/A
Assessment:	The survey undertaken is considered to align with the methods detailed in the available survey guidelines, are suitable to inform the assessment of the species for the BDAR and achieve the overarching aims of the guidelines.					
Little Bent-winged Bat					**OEH (2018)**	**DEWHA (2010c)**
Harp trapping (Oct-Mar) - bats	8 nights (in total) from 4 sites. (Oct-Dec 2016)	None	24 nights from 7 sites. (Oct-Dec 2016)	Trapping targeted to riparian areas or cliff lines within the proposed mining	Oct – March Total effort: 8.	N/A

Method	Biodiversity Assessment Development Footprint survey effort		Subsidence Assessment Subject Land (Prescribed impacts)	Habitat surveyed and other notes	NSW survey guidelines summary	Commonwealth survey guidelines summary
	2016-2021	2020-2021				
				area. N.B. cave, mine and tunnel features absent from Subject Land.	Minimum number of nights: 4.	
Assessment:	The survey undertaken is considered to align with the methods detailed in the available survey guidelines, are suitable to inform the assessment of the species for the BDAR and achieve the overarching aims of the guidelines.					

2.6.2 Methods – weather conditions during field survey

Weather partly dictated survey techniques employed on any day. For example, frog surveys were undertaken mostly during warmer nights, diurnal bird surveys confined to the morning or at dusk on hot days, and owl call playback surveys were undertaken on calm evenings. Daily weather observations for Campbelltown (station 068257) can be viewed in Appendix 6.

2.6.3 Results – fauna

One-hundred and forty-eight native fauna species were recorded during the surveys, which of 20 amphibians, 71 bird, 42 mammal and 15 reptile species. A list of fauna recorded in the Biodiversity Assessment Development Footprint or Subsidence Assessment Subject Land is provided in Appendix 5.

Four species of exotic fauna were recorded: Fox, Cat, Rabbit and House Mouse. The exotic fauna are well established within the region and are not newly invasive with all of these species being relatively common and widespread throughout the region. The exotic fauna species were observed to have comparatively lower densities within the Subsidence Assessment Subject Land than neighbouring rural lands. This pattern is attributed to the large expanses of consolidated bushland with low levels of fragmentation and the low productivity of the majority of the Subsidence Assessment Subject Land. Of the invasive species recorded, the Fox was most encountered, via detection with infrared cameras.

Of the 148 species recorded, 19 species are threatened species listed under the schedules of the BC Act or EPBC Act:

- Large Bent-winged Bat (*Miniopterus schreibersii oceanensis*).
- Eastern Cave Bat (*Vespadelus troughtoni*).
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*).
- Eastern Freetail-bat (*Mormopterus norfolkensis*).
- Eastern Pygmy-possum (*Cercartetus nanus*).
- Gang-gang Cockatoo (*Callocephalon fimbriatum*).
- Giant Burrowing Frog (*Heleioporus australiacus*).
- Golden-tipped Bat (*Kerivoula papuensis*).
- Greater Broad-nosed Bat (*Scoteanax rueppellii*).
- Greater Glider (*Petauroides volans*).
- Grey-headed Flying-fox (*Pteropus poliocephalus*).
- Koala (*Phascolarctos cinereus*).
- Little Bentwing-bat (*Miniopterus australis*).
- Littlejohn's Tree Frog (*Litoria littlejohni*).
- Rosenberg's Goanna (*Varanus rosenbergi*).
- Scarlet Robin (*Petroica boodang*).
- Varied Sittella (*Daphoenositta chrysoptera*).
- White-bellied Sea-Eagle (*Haliaeetus leucogaster*).
- Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*).

The threatened fauna recorded, along with the number of records has been provided in Table 25 and shown on Figure 13.

A total of 388 hollow-bearing trees were recorded within the Biodiversity Assessment Development Footprint. A register for the hollow-bearing trees has been provided in Appendix 7, and the location of the trees provided on Figure 13.

2.6.4 Threatened fauna – candidate species analysis

A total of 33 candidate threatened fauna species were identified by the BAM-C as species credit species. Table 25 details the list of candidate threatened fauna species, including habitat constraints and required survey timing (as identified in the BAM-C).

A status column indicates whether a species was recorded at the Biodiversity Assessment Development Footprint or considered absent based on survey or other means. A further status column assesses the presence of threatened fauna within the wider Subject Land (ie. habitat not directly impacted).

Table 25: Candidate fauna species analysis

Scientific Name	Common name	BC Act	EPBC Act	Recommended survey month	Credit status and species credit component	SAII status	Associated PCT and habitat constraints	Assessment of threatened fauna – Biodiversity Assessment Development Footprint		Assessment of threatened fauna within Subject Land	
								Habitat assessment and targeted survey results and justification	Species polygon required?	Assessment of threatened fauna within the wider Subject Land - Habitat assessment and targeted survey results and justification	Species polygon required?
Anthochaera phrygia	Regent Honeyeater	CE	CE	Not required for species credit species where important areas are mapped.	Dual (Mapped important areas)	Yes – if important area impact	Mapped important areas trigger species credit component.	Subject Land not a mapped important area and therefore is not considered further.	No	Subject Land not a mapped important area and therefore is not considered further.	No
Burhinus grallarius	Bush-stone Curlew	E	-	All year	Species	No	Habitat constraints include fallen/standing dead timber including logs within associated PCTs 1250, 978, 1181, 1395 and 1804.	Not recorded during targeted survey, limited records from locality. Not considered likely to occur based on survey and records, and therefore consider vagrant at best.	No	Not recorded during targeted survey, limited records from locality. Not considered likely to occur based on survey and records, and therefore consider vagrant at best.	No
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	October - January	Dual (Breeding habitat)	No	Habitat constraints are trees with suitable breeding hollows within associated PCTs 1250, 1181, 1395 and 1804. Hollow prescription: Eucalypt tree species with hollows greater than 9 cm diameter.	Species is known to be present – recorded in the Subject Land in 2021, a total of 7 records in the survey area since 2016. Stag watches and considerable time spent inspecting hollow-bearing tree use at the proposed Ventilation Shaft Site did not detect this species utilising hollows. One individual was heard moving through the eastern end of the proposed Ventilation Shaft Site on one occasion.	Yes. As survey was conducted outside of the nominated survey months the species is assumed to breed within areas where suitable sized hollows are present.	The species needs to be assumed to be present as targeted survey (ie hollow-bearing tree survey) not completed across the wider Subject Land.	Yes - assumed to be present within associated PCTs 1083, 1250, 1181, 1395 and 1804.
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-	April -August	Dual (Breeding)	No	Habitat constraints are trees with suitable breeding hollows within associated PCTs 1083, 1181, 1245, 1250 and 1395. Species also requires Allocasuarina and Casuarina feed trees for foraging habitat to be identified. Hollow prescription: living or dead trees with hollows greater than 15cm diameter and greater than 8 m above ground).	Known to be present but uncommon in the locality. Recorded prior to 2016 in nearby Area 3B. Not recorded during any surveys since 2016. Low abundance of Allocasuarina and Casuarina species in the proposed Ventilation Shaft Site.	No. Hollow-bearing tree survey has confirmed that despite presence of suitable sized hollows no potential nest hollows are being used by Glossy Black-Cockatoos at the proposed Ventilation Shaft Site. Bird surveys and stag watches have not detected this species breeding or otherwise in the Subject Land in any years of survey.	The species needs to be assumed to be present as targeted survey not completed across the wider Subject Land.	Yes - assumed to be present within associated PCTs 1083, 1181, 1245, 1250 and 1395.
Cercartetus nanus	Eastern Pygmy-possum	V	-	October - March	Species	No	Associated PCTs include 1083, 1181, 1245, 1250 and 1395.	Known to be present. Previously recorded with three observations (Niche 2020) at the proposed Ventilation Shaft Site and within other parts of the Subject Land.	Yes. Clearing of potential breeding, sheltering, and foraging habitat in surface infrastructure areas.	The species needs to be assumed to be present as targeted survey not completed across the wider Subject Land.	Yes - assumed to be present within associated PCTs 1083, 1181, 1245, 1250 and 1395.

Scientific Name	Common name	BC Act	EPBC Act	Recommended survey month	Credit status and species credit component	SAII status	Associated PCT and habitat constraints	Assessment of threatened fauna – Biodiversity Assessment Development Footprint		Assessment of threatened fauna within Subject Land	
								Habitat assessment and targeted survey results and justification	Species polygon required?	Assessment of threatened fauna within the wider Subject Land - Habitat assessment and targeted survey results and justification	Species polygon required?
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	November - January	Species	Yes if breeding habitat present	Habitat constraints are habitat within 2 km of rocky areas containing caves, overhangs, outcrops, or crevices within associated PCTs 1083, 1181, 1245, 1250 and 1395.	The species was not detected during ultrasonic call recording surveys or harp trapping surveys in the extensive baseline surveys in 2016. The area proposed for the Dendrobium Pit Top Carpark Extension (located over 10 km away from the Area 5) may have foraging habitat potential, is within 2km of cliff lines, and has records within proximity. As such, it is assumed that this habitat may be suitable for Large-eared pied Bat foraging.	Yes – for Dendrobium Pit Top only.	The species needs to be assumed to be present as targeted survey not completed across the entirely of the wider Subject Land.	Yes - assumed to be present within associated habitat within 2 km of rocky areas containing caves, overhangs, outcrops or crevices within associated PCTs 1083, 1181, 1245, 1250 and 1395.
Dasyornis brachypterus	Eastern Bristlebird	E	E	September - May	Species	No	Associated PCTs include 978 and 1083.	Extensive bird surveys conducted in swamp habitat, vent shaft site and other areas subject to clearing have not recorded the species. Closest record 25 km south.	No	Extensive bird surveys conducted in swamp habitat, vent shaft site and other areas subject to clearing have not recorded the species. Closest record 25 km south.	No
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	-	July - December	Dual (Breeding)	No	Habitat constraints include Waterbodies and living or dead trees within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines within associated PCTs 978, 1083, 1181, 1250, 1395 and 1804. Breeding habitat is live large old trees and the presence of a large stick nest within tree canopy; or an adult with nest material; or adults observed duetting within breeding period.	Surveys recorded this species flying overhead, but no trees with large stick nests were detected within the direct impact areas and surveys of these areas did not detect the species.	No	The species needs to be assumed to be present as targeted survey not completed across the wider Subject Land.	Yes - assumed to be present within associated PCTs 978, 1083, 1181, 1250, 1395 and 1804.
Heleioporus australiacus	Giant Burrowing Frog	V	V	September - May	Species	No	Associated PCTs include 978, 1083, 1181, 1245, 1250, 1395, 1804.	The habitat within the areas proposed for surface infrastructure does not contain suitable watercourse habitat.	No	The species is known to occur and assumed to be present throughout relevant stream and buffer areas.	Yes - assumed to be present within creek and buffer areas associated with PCTs 978, 1083, 1181, 1245, 1250, 1395, 1804.
Hieraaetus morphnoides	Little Eagle	V	-	April, September, October	Dual (Breeding)	No	Habitat constraints include nest trees - live	The species was not recorded during targeted survey.	No	The species needs to be assumed to be present as	Yes - assumed to be present within

Scientific Name	Common name	BC Act	EPBC Act	Recommended survey month	Credit status and species credit component	SAII status	Associated PCT and habitat constraints	Assessment of threatened fauna – Biodiversity Assessment Development Footprint		Assessment of threatened fauna within Subject Land	
								Habitat assessment and targeted survey results and justification	Species polygon required?	Assessment of threatened fauna within the wider Subject Land - Habitat assessment and targeted survey results and justification	Species polygon required?
							(occasionally dead) large old trees within vegetation within associated PCTs 978, 1083, 1181, 1245, 1250, 1395, 1804.	No trees with large stick nests were detected within the direct impact areas.		targeted survey not completed across the wider Subject Land.	associated PCTs 978, 1083, 1181, 1245, 1250, 1395, 1804.
Hoplocephalus bungaroides	Broad-headed Snake	E	V	August - September	Dual (Breeding)	Yes – if breeding habitat present	Habitat constraints include rocky areas including escarpments, outcrops and pagodas within the Sydney Sandstone geologies within associated PCTs 978, 1083, 1181, 1245, 1250 and 1804.	Broad-headed Snake was not detected in the direct impact areas, which do not support breeding habitat for the species. The potential habitat modelling did not identify preferred habitat within the direct impact areas.	No	The species needs to be assumed to be present as targeted survey did not meet all guidelines and the species is known to occur sporadically in relevant habitat.	Yes - assumed to be present within associated PCTs where prescribed habitat areas occur.
Isoodon obesulus obesulus	Southern Brown Bandicoot (eastern)	E	E	All Year	Species	No	Habitat constraints include: requires dense ground cover in a variety of habitats. Associated PCTs: 978, 1083, 1181, 1245, 1250, 1395, 1804.	This species has not been detected in the Subject Land despite multiple years of survey since 2016. The species has been recorded twice within 5 km of the Subject Land however both records are more than 20 years old. The species is not considered to occur.	No	Not recorded during targeted survey, limited records from locality. Not considered likely to occur based on survey and records.	No
Lathamus discolor	Swift Parrot	E	CE	May, June, July, August,	Dual (Mapped important areas)	Yes if occurs in important areas	Mapped important areas trigger species credit component.	Subject Land not a mapped important area.	No	Subject Land not a mapped important area.	No
Litoria aurea	Green and Golden Bell Frog	E	V	January, February, march, November, December	Species	No	Habitat constraints are habitats within 1km of semi-permanent and ephemeral wet areas / swamps / waterbodies, within associated PCTs 1083, 1181, 1245, 1250, 1395, 1804.	The Subject Land provides no habitat for Green and Gold Bell Frogs due to the presence of waterbodies with macrophyte vegetation (i.e. Typha sp.), however habitat is limited, and the species has not been recorded over multiple years of survey since 2016. The species is not known from the area.	No	The species was not detected during surveys and habitat not suitable.	No
Litoria littlejohni	Littlejohn's Tree Frog	V	V[11]	July - November	Species	No	Associated PCTs include 1083, 1181, 1245, 1250, 1395, 1804.	Recorded from swamps and creeks within the Project area. Previously recorded: 41 observations since 2016, including tadpole observations of over 100 individuals.	No. The areas proposed for surface infrastructure do not contain suitable habitat for the species.	The species is known to occur and has been assumed to be present throughout relevant stream and buffer areas.	Yes - assumed to be present within associated PCTs 1083, 1181, 1245, 1250, 1395, 1804.
Lophoictinia isura	Square-tailed Kite	V	-	January, September, October,	Dual (Breeding)	No	Habitat constraints including nest trees within associated PCTs 1083,	The species was not recorded during targeted survey.	No	The species needs to be assumed to be present as	Yes - assumed to be present within associated PCTs

[11] *Listed as 'Vulnerable' under the EPBC Act at the time of the "controlled action" decision (13 January 2022) and therefore assessed as 'Vulnerable' rather than 'Endangered' (refer section 158A of the EPBC Act).*

Scientific Name	Common name	BC Act	EPBC Act	Recommended survey month	Credit status and species credit component	SAII status	Associated PCT and habitat constraints	Assessment of threatened fauna – Biodiversity Assessment Development Footprint		Assessment of threatened fauna within Subject Land	
								Habitat assessment and targeted survey results and justification	Species polygon required?	Assessment of threatened fauna within the wider Subject Land - Habitat assessment and targeted survey results and justification	Species polygon required?
				November, December			1181, 1245, 1250, 1395, 1804.	No trees with large stick nests were detected within the direct impact areas.		targeted survey not completed across the wider Subject Land.	1083, 1181, 1245, 1250, 1395, 1804.
Meridolum corneovirens	Cumberland Plain Land Snail	E	-	All year	Species	No	Associated PCTs include 1395.	This species is not associated with any PCTs that would be subject to direct impacts. Although there are no stated geographic restrictions for the species in the Sydney Cataract IBRA subregion, the species' geographic range is described to extend as far south as Picton in the Sydney Basin, which is approximately 20 km north-west of the Subject Land. The nearest records are approximately 10 km away and appear to mark the southern extent of the species.	No	This species is not associated with any PCTs that would be subject to direct impacts. Although there are no stated geographic restrictions for the species in the Sydney Cataract IBRA subregion, the species' geographic range is described to extend as far south as Picton in the Sydney Basin, which is approximately 20 km north-west of the Subject Land. The nearest records are approximately 10 km away and appear to mark the southern extent of the species.	No
Meridolum maryae	Maroubra Woodland Snail	E	-	All Year	Species	No	Associated PCTs include 1804.	The species has only been recorded as far as 5 km from the coast, however the Subject Land is approximately 20 km from the coast. It is considered very unlikely that the species is present in the Subject Land.	No (vagrant)	The species has only been recorded as far as 5 km from the coast, however the Subject Land is approximately 20 km from the coast. It is considered very unlikely that the species is present in the Subject Land.	No
Miniopterus australis	Little Bentwing- Bat	V	-	December – February	Dual (Breeding)	Yes – if breeding habitat is present	Habitat Constraint for Breeding: Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records in BioNet with observation type code 'E nest-roost' microhabitat code 'IC – in cave' observation type code 'E nest-roost' with numbers of individuals >500 or from the scientific literature within associated PCTs 978, 1083, 1181, 1245, 1250, 1395, 1804.	The species was detected once in proximity to the Subject Land in by Niche in October 2016. There are two other records of the species on BioNet (DPIE 2021) within 5 km of the Subject Land, neither of those indicate that the species was seen in a cave or nest-roost, or in numbers over 500. The species appears to have a limited occurrence in this locality. It is likely that the Subject Land is utilised as foraging and potentially roosting for the species but is unlikely to be utilised as breeding habitat. Areas to be impacted directly do not support any breeding habitat and limited roosting habitat.	No. No potential breeding habitat was detected in direct impact areas during extensive survey.	The species was detected once in proximity to the Subject Land in by Niche in October 2016. There are two other records of the species on BioNet (DPIE 2021) within 5 km of the Subject Land, neither of those indicate that the species was seen in a cave or nest-roost, or in numbers over 500. The species appears to have a limited occurrence in this locality. It is likely that the Subject Land is utilised as foraging and potentially roosting for the species but is unlikely to be utilised as breeding habitat. Areas to be impacted indirectly do not support any breeding	Not required. No potential breeding habitat or occupation of habitats were detected in indirect impact areas during survey.

Scientific Name	Common name	BC Act	EPBC Act	Recommended survey month	Credit status and species credit component	SAII status	Associated PCT and habitat constraints	Assessment of threatened fauna – Biodiversity Assessment Development Footprint		Assessment of threatened fauna within Subject Land	
								Habitat assessment and targeted survey results and justification	Species polygon required?	Assessment of threatened fauna within the wider Subject Land - Habitat assessment and targeted survey results and justification	Species polygon required?
										habitat and limited roosting habitat	
Miniopterus orianae oceanensis	Large Bent-winged Bat	V	-	December – February	Dual (Breeding)	Yes – if breeding habitat is present	Habitat Constraint for Breeding: Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records in BioNet with observation type code 'E nest-roost' microhabitat code 'IC – in cave' observation type code 'E nest-roost' with numbers of individuals >500 or from the scientific literature within associated PCTs 978, 1083, 1181, 1245, 1250, 1395, 1804.	Niche recorded 37 individuals in the survey area in October 2016. There are 21 other records of the species on BioNet (DPIE 2021) within 5 km of the Subject Land, none of those indicate that the species was seen in a cave or nest-roost, or in numbers over 500. It is likely that the Subject Land is utilised as foraging and potentially roosting for the species but is unlikely to be utilised as breeding habitat. Areas to be impacted directly do not support any breeding habitat and limited roosting habitat.	No. No potential breeding habitat was detected in direct impact areas during extensive survey.	Niche recorded 37 individuals in the survey area in October 2016. There are 21 other records of the species on BioNet (DPIE 2021) within 5 km of the Subject Land, none of those indicate that the species was seen in a cave or nest-roost, or in numbers over 500. It is likely that the Subject Land is utilised as foraging and potentially roosting for the species but is unlikely to be utilised as breeding habitat. Areas to be indirectly impacted do not support any breeding habitat and limited roosting habitat	Not required. No potential breeding habitat was detected in indirect impact areas during survey
Mixophyes balbus	Stuttering Frog	E	V	September – March	Species	Yes –Only applies to South Sydney Basin Bioregion and South Coast populations	Associated PCTs include 978, 1181, 1245, 1250.	Despite extensive surveys undertaken since 2016, the species has not been recorded by Niche in the survey area. The species is not known to occur in the Sydney Cataract IBRA sub-region and there are no nearby records of the species, with the closest being 20 km south at Macquarie Pass National Park. As such, it is considered unlikely that the species inhabits the Subject Land.	No	Despite extensive surveys undertaken since 2016, the species has not been recorded by Niche in the survey area. The species is not known to occur in the Sydney Cataract IBRA sub-region and there are no nearby records of the species, with the closest being 20 km south at Macquarie Pass National Park. As such, it is considered unlikely that the species inhabits the Subject Land.	No
Myotis macropus	Southern Myotis	V	-	October – January	Species	No	Habitat Constraints (breeding): hollow bearing trees and bridges, caves or artificial structures within 200 m of riparian zone with pools/ stretches 3 m or wider. This includes rivers, creeks, billabongs, lagoons, dams and other	Despite surveys undertaken since 2016, the species has not been recorded by Niche in the Subject Land. However, there are 20 records for the species in the locality. Areas of direct impact do not have pools with stretches 3 m wider.	No	The species needs to be assumed to be present as targeted survey not completed across the wider Subject Land.	Yes - assumed to be present within suitably sized watercourses. Species polygon incorporates relevant stream and buffer areas.

Scientific Name	Common name	BC Act	EPBC Act	Recommended survey month	Credit status and species credit component	SAII status	Associated PCT and habitat constraints	Assessment of threatened fauna – Biodiversity Assessment Development Footprint		Assessment of threatened fauna within Subject Land	
								Habitat assessment and targeted survey results and justification	Species polygon required?	Assessment of threatened fauna within the wider Subject Land - Habitat assessment and targeted survey results and justification	Species polygon required?
							waterbodies on or within 200 m of the site.				
Ninox strenua	Powerful Owl	V	-	May, June, July, August	Dual (Breeding)	No	Habitat constraints: hollow bearing trees; Living or dead trees with hollow greater than 20cm diameter and greater than 4 m above the ground within associated PCTs 1083, 1181, 1245, 1250 and 1395.	Not recorded roosting or breeding within areas of potential breeding habitat.	No	The species needs to be assumed to be present as targeted survey not completed across the entirety of the wider Subject Land.	Yes - assumed to be present within associated PCTs 1083, 1181, 1245, 1250 and 1395.
Pandion cristatus	Eastern Osprey	V	-	April to November	Dual (Breeding)	No	Habitat constraints include the presence of stick-nests in living and dead trees (>15 m) or artificial structures within 100 m of a floodplain for nesting within associated PCTs 978, 1083, and 1250.	The species was not recorded during targeted survey. No trees with large stick nests were detected within the direct impact areas.	No	The species needs to be assumed to be present as targeted survey not completed across the wider Subject Land.	Yes - assumed to be present within associated PCTs 978, 1083, and 1250.
Petalura gigantea	Giant Dragonfly	E	-	January - December	Species	Yes	Habitat constraints include swamps and within 500 m of swamps within associated PCT 978.	No habitat.	No	Yes, targeted assessment completed by Cardno (2022). Species known to occur in Subject Land.	Yes
Petauroides volans	Greater Glider	-	V	All Year	Species	No	Habitat constraint of hollow bearing trees within associated PCTs 1083, 1181, 1245, 1250, and 1395.	Recorded outside of direct impact areas but not within impacted areas despite extensive survey.	No	The species needs to be assumed to be present as targeted survey not completed across the entirety of the wider Subject Land.	Yes - assumed to be present within associated PCTs 1083, 1181, 1245, 1250, and 1395.
Petaurus norfolcensis	Squirrel Glider	V	-	All year	Species	No	Associated PCTs include 1083, 1181, 1250, and 1395. Relies on large old trees with hollows for breeding and nesting.	Not recorded during survey or from the locality.	No	Not recorded during survey across the Subject Land. No records in the locality. Not recorded previously during assessments associated with Dendrobium. Unlikely to be present.	No
Pezoporus wallicus wallicus	Eastern Ground Parrot	V	-	All Year	Species	No	Associated PCTs include 978, and 1804.	Extensive bird surveys conducted in swamp habitat and areas subject to clearing have not recorded the species. Closest record 25 km south.	No	No – the linked PCTs have been surveyed and the species not recorded.	No

Scientific Name	Common name	BC Act	EPBC Act	Recommended survey month	Credit status and species credit component	SAII status	Associated PCT and habitat constraints	Assessment of threatened fauna – Biodiversity Assessment Development Footprint		Assessment of threatened fauna within Subject Land	
								Habitat assessment and targeted survey results and justification	Species polygon required?	Assessment of threatened fauna within the wider Subject Land - Habitat assessment and targeted survey results and justification	Species polygon required?
Phascolarctos cinereus	Koala	V	V[12]	All Year	Dual (Important habitat)	No	Habitat constraints includes areas identified via survey as important habitat ('Important' habitat is defined by the density of Koalas and quality of habitat determined by on-site survey) within associated PCTs 1083, 1181, 1245, 1250, 1395, and 1804.	Extensive surveys for Koalas did not detect the species within the proposed Ventilation Shaft Site which is where most direct impacts would occur. However, several observations of the species have been made in adjacent habitats. The proposed Ventilation Shaft Site has been considered to be low quality habitat based on lack of Koala use the landscape position and prevailing soil types, however, on a conservative basis the site is considered important habitat.	Yes	The species needs to be assumed to be present as targeted survey not completed across the wider Subject Land.	Yes - assumed to be present within associated PCTs 1083, 1181, 1245, 1250, 1395, and 1804
Pseudophryne australis	Red-crowned Toadlet	V	-	All Year	Species	No	Associated PCTs include 978, 1083, 1181, 1245, 1250, 1395, and 1804.	Clearing of potential breeding and sheltering habitat primarily around creeks.	Yes. Limited clearing impacts. A species polygon has been provided to address direct impacts.	The species is known to occur and has been assumed to be present throughout relevant stream and buffer areas.	Yes - assumed to be present within associated PCTs 978, 1083, 1181, 1245, 1250, 1395, and 1804
Pteropus poliocephalus	Grey-headed Flying Fox	V	V	October, November, December	Dual (Breeding)	No	Habitat constraints include breeding camps within associated PCTS 978, 1083, 1181, 1245, 1250, 1395, and 1804.	This species was observed flying over the Project area and foraging in trees within the Subject Land, however there are no breeding camps that would be impacted by the Project.	No	This species was observed flying over the Subject Land and foraging in trees within the Subject Land, however there are no breeding camps that would be impacted by the Project.	No
Tyto novaehollandiae	Masked Owl	V	-	May - August	Dual (Breeding)	No	Habitat constraints include hollow bearing trees; living or dead trees with hollows greater than 20cm diameter within associated PCTs 1083, 1181, 1245, 1250, and 1395.	Not detected during survey. Not considered to occur.	No	The species needs to be assumed to be present as targeted survey not completed across the entirety of the wider Subject Land.	Yes - assumed to be present within associated PCTs 1083, 1181, 1245, 1250, and 1395
Tyto tenebricosa	Sooty Owl	V	-	April - August	Dual (Only for cave breeding habitat to be		Habitat constraints include caves or cliff-lines/ledges, and hollow bearing trees; Living or dead trees with hollows greater than 20cm	Not detected during survey. Not considered to occur.	No	The species needs to be assumed to be present as targeted survey not completed across the entirety of the wider Subject Land.	Yes - assumed to be present within associated PCTs 1245, 1250, and 1395.

[12] *Listed as 'Vulnerable' under the EPBC Act at the time of the "controlled action" decision (13 January 2022) and therefore assessed as 'Vulnerable' rather than 'Endangered' (refer section 158A of the EPBC Act).*

Scientific Name	Common name	BC Act	EPBC Act	Recommended survey month	Credit status and species credit component	SAII status	Associated PCT and habitat constraints	Assessment of threatened fauna – Biodiversity Assessment Development Footprint		Assessment of threatened fauna within Subject Land	
								Habitat assessment and targeted survey results and justification	Species polygon required?	Assessment of threatened fauna within the wider Subject Land - Habitat assessment and targeted survey results and justification	Species polygon required?
					identified by survey)		diameter within associated PCTs 1245, 1250, and 1395.				

Legend: V = Vulnerable, E = Endangered, CE = Critically Endangered listing status under the BC Act and/or EPBC Act

2.6.5 Results – threatened fauna

Based on the results of the candidate analysis and associated surveys and analysis, five threatened fauna (species credits) were deemed to have habitat within the Biodiversity Assessment Development Footprint:

- Eastern Pygmy-possum (*Cercartetus nanus*).
- Gang-gang Cockatoo (*Callocephalon fimbriatum*).
- Koala (*Phascolarctos cinereus*).
- Large-eared Pied Bat (*Chalinolobus dwyeri*).
- Southern Myotis (*Myotis macropus*).

A further 19 threatened fauna (species credits) have been assumed to have habitat within the Subject Land (Table 26). Many of these species have been assumed present, purely due to the inability to survey the area per relevant guidelines given the size of the Subject Land.

2.6.6 Threatened fauna species polygons

A species polygon for each of the species likely to occur has been generated.

A species polygon for each threatened fauna have been derived from the associated PCTs and associated habitat requirements specified in the TBDC. Details of the species polygon are provided in Table 26 and shown on the associated figure.

The portion of the species polygon that may be impacted by direct and/or indirect impacts assessed in section 4.

Table 26. Threatened fauna species polygons

Candidate fauna species	Species polygon requirements	Figure reference
Callocephalon fimbriatum Gang-gang Cockatoo	Polygon formed from the entire extent of associated PCTs 1083, 1250, 1181, 1395 and 1804. The species polygon does not extend into the Biodiversity Assessment Development Footprint.	Figure 14a
Calyptorhynchus lathami Glossy Black-Cockatoo	Polygon formed from the entire extent of associated PCTs 1083, 1181, 1245, 1250 and 1395. The species polygon does not extend into the Biodiversity Assessment Development Footprint.	Figure 14b
Cercartetus nanus Eastern Pygmy-possum	Polygon formed from the entire extent of associated PCTs 1083, 1181, 1245, 1250 and 1395.	Figure 14c
Chalinolobus dwyeri Large-eared Pied Bat	Polygon formed from the entire extent of associated PCTs 1083, 1181, 1245, 1250 and 1395 as all occur within 2 km of rocky areas containing caves, overhangs, outcrops, or crevices. The species polygon does not extend into the Biodiversity Assessment Development Footprint.	Figure 14d
Haliaeetus leucogaster White-bellied Sea-Eagle	Polygon formed from the entire extent of associated PCTs 978, 1083, 1181, 1250, 1395 and 1804. The species polygon does not extend into the Biodiversity Assessment Development Footprint.	Figure 14e
Heleioporus australiacus Giant Burrowing Frog	Polygon formed from relevant stream buffer areas of associated PCTs 978, 1083, 1181, 1245, 1250, 1395, 1804. The species polygon does not extend into the Biodiversity Assessment Development Footprint.	Figure 14f
Hieraaetus morphnoides Little Eagle	Polygon formed from the entire extent of associated 978, 1083, 1181, 1245, 1250, 1395, 1804. The species polygon	Figure 14g

Candidate fauna species	Species polygon requirements	Figure reference
	does not extend into the Biodiversity Assessment Development Footprint.	
Hoplocephalus bungaroides Broad-headed Snake	Polygon formed from relevant buffer areas of prescribed rocky habitat within associated PCTs.	Figure 14h
Litoria littlejohni Littlejohn's Tree Frog	Polygon formed from relevant stream buffer areas of associated PCTs 978, 1083, 1181, 1245, 1250, 1395, and 1804. The species polygon does not extend into the Biodiversity Assessment Development Footprint.	Figure 14i
Lophoictinia isura Square-tailed Kite	Polygon formed from the entire extent of associated PCTs 1083, 1181, 1245, 1250, 1395, 1804. The species polygon does not extend into the Biodiversity Assessment Development Footprint.	Figure 14j
Myotis macropus Southern Myotis	Polygon formed from relevant stream buffer areas of associated PCTs. The species polygon does not extend into the Biodiversity Assessment Development Footprint.	Figure 14k
Ninox strenua Powerful Owl	Polygon formed from the entire extent of associated PCTs 1083, 1181, 1245, 1250 and 1395. The species polygon does not extend into the Biodiversity Assessment Development Footprint.	Figure 14l
Pandion cristatus Eastern Osprey	Polygon formed from the entire extent of associated PCTs 978, 1083, and 1250. The species polygon does not extend into the Biodiversity Assessment Development Footprint.	Figure 14m
Petalura gigantea Giant Dragonfly	Polygon formed includes the three swamps deemed suitable breeding and foraging habitat for the Giant Dragonfly by Cardno (2022) and Invertebrate Identification Australia (2019, 2020), as well as swamps within 500 m of potential or known breeding	Figure 14n
Petauroides Volans Greater Glider	Yes - assumed to be present within associated PCTs 1083, 1181, 1245, 1250, and 1395.	Figure 14l
Phascolarctos cinereus Koala	Polygon formed from the entire extent of associated PCTs 1083, 1181, 1245, 1250, 1395, and 1804.	Figure 14o
Pseudophryne australis Red-crowned Toadlet	Polygon formed from relevant stream buffer areas of associated PCTs 978, 1083, 1181, 1245, 1250, 1395, 1804. The species polygon does not extend into the Biodiversity Assessment Development Footprint.	Figure 14p
Tyto novaehollandiae Masked Owl	Polygon formed from the entire extent of associated PCTs 978, 1083, 1181, 1245, 1250, 1395, and 1804. The species polygon does not extend into the Biodiversity Assessment Development Footprint.	Figure 14q
Tyto tenebricosa Sooty Owl	Polygon formed from the entire extent of associated PCTs 1245, 1250, and 1395. The species polygon does not extend into the Biodiversity Assessment Development Footprint.	Figure 14r

2.6.7 Matters of National Environmental Significance – fauna

A total of 67 EPBC Act listed fauna were considered in the assessment based on the database reviews detailed in section 2.2.1 (Appendix 2).

Each of the species from the PMST have been assessed in terms of their likelihood to occur within the Subject Land (Appendix 2) and incorporated to the candidate species list for assessment where there is a high or known likelihood to occur. Threatened fauna specifically addressed in the SEARs include: Grey-

headed Flying Fox, Littlejohn's Tree Frog, Koala, Greater Glider, Giant Burrowing Frog, Broad-headed Snake, Large-eared Pied Bat, and Swift Parrot which have been assessed accordingly in Appendix 2.

As discussed in section 2.6.3, four threatened fauna listed on the EPBC Act were recorded during the field survey:

- Greater Glider (vulnerable).
- Grey-headed Flying-fox (vulnerable).
- Koala (vulnerable[13]).
- Littlejohn's Tree Frog (vulnerable[13]).

In addition to the above species, the field survey and the results of the likelihood of occurrence (Appendix 2 and subsequent assessment of Candidate species) concluded that following Commonwealth threatened fauna may also utilise the Subject Land:

Threatened fauna that are regarded as 'species credit' fauna:

- Eastern Bristlebird (endangered).
- Southern Brown Bandicoot (eastern) (endangered).
- Large-eared Pied Bat (vulnerable).
- Giant Burrowing Frog (vulnerable).
- Broad-headed Snake (vulnerable).
- Littlejohn's Tree Frog (vulnerable[13]).
- Stuttering Frog (vulnerable).
- Greater Glider (vulnerable).
- Koala (vulnerable[13]).

Threatened fauna that are regarded as Ecosystem credit fauna (assumed in the BAM-C as being present based on PCTs) (Table 13):

- Spotted-tailed Quoll (endangered).
- Grey-headed Flying-fox (vulnerable).
- Broad-headed Snake (vulnerable).
- Swift Parrot (critically endangered).
- Regent Honeyeater (critically endangered).
- Koala (vulnerable[13]).
- New Holland Mouse (vulnerable).

EPBC Act listed threatened fauna that have been assumed to be present within the Biodiversity Assessment Development Footprint include: Koala, and Large-eared Pied Bat. Direct impacts to these species are detailed in section 4.

In regard to EPBC Act listed Migratory species, none were recorded within the Subject Land, however the Satin Flycatcher (*Myiagra cyanoleuca*) was recorded during surveys outside of the Subject Land.

[13] *Listed as 'Vulnerable' under the EPBC Act at the time of the "controlled action" decision (13 January 2022) and therefore assessed as 'Vulnerable' rather than 'Endangered' (refer section 158A of the EPBC Act).*

A number of listed migratory species have been recorded from the locality and in some cases have the potential to fly over the Subject Land. Species that may occasionally forage within the Subject Land include: Fork-tailed Swift (*Apus pacificus*), Satin Flycatcher (*Myiagra cyanoleuca*), Black-faced Monarch (*Monarcha melanopsis*), Spectacled Monarch (*Monarcha trivirgatus*), and Rufous Fantail (*Rhipidura rufifrons*).

The species above have been assessed further in section 4.10 in regard to the Commonwealth Assessment Criteria.

2.7 Prescribed entities

Prescribed biodiversity impacts are impacts on biodiversity values in addition to, or instead of, impacts from clearing vegetation and/or loss of habitat. Prescribed additional biodiversity impacts (prescribed impacts) must be assessed as part of the BOS, as per clause 6.1 of the BC Regulation. Such prescribed impacts (including direct and indirect impacts) are impacts:

(a) the impacts of development on the following habitat of threatened species or ecological communities—
(i) karst, caves, crevices, cliffs and other geological features of significance,
(ii) rocks,
(iii) human made structures,
(iv) non-native vegetation,
(b) the impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range,
(c) the impacts of development on movement of threatened species that maintains their lifecycle,
(d) the impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including from subsidence or upsidence resulting from underground mining or other development),
(e) the impacts of wind turbine strikes on protected animals,
(f) the impacts of vehicle strikes on threatened species of animals or on animals that are part of a threatened ecological community.

An analysis of threatened species that have been confirmed/assumed to have presence within the Subject Land, in respect to the prescribed impacts above, has been provided in Table 27. For those threatened species that occur within areas that may be subject to prescribed impacts, they have been discussed in detail below.

Table 27. Analysis of threatened biodiversity assumed/confirmed as present in Subject Land in relation to prescribed impacts

Scientific name	Common name	BC Act Status	EPBC Act Status	Associated PCTs and habitat constraints	Geographic limitations specified in BAM-C	Is the species likely to use habitat associated with a prescribed biodiversity impact feature?	Species requires further consideration?
Threatened flora							
Acacia baueri subsp. *aspera*	*Acacia baueri* subsp. *aspera*	V	-	978; 1083	-	The species was not detected during field surveys. The species has not been detected in the locality by other exploration or monitoring projects undertaken by IMC. The closest known record is over 11 km to the east of the Subject Land which was recorded in 1969 associated with Mount Kiera road upgrades. The TBCD (2021) states that the species is 'occurs in low, damp heathlands, often on exposed rocky outcrops over a wide range of climatic and topographical conditions'. Exposed rocky outcrop within heathlands are unlikely to be impacted by subsidence. The species is unlikely to occur on the edge of cliffs, nor within watercourses. The swamp habitat (despite being associated with PCT978) does not fit the habitat description in the TBCD (2021). The potential habitat for this species within the Subject Land is relatively stable, not considered a GDE and therefore, it is not considered susceptible to subsidence. In light of the above, and the records for the species, it is of low likelihood to occur within subsidence sensitive habitat.	Not considered further.
Acacia bynoeana	Bynoe's Wattle	E	V	1083; 1181; 1250; 1395	-	The species was not detected within during field surveys detailed in section 2.5.1. Potential habitat for the species is not within Coastal Upland Swamps, watercourses or on the edge of clifflines. Occurs in heath or dry sclerophyll forest on sandy soils, which does not typically fit the Coastal Upland Swamp soil type nor the permanent watercourses. The species was not detected in such features during the field survey. The species has therefore been considered unlikely to have habitat within Coastal Upland Swamps, watercourses and on the edge of clifflines within the Subject Land. The potential habitat for this species within the Subject Land is relatively stable, not considered a GDE and therefore, it is not considered susceptible to subsidence.	Not considered further.
Acacia pubescens	Downy Wattle	V	V	1083; 1181; 1395		Species not detected during field surveys, and not known from the locality. Furthermore, the records for the nearest species is over 30 km to the north. Given the extensive biodiversity work completed throughout the locality, it may be reasonable to suggest that if suitable habitat was present, there would be recent records within locality. The species has therefore been considered to have a low likelihood of occurrence within habitat within Coastal Upland Swamps, watercourses and on the edge of clifflines within the Subject Land. The potential habitat for this species within the Subject Land is relatively stable, not considered a GDE and therefore, it is not considered susceptible to subsidence.	Not considered further.
Astrotricha crassifolia	*Thick-leaf Star-hair*	V	V	1083; 1181; 1250; 1395		Species not detected during field surveys. The species is known from two populations - Brisbane Water and Woronora. Brisbane Water population is Sterile or primarily clonal. It is unknown if the Woronora population produces viable seed, currently only mature plants and resprouters present (TBDC). The Thick-leaf Star-hair grows on dry ridgetops to 300 m altitude (Benson & McDougall 1993) and is associated with very rich heath, or dry sclerophyll woodland (Harden 1992). The Subject Land is greater than 300 m in elevation. The species has therefore been considered to have a low likelihood of occurrence within habitat within Coastal Upland Swamps, watercourses and on the edge of clifflines within the Subject Land. The potential habitat for this species within the Subject Land is relatively stable, not considered a GDE and therefore, it is not considered susceptible to subsidence.	Not considered further.
Caesia parviflora var. *minor*	Small Pale Grass-lily	E	-	1083; 1395		The species is not associated with Coastal Upland Swamps, nor is associated with habitat within watercourses and on the edge of clifflines. Species not detected during field surveys, and not known from the locality. Furthermore, the records for the nearest species is over 40 km to the north. Given the extensive biodiversity work completed throughout the locality, it may be reasonable to suggest that if suitable habitat was present, there would be recent and closer records within locality. The potential habitat associated with this this species within the Subject Land is relatively stable, not considered a GDE and therefore, it is not considered susceptible to subsidence.	Not considered further.

Scientific name	Common name	BC Act Status	EPBC Act Status	Associated PCTs and habitat constraints	Geographic limitations specified in BAM-C	Is the species likely to use habitat associated with a prescribed biodiversity impact feature?	Species requires further consideration?
Caladenia tessellata	Thick Lip Spider Orchid	E	V	1083; 1181; 1250; 1395	-	As per the TBCD (2021), the species has records from the Sydney area (old records), Wyong, Ulladulla and Braidwood in NSW. Populations in Kiama and Queanbeyan are presumed extinct. No known records for the species occur near the Subject Land. Furthermore, in New South Wales, the species is generally found in grassy dry sclerophyll woodland on clay loam or sandy soils, less commonly in heathland on sandy loam soils. Species not detected during field surveys, and not known from the locality. Furthermore, no records for the species within the locality, and nearest records are towards Kiama. The potential habitat for this species within the Subject Land is relatively stable, not considered a GDE and therefore, it is not considered susceptible to subsidence.	Not considered further.
Callistemon linearifolius	Netted Bottle Brush	V	-	1083; 1181; 1250; 1395	-	Species not detected during field surveys. Based on its habitat preference, it is unlikely to occur within Coastal Upland Swamps, within watercourses, or on the edge of clifflines. The potential habitat for this species within the Subject Land is relatively stable, not considered a GDE and therefore, it is not considered susceptible to subsidence.	Not considered further.
Cryptostylis hunteriana	Leafless Tongue Orchid	V	V	978; 1083	-	*Cryptostylis hunteriana* is associated with PCT978 in the TBCD (2021). As field surveys as per the DPIE (2020) Plant Survey Guidelines could not cover the entire area of the Coastal Upland Swamps, the species cannot be dismissed from potentially being present within PCT978. If present, the species would likely occupy the drier portions of the swamps, such as Restioid-Heath and areas of Eucalypt Fringing Woodland as the species appear to not be associated with waterlogged environments (ie. Teatree Thicket).	Considered further given may have habitat within Coastal Upland Swamps.
Deyeuxia appressa	Deyeuxia appressa	E	E	1083		A highly restricted NSW endemic known only from two pre-1942 records in the Sydney area. Was first collected in 1930 at Herne Bay, Saltpan Creek, off the Georges River, south of Bankstown. Was then collected in 1941 from Killara, near Hornsby. Has not been collected since and may now be extinct in the wild due to the level of habitat loss and development that has occurred within these areas. Given that D. appressa hasn't been seen in over 60 years, almost nothing is known of the species' habitat and ecology. The species has not been recorded during the field campaigns associated with the Project, monitoring campaigns. Furthermore, it has not been detected in the locality despite the significant amount of biodiversity assessments completed. Therefore, we deem the species unlikely to occur. The potential habitat for this species within the Subject Land is relatively stable, not considered a GDE and therefore, it is not considered susceptible to subsidence.	Not considered further.
Epacris purpurascens var. *purpurascens*	*Epacris purpurascens* var. *purpurascens*	V	-	1083; 1181; 1395	-	*Epacris purpurascens var. purpurascens is* associated with PCT978 in the TBCD (2021). As field surveys as per the DPIE (2020) Plant Survey Guidelines could not cover the entire area of the Coastal Upland Swamps, the species cannot be dismissed from potentially being present within PCT978. The species has been previously recorded in Coastal Upland Swamps within the locality and is likely to utilise the drier portion of the swamp.	Considered further given may have habitat within Coastal Upland Swamps.
Eucalyptus camfieldii	Camfield's Stringybark	V	V	1083; 1183; 1250	-	The species was not detected during targeted survey. Unlikely to be present and have habitat within subsidence sensitive habitat. The potential habitat for this species within the Subject Land is relatively stable, not considered a GDE and therefore, it is not considered susceptible to subsidence.	Not considered further.
Genoplesium baueri	Bauer's Midge Orchid	E	E	1083	-	As discussed in adjacent column, the species is associated with PCT1083 which occupies 1187 ha within the Subject Land. The vegetation that is sensitive to subsidence is associated with the riparian vegetation, swamps and on the edges of cliff faces which this species is not associated. The potential habitat for this species within the Subject Land is relatively stable, not considered a GDE and therefore, it is not considered susceptible to subsidence.	Not considered further.
Grevillea parviflora subsp. *parviflora*	Small-flower Grevillea	V	V	978; 1083; 1395	-	The species was not detected during the field survey. Unlikely to be present and have habitat within subsidence sensitive habitat ie. unlikely to occur on the edge of cliffs, within watercourses or within swamps. The potential habitat for this species within the Subject Land is relatively stable, not considered a GDE and therefore, it is not considered susceptible to subsidence.	Not considered further.
Grevillea raybrownii	*Grevillea raybrownii*	V	V	1083; 1181	-	The species was not detected during the field survey. Unlikely to be present and have habitat within subsidence sensitive habitat ie. unlikely to occur on the edge of cliffs, within watercourses or within swamps. The potential habitat for this species within the Subject Land is relatively stable, not considered a GDE and therefore, it is not considered susceptible to subsidence.	Not considered further.

Scientific name	Common name	BC Act Status	EPBC Act Status	Associated PCTs and habitat constraints	Geographic limitations specified in BAM-C	Is the species likely to use habitat associated with a prescribed biodiversity impact feature?	Species requires further consideration?
Helichrysum calvertianum	*Helichrysum calvertianum*	V	-	1083; 1181	-	The species was not detected during the field survey. Unlikely to be present and have habitat within subsidence sensitive habitat ie. unlikely to occur on the edge of cliffs, within watercourses or within swamps. The potential habitat for this species within the Subject Land is relatively stable, not considered a GDE and therefore, it is not considered susceptible to subsidence.	Not considered further.
Hibbertia puberula	*Hibbertia puberula*	E	-	978; 1083; 1181; 1250; 1395	-	The species is also described in the TBCD (2021) as 'Occurs on sandy soil often associated with sandstone, or on clay… Habitats are typically dry sclerophyll woodland communities, although heaths are also occupied'. No known populations within 10 km of the Subject Land. The species was not detected during the field survey. Unlikely to be present and have habitat within subsidence sensitive habitat ie. unlikely to occur on the edge of cliffs, within watercourses or within swamps. The potential habitat for this species within the Subject Land is relatively stable, not considered a GDE and therefore, it is not considered susceptible to subsidence.	Not considered further.
Hibbertia stricta subsp. *furcatula*	*Hibbertia stricta* subsp. *furcatula*	E	-	1083; 1181; 1250	-	Habitats are typically dry sclerophyll woodland communities. The species is not associated with watercourses or known to occur on edge of cliff lines. The plant has not been recorded in upland swamps or has been recorded during the swamp monitoring. The potential habitat for this species within the Subject Land is relatively stable, not considered a GDE and therefore, it is not considered susceptible to subsidence.	Not considered further.
Leucopogon exolasius	Woronora Beard-heath	V	V	1083; 1181; 1250	-	The species was not detected during the field survey. Unlikely to be present and have habitat within subsidence sensitive habitat ie. unlikely to occur on the edge of cliffs, within watercourses or within swamps. The potential habitat for this species within the Subject Land is relatively stable, not considered a GDE and therefore, it is not considered susceptible to subsidence.	Not considered further.
Leucopogon fletcheri subsp. *fletcheri*	*Leucopogon fletcheri* subsp. *fletcheri*	E	-	1083; 1181; 1395	-	Highly unlikely. The species occurs in dry eucalypt woodland or in shrubland on clayey lateritic soils. The ridgeline environments are sandstone. The species is not known to occur in swamps or watercourses. Not detected during survey, nor has the species been recorded in the locality. The potential habitat for this species within the Subject Land is relatively stable, not considered a GDE and therefore, it is not considered susceptible to subsidence.	Not considered further.
Melaleuca deanei	Deane's Paperbark	V	V	1083; 1181; 1250; 1395	-	As noted in the TBCD (2021), the species occurs in two distinct areas, in the Ku-ring-gai/Berowra and Holsworthy/Wedderburn areas respectively. There are also more isolated occurrences at Springwood (in the Blue Mountains), Wollemi National Park, Yalwal (west of Nowra) and Central Coast (Hawkesbury River) areas. The TBCD (2021) notes that the 'species occurs mostly in ridgetop woodland, with only 5% of sites in heath on sandstone.' The species is not associated with swamp or watercourse habitat. The potential habitat for this species within the Subject Land is relatively stable, not considered a GDE and therefore, it is not considered susceptible to subsidence.	Not considered further.
Persoonia acerosa	Needle Geebung	V	V	1083; 1181	-	The species is unlikely to occur within habitat sensitive to subsidence. The species was not detected during the survey, nor has been previously recorded within swamp monitoring campaigns, or has records within the locality. The potential habitat for this species within the Subject Land is relatively stable, not considered a GDE and therefore, it is not considered susceptible to subsidence.	Not considered further.
Persoonia bargoensis	Bargo Geebung	E	V	1083; 1181; 1250; 1395	-	The species is unlikely to occur within habitat sensitive to subsidence. The species was not detected during the survey, nor has been previously recorded within swamp monitoring campaigns, or has records within the locality. The species is typically located within Bargo NSW. The potential habitat for this species within the Subject Land is relatively stable, not considered a GDE and therefore, it is not considered susceptible to subsidence.	Not considered further.
Persoonia hirsuta	Hairy Geebung	E	E	1083; 1181; 1250; 1395	-	The species is unlikely to occur within habitat sensitive to subsidence. The species was not detected during the survey, nor has been previously recorded within swamp monitoring campaigns, or has records within the locality. The potential habitat for this species within the Subject Land is relatively stable, not considered a GDE and therefore, it is not considered susceptible to subsidence.	Not considered further.

Scientific name	Common name	BC Act Status	EPBC Act Status	Associated PCTs and habitat constraints	Geographic limitations specified in BAM-C	Is the species likely to use habitat associated with a prescribed biodiversity impact feature?	Species requires further consideration?
Persoonia nutans	Nodding Geebung	E	E	1395	-	The species is unlikely to occur within habitat sensitive to subsidence. The species was not detected during the survey, nor has been previously recorded within swamp monitoring campaigns, or has records within the locality. The potential habitat for this species within the Subject Land is relatively stable, not considered a GDE and therefore, it is not considered susceptible to subsidence.	Not considered further.
Pomaderris adnata	Sublime Point Pomaderris	E	-	1083	-	The species is Known only from one site at Sublime Point, north of Wollongong. The species was not detected during the survey, nor has been previously recorded within swamp monitoring campaigns, or has records within the locality. The potential habitat for this species within the Subject Land is relatively stable, not considered a GDE and therefore, it is not considered susceptible to subsidence.	Not considered further.
Pomaderris brunnea	Brown Pomaderris	E	V	1181; 1395	-	The species may have habitat immediately adjacent to the riparian areas within the Subject Land. The species has been previously recorded within 2 km of the Subject Land so has been assessed on a precautionary basis as occupying gully environments adjacent to riparian areas.	Considered further.
Prasophyllum fuscum	Slaty Leek Orchid	CE	V	978; 1181; 1395; 1804	-	The TBCD (2021) and available information do not provide great certainty on the validity of previous records. For example, the TBCD (2021) notes: - 'The type specimen is from "moist meadows towards the Georges River" in the Sydney area. The species is likely to be extinct from this area. - Harden (1993) states that it is confined to the Blue Mountains area. However, some authorities believe Prasophyllum species from this area are not P. fuscum, but an undescribed species. - Some authorities believe it is identical to P. uroglossum which occurs in the Wingecarribee area.' The above makes it difficult to conclude much about the known distribution of the species, however based on a literature review, the species has a very restricted range. The Scientific Determination for the species notes that the total population, based on a single observation in 2007, is estimated to be approximately 25 mature individuals. The only recent collection of the species is from a roadside in the Wilton district. It is currently known from a single population and has an area of occupancy of no more than 4 km2 based on the species occupying a single 2 x 2 km grid, the spatial scale recommended for assessing areas of occupancy. Based on the above highly restricted distribution, is seems unlikely that the species would occur within swamps, within watercourses or on the edge of cliffs.	Not considered further.
Prostanthera densa	Villous Mint-bush	V	V	1083; 1181; 1250;	-	Highly unlikely to be present within the Subject Land given the species occurs in habitat near coastal headlands and near coastal ranges, chiefly on sandstone, and rocky slopes near the sea. The potential habitat for this species within the Subject Land is relatively stable, not considered a GDE and therefore, it is not considered susceptible to subsidence.	Not considered further.
Pterostylis saxicola	Sydney Plains Greenhood	E	E	1083; 1181; 1250; 1395	-	Habitat for the species may occur within PCT1395 within the Subject Land, given the soils of the PCT are associated with transitional/shale soils. PCT1395 is however located away from clifflines, and as such, does not match the TBCD (2021) habitat requirements. The potential habitat for this species within the Subject Land is relatively stable, not considered a GDE and therefore, it is not considered susceptible to subsidence.	Not considered further.
Pultenaea aristata	Prickly Bush-pea	V	V	978; 1083; 1804	-	*Pultenaea aristata* is associated with PCT978 in the TBCD (2021). As field surveys as per the DPIE (2020) Plant Survey Guidelines could not cover the entire area of the Coastal Upland Swamps, the species cannot be dismissed from potentially being present within PCT978. The species has been previously recorded in Coastal Upland Swamps within the locality and is likely to be associated with the drier portion of swamps.	Considered further.
Threatened fauna							
Burhinus grallarius	Bush-stone Curlew	E	-	Habitat constraints include fallen/standing dead timber including logs within associated PCTs 1250, 978, 1181, 1395 and 1804.	-	The species is associated with PCT978 which correspond to Coastal Upland Swamps, and PCT1395 which is Shale Sandstone Transition Forest. However, key habitats for this species include open forests and woodlands with a sparse grassy groundlayer and fallen timber. Whilst the species may be a transient visitor to areas of Upland Swamps, the important habitat features (ie fallen timber) are not considered susceptible to potential subsidence impacts. Fallen timber and logs would remain within all vegetation types across the Subject Land.	Not considered further.

Scientific name	Common name	BC Act Status	EPBC Act Status	Associated PCTs and habitat constraints	Geographic limitations specified in BAM-C	Is the species likely to use habitat associated with a prescribed biodiversity impact feature?	Species requires further consideration?
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	Habitat constraints are trees with suitable breeding hollows within associated PCTs 1250, 1181, 1395 and 1804. Hollow prescription: Eucalypt tree species with hollows greater than 9 cm diameter.	-	Key habitat constraints in the form of breeding hollows for this species are not considered susceptible to potential subsidence impacts.	Not considered further.
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-	Habitat constraints are trees with suitable breeding hollows within associated PCTs 1083, 1181, 1245, 1250 and 1395. Species also requires Allocasuarina and Casuarina feed trees for foraging habitat to be identified. Hollow prescription: living or dead trees with hollows greater than 15cm diameter and greater than 8 m above ground).	-	Key habitat constraints in the form of breeding hollows for this species are not considered susceptible to potential subsidence impacts.	Not considered further.
Cercartetus nanus	Eastern Pygmy-possum	V	-	Associated PCTs include 1083, 1181, 1245, 1250 and 1395.	-	This species is found in a broad range of habitats from rainforest through sclerophyll forest and woodland to heath. Habitats within Coastal Upland Swamps, may be susceptible to potential subsidence impacts.	Considered further.
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Habitat constraints are habitat within 2 km of rocky areas containing caves, overhangs, outcrops or crevices within associated PCTs 1083, 1181, 1245, 1250 and 1395.	-	The species was not recorded during the targeted surveys within the Biodiversity Assessment Development Footprint; however, the species is associated with all vegetation types that occur within the Subject Land, and the Subject Land is located within 2km of rocky areas. As such, its presence cannot be excluded. It is likely that the species may forage within the Subject Land, however the lack of records during the survey, and the lack of historic records, may reasonably suggest that the species does not have a breeding site nearby. We have assessed this species on the precaution that it may forage within the area and could potentially have some habitat with crevices of the Subject Land.	Considered further.
Dasyornis brachypterus	Eastern Bristlebird	E	E	Associated PCTs include 978 and 1083.	-	Key habitats for the Eastern Bristlebird include dense, low vegetation including heath, and open woodland with a heathy understorey. While one of the PCT associations corresponds to Coastal Upland Swamps and is susceptible to potential subsidence impacts, it is considered unlikely that any impacts would contribute to an overall change to the structure of the community such that it would impact upon habitat for the Eastern Bristlebird.	Not considered further.
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	-	Habitat constraints include Waterbodies and living or dead trees within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines within associated PCTs 978, 1083, 1181, 1250, 1395 and 1804. Breeding habitat is live large old trees AND the presence of a large stick nest within tree canopy; or an adult with nest material; or adults observed duetting within breeding period.	-	Key habitat constraints for this species such as large live or dead trees in proximity to waterways and waterbodies, are not considered susceptible to potential subsidence impacts. Neither are its key prey species which include fish, freshwater turtles, waterbirds, reptiles, mammals and carrion.	Not considered further.

Scientific name	Common name	BC Act Status	EPBC Act Status	Associated PCTs and habitat constraints	Geographic limitations specified in BAM-C	Is the species likely to use habitat associated with a prescribed biodiversity impact feature?	Species requires further consideration?
Heleioporus australiacus	Giant Burrowing Frog	V	V	Associated PCTs include 978, 1083, 1181, 1245, 1250, 1395, 1804.	-	Potential to occur within Coastal Upland Swamps and waterways within the Subject Land.	Considered further.
Hieraaetus morphnoides	Little Eagle	V	-	Habitat constraints include nest trees - live (occasionally dead) large old trees within vegetation within associated PCTs 978, 1083, 1181, 1245, 1250, 1395, 1804.	-	Key habitat constraints for this (nest trees) are not considered susceptible to potential subsidence impacts. Neither are its key prey species which include birds, reptiles and mammals.	Not considered further.
Hoplocephalus bungaroides	Broad-headed Snake	E	V	Habitat constraints include rocky areas including escarpments, outcrops and pogodas within the Sydney Sandstone geologies within associated PCTs 978, 1083, 1181, 1245, 1250 and 1804.	-	Potential to occur within rocky outcrops and clifflines within the Subject Land.	Considered further.
Isoodon obesulus obesulus	Southern Brown Bandicoot (eastern)	E	E	Habitat constraints are: requires dense ground cover in a variety of habitats. Associated PCTs: 978, 1083, 1181, 1245, 1250, 1395, 1804.	-	While some of the PCT associations correspond to vegetation communities that may be impacted by subsidence, it is unlikely that habitats suitable for this species would be modified to such an extent that they become unsuitable.	Not considered further.
Litoria littlejohni	Littlejohn's Tree Frog	V	V	Associated PCTs include 1083, 1181, 1245, 1250, 1395, 1804.	-	Potential to occur within Coastal Upland Swamps and waterways within the Subject Land.	Considered further.
Lophoictinia isura	Square-tailed Kite	V	-	Habitat constraints including nest trees within associated PCTs 1083, 1181, 1245, 1250, 1395, 1804.	-	Key habitats for this species include dry woodlands, open forests and timbered watercourses. These overall habitats are not considered susceptible to potential subsidence impacts, or to modification to such an extent they would no longer represent suitable habitat. This species is specialised to prey on passerine species, which are also not considered to be overall susceptible to potential subsidence impacts.	Not considered further.
Meridolum corneovirens	Cumberland Plain Land Snail	E	-	Associated PCTs include 1395.	-	Key habitat features for this species include litter of bark, leaves and logs, or shelters in loose soil around grass clumps. These features are unlikely to be impacted by subsidence.	Not considered further.
Meridolum maryae	Maroubra Woodland Snail	E	-	Associated PCTs include 1804.	-	Key habitat features for this species include leaf litter of coastal vegetation communities most often in heathland. PCT 18-4 has the potential to be indirectly impacted by subsidence, however it is unlikely that habitats present for this species (leaf litter in heathy vegetation) within the Subject Land would be impacted by subsidence to a degree at which these habitats would no longer be suitable for this species.	Not considered further.
Myotis macropus	Southern Myotis	V	-	Habitat Constraints (breeding): hollow bearing trees and bridges, caves or artificial structures within 200 m of riparian zone with pools/ stretches 3 m or wider. This include rivers, creeks, billabongs, lagoons, dams and other waterbodies on or within 200 m of the site.	-	The Southern Myotis is dependent on waterways with pools of 3 m wide or greater for foraging. Habitat surrounding waterways is also used for breeding and roosting. All habitat on the Subject Land where the Subject Land is within 200 m of a waterbody with pools/ stretches 3 m or wider may occur potential foraging habitat. The species may also have roosting habitat within overhangs and hollowing bearing trees through the Subject Land.	Considered further.
Ninox strenua	Powerful Owl	V	-	Habitat constraints: hollow bearing trees; Living or dead trees with hollow greater than 20 cm diameter and greater than 4 m above the ground within associated PCTs 1083, 1181, 1245, 1250 and 1395.	-	The species may occupy a broad range of habitat types and the key habitat constraints (large tree hollows) are not considered susceptible to potential subsidence impacts. Neither are its key prey species (medium-sized arboreal marsupials).	Not considered further.

Scientific name	Common name	BC Act Status	EPBC Act Status	Associated PCTs and habitat constraints	Geographic limitations specified in BAM-C	Is the species likely to use habitat associated with a prescribed biodiversity impact feature?	Species requires further consideration?
Pandion cristatus	Eastern Osprey	V	-	Habitat constraints include the presence of stick-nests in living and dead trees (>15 m) or artificial structures within 100 m of a floodplain for nesting within associated PCTs 978, 1083, and 1250.	-	Key habitat constraints for this species are not considered susceptible to potential subsidence impacts. Neither are fish, which form the key prey species for the Eastern Osprey.	Not considered further.
Petalura gigantea	Giant Dragonfly	E	-	Habitat constraints include Swamps and within 500 m of swamps within associated PCT 978.	-	Giant Dragonfly survey and impact assessment has been documented by Cardno (2022) and local and regional impacts of mining on the Giant Dragonfly studied by Invertebrate Identification Australia (2019, 2020). Giant Dragonfly is found typically in permanent swamps and bogs containing some free water and open vegetation. It is considered an obligate groundwater dependent mire (peat-forming wetland) dwelling species (Cardno 2022). Its breeding success is dependent on sites with a groundwater regime that provides enough surface moisture to minimise desiccation of eggs and early larval instars, peatland soils suitable for burrowing by larvae, and that have a water table height that allows larvae to access or extend their burrows (Cardno 2022). Cardno (2022) and Invertebrate Identification Australia (2019, 2020) assessed suitability of swamp habitat and surveyed for Giant Dragonfly. Of the 22 swamps that occur within the Subject Land, only three swamps are deemed suitable breeding and foraging habitat for the Giant Dragonfly, and no Giant Dragonflies were observed during the extensive survey undertaken by Invertebrate Identification Australia (2019, 2020). The three suitable swamps are Den111, Den121 and Den122. According to Cardno (2022) swamps within 500 m of potential or known breeding swamps were considered to be potential foraging habitat, however the species mobility and genetic diversity between and within populations is currently not well known and there is little evidence to suggest the species would utilise swamps for foraging that are not also suitable for breeding (Invertebrate Identification Australia pers. comm. 2021). The species' mobility and genetic diversity/relationships forms an aspect of the Invertebrate Identification Australia (2019, 2020) study in progress.	Considered further.
Petauroides volans	Greater Glider	-		Habitat constraint of hollow bearing trees within associated PCTs 1083, 1181, 1245, 1250, and 1395.	-	The key habitat constraint for this species (hollow bearing trees) are not considered susceptible to potential subsidence impacts.	Not considered further.
Petaurus norfolcensis	Squirrel Glider	V	-	Associated PCTs include 1083, 1181, 1250, and 1395.	-	The key habitat constraint for this species (abundant tree hollows) are not considered susceptible to potential subsidence impacts.	Not considered further.
Pezoporus wallicus wallicus	Eastern Ground Parrot	V	-	Associated PCTs include 978, and 1804.	-	While the PCT associations correspond to Coastal Upland Swamps, which may be impacted by subsidence, it is unlikely that habitats suitable for this species would be modified to such an extent that they become unsuitable.	Not considered further.
Phascolarctos cinereus	Koala	V	V[14]	Habitat constraints includes areas identified via survey as important habitat ('Important' habitat is defined by the density of Koalas and quality of habitat determined by on-site survey) within associated PCTs 1083, 1181, 1245, 1250, 1395, and 1804	-	The key habitat constraint for this species (eucalypt woodlands and forests and feed trees) are not considered susceptible to potential subsidence impacts.	Not considered further.
Pseudophryne australis	Red-crowned Toadlet	V	-	Associated PCTs include 978, 1083, 1181, 1245, 1250, 1395, and 1804.	-	Potential to occur within ephemeral streams or soaks amongst sandstone or adjacent to Coastal Upland Swamps within the Subject Land.	Considered further.

[14] *Listed as 'Vulnerable' under the EPBC Act at the time of the "controlled action" decision (13 January 2022) and therefore assessed as 'Vulnerable' rather than 'Endangered' (refer section 158A of the EPBC Act).*

Scientific name	Common name	BC Act Status	EPBC Act Status	Associated PCTs and habitat constraints	Geographic limitations specified in BAM-C	Is the species likely to use habitat associated with a prescribed biodiversity impact feature?	Species requires further consideration?
Pteropus poliocephalus	Grey-headed Flying Fox	V	V	Habitat constraints include Breeding camps within associated PCTs 978, 1083, 1181, 1245, 1250, 1395, and 1804.	-	No breeding camps have been identified within the Subject Land. Feed trees for the species are not considered susceptible to potential subsidence impacts.	Not considered further.
Tyto novaehollandiae	Masked Owl	V	-	Habitat constraints include hollow bearing trees; Living or dead trees with hollows greater than 20 cm diameter within associated PCTs 1083, 1181, 1245, 1250, and 1395.	-	The key habitat constraint for this species (large hollow bearing trees) are not considered susceptible to potential subsidence impacts. Neither are its key prey species (ground dwelling mammals).	Not considered further.

a. Habitat of threatened entities including

(i) karst, caves, crevices, cliffs and other geological features of significance,
(ii) rocks,
(iii) human made structures,
(iv) non-native vegetation,

There are cliffs and rocky outcrops (with crevices) in the Subject Land as well as rocky areas (with surface rock) (Figure 6).

No areas of karst topography, human-made structures, non-native vegetation or other geological features of significance were identified in the Subsidence Assessment Subject Land that would provide suitable habitat for any threatened species.

Since cliffs, crevices, and rocks are on the Subject Land, the assessor must:

i. prepare a list of threatened entities that use or are likely to use these habitat features on the Subject Land and within the surrounding assessment area

The threatened species that may utilise the habitat features and be regarded as prescribed impact entities include:

- Broad-headed Snake (Breeding) (*Hoplocephalus bungaroides*).
- Southern Myotis (*Myotis Macropus*).
- Large-eared Pied Bat (*Chalinolobus dwyeri*).

ii. describe how these features provide habitat for, or are used by, each threatened entity (based on published literature and other reliable sources).

The habitat and habitat description associated with each of the threatened species has been provided in Table 25 and Table 27 with the location of habitat features presented in the associated species polygon figures.

b. connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range

Native vegetation within the Subject Land is connected to extensive areas of native vegetation associated with the Metropolitan Special Area. Habitat connectivity (native vegetation cover) is shown on Figure 5.

Where corridors or other areas of connectivity link habitat for threatened entities, the assessor must:

i. Prepare a list of threatened entities that are likely to use or are a part of the connectivity or corridor.

All threatened fauna and threatened flora species that are known or assumed to be present within the Subject Land, would likely use the surrounding habitat types for movement and exchange of genetic material. Those threatened species that are known or assumed to be present within the Subject Land, and thus would use the surrounding landscape for connectivity, are provided in Table 13 (predicted species) and Table 27.

ii. *describe the importance of the connectivity to threatened entities, particularly for maintaining movement that is crucial to the species' life cycle (based on published literature and other reliable sources).*

The Subject Land is within contiguous habitat that connects the Southeast and Tablelands Regional Plan Corridor and the Illawarra Shoalhaven Regional Plan Corridor. This habitat links the Woronora Plateau in the east to the Nattai Plateau in the west. Habitat connectivity of the Subject Land to the surrounding habitat types, is important to maintain the movement and exchange of genetic material across the locality for all threatened biodiversity. As connectivity would not be lost because of the Project (section 4) it is highly unlikely that the Project would have any impacts on connectivity that would crucially impact upon movement such that the life cycle of threatened biodiversity would be significantly impacted.

c. Water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities

Watercourses and mapped drainage lines that occur in the Subject Land as shown on Figure 4.

Groundwater Dependent Ecosystems within the Subject Land correlate to Coastal Upland Swamps which are shown on Figure 9. Coastal Upland Swamps are detailed in section 2.3.2.

Coastal Upland Swamps are mapped as 'high potential terrestrial Groundwater Dependent Ecosystems' within the Bureau of Meteorology Groundwater Dependent Ecosystems Atlas (Bureau of Meteorology 2022) and are reliant on the subsurface presence of groundwater.

Most of the vegetation outside of areas of Coastal Upland Swamps within the Subject Land are mapped as having a 'low potential to be terrestrial Groundwater Dependent Ecosystem' as per (Bureau of Meteorology 2022). These areas typically occur along ridgelines and are unlikely to be reliant on groundwater processes to maintain ecosystem processes and would naturally experience periods of drought. As such, the areas of 'low potential terrestrial Groundwater Dependent Ecosystem' are unlikely to be greatly influenced by any potential subsidence related impacts.

Areas of 'moderate potential terrestrial Groundwater Dependent Ecosystems' are also mapped as occurring along creeklines, gullies and associated riparian zones within the Subject Land (Bureau of Meteorology 2022). These areas align with the mapping of PCT1181, PCT1395 and PCT1250. While these areas have been mapped as having a moderate potential for groundwater interaction, the PCTs would not be wholly reliant on groundwater interactions to maintain ecosystem or community processes. In the event of any subsidence impact, localised changes in community composition towards species less reliant on groundwater interaction may occur, but this is not anticipated to lead to an overall change in the communities. Potential impacts to PCT 1395, which aligns to Shale Sandstone Transition Forest TEC are considered in section 4.5.1 and 4.10.

Where water bodies or any hydrological processes that sustain threatened entities occur on the Subject Land, the assessor must:

i. *prepare a list of threatened entities that may use or depend on water bodies or hydrological processes for all or part of their life cycle, or*

Threatened entities that use or are likely to use these habitat features on the Subject Land and within the surrounding assessment area are listed in Table 27.

Threatened species that may occur and rely on hydrological processes associated with watercourses include:

- Giant Burrowing Frog (*Heleioporus australiacus*).
- Littlejohn's Tree Frog (*Litoria littlejohni*).
- Red-crowned Toadlet (*Pseudophryne australis*).
- Southern Myotis (*Myotis Macropus*).
- *Pomaderris brunnea.*

Coastal Upland Swamps within the Subject Land rely on hydrological processes for persistence. Threatened species that may use swamp environments, include:

- *Cryptostylis hunteriana.*
- *Epacris purpurascens* var. *purpurascens.*
- *Pultenaea aristata.*
- Eastern Pygmy-possum (*Cercartetus nanus*).
- Littlejohn's Tree Frog (*Litoria littlejohni*).
- Giant Burrowing Frog (*Heleioporus australiacus*).
- Giant Dragonfly (*Petalura gigantea*).

ii. prepare a list of threatened entities that will be, or are likely to be impacted by changes to existing water bodies or hydrological processes or the construction of a new water body

Threatened entities that use or are likely to use these habitat features on the Subject Land and within the surrounding assessment area are listed in Table 27 and included above.

iii. describe the habitat provided for each threatened entity by the water body or hydrological process, including consideration of water quality, volume, flow paths and seasonal patterns (based on published literature and other reliable sources)

The habitat and habitat description associated with each of the threatened species entities has been provided in Table 27, and further discussed in section 4.6.

Coastal Upland Swamp environments within the Subject Land (Figure 9) are discussed in section 2.3.2 and 4.6.4.

An assessment of the potential impacts to the species is provided in section 4.6.

d. wind turbine strikes on protected animals

Not relevant to this BDAR.

e. vehicle strikes on threatened species of animals or on animals that are part of a threatened ecological community

All predicated fauna species listed in Table 13 (predicted species) and fauna candidate species in Table 27 have a potential to interact with vehicles along fire trails (Figure 4) during the construction and on-going maintenance and operation of the surface infrastructure. However, there will be mitigation measures proposed (e.g., Slow speed limits) to minimise vehicle interactions (section 5). A list of species with the potential to interact with vehicles is provided below, however it should be noted that this list is generated based on species predicted by the BAM rather than consideration of those occurring within the Subject Land which is addressed in section 2.6:

- Black Bittern.
- Black-chinned Honeyeater (eastern subspecies).
- Broad-headed Snake.
- Bush-stone Curlew.
- Dusky Woodswallow.
- Eastern Bristlebird.
- Eastern Coastal Free-tailed Bat.
- Eastern False Pipistrelle.
- Eastern Grass Owl.
- Eastern Ground Parrot.
- Eastern Osprey.
- Eastern Osprey.
- Eastern Pygmy-possum.
- Flame Robin.
- Gang-gang Cockatoo.
- Giant Burrowing Frog.
- Giant Dragonfly.
- Glossy Black Cockatoo.
- Glossy Black-Cockatoo.
- Golden-tipped Bat.
- Greater Broad-nosed Bat.
- Greater Glider.
- Green and Golden Bell Frog.
- Grey-headed Flying Fox.
- Koala.
- Large Bent-winged Bat.
- Large-eared Pied Bat.
- Little Bent-winged Bat.
- Little Eagle.
- Little Lorikeet.
- Littlejohn's Tree Frog.
- Masked Owl.
- New Holland Mouse.
- Olive Whistler.
- Powerful Owl.
- Powerful Owl.
- Red-crowned Toadlet.
- Regent Honeyeater.
- Rose-crowned Fruit-Dove.
- Rosenberg's Goanna.
- Scarlet Robin.
- Sooty Owl.
- Southern Brown Bandicoot (eastern).
- Southern Myotis.
- Spotted Harrier.
- Spotted-tailed Quoll.
- Square-tailed Kite.
- Squirrel Glider.
- Stuttering Frog.
- Superb Fruit-Dove.
- Swift Parrot.
- Turquoise Parrot.
- Varied Sittella.
- White-bellied Sea-Eagle.
- White-throated Needletail.
- Yellow-bellied Glider.
- Yellow-bellied Sheathtail-bat.

3. Avoid and Minimise Impacts

3.1 Measures to avoid and minimise impacts

In accordance with the BAM, proponents of a development must demonstrate the measures employed to avoid, mitigate, and offset impacts to biodiversity values. This section outlines the avoidance, and minimisation strategies that IMC has incorporated into the Project location and design or would employ during construction, operation and/or completion of the Project to reduce impacts on biodiversity values.

3.2 Avoid or minimise biodiversity impacts when locating the proposal

The Project proposes the extraction of additional metallurgical coal reserves within the existing CCL 768 for the Dendrobium Mine. The extraction of additional Project metallurgical coal reserves would be supported by the development of supporting infrastructure and the use and augmentation of existing surface facilities at the Dendrobium Mine. The Project underground mining area would allow for the continuation of the existing approved underground mining operations at the Dendrobium Mine, thereby minimising any new surface disturbance that would otherwise be associated with a separate mine.

The location of the Project is dictated by many aspects – including the location of the mining lease, resource, and geological constraints. Alternative locations were considered and submitted to the Department as per the previous application (for Area 5 and 6). These have been summarised below in respect the biodiversity impacts associated with the application.

The key alternatives considered when locating the proposal have been based on the following key assumptions and constraints:

- All alternative mine designs considered are based on layouts located with IMC's existing tenement (CCL 768).
- Key IMC commitments adopted for the previous application have been retained, namely:
    - No mining beneath reservoirs, with at least 1,000 metre (m) setback from dam walls and 300 m setback from full supply levels (FSLs).
    - No mining beneath named watercourses (i.e. Avon River, Cordeaux River, Wongawilli Creek, Donalds Castle Creek).

3.2.1 Alternative Longwall Layouts

The alternative mine designs that have been considered include:

- Longwall mining in Areas 4, 5 and 6, as per the layouts in the previous application (for Areas 5 and 6).
- Longwall mining in Areas 5 and 6, as per the layouts in the previous application.
- Longwall mining in Area 5 only as per the layout in the previous application.
- Avoidance of WaterNSW 'significant streams' and Upland Swamps with 100 m setback from "all third order and above streams, all tributary streams flowing directly into reservoirs irrespective of their order, and streams and tributaries with upland swamps" and 60 m setback from Upland Swamps within the extent of longwall mining proposed for the Project.

Longwall Mining in Areas 4, 5 and 6

Based on the key mine design metrics, longwall mining in Areas 4, 5 and 6 is considered to be economically viable. However, while the inclusion of Area 4, Area 6 and the larger Area 5 (as per the previous application) would significantly increase resource recovery, with associated increases in economic benefits (including royalties, mine life, employment and direct expenditure), this alternative mine design is not proposed in consideration of potential environmental impacts (including the significant number of swamps

in Area 4) and the potential increase in potential impacts for the key issues identified by the Independent Planning Commission (IPC) for the previous application.

Longwall Mining in Areas 5 and 6 (as per Previous Application)

Longwall mining in Areas 5 and 6, consistent with the previous application, is considered to be economically viable, as described in the EIS for the previous application. The inclusion of Area 6 and the larger Area 5 (as per the previous application) would significantly increase resource recovery, with associated increases in economic benefits (including royalties, mine life, employment and direct expenditure). In addition, the NSW Government concluded the previous application was in the public interest in its "whole-of-government" Assessment Report. However, this alternative mine design is not proposed for the Project as it was refused by the IPC for the previous application.

The biodiversity impacts associated with the application were assessed in the Niche (2019) Biodiversity Assessment Report for the previous applicationwhich was submitted to DPIE in 2019, and the Niche (2020) Supplementary Biodiversity Assessment Report for the previous application. In summary, key conclusions of the biodiversity impact assessment include:

- 28.5 ha of vegetation clearing, including approximately 1 ha of Shale Sandstone Transition Forest TEC.
- Direct and indirect impacts to six threatened fauna species listed as species credits.
- Potential subsidence related impacts to 25 Coastal Upland Swamps, including one swamp (Den 98) that is regarded as a swamp of special significance.
- Subsidence related impacts to habitat features along watercourses, cliffs, and swamps across two mining domains.

Longwall Mining in Area 5 (as per Previous Application)

Based on the key mine design metrics, this alternative mine plan is considered to be economically viable. However, while the inclusion of the larger Area 5 (as per the previous application) would increase resource recovery, with associated increases in economic benefits (including royalties, mine life, employment and direct expenditure), this alternative mine design is not proposed as IMC has re-designed the Area 5 mine plan to target the high-quality metallurgical coal resource with associated reductions in potential impacts on key features, which has reduced the potential environmental impacts of the Project.

The biodiversity impacts associated with longwall mining in Area 5 as per the previous application were assessed in the Niche (2019) Biodiversity Assessment Report for the previous application which was submitted to DPIE in 2019, and the Niche (2020) Supplementary Biodiversity Assessment Report for the previous application. In summary, key conclusions of the biodiversity impact assessment that relate to Area 5 include:

- Approximately 15 ha of vegetation clearing associated with Ventilation Shaft Sites for Area 5, including approximately 1 ha of Shale Sandstone Transition Forest TEC.
- Direct and indirect impacts to six threatened fauna species listed as species credits.
- Potential subsidence related impacts to 24 Coastal Upland Swamps, including one swamp (Den 98) that is regarded as a swamp of special significance.
- Subsidence related impacts to habitat features along watercourses, cliffs, and swamps across the mining domain.

Avoidance of WaterNSW 'Significant Streams' and Upland Swamps

In consideration of the advice provided by WaterNSW to the Department on the SEARs, this alternative considers a 100 m setback from "all third order and above streams, all tributary streams flowing directly into reservoirs irrespective of their order, and streams and tributaries with upland swamps" and a 60 m setback from Upland Swamps within the extent of longwall mining proposed for the Project.

The 100 m setback is based on the adopted setback from 'key stream features', which is expected to reduce the likelihood of 'Type 3' impacts (although the risk would not be nil). The setback would need to be increased to greater than 400 m to be beyond the setback distance where Type 3 impacts have been observed at the Dendrobium Mine.

Based on the key mine design metrics, this alternative mine plan is not considered to be economically viable. The avoidance of directly mining beneath 'significant streams' (as defined by WaterNSW) as well as Upland Swamps would result in a significant decrease in resource recovery and increase in operational costs (due to the number of longwall changeouts that would be required to avoid directly mining beneath these features).

This is consistent with the advice of the Independent Advisory Panel for Underground Mining (IAPUM) (2020) for the previous application, which acknowledged that complete avoidance of swamps/streams is not possible:

The Panel recognises that not all streams, swamps or other ecological assets can be protected while still having a viable mining plan.

As such, this alternative mine design is not considered to be a 'feasible' alternative for the Project.

3.2.2 Alternative surface infrastructure locations

The Project includes use of existing infrastructure (namely the Dendrobium Pit Top, Kemira Valley Coal Loading Facility, Kemira Valley Rail Line, Dendrobium CPP, Shaft Sites Nos 1, 2 and 3 and the West Cliff Stage 3 Coal Wash Emplacement) which would reduce the requirement for additional surface disturbance including potential native vegetation and associated habitat clearing.

The location of the Ventilation Shaft Site No 5 was subject to an initial preliminary biodiversity constraints assessment to inform longwall layout design so as to avoid areas of TECs (including Coastal Upland Swamps and Shale Sandstone Transition Forest) and watercourses. The proposed sites were then inspected and re-located from the preliminary location where such features occurred. A larger footprint (approximately 20 ha) was inspected for the proposed Ventilation Shaft Site to inform the layout of surface infrastructure. The location was positioned adjacent to existing Fire Trails to minimise additional disturbance within native vegetation areas for the creation of new access roads and utilises an existing cleared area previously used for works in the Metropolitan Special Area.

Service boreholes have been co-located at the Ventilation Shaft Site to minimise the need for additional disturbance outside the site.

The ETL would be co-located along an existing fire track that would limit the requirement for additional clearance of native vegetation associated with the infrastructure.

The temporary water pipeline and Cordeaux construction carpark has been located along the existing fire track, and along an old borehole access track. This location minimises the need for primary clearing of remnant vegetation.

Further to this, the majority of the Dendrobium Pit Top Carpark Extension is located within previously cleared areas limiting the requirement for additional clearance of native vegetation.

3.3 Avoid or minimise biodiversity impacts when designing the proposal

3.3.1 Underground mining layout

A number of key constraints and longwall setbacks have been considered in the development of the Project surface infrastructure and underground mining layout, based on previous mining and impact management experience at the Dendrobium Mine, review and analysis of available monitoring data from other operations across the Woronora Plateau. The longwall setbacks from areas of key constraint have avoided and reduced the potential subsidence related indirect impacts to flora and fauna habitat along watercourses, and important swamp clusters.

Avoidance of key surface features has been incorporated into the design of the Project, and IMC has proposed a Project design that includes the following measures:

- minimum longwall mining setback distance of 1,000 m from dam walls.
- minimum longwall mining setback distance of 300 m from the Full Supply Level of the Avon Dam.
- not longwall mine beneath 3rd, 4th and 5th order (or above) streams.
- set longwall mining at a distance of at least 400 m from named watercourses (i.e. the Avon River, Cordeaux River, Donalds Castle Creek and Wongawilli Creek).
- avoid longwall mining beneath identified key stream features.
- avoid longwall mining beneath “Area 4” swamp cluster.
- use existing infrastructure (namely the Dendrobium Pit Top, Kemira Valley Coal Loading Facility, Kemira Valley Rail Line, Dendrobium CPP, Shaft Sites Nos 1, 2 and 3 and the West Cliff Stage 3 Coal Wash Emplacement) which would reduce the requirement for additional surface disturbance.

Alternatives considered in relation to longwall width and mining methods are detailed below. As summarised below, IMC proposes conventional longwall underground mining methods and would have void widths of up to approximately 305 m for the Project.

Alternative Longwall Widths and Mining Methods

Subsidence-related Surface Impacts

With respect to surface impacts (e.g. to stream beds, swamps), experience at Dendrobium Mine and other mining operations shows that surface impacts related to subsidence can occur at void widths significantly narrower than 305 m. MSEC (2019) conducted an analysis of variable longwall widths and concluded the following:

- although maximum predicted vertical subsidence decreases as longwall void width reduces, the predicted conventional strains are still sufficient to result in the fracturing of bedrock for reduced longwall widths down to approximately 150 m;
- valley related effects are seen at narrow longwall widths and therefore, so are related potential impacts; and
- strains due to the valley related effects would still be sufficient to result in fracturing of rockbars, pools and bedrock above and adjacent to the longwalls and, therefore, resultant surface water losses for reduced longwall widths down to approximately 150 m.

Accordingly, adverse environmental impacts are still anticipated for reduced longwall widths down to approximately 150 m and the potential for losses in surface flow and diversion of water from the bases of

pools and/or Upland Swamps would therefore be largely unchanged by the adoption of narrower longwall panels.

In their advice on the previous application, the IAPUM (2020) concluded the following in regard to narrower panel widths:

At Dendrobium Mine, longwall panel width is not the key control when considering environmental impacts on natural surface features due to mining-induced non-conventional subsidence, in particular, valley closure. This is because environmental impacts due to non-conventional surface subsidence start to plateau at longwall panel widths that are reported to be too narrow to be economic at Dendrobium Mine.

The Assessment Report for the Dendrobium Mine Extension Project State Significant Development SSD-8194 (DPIE 2020b) stated:

*… the only avoidance measure that can largely protect upland swamps is setbacks from longwall voids (of any width). Undermining at a narrower void width would not protect upland swamps (*see section *6.6.40 of EIS).*…

The Department concludes that reducing longwall void width is not an effective means of reducing, much less eliminating, the environmental impacts of the Project. This position is confirmed by the Mining Panel's conclusions (see section 6.2.58 of EIS).

The adoption of narrower longwall panels for the Project would still require IMC to apply the same compensatory and offset measures to address potential impacts to surface features, including water quality, aquatic ecology and Upland Swamps that have been adopted for the proposed 305 m wide Project longwall voids. It should be noted that impacts to surface features have already been significantly reduced when compared to the Project, due to the reduction in layout of 60% (mine plan area).

Bord and Pillar and Partial Extraction Mining Method

The Dendrobium Mine currently uses conventional longwall underground mining methods. While bord and pillar mining is an underground mining technique that can be viable for some shallow coal seams, it is uneconomic in Australia to use bord and pillar mining as the primary production method at depths from the surface that are greater than about 200 m (Department of Planning, 2008).

Longwall mining is also recognised as a safer mining method compared with bord and pillar. The Southern Coalfield Panel Report (Department of Planning, 2008) stated:

Safety, productivity and cost considerations dictate that longwall mining is now the only major, viable, high production mining method in the majority of Australian underground coal mines that operate at a depth of greater than about 300 m and in virtually all new coal mines (irrespective of depth).

The depth of the Bulli Seam in the Project extent of longwall mining area ranges from approximately 250 m to 390 m from the surface. In addition, when considering safety, productivity and costs, longwall mining is considered to be the only viable mining method for the Project and therefore alternative extraction methods are not proposed.

3.3.2 Surface infrastructure

As previously discussed above, design of the surface infrastructure has been planned to avoid or minimise biodiversity impacts as much as practical by focusing on:

- reducing vegetation clearing by locating surface infrastructure within previously disturbed areas or adjacent to Fire Trails.
- limiting vegetation clearing only to areas that are considered necessary for construction and operational purposes.
- avoiding clearing of riparian vegetation or TECs.

As per the BAM, key avoidance measures associated with the proposal have been addressed in Table 28.

Table 28. Designing proposal – avoiding and minimising direct and indirect impacts on native vegetation, threatened species, threatened ecological communities and their habitats

Avoidance	The Project
Reducing the proposal's clearing footprint by minimising the number and type of ancillary facilities	The Project has proposed ancillary sites that must be constructed for the safe and necessary operation of the mine. The design of the surface infrastructure has been reduced as far as practical to ensure safe operation in accordance with relevant regulations and guidelines. As discussed in section 3.2, the location of the surface infrastructure has been located adjacent to existing fire trails, or within previously cleared areas where possible. The Project has reduced proposed native vegetation clearing from 28.5 ha (previous application) to approximately 19.85 ha.
Locating ancillary facilities in areas that have no biodiversity values	Measures to reduce the impact to biodiversity values are discussed above. The surface infrastructure has been located where possible in previously disturbed areas. However approximately 19.85 ha of native vegetation, would be directly impacted. The surface infrastructure has not been located within any TEC. The vegetation to be impacted is predominately PCT1083 which is a dominant PCT within the locality. The surface infrastructure has been located immediately adjacent to existing cleared areas, and fire trails to reduce further access requirements. The surface infrastructure would not directly impact upon threatened flora. The surface infrastructure would impact Koala, Gang-gang Cockatoo and Eastern Pygmy Possum habitat primary related to the Ventilation Shaft Site construction. The species are likely to use the surrounding habitat. Avoiding impacts to the species is unlikely to be achieved based on the area required for the Ventilation Shaft Site layout.

Avoidance	The Project
Locating ancillary facilities in areas where the native vegetation or threatened species habitat is in the poorest condition (i.e. areas with the lowest vegetation integrity scores)	As discussed above, the ancillary facilities are located where possible in areas that have been historically cleared or maintained as an existing Fire Trail easement. Vegetation clearing has been limited where possible including the following: The in-tact native vegetation along areas of the ETL that need to be impacted will be cleared and maintained to below a 2 metres height, will be retained in the same condition as the existing fire break, which amounts to a total area of 3.87 ha that will be modified to accommodate the ETL. The fire break vegetation that is currently maintained by WaterNSW will not be subject to additional vegetation clearing with the exception of a conservative estimate of 1 x 1 metres disturbance around each of the estimated 100 ETL poles, which we have attributed a conservative area of 0.1 ha of direct impact that will be assessed as a total loss for the purpose of offsetting. A further 0.13 ha of native vegetation that occurs immediately adjacent to the Fire Trail, may need to be modified/trimmed to allow for truck movement into the site during the construction for the infrastructure. The Cordeaux Dam Access Road Construction Carpark requires an area of 0.15 ha. The area for the temporary carpark would be located within a mown area adjacent to existing access road. The area does align to native vegetation (eg. Native grasses and forbs) however is regularly slashed/mown. The extension of the Dendrobium Pit Top Carpark Extension would require an additional 0.17 ha of impact to extend the existing carpark which has been located in an area that is predominately occupied by weeds. The vegetation to be cleared for surface infrastructure has VI scores that range from 24 to 52.5. A VI score of 52.5 is generally associated with the remnant vegetation to be cleared for the Ventilation Shaft Site. The lower scores are attributed to the areas that have been previously slashed, maintained in the existing easement. In terms of impacts to threatened flora, the Project would avoid direct impacts. The records of Acacia bynoeana and Epacris purpurescens var purpurescens can be avoided. Further mitigation measures would be undertaken to safeguard against threatened flora during the ETL pole placement and waterpipe line placement. Important habitat features, such as 388 hollow-bearing trees would be cleared for the Project. The tree hollows predominately occur across the PCT1083. This PCT is dominated by *Eucalyptus racemosa*, and the occurrence of hollows within this tree, and that of the wider PCT1083 are not uncommon as evident in traverses throughout the Subject Land. Avoiding impacts to hollow-bearing trees would unlikely be achievable based on the area required for the Ventilation Shaft Site and the landscape context (ie. remnant bushland areas). Targeted surveys for threatened fauna did not detect the use of the hollows by the threatened owls and mammals, though whilst not detected, we have assumed that the hollows may be used by the Gang-gang Cockatoo given we could not meet the seasonal monitoring for the species as per the TBDC.

Avoidance	The Project
Locating ancillary facilities in areas that avoid habitat for species and vegetation that has a high threat status (e.g. an EEC or critically endangered ecological community (CEEC) or is an entity at risk of a serious and irreversible impact (SAII)	The ancillary facilities are not located in areas that consist of a TEC. TECs have been actively avoided in the planning of infrastructure. The ancillary facilities are not located in an area that results in a direct impact to an SAII candidate species. The ancillary facilities are not located in areas that would likely place threatened biodiversity at risk of extinction.
Actions and activities that provide for rehabilitation, ecological restoration and/or ongoing maintenance of retained areas of native vegetation, threatened species, threatened ecological communities and their habitat on the Subject Land.	Infrastructure would be removed, and surface development areas rehabilitated progressively or at the end of the Project life, unless otherwise agreed with the relevant government agencies and landholders. Progressive rehabilitation of surface infrastructure that is no longer required has the effect of minimising the duration of the impacts. In the long-term, all sites would be rehabilitated to a safe, stable, and sustainable landform of a similar character to surrounding areas. The general rehabilitation and mine closure goals for the Project would be to: - comply with relevant or applicable legislative requirements. - protect public and employee health, safety and welfare. - limit or mitigate adverse environmental effects. - protect Indigenous values. - achieve sustainable land use as agreed with the applicable government regulator, and engagement with local communities. Infrastructure sites in the Metropolitan Special Area would target rehabilitation of native vegetation back to the pre-existing Plant Community Type (largely PCT1083) to reinstate pre-existing habitat. It is envisaged that ecological restoration plans would be prepared to support the agreed rehabilitation objectives.

Avoid or minimise prescribed biodiversity impacts when locating the proposal

Those threatened biodiversity that are associated with prescribed impacts have been nominated in section 2.7 and assessed in section 4.

Prescribed impacts that are applicable to the proposal area include:

(a) the impacts of development on the following habitat of threatened species or ecological communities—
(i) karst, caves, crevices, cliffs and other geological features of significance,
(ii) rocks,
(iii) human made structures,
(iv) non-native vegetation,
(b) the impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range,
(c) the impacts of development on movement of threatened species that maintains their lifecycle,
(d) the impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including from subsidence or upsidence resulting from underground mining or other development),
(e) the impacts of wind turbine strikes on protected animals,

(f) the impacts of vehicle strikes on threatened species of animals or on animals that are part of a threatened ecological community.

For the most part, the prescribed impacts are attributed to the subsidence from the longwall mining activities. Avoiding subsidence entirely is not achievable for the Project. To reduce the extent of subsidence, the Project has applied the setbacks and measures specified in section 3.3.1. The proposed mine plan represents a 60% reduction in mine plan area compared to the previous application.

Design the proposal to avoid or minimise prescribed biodiversity impacts

The design of the proposal has implemented the measures and setback identified in section 3.3.1 to avoid or minimise prescribed biodiversity impacts.

The proposal would also employ relevant monitoring, and corrective actions relating to subsidence related impacts to biodiversity features to minimise prescribed impacts (section 5). Impacts to third order streams and key stream features are proposed to be rehabilitated as agreed with agency stakeholders where reasonable and feasible.

The design criteria provided in section 7.2.2 of the BAM, has been addressed in Table 29 below to demonstrate consideration of proposal avoidance or minimisation to prescribed impacts.

Table 29. Design measures that can avoid and minimise prescribed impacts

Design measures that can avoid and minimise prescribed impacts	The Project
a. Engineering solutions, such as proven techniques to:	
i. minimise fracturing of bedrock underlying features of geological significance, or groundwater-dependent communities and their supporting aquifers	The proposed mine plan represents a 60% reduction in mine plan area compared to the previous application and would result in a commensurate reduction in subsidence related effects. The Project would: • not longwall mine beneath 3rd, 4th and 5th order (or above) streams • set longwall mining at a distance of at least 400 m from named watercourses (i.e. the Avon River, Cordeaux River, Donalds Castle Creek and Wongawilli Creek) • avoid longwall mining beneath identified key stream features (thereby minimising likelihood of impact.
ii. restore connectivity and movement corridors	Infrastructure areas in the Metropolitan Special Area would target rehabilitation of native vegetation back to the pre-existing Plant Community Type (largely PCT1083) in order to reinstate pre-existing habitat, as agreed with Agency stakeholders at decommissioning. Impacts to third order streams and key stream features are proposed to be rehabilitated as agreed with agency stakeholders where reasonable and feasible.
b. Design elements that minimise interactions with threatened entities, such as:	
i. designing turbines to dissuade perching and minimise the diameter of the rotor swept area	Not relevant

Design measures that can avoid and minimise prescribed impacts	The Project
ii. designing fencing to prevent animal entry to transport corridors	Temporary fencing will be placed around the construction areas whilst earth works are being undertaken. Connectivity is highly unlikely to be impacted by the temporary fencing. Security fencing will be placed around the footprint of the Ventilation Shaft Site. The fencing would not impede fauna connectivity surrounding the infrastructure.
iii. providing vegetated buffers rehabilitated with native species	The Project would not require the installation of vegetated buffers. Remnant vegetation surrounding the surface infrastructure would be left in place. All areas of remnant vegetation would be rehabilitated back to its associated PCT upon decommissioning.
c. Maintaining environmental processes that are critical to the formation and persistence of habitat features not associated with native vegetation	The extent of subsidence has been assessed by MSEC (2022) and has been summarised in Table 37. The extent of subsidence is unlikely to result in the loss of all clifflines, watercourses, such that it would impact the habitat of threatened flora and fauna. This has been detailed in section 4.6.
d. Maintaining hydrological processes that sustain threatened entities	Subsidence has the potential to result in changes to swamp vegetation across 16 Coastal Upland Swamps. An assessment into the impacts associated with the Coastal Upland Swamps is provided in section 2.3.2. The potential subsidence related impacts to Coastal Upland Swamps cannot be avoided by the Project. The Project has minimised the longwall layouts as much as practical, which in turn, has avoided potential impacts to swamps previously assessed in original EIS submission for Area 5. All Coastal Upland Swamps would be monitored for potential impacts via a formal monitoring program, and remediation measures undertaken as per the relevant approved management plan (e.g. The Swamp Impact Monitoring, Management and Contingency Plan, IMC, 2020) to reduce the potential long-term hydrological impacts to the swamp. Hydrological processes in relation to threatened flora and fauna are assessed in section 4.6.4. The Project would result in unavoidable impacts to watercourses, which may result in loss of pools, and ponding. The impacts have been reported in MSEC (2022). Riparian areas would be monitored for potential impacts via a formal monitoring program, and remediation measures undertaken as per the relevant approved management plan (e.g. Watercourse Impact Monitoring, Management and Contingency Plan, IMC, 2020) to reduce the potential long-term hydrological impacts to the creeklines.
e. Controlling the quality of water released from the site, to avoid or minimise downstream impacts on threatened entities.	Not applicable.

4. Impact Assessment

The Impact Assessment forms Stage 2 of the BDAR as detailed in section 8 of the BAM. Further Assessments of Significance have been carried out for those species listed under the EPBC Act that may potentially be impacted by the Project. The impact assessment has incorporated the findings from the specialist studies (ie. MSEC (2022); Watershed (2021)) to determine the severity and potential for impacts on biodiversity.

The SEARs for the Project (Appendix 1) suggest an assessment of impacts addressing the matters outlined in *Guidelines for developments adjoining land and water managed by DECCW* (DECCW 2010) and include:

a. The nature of the impacts, including direct and indirect impacts.
b. The extent of the direct and indirect impacts.
c. The duration of the direct and indirect impacts.
d. The objectives of the reservation of the land.

An assessment of impacts has been included in the EIS for the Project, with relevant details associated directly with biodiversity provided throughout this section of the BDAR, with a specific discussion on impacts to conservation land provided in section 4.8.

4.1 Direct impacts on native vegetation and habitat

The Project would result in the clearance of native vegetation and habitat totalling an area of approximately 19.85 ha associated with the construction and operation of surface infrastructure. The area of direct impact associated with each Project surface infrastructure component is shown in Table 30. None of the native vegetation to be cleared is listed as a TEC on the BC Act or EPBC Act.

All native vegetation areas would be rehabilitated following decommissioning as per IMC's closure standards and rehabilitation strategy (see section 5.2.3), and all potential indirect impacts minimised through implementation of the mitigation measures detailed in section 5.1.

Table 30. Direct vegetation clearing

PCT Code	Corresponding TEC	Condition	Current VI score	Future VI score	Area of direct impact (vegetation clearing within the Biodiversity Assessment Development Footprint) (ha)						Total (ha)
					Ventilation Shaft Site No 5A	Ventilation construction – water shaft and pipeline	Ventilation shaft construction – Fire Trail Upgrade	ETL	Dendrobium Pit Top Carpark Extension	Cordeaux Dam Access Road Construction Carpark	
1250	Not listed	Good	42.4	0.0	0	0	0.10	1.00	0	0	**1.1**
1083	Not listed	Good	52.5	0.0	13.38	0.14	0.11	2.99[15]	0	0	**16.62**
		Low	26	0.0	1.26	0.55	0	0.00[16]	0	0.15	**1.96**
1245	Not listed	Low	26.2	0.0	0	0	0	0	0.17	0	**0.17**
Total					**14.64**	**0.69**	**0.21**	**3.99**	**0.17**	**0.15**	**19.85**

[15] Includes 0.1 ha for the direct impact associated with the ETL pole installation.

[16] As per Table 8, approximately 2.98 ha of PCT1083 Low condition occurs within the Biodiversity Development Assessment Footprint, however the 2.98 ha would not need to be removed as it is currently acting as a fire break within the existing easement that is currently maintained by WaterNSW. Similarly, as per Table 8, approximately 0.43 ha of PCT1250 Low condition occurs within the Biodiversity Development Assessment Footprint. This is also used as a fire break within the existing easement that is currently maintained by WaterNSW. As such, both PCT1083 and PCT1250 Low condition would not be cleared for the Project and thus would not be directly impacted.

4.2 Direct impacts on native vegetation and habitat

No TEC occurs within the Biodiversity Assessment Development Footprint and thus no TEC would be directly impacted by the Project.

4.3 Direct impacts to threatened flora

As discussed in section 2.5.3, two threatened flora species (*Acacia bynoeana* and *Epacris purpurescens var. purpurescens*) were recorded within the existing Fire Trail easement within the Subject Land. The individuals would not be cleared for the Project. Mitigation measures are proposed to section 5.1 to further safeguard against potential impacts to the individuals during the ETL pole placement.

No other threatened flora were recorded within the areas proposed for surface infrastructure (direct impact), and thus no threatened flora are likely to be directly impacted.

4.4 Direct impacts to threatened fauna

The Project would result in an impact to threatened fauna due to the clearing of habitat for the surface infrastructure or associated with indirect and prescribed impacts which are addressed in sections 4.5 and 4.6).

The Project would result in the clearing of 19.85 ha of habitat associated with the PCTs detailed in Table 30.

The direct impacts to fauna also include the removal of 388 hollow-bearing trees and microhabitat features such as fallen logs, rocks and litter debris within the impacted PCTs.

As identified in the candidate assessment (section 2.5.3) five species credit fauna have potential habitat within the Biodiversity Assessment Development Footprint that would be directly impacted by the Project. The direct impacts to the five threatened fauna recorded, or within habitat to occur within the Biodiversity Assessment Development Footprint has been provided in Table 31 and discussed below.

All other threatened fauna predicted to occur within the Biodiversity Assessment Development Footprint (section 2.4.1) are regarded as ecosystem credit fauna, and do not require any further consideration under the BAM.

Table 31. Summary of direct impacts to threatened fauna

Species	Scientific Name	Biodiversity risk weighting	SAII	Area of direct impact (ha)
Gang-gang Cockatoo	*Callocephalon fimbriatum*	2.00	No	15.30
Eastern Pygmy Possum	*Cercartetus nanus*	2.00	No	18.95
Koala	*Phascolarctos cinereus*	2.00	No	17.69
Large-eared Pied Bat	*Chalinolobus dwyeri*	2.00	No	0.17
Southern Myotis	*Myotis macropus*	2.00	No	4.98

4.4.1 Gang-gang Cockatoo – direct impacts

A targeted species survey (ie. monitoring as specified in the TBCD (2021)) was not completed at the time of BDAR preparation. Given the species has been recorded by Niche in the Subject Land (although not recorded using suitable breeding hollows), the species polygon within the Biodiversity Assessment Study Footprint has been created based on potential nest trees that were mapped by Niche within the surface infrastructure areas. Potential nest trees are (as described in the TBDC) - *forest and woodland eucalypts containing hollows that are at least 9 m above the ground, and with hollow diameter of 10 cm or larger*.

A 200 m buffer was applied to each of the suitable habitat trees, which was then used to intersect the areas of vegetation subject to direct impacts to obtain an area of impact for the Gang-gang Cockatoo within each vegetation zone. The area of direct impact to the suitable habitat trees was associated with the direct impacts required for the Ventilation Shaft Site No 5A, and portions of the ETL easement. The area of direct impact (species polygon) is provided Table 32 and shown on Figure 14a.

Table 32. Areas of PCTs subject to direct impact that constitute species polygon for Gang-gang Cockatoos

PCT ID	Vegetation zone	Surface infrastructure	Area (ha)
1083	Good	Ventilation Shaft Site No 5A	13.38
1083	Good	Ventilation construction – Fire Trail Upgrade	0.05
1250	Good	ETL	0.39
1083	Good	ETL	1.48
Total species polygon area (ha) associated with direct impacts			**15.30**

4.4.2 Koala – direct impacts

Phillips and Callaghan (2000) identified that *Eucalyptus punctata* (Grey Gum) and *E. agglomerata* (Blue-leaved Stringybark) were most preferred by Koalas in the forest and woodland in the Campbelltown area, which is approximately 30 km north of the Subject Land. Their research also noted that the Koalas showed a preferential utilisation of *E. punctata* and *E. agglomerata* on substrates derived from shales, compared with the same species on sandstones, suggesting that their use by Koalas was influenced by differences in nutrient status between substrates (Phillips and Callaghan 2000).

Within the nearby Upper Nepean State Conservation Area, Koalas have been observed using several different browse species including *Eucalyptus globoidea* (White Stringybark), *E. sieberi* (Silvertop Ash), Grey Gum, *E. piperita* (Sydney Peppermint), *Corymbia gummifera* (Red Bloodwood) and *Eucalyptus agglomerata* (Blue-leaved Stringybark) (OEH 2017). Koala observations within the Upper Nepean State Conservation

Area appear to be consistent with research on Koalas in nearby populations undertaken by Phillips and Callaghan (2000) which showed a preference towards trees associated with richer soils (OEH 2017).

The breeding season for the Koala peaks between September and February and animals travel the furthest in this period (Dique et al. 2003). Female Koalas do not always breed every year (Martin and Handasyde 1999). The gestation period for the Koala is approximately 35 days (Martin and Handasyde 1999). Following birth, the young remains in the pouch for approximately six months and on leaving the pouch remain dependent on its mother as 'back young', reaching independence at approximately one year of age (Martin and Handasyde 1999). Dispersal distances for young Koalas generally range from 1 to 10 km (Gall 1980, Mitchell 1990, Dique et al. 2003), which may vary, depending on the availability of unoccupied habitat. The Koala reaches sexual maturity at approximately two years of age and has a life expectancy of approximately 10 years (Martin and Handasyde 1999).

The home range of the Koala varies in relation to environmental factors, such as site productivity, but also in relation to tree species composition, degree of habitat fragmentation, and population density. The home range of the Koala in semi-arid forests and woodlands is usually much larger (greater than 100 ha) than in temperate forests nearer the coast (less than 3 ha), and there is less overlap between the home range of individual animals (Hindell and Lee 1988, Mitchell 1990, Hasegawa 1995, Melzer 1995, White 1999, Ellis et al. 2002).

In the Sydney Basin bioregion, where the Subject Land is located, Koalas occur around the Central Coast, Blue Mountains and the fringes of the Cumberland Plain (DEC 2018). The number of Koalas occurring on the Central Coast of NSW are estimated to have been approximately 1,900 individuals in 2010; the population in Campbelltown and the surrounding area are considered to be increasing slowly since the 1980s with approximately 300 animals estimated in 2010 (DEC 2018).

There have been numerous sightings of the Koala distributed over the broader locality of the Subject Land, including across most of the Upper Nepean State Conservation Area, south of the Nepean and Avon dams (OEH 2017). The Koalas residing in the Upper Nepean State Conservation Area are considered to be a distinct population but retain linkages with other known sub-populations in the area, including those in Dharawal National Park to the north, Nattai National Park and Bargo and Bargo River State Conservation Areas to the west, and Morton National Park to the south (OEH 2017).

Phillips and Callaghan (2000) speculated that, in the Campbelltown area, the Koala occurs at low densities because of the relatively low habitat quality and its associated carrying capacity, more than other factors. The fact that Koalas within the area showed preferential utilisation of trees on substrates derived from shales, compared with the same tree species present on sandstones, indicated that the low activity levels reported for Koalas in the area may be typical of those to be expected in low-nutrient environments (Phillips and Callaghan 2000). Further, they suggest that the presence of a sparsely distributed food resource may result in relatively large-ranging patterns by resident animals in the population.

The Koala is considered highly unlikely to be impacted via subsidence impacts from the Project. Subsidence is highly unlikely to result in the loss of Koala feed trees across the Subject Land. Potential impacts for the Koala are related to clearing for surface infrastructure, primarily the proposed Ventilation Shaft Site No 5A and ETL.

A Koala was heard calling from the vicinity of Ventilation Shaft Site No 5A in response to call playback survey (Figure 13). No preferred feed trees are present within Ventilation Shaft Site No 5A, which is dominated by *Corymbia gummifera*, *Eucalyptus haemastoma* and *Eucalyptus racemosa*. Koala SAT surveys

and spotlighting did not detect Koalas within Ventilation Shaft Site No 5A, however SAT surveys in other areas of the same PCT did, which demonstrates that Koalas may be using this area.

A known area of resident Koalas occurs within Sandstone Transition Forest areas approximately 450 m north of Ventilation Shaft Site No 5A. An adult and joey were observed alongside Fire Trail No. 6 during the survey. Koalas were observed within areas mapped as core habitat 450 m north regularly during spotlighting and call playback and Koala scats were relatively dense throughout these areas where searches were done sporadically. Koala scats were also recorded beneath *Eucalyptus punctata* within Sandstone Gully Peppermint Forest approximately 170 m north of Ventilation Shaft Site No 5A. Sandstone Gully Peppermint Gully Forest borders the Ventilation Shaft Site No 5A but does not occur within it.

PCT 1245 has been mapped at the Dendrobium Carpark Extension site, is located adjacent to areas that contains preferred Koala feed trees, and as such, has been included as habitat despite not being of ideal habitat quality.

A species polygon as shown on Figure 14o has therefore been provided for the direct impact associated with the habitat for the species (Table 33).

Table 33. Areas of PCTs subject to direct impact that constitute species polygon for Koalas

PCT ID	Vegetation zone	Surface infrastructure	Area (ha)
1083	Good	Ventilation Shaft Site No 5A	13.38
1083	Good	Ventilation construction – water shaft and pipeline	0.14
1083	Good	Ventilation construction – Fire Trail Upgrade	0.10
1250	Good	Ventilation construction – Fire Trail Upgrade	0.01
1250	Good	ETL	1.00
1083	Good	ETL	2.89
1245	Low	Dendrobium Pit Top Carpark Extension	0.17
Total species polygon area (ha) associated with direct impacts			**17.69**

4.4.3 Eastern Pygmy Possum – direct impacts

The Eastern Pygmy-possum is found in a broad range of habitats from rainforest through sclerophyll forest and woodland to heath, but in most areas woodlands and heath appear to be preferred (OEH 2017). The species is an important pollinator, feeding largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes. It shelters in hollows, able to utilise a range of sizes, particularly small hollows, and may also be found sheltering in rotten stumps, abandoned bird nests, ringtail possum dreys and may also construct its own dreys and have multiple nesting sites within its home range (OEH 2017).

There are two Bionet records for Eastern Pygmy-possums within the Subject Land from 1997 and the species was recorded by Niche in Ventilation Shaft Site No 5A, approximately 130 m from the transmission easement and within the broader area on infrared cameras.

The entire Subject Land (with the exception of cleared land) comprises preferred habitat for the Eastern Pygmy-possum. However, the species habitat is considered unlikely to be indirectly impacted by subsidence to an extent that would modify the species life cycle (section 4.6).

While the species may occasionally utilise the low condition regenerating vegetation for foraging, these vegetation zones would not be modified to facilitate the Project, except for the low vegetation in the proposed Ventilation Shaft Site No 5A. Therefore, the species polygon is composed of all vegetation in a

good condition that would be subject to clearing or modification, and low condition vegetation in the proposed Ventilation Shaft Site.

The species polygon for the Eastern Pygmy possum has been provided on Figure 14c (Table 34).

Table 34. Areas of PCTs subject to direct impact that constitute species polygon for Eastern Pygmy-possum

PCT ID	Vegetation zone	Surface infrastructure	Area (ha)
1083	Good	Ventilation Shaft Site No 5A	13.38
1083	Low	Ventilation Shaft Site No 5A	1.26
1083	Good	Ventilation construction – water shaft and pipeline	0.14
1083	Good	Ventilation construction – Fire Trail Upgrade	0.10
1250	Good	Ventilation construction – Fire Trail Upgrade	0.01
1250	Good	ETL	1.00
1083	Good	ETL	2.89
1245	Low	Dendrobium Pit Top Carpark Extension	0.17
Total species polygon area (ha) associated with direct impacts			**18.95**

4.4.4 Large-eared Pied Bat – direct impacts

Sufficient survey has been undertaken to exclude Large-eared Pied Bats from the Biodiversity Assessment Development Footprint, except for the Dendrobium Pit Top Carpark Extension. The Dendrobium Pit Top Carpark Extension contains suitable habitat for foraging as there are nearby records for the species. It therefore has assumed that the species may use the foraging habitat in the Dendrobium Pit Top Carpark Extension.

The portion of the species polygon impacted for the Large-eared Pied Bat is therefore the entire area of native vegetation within the Dendrobium Pit Top Carpark Extension, which amounts to 0.17 ha and as shown on Figure 14d (Table 35).

Table 35. Areas of PCTs subject to direct impact that constitute species polygon for Large-eared Pied Bat

PCT ID	Vegetation zone	Surface infrastructure	Area (ha)
1245	Low	Dendrobium Pit Top Carpark Extension	0.17
Total species polygon area (ha) associated with direct impacts			**0.17**

4.4.5 Southern Myotis – direct impact

The Southern Myotis would be directly impacted by clearing of potential roosting and breeding hollow-bearing trees that occur within 200 m of watercourses that contain stream morphology suitable for foraging, i.e., watercourses containing pools of 3 m or wider. A buffer was applied to suitable foraging habitat and intersected with the validated vegetation in the direct impact area to generate the areas of direct impact to the Southern Myotis habitat. The buffer areas encompassed portion of the Biodiversity Assessment Development Footprint as provided in Table 36, and shown on Figure 14k.

Table 36. Areas of PCTs subject to direct impact that constitute species polygon for the Southern Myotis

PCT ID	Vegetation zone	Surface infrastructure	Area (ha)
1083	Good	Ventilation Shaft Site No 5A	4.38
1083	Good	ETL	0.13
1250	Good	Ventilation construction – Fire Trail Upgrade	0.01
1250	Good	ETL	0.36
Total species polygon area (ha) associated with direct impacts			**4.88**

4.5 Indirect impacts

Indirect impacts that are to be considered in a BDAR are provided in section 8.2 of the BAM. Indirect impacts that are relevant to the Project are detailed below.

4.5.1 Subsidence and its potential impacts to terrestrial ecology values

Predictions regarding the likelihood and potential impact of subsidence for the Project were investigated and reported by MSEC (2022). Natural surface features within the Subject Land sensitive to subsidence movements identified by MSEC (2022) include the following:

- Drainage lines.
- Cliffs.
- Rocky outcrops steep slopes.
- Swamps, wetlands, and water related ecosystems.

These features provide habitat for a range of biodiversity, therefore consideration of the potential effects of subsidence on these features and threatened biodiversity is addressed in this report.

Forest and woodland vegetation types that occur away from drainage lines, watercourses and clifflines are unlikely to be susceptible to subsidence related impacts. Cracks in the ground surface may appear, but it is highly unlikely that the hydrology would be influenced to such a state that the woodland/forest vegetation would result in significant die back events or changes to floristics and structure.

The potential effects of subsidence include:

- Fracturing of river and creek beds, which may result in:
    - surface water flow diversion in the streams.
    - reduced flows and pool water levels.
- Changes in levels of ponding, scouring or desiccation due to mining induced tilt.
- Instability and rock falls along cliff-faces.
- Slippages, erosion and rock falls on steep slopes and rock ledges.

A summary of the predicted impacts that the Project may have on natural surface features sensitive to subsidence (as described by MSEC 2022), and the associated potential impacts to ecology, are described in Table 37.

The potential for subsidence related prescribed impacts, are addressed in section 4.6.

Table 37. Subsidence Related Impacts to Biodiversity (MSEC 2022)

Natural feature	Description of natural feature	Subsidence impact (MSEC 2022)
Avon River	The Avon River commences near Calderwood, within the Wollongong LGA and flows generally north reaching its confluence with the Cordeaux River, south of the Wilton township. The Avon River is located west of the Area 5. The Avon River does not occur within 600 m of the Subject Land	The Avon River is located at minimum distances of 900 m from the proposed longwalls. At these distances, the named streams are not predicted to experience measurable conventional subsidence effects.
Cordeaux River	The Cordeaux River commences below Mount Keira, within the Wollongong LGA and flows generally north and northwest joined by the Avon River before its confluence with the Nepean River, south of the Wilton township. The Cordeaux River is located to the south of Area 5. The Cordeaux River does not occur within 600 m of the Subject Land	The Cordeaux River is located more than 1.9 km from the proposed longwalls. At this distance, the Cordeaux River is not predicted to experience measurable conventional subsidence effects.
Donalds Castle Creek	Donalds Castle Creek is located to the east of the proposed longwalls. Donalds Castle Creek generally flows in a northerly direction and drains into the Cordeaux River. The bed of the creek comprises exposed bedrock containing rockbars with standing pools. There are also other controlling features including boulderfields, riffle zones and debris accumulations. Donalds Castle Creek does not occur within 600 m of the Subject Land.	Donalds Castle Creek is located more than 700 m from the proposed longwalls. At is distance, the Donalds Castle Creek is not predicted to experience measurable conventional subsidence effects.
Wongawilli Creek	Wongawilli Creek is located to the east of the proposed longwalls. Wongawilli Creek is a third order perennial stream with a small base flow and increased flows for short periods of time after each significant rain event. Pools in the creek are permanent (based on monitoring to date) and naturally develop behind the rockbars and at the sediment and debris accumulations. Wongawilli Creek does not occur within 600 m of the Subject Land.	Wongawilli Creek is located more than 1.9 km from the proposed longwalls. At this distance, Wongawilli Creek is not predicted to experience measurable conventional subsidence effects.
Unnamed streams	Unnamed streams are located across the Subject Land. There are first and second order streams located directly above the proposed mining area. The unnamed streams that are located directly above or adjacent to the proposed longwalls have been labelled	The streams have exposed bedrock with some standing pools. There are also other controlling features including boulderfields, riffle zones and debris accumulations. The total length of the third order sections of the streams within the 35° angle of draw and the 600 m boundary are approximately 1.3 km and 2.2 km, respectively. Fracturing could occur along the third order sections of the streams located within 400 m of the proposed mining area. The potential for Type 3 impacts has been based on the experience from mining in Area 3B. It has been assessed that approximately 15 % of the stream controlling features (i.e. rockbars, steps and other controlling features) located

Natural feature	Description of natural feature	Subsidence impact (MSEC 2022)
	AR19, AR31, AR32, DC8, DC9, DC10, LA12, LA13, LA14, LA15 and LA17.	within 400 m of the proposed longwalls could experience Type 3 impacts. This represents approximately five rockbars along the third order sections of the streams. The first and second order sections of the streams located directly above the proposed longwalls are expected to experience the full range of predicted subsidence effects. There is potential for locally increased ponding due to the mining-induced tilt along streams DC8 and, to lesser extents, the other first and second order streams. There could be localised tilt-induced ponding areas along the unnamed streams where the natural gradients are low immediately upstream of the longwall chain pillars or upstream of the perimeter of the proposed mining area. It is expected that fracturing of bedrock would occur along the sections of the streams that are located directly above the proposed longwalls. Fracturing can also occur outside the extents of the proposed longwalls, with fracturing possible at distances up to approximately 400 m. Surface water flow diversions are likely to occur along the sections of streams that are located directly above and adjacent to the proposed longwalls.
Cliffs	A cliff is defined as a continuous rockface having a minimum height of 10 m, a minimum length of 20 m and a minimum slope of 2 to 1 (i.e. having a minimum angle to the horizontal of 63°). There are 12 cliffs that have been identified directly above the proposed longwalls in Area 5. There are also 32 additional cliffs that are located outside the extents of the proposed longwalls and within the 35° angles of draw. There are 12 cliffs that have been identified directly or partially above the proposed longwalls in Area 5, being Refs. DC8-CF1, DC8-CF2, DC8-CF3, DC8-CF4, DC8-CF6, LA8_CF10, LA8A_CF1, LA14-CF1, LA14-CF2, LA15-CF1, LA15-CF2 and LA17-CF1. There are an additional 32 cliffs that are located outside of the proposed mining area and within the 35° angle of draw.	**Impact Assessments for the Cliffs** The overall lengths of each of the cliffs within the Subject Land range between 20 m and 200 m. It is noted that the longer cliff lines comprise several separate cliffs and minor cliffs and are intermittently discontinuous. The total length of the cliffs located directly or partially above the proposed longwalls is approximately 0.8 km. The total length of the cliffs located outside the mining area and within the 35° angle of draw is approximately 1.4 km. The cliffs located directly above the proposed longwalls could experience fracturing and, where the exposed rock face is marginally stable, this could result in cliff instabilities. It has been estimated that between 7 % and 10 % of the total length, or between 3 % and 5 % of the total face area of the cliffs located directly or partially above the proposed longwalls in Area 5 would be impacted. This represents a total length of impact of approximately 60 m to 80 m, or a total face area of impact of approximately 300 m^2 to 500 m^2. Isolated rock falls could occur at some of the cliffs located outside the extents of the proposed longwalls, which would represent less than 1 % of the affected cliffs. It is estimated that these impacts would affect a total length of less than 20 m or a face area of less than 100 m^2.
Rocky outcrops and steep slopes	Rock outcrops and steep slopes are located across the Subject Land. These features predominately occur along the alignments of the streams.	These features are expected to experience the full range of predicted movements. The potential impacts include tension cracks at the tops of the rock outcrops and steep slopes, buckling of the bedrock at the bottoms of the rock outcrops, and compression ridges at the bottoms of the steep slopes. The surface deformations are expected to be similar to those previously observed at the Dendrobium Mine, having crack widths up to approximately 400 mm, but typically in the order of 100 mm to 150 mm in width. It is possible, therefore, that remediation may be required in some areas, including infilling of surface cracks with soil or other suitable materials, or by locally regrading and recompacting the surface.
Swamps, wetlands and water	A description of Coastal Upland Swamps can be found in section 4.5.2.	**Impact Assessments for the Swamps** The predicted post-mining grades within the swamps are similar to the natural grades and, therefore, it is not expected that there would be adverse changes in ponding or scouring within the swamps due to the mining-induced tilt. It is predicted that there would not be significant changes in the distribution of the stored surface waters within

Natural feature	Description of natural feature	Subsidence impact (MSEC 2022)
related ecosystems		the swamps due to the predicted mining-induced tilt or vertical subsidence. Fracturing of bedrock is expected to occur beneath the swamps that are located directly above the proposed longwalls. The soil crack and rock fracture widths due to the extraction of the proposed longwalls in Area 5 are expected to be similar to but, on average, less than those previously observed at the Dendrobium Mine. The measured surface deformations were generally less than 50 mm in width (i.e. 79 % of the cases) but had widths between 50 mm and 150 mm in 15 % of cases, between 150 mm and 300 mm in 5 % of cases and greater than 300 mm in approximately 1 % of cases. The discussions on the potential impacts due to changes in the surface water flows, groundwater and the environmental consequences for the swamps are provided by the specialist surface water, groundwater and ecology consultants on the Project. **Potential for changes in surface water flows due to mining-induced tilts** Mining can potentially affect surface water flows through swamps, if the mining-induced tilts are much greater than the natural gradients, potentially resulting in increased levels of ponding or scouring, or affecting the distribution of the water within the swamps. The headwater swamps are located on the sides of the valleys and, therefore, natural gradients are greater than those along the streams. It is unlikely, therefore, that there would be large-scale adverse changes in the levels of ponding or scouring of the swamps based on the predicted mining-induced tilt or vertical subsidence. Further discussions on the potential impacts due to changes in surface water flows and storage are provided by the specialist surface water consultant in the report by Hydro Engineering and Consulting (2022) and the specialist ecology consultant in the reports by Cardno (2022). Potential for cracking in the swamps and fracturing of bedrock Fracturing of bedrock has been observed in the past, as a result of longwall mining, where tensile strains have been greater than 0.5 mm/m or where the compressive strains have been greater than 2 mm/m. There are 15 swamps that have been identified entirely or partially above the proposed longwalls in Area 5, being Den86, Den99, Den100, Den101, Den102, Den106, Den107, Den108, Den109, Den110, Den111, Den114, Den121, Den122 and Den123. The predicted strains for these swamps are 4 mm/m tensile and 5 mm/m compressive based on the 95 % confidence levels. The valley infill swamps located directly above the longwalls (i.e. Den108, Den111 and Den 121) could also experience compressive strains of 10 mm/m to 20 mm/m due to valley-related effects. Fracturing could therefore occur in the bedrock beneath the swamps that are located directly above the proposed longwalls. Soil cracking could also be visible at the surface where the depth of bedrock is shallow. The range of potential fracture and crack widths in Area 5 has been based on that previously observed at the Dendrobium Mine.

Natural feature	Description of natural feature	Subsidence impact (MSEC 2022)
		The valley infill swamps have layers of organic soil that overlie the shallow natural surface soils and underlying bedrock along the alignments of the streams. In most cases, cracking would generally not be visible at the surface within these swamps, except where the depths of bedrock are shallow or exposed. The headwater swamps have soil layers which overly the bedrock on the valley sides. It is expected that the potential for fracturing in these locations would be less when compared to the bases of the valleys, where higher compressive strains occur due to the valley-related movements, and due to the higher depths of cover along the valley sides. The valley infill swamps located directly above the proposed longwalls (i.e. Den108, Den111 and Den 121) are also predicted to experience up to 375 mm upsidence and 375 mm closure. These valley-related effects could result in the dilation of the strata beneath these valley infill swamps. It has been previously observed that the depth of fracturing and dilation of the uppermost bedrock, resulting from valley-related effects, is generally in the order of 10 m to 15 m (Mills 2003, Mills 2007, and Mills and Huuskes 2004). The dilated strata beneath the streams within or upstream of the valley infill swamps could result in the diversion of some surface water flows beneath parts of these swamps. The streams upstream of these swamps flow during and shortly after rainfall events. Where there is no connective fracturing to any deeper storage, it is likely that surface water flows will re-emerge at the limits of fracturing and dilation. There are seven swamps that are located outside but within 600 m of the proposed longwall (i.e. Den85, Den97, Den98, Den103, Den104, Den105 and Den120). The predicted conventional strains for these swamps are less than 0.5 mm/m tensile and less than 2 mm/m due to the mining of the proposed longwalls. However, the sections of the valley infill swamps located within the 35° angle of draw could experience compressive strains in the order of 2 mm/m to 5 mm/m due to the valley-related effects. Fracturing has been observed in streams located outside the extents of previously extracted longwalls in the NSW coalfields. Fracturing has been observed up to 400 m from longwalls; however, these have occurred within large valleys and have not resulted in adverse impacts. Hence, it is possible that minor and isolated fracturing could occur in the bedrock beneath the swamps located outside the extents of the proposed longwalls; however, it is unlikely to result in adverse surface impacts on these swamps.

4.5.2 Inadvertent impacts on adjacent habitat or vegetation

Inadvertent impacts to adjacent habitat surrounding the areas of direct impact are not likely to occur because mitigation measures will be employed to prevent adjacent vegetation and habitat from inadvertently being impacted (section 5). These include:

- Demarcation for the boundary of vegetation clearing at the edge of the Biodiversity Assessment Development Footprint where it occurs immediately adjacent to native vegetation.
- Marking and flagging of *Acacia bynoeana* and *Epacris purpurescens* var. *purpurescens* that occur along the existing Fire Trail as shown on Figure 10.
- Signposting to inform Project personnel and site visitors of areas of conservation value to restrict entry or inform behaviour that will reduce incidental interactions with fauna.
- Contractor education about demarcated areas.
- Parking restricted to designated areas.
- Relevant sign posting of no/go zones.

During construction there is potential for equipment to trigger a fire ignition event (e.g. welding). The potential for this to occur is higher during the hotter months. Mitigation measures include Catchment Closures during Fire Ban Days, fire extinguishers in vehicles, spill kits etc. To date, no bushfires have started from contractors/employees at Dendrobium Mine during construction activities. The Dendrobium Mine Bushfire Management Plan will incorporate bushfire management protocols to prevent and deal with the potential for bushfire and IMC Hot Work Permits will detail controls to mitigate the risk of ignition from hot works such as welding.

4.5.3 Reduced viability of adjacent habitat due to edge effects

Edge effects are indirect impacts created because of fragmentation of habitat, that may lead to increased light, noise, vibration, weeds or altered temperature and humidity, which often result in changes to the ecosystem that occurs at or near the edge.

4.5.3.1 Clearing of native vegetation

The Project would result in the clearance of native vegetation and habitat totalling an area of approximately 19.85 ha, associated with the construction and operation of surface infrastructure. Most of the clearing would be associated with Ventilation Shaft Site No 5A (14.64 ha) and would lead to an increase in edge effects around cleared areas at this location. The Ventilation Shaft Site has been situated such that it runs along Fire Trail 6, which is already subject to clearing and edge effects, such that the proposed clearing will not fragment areas of native vegetation and limits, as practicable, the introduction of additional edge effects. The proposed Ventilation Shaft Site for the Project is to be rehabilitated to a post-closure land use of forest, similar to the surrounding vegetation.

An ETL would be required to service the Ventilation Shaft Site. The proposed ETL easement would follow the existing Fire Trail, along an existing fire break for much of the traverse but will result in the removal of in-tact native vegetation on the edge of the Fire Trail (3.99 ha). Native regeneration that occurs along the existing easement is currently maintained at a low height by WaterNSW to act as a fire break (3.41 ha).

Where possible, the areas proposed for surface infrastructure have utilised existing disturbed areas, to limit or avoid the creation of new edge effected areas and fragmentation of habitats. Because of this, the Project would not result in the establishment of new tracks that fragment areas of habitat from one another or create new linear barriers to species movement.

None of the native vegetation to be cleared is listed as a TEC on the BC Act or EPBC Act, and no threatened flora were recorded within the areas proposed for surface infrastructure (direct impact). On this basis, it is considered unlikely that edge effects because of the clearing of native vegetation would impact upon TEC's or threatened flora.

Habitat for threatened fauna would be impacted by the clearing of native vegetation, as discussed in section 4.4. The Ventilation Shaft Site has the potential to fragment fauna habitat in the area, however there is extensive habitat within the immediate surrounding locality to not impeded fauna movement.

All surface infrastructure would be progressively rehabilitated upon decommissioning and will eventually be entirely revegetated to a native PCT, which will recreate fauna habitat. Impacts to fauna from vehicles during the construction and operational phase of the surface infrastructure are anticipated to be low. The speed limit within the WaterNSW land is 40 km/hour on unsealed fire trails.

The new edges of the surface infrastructure could facilitate the establishment and spread of introduced plant species. In the context of the proposed Ventilation Shaft Site and associated infrastructure, the sites occur within a relatively intact natural landscape with minimal weeds. The spread of introduce weeds would typically be limited to machinery/vehicles/personnel carrying weed seed. As such, weed spread is not likely to contribute to significant management effort for the proposed Ventilation Shaft Site compared to if the site was in a highly weed infested area. Appropriate monitoring and control measures (such as vehicle wash down and weed control) would be implemented at the surface infrastructure sites during and after construction, to assist in preventing weed invasion. The Dendrobium Pit Top Carpark Extension area is currently subject to weeds. Weed control immediately surrounding the carpark would be undertaken routinely in accordance with existing management plans.

All native vegetation areas would be rehabilitated following decommissioning as per IMC's closure standards and rehabilitation strategy (see section 5.2.3), all potential indirect impacts minimised through implementation of the mitigation measures detailed in section 5.1. These include:

- Demarcation for the boundary of vegetation clearing at the edge of the Biodiversity Assessment Development Footprint where it occurs immediately adjacent to native vegetation.
- Signposting to inform Project personnel and site visitors of areas of conservation value to restrict entry or inform behaviour that will reduce incidental interactions with fauna.
- Weed management and pest management and monitoring will be implemented.
- Sediment controls to be applied in areas that may result in runoff during construction and operation.

4.5.3.2 Noise and light disturbance

Noise associated with construction works has the potential to disturb fauna species. Surface construction activities would occur during the daytime at all surface facilities. Night-time construction activities would not occur at any of the existing or proposed surface facilities, with the exception of the Ventilation Shaft Site, which would occur 24 hours per day, seven days per week (i.e. during the night-time period). All construction activities would be temporary in nature and would be managed to minimise construction noise impacts. Given the short-term duration, impacts to native fauna are likely to be minor.

The Ventilation Shaft Site would have potential to generate ongoing operational noise mainly through the fans proposed to operate at the upcast shaft. Predicted operational noise levels at other Project facilities (e.g. Dendrobium Pit Top, Kemira Valley Coal Loading Facility etc.) would be similar to existing noise levels

for the Dendrobium Mine. It is unlikely that the noise generated from Ventilation Shaft Site would be such that local populations of fauna would move out of the immediate vicinity resulting in impacts to fauna populations and lifecycles.

Existing noise mitigation and management measures would be implemented for the Project where applicable at the existing and proposed surface facilities, and the existing Dendrobium Mine Noise Management Plan would be reviewed and revised accordingly.

Lighting associated with surface operations is mostly fixed lighting for safety, security, and operational purposes. Potential lighting impacts from visual stray light are associated with flood lighting of key operational areas such as Dendrobium Pit Top and the Kemira Valley Coal Loading Facility (e.g. yards, carparks etc.). The Project is not likely to increase the artificial lighting impacts at existing surface facilities.

Additional lighting impacts associated with the Project would be related to the Ventilation Shaft Site (during construction phase – which would occur 24 hours, 7 days per week) and at the Cordeaux Pit Top, when used for operational access. These sites are located most proximal to bushland setting and hence most likely to impact on biodiversity in the immediate vicinity. Night lighting impacts at the proposed Ventilation Shaft Site due to construction would be localised and temporary. Standard lighting management measures and controls consistent with those specified in the existing Dendrobium Mine Lighting Management Plan would be implemented during Project Ventilation Shaft Site construction activities to reduce potential lighting impacts. Given the construction phase is temporary, no long-term impacts associated with lighting are predicted to occur.

No other night lighting for construction activities is required (all other construction during the day) nor are there further changes to current operational night lighting arrangements proposed for the Project.

Existing mitigation and management measures would continue for the Dendrobium Mine and would be implemented for the Project where applicable (e.g. standard lighting mitigation measures at the existing Dendrobium Pit Top carpark would be implemented at the proposed Dendrobium Pit Top Carpark Extension). The existing Dendrobium Mine Lighting Management Plan would be reviewed and revised accordingly for the Project.

4.5.3.3 Vehicle strike

Impacts to fauna from vehicles during the construction and operational phase of the surface infrastructure are anticipated to be low. The speed limit within the WaterNSW land is 40 km/hour in unsealed areas, and construction activities at night would be restricted to a skeleton drilling crew.

Monitoring of vehicle strikes would be undertaken, which may inform further protocols to reduce potential impacts (e.g. slower speed limits). Vehicle strikes are also discussed further in relation to prescribed impacts (section 4.6.5).

4.5.4 Increased risk of starvation or exposure and loss of shade or shelter

The Project would result in a direct impact to 19.85 ha of native vegetation (section 4.1). Given the location of the Subject Land within a relatively intact landscape, it is highly unlikely that the Project would result in a higher risk of starvation and loss of shelter for local fauna populations.

Potential impacts to habitat because of subsidence is detailed in section 4.6. Given the surrounding vegetation and habitat, even if the likelihood of subsidence as predicted by MSEC (2022) occurs resulting in

impacts to the foraging and sheltering habitats present in the Subject Land, these impacts are unlikely to reduce the availability of habitat to the extent that local populations would be put at an increased risk of starvation or exposure.

4.5.5 Loss of breeding habitat

Breeding habitat in the Subject Land includes rocky outcrops (caves and crevices), rocky areas, hollow-bearing trees, pools and swamps.

The Project would result in the following impacts to potential breeding habitat:

- Potential disturbance of Broad-headed Snake breeding habitat and potential death of individuals due to minor rockfall or cliff line collapse (assessed in section 4.6.2).
- Removal of up to 388 hollow-bearing trees to support the surface infrastructure. A register for the hollow-bearing trees has been provided in Appendix 7, and the location of the trees provided on Figure 13.
- Subsidence has the potential to result in the loss of pools that could support breeding habitat for Littlejohn's Tree Frog, Red-crowned Toadlet and Giant Burrowing Frog (section 4.6.4).
- Subsidence has the potential to result in changes to three swamps (Den 111, 121 and 122) that have been identified by Invertebrate Identification (2021) as being suitable potential breeding habitat for Giant Dragonfly (section 4.6.4).

4.5.6 Removal and disturbance of rocks, including bush rock

The direct impacts associated with the surface infrastructure would result in the removal of 19.85 ha of native vegetation (section 4.1).

The Project would result in the removal of some surface rocks that are scattered throughout the location of Ventilation Shaft Site No 5A. The potential for threatened fauna to utilise the surface rocks at Ventilation Shaft Site No 5A has been assessed during the candidate species assessment provided in section 2.6.4.

The other surface area locations would not require the removal of surface rocks.

4.5.7 Erosion and Sedimentation

Erosion of soils during construction and operation of the Project may involve the following:

- Alteration of soil structure beneath infrastructure items, and roads (these have been taken into consideration within the Subject Land calculations).
- The increase of surface water flow from the Subject Land during rain events into the woodland areas around the surface infrastructure.

Mitigation measures will be put in place during the construction and operation to limit the erosion and sedimentation and deposition of soil particulates in drainage lines and vegetation surrounding the surface infrastructure. Specifically, the Ventilation Shaft Site has been planned with a zero-surface water discharge design objective to avoid water quality impacts on downstream waters and biodiversity. This would be achieved by discharge of sediment basin and process water to a dewatering borehole into the mine workings.

With the mitigation measures in place, it is likely that the potential for erosion and sedimentation would be contained within the Subject Land.

4.5.8 Air Quality/Dust Emissions

Most potential air quality related impacts due to the Project are related to the development/expansion of the Project surface facilities rather than the extension of the underground mining of coal. As such, dust and odour emissions associated with Ventilation Shaft Site No 5A, including pollutants from pre- and post-drainage flaring, as this location is the most isolated and proximal to bushland settings.

Background nitrogen dioxide concentrations proximal to the Ventilation Shaft Site are expected to be low to negligible and therefore cumulative impacts due to flaring are not expected.

The impact of dust emissions at the Ventilation Shaft Site is predicted to be minor, with short-term minor dust during construction. Such short-term impacts are likely to have negligible impacts to biodiversity.

4.5.9 Weeds, pathogens, and pest animals

The *NSW Biosecurity Act 2015* (Biosecurity Act) provides for the protection from the threat of exotic animals, plants, pests, diseases, and contaminants throughout the NSW. The Biosecurity Act in relation to the Project, regulates for the containment or suppression of existing weeds, pest animals and pathogens and the prevention of new incursions. Under the Biosecurity Act, all persons have a general biosecurity duty to prevent, eliminate or minimise the spread or introduction of identified biosecurity matters.

The condition of vegetation across most of the Subject Land is in relatively undisturbed condition, owing to the restricted access through WaterNSW Special Areas. The BAM plots collected through most the Subject Land support that weed occurrence is absent or very low.

The area where weeds occupy much of the Biodiversity Assessment Development Footprint, is located at the Dendrobium Pit Top Carpark Extension. Dominant weeds include: *Chloris gayana, Ligustrum lucidum, Ligustrum sinense, Paspalum dilatum, Bidens Pilosa, Verbena botanisensis, Conyza bonariensis, and Cinnamomum camphora.* The remainder of the surface infrastructure areas are relatively free of weed incursion.

The Project has potential to introduce weed species however the potential is relatively low given the mitigation measures that would be employed (section 5).

A total of four vertebrate pest species were recorded during surveys for the Project:

- Cat (*Felis catus*).
- Fox (*Vulpes vulpes*).
- House Mouse (*Mus musculus*).
- Rabbit (*Oryctolagus cuniculus*).

The Project has the potential to improve access or increase predation of native fauna by pest animal species through the clearing of native vegetation, however the potential is relatively low given the mitigation measures that would be employed (section 5).

No evidence of existing plant or soil pathogens such as Myrtle Rust *Puccinia psidii* or *Phytophthora cinnamomi* were identified in the Subject Land during the field survey. The Project would mitigate the risk of introducing these pathogens to the Subject Land as detailed in section 5.

Examples of mitigation measure to be employed to minimise the potential for impacts associated with weeds, pathogens and pest animals include:

- Appropriate monitoring and control measures (such as vehicle wash down) would be implemented at the surface infrastructure sites during and after construction, to assist in preventing weed invasion.
- Weed control immediately surrounding the Dendrobium Pit Top Carpark Extension area that is subject to existing weeds would be undertaken routinely in accordance with existing management plans.
- Weed management and pest management and monitoring to be implemented in the relevant Management Plans for the Project.

Based on the above, the Project is consistent with provisions of the Biosecurity Act.

4.6 Prescribed biodiversity impacts

As per the BAM, the assessor must assess the prescribed impacts that the Project will, or is likely to have, on threatened entities and their habitat, considering:

- the TECs, threatened species and their habitat;
- ongoing or future impacts that the Project will have on biodiversity values, considering the measures taken to avoid or minimise impacts; and
- the spatial and temporal extent of the impacts likely to result from changes in land use arising from the Project, in accordance with subsections 8.3.1–8.3.6 of the BAM.

The BDAR must include an assessment of any prescribed impacts of the Project on threatened entities and their habitat, and describe:

- The nature, extent, frequency, duration, and timing of prescribed impacts that may occur:
    - i. during construction;
    - ii. during operation; and
    - iii. that are uncertain (predictions should be made).
- The consequences of prescribed impacts on biodiversity values.
- Any limitations to data, assumptions, and predictions about impacts on biodiversity.

An assessment for each of the relevant prescribed biodiversity impacts have been completed in the following sections.

Predictions regarding the likelihood and potential impact of subsidence for the Project were investigated and reported by MSEC (2022), with information application to this BDAR summarised in 4.5.1.

4.6.1 Prescribed impact entities

Prescribed impact entities are identified in section 2.7.

This includes:

- One TEC – Coastal Upland Swamps which is listed as Endangered on the BC Act and EPBC Act has the potential to be impacted by changes in hydrology due to subsidence.
- Three threatened flora species (*Cryptostylis hunteriana, Epacris purpurescens var purpurscens, and Pultenaea aristata*) have habitat within Coastal Upland Swamps, and if are present, may potentially be impacted by changes to swamp habitat.
- One threatened flora species (*Pomaderris brunnea*) may have habitat along the gully environments adjacent to riparian areas.
- Four threatened fauna species (Giant Dragonfly, Littlejohn's Tree Frog, Giant Burrowing Frog and Eastern Pygmy Possum) that have habitat within Coastal Upland Swamps, and if present, may have habitat potentially impacted through changes to swamp habitat.
- Three threatened fauna species (Broad-headed Snake, Southern Myotis and Large-eared Pied Bat) have the potential to be affected by prescribed impacts on rocky outcrops (caves and crevices) and rocky areas.
- Four threatened fauna species (Red-crowned Toadlet, Littlejohn's Tree Frog, Giant Burrowing Frog, and Southern Myotis) may have habitat along the riparian environments that may be subject to loss of pools.

An assessment for each of the relevant prescribed biodiversity impacts has been completed in the following sections.

4.6.2 Karst, caves, crevices, cliffs, rocks and other geological features of significance

An assessment of the impacts of the Project on threatened entities associated with karst, caves, crevices, cliffs, rocks and other geological features of significance is provided in Table 37. Impacts to crevices, cliffs and rocks may result in impacts to Broad-headed Snake habitat, Southern Myotis and Large-eared Pied Bat habitat.

a) predict the nature, extent and duration of short-term and long-term impacts

According to MSEC (2022), there are 12 cliffs that have been identified directly above the proposed longwalls in Area 5 (Figure 6). There are also 32 additional cliffs that are located outside the extents of the proposed longwalls and within the Subsidence Assessment Subject Land. The cliffs located directly above the proposed longwalls could experience fracturing and, where the exposed rock face is marginally stable, this could result in cliff instabilities. It has been estimated that between 7% and 10% of the total length, or between 3% and 5% of the total face area of the cliffs located directly or partially above the proposed longwalls in Area 5 would be impacted. This represents a total length of impact of approximately 60 m to 80 m, or a total face area of impact of approximately 300 m^2 to 500 m^2 located directly or partially above the proposed longwalls within the Subsidence Assessment Subject Land.

Isolated rock falls could occur at some of the cliffs located outside the extents of the proposed longwalls, which would represent less than 1% of the affected cliffs. It is estimated that these impacts would affect a total length of less than 20 m or a face area of less than 100 m^2. As such, we have therefore assumed that there will be less than 20 m of potential long-term impacts to cliff habitat outside the extents of the proposed longwalls within the Subsidence Assessment Subject Land.

Rock outcrops and steep slopes are located across the Subsidence Assessment Subject Land. These features predominately occur along the alignments of the streams. These features are expected to experience the full range of predicted movements. The potential impacts include tension cracks at the tops of the rock outcrops and steep slopes, buckling of the bedrock at the bottoms of the rock outcrops, and compression ridges at the bottoms of the steep slopes. The surface deformations are expected to be similar to those previously observed at the Dendrobium Mine, having crack widths up to approximately 400 mm, but typically in the order of 100 mm to 150 mm in width. The cracks along steep slopes would likely result in a relatively short-term impact given the cracks overtime would fill with debris.

Outside of the rock outcrops, steep slopes and cliff lines identified, rocks that are occurring generally within the forested sections of the Subsidence Assessment Subject Land are not considered sensitive to subsidence impacts.

(b) predict the consequences of impacts on the threatened entities identified in Subsection 6.1.1

Impacts of subsidence may result in loss or injury to threatened fauna utilising the habitats along cliffs, steep slopes, and rocky areas, if the species were to use the portion of the feature at the time of impact. However, these impacts are likely to be localised and not likely to lead to the loss of an entire sub-population of threatened species.

Long-term impacts may include destruction of crevices that may be used as roosting for the Southern Myotis and Large-eared Pied Bat if the species were to use the impacted portion of the feature. Although it is noted that in the case of Southern Myotis, this species may also occupy tree hollows and as such is unlikely to be reliant on crevices for roosting (Campbell 2009). Reptiles, such as the Broad-headed Snake are less likely to be impacted by long-term impacts as they are likely to adjust to and utilise the altered rocky habitat.

Based on the MSEC (2022) predictions, there is potential for habitat to be impacted by the Project, however impacts are predicted to be minor (up to 1% of the feature impacted) and, as this impact is not expected to lead to the loss of a breeding population in the Subject Land or locality, the consequence to these species in a regional context are likely to be negligible as discussed in Table 38.

Table 38: Potential impacts to threatened species and threatened ecological communities associated with karst, caves, crevices, cliffs and rocks

Species	Assessment of potential impact on candidate species	Consequences for local and bioregional persistence
Broad-headed Snake	The Broad-headed Snake has a limited potential for breeding habitat within the Subject Land. This is in consideration of the very specific habitat required for sheltering. The species requires shelter under rocks with a west to north-west aspect and is usually found in rocky outcrops and sandstone ridgetops (OEH 2018b). Surveys for Broad-headed Snake did not detect the species; however, it has been previously recorded within the north-eastern boundary of Area 5 and in the locality. The lack of detection of the species and habitat mapping undertaken for the Project may indicate a limited occurrence, low level of	It is highly unlikely that the loss of approximately 0.12 ha of potential breeding habitat would result in a significant impact to the species such that its local and bioregional persistence would be adversely affected.

Species	Assessment of potential impact on candidate species	Consequences for local and bioregional persistence
	occupation, and potentially an overall sub-optimal habitat within the Subsidence Assessment Subject Land. Survey was not conducted during the optimal season for the species according to the TBCD (August-September), however was conducted during the period of greatest activity for the species, late spring through to mid-summer, (DSEWPC 2011), as well as March and July, when the species would be expected to be occupying winter sheltering habitats and detectable in such areas. Potential habitat for this species was modelled by mapping areas with a westerly to north-easterly aspect with slopes of 30 degrees or greater (this is a conservative model given the forementioned west to north-west habitat prescription). To account for movement, we have included a 30 m buffer to areas of rocky habitat (Figure 14h). Habitat modelling allowed for detection of cliffs and steep slopes with a favourable aspect for the species. Habitat modelling assisted in identifying areas in which to conduct field survey, however it was observed that much of the modelled area did not support preferred habitat for the species. Impacts to any potential habitat for this species is likely to be limited, based on previous observations of subsidence within adjacent mined areas and MSEC predictions of subsidence for the Project. MSEC (2022) predicts subsidence impacts such as rockfalls are limited in their extent. The limited rockfalls would need to be coincident with the restricted sheltering habitat for the Broad-headed Snake, and the subsidence impacts would need to be deleterious for impacts to occur to the species. As such, minimal impacts are predicted to occur for the Broad-headed Snake. A species polygon showing the exact area of impact for this species is not possible given the locations of rockfalls cannot accurately be predicted and they may or may not coincide with actual habitat for the Broad-headed Snake. As discussed in section 6.3, an offset amount of 0.12 ha (1,200 m^2) has been applied for this species. This area includes the maximum predicted area of cliff face impacts within and outside the extent of the proposed longwalls (600 m^2, MSEC 2022) and a further 600 m^2 to encompass adjacent steep slopes and outcropping areas.	
Southern Myotis	The TBCD (2021) notes that the Southern Myotis may have habitat within 'Bridges, caves or artificial structures within 200 m of riparian zone'. Whilst not mentioned specifically, crevices and overhangs may provide roosting habitat for the species. Such features are associated with the steep slopes and clifflines provided on Figure 14k. The species also utilises hollow-bearing trees for roosting. The Subject Land would have relatively extensive hollows that would not be impacted by the Project. Impacts to any potential habitat for this species is likely to be limited, based on previous observations of subsidence within adjacent mined areas, and MSEC predictions of subsidence for	Long-term impacts are unlikely given the abundance of high-quality breeding habitat that occurs in unimpacted areas in the vicinity of the Subject Land and in the locality.

Species	Assessment of potential impact on candidate species	Consequences for local and bioregional persistence
	the Project. MSEC (2022) predicts subsidence impacts such as rockfalls are limited in their extent. The limited rockfalls would need to be coincident with potential overhang/crevice habitat that the species occupies. Based on the MSEC predictions, and the availability of roosting habitat within the Subject Land, it may be reasonable to suggest that the impact may be relatively minor in scale. A species polygon has been discussed further in this section in relation to the loss of the potential foraging habitat.	
Large-eared Pied Bat	The TBCD (2022) states that the species is 'Found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes'. In terms of breeding habitat, the structure of maternity roosts has been recorded as very specific, being arch caves with dome roofs (DERM 2011), with identified breeding sites generally being within sandstone caves although overhangs may also be used. As cave features are absent from the Subject Land, suitable breeding habitat would be limited in occurrence along clifflines. The species is occasionally found in caves, mines, culverts and generally roosts in tree hollows. The Subject Land would have relatively extensive hollows suitable for roosting that would not be impacted by the Project. No Bionet records exist for the species within the Subject Land, and despite evident survey undertaken across the Avon and Cordeaux catchment, only two Bionet records exist in proximity to the Subject Land, approximately 1.5 km (2003) and 2.3 km (2007) from the Subject Land. The species was not detected within Area 5 during ultrasonic call recording surveys or harp trapping surveys in the extensive baseline surveys in 2016 (section 2.6.3). This may indicate a low likelihood of occurrence within the Subject Land. Furthermore, the lack of records during the survey, the lack of historic records, and lack of cave environments may reasonably suggest that the species does not have a breeding site nearby. Potential roosting habitats for this species may be indirectly impacted by subsidence. These potential indirect impacts include cracking and collapsing of rocky outcrops, overhangs, and cliffs. The potential for these impacts to occur however is likely to be minor. Based on the experience of mining at Dendrobium, Appin and Tower Collieries, there have been no large-scale cliff instabilities observed outside the extents of longwall mining. There have been small and isolated rockfalls observed outside the extents of mining, but these represent a very small proportion of the total length of cliffline. Given rock falls are likely to be minor and isolated, habitat features are unlikely to be greatly impacted by subsidence.	When all the factors discussed are considered together, it is highly unlikely that subsidence associated with the Project would result in a significant impact to the species such that its local and bioregional persistence would be adversely affected.

(c) justify predictions with appropriate modelling, relevant literature and other published sources (if available), or advice from experts.

The predictions and appropriate modelling of subsidence related impacts are detailed in MSEC (2022). The predictions have been relied upon to predict likelihood and severity of impacts to threatened species habitats. The predicted conventional subsidence parameters for the longwalls were determined using the IPM, which was developed by MSEC, and calibrated to local conditions based on the available monitoring data.

The database consists of detailed subsidence monitoring data from collieries in NSW including: Angus Place, Appin, Baal Bone, Bellambi, Beltana, Blakefield South, Bulli, Chain Valley, Clarence, Coalcliff, Cooranbong, Cordeaux, Corrimal, Cumnock, Dartbrook, Delta, Dendrobium, Eastern Main, Ellalong, Fernbrook, Glennies Creek, Gretley, Invincible, John Darling, Kemira, Lambton, Liddell, Mandalong, Metropolitan, Mt. Kembla, Munmorah, Nardell, Newpac, Newstan, Newvale, Newvale 2, South Bulga, South Bulli, Springvale, Stockton Borehole, Teralba, Tahmoor, Tower, Wambo, Wallarah, Western Main, Ulan, United, West Cliff, West Wallsend, and Wyee (MSEC 2022).

The database consists of the observed incremental subsidence profiles, which are the additional subsidence profiles resulting from the extraction of each longwall within a series of longwalls. It can be seen from the normalised incremental subsidence profiles within the database, that the observed shapes and magnitudes are reasonably consistent where the mining geometry and local geology are similar.

Subsidence predictions made using the IPM use the database of observed incremental subsidence profiles, the longwall geometries, local surface and seam information and geology. The method tends to over-predict the conventional subsidence effects (i.e. is slightly conservative) where the mining geometry and geology are within the range of the empirical database.

The MSEC (2022) subsidence predictions have been reconciled with the habitat requirements as per the TBCD for each subject threatened species, in order to provide an indication of the extent of habitat impact.

4.6.3 The impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range

(a) describe the nature, extent, and duration of short-term and long-term impacts.

The Project proposes to extend the mine life at the Dendrobium Mine to 31 December 2041 and so would result in a relatively medium/long-term impact to habitat that are associated with the areas proposed for surface infrastructure, which amounts to 19.85 ha. All vegetation to be impacted would be rehabilitated upon decommissioning.

The removal of the habitat is unlikely to significantly disrupt connectivity and movement by threatened biodiversity, given the availability of surrounding habitat that would not be obstructed by the Project.

Based on subsidence prediction presented in MSEC (2022) the potential for changes to habitat features within drainage lines, swamps and clifflines are unlikely to be of such that it would result in obstacles to movement of threatened species throughout the landscape as detailed in Table 39.

(b) predict the consequences of impacts for the persistence of the threatened entities identified in Subsection 6.1.3, taking into consideration mobility, abundance, range and other relevant life history factors

Table 39. Potential impacts on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range

Area of connectivity	Species	Movement patterns key to the life cycle of the species	Nature, extent and duration of short and long-term impacts to connectivity	Consequences of the impacts for the local and bioregional persistence
Ventilation Shaft Site No 5A and supporting infrastructure	Koala Eastern Pygmy Possum Gang-gang Cockatoo And all Predicted species listed in Table 13.	Generally, wide-ranging species that are not reliant on habitat features within the Biodiversity Assessment Development Footprint and are equally or better represented within adjacent and surrounding areas. Extensive habitat surrounds the areas proposed for surface infrastructure and thus it is highly unlikely movement patterns would be disrupted. The increased disturbance associated with the ETL is unlikely to impede the movement of the subject threatened fauna.	Removal of 14.64 ha of movement habitat for surface infrastructure at Ventilation Shaft Site No 5A would be long-term, however would be rehabilitated following decommissioning.	Low – large areas of suitable habitat, including areas containing higher quality foraging habitat, will continue to provide habitat for Koalas and other threatened fauna. Movement across the landscape is unlikely to be altered. The Project is unlikely to hinder movement between sub-populations that would impact upon local or bioregional persistence.
Dendrobium Pit Top Carpark Extension and Cordeaux Dam Access Road Construction Carpark	All Predicted species listed in Table 13.	Given the location is proposed in an area that has been historically cleared, it is highly unlikely that movement patterns of threatened species would be disrupted by the removal of already cleared/modified habitat.	The impact to habitat would be long-term, however movement patterns are unlikely to be impacted.	Low - large areas of suitable habitat surrounding the site, including areas containing higher quality foraging habitat. The surrounding habitat will continue to provide habitat for threatened species movement.
Riparian areas in the Subsidence Assessment Subject Land	Amphibians: Littlejohn's Tree Frog, Giant Burrowing Frog, Red-crowned Toadlet. *Pomaderris brunena*.	The riparian areas within the Subject Land may be used by all species for dispersal, foraging, and movement (including movement of seed). As predicted by MSEC (2022), the Project has the potential to result in the loss of pools; loss of holding capacity; and ponding in areas (section 4.6.4). Dispersal and movement of threatened frogs throughout available habitat would not be directly impeded by predicted subsidence or clearing impacts. Impacts from the Project do not include introduction of significant barriers to movement.	Subsidence impacts may permanently alter the holding capacity of breeding pools, which may result in decreased rates of successful metamorphosis from tadpole to adult life stages for frogs, particularly in dry years when pools receive limited recharge from rainfall. Migration to refuge areas which are not impacted by subsidence is not expected to be impeded by the Project,	Low – large areas of suitable intact habitat occur around, and interspersed throughout, areas prone to subsidence impacts. No physical barriers to migration would be introduced by the Project. Most species would likely suffer negligible or non-significant impacts on connectivity based on the limited potential for impacted areas to

Area of connectivity	Species	Movement patterns key to the life cycle of the species	Nature, extent and duration of short and long-term impacts to connectivity	Consequences of the impacts for the local and bioregional persistence
		Dispersal amongst Littlejohn's Tree Frog and Giant Burrowing Frog populations is expected to occur at a scale of kilometres to tens of kilometres (e.g. Klop-Toker et al. 2021). The Red-crowned Toadlet is expected to have more limited movement, however is likely less prone to subsidence impacts due to a shorter tadpole stage and therefore pool retention times. Connectivity around areas that may be impacted via subsidence is expected to remain given the intact landscape.	however the level to which this would occur or be required depends on the ability of frogs to persist in subsidence impacted areas and their site fidelity. The predicted extent of reduced recruitment has been assessed as the area within 60 m of longwall mining plus an additional area within 400 m of longwall mining, which is considered to experience reduced recruitment for approximately 50% of breeding pools (see Table 40). The extent to which successful metamorphosis and recruitment is prevented within these areas is not known however is considered to be high (i.e. significant proportion of frogs) for areas immediately above longwall mining and becoming lower within distance from the longwall, such that areas between 60-400 m above the longwall are considered to be moderate to negligible impacts.	become fragmented from surrounding areas/sub-populations
Swamp environments – threatened flora in the predicted subsidence extent	*Pultenaea aristiata* *Epacris purpurescens var. purpurescens.* *Cryptostylis hunteriana*	Threatened flora in relation to swamp environments are discussed in section 4.6.4. No threatened flora were recorded within the Coastal Upland Swamps within the Subject Land and are only included for further assessment based on a precautionary basis. Each of the species have associated habitat within the drier portions of the swamps, and within PCT1083 or Eucalypt Fringing Woodland – the	Low likelihood for long-term impacts to connectivity.	Low – large areas of potential habitat across the Subject Land. Habitat immediately adjacent to swamps would also provide habitat for the species.

Area of connectivity	Species	Movement patterns key to the life cycle of the species	Nature, extent and duration of short and long-term impacts to connectivity	Consequences of the impacts for the local and bioregional persistence
		vegetation community that a swamp may eventually transition to following subsidence related impacts. As such, if a swamp was to transition to a woodland vegetation type because of subsidence related hydrological change, it may be reasonable to suggest that the species would have still have habitat present. The species are all related with sandstone, and shale soils, and would not be only reliant upon peaty soils found within swamps. The Project is therefore unlikely to result in obstacles for the species dispersal, or establishment within the surrounding habitat types.		
Swamp environments – threatened fauna in the predicted subsidence extent	Giant Dragonfly Littlejohn's Tree Frog Eastern Pygmy Possum Giant Burrowing Frog (further information provided in section 4.6.4)	A total of 16 swamps within the Subject Land may be subject to subsidence related impacts (see detailed discussion/analysis further in section 4.6.4). Subsidence may result in a change to the swamp sub vegetation community types (ie. wetter swamp vegetation transitioning to a drier vegetation type). If such impacts were to occur, the habitat potential for Giant Dragonfly, Littlejohn's Tree Frog and Giant burrowing Frog may be impacted. The habitat for Eastern Pygmy Possum would likely be unaffected, as the species can utilise all the surrounding PCTs within the Subject Land. Dispersal and movement throughout available habitat of the three species considered would not be directly impeded by predicted subsidence or clearing impacts. Impacts from the Project do not include introduction of significant barriers to movement. Nonetheless, there is potential for the Project to limit effective dispersal of Littlejohn's Tree Frog and Giant Dragonfly due to lifecycle characteristics referred to below. Dispersal amongst Littlejohn's Tree Frog and Giant Burrowing Frog populations is expected to occur at a scale of kilometres to tens of kilometres (e.g. Klop-Toker et al. 2021).	If swamps were to be impacted, and transition to a drier vegetation type, it could result in a long-term impact to the Giant Dragonfly through limited ability to colonise/migrate to other breeding areas/swamps. Klop-Toker et al. (2021) found that Littlejohn's Tree Frog is able to disperse significant distances, moving between mining and un-mined areas within the Dendrobium Mine lease. The dispersal of Littlejohn's Tree Frog from impacted areas is likely to occur but be primarily limited to discrete catchment boundaries and may be limited by high site fidelity. Giant Burrowing Frogs are not restricted to watercourses and may be found at significant distances from creek lines, for this reason the	Local persistence of Giant Dragonfly could be impacted if the swamps which the species using as breeding habitat is changed. Local persistence of Giant Burrowing Frog and Littlejohn's Tree Frog would be impacted where habitat within swamps and watercourses has changed, however movement of the species would still persist throughout watercourses of the Subject Land and surrounds at least within the Cordeaux (and likely Avon) catchment areas.

Area of connectivity	Species	Movement patterns key to the life cycle of the species	Nature, extent and duration of short and long-term impacts to connectivity	Consequences of the impacts for the local and bioregional persistence
		Klop-Toker et al. (2021) suggest that the movement of Littlejohn's Tree Frog throughout the catchment is thought to be limited due to inferred high site fidelity. Movement across catchment boundaries appears to be relatively limited (Klop-Toker et al., 2021), with Stock et al. (N.D) suggesting terrestrial dispersal may be limited, and that gene flow may predominately occur along creek lines. The causal factors underlying these findings are not well known and the level of movement between Littlejohn's Tree Frog within the Dendrobium and Avon catchments into adjacent catchments has not been tested. Therefore, the dispersal of Littlejohn's Tree Frog from impacted areas is likely to occur but be primarily limited to discrete catchment boundaries and may be affected by high site fidelity. Dispersal for Giant Dragonfly is expected to occur over a range of 500 m to 1 km, however is not definitely established. Where/if swamps that are potential breeding habitat for Giant Dragonfly become drier to the extent they are no longer suitable for breeding there is potential that movement to other swamps may not be possible based on required dispersal distances.	potential impacts to watercourses are not considered a limiting factor to their dispersal. The Eastern Pygmy Possum is unlikely to be impacted.	
Clifflines/Steep slopes in the predicted subsidence extent	Broad-headed Snake Southern Myotis Large-eared Pied Bat	Unlikely to result in changes to movement patterns given the relatively small predicted impacts as detailed in MSEC (2022). The Southern Myotis and Large-eared Pied Bat can roost in hollow-bearing trees; and all crevice habitats would not be impacted by the Project. Similarly, the area of potential impact to Broad-headed Snake habitat is relatively minor, and the cracking of surface rock may increase habitat for the species.	Low – as discussed in Table 39	Low – as discussed in Table 39.

(c) justify predictions of impacts with relevant literature and other published sources of information.

As previously described in section 4.6.2.

4.6.4 Water quality, water bodies, and hydrological processes

Water bodies within the Subject Land are ephemeral waterways and drainage lines (Figure 4).

Coastal Upland Swamps are also considered given the association with hydrological processes. Coastal Upland Swamps have been specifically addressed in within this section of the BDAR (see section c), with further supporting information provided in Appendix 9 and Appendix 10.

The potential prescribed impact to such features is discussed below.

(a) describe the nature, extent, and duration of short-term and long-term impacts.

The area potentially subject to subsidence effects (including far-field or valley-related movements) within Area 5 according to MSEC (2022), is approximately 1,989 ha. The combined length of all streams within the Subject Land that is prone to subsidence is approximately 33.25 km which includes all first, second and third order streams within 400 m of proposed longwalls.

Potential impacts on water quality, water bodies, and hydrological processes are outlined in Table 37 and include predicted cracking of bedrock, ponding and some diversion of surface water into the strata below (i.e., during periods of light rainfall). These impacts are expected to eventually dissipate over time, and the gradients along the drainage lines would approach grades similar to those that existed before mining and fractures are expected to fill with alluvial and colluvial material over time. However, the timescale in which filling of fractures would occur is not known and therefore impacts are considered to be long-term based on the typical lifecycle of species likely to be impacted. Stress fracturing or cracking of bedrock beneath ephemeral waterways is expected to occur; however, overland flow is expected to pass over the cracks during moderate to heavy rainfall with minimal impact to hydrological processes for these events.

The scouring and erosion predicted during heavy rain periods is expected to temporarily increase sediment laden runoff; however, this should cease once the cracks and fractures either fill in naturally or are remediated. In the case of large cracks and fractures, remediation works may be undertaken in accordance with an updated Watercourse Impact Monitoring Management and Contingency Plan (section 5.2).

In addition to direct hydrological impacts, localised water quality impacts, particularly increased concentration of iron and iron flocculent have the potential to occur as observed in previously mined beneath areas and documented within the aquatic ecology assessment for the Project (Cardno 2022):

> *Potential impacts to water quality as a result of the predicted subsidence effects associated with the Project would be localised and minor (HEC 2022). Although mine subsidence effects can result in isolated, episodic pulses in iron, manganese, aluminium and electrical conductivity, there have been no reports of any measurable effect on water quality in downstream dams in the Southern Coalfield.*
>
> *Localised increases in sediment load in the water due to mine-induced erosion, reductions in DO levels and increases in acidity and metal concentrations, resulting from the diversion of sub-surface flows and weathering or leaching of minerals may impact on aquatic biota. As mining-induced erosion is predicted to be localised and short-term and limited to drainage lines overlying the proposed longwalls, impacts on biota are likely to also be*

minor, localised and short-term. Also, there are likely to be negligible impacts on primary productivity in drainage lines due to the general absence of aquatic plants in these watercourses. The weathering of freshly exposed fractures in the sandstone rocks could result in minor, localised, transient increases in salinity and concentrations of iron, manganese, aluminium, zinc and nickel, and decreases in DO levels. Increases in iron staining could result in smothering of the substratum and sessile biota, but this would only extend a short distance (< 1km) downstream from where surface water flow re-emerges. The diversion of surface water into sub-surface layers could affect the quality of the water in the drainage lines at and immediately downstream of the point where surface flows return. These effects are expected to be localised. Changes in oxygen level (e.g. DO) due to mining are predicted to be minor, localised and short-term and are therefore likely to have only a low impact on aquatic biota.

Coastal Upland Swamps are also considered given the association with hydrological processes. Coastal Upland Swamps have been specifically addressed in section 4.6.4(c), with further supporting information provided in Appendix 9 and Appendix 10 which detail the potential for short and long-term impacts associated with subsidence.

(b) predict the consequences to the threatened entities identified in Subsection 6.1.4.

Table 40 details the potential impacts to the threatened biodiversity reliant on drainage features in the Subject Land.

Table 40. Potential impacts to water quality, water bodies and hydrological processes that sustain threatened species and TECs

Species or ecological communities	Nature, extent and duration of short and long-term impacts	Likely Consequences
Littlejohn's Tree Frog & Giant Burrowing Frog	**Littlejohn's Tree Frog** Within the Subject Land, the species relies upon semi-permanent to permanent pools for tadpole development (Biosis 2016a, Daly and Craven 2007), with maturation times for tadpoles of the species having been observed to take around 4 months (Anstis 2002) but dependent on seasonal temperatures, and other factors. Klop-Toker et al. (2021) suggest between 3 to 4 months in summer and 5 to 11 months in winter. Pools of sufficient depth and hydroperiod within the Subject Land were almost exclusively located along second and third order streams or first order streams downstream of headwater swamps. Potential impacts from mining induced subsidence for the species are outlined above in section 4.6.4, and within the EPBC Act Assessment of Significance for the species (Appendix 8), which should be read in conjunction with this table. Impacts to the species may occur due to cracking of bedrock underneath swamps and streams, resulting in changes to hydrology and water quality of existing habitat. The combined length of all streams within the Subject Land that is prone to subsidence is approximated at 33.25 km which includes all first, second and third order streams within 400 m of proposed longwalls. The most recent iteration of ongoing monitoring programs undertaken within the Dendrobium Mine Lease Area (see Figure 16) identified that an ecological response had been detected at several impact sites within Dendrobium Areas 3A and 3B, with observed impacts most frequent and acute in areas that have been directly mined beneath (Niche 2021). The report described observed patterns of limited water retention at impact monitoring sites post-mining, indicating that mining is having an impact on the species due to decreased tadpole survivorship (Niche 2021). Similarly, Klop-Toker et al. (2021) found that recruitment has been reduced within mined areas of the Dendrobium Mine Lease Area, due to a loss of habitat after subsidence. Despite this Littlejohn's Tree Frogs have been observed consistently from both Control and Impact sites during annual monitoring since monitoring began in 2006 (Niche 2021), indicating breeding habitats may continue to be utilised despite impacts in some areas, at least	The likely consequence of the Project on both the Littlejohn's Tree Frog and Giant Burrowing Frog may impact 13.26 ha as detailed in the included table. Assessments of significance under the Commonwealth significant impact guidelines have been undertaken for these species (Appendix 8). These assessments indicate that the Project may possibly result in a significant impact upon the Littlejohn's Tree Frog and Giant Burrowing Frog populations as it has the potential to: - Disrupt the breeding cycle of an important population. - Lead to a long-term decrease in the size of an important population. - Decrease the availability or quality of habitat for the Littlejohn's Tree Frog

Species or ecological communities	Nature, extent and duration of short and long-term impacts	Likely Consequences
	in the short term (less than 10 years) and albeit at reduced abundances. However, the ability of Littlejohn's Tree Frog to persist on a long-term basis in areas that are directly mined beneath by longwall mining should be considered questionable based on conclusions from recent studies Klop-Toker et al. (2021). However, studies (e.g. Klop-Toker et al. 2021) have noted that areas of un-impacted habitat within the mine areas continue to support high numbers of tadpoles and regular recruitment. Therefore, the extent to which these impacts affect the overall viability of the regional population or the species is not yet clear and will be dependent on population size, extent of mining within the region, the capacity for recovery of hydrological patterns (not yet demonstrated) or effective supplementation of breeding ponds (which has had some documented success in other areas of the species range). Littlejohn's Tree Frog has been recorded within 5 of the 11 tributaries within the Subject Land in at least one pool, occasionally several. Additional survey is likely to result in additional pools being confirmed as breeding habitat for the species, however it is not expected that all pools or all stream sections/tributaries would be occupied by the species. To quantify available habitat at several scales (Figure 16) all first to third order streams have been considered within areas of potential habitat for the species. On this basis, the impact area is calculated at 33.25 km of stream (which includes all first, second and third order streams within 400 m of proposed longwalls); Potential habitat within the Cataract IBRA subregion is 2,298 km (area b, which includes known and potential habitat based on land use, geology and continuity with existing records[17]); Regional extent of occurrence is 1,305 km (area c, which is the area made from a polygon bounded by records of the species within the Cataract IBRA subregion); and regional area of occupancy is 520.2 km (area d which is the combined stream length within all 2km grid cells with a species record). The proportion of Littlejohn's Tree Frog habitat impacted by the current proposal in a regional context represents between 1.5 – 2.6% of potential and available habitat within the region.	to the extent for the that the species is likely to decline.

[17] Area (b) represents the combined area of streams within generally intact bushland on primarily sandstone substrates that are west of the Illawarra escarpment. Most of the areas lie within the area bounded by existing Littlejohn's Tree Frog records, however an additional allowance has been made (generally up to 10 km) to cater for limited detection of the species in areas that are potential habitat but are unlikely to have had repeated targeted surveys. Certain areas meeting this description that are more likely to have had targeted surveys (such as the Royal National Park) have been omitted from this area.

Species or ecological communities	Nature, extent and duration of short and long-term impacts	Likely Consequences

Following work by Klop-Toker et al. (2021) and Stock et al. (N.D) suggesting movement across catchment boundaries appears to be relatively limited, the same calculations have also been presented for the Cordeaux and Avon catchment only, which represents a potential local population for the species. The proportion of Littlejohn's Tree Frog habitat impacted by the current proposal in this narrower context represents between 5.5 – 13.5% of available habitat within the Cordeaux and Avon catchment. Connection between the Cordeaux and Cataract catchment area to the North of Picton Road is considered moderately likely given the proximity of records, however has not yet been definitely established. Therefore, this area has not been included within the local population scenario.

Area	Cumulative length of 1st, 2nd and 3rd order streams (km)	Proportion of impact area within the specified area (%)
Impact area		
(a) Proposed impact area (within 400 m of proposed longwalls)	33.25	N/A
Regional habitat: potential and occupied habitat within the Cataract IBRA subregion		
(b) Potential habitat including areas of similar geology, land-use and continuity with existing records	2,298	1.45%
(c) Extent of occurrence minimum convex polygon based upon Bionet records	1,305	2.55%
(d) Area of occupancy based on records within 2 km x 2 km grids within area c above.	520.2	6.39%
Local habitat: potential and occupied habitat within the Cordeaux and Avon catchment		
(e) Potential habitat including areas of similar geology and land-use and continuity with existing records	609.07	5.46%

Species or ecological communities	Nature, extent and duration of short and long-term impacts			Likely Consequences
	(f) Min convex polygon based upon Bionet records	246.2	13.51%	
	(g) Area of occupancy based on 2 km x 2 km grids.	213.8	15.55%	

Cumulative impacts should also be considered when assessing the proportional impact from the Project. The areas tabled below have been used as a basis upon which to compare the proposed impact area against areas of potential habitat in other areas of existing or future mining versus protected areas such as National Parks.

Area (as per Figure 16)	Regional habitat: potential and occupied habitat within the Cataract IBRA subregion		Local habitat: potential and occupied habitat within the Cordeaux and Avon catchment	
	Cumulative stream length (km)	Proportion of total area of potential habitat (area b, above)	Cumulative stream length (km)	Proportion of total area of potential habitat (area e, above)
Proposed impact area (within 400 m of proposed longwalls)	33.25	1.45%	33.25	5.46%
Dendrobium Mine extraction areas (maximal)	74.80	3.26%	74.80	12.28%
Approved future mining longwalls - Dendrobium	1.13	0.05%	1.13	0.19%
Southern Coalfield (All Mines)	266.65	11.60%	203.59	33.43%
National parks	688.65	29.97%	19.86	3.26%
Other	880.18	38.30%	30.01%	4.93%
Total (excluding proposed impact area)	**2298.00**	**100%**	**609.07**	**100%**

Species or ecological communities	Nature, extent and duration of short and long-term impacts	Likely Consequences
	The approach to a species polygon (or area of maximum offset liability) for this species is tabled below and illustrated in Figure 14i. The species polygon comprises potentially impacted foraging, sheltering and breeding habitat totalling 13.26 ha. It is intended that these offsetting calculations be refined during monitoring for the species post-approval (but prior to mining) to confirm the area of habitat occupied by the species within the Subject Land. Confirmation of changes to groundwater (within swamps) or pool water (within creeks) would also be required to determine impacts for the species, consistent with confirmation of impacts to swamp habitat outlined within the Swamps Offset Policy (OEH 2016a). **Giant Burrowing Frog** The Giant Burrowing Frog has been recorded in preferred habitats once in the east of the Subject Land along a 3rd order tributary to Donalds Castle Creek as well as south and east of the Subject Land approximately 1 km away (Figure 10). Detectability of adults of the species typically requires significant rainfall (DECC 2009) prior to or during survey, which is when most breeding occurs (e.g. DoE 2018d; Penman et. al 2008). Activity is described as occurring through September to May, but reliant on heavy rain (DECC 2009). Tadpole surveys and nocturnal searches in suitable habitat and weather conditions are more effective than call surveys (DEWHA 2010b). While a range of methods to detect the species were employed in the present survey, tadpole surveys were a focus due to limitations in access to the site during and after heavy rain. In addition, it was recognised that tadpole survey is likely to aid in identifying limiting habitat for tadpole development. Tadpoles are present for months after breeding events, however adult frogs do not breed in all years (DEWHA 2010b) and recent monitoring as part of Dendrobium Area 3B subsidence monitoring have highlighted absence of tadpoles in some years versus abundant tadpoles in limited areas in others (Biosis 2016b). Given, these factors, it is assumed that the Giant Burrowing Frog is present throughout the preferred habitats of the Subject Land despite its lack of detection in the present survey. Within the Subject Land, the species relies upon semi-permanent pools for tadpole development, with maturation times for tadpoles having been observed to take 3-11 months (Watson and Martin 1973). Pools of sufficient depth and hydroperiod within the catchment area were almost exclusively located along 2nd order or higher streams or else 1st order streams where headwater swamps are positioned upstream.	

Species or ecological communities	Nature, extent and duration of short and long-term impacts	Likely Consequences
	Impact Considerations Swamps act as a buffer allowing for more continuous and even water flows along streams after rain events (e.g. Young 2017) and thus greater hydroperiods (or permanency) within pools along smaller streams. This may influence tadpole development for species with lengthy periods of metamorphosis. Therefore, while swamps are not considered required for tadpole development, they may aid in providing suitable conditions downstream for tadpole development to occur, particularly along 1st and 2nd order streams. Swamps and heath may aid in providing suitable conditions to forage and shelter, facilitated through moisture availability and abundance of debris. However, the species is known to shelter in a range of habitats. The extent to which drying of swamps might impact the capacity of swamp sites to provide ideal sheltering conditions is unknown, however it seems likely that swamps are more important in regard to enhancing opportunities for tadpole development downstream rather than providing ideal sheltering habitat given the variety of sheltering habitats reportedly used. Also, expected changes in swamp composition due to subsidence is unlikely to prevent their capacity to be used as a sheltering environment although may add some increased risk of desiccation for some swamps. The approach to a species polygon for offsetting for this species is the same for Littlejohn's Tree Frog which is described above and illustrated in Figure 14f. The species polygon comprises potential impacted foraging, sheltering and breeding habitat totalling 13.26 ha. It is intended that these offsetting calculations be refined during monitoring for the species post-approval (but prior to mining) to confirm the area of habitat occupied by the species within the Subject Land. Confirmation of changes to groundwater (within swamps) or pool water (within creeks) would also be required to determine impacts for the species, consistent with confirmation of impacts to swamp habitat outlined within the Swamps Offset Policy (OEH 2016a). **Table 41: Determination of Species Polygons impacted for Littlejohn's Tree Frog and Giant Burrowing Frog**	

Feature	Explanation of Area Determination	Area of habitat
All streams within 60 m of longwalls	All watercourse sections with a width of the stream as mapped by IMC.	3.04
Streams between 60-400 m of longwalls	Severity of subsidence impacts (such as limited retention of water within pools) have been demonstrated to decrease significantly where longwalls have not been mined directly below the stream. For example, previous monitoring of breeding pools close to longwall mining has demonstrated pool levels consistent within pre-mining levels, particularly when pools are upstream of longwalls (e.g. Biosis 2016, Biosis 2017). Stream sections were intersected with PCT mapping to assign PCTs to the areas of impacts for offsetting purposes. No quantitative subsidence predictions have been provided by MSEC for smaller streams between 60 and 400 m of longwalls. However, given that major streams within this distance of longwalls are predicted to experience impacts we have quantified that over <10% of their length, the overall area of stream sections between 60 and 400 m has been halved to determine the maximum possible impact area.	1.59
Swamps within 60 m of longwalls	For the purpose of an offset strategy, all swamps either wholly or partially within 60 m of longwalls have been retained within species polygons, since there is potential for impacts to swamps to impact foraging and sheltering habitat and therefore the occurrence of Littlejohn's Tree Frog within these environments. Based on a review of records and literature, it is expected that not all swamps or swamp areas would provide important habitat to Littlejohn's Tree Frog (i.e. habitat used on a regular basis). Records for Littlejohn's Tree Frogs within swamps appear to be concentrated within larger, wetter swamps with pools immediately downstream or within the swamp. Therefore, the overall offset requirement for this species is expected to reduce once additional surveys and monitoring of actual impacts occurs.	8.63
Fringing riparian vegetation	Fringing riparian vegetation has not been included within any offset calculations as no subsidence impacts to these habitats Is likely to occur as demonstrated via monitoring (e.g. Biosis 2016, Biosis 2017c).	0
Total area of potential impact to habitat		**13.26**

Species or ecological communities	Nature, extent and duration of short and long-term impacts	Likely Consequences
Red-crowned Toadlet	The Red-crowned Toadlet has been recorded in preferred habitat near the eastern part of the Subject Land beside Fire Trail 6 in 2014; in the far north western corner of the 400 m buffer around the proposed longwalls in 1997; and there are numerous records of the species south of the Subject Land (Figure 14p). The species has typically been found in table drains, soaks and along 1st order watercourses. Habitat for the species has been described as temporary creeks, gutters and soaks and under rocks and logs (NPWS 2001a). While some records of the species in the local area are adjacent to swamps, it is not considered that swamps play an important role in providing appropriate breeding or sheltering habitat, since the species is found from a wide range of habitats without swamps and there is no emphasis on swamp communities within habitat prescriptions for this species (e.g. OEH 2018, Thumm and Mahoney 1999). The species may have gone undetected during some of the current survey due to lack of significant rain prior to the survey period (the species has recently been detected during survey to the north of the Subject Land after 2018 spring/summer rains ended a period of relative drought). However, much of the survey timing was appropriate for detection of the species according to relevant guidelines (DECC 2009), which would suggest that the species is restricted to pockets of the Subject Land, consistent with other occurrences within the catchment area. <u>Impact Considerations</u> Given its habitat preferences appear to be largely dependent upon surface water runoff and seepage rather than groundwater and requirements for semi-permanent pools, it is considered that this species is less sensitive to impacts from subsidence in comparison with other 'species credit' amphibians. Nonetheless, changes in hydrology related to cracking of bedrock underlying streams providing habitat for the Red-crowned Toadlet have the potential to influence moisture levels and retention of moisture within small pools, soaks and leaf litter environments on which Red-crowned Toadlet's rely to complete their lifecycle. The Red-crowned Toadlet is assumed to be present in some areas, particularly along 1st order streams. Within 60 m of the proposed longwalls, these environments have been considered to experience the full range of expected subsidence impacts. Based on subsidence predictions for larger streams, subsidence impacts are expected to decrease within increasing distance	The likely consequence of the Project on the Red-crowned Toadlet may impact 3.5 ha.

Species or ecological communities	Nature, extent and duration of short and long-term impacts	Likely Consequences

from longwalls up to a distance of 400 m (MSEC 2022). The approach to a species polygon for offsetting was to calculate the area of all first order streams by using the available linear stream mapping and applying a 1 m buffer to each side to account for the area of impact within 60 m of proposed longwalls, then intersected with vegetation mapping to assign the impact area to a PCT (Table 42). The same method was applied for relevant stream sections between 60 m and 400 m of proposed longwalls, however this area was halved to account for the decreasing gradient of impacts over distance from the longwalls (based on predicted modelling of subsidence impacts for larger streams). The combined area of the species polygon (representing potential area of impact to identified habitat) constitutes 3.5 ha as shown below and on Figure 14p.

Table 42. Determination of species polygon associated with indirect impacts for Red-crowned Toadlet

PCT ID	100% of Area (ha) within 60 m buffer	50% of Area (ha) within 60-400 m buffer	Total area
978	0.29	0.05	0.35
1083	0.88	0.29	1.18
1181	1.04	0.37	1.41
1250	0.31	0.13	0.44
1395	0.11	0.00	0.11
1804	0.01	0.00	0.01
TOTAL	**2.65**	**0.85**	**3.50**

Species or ecological communities	Nature, extent and duration of short and long-term impacts	Likely Consequences
Giant Dragonfly	Giant Dragonfly survey and impact assessment has been documented by Cardno (2022) and local and regional impacts of mining on the Giant Dragonfly studied by Invertebrate Identification Australia (2019, 2020). Giant Dragonfly is found typically in permanent swamps and bogs containing some free water and open vegetation. It is considered an obligate groundwater dependent mire (peat-forming wetland) dwelling species (Cardno 2022). Its breeding success is dependent on sites with a groundwater regime that provides enough surface moisture to minimise desiccation of eggs and early larval instars, peatland soils suitable for burrowing by larvae, and that have a water table height that allows larvae to access or extend their burrows (Cardno 2022; Baird 2012). Cardno (2022) and Invertebrate Identification Australia (2019, 2020) assessed suitability of swamp habitat and surveyed for Giant Dragonfly. Of the 22 swamps that occur within the Subject Land, only three swamps are deemed suitable breeding and foraging habitat for the Giant Dragonfly, and no Giant Dragonflies were observed during the extensive survey undertaken by Invertebrate Identification Australia (2019, 2020). The three suitable swamps are Den111, Den121 and Den122. To quantify potential impacts for Giant Dragonfly and create the species polygons for the species, the determination for habitat suitability assessed by Invertebrate Identification Australia (2019, 2020) has been used (Figure 14n). The species polygon comprises PCT978 and PCT1804, which comprises VZs Banksia thicket, Teatree Thicket and restioid heath (subcommunities susceptible to hydrological changes) that are: • Within or intersecting the 60 m buffer (impacted swamps likely to experience the full range of expected subsidence impacts). • Deemed as suitable habitat by Invertebrate Identification Australia (2019, 2020).	The likely consequence of the Project on the Giant Dragonfly may impact 3.68 ha.

<table>
<tr><th>Species or ecological communities</th><th>Nature, extent and duration of short and long-term impacts</th><th>Likely Consequences</th></tr>
<tr><td></td><td>Table 43. Determination of species polygon associated with indirect impacts for Giant Dragonfly
<table>
<tr><th>PCT ID</th><th>Vegetation zones</th><th>Breeding swamps habitat</th><th>Foraging swamps</th><th>Total</th></tr>
<tr><td>978</td><td>Banksia Thicket</td><td>0.00</td><td>0.04</td><td>0.04</td></tr>
<tr><td>1804</td><td>Tea-tree Thicket</td><td>0.00</td><td>0.18</td><td>0.18</td></tr>
<tr><td>978</td><td>Sedgeland-Heath Complex - Restioid Heath</td><td>0.98</td><td>2.48</td><td>3.46</td></tr>
<tr><td colspan="2">TOTAL</td><td>0.98</td><td>2.7</td><td>3.68</td></tr>
</table></td><td></td></tr>
<tr><td>Southern Myotis</td><td>The Southern Myotis has potential foraging habitat over pools that are greater than 3 m, which the species use for catching insects and small fish by raking their feet across the water surface. These pools and their streams have been mapped by IMC, and has been provided on Figure 14k. MSEC (2022) did not predict that all these suitable foraging pools would be impacted, however, state that some pools may have changes to holding capacity, and ponding (section 4.5.1).

To account for the extent of potential impacts, all sections downstream of the first pools which have a capacity of 3 m or greater in width have been included in the species polygon for prescribed impacts (Figure 14k). This area accounts for 4.75 ha of potential foraging habitat. This is likely to be a conservative estimate of foraging habitat, as the width measurement was based on peak capacity of the pools and may not reflect the true extent of suitable habitat in the Subject Land.</td><td>Unlikely to result in long-term impacts.</td></tr>
<tr><td>Eastern Pygmy Possum</td><td>There are two Bionet records for Eastern Pygmy-possum within the Subject Land from 1997, and the species was recorded by Niche at the Ventilation Shaft Site, and approximately 130 m from the proposed ETL and within the broader area on infrared cameras.

The entire Subject Land (except for cleared land) comprises preferred habitat for the Eastern Pygmy-possum. A species polygon has been formed from the entire extent of associated PCTs 1083, 1181, 1245, 1250 and 1395 within the Subject Land. This species is found in a broad range of habitats from rainforest through sclerophyll forest and woodland to heath and is associated with most of the vegetation/habitat within the Subject Land, given its wide range of foraging resources. Foraging</td><td>No significant consequences to the Eastern Pygmy-possum are anticipated.</td></tr>
</table>

Species or ecological communities	Nature, extent and duration of short and long-term impacts	Likely Consequences
	habitats within Coastal Upland Swamps, may be susceptible to potential subsidence impacts. However minimal impacts from subsidence are anticipated as the species is known to occur from all surrounding vegetation types and is not reliant on habitat impacted by subsidence. In addition to this, as discussed in section 4.6.3, the species would also utilise vegetation types that a swamp could transition to, if it were impacted.	
Coastal Upland Swamp	The predicted subsidence movements have the potential to result in hydrological changes, which have the potential to result in the following key changes to Coastal Upland Swamps in the Subject Land: • Reduction in groundwater levels or desaturation of the upland swamp sediments; and/or • Transition of the upland swamp to a drier vegetation type; and/or • Desaturation of soil particles exposing the swamp to peat desiccation; and/or • Exposure to greater bushfire intensity due to loss of inundation; and/or • Increased scour and erosion events. Impacts to Coastal Upland Swamps as a result of subsidence are difficult to predict, but where they may occur they would be long-term. The potential for impacts to Coastal Upland Swamps are described in detail below in section (c).	Long-term impacts to Coastal Upland Swamps are possible.
Riparian vegetation	Subsidence from the Project may result in the following impacts to non-swamp riparian vegetation (i.e., vegetation that occurs within, or immediately adjacent to watercourses of the Subject Land): • Vegetation die-back around strata gas emission/drainage sites within creeks. • Changes to the floristic composition of vegetation communities immediately adjacent to creeks/ponds where fracturing may result in changes to water flow and water retention periods. Each of these subsidence related impacts are discussed below. ***Vegetation Die-Back Around Strata Gas Emission/Drainage Sites within Creeks*** The release of gas emissions from fracturing of sandstone strata may occur as a result of subsidence. Gas may be released into rivers and streams as these areas form topographical low points in the landscape.	Unlikely to result in significant long-term impacts.

Species or ecological communities	Nature, extent and duration of short and long-term impacts	Likely Consequences
	The Project has the potential to result in enhanced strata gas emissions overlying watercourses. While not affecting water quality per se, the gas expression associated with release of strata gas has the potential to cause vegetation dieback in the vicinity of the gas release point. Vegetation dieback as result of gas emissions is a rare event and has only occurred previously on one occasion at Tower Mine, over small areas in the base of the Cataract Gorge that had been directly mined beneath by Longwalls 10 and 14 (Eco Logical Australia, 2004 in TEC 2007), and small localised changes to riparian vegetation along a section of the Waratah Rivulet (HC 2007). These impacts were short term impacts, and limited to small areas of vegetation, local to the points of emission, and when the gas emissions declined, the affected areas were successfully restored. No similar impacts have been reported during the mining of Dendrobium Area 3. PCTs that occur along the riparian zones of the Subject Land are PCT1083 Red Bloodwood - Scribbly Gum heathy woodland, and PCT1250 Sydney Peppermint - Smooth-barked Apple - Red Bloodwood shrubby open forest. It is possible (though unlikely) that some localised die back from gas emissions may occur to these PCTs where plants occur immediately above or adjacent to the point of gas emission. Given MSEC (2022) reports that gas releases resulting in observable vegetation die back are not common, and in the instance where it has occurred at Tower Colliery the impacts were limited to small areas that were successfully revegetated, it is expected that any impacts to the PCTs as a result of gas emissions from the Project would be limited in extent and temporal in nature, and that, as for the sites previously affected by gas emissions, if it was to occur, the vegetation would regenerate once the gas emissions ceased. As such, it is considered unlikely that gas emissions from subsidence would result in a decrease in the extent of the PCTs and habitat within the Subject Land. ***Changes to Riparian Floristic Composition due to Increased Levels of Ponding, Scouring or Desiccation*** Changes in the grade of a stream as a result of subsidence has the potential to lead to increased ponding, scouring and/or desiccation. MSEC (2022) states '*It is possible that there could be very localised areas along the streams which could experience small increases in the levels of ponding, where the predicted maximum tilts occur in the locations where the natural gradients are low. However, as the predicted changes in grade are typically less than 1%, any localised changes in ponding are expected*	

Species or ecological communities	Nature, extent and duration of short and long-term impacts	Likely Consequences
	to be minor and not result in adverse impacts on these streams. Predicted maximum increases in grade (which may lead to scouring) are relatively small compared with natural grades and the potential increase for scouring is not expected to be significant'. Vegetation communities which are independent of groundwater and not closely associated with the water levels and hydrology of the creeks are unlikely to be impacted by subsidence due to underground mining. The localised changes to ponding are predicted by MSEC (2022) to be relatively minor and not result in adverse impacts on the streams. It is similarly expected that any potential impacts to riparian vegetation that may affect the floristic composition of the community would be minor, and highly localised being limited to the area immediately adjacent to the water source. In the Southern Coalfield, previous impacts to riparian vegetation as a result of subsidence have been minor in occurrence, and mostly attributed from gas release causing relatively short-term damage to the vegetation, rather than changes to hydrological regimes (as mentioned above). To date, regular, long-term monitoring of vegetation potentially subject to the impacts of subsidence (undertaken by IMC), has not reported any significant areas of vegetation die back as a result of subsidence. Small areas of vegetation die back have been reported in Biosis (2015; 2016), however as discussed in the assessments it is unclear if the events are related to subsidence or a natural event. Regardless, from the monitoring to date, based on only a small number of gas emissions events being reported at Tower Mine and Waratah Rivulet (Eco Logical Australia, 2004 in TEC 2007; HC 2007) such events seem to be relatively minor, temporary in nature and relatively rare. Unlike the Coastal Upland Swamps, the vegetation adjacent to the creeks is not solely reliant upon groundwater for survival. The presence of water within these watercourses is subject to weather conditions and rainfall events: many areas of the watercourses experience extended dry periods. The vegetation within these areas is therefore already adapted to temporal changes in the availability of water and periods of dryness. As such, impacts, should they occur, are likely to be highly localised with only minor changes to species composition depending on the interaction of that species with changes in water availability. As such, should water diversion occur as a result of subsidence, it is unlikely to result in significant alterations to the composition of the communities or vegetation die back. As such, it is considered unlikely that subsidence would result in any extensive or significant impact to native riparian vegetation within the Subject Land. It is highly unlikely that potential impacts	

Species or ecological communities	Nature, extent and duration of short and long-term impacts	Likely Consequences
	as a result of a predicted change to stream hydrology, would decrease the area of PCTs or vegetative habitat that currently occurs along the creeklines of the Subject Land.	
Threatened flora: *Cryptostylis hunteriana* *Epacris purpurescens var purpurescens* *Pomaderris brunnea* *Pultenaea aristata*	***Die-Back of Threatened Flora that Occurs Immediately Adjacent to a Strata Gas Emission/Drainage Event*** As discussed in relation to native vegetation, die-back of plants from gas emissions is a rare event. If such an event was to happen, it would be very localised, and unlikely to result in large scale die back of native flora. The likelihood for threatened flora to be located immediately adjacent to the edge of a watercourse, that may have foliage exposed to a gas emission event is considered low. Most of the subject threatened flora (*Pultenaea aristata*, *Cryptostylis hunteriana,* and *Epacris purpurescens* var *purpurescens*) generally occurs on the high elevations in woodland or swamp habitats that are positioned away from the watercourse bed. And similarly, *Pomaderris brunnea* and the known populations of *Leucopogon exolasius* are typically likely to occur on the mid-bank to higher banks and gullies, away from the creek bed. Furthermore, the population of *Leucopogon exolasius* that was recorded within Area 5, occurs away from riparian areas. As such, threatened flora are unlikely to be impacted by strata gas emission/drainage events. ***Loss of Threatened Flora and its Habitat as a Result of a Changed Hydrological Regime*** *Cryptostylis hunteriana, Epacris purpurscens* var*. purpurescens, Pultenaea aristata,* have potential habitat with Coastal Upland Swamps. As discussed in the section below, and Appendix 9, Coastal Upland Swamps may be subject to changes in hydrology through bedrock fracturing and mining induced tilt which could result in changes to vegetative response and ecosystem function. The species can also inhabit Eucalypt Fringing Woodland or Exposed Sandstone Scribbly Gum vegetation communities which Coastal Upland Swamp could eventually transition to over time in response to hydrological change. Based on the lack of detection within Coastal Upland Swamps, the low likelihood for catastrophic events, and habitat within drier vegetation communities, it is considered that the likelihood of impacts to potential habitat within Coastal Upland Swamps for *Cryptostylis hunteriana, Epacris purpurscens var. purpurescens,* and *Pultenaea aristata* are relatively low. This is further supported with the lack of detection of both species during the field campaigns and monitoring.	If a threatened flora species population was present within Coastal Upland Swamps it could be long-term, however population not detected during surveys and monitoring.

Species or ecological communities	Nature, extent and duration of short and long-term impacts	Likely Consequences
	In relation to changes to water flow and standing pools, this is unlikely to affect *Cryptostylis hunteriana, Epacris purpurscens var. purpurescens, and Pultenaea aristata*. The species do not occur submerged, immersed, or directly connected via roots to the water within permanent pools. All species would naturally be exposed to periods of drought. The drying of pools or predicted changes to the hydrological regime to watercourses within the Subject Land are therefore unlikely to result in impacts to these threatened flora species.	

(c) where the proposed impact is in relation to longwall mining, calculate the maximum predicted offset liability as per the Addendum to NSW Biodiversity Offsets Policy for Major Projects: upland swamps impacted by longwall mining subsidence, using predictions of impacts on water dependant plant communities and the threatened species they support

MSEC (2022) predicted several potential subsidence related impacts that may be experienced in Coastal Upland Swamps within the Subject Land (Table 37). To assess how subsidence may impact upon the extent, floristic composition and habitat within the Coastal Upland Swamps, the results of the existing monitoring campaigns, relevant studies and documentation on historic erosion events have been reviewed and included in Appendix 9. Of relevance are the findings from the Dendrobium Mine Area 3A and 3B Coastal Upland Swamp monitoring program, that begun in 2003 across approximately 15 Coastal Upland Swamps, with findings reported annually.

The impact predictions provided in MSEC (2022) (Table 37) indicate that Coastal Upland Swamps partially or entirely located above the proposed longwalls are expected to experience the full range of predicted subsidence movements, compared to Coastal Upland Swamps located outside the extent of the proposed longwalls which will experience reduced levels of subsidence. It is not expected that there would be adverse changes in the levels of ponding or scouring of the Coastal Upland Swamps based on the predicted mining induced tilt, or significant changes in the distribution of surface waters due to mining induced tilt or vertical subsidence.

Based on assessments of water levels and recession rates around past mining in Areas 2, 3A and 3B, it was concluded by Watershed (2021) (Appendix 13) that hydrographs from swamp piezometers directly above or within 60 m of longwalls exhibit a mining effect, be that through a reduction in the water table to below pre-mining levels and/or increased recession (drainage) rate. Effects on swamp water tables were not reported at distances greater than 60 m from a longwall panel.

Of the 22 Coastal Upland Swamps recorded within the Subject Land, 16 are located above longwalls or occur wholly or partially within 60 m from the proposed longwalls (Figure 9)(Table 45).

The predicted subsidence movements have the potential to result in hydrological changes, which have the potential to result in the following key changes to Coastal Upland Swamps in the Subject Land:

- Reduction in groundwater levels or desaturation of the upland swamp sediments; and/or
- Transition of the upland swamp to a drier vegetation type; and/or
- Desaturation of soil particles exposing the swamp to peat desiccation; and/or
- Exposure to greater bushfire intensity due to loss of inundation; and/or
- Increased scour and erosion events.

Each of these potential impacts in relation to the Subject Land has been discussed in an impact assessment provided in Appendix 9 for the potential impacts to Coastal Upland Swamps. The impact assessment discussion has incorporated the results from the IMC, Metropolitan Coal and Wollongong Coal Coastal Upland Swamp monitoring where available.

As discussed in Appendix 9 key conclusions provided in the Biosis 2016/2017 Dendrobium Swamp Monitoring Report and the Niche (2021) monitoring results, have been summarised in Table 44 below.

Table 44. Dendrobium Swamp monitoring 2016/2017 (Biosis 2017) and Niche (2021) results

Monitoring	Biosis (2017) results summary	Niche (2021) results summary
LiDAR mapping of total upland swamp area	• The area of upland swamps decreased relative to the 2014 baseline in 2017 across all impact and control swamps assessed, with the exception of Swamp 08 (impact swamp) which recorded a marginal increase. • The changes observed in "impacted" upland swamp extent between 2016 to 2017 are comparable to those observed at the control swamps. • No significant change in the extent of individual upland swamps across both the control and impact treatments was observed in 2017. • Both "impact" and control swamps recorded a decrease in extent, which reflects a change that is observed on a regional scale and is not attributable to localised mining impacts. • While all upland swamps within the Subject Land have decreased from the baseline minimal change was identified between 2016 and 2017.	Direct comparisons of the 2020 data with previous years data show a decrease in swamp extent in 2020 relative to previous years. The decrease in total swamp extent is a continuation of the trend from previous years monitoring of decreasing swamp extent. Areas of drying/die-back were observed in Impact Upland Swamps during the 2020 field survey and in the UAV Imagery. However these areas were still mapped as areas of Upland Swamp in 2020, as it was not clear if vegetation within the swamp was experiencing die-back, or just going through a period of drying. The cumulative impact of mining on total swamp extent is represented by the change in swamp extent compared to baseline. Generally, across control and impact swamps, there was a contraction in total swamp extent between 2019 and 2020. This catchment wide effect may be a result of the significant drought that peaked in 2018/2019 impacting moisture availability for swamps across the catchment. Upland Swamps have not yet responded to the increase in rainfall experienced in 2020.
LiDAR mapping of individual groundwater dependent communities within swamps	• No significant change in the extent of individual upland swamps across both the control and impact treatments was observed in 2017. Both "impact" and control swamps recorded a decrease in extent, which reflects a change that is observed on a regional scale and is not attributable to localised mining impacts. • The change in extent of vegetation communities within upland swamps from the baseline is most notable at impact sites, with declines in extent identified for all vegetation communities. The declines were most noticeable within the Tea-tree Thicket community, indicating that this community is the most sensitive community, however Tea-tree Thicket only comprises 5% of all Coastal Upland Swamp vegetation in the Subject Land, its overall extent is small and is disproportionately influenced by change at transitional zones between communities. • The decline of Tea-tree Thicket Community from its baseline extent is not statistically significant.	Previous monitoring reports detected a change in extent of Upland Swamp sub-communities from baseline; most notable at Impact Upland Swamps (Biosis 2020), which was a continuation of the trend across the Impact Upland Swamps, first recorded in 2014 (Biosis 2020). A similar pattern was observed across the Control Upland Swamps, although the degree of change was not as great as that recorded at the Impact Upland Swamps (Biosis 2020). This trend is likely to be continuing, based on observations of die-back/drying within Impact Upland Swamps during field survey in 2020. However, these trends cannot be confirmed from the 2020 data. Different approaches to mapping sub-communities (CHM used) and areas of die-back/drying, have led to a situation where change in Impact Upland Swamp sub-communities extent in comparison to change in Control Upland Swamps sub-communities extent could not be assessed in 2020. As part of future monitoring, the 2020 CHM (and subsequent sub-community extent verification using high resolution aerial imagery) will be applied to all previous years LiDAR data (where available) to ensure results between years are comparable. Further, application of high resolution 4 band imagery (BGR-NIR) would remove subjectivity in mapping areas of die-back/drying (which were detected in 2020 and previous years monitoring) in the Upland Swamps.
Total Species Richness (TSR)	• An overall decline in TSR has been observed at all sites and is likely indicative of landscape scale factors, such as changes in	Trends across swamps indicate declining TSR post-mining for most (but not all) Impact Upland Swamps.

Monitoring	Biosis (2017) results summary	Niche (2021) results summary
	climatic conditions, natural succession of swamp vegetation and/or changes on upland swamp vegetation following bushfire. • Whilst vegetation dynamics associated with fire may explain observed declines in richness and diversity at all sites, it is unlikely to have been the only factor contributing to the changes observed at post-mining sites.	An assessment of overall trends in Dendrobium Area 3 data reveals highly variable TSR. TSR is highly variable between years, and across each mining status ('Control', 'Pre-mining', 'Post-mining (within RMZ)', or 'Mined beneath'). It appears there is high variability in TSR in all Upland Swamps regardless of year or mining status. However, the TSR in Impact Upland Swamps (mined beneath) appears to be declining over time in comparison to the Controls. It cannot be determined whether this is an artefact of sampling (i.e. some swamps have only been sampled a few times), or actual patterns due to disturbance (e.g. die-back may have reduced species richness initially, followed by colonisation by non-swamp species in disturbed areas) from this plot analysis alone as such analysis of species composition is undertaken to compliment TSR analysis. Cumulative impacts have been observed at a number of Impact Upland Swamps, which show trends of significant decline in TSR over time.
Flora composition	• All data for each monitoring site was combined to analyse changes in flora species composition over time using a multivariate presence-absence model. • Statistically significant yearly, and occasionally seasonal, trends in species composition were detected at most sites, regardless of mining area (Dendrobium Area 3A or 3B) or treatment (control or impact sites) when applying a conservative 0.1 alpha significance threshold. • In addition to the yearly and seasonal trends across all sites, a significant change in species composition pre-mining to post-mining was found at two of the six sites; Swamp 15B and Swamp 15A(2) (impact swamps). At the remaining sites there is no statistical significance in floristic composition when compared to before and after mining and between control and impact sites. • Statistically significant yearly and, occasionally, seasonal trends in species composition were detected at most sites, regardless of mining area or treatment. Such global trends are indicative of natural turnover of species within upland swamps in response to seasonal and annual variability in climate, competition, disturbance and edaphic factors including nutrient availability.	Compositional changes show trends of the loss of wetland flora species, which are either being replaced by species more tolerant of drier soil (suggesting changes toward drier swamp subcommunities) or not being replaced with any new vegetation (suggesting the die-back of swamp vegetation) broadly across monitored Upland Swamps, particularly for those Impact Upland Swamps that have longer post mining impact data available, although it is reasonable to expect natural species turnover to occur at a swamp, especially after an extended drought period. Cumulative impacts have been observed at a number of Impact Upland Swamps, which show trends of significant changes to composition, with 'wetter' species becoming less common post impact, suggesting a loss of species that prefer moist soils. Some swamps show species dying out over time, with limited recruitment of new species, suggestive of dieback.

As discussed in Appendix 9, key conclusions from the impact assessment include the following:

- Detecting changes in Coastal Upland Swamp vegetation and habitat change as a result of subsidence is confronted with many limitations and variables, and as such, results from the monitoring programs have not been conclusive to date. This is largely attributed to the time over which change may be observed in vegetation as a result of subsidence, influences of the surrounding landscape, current limitations of monitoring, in particular current LiDAR and aerial photograph interpretation models, and the unique nature of each swamp and its subsidence impacts.
- No large-scale study has been completed to compile and analyse trends in the pre and post mining data from the Coastal Upland Swamps piezometer results from the IMC, Metropolitan Coal and Wollongong Coal monitoring programs. However, the results available indicate that when a longwall passes beneath or within 60 m of an upland swamp, subsidence may result in a change in groundwater recession levels. It is therefore likely that swamps located above or within 60 m of the proposed longwalls (16 are located above longwalls), would experience some degree of impact from changes to groundwater levels (Watershed 2022).
- The Coastal Upland Swamps within the Subject Land comprise predominately drier vegetation types including: approximately 46% of PCT978 Eucalypt Fringing Woodland (not part of the threatened community listing), 45% of Restioid Heath, and 0.6% of Banksia Thicket. Wetter swamp communities consisted of 7% of PCT1804 Tea-tree Thicket. It may be reasonable to conclude based on monitoring data and literature review, that a decrease in species distribution or abundance, or extent of sub-communities, that are reliant on semi-permanent to permanent waterlogging (such as Tea-tree Thicket and Cyperoid Heath) within a swamp that has experienced lower water levels following mining, may indicate an impact from mining. Similarly, an increase in drier vegetation types within swamps that have experienced lower water levels following mining, such as Banksia Thicket or Eucalypt Fringing Woodland, may also serve as an indicator of mining impacts.
- Despite detected changes in groundwater in swamps located above longwalls, there have been no strong links detailed in the monitoring reports to date that indicate that a significant vegetation response has occurred in Coastal Upland Swamps due to hydrological changes associated with mining. This may be attributed to the long-term timeframes to which such trends may be detected.
- Given the Coastal Upland Swamps of the Subject Land are made of up of 92% of drier sub-vegetation communities (Eucalypt Fringing Woodland, Banksia Thicket and Restioid Heath), it is also possible that these communities are more resilient to hydrological changes, given they are not as dependent on waterlogged peat compared to wetter sub-vegetation communities (Teatree Thicket, and Cyperoid Heath). However to date, no studies have been completed to support this.
- A reduction in the water table from subsidence may result in changes to the cohesion of the soils within Coastal Upland Swamps. The organic matter within the soil may undergo a hydrophobic reaction, which in turn results in the organic matter, which binds the sand grains, becoming loose and resulting in sediments that are highly erodible (Young 2017, DPE 2015). As described above, Coastal Upland Swamps directly above and within 60 m of proposed longwalls are expected to exhibit a change in groundwater as a response to mining. However, it is possible that should a decrease in waterlogging occur, it may result in peat desiccation which would expose the Coastal Upland Swamp to greater intensity burns. In relation to the Project, MSEC (2022) states that for the Coastal Upland Swamps in the Subject Land it is not expected there will 'be adverse changes in the levels of ponding or scouring within the swamps due to mining induced tilt'. Over 500 swamps have been directly mined beneath in the Southern Coalfield using varying methods (Richardson and Ryan 2007), with only three (0.6%) exhibiting scour and erosion events.

Based on the results of Watershed (2021) and the impact assessment provided in Appendix 9, subsidence related impacts such as hydrological changes are likely to occur in Coastal Upland Swamps above and within 60 m of the longwalls, with some potential for impacts elsewhere within the Subject Land (Table 45). This has potential to impact upon the Coastal Upland Swamp system in the long-term.

Table 45. Area of Coastal Upland Swamps within 60 m of longwall panels

Swamp	Type	Swamp Area (ha)	Total Coastal Upland Swamp TEC (ha)
Den100	Headwater	0.84	0.46
Den101	Headwater	0.81	0.4
Den102	Headwater	0.51	0.27
Den103	Headwater	1.16	0.53
Den106	Headwater	1.08	0.66
Den107	Headwater	0.54	0
Den108	Valley In-fill	0.41	0.11
Den109	Headwater	0.96	0.41
Den110	Headwater	0.49	0.25
Den111	Valley In-fill	0.36	0.17
Den114	Headwater	0.61	0
Den121	Valley In-fill	1.19	0.46
Den122	Headwater	0.61	0.35
Den123	Headwater	0.4	0.13
Den86	Headwater	4.66	2.37
Den99	Headwater	3.21	2.03
Total		**17.84**	**8.6**

(d) justify predictions of impacts with appropriate modelling (if available), relevant literature and other published sources of information, or consultation with species experts.

MSEC (2022) used the modelling for subsidence predictions as detailed in section 4.6.1 (c) above.

Monitoring Reports, and literature used to assess Coastal Upland Swamps has been provided in Appendix 9.

Watershed (2021) Geographic review of mining effects on Upland Swamps at Dendrobium Mine has been attached to this BDAR (Appendix 13).

4.6.5 The impact of vehicle strikes on threatened species of animals or on animals that are part of a threatened ecological community.

All construction and operation work would be subject to existing speed limit restrictions (40km/hour on unsealed roads) when in WaterNSW Special Areas, and applicable NSW road speed limits when travelling to the site.

All work within the WaterNSW Special Areas needs approval, and has access requirements and restrictions for night work, and work during heavy rain periods. A skeleton drilling crew would operate at night during construction of the ventilation shafts. The speed limit imposed, along with night/wet weather restrictions would reduce vehicle/fauna interactions.

The Project would apply mitigation measures to avoid vehicle interactions to fauna. The mitigation measures are provided in section 5.1 and are expected to reduce all vehicle/fauna interactions.

4.7 Cumulative impacts

The Project would expand longwall coal mining within the Dendrobium Areas following on from mining of Dendrobium Area 3 to the south, which was approved in 2008. Generally, the Project will add to cumulative impacts from longwall mining via additional clearing and subsidence. Future applications for longwall coal mining within the Southern Coalfield are likely to occur, within existing constraints to mining, including extent of the coal resource and environmental considerations.

The Dendrobium Mine Area 3 was assessed as having an impact to the following biodiversity features:

- Potential changes to hydrology associated with Coastal Upland Swamps, including eight upland swamps within the subsidence area associated with Dendrobium 3B, and four within Dendrobium 3C.
- Potential impacts to creeks and watercourses (such as diversion of pools and ponding) which support threatened amphibians including Littlejohn's Tree Frog, Red-crowned Toadlet and Giant Burrowing Frog.
- Potential changes to swamp habitat for the Giant Dragonfly as a result of hydrological changes.

Cumulative local impacts as a result of the Project include:

- Changes to hydrology associated with Coastal Upland Swamps – as assessed in section 4.6.4 of this BDAR.
- Increase in vegetation clearing of 19.85 ha (section 4.1).
- Increase in clearing of habitat supporting threatened fauna (section 4.4).
- Removal of 388 hollow-bearing trees.
- Potential impacts to creeks and watercourses (such as diversion of pools and ponding) which support threatened amphibians including Littlejohn's Tree Frog, Red-crowned Toadlet and Giant Burrowing Frog.
- Potential changes to swamp habitat for the Giant Dragonfly as a result of hydrological changes.

4.8 Impacts to adjacent conservation areas

The Subject Land is located approximately 500 m to the south and east of the Upper Nepean State Conservation Area (Figure 5). The Subject Land is also located within the Special Area Catchment Lands managed by WaterNSW. The area consists of expansive patches of bushland that provide important habitat, connectivity, and protection to threatened biodiversity across the Illawarra, Sydney Basin and Southern Highlands.

The Upper Nepean State Conservation Area aims to protect over 25,314 ha of bushland in the upper catchment of the Nepean River, which includes 13 threatened ecological communities that cover nearly 15% of the park, 9 threatened plant species and 32 threatened animal species including protection of a significant population of Koalas (DPIE 2020e).

The surface infrastructure proposed by IMC is located outside of the Upper Nepean State Conservation Area and therefore the Project will not directly impact these lands. The Project underground mining area is proximal to the Upper Nepean State Conservation Area. The proposed longwalls do not directly mine beneath the Upper Nepean State Conservation Area, however a portion (approximately 8 ha) of the Upper Nepean State Conservation Area is located within the 600 m boundary from the proposed longwalls. The streams within the Upper Nepean State Conservation Area could experience valley-related effects, however fracturing or other physical impacts are not expected due to the distance from the proposed longwalls (e.g. approximately 410 m from nearest proposed longwall). The furthest distances that fracturing have been

observed outside of previously extracted longwalls are 290 m at Dendrobium Mine and 400 m elsewhere in the Southern Coalfield. It is considered unlikely, therefore, that adverse physical impacts would occur within the Upper Nepean State Conservation Area due to the mining of the proposed longwalls.

The Subject Land and Biodiversity Assessment Development Footprint are located within the Special Area Catchment Lands. The extent of the direct impacts to 19.85 ha of native vegetation/habitat associated with the Project is unlikely to result in a significant impact to threatened biodiversity, and therefore the regional population residing in the Special Area Catchment Lands or Upper Nepean State Conservation Area would not be significantly impacted. The available habitat surrounding the Biodiversity Assessment Development Footprint is relatively extensive compared to the 19.85 ha of vegetation/habitat to be impacted. Impacts to connectivity because of direct impacts to vegetation/habitat are unlikely to impede movement of fauna. The Biodiversity Assessment Development Footprint is located immediately adjacent to existing tracks and trails, and movement is not obstructed around the Biodiversity Assessment Development Footprint.

Indirect impacts would occur for the life of the undergrounding mining operations. The impacts have been quantified and assessed in MSEC (2022). The indirect impacts from subsidence to threatened species and communities (prescribed impacts) are detailed in section 4.6, which conclude that impacts to local and regional persistence of the species is unlikely to be significantly impacted.

The surface infrastructure proposed by IMC is located outside of the Illawarra Escarpment State Conservation Area. The Dendrobium Pit Top Carpark is located approximately 1 km from the Illawarra Escarpment State Conservation Area (Figure 5). Given the relatively small area of impact (0.17 ha) to habitat, it is highly unlikely there would be any impact on the Illawarra Escarpment State Conservation Area. The proposed longwalls are located approximately 10 km away. Therefore, the Project would not have direct or indirect impacts on the Illawarra Escarpment State Conservation Area.

4.9 Serious and irreversible impacts

The BC Act and the *Local Land Services Act 2013* imposes various obligations on decision-makers in relation to impacts on biodiversity values that are at risk of Serious and Irreversible Impacts (SAII). These obligations generally require a decision-maker to determine whether the residual impacts of a proposed development on biodiversity values (that is, the impacts that would remain after any proposed avoid or mitigate measures have been taken) are serious and irreversible.

The BC Act and the BC Regulation provide a framework to guide the approval authority in making this determination. The framework consists of a series of principles defined in section 6.7 of the BC Regulation and supporting guidance, provided for under section 6.5 of the BC Act, to interpret these principles. Criteria to interpret the principles is included in Table 1 of Guidance to assist a decision-maker to determine a serious and irreversible impact (DPIE 2019b) and these are addressed below.

Based on the result of the field survey, candidate species assessment (Threatened flora: section 2.5.3; Threatened fauna: section 2.6.4) and analysis against prescribed impacts , the following candidate species are regarded as SAII entities which may be impacted by the Project:

- Broad-headed Snake (assumed present).
- Giant Dragonfly (assumed present).

The habitat associated with both species are shown on Figure 17.

Shale Sandstone Transition Forest and the following threatened flora are also SAII entities which occur, or have been assumed to occur, within the Subject Land: *Deyeuxia appressa, Genoplesium baueri, Melaleuca deanei, Persoonia hirsuta* and *Pomaderris adnata.*

No SAII have been completed for Shale Sandstone Transition Forest nor the above threatened flora, as direct and indirect impacts are unlikely.

SAII assessments have been completed to assist the determining authority with evaluating the extent and severity of the impact to Broad-headed Snake and Giant Dragonfly (Appendix 11).

4.10 Impacts to Matters of National Environmental Significance

4.10.1 Threatened Ecological Communities listed under the EPBC Act

The Project would result in the potential for subsidence related impacts on the TEC portions of Coastal Upland Swamps, in the form of bedrock fracturing, hydrological changes and ecosystem function.

An Assessment of Significance has been completed for potential impacts to Coastal Upland Swamps which has been provided in Appendix 9.

The Assessment concluded that a significant impact to Coastal Upland Swamp TEC is possible due to the following:

- There is the possibility that the TEC portions of Coastal Upland Swamps, in particular, swamps directly mined beneath, may transition to a drier woodland vegetation type and thus reduce the extent and composition of the TEC.
- A study by Watershed (2021) has concluded that swamps within 60 m of a longwall may exhibit a groundwater recession change. The TEC portions of Coastal Upland Swamps directly above the longwalls, or which occur within 60 m of the proposed longwalls are likely to experience hydrological changes. Indirect impacts associated with this include:
    - change in groundwater recession and flow.
    - change in surface water flow.
    - transition to a drier woodland vegetation type.
    - soil cohesion changed to erodible particles.
- The Project may potentially modify or impact abiotic (non-living) factors (such as water, nutrients, or soil) necessary for survival and persistence of the TEC.

A biodiversity offset for the TEC portions of the Coastal Upland Swamps has been quantified in section 6.3.

Shale Sandstone Transition Forest occurs within the Subject Land, however it will not be directly impacted by the Project and is unlikely to be indirectly impacted. An Assessment of Significance was completed on a precautionary basis which concluded that significant impacts are unlikely (Appendix 8).

4.10.2 Threatened flora listed under the EPBC Act

As discussed in section 2.5.5, no EPBC Act listed threatened flora are likely to occur within the Biodiversity Assessment Development Footprint, and thus no threatened flora are likely to be directly impacted by the Project.

Whilst there are 22 EPBC Act listed threatened flora that may have habitat within the Subject Land (section 2.5.5), only three were deemed to have habitat subject to indirect/prescribed impacts: *Pomaderris brunnea* (recorded within the locality by Bionet with marginal potential to occur within riparian areas), *Pultenaea aristata* (potential to occur within swamps) and *Cryptostylis hunteriana* (potential to occur within swamps). The species have been assessed in section 2.7 and section 4.6, and accompanied by an Assessment of Significance (Appendix 8).

The Assessments of Significance concluded that a significant impact to *Cryptostylis hunteriana, Leucopogon exalasius, Pomaderris brunnea*, and *Pultenaea aristata* is unlikely based on the following:

- The species were not detected in the areas of surface infrastructure, and as such are unlikely to be directly or indirectly impacted by the surface infrastructure works.
- Mitigation measures would be employed to minimise impacts to threatened flora and habitat during construction and operation (section 5.1).
- The species are unlikely to be impacted by subsidence given the population of the species does not occur within the riparian inundation area of the creek within the Subject Land. Thus any potential hydrological change as a result of subsidence within such environments are unlikely to impact upon *Cryptostylis hunteriana, Pomaderris brunnea* and *Pultenaea aristata.*
- Gas emissions as a result of subsidence are predicted to be rare, and given the species are not likely to occur within the creeklines or the lower bank, potential impacts from gas emission would largely be avoided.
- All the species occupy the drier portions of swamp environments and are also associated with the PCT1083 and Eucalypt Fringing Woodland – which are the vegetation communities that swamps may transition to.
- It is highly unlikely that falling cliffs/rocks as a result of subsidence would impact the species.

An Assessments of Significance was also completed for *Acacia bynoeana* and *Leucopogon exalasius* (known to occur within the Subject Land) (Appendix 8). The species were determined as unlikely to be significantly impacted by the Project given the species would not be directly impacted, and the habitat they reside within is unlikely to be subject to indirect impacts.

No EPBC Act listed threatened flora species are therefore considered likely to be significantly impacted by the Project.

4.10.3 Threatened fauna listed under the EPBC Act

As discussed in section 2.6.7, EPBC Act listed threatened fauna that have potential to occur in Biodiversity Assessment Development Footprint and would be subject to direct impacts include the following 'species credit' fauna: Koala and Large-eared Pied Bat. A detailed description of the impacts to both species has been provided in section 4.4.2 and 4.4.4 respectively.

The Greater Glider, Swift Parrot, Spotted-tail Quoll, White-throated Needletail and Grey-headed Flying Fox have been identified in the SEARs for consideration, and have potential foraging habitat with the Biodiversity Assessment Development Footprint. The species are regarded as ecosystem credits species on the BC Act, and thus the direct impacts to habitat are ultimately accounted for in the offset proposed for the impacted PCTs (section 6.1). Assessments of Significance concluded that the Project is unlikely to have a significant impact as a result of direct impacts (Appendix 8).

As discussed in section 4.6, the Project may have prescribed impacts to the following EPBC Act listed threatened fauna: Broad-headed Snake, Littlejohn's Tree Frog, and Giant Burrowing Frog. The assessment of significance completed for Littlejohn's Tree Frog, and Giant Burrowing Frog concluded that subsidence could result in a significant impact to both amphibians given the potential loss of breeding pools that may sustain a local population. Both species have been addressed further in relation to biodiversity offsetting (section 6.3). The assessment of significance completed for the Broad-headed Snake indicated that a significant impact to this species is unlikely to occur.

Assessments of Significance have been completed for those listed Migratory fauna under the EPBC Act that may occasionally forage within the Subject Land: Fork-tailed Swift (*Apus pacificus*), Black-faced Monarch (*Monarcha melanopsis*), Spectacled Monarch (*Monarcha trivirgatus*), Rufous Fantail (*Rhipidura rufifrons*) and Satin Flycatcher (*Myiagra cyanoleuca*).

The assessments concluded that a significant impact was unlikely for migratory species.

4.10.1 Assessment of MNES identified in the SEARs

A summary of the assessment of each Matter of National Environmental Significance specifically identified by the SEARs is provided in Table 46. A biodiversity offset has been proposed for Coastal Upland Swamps, Littlejohn's Tree Frog and Giant Burrowing (section 6).

Table 46. Assessment summary of each MNES identified by the SEARs

MNES	Status	Assessment summary
Coastal Upland Swamps in the Sydney Basin Bioregion	Endangered	• A total of 16 Coastal Upland Swamps totalling an area of 8.6 ha occur within 60 m of the proposed longwalls which could be impacted by subsidence. • No direct impact via the clearing of vegetation associated with this TEC is proposed. • Indirect impacts associated with the potential for subsidence are addressed in section 4.6.4 and Appendix 9. • An assessment of significance in accordance with the Significant impact guidelines has been undertaken (Appendix 8). This assessment concluded that the Project has the potential to significantly impact upon Coastal Upland Swamps within the Subject Land. • The Offset Liability for predicted impacts to Coastal Upland Swamps is detailed in Appendix 10.
Shale Sandstone Transition Forest of the Sydney Basin Bioregion	Critically Endangered	• A total of 91.18 ha of Shale Sandstone Transition Forest has been recorded within Subject Land. • Shale Sandstone Transition Forest TEC would not be directly impacted and is considered unlikely to be impacted by subsidence (section 4.9). • An assessment of significance in accordance with the Significant impact guidelines has been undertaken (Appendix 8). This assessment concluded that the Project has the potential to significantly impact upon Shale Sandstone Transition Forest of the Sydney Basin Bioregion within the Subject Land.
Grey-headed Flying-fox (*Pteropus poliocephalus*)	Vulnerable	• The Grey-headed Flying Fox was observed flying over and foraging in trees within the Subject Land. • Habitats for this species may be directly impacted by vegetation clearing for surface infrastructure but are not considered sensitive to potential indirect subsidence impacts.

MNES	Status	Assessment summary
		• An assessment of significance in accordance with the Significant impact guidelines has been undertaken (Appendix 8). This assessment has concluded that the Project is unlikely to significantly impact upon the Grey-headed Flying Fox.
Littlejohn's Tree Frog (*Litoria littlejohni*)	Vulnerable[17]	• Littlejohn's Tree Frog has been recorded and suitable habitat mapped within the Subject Land. • The species has not been recorded in the Biodiversity Assessment Development Footprint, and as such no direct impacts to this species will occur through vegetation clearing associated with the Project. • The habitats for this species are considered susceptible to indirect impacts associated with potential subsidence, described in sections 4.5.5 and 4.6.4. • An assessment of significance in accordance with the Significant impact guidelines has been undertaken (Appendix 8). This assessment has concluded that the Project has the potential to significantly impact upon the Littlejohn's Tree Frog within the Subject Land. • Proposed offsets for indirect impacts from subsidence are detailed in section 6.3, and Biodiversity Offset Strategy in section 7.
Koala (*Phascolarctos cinereus*)	Vulnerable[18]	• Koalas were recorded within the Biodiversity Assessment Development Footprint during surveys. • Habitats for this species may be directly impacted by vegetation clearing for surface infrastructure but are not considered sensitive to potential indirect subsidence impacts. • An assessment of significance in accordance with the Significant impact guidelines has been undertaken (Appendix 8). This assessment has concluded that the Project is unlikely to significantly impact upon the Koala. • A Koala Plan of Management would be prepared for the Project to provide further safeguards to minimise impacts to the Koala (section 5.2.2). • Proposed offsets for impacts to habitats for this species are detailed in section 6.3, and Biodiversity Offset Strategy in section 7..
Giant Burrowing Frog (*Heleioporus australiacus*)	Vulnerable	• The Giant Burrowing Frog has been recorded and suitable habitat mapped within the Subject Land.

[18] *Listed as 'Vulnerable' under the EPBC Act at the time of the "controlled action" decision (13 January 2022) and therefore assessed as 'Vulnerable' rather than 'Endangered' (refer section 158A of the EPBC Act).*

MNES	Status	Assessment summary
		• The species has not been recorded in the Biodiversity Assessment Development Footprint, and as such no direct impacts to this species will occur through vegetation clearing associated with the Project. • The habitats for this species are considered susceptible to indirect impacts associated with potential subsidence, described in sections 4.5.5 and 4.6.4. • An assessment of significance in accordance with the Significant impact guidelines has been undertaken (Appendix 8). This assessment has concluded that the Project has the potential to significantly impact upon the Giant Burrowing Frog within the Subject Land. • Proposed offsets for indirect impacts from subsidence are detailed in section 6.3, and Biodiversity Offset Strategy in section 7.
Broad-headed Snake (*Hoplocephalus bungaroides*)	Vulnerable	• The Broad-headed Snake has been assumed to be present within the Subject Land. • The species has not been recorded in the Biodiversity Assessment Development Footprint, and as such no direct impacts to this species will occur through vegetation clearing associated with the Project. • The habitats for this species are considered susceptible to indirect impacts associated with potential subsidence, described in sections 4.5.5 and 4.6.4. • An assessment of significance in accordance with the Significant impact guidelines has been undertaken (Appendix 8). This assessment has concluded that the Project is unlikely to significantly impact upon the Broad-headed Snake within the Subject Land. • Proposed offsets for indirect impacts from subsidence are detailed in section 6.3, and Biodiversity Offset Strategy in section 7.
Large-eared Pied Bat, Large Pied Bat (*Chalinolobus dwyeri*)	Vulnerable	• The Large-eared Pied Bat was not detected within Area 5 during ultrasonic call recording surveys or harp trapping surveys in the extensive baseline surveys in 2016. As such, the species is considered unlikely to be subject to any indirect impacts associated with subsidence. Due to the lack of records despite targeted survey and limits potential for subsidence impacts an assessment of significance has not been undertaken for indirect impacts within the Subject Land. • The area proposed for the Dendrobium Pit Top Carpark may have foraging habitat potential (0.17 ha) and the species has been assumed to be present. • An assessment of significance in accordance with the Significant impact guidelines has been undertaken (Appendix 8). This assessment has concluded that the

MNES	Status	Assessment summary
		Project is unlikely to significantly impact upon the Large-eared Pied Bat within the Biodiversity Assessment Development Footprint. • Proposed offsets for impacts to habitats for this species are detailed in section 6.2, and the Biodiversity Offset Strategy in section 7.
Swift Parrot (*Lathamus discolor*)	Critically Endangered	• The species has been assumed as present however the species was not detected during survey. • An assessment of significance in accordance with the Significant impact guidelines has been undertaken (Appendix 8). This assessment has concluded that the Project is unlikely to significantly impact upon the Swift Parrot. • As an ecosystem credit species under the BC Act, direct impacts to habitat are ultimately accounted for in the offset proposed for the impacted PCTs (section 6.1), with the Biodiversity Offset Strategy identified in section 7.
Silver Perch (*Bidyanus bidyanus*)	Critically Endangered	• This species is considered unlikely to occur within the Subject Land or be impacted by the Project (Appendix 2). As such an assessment of significance has not been completed for this species. • While a translocated population exists within Cataract Dam, Silver Perch are endemic to the Murray-Darling system. Cataract Dam is located approximately 15 kilometres north of the Subject Land and will not be impacted by the Project. Silver Perch are not known from Avon Dam or connected waterways downstream of the Subject Land.
Rufous Pomaderris, Brown Pomaderris (*Pomaderris brunnea*)	Vulnerable	• The known records for the species would not be impacted for surface infrastructure associated with the Project and survey within the direct impact areas did not identify the species. • An assessment of significance in accordance with the Significant impact guidelines has been undertaken (Appendix 8). This assessment has concluded that the Project is unlikely to significantly impact upon *Pomaderris brunnea,* directly or indirectly.
Woronora Beard-heath (*Leucopogon exolasius*)	Vulnerable	• No individuals were recorded within the areas proposed for surface infrastructure and the known records for the species would not be impacted for surface infrastructure associated with the Project. • An assessment of significance in accordance with the Significant impact guidelines has been undertaken (Appendix 8). This assessment has concluded that the

MNES	Status	Assessment summary
		Project is unlikely to significantly impact upon *Leucopogon exolasius,* directly or indirectly.
Bargo Geebung (*Persoonia bargoensis*)	Vulnerable	• No individuals were recorded within the areas proposed for surface infrastructure and the known records for the species would not be impacted for surface infrastructure associated with the Project. • The species is unlikely to occur within habitat sensitive to subsidence. The species was not detected during the survey, nor has been previously recorded within swamp monitoring campaigns, or has records within the locality. The species is typically located within Bargo NSW. In light of these factors an assessment of significance has not been completed.
Kangaloon Sun Orchid (*Thelymitra kangaloonica*)	Critically Endangered	• *Thelymitra kangaloonica* (Thelymitra sp. Kangaloon) is only known to occur on the southern tablelands of NSW in the Moss Vale / Kangaloon / Fitzroy Falls area at 550-700 m above sea level. It is known to occur at three swamps that are above the Kangaloon Aquifer. These swamps are a part of the ecological community "Temperate Highland Peat Swamps on Sandstone" which is listed under the EPBC Act. • It is found in swamps in sedgelands over grey silty grey loam soils. • The habitat and distribution of the species does not occur within the Project. As such an assessment of significance has not been completed.
Prickly Bush-pea (*Pultenaea aristata*)	Vulnerable	• No individuals were recorded within the areas proposed for surface infrastructure and therefore would not be impacted for surface infrastructure associated with the Project. • *Pultenaea aristata* was not recorded within the Subject Land but the species is known to be associated with Coastal Upland Swamp vegetation and known to occur in association with areas of impeded drainage and creek lines within sandstone woodland and gully forest plant communities. • An assessment of significance in accordance with the Significant impact guidelines has been undertaken (Appendix 8). This assessment has concluded that the Project is unlikely to significantly impact upon *Pultenaea aristata*, directly or indirectly.
Deane's Melaleuca (*Melaleuca deanei*)	Vulnerable	• No individuals were recorded within the areas proposed for surface infrastructure and therefore would not be impacted for surface infrastructure associated with the Project. • Targeted survey confirmed that the species is unlikely to occur along the edges of cliff lines within the

MNES	Status	Assessment summary
		Subject Land and the species is not associated with swamp or watercourse habitat. As such this species is not considered susceptible to potential subsidence impacts and is unlikely to be impacted by the Project. In light of this, an assessment of significance has not been completed.
Hairy Geebung, Hairy Persoonia (*Persoonia hirsuta*)	Endangered	• No individuals were recorded within the areas proposed for surface infrastructure and therefore would not be impacted for surface infrastructure associated with the Project. • The species is unlikely to occur within habitat sensitive to subsidence. The species was not detected during the survey, nor has been previously recorded within swamp monitoring campaigns, or has records within the locality. Given these factors, an assessment of significance has not been completed.
Scrub Turpentine, Brown Malletwood (*Rhodamnia rubescens*)	Critically Endangered	• No individuals were recorded within the areas proposed for surface infrastructure and therefore would not be impacted for surface infrastructure associated with the Project. • The species is associated with 'littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils.' No such features occur within the Subject Land. As such, the species is unlikely to be indirectly impacted by the Project. As such, an assessment of significance has not been completed.

5. Mitigation and Management measures

5.1 Mitigation

Indirect impacts associated with the Project will largely occur as a result of subsidence related impacts, or during the construction of the surface infrastructure, as identified in section 4.5. All impacts will be minimised where possible through management procedures. A range of indirect impacts are likely to, or could, occur as a result of the Project including:

- Increased noise and dust.
- Erosion or sedimentation around the surface infrastructure during construction and operation.
- Increased spreading of weed propagules.
- Increased edge-effects on the adjacent woodlands.
- Water diversion from subsidence cracking.

The indirect impacts described above are variable in terms of the distance they may extend from the area of impact, and in many cases, due to mitigation measures, indirect impacts will be completely contained within the direct disturbance area.

Indirect impacts on the biodiversity values surrounding the Biodiversity Assessment Development Footprint, along with recommended mitigation measures to minimise identified impacts, are discussed in Table 47. The IMC Environmental Co-ordinator will be responsible for the implementation and monitoring of mitigation measures outlined in Table 47.

Table 47: Mitigation and management measures to manage direct and indirect impacts

Impact	Mitigation measure	Method	Timing	Frequency	Responsibility	Risk and consequence of residual impact
Direct impact mitigation						
Native vegetation and habitat impacts outside of Biodiversity Assessment Development Footprint during construction and operation	Demarcation of direct impact area	- Demarcation of clearing areas. - Relevant signage installed. - Inform contractors of no-go zones.	Prior to construction	On-going during construction	IMC	Low
Loss / injury of fauna during vegetation clearing	Staged vegetation clearing process	A vegetation clearing protocol would be incorporated in a Management Plan and would include the following: - Prior to clearing of native vegetation, ecologists are to survey for ground-dwelling fauna and to remove any fauna/fauna habitat (nests or hollow logs) to adjacent habitat that would not be further disturbed. - Prior to clearing all hollow-bearing trees are to be marked. Underscrubbing would then take place within the vegetation surrounding the hollow-bearing trees.	Prior to vegetation clearing / Construction	Throughout the duration of clearing	IMC	Low

Impact	Mitigation measure	Method	Timing	Frequency	Responsibility	Risk and consequence of residual impact
		- After a 24 hour period, in the presence of an ecologist, the hollow-bearing trees would be gently felled. - Any fauna displaced during clearing are to be captured if required to protect the animal from harm and relocated to previously identified, safe areas (fauna to be captured and handled only by personnel trained to do so), or otherwise promoted to move into adjoining areas outside the disturbance area. - In an event that fauna are injured during clearing, the NSW Wildlife Information, Rescue and Education Service (WIRES) will be contacted to handle and collect for appropriate care and rehabilitation.				
Noise levels impact surrounding fauna	Operation hours	- The majority of noise sources at the surface facilities for the Project would effectively be unchanged from the existing operations of the approved Dendrobium Mine, with the exception of the proposed surface infrastructure to support underground mining operations. These sites are surrounded	During construction	Throughout the duration of construction	IMC	Low

Impact	Mitigation measure	Method	Timing	Frequency	Responsibility	Risk and consequence of residual impact
		by bushland and are isolated from residential receivers. - Surface construction activities to only occur during the day-time at all sites except the Ventilation Shaft Site. - Night-time construction activities would not occur at any of the existing or proposed surface facilities, except for Ventilation Shaft Site. Construction at the Ventilation Shaft Site would occur 24 hours per day, seven days per week (i.e. with a skeleton drilling crew during the night-time period). - All construction activities would be temporary in nature and would be managed to minimise construction noise impacts. - Ventilation Shaft Site No 5A is the surface facilities most isolated from urbanised areas.				
Sedimentation from construction and operation impacting surrounding habitat	Sediment controls planned and installed	- Installation of sediment controls barriers during the construction phase and operation to limit the erosion and sedimentation and deposition of soil particulates in drainage lines and	Prior to, and during construction and operation	Throughout the duration of construction and operations	IMC	Low

Impact	Mitigation measure	Method	Timing	Frequency	Responsibility	Risk and consequence of residual impact
		vegetation surrounding the surface infrastructure. - Regular checks and replacement of sediment controls. - Dewatering borehole on Ventilation Shaft Site is planned to discharge sediment basin and process water to mine workings to avoid surface water discharges from site. - Work restrictions during period of wet weather imposed.				
Vehicle fauna strikes during construction and operation	Vehicle speeds; contractor awareness	- Impacts to fauna from vehicles during the construction and operational phase of the surface infrastructure are anticipated to be low. - The speed limit within the WaterNSW land are 40 km/hour in unsealed areas. - Night construction at Ventilation Shaft Site restricted to a skeleton drilling crew. - Maintain vehicle / fauna interaction log and amend speed limits if required to avoid incidents.	At all times when accessing the site	Throughout the duration of operations	IMC	Low

Impact	Mitigation measure	Method	Timing	Frequency	Responsibility	Risk and consequence of residual impact
Potential for fire ignition during construction and operation	Safety gear; training; and contractor awareness	- During construction there is potential for equipment to trigger a fire ignition event e.g. welding. The potential for this to occur is higher during the hotter months. Mitigation measures include Catchment Closures during Fire Ban Days, fire extinguishers in vehicles, spill kits, IMC hot work permit process etc. - Contractors provided with sufficient training.	At all times when accessing the site	Throughout the duration of construction and operations	IMC	Low
Impacts to threatened flora during ETL pole placement and pipeline placement	Installation supervised by ecologist in areas near threatened flora	- Ecologist to supervise the ETL pole placement and pipeline placement to ensure no threatened flora impacted.	At installation of ETL poles and water pipe	At installation (and decommissioning) of ETL poles and water pipe	IMC	Low
Weed establishment adjacent to Biodiversity Assessment Development Footprint	Weed control	- Vehicle inspections prior to construction work to ensure vehicles are clean. - Vehicle washdown required prior to entering site. - Weed control immediately surrounding the Biodiversity Assessment Development Footprint in accordance with updated management plans.	During construction and operation	Throughout the duration of construction operations	IMC	Low

Impact	Mitigation measure	Method	Timing	Frequency	Responsibility	Risk and consequence of residual impact
Indirect impact mitigation						
Native vegetation and habitat	Subsidence remediation – (third order streams and key stream features)	Reasonable and feasible rehabilitation measures (e.g. grouting) as agreed with Agency stakeholders under any revised Watercourse Impact Monitoring Management and Contingency Plan.	After Level 3 impacts have been identified to third order streams or key stream features during post mining monitoring.	As required and agreed with Agency stakeholders.	IMC	Low
	Subsidence remediation – Swamps	Reasonable and feasible rehabilitation measures (e.g. erosion control measures) as agreed with Agency stakeholders under any revised Swamp Impact Monitoring Management and Contingency Plan.	After impacts have been identified to swamps during post mining monitoring.	As required and agreed with Agency stakeholders.	IMC	Low
	Longwall panel traverses	Any evidence of subsidence impacts compared to baseline condition (e.g. surface cracking, ponding, deterioration in tree health outside natural variation, weed incursion and/or infestation). Nature and extent of any impacts on flora and fauna habitats and evidence of any impacts on terrestrial fauna. The extent and condition of identified threatened flora species or TECs will be recorded and compared to the baseline condition.	Pre-mining impact baseline data for two years prior to secondary extraction annual as well as annual monitoring during and at least two years following longwall extraction.	Annually	IMC	Low

Impact	Mitigation measure	Method	Timing	Frequency	Responsibility	Risk and consequence of residual impact
Threatened amphibians	Biodiversity monitoring program – Littlejohn's and Giant Burrowing Frog Monitoring	Implement annual monitoring program targeting threatened amphibians. Monitoring to consider expansion of the current Dendrobium Amphibian Monitoring Program and including both impact and control sites to enable distinction between mining impacts and wider regional population changes or natural fluctuations caused by events such as drought.	Pre-mining impact baseline data prior to secondary extraction as well as annual monitoring during and at least two years following longwall extraction.	Annually	IMC	Low
Coastal Upland Swamps	Biodiversity monitoring program – Coastal Upland Swamps	Implement annual monitoring program to assess extent and condition of Coastal Upland Swamps within the Subject Land and locality. Monitoring to consider expansion of the current Dendrobium Swamp Program and including both impact and control sites to enable distinction between mining impacts and wider regional population changes or natural fluctuations caused by events such as drought.	Pre-mining impact baseline data prior to secondary extraction as well as annual monitoring during and at least two years following longwall extraction.	Annually	IMC	Low

Impact	Mitigation measure	Method	Timing	Frequency	Responsibility	Risk and consequence of residual impact
Giant Dragonfly	Biodiversity monitoring program – Giant Dragonfly	Implement research into the Giant Dragonfly to understand habitat extent and potential impacts from subsidence in the locality. Expansion of the current research program to be considered to enable distinction between mining impacts and wider regional population changes or natural fluctuations caused by events such as drought.	Pre-mining impact baseline data prior to secondary extraction as well as annual monitoring during and at least two years following longwall extraction.	Annually	IMC	Low

5.2 Plans and procedures for reducing direct and indirect impacts

IMC currently has several existing approved Dendrobium Area 3 management plans, which detail the mitigation and management associated with the Dendrobium mine and associated workings. Key management plans include:

- Swamp Impact Monitoring Management and Contingency Plan.
- Watercourse Impact Monitoring Management and Contingency Plan.
- Pollution Incident Response Management Plan EPL3241.
- Dendrobium Mine Air Quality Management Plan.
- Dendrobium Mine Bushfire Management Plan.
- Dendrobium Mine Landscape Management Plan.
- Dendrobium Mine Noise Management Plan.
- Dendrobium Mine Waste Management Plan.
- Dendrobium Mine Lighting Management Plan.
- Dendrobium Mine Traffic Management Plan.

Operations for the Project will continue to be managed in accordance with the existing plans, which would be revised and updated to incorporate the additional environmental management requirements as outlined in the EIS and any approval conditions for the Project. The Landscape Management Plan and other relevant management plans as required by an approval would be updated to include biodiversity management measures associated with the construction and operation of the Project in order to protect and manage important biodiversity values.

All management plans would be submitted/updated to the satisfaction of relevant State and Commonwealth agencies. The plans would also be prepared/updated in consultation with the relevant NSW government agency, which would be outlined in the conditions of Project Approval, should the Project be approved.

Key components to be updated and incorporated into the existing Plans include:

Vegetation clearing protocol for surface infrastructure sites

A vegetation clearing protocol would be incorporated in a Landscape Management Plan and would include the following:

- Prior to clearing of native vegetation, ecologists are to survey for ground-dwelling fauna and to remove any fauna/fauna habitat (nests or hollow logs) to adjacent habitat that would not be further disturbed.
- Prior to clearing all hollow-bearing trees are to be marked. Underscrubbing would then take place within the vegetation surrounding the hollow-bearing trees.
- After a 24-hour period, in the presence of an ecologist, the hollow-bearing trees would be gently felled.
- Any fauna displaced during clearing are to be captured if required to protect the animal from harm and relocated to previously identified, safe areas (fauna to be captured and handled only by personnel trained to do so), or otherwise promoted to move into adjoining areas outside the disturbance area.
- In an event that fauna are injured during clearing, the NSW Wildlife Information, Rescue and Education Service (WIRES) will be contacted to handle and collect for appropriate care and rehabilitation.

Employee Education and General Environmental Controls

Employees and contractors would be educated on, and required to implement the following controls, to avoid or at least minimise potential environmental impacts associated with the construction of the surface infrastructure.

- Participate in a site induction including any site-specific environmental constraints, protocols, and safeguards.
- Minimise dust generation by minimising the extent and time that bare soil is exposed and by appropriate dust suppression.
- Procedures for the management of hydrocarbon and/or chemical spills throughout the Subject Land including the requirements for vehicles to carry spill kits.
- Ensuring vehicles remain on designated roads and tracks and abide by site speed limits, through use of signposting and driver education during the induction process and in on-going Project discussions.
- Management and removal of all rubbish from the Subject Land.
- Observe no- go areas and limit of works.

Weed Management

Weed management activities during the Project will include:

- Management protocols for the identification of noxious or significant environmental weeds within areas to be cleared (to avoid transporting the weeds to rehabilitation areas or other parts of the site).
- Regular site inspections by qualified bushland regenerator.
- Regular weed control (weed spraying) on the edge of the Biodiversity Assessment Development Footprint (where and if required).

5.2.1 Fire management

IMC currently has the Dendrobium Mine Bushfire Management Plan. Fire prevention and suppression are detailed within the Dendrobium Mine Bushfire Management Plan including emergency protocols should a fire occur. The Dendrobium Mine Bushfire Management Plan would be updated where required to reflect the Project.

5.2.2 Koala plan of management

A Koala Plan of Management would be prepared for the Project to provide further safeguards to minimise impacts to the Koala. The Koala Plan of Management include:

- Minimising clearing in areas of core or potential Koala habitat.
- Rehabilitation of the surface infrastructure following decommissioning.
- Reducing the risk of Koala injury and death (including pre-clearing surveys, establishment of speed limits on all tracks and roads and Koala-specific inductions for all personnel).
- Koala injury monitoring.

5.2.3 Rehabilitation

The rehabilitation strategy for the Project would be undertaken in accordance with IMC's closure standards and rehabilitation strategy, which addresses closure criteria and land use. This includes requirements for the rehabilitation of disturbed areas (e.g., proposed Ventilation Shaft Site), decommissioning of infrastructure (e.g., Dendrobium Pit Top), remediation of contaminated sites, treatment and disposal of wastes, land use options, and post closure monitoring and management. Consideration is also given to

economic transitions at mine closure and supporting sustainable communities. Rehabilitation and closure is considered in Attachment 9 of the EIS.

Existing overall rehabilitation objectives for the Dendrobium Mine which would continue for the Project are that the final rehabilitated landforms must be:

- Safe.
- Stable.
- Non-polluting.
- Consistent with key stakeholder expectations (where practical) and surrounding lands.

For all sites other than the Kemira Valley Rail Line and Dendrobium CPP, additional rehabilitation objectives are that:

- Ecosystem function should be restored with the establishment of local native plant species.
- The ecosystem must be self-sustaining.

Several post-mining land uses were considered for the Project. The timeframe of the Project (i.e., until 31 December 2041) limits the certainty with which the post mining land use can be defined. However, for the purposes of rehabilitation and mine closure planning for the Project, an interim post-mining land use of native vegetation has been selected for all domains except the Dendrobium CPP. IMC considers that native vegetation represents the highest standard of rehabilitation likely to be required for all relevant sites.

The proposed Ventilation Shaft Site for the Project is to be rehabilitated to a post-closure land use of forest, like the surrounding vegetation. During decommissioning, all infrastructure would be removed to ensure the proposed Ventilation Shaft Site is safe and free of hazardous materials (subject to heritage and alternative end use considerations). The proposed Ventilation Shaft Site would be sealed, with any contaminated soils identified remediated by removal, encapsulation, or land-farming on-site. The final landform established would be stable and consistent with the surrounding environment and designed to reduce erosion. Once the landform is established, plant growth medium would be established with local native plant species with the rehabilitation objective of restoring self-sustaining ecosystem function to the site.

Key rehabilitation performance measures and completion criteria have been developed for the Project. Post-closure monitoring of rehabilitation areas at the Project would be conducted to assess the progress of rehabilitation areas and the effectiveness of the rehabilitation techniques being used to determine the need for any maintenance and/or contingency measures. Rehabilitation progress of the Project and rehabilitation techniques and materials would be regularly evaluated.

Existing surface infrastructure with no additional disturbance (i.e., land/vegetation clearance) would be rehabilitated in accordance with existing rehabilitation practices and measures for the approved Dendrobium Mine.

6. Quantifying Offset Requirements

6.1 Offset requirements

The BAM identifies the BAM-C as the appropriate tool for quantifying the offsets required in both ecosystem credit and species credit terms. The BAM-C is used to quantify the direct impact to threatened biodiversity and can be used to quantify indirect/prescribed impacts.

The credit requirement for direct impacts is provided in section 6.2, and the approach to offsetting the indirect impacts to threatened biodiversity are provided in section 6.3.

The Project is assessed as per the Assessment Bilateral Agreement which achieves streamlining benefits for all NSW proponents that use the Biodiversity Offsets Scheme (BOS) and need approval under the EPBC Act. The Australian Government has endorsed the BOS under the EPBC Act Condition-setting Policy, and as such any NSW proponent who needs an EPBC Act approval can use the NSW BOS to assess and meet their biodiversity offset requirements.

The impacts to Commonwealth MNES have been assessed in this BDAR, which has identified potential significant impacts from the Project's indirect impacts to Coastal Upland Swamps; Littlejohn's Tree Frog; and Giant Burrowing Frog. A biodiversity credit offset has been provided for these species in section 6.3.

No further significant impacts for Commonwealth threatened biodiversity are likely, however the Project will provide an offset for direct impacts to the Commonwealth listed Koala and large-eared Pied Bat.

6.2 Offsets for direct impacts

The area of direct impact for vegetation requiring an offset is detailed in section 4.1, and the area of direct impact to threatened fauna requiring an offset detailed in section 4.4.

The area of impact has been entered into the BAM-C along with the applicable BAM Plot attribute data (Appendix 4). Details of the BAM inputs have been discussed throughout this BDAR. Appendix 12 includes the full output of the BAM-C for the Project which defines the ecosystem and species credits required to offset the Project.

The results of the BAM-C ecosystem offset credit requirements, including current, future and change in vegetation integrity scores are shown in the table below.

Table 48: Ecosystem credit requirement for direct impacts

Zone	Vegetation zone name	Vegetation integrity loss	Area (ha)[19]	Sensitivity to loss	Sensitivity to loss (Justification)	Species sensitivity to gain class	Biodiversity risk weighting	Ecosystem credits
PCT1250 - Coastal sandstone gully forest								
1	1250_Good	42.4	1.1	Low Sensitivity to Loss	30%	High Sensitivity to Potential Gain	1.5	17
								Subtotal: 17
PCT1245 Illawarra Escarpment Blue Gum wet forest								
5	1245_Low	26.2	0.17	Low Sensitivity to Loss	43%	High Sensitivity to Potential Gain	1.5	2
								Subtotal: 2
PCT1083 Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion								
3	1083_Good	52.5	16.6	Low Sensitivity to Loss	17%	High Sensitivity to Potential Gain	1.5	327
4	1083_Low	26	1.96	Low Sensitivity to Loss	17%	High Sensitivity to Potential Gain	1.5	19
								Subtotal: 346

The results of the BAM-C species offset credit requirements are shown in Table 49 for those species directly impacted by the Project. The Koala and Large-eared Pied bat are listed as threatened on the EPBC Act.

Table 49. Species credits required for direct impacts

Vegetation zone name	Habitat condition (vegetation integrity) loss	Area (ha)[20]	Sensitivity to loss	Sensitivity to gain	Biodiversity risk weighting	Potential SAII	Species credits
Callocephalon fimbriatum / Gang-gang Cockatoo (Fauna)							
1083_Good	52.5	14.9	Moderate Sensitivity to Loss	High Sensitivity to Potential Gain	2	No	391
1250_Good	42.4	0.39	Moderate Sensitivity to Loss	High Sensitivity to Potential Gain	2	No	8
							Subtotal: 399
Cercartetus nanus / Eastern Pygmy-possum (Fauna)							

[19] The BAM-C rounds the area within vegetation zones to the nearest decimal place in some cases.

[20] The BAM-C rounds the area within vegetation zones to the nearest decimal place in some cases.

Vegetation zone name	Habitat condition (vegetation integrity) loss	Area (ha)[20]	Sensitivity to loss	Sensitivity to gain	Biodiversity risk weighting	Potential SAII	Species credits
1083_Good	52.5	16.5	Moderate Sensitivity to Loss	High Sensitivity to Potential Gain	2	No	433
1083_low	26	1.3	Moderate Sensitivity to Loss	High Sensitivity to Potential Gain	2	No	16
1245_Low	26.2	0.17	Moderate Sensitivity to Loss	High Sensitivity to Potential Gain	2	No	2
1250_Good	42.4	1	Moderate Sensitivity to Loss	High Sensitivity to Potential Gain	2	No	21
							Subtotal: 472
Chalinolobus dwyeri / Large-eared Pied Bat (Fauna)							
1245_Low	26.2	0.17	Moderate Sensitivity to Loss	Very High Sensitivity to Potential Gain	3	No breeding habitat impacted	3
							Subtotal: 3
Myotis macropus / Southern Myotis (Fauna)							
1083_Good	52.5	4.5	Moderate Sensitivity to Loss	High Sensitivity to Potential Gain	2	No	118
1250_Good	42.4	0.37	Moderate Sensitivity to Loss	High Sensitivity to Potential Gain	2	No	8
							Subtotal: 126
Phascolarctos cinereus / Koala (Fauna)							
1083_Good	52.5	16.5	Moderate Sensitivity to Loss	High Sensitivity to Potential Gain	2	No	433
1245_Low	26.2	0.17	Moderate Sensitivity to Loss	High Sensitivity to Potential Gain	2	No	2
1250_Good	42.4	1	Moderate Sensitivity to Loss	High Sensitivity to Potential Gain	2	No	21
							Subtotal: 456

6.3 Offsets for indirect impacts from subsidence

As stated in the BAM the '*retirement of biodiversity credits may be used with other conservation measures to mitigate prescribed impacts or the indirect impacts of a proposal on areas of native vegetation, TECs and/or threatened species, or their habitat adjacent to the Subject Land. Where part or all of the indirect or prescribed impacts cannot be avoided, minimised or mitigated, the assessor can propose offsets or other measures that benefit threatened entities and their habitat. The approach to calculating any proposed offsets should be documented and justified*'

A biodiversity offset has been applied to threatened biodiversity that may sustain a potential significant loss to habitat associated with prescribed impacts. The threatened biodiversity assessed in section 4.6 as experiencing a potential loss to habitat include:

- Coastal Upland Swamps in the Sydney Basin Bioregion TEC.
- Heleioporus australiacus / Giant Burrowing Frog.
- Hoplocephalus bungaroides / Broad-headed Snake.
- Litoria littlejohni / Littlejohn's Tree Frog.
- Myotis macropus / Southern Myotis.
- Petalura gigantea / Giant Dragonfly.
- Pseudophryne australis / Red-crowned Toadlet.

Details regarding the portion of the species polygons subject to the prescribed impacts are documented in section 4.6 and summarised below.

6.3.1 Threatened species

An offset liability for threatened species has been generated based on the conclusions of the prescribed impact assessment detailed in section 4.6. The assessment concluded that six threatened fauna may exhibit an impact as a result prescribed impact, and therefore IMC have put forward an offset using the BAM-C for the six species. A summary of the impact areas and associated PCTs are provided in Table 50, with the justification for the areas provided in section 4.6. The BAM-Plot attributed data for the Subject Land, which was entered into the BAM-C is provided in Appendix 4, and landscape attributes associated with the BAM-C provided in section 2.1.

Table 50. Summary of species polygons potentially indirectly impacted

Vegetation zone	Total area of indirect impact (ha)
Red-crowned Toadlet	
978	0.35
1083	1.18
1181	1.41
1250	0.44
1395	0.11
1804	0.01
TOTAL	**3.50**
Giant Dragonfly	
978	0.04

Vegetation zone	Total area of indirect impact (ha)
1804	0.18
978	3.46
TOTAL	3.68
Broad-headed Snake	
1083*	0.12
TOTAL	**0.12**
Littlejohn's Tree Frog	
1083*	13.26
TOTAL	**13.26**
Giant Burrowing Frog	
1083*	13.26
TOTAL	**13.26**
Southern Myotis	
1083*	4.75
TOTAL	**4.75**

*habitat features such as cliffs and watercourses do not correlate to specific vegetation zone. As such, we have associated the area of impact to PCT1083 given it is dominant PCT within the Subject Land and is associated with the occurrence of such habitat features.

The biodiversity credits generated for the indirect impacts to the threatened fauna are provided in Table 51.

Table 51. Species credits potentially required for impact on Upland Swamps, Watercourses and Cliffs

Species	Vegetation zone within the area of prescribed impact	Habitat condition (vegetation integrity) loss	Area of species polygon subject to prescribed impacts (ha)[21]	Sensitivity to loss	Sensitivity to gain	Biodiversity risk weighting	Potential SAII	Species credits
Heleioporus australiacus / Giant Burrowing Frog	1083_Good	51.8	13.3	Moderate Sensitivity to Loss	Moderate Sensitivity to Potential Gain	1.5	No	257
Hoplocephalus bungaroides / Broad-headed Snake	1083_Good	51.8	0.12	High Sensitivity to Loss	Very High Sensitivity to Potential Gain	3	Yes	5
Litoria littlejohni / Littlejohn's Tree Frog	1083_Good	51.8	13.3	Moderate Sensitivity to Loss	High Sensitivity to Potential Gain	2	No	343
Myotis macropus / Southern Myotis	1083_Good	51.8	4.8	Moderate Sensitivity to Loss	High Sensitivity to Potential Gain	2	No	123
Petalura gigantea / Giant Dragonfly	978_Good_Banksia	78.6	0.04	High Sensitivity to Loss	Very High Sensitivity to Potential Gain	3	Yes	2
	1084_Good_TTT	52.8	0.18	High Sensitivity to Loss	Very High Sensitivity to Potential Gain	3	Yes	7
	978_Good_Restoid	67.3	3.5	High Sensitivity to Loss	Very High Sensitivity to Potential Gain	3	Yes	177
Pseudophryne australis / Red-crowned Toadlet	1083_Good	51.8	3.5	Moderate Sensitivity to Loss	Moderate Sensitivity to Potential Gain	1.5	No	68
Total								**982**

* Attributed to 1083 – as watercourse, pools and PCT occurs where the majority of cliff, creeklines and subject and have been mapped. Exactly area of indirect impact is not known.

[21] Note that the BAM-C rounds the areas to the nearest decimal place in some instances. As such, they may be a slight different to the amount specified as the direct impact, compared to the output of the BAM-C.

6.3.2 Coastal Upland Swamps

The offset strategy presented herein is primarily based on the Swamps Offset Policy (OEH 2016a) and the BAM. The BAM prescribes practices to calculate offsets for clearing impacts, however does not apply to lesser or indirect impacts including:

- downstream impacts on hydrology and environmental flows on surface vegetation and Groundwater Dependent Ecosystems; and
- subsidence and cliff falls associated with mining developments.

The Swamps Offset Policy (OEH 2016a) states:

> *Subsidence impacts on Coastal Upland Swamps are inherently more uncertain than the clearing of native vegetation and it takes time and monitoring to ascertain whether impacts have occurred. This means that this addendum applies beyond the development application stage of a major project and requires an adaptive management approach to environmental consequences throughout the life cycle of a major project that involves longwall mining underneath Coastal Upland Swamps.*

Thus, the Swamps Offset Policy employs a two-staged approach to confirm eventual offset requirements for a project consisting of:

1. identification of the maximum predicted offset liability based on subsidence predictions; and
2. confirmation of actual subsidence impacts based on analysis of piezometer groundwater monitoring data post mining over a 24 month period.

The proponent must demonstrate a legal ability to secure the maximum predicted offset prior to approval of each Extraction Plan. The offset strategy presented herein presents the maximum predicted offset liability based on knowledge and monitoring of previous subsidence impacts within the locality. It also provides some information on strategies that will be employed to secure required offsets. A final offset strategy with specifics of proposed offset measures will be developed and presented for each Extraction Plan as per the requirements of the Swamps Offset Policy.

The Swamps Offset Policy requires that the loss of the Coastal Upland Swamp should be assumed, for example, that the total area of the Coastal Upland Swamp has essentially been cleared and is devoid of ecosystem function. This is summarised in the Swamps Offset Policy as follows:

> *It is recognised that the impact of altering the hydrological regime within Coastal Upland Swamps is not equivalent to removing all vegetation. However, this impact is likely to result in total loss of the upland swamp ecological community in the long-term as a result of loss of critical ecosystem function. When predicting the offset liability it is the loss of the upland swamp ecological community, including the threatened species that reply on that community, which must be calculated to determine the offset liability.*

Whilst IMC acknowledges that a groundwater change may be experienced in Coastal Upland Swamps in the Subject Land, there is strong evidence that indicates native vegetation and fauna habitat would still persist following mining. IMC propose that this be taken into consideration when determining the biodiversity offset liability associated with Coastal Upland Swamps. This is supported by Watershed's (2022) analysis of historic swamp piezometer data from the Dendrobium Mine, which concluded that subsidence induced groundwater impacts have not been observed in Coastal Upland Swamps further than 60 m from longwalls (Appendix 13). Evidence to support this based on the existing Dendrobium Mine Area 3A and 3B Coastal Upland Swamp monitoring program, and relevant literature has been provided in Appendix 10 of this report.

To determine the biodiversity credits required for Coastal Upland Swamps, two scenarios have been applied in the BAM-C:

- A 'full loss scenario': the entire swamp within 60 m of longwalls is completely lost – no vegetation or habitat remains. The future site value loss in the BAM-C is attributed a score of zero.
- A 'partial loss' scenario: the entire swamps within 60 m of longwalls would experience a change in vegetation – transitioning to PCT978 Eucalypt Fringing Woodland or PCT 1083. The future site values in the BAM-C have been amended to reflect the vegetation and habitat that would remain, which is supported by the monitoring data recorded to date. Details of the amended scores have been provided in Appendix 10.

The biodiversity credits generated based on both scenarios have been provided in Table 52. IMC propose to proceed with the 'partial loss' scenario in light of the above reasoning, as supported by the monitoring data to date (Appendix 9 and Appendix 10) and as supported by DPIE in the previous application.

The final offset liability for Coastal Upland Swamps would be determined post mining based on piezometric data (or other relevant data) and the relevant approval conditions. IMC propose the biodiversity credits associated with the partial loss scenario be applied.

Table 52. Ecosystem credits potentially required for impact on Upland Swamps

Zone	Vegetation zone name	Vegetation integrity loss	Area	Sensitivity to loss	Sensitivity to loss (Justification)	Species sensitivity to gain class	Biodiversity risk weighting	Ecosystem credits
Full loss scenario – Ecosystem credits required if all the vegetation and habitat was lost								
1	978_Good_Banksia	78.6	0.15	High Sensitivity to Loss	48%	High Sensitivity to Potential Gain	2	6
2	1084_good	78.6	0.18	High Sensitivity to Loss	48%	High Sensitivity to Potential Gain	2	5
3	978_Good_Restoid	67.3	8.3	High Sensitivity to Loss	48%	High Sensitivity to Potential Gain	2	279
Total								**290**
Partial loss scenario - Ecosystem credits potentially required for impact on Upland Swamps – with attributes amended to reflect monitoring data/literature to date								
1	978_Good_Banksia	78.6	0.15	High Sensitivity to Loss	48%	High Sensitivity to Potential Gain	2	3
2	1084_good	78.6	0.18	High Sensitivity to Loss	48%	High Sensitivity to Potential Gain	2	1
3	978_Good_Restoid	67.3	8.3	High Sensitivity to Loss	48%	High Sensitivity to Potential Gain	2	103
Total								**107**

6.4 Commonwealth Offset liability

The Project is assessed under the Bilateral Agreement, and as such, the retirement of biodiversity credits as per the NSW Biodiversity Offset Scheme is an acceptable offsetting mechanism for Commonwealth entities.

The retirement of Biodiversity credits is required for the following Commonwealth listed threatened biodiversity that have been assessed as potentially significantly impacted by the Project:

- Coastal Upland Swamps.
- Giant Burrowing Frog.
- Littlejohn's Tree Frog.

No other threatened biodiversity was deemed to be significantly impacted via the Assessment of Significance Assessment (Appendix 8).

Whilst the Assessments of Significance did not determine a significant impact for the Koala and Large-eared Pied Bat, both species would subsequently be offset for the Project.

The biodiversity credits required for the above species are detailed in section 6.2 and section 6.3.

7. Biodiversity Offset Strategy

7.1 Satisfying the Biodiversity Offset obligation

The Project would require a biodiversity offset for both BC Act and EPBC Act listed threatened entities as detailed in section 6 and summarised in Table 53. The biodiversity offset would require the formal retirement of the biodiversity credit obligation as per the Biodiversity Offset Scheme. The Australian Government has also formally endorsed the NSW Biodiversity Offsets Scheme through the *Environment Protection and Biodiversity Conservation Act Condition-setting Policy*, and as such, this streamlines the options and approvals associated with retiring the Project's biodiversity offsetting obligation.

Table 53. Summary of Biodiversity Credits required for the Project

PCT/Threatened species	Credits required
Direct impact credits	
PCT1250 Coastal sandstone gully forest	17
PCT1245 Illawarra Escarpment Blue Gum wet forest	2
PCT1083 Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion	346
Callocephalon fimbriatum / Gang-gang Cockatoo	399
Cercartetus nanus / Eastern Pygmy-possum	472
Chalinolobus dwyeri / Large-eared Pied Bat	3
Myotis macropus / Southern Myotis	126
Phascolarctos cinereus / Koala	456
Indirect / prescribed impact credits	
Coastal Upland Swamps (PCT978/1804)	107
Heleioporus australiacus / Giant Burrowing Frog	257
Hoplocephalus bungaroides / Broad-headed Snake	5
Litoria littlejohni / Littlejohn's Tree Frog	343
Myotis macropus / Southern Myotis	123
Petalura gigantea / Giant Dragonfly	186
Pseudophryne australis / Red-crowned Toadlet	68

The biodiversity credit obligation can be retired through the purchasing of credits available on the market, establishing a Biodiversity Stewardship Site(s), or Payment into the Biodiversity Conservation Fund.

IMC have investigated the following options to formally satisfy the offset obligation for both State and Commonwealth, which include the following:

1. Establish a Biodiversity Stewardship Site(s) with the required biodiversity values and formally retire the credits.
2. Retire credits from existing IMC BioBanking sites – noting that this would only satisfy a portion of Koala credits, and potentially Large-eared Pied Bat and Eastern Pygmy Possum credits.
3. Purchase biodiversity credits from the credit market and formally retire the credits.
4. Payment of the biodiversity offset obligation into the Biodiversity Conservation Fund.

Each option investigated by IMC are discussed below.

7.1.1 Establish a Biodiversity Stewardship Site (Dendrobium Mine Extension Project - Offset Site)

IMC may consider the establishment a Biodiversity Stewardship Site across portions of an approximately 65 ha land parcel within Maddens Plains NSW (referred to as the potential Dendrobium Mine Extension Project - Offset Site). The 65 ha land parcel consist of four lots, which adjoin Dharawal Nature Reserve and Dhawaral National Park, and consist predominately of Coastal Upland Swamps (Figure 18). The site is not subject to an existing conservation agreement.

Preliminary site investigations to formally establish the land parcels as a Biodiversity Stewardship Site are currently underway, and have thus far consisted of:

- Vegetation validation.
- Threatened amphibian surveys (spotlighting and songmeter analysis).
- Credit estimates based on some BAM plot data.

The establishment of the potential Dendrobium Mine Extension Project - Offset Site would result in the following:

- In-perpetuity management funding for 51.4 ha of Coastal Upland Swamp TEC.
- Protection of known Littlejohn's Tree Frog habitat.
- Potential habitat for a range of other threatened fauna, including Eastern Pygmy Possum and Giant Burrowing Frog.
- Contribution to local pest control, which will assist the pest management within Dharawal Nature Reserve and Dhawaral National Park.

Biodiversity credit estimates for the potential Dendrobium Mine Extension Project - Offset Site, and the portion of the offset liability the Site would contribute, are shown in Table 54. The estimated credits would satisfy the offset liability for Coastal Upland Swamps (PCT978) and partially the Littlejohn's Tree Frog. Further credits may be generated for the Eastern Pygmy Possum and potentially the Giant Burrowing Frog if detected via survey or approved by a species expert.

Table 54. Biodiversity Credit Estimates for the Potential Dendrobium Extension Project - Offset Site

Credit Type	Area	Estimated credits	Credit obligation	% of credit obligation
PCT978	51.4	411	107 (partial loss) 290 (full loss)	100%
Littlejohn's Tree Frog (Litoria littlejohni)	21	166	343	48%

7.1.2 Establish additional Biodiversity Stewardship Sites on IMC Landholdings

IMC has over 1,000 ha of native vegetation on the eastern portion of the Illawarra escarpment (Figure 19). Existing vegetation mapping by NPWS (2003a) have mapped PCT1083, PCT1245, and PCT1250 at the site. Vegetation validation would need to be completed across the site to determine the extent of the PCTs, however based on the existing mapping, it is likely that the site would contain a far greater credit generation for PCT1250 and PCT1245 than that required for the Project.

The site also has the potential to provide credits for the Koala and Littlejohn's Tree Frog given both species have been recorded nearby, however this would need to be confirmed via field survey or expert report.

7.1.3 Retirement of biodiversity credits available at IMC BioBank sites

IMC has registered BioBank sites at Appin/Douglas Park. IMC may consider retiring available Koala species credits from these sites for the Project and consider adding additional species credits for Eastern Pygmy Possum and Large-eared Pied Bat (should they be detected on-site).

7.1.4 Purchase biodiversity credits on the market

IMC may consider purchasing available biodiversity credits that become available for sale on the market.

To date, a search of Public Credit Register has determined the following credits available or as an Expression of Interest:

- PCT1245 Illawarra Escarpment Blue Gum wet forest – 257 credits.
- Cercartetus nanus / Eastern Pygmy-possum – 9 credits.
- Myotis macropus / Southern Myotis – 3,128 credits.
- Pseudophryne australis / Red-crowned Toadlet – 5,837 credits.
- Chalinolobus dwyeri / Large-eared Pied Bat – 1680 credits.

7.1.5 Payment into the Biodiversity Conservation Fund

IMC may consider payment into the Biodiversity Conservation Fund for the offset liability or residual amounts based on the above offsetting options.

7.2 Finalisation of the Offset Package

The Offset package detailed above, would be formalised in Extractions Plans should the Project be approved. The offsetting options available present minimal risk that IMC can satisfy their offset obligation retirement as summarised in Table 55.

The biodiversity credit obligation associated with direct impacts would be retired prior to the direct clearing from occurring.

The biodiversity credit obligation for indirect impacts would be formalised in Extraction Plans should the Project be approved. The subsidence related offset liability (Coastal Upland Swamps, Littlejohn's Tree Frog, Giant Burrowing Frog, Southern Myotis, Broad-headed Snake and Giant Dragonfly) are only required to be secured or credits retired once the impacts of mining are confirmed through monitoring and reviewed by the Independent Expert Panel (OEH 2016). Where it is predicted that a partial impact to a Coastal Upland Swamp is likely, then only the portion of the swamp likely to experience greater than negligible environmental consequences should be included in the offset calculation. Similarly, it is proposed that where currently conservatively predicated impacts to Littlejohn's Tree Frog, Giant Burrowing Frog, Southern Myotis, Broad-headed Snake and Giant Dragonfly are demonstrated to not have eventuated, that the credit liability for these species be reduced, and detailed accordingly in the Extraction Plan monitoring and reporting documents.

Table 55. Offsetting Options Summary

Credit type	Offsetting options					Biodiversity credit obligation met?
	Existing BioBank sites credit requirement	Establish Stewardship site – Potential Dendrobium Mine Extension Project Offset Site	Establishment Stewardship site – IC landholding	Credits available from the market	Payment into the BCT Fund	
HN566 Red Bloodwood - scribbly gum heathy woodland on sandstone plateaus, Sydney Basin Bioregion	-	-		-	✓	**Yes**
ME044 Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes	-	-	✓	✓	✓	**Yes**
Coastal Upland Swamp TEC: Needlebush - banksia wet heath on sandstone plateaux of the Sydney Basin Bioregion / Needlebush - Banksia wet heath swamps on coastal sandstone plateaus of the Sydney basin	-	✓	-	-	✓	**Yes**
Koala	✓	-	-	✓	✓	**Yes**
Littlejohn's Tree Frog	-	✓	Potential	-	✓	**Yes**
Broad-headed Snake	-	-	Potential	-	✓	**Yes**
Giant Burrowing Frog	-	-	Potential	-	✓	**Yes**
Red-crowned Toadlet	-	-	✓	✓	✓	**Yes**
Giant Dragonfly	-	-	-	-	✓	**Yes**
Eastern Pygmy Possum	-	Potential		✓	✓	**Yes**
Large-eared Pied Bat	-	-	Potential	✓	✓	**Yes**
Southern Myotis	-	-	Potential	✓	✓	**Yes**

8. Conclusion

This report provides a biodiversity assessment to address the potential impacts associated with the Project, and an offset strategy for those impacts that cannot be avoided in accordance with the BAM.

The Project would result in the direct impact to approximately 19.85 ha of native vegetation and habitat associated with the clearing for surface infrastructure (Biodiversity Assessment Development Footprint).

Project planning and design has been successful in avoiding potential direct impacts to TECs such that no TECs would be directly impacted by the Project.

No threatened flora would be directly impacted by the Project.

Four threatened fauna would be directly impacted by the Project including Eastern Pygmy Possum, Gang-gang Cockatoo, Koala, Large-eared Pied Bat, and Southern Myotis and habitat.

The direct impacts of the Project were deemed unlikely to have a significant impact to any Commonwealth listed threatened biodiversity.

Indirect and prescribed impacts have been largely associated with subsidence mechanisms. This BDAR has used the subsidence predictions within MSEC (2022) and potential changes to water quality and hydrological processes within Watershed (2021) to assist with the assessment of impacts on threatened biodiversity.

This assessment has concluded that native vegetation (non-swamp types) are highly unlikely to be significantly impacted by subsidence related impacts from the Project.

Habitat features that may be impacted by subsidence and subsidence-related effects (e.g. changes to hydrological processes)from the Project include Coastal Upland Swamps, watercourses, cliffs and steep slopes.

Based on a detailed impact assessment and literature review, it has been concluded that impacts to Coastal Upland Swamps are not likely to be immediate and may take some time to detect any type of vegetative response. Given the uncertainties around potential long-term impacts, a significant impact was conservatively assumed for the Commonwealth assessment for Coastal Upland Swamps. A biodiversity offset as per the Swamps Offset Policy (OEH 2016a) and the BAM, has been proposed.

Through an analysis of MSEC (2022) subsidence predictions and known habitat for threatened flora in the Subject Land, it was determined that subsidence impacts resulting in loss of threatened flora is unlikely.

Eight species credit fauna were determined to have habitat indirectly impacted by the Project by subsidence, including: Broad-headed Snake, Eastern Pygmy Possum, Giant Burrowing Frog, Giant Dragonfly, Large-eared Pied Bat, Littlejohn's Tree Frog, Southern Myotis, and Red-crowned Toadlet.

Based on the results of the Commonwealth Assessments of Significance, a significant impact to the Giant Burrowing Frog and Littlejohn’s Tree Frog was considered likely. A significant impact to other threatened fauna listed under the EPBC Act is considered unlikely.

A biodiversity offset in accordance with the BAM (including the NSW Offset Policy) and Swamps Offset Policy (OEH 2016a) has been provided for the following:

- Native vegetation clearing.

- Habitat clearing, potentially impacting Koala, Eastern Pygmy Possum, Southern Myotis and Large-eared Pied Bat habitat.
- Potential subsidence related impacts to Coastal Upland Swamps.

A biodiversity offset has also been proposed for potential subsidence related impacts to habitat associated with Littlejohn's Tree Frog, Giant Burrowing Frog, Red-crowned Toadlet, Broad-headed Snake, Southern Myotis and Giant Dragonfly.

Under the EPBC Act, only those threatened entities that may be significantly impacted by the Project are required to be offset. The Project would therefore require an offset for the following potentially significant impacted entities:

- Coastal Upland Swamps.
- Giant Burrowing Frog.
- Littlejohn's Tree Frog.

The biodiversity offset would require the formal retirement of the biodiversity credit obligation as per the Biodiversity Offset Scheme. The Australian Government has also formally endorsed the NSW Biodiversity Offsets Scheme through the Environment Protection and Biodiversity Conservation Act Condition-setting Policy, and as such, this streamlines the options and approvals associated with retiring the Project's biodiversity offsetting obligations.

The maximum offset credit liability required to offset the Project was completed using the BAM-C. The credits required include the following:

PCT/Threatened species	Credits required
Direct impact credits	
PCT1250 - Coastal sandstone gully forest	17
PCT1245 Illawarra Escarpment Blue Gum wet forest	2
PCT1083 Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion	346
Callocephalon fimbriatum / Gang-gang Cockatoo	399
Cercartetus nanus / Eastern Pygmy-possum	472
Chalinolobus dwyeri / Large-eared Pied Bat	3
Myotis macropus / Southern Myotis	126
Phascolarctos cinereus / Koala	456
Indirect / prescribed impact credits	
Coastal Upland Swamps (PCT978/1804)	107
Heleioporus australiacus / Giant Burrowing Frog	257
Hoplocephalus bungaroides / Broad-headed Snake	5
Litoria littlejohni / Littlejohn's Tree Frog	343
Myotis macropus / Southern Myotis	123
Petalura gigantea / Giant Dragonfly	186
Pseudophryne australis / Red-crowned Toadlet	68

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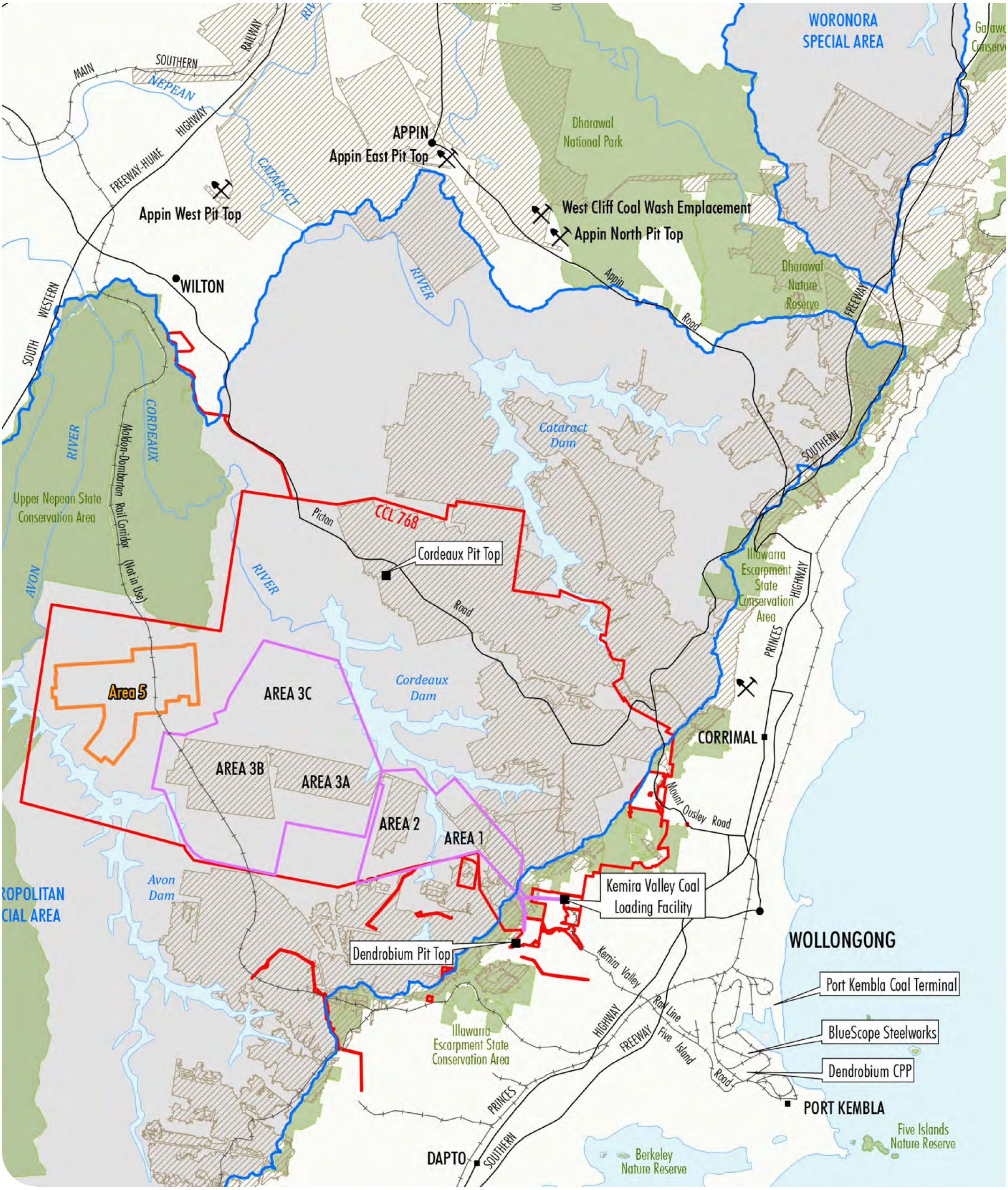
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Figures



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GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Proj. #: 6624
Client: Illawarra Metallurgical Coal

Regional Location

Dendrobium Mine Extension Project BDAR

Figure 1

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Upper Nepean State Conservation Area

Cordeaux Dam Access Road Temporary Construction Carpark

Cordeaux Pit Top

Cataract Dam

Illawarra Escarpment State Conservation Area

Picton Road

Electricity Transmission Line

CCL 768

Pump Station & Water Supply Pipeline

Area 5

Ventilation Shaft Site No. 5A

Area 3C

Mine Water Extraction Borehole & Water Supply Pipeline

Cordeaux Dam

Dendrobium Nos 2 and 3 Shafts

Area 3B

Area 3A

Area 2

Area 1

Avon Dam

Dendrobium No 1 Shaft

Kemira Valley Coal Loading Facility

Dendrobium Pit Top

Dendrobium Pit Top Carpark Extension

Illawarra Escarpment State Conservation Area

Kemira Valley Rail Line

Kemira Valley Rail Line

CORRIMAL

SOUTHERN PRINCES HIGHWAY

WOLLONGONG

Port Kembla Coal Terminal

BlueScope Steelworks

Dendrobium CPP

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Niche Proj. #: 6624
Client: Illawarra Metallurgical Coal

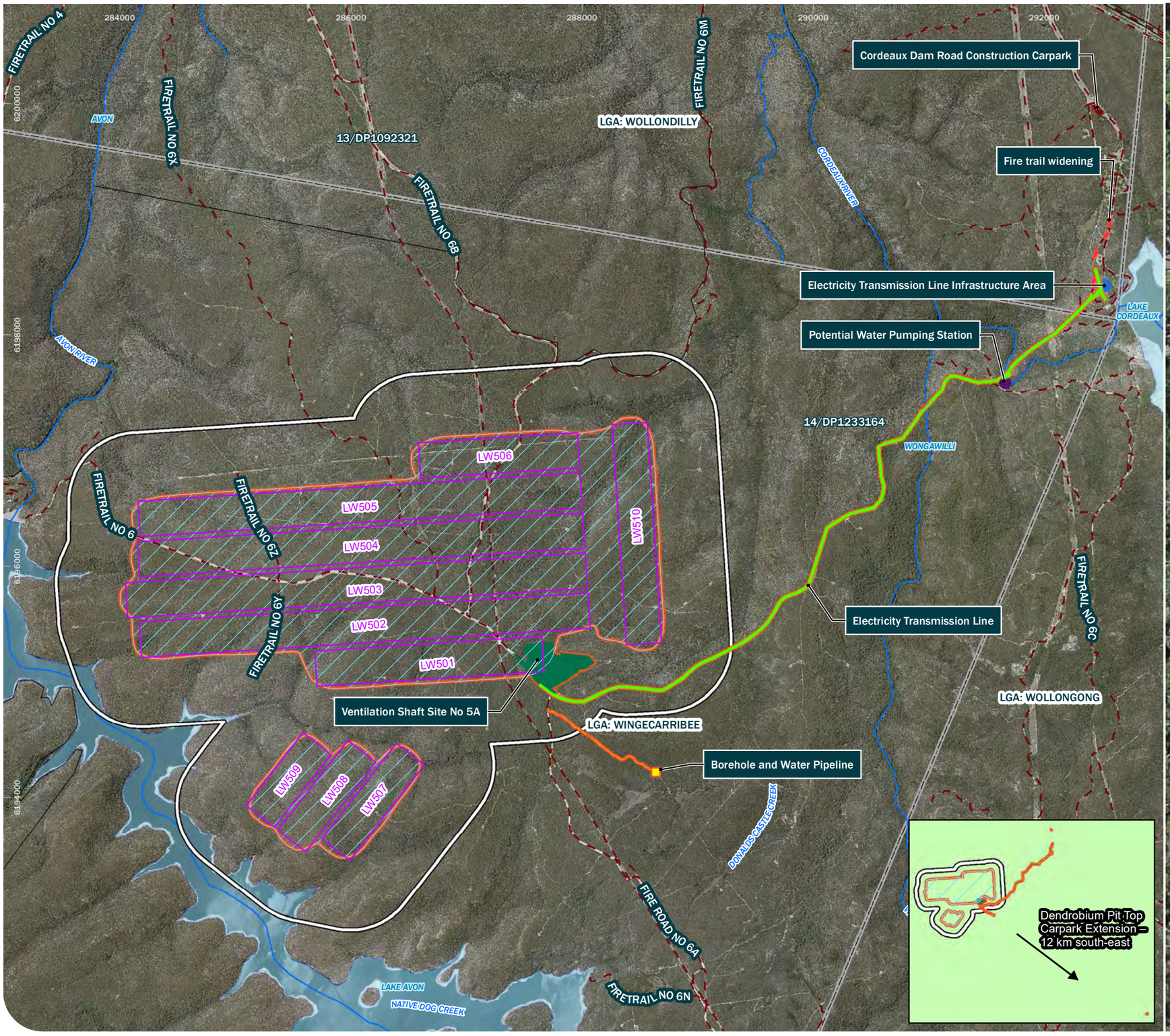
General Arrangement Dendrobium Mine Extension Project

Dendrobium Mine Extension Project BDAR

Figure 2

Imagery@ Illawarra-Coal Dec 2018

Drawn by: JB/YH File: T:\spatial\projects\da6600\da6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_2_Arrangement.mxd Last updated: 11-Mar-22 12:16 PM





niche Environment and Heritage

0 1,000
m
GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

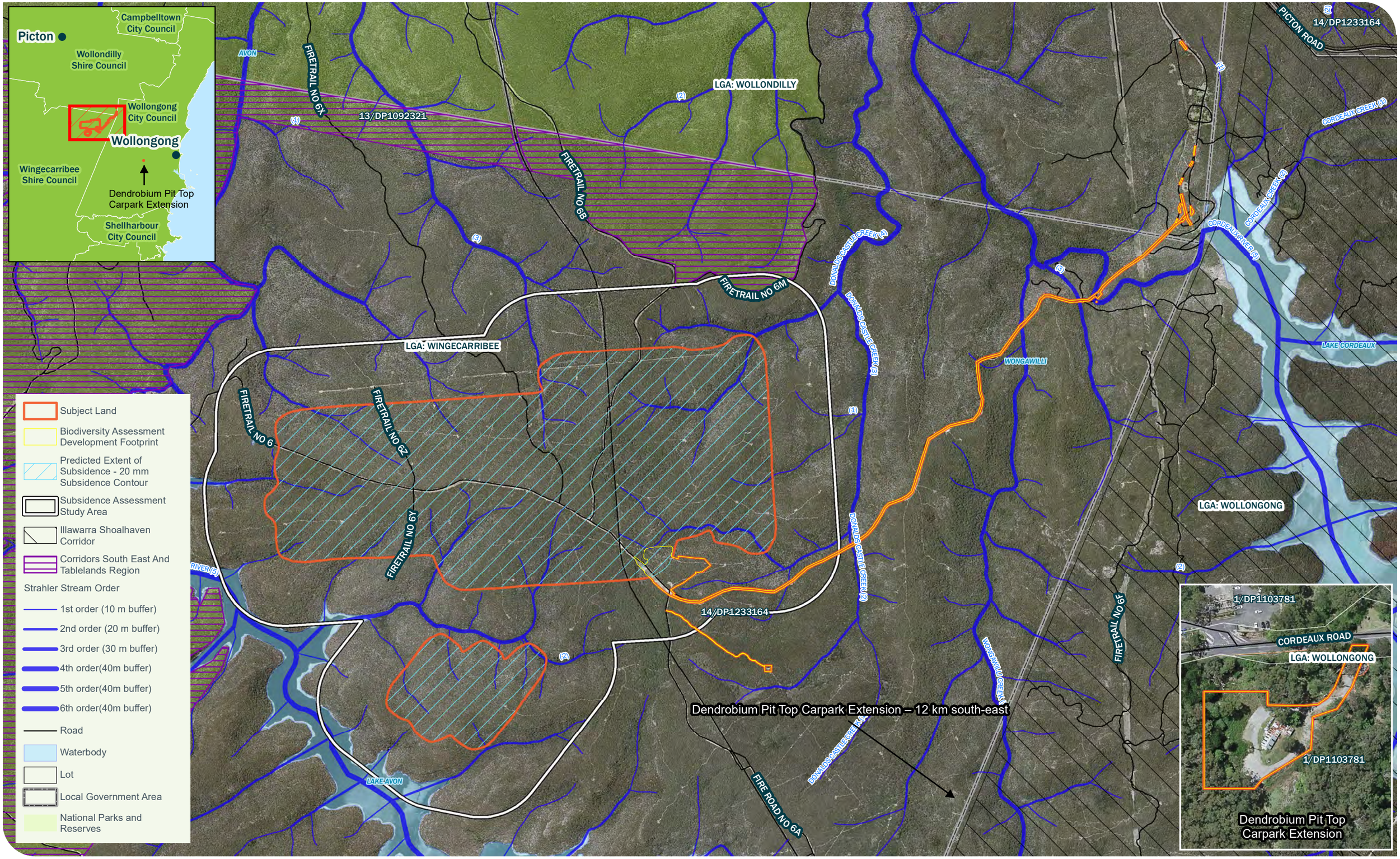
Subject Land

Dendrobium Mine Extension Project BDAR

Figure 3

Imagery @ Illawarra-Coal Dec 2018

Drawn by: JB/YH File: T:\spatial\projects\6600\6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_3_SubjectLand.mxd Last updated: 11-Mar-22 2:19:52 PM



niche Environment and Heritage

0 750

m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Proj. #: 6624
Client: Illawarra Metallurgical Coal

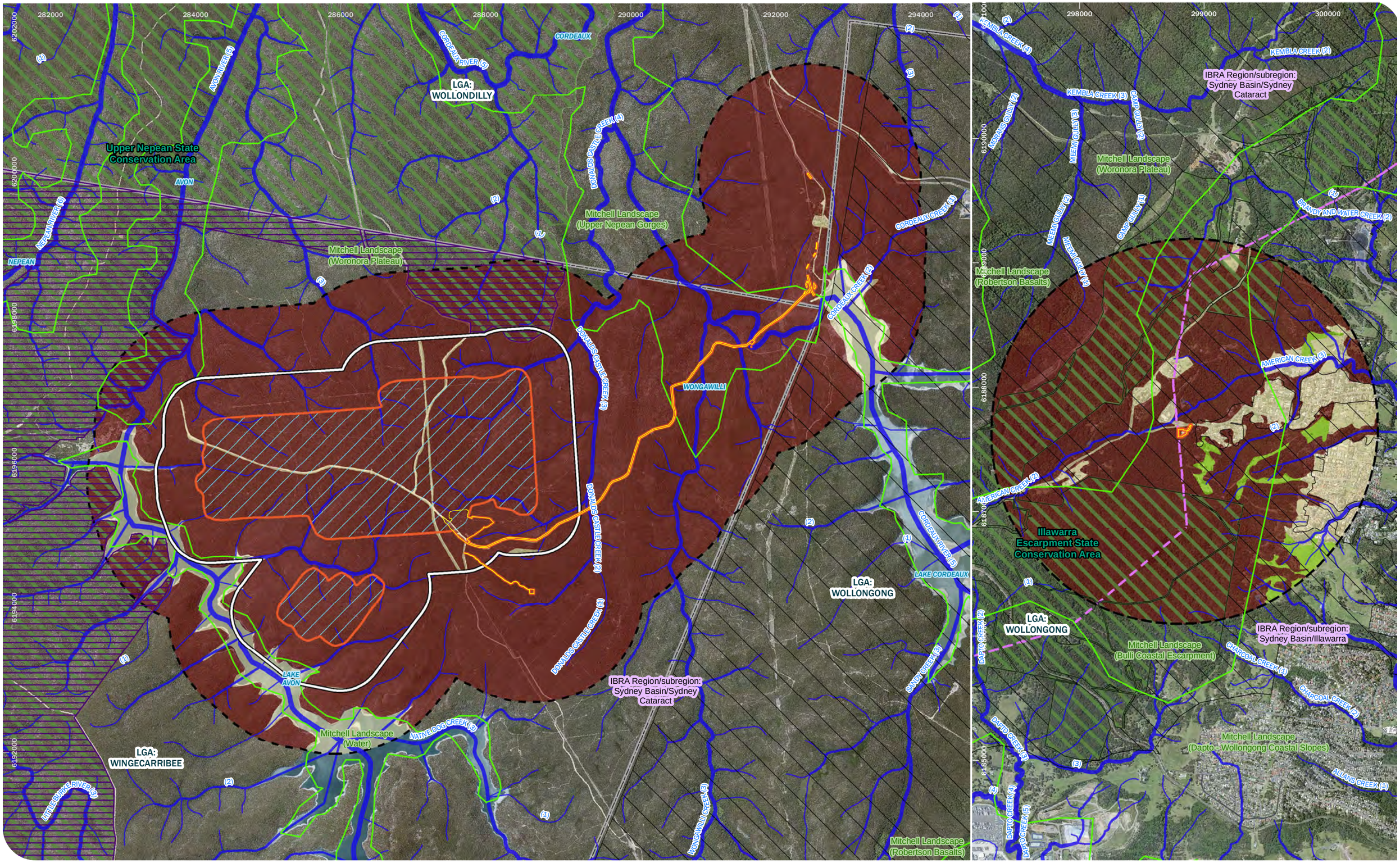
Site Map

Dendrobium Mine Extension Project BDAR

Figure 4

Imagery@ Illawarra-Coal Dec 2018

Drawn by: Jes Bear/YH File: T:\spatial\projects\6600\6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_4_SiteMap.mxd Last updated: 07-Feb-22 5:32:08 PM



niche Environment and Heritage

0 1,000
m
GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

- Subject Land
- Assessment Area (1500 m buffer)
- Biodiversity Assessment Development Footprint
- Predicted Extent of Subsidence - 20 mm Subsidence Contour
- Subsidence Assessment Study Area

Strahler Stream Order
- 1st order (10 m buffer)
- 2nd order (20 m buffer)
- 3rd order (30 m buffer)
- 4th order(40m buffer)
- 5th order(40m buffer)
- 6th order(40m buffer)

- Illawarra Shoalhaven Corridor
- Corridors South East And Tablelands Region
- Waterbody

- Local Government Area
- National Parks and Reserves
- Mitchell Landscape
- IBRA region/subregion

Vegetation Type
- Woodland
- Native-Grassland
- Cleared

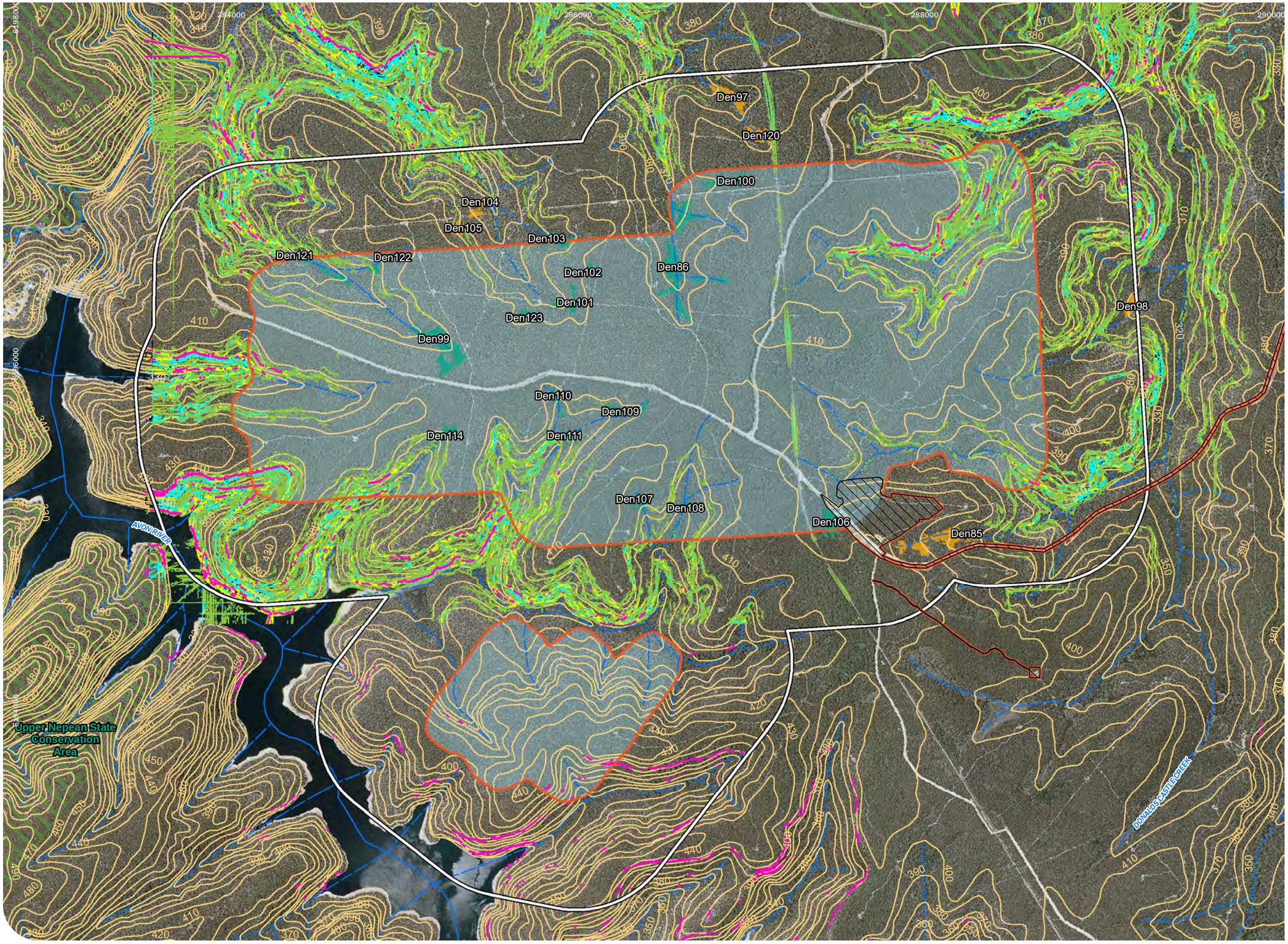
Location Map

Dendrobium Mine Extension Project BDAR

Figure 5

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Baur/YH File: T:\spatial\projects\st6624\Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_5_LocationMap.mxd Last updated: 03-Feb-22 1:01:13 PM



Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Contour 10m

Perennial Stream

Non-Perennial Stream

Coastal Upland Swamps – within predicted indirect impact buffer

Coastal Upland Swamps – outside of predicted indirect impact buffer

MSEC (2021) Cliffs and Steep Slope Mapping

Steep Slopes gradient greater than 1in1.5 to 2

Steep Slopes gradient 1in3 to 1in1

Steep Slopes gradient 1in2 to 1in1.5

Steep Slopes gradient 1in1.5 to 1.1

Cliffs

niche Environment and Heritage

0 600

m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Habitat features subject to potential indirect impacts from subsidence

Dendrobium Mine Extension Project BDAR

Figure 6a

Imagery @ Illawarra-Coal Dec 2018

v2.0

Drawn by: Jess Beer/YH File: T:\spatial\projects\ia6600\a6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_6a_h_cliffs_steeps.mxd Last updated: 14-Feb-22 15:34:8 PM



- Subject Land
- Biodiversity Assessment Development Footprint
- Predicted Extent of Subsidence - 20 mm Subsidence Contour
- Subsidence Assessment Study Area
- Contour 10m
- Non-Perennial Stream
- Coastal Upland Swamps – within predicted indirect impact buffer
- Coastal Upland Swamps – outside of predicted indirect impact buffer

MSEC (2021) Cliffs and Steep Slope Mapping

- Steep Slopes gradient greater than 1in1.5 to 2
- Steep Slopes gradient 1in3 to 1in1
- Steep Slopes gradient 1in2 to 1in1.5
- Steep Slopes gradient 1in1.5 to 1.1
- Cliffs

niche Environment and Heritage

0 120
m
GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Habitat features subject to potential indirect impacts from subsidence

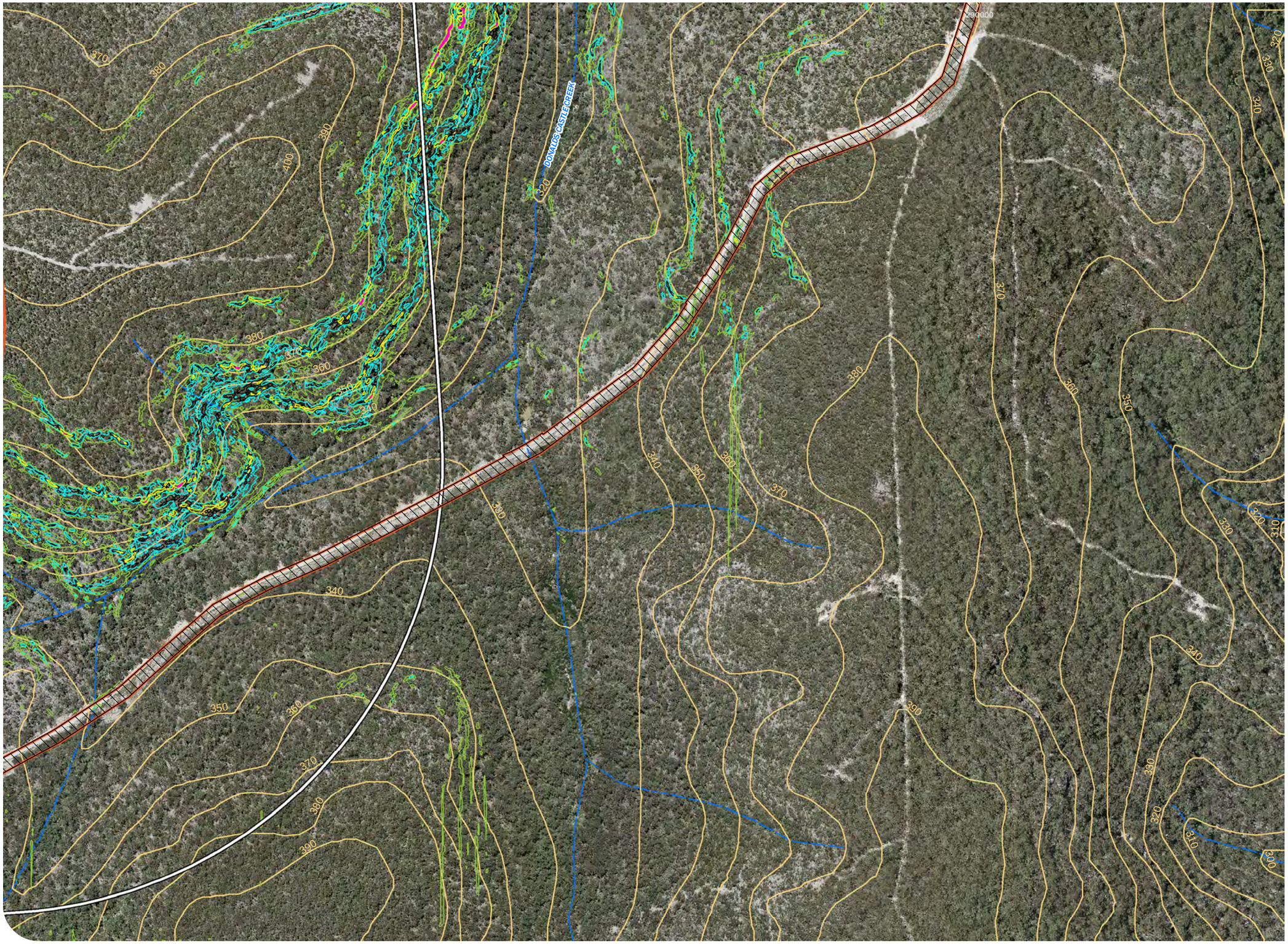
Dendrobium Mine Extension Project BDAR

Figure 6b

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Bear/YH File: T:\spatial\projects\ia6600\a6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_6a_h_diffs_steeps.mxd Last updated: 14-Feb-22 15:34:8 PM

v2.0



Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Contour 10m

Non-Perennial Stream

MSEC (2021) Cliffs and Steep Slope Mapping

Steep Slopes gradient greater than 1in1.5 to 2

Steep Slopes gradient 1in3 to 1in1

Steep Slopes gradient 1in2 to 1in1.5

Steep Slopes gradient 1in1.5 to 1.1

Cliffs

niche Environment and Heritage

0 120

m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

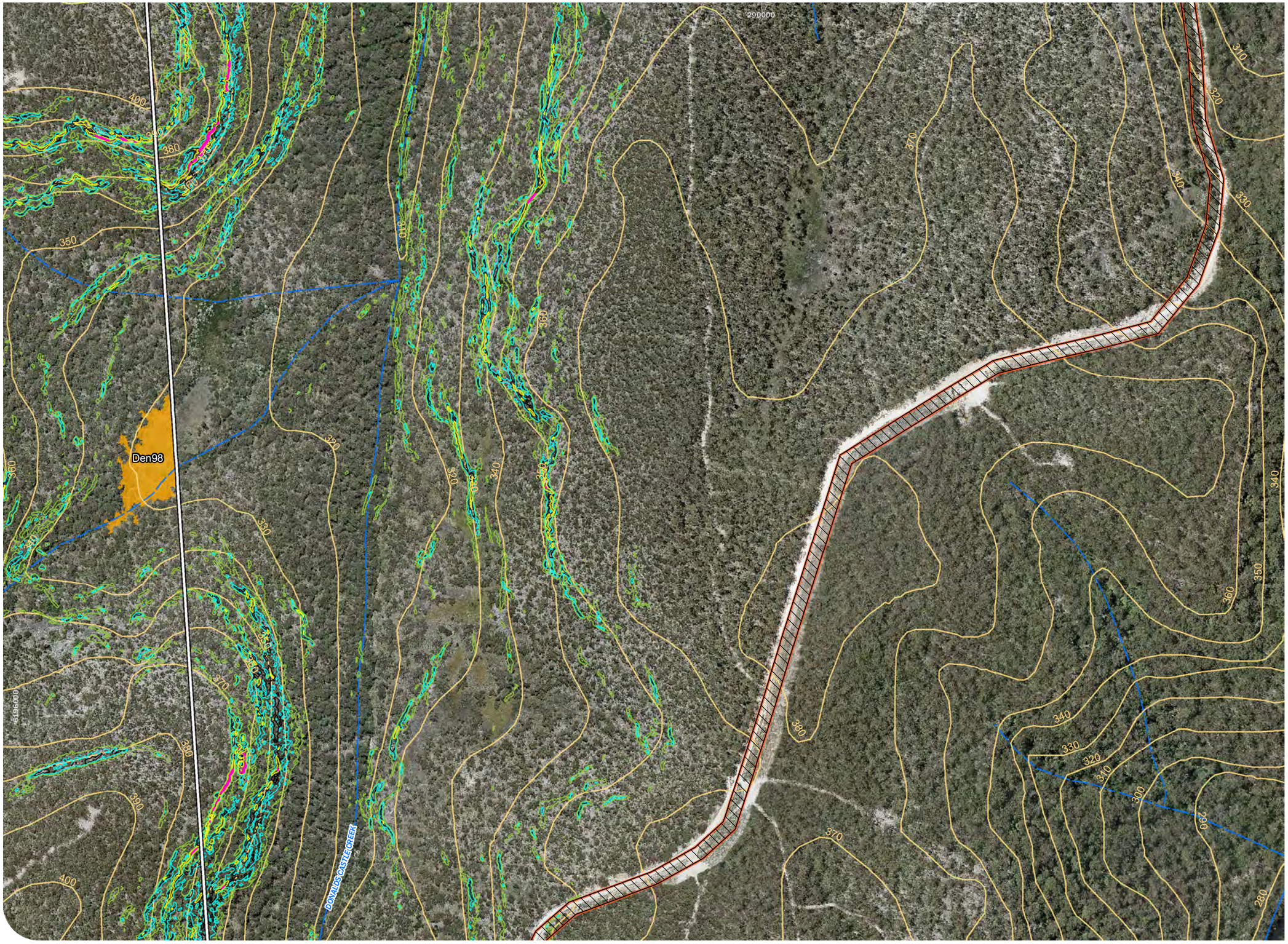
Habitat features subject to potential indirect impacts from subsidence

Dendrobium Mine Extension Project BDAR

Figure 6c

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jes & Bear/YH File: T:\spatial\projects\ad6624_Dendrobium_BDAR\Maps\report\BDAR6624_Figure_6a_h_cliffs_steeps.mxd Last updated: 14-Feb-22 15:34:48 PM



Subject Land

Biodiversity Assessment Development Footprint

Subsidence Assessment Study Area

Contour 10m

Perennial Stream

Non-Perennial Stream

Coastal Upland Swamps – outside of predicted indirect impact buffer

MSEC (2021) Cliffs and Steep Slope Mapping

Steep Slopes gradient greater than 1in1.5 to 2

Steep Slopes gradient 1in3 to 1in1

Steep Slopes gradient 1in2 to 1in1.5

Steep Slopes gradient 1in1.5 to 1.1

Cliffs

niche Environment and Heritage

0 120

m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Habitat features subject to potential indirect impacts from subsidence

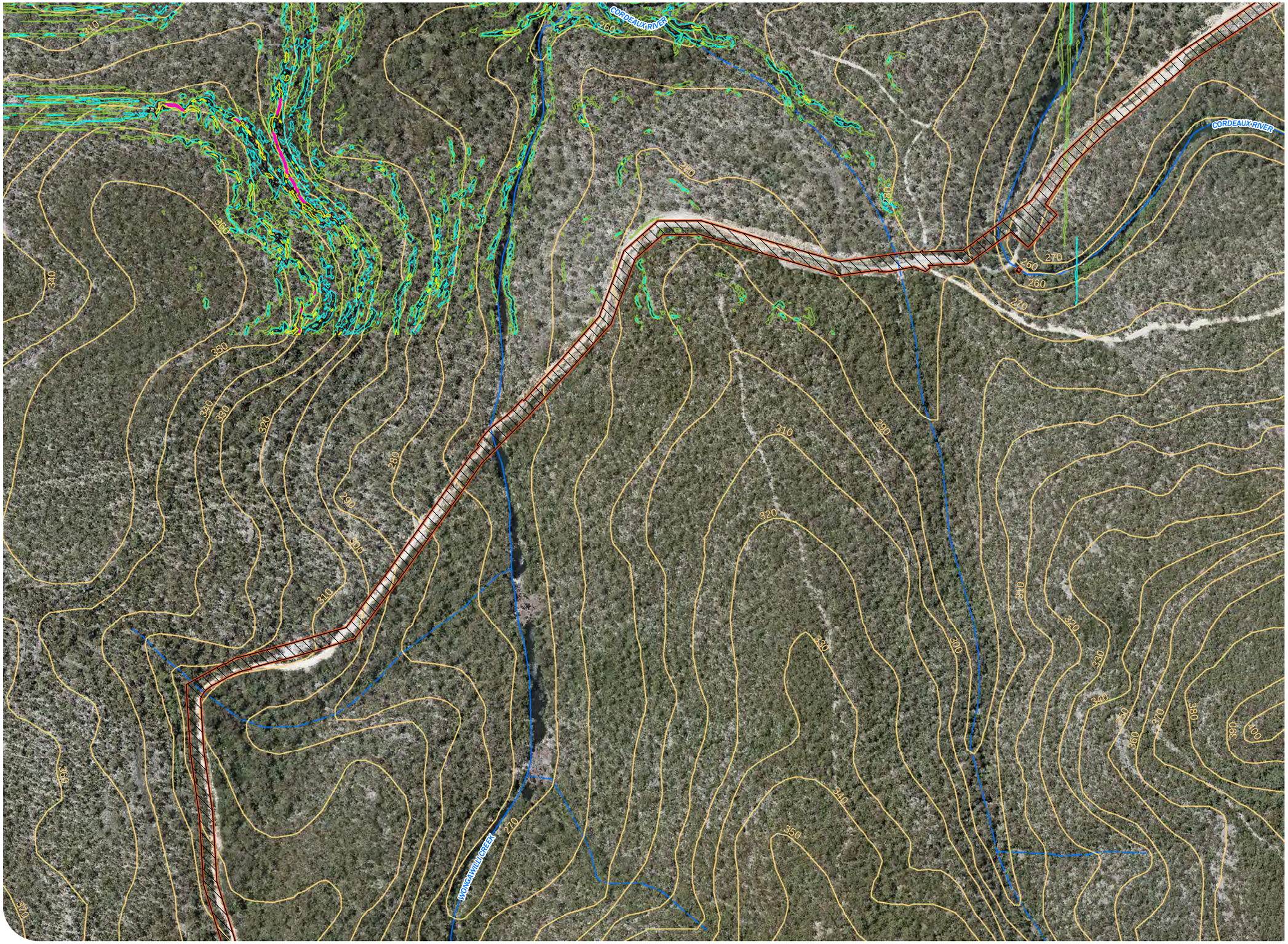
Dendrobium Mine Extension Project BDAR

Figure 6d

Imagery @ Illawarra-Coal Dec 2018

v2.0

Drawn by: Jess Bear/YH File: T:\spatial\projects\ad6600\ad6624_Dendrobium_BDAR\Maps\report\BDAR6624_Figure_6a_h_cliffs_steeps.mxd Last updated: 14-Feb-22 15:34:48 PM



Subject Land

Biodiversity Assessment Development Footprint

Contour 10m

Perennial Stream

Non-Perennial Stream

MSEC (2021) Cliffs and Steep Slope Mapping

Steep Slopes gradient greater than 1in1.5 to 2

Steep Slopes gradient 1in3 to 1in1

Steep Slopes gradient 1in2 to 1in1.5

Steep Slopes gradient 1in1.5 to 1.1

Cliffs

niche Environment and Heritage

0 120

m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Habitat features subject to potential indirect impacts from subsidence

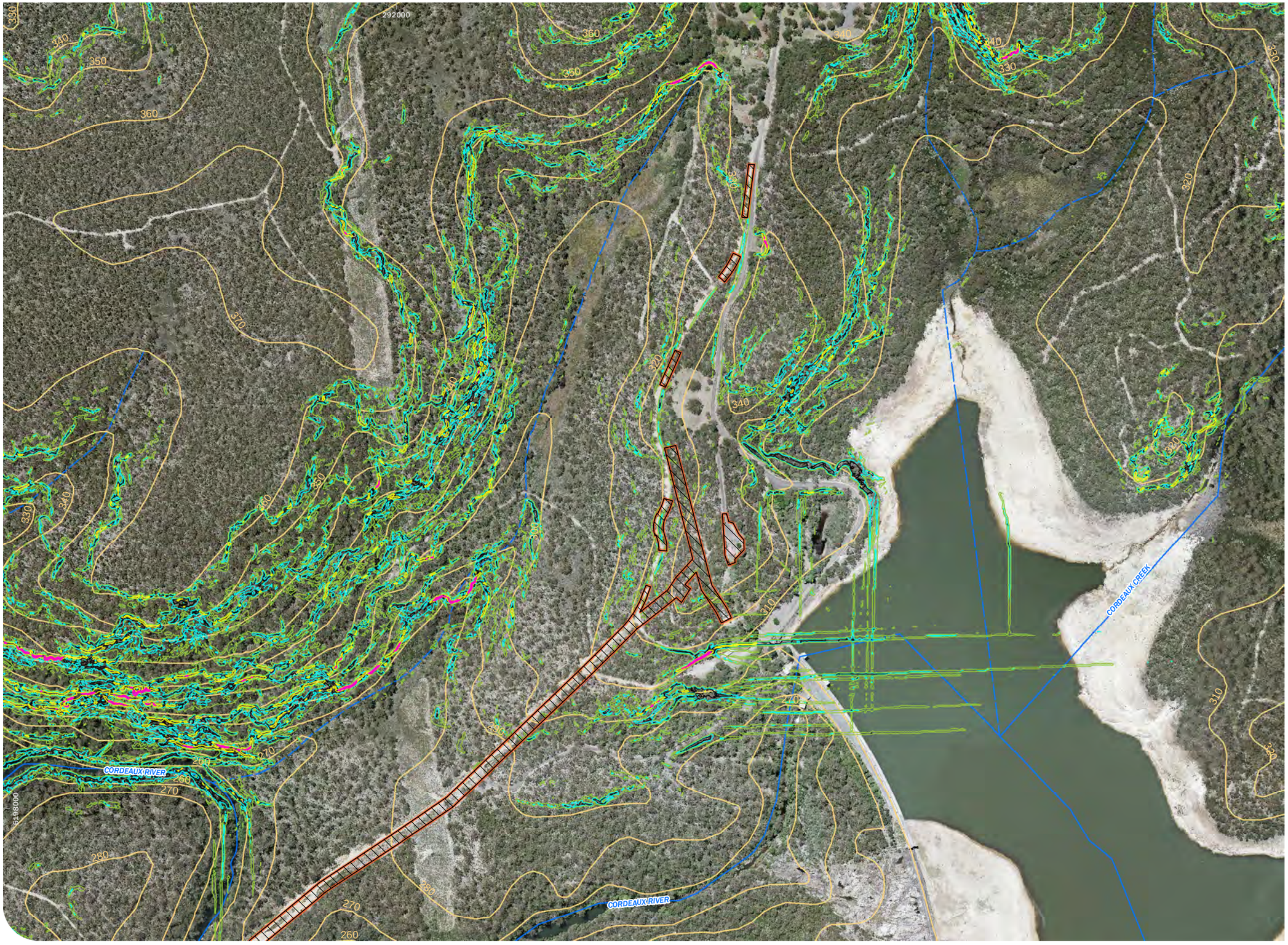
Dendrobium Mine Extension Project BDAR

Figure 6e

Imagery @ Illawarra-Coal Dec 2018

v2.0

Drawn by: Jess Beal/YH File: T:\spatial\projects\6600s\6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_6e_h_cliffs_steeps.mxd Last updated: 14-Feb-22 15:34:48 PM



Subject Land

Biodiversity Assessment Development Footprint

Contour 10m

Perennial Stream

Non-Perennial Stream

MSEC (2021) Cliffs and Steep Slope Mapping

Steep Slopes gradient greater than 1in1.5 to 2

Steep Slopes gradient 1in3 to 1in1

Steep Slopes gradient 1in2 to 1in1.5

Steep Slopes gradient 1in1.5 to 1.1

Cliffs

niche Environment and Heritage

0 160

N

m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Habitat features subject to potential indirect impacts from subsidence

Dendrobium Mine Extension Project BDAR

Figure 6f

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Bear/YH File: T:\spatial\projects\6624\06\6624_Dendrobium_BDAR\Maps\report\BDAR6624_Figure_6a_h_cliffs_steeps.mxd Last updated: 14-Feb-22 15:34:48 PM



Subject Land

Biodiversity Assessment Development Footprint

Contour 10m

Non-Perennial Stream

MSEC (2021) Cliffs and Steep Slope Mapping

Steep Slopes gradient greater than 1in1.5 to 2

Steep Slopes gradient 1in3 to 1in1

Steep Slopes gradient 1in2 to 1in1.5

Steep Slopes gradient 1in1.5 to 1.1

niche Environment and Heritage

0 40

m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Habitat features subject to potential indirect impacts from subsidence

Dendrobium Mine Extension Project BDAR

Figure 6g

Imagery @ Illawarra-Coal Dec 2018

v2.0

Drawn by: Jess Bear/YH File: T:\spatial\projects\ad6000\6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_6a_h_cliffs_steeps.mxd Last updated: 14-Feb-22 1:53:48 PM



Subject Land

Biodiversity Assessment Development Footprint

Contour 10m

Non-Perennial Stream

niche Environment and Heritage

0 40

m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Habitat features subject to potential indirect impacts from subsidence

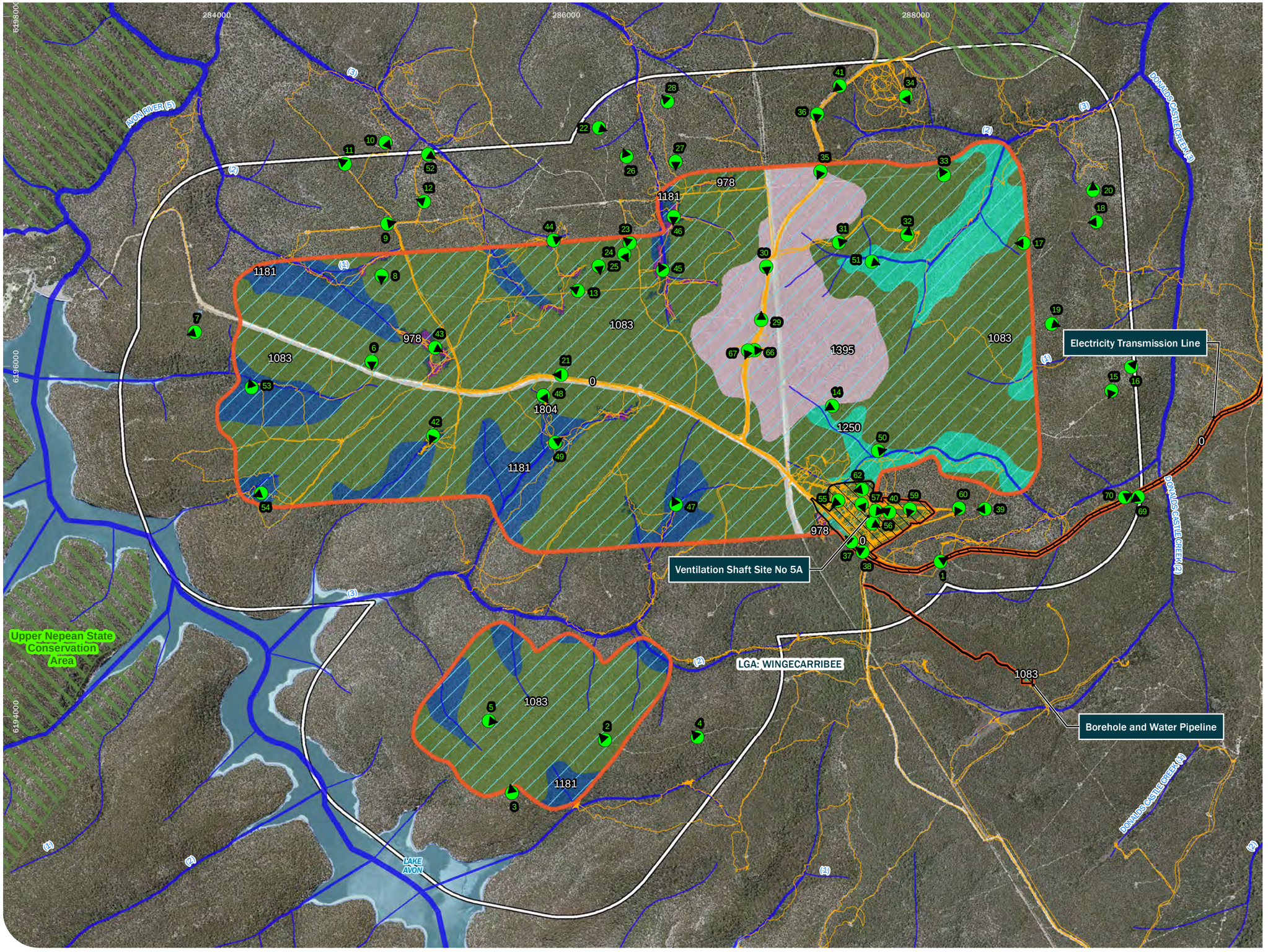
Dendrobium Mine Extension Project BDAR

Figure 6h

Imagery @ Illawarra-Coal Dec 2018

v2.0

Drawn by: Jess Bear/YH File: T:\spatial\projects\sab6600\sa6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_6a_h_cliffs_steeps.mxd Last updated: 14-Feb-22 15:34:48 PM



- Subject Land
- Biodiversity Assessment Development Footprint
- Predicted Extent of Subsidence - 20 mm Subsidence Contour
- Subsidence Assessment Study Area
- BAM Vegetation Integrity Plot Locations
- Threatened Flora and Fauna transects

Strahler Stream Order

- 1st order (10 m buffer)
- 2nd order (20 m buffer)
- 3rd order (30 m buffer)
- 4th order(40m buffer)
- 5th order(40m buffer)
- Waterbody
- Local Government Area
- National Parks and Reserves

Validated Plant Community Types and Condition

- Cleared Land
- PCT 978:Needlebush - banksia wet heath on sandstone plateaux of the Sydney Basin Bioregion - Sedgeland-Heath Complex (Restiod Heath) - Good
- PCT 978:Needlebush - banksia wet heath on sandstone plateaux of the Sydney Basin Bioregion - Fringing Eucalypt Woodland - Good
- PCT 978:Needlebush - banksia wet heath on sandstone plateaux of the Sydney Basin Bioregion - Banksia Thicket - Good
- PCT 1083: Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion - Good
- PCT 1083: Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion - Low
- PCT 1181: Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion - Good
- PCT 1250: Sydney Peppermint - Smooth-barked Apple - Red Bloodwood shrubby open forest on slopes of moist sandstone gullies, eastern Sydney Basin Bioregion - Good
- PCT 1250: Sydney Peppermint - Smooth-barked Apple - Red Bloodwood shrubby open forest on slopes of moist sandstone gullies, eastern Sydney Basin Bioregion - Low
- PCT 1395: Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion - Good
- PCT 1804:Needlebush - Banksia wet heath swamps on coastal sandstone plateaus of the Sydney basin - Tea Tree Thicket - Good

niche Environment and Heritage

0 400
m
GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

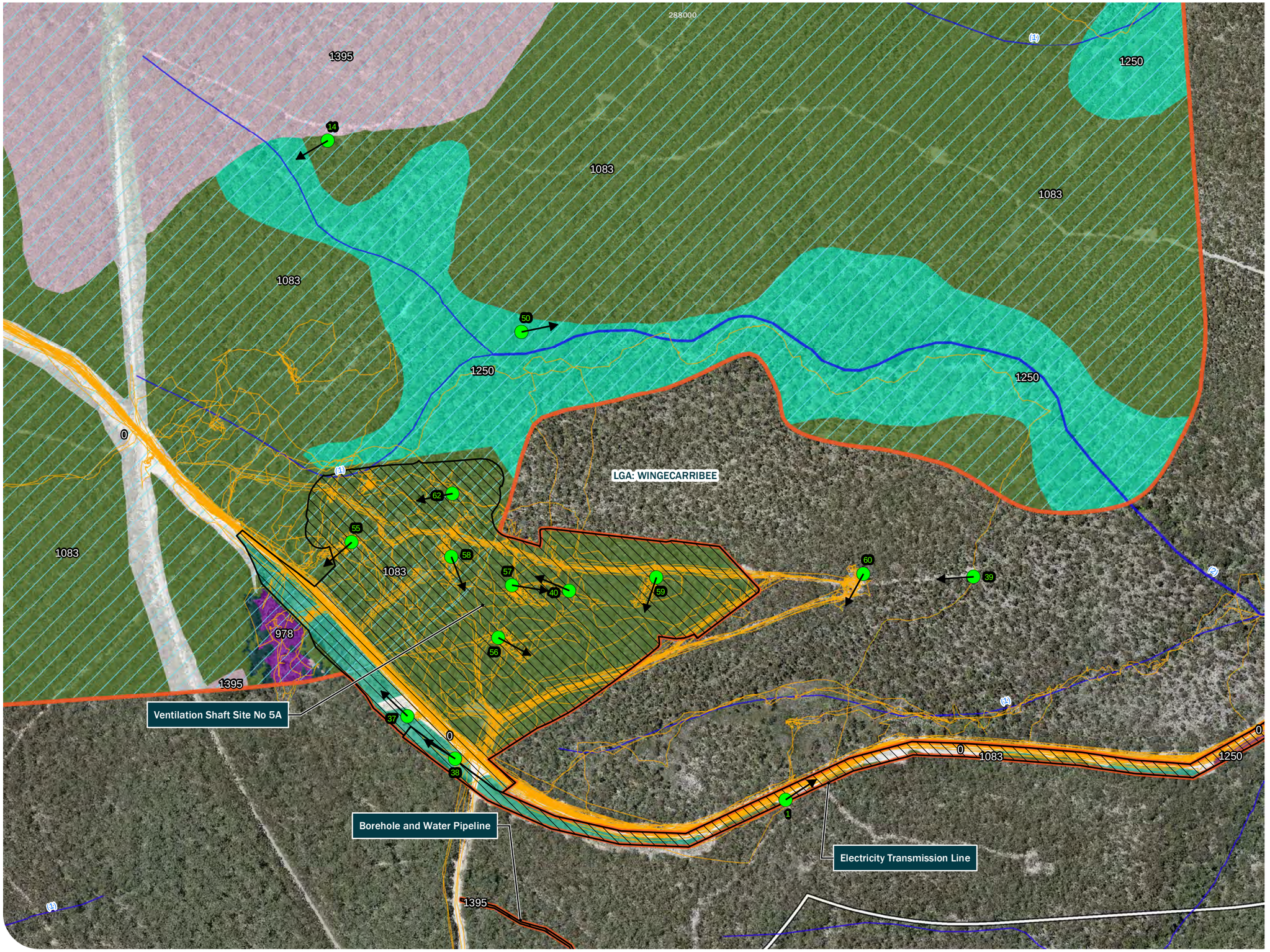
Vegetation survey effort

Dendrobium Mine Extension Project BDAR

Figure 7a

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Bear/ YH File: T:\spatial\projects\ab6600\ab6624_Dendrobium_BDAR\Maps\report\BDAR16624_Figure_7a_h_VegSurveyEffort.mxd Last updated: 14-Feb-22 12:08:01 PM



Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

BAM Vegetation Integrity Plot Locations

Threatened Flora and Fauna transects

Strahler Stream Order

1st order (10 m buffer)

2nd order (20 m buffer)

Local Government Area

Validated Plant Community Types and Condition

Cleared Land

PCT 978:Needlebush - banksia wet heath on sandstone plateaux of the Sydney Basin Bioregion - Sedgeland-Heath Complex (Restiod Heath) - Good

PCT 978:Needlebush - banksia wet heath on sandstone plateaux of the Sydney Basin Bioregion - Fringing Eucalypt Woodland - Good

PCT 1083: Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion - Good

PCT 1083: Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion - Low

PCT 1250: Sydney Peppermint - Smooth-barked Apple - Red Bloodwood shrubby open forest on slopes of moist sandstone gullies, eastern Sydney Basin Bioregion - Good

PCT 1250: Sydney Peppermint - Smooth-barked Apple - Red Bloodwood shrubby open forest on slopes of moist sandstone gullies, eastern Sydney Basin Bioregion - Low

PCT 1395: Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion - Good

niche Environment and Heritage

0 100 m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Vegetation survey effort

Dendrobium Mine Extension Project BDAR

Figure 7b

Imagery @ Illawarra-Coal Dec 2018

v2.0

Drawn by: Jess Bear/YH File: T:\spatial\projects\ab6600\ab6624_Dendrobium_BDAR\MapReport\BDAR\6624_Figure_7a_h_VegSurveyEffort.mxd Last updated: 14-Feb-22 12:08:01 PM



Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

BAM Vegetation Integrity Plot Locations

Threatened Flora and Fauna transects

Strahler Stream Order

1st order (10 m buffer)

2nd order (20 m buffer)

3rd order (30 m buffer)

Local Government Area

Validated Plant Community Types and Condition

Cleared Land

PCT 1083: Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion - Good

PCT 1083: Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion - Low

PCT 1250: Sydney Peppermint - Smooth-barked Apple - Red Bloodwood shrubby open forest on slopes of moist sandstone gullies, eastern Sydney Basin Bioregion - Good

PCT 1250: Sydney Peppermint - Smooth-barked Apple - Red Bloodwood shrubby open forest on slopes of moist sandstone gullies, eastern Sydney Basin Bioregion - Low

niche Environment and Heritage

0 100

m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Vegetation survey effort

Dendrobium Mine Extension Project BDAR

Figure 7c

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Bear?H File: T:\spatial\projects\ia6600\a6624_Dendrobium_BDAR\Mapsreport\BDAR6624_Figure_7a_h_VegSurveyEffort.mxd Last updated: 14-Feb-22 12:08:01 PM

290000

6196000

LGA: WINGECARRIBEE

DOWLING CASTLE CREEK (3)

IVONGOMULLI CREEK (3)

Electricity Transmission Line

18
73
72
71
16
15

1250
1083
0

(1)
(4)
(2)

Subject Land

Biodiversity Assessment Development Footprint

Subsidence Assessment Study Area

BAM Vegetation Integrity Plot Locations

Threatened Flora and Fauna transects

Strahler Stream Order

1st order (10 m buffer)

2nd order (20 m buffer)

3rd order (30 m buffer)

Local Government Area

Validated Plant Community Types and Condition

Cleared Land

PCT 1083: Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion - Good

PCT 1083: Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion - Low

PCT 1250: Sydney Peppermint - Smooth-barked Apple - Red Bloodwood shrubby open forest on slopes of moist sandstone gullies, eastern Sydney Basin Bioregion - Good

niche Environment and Heritage

0 100

m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

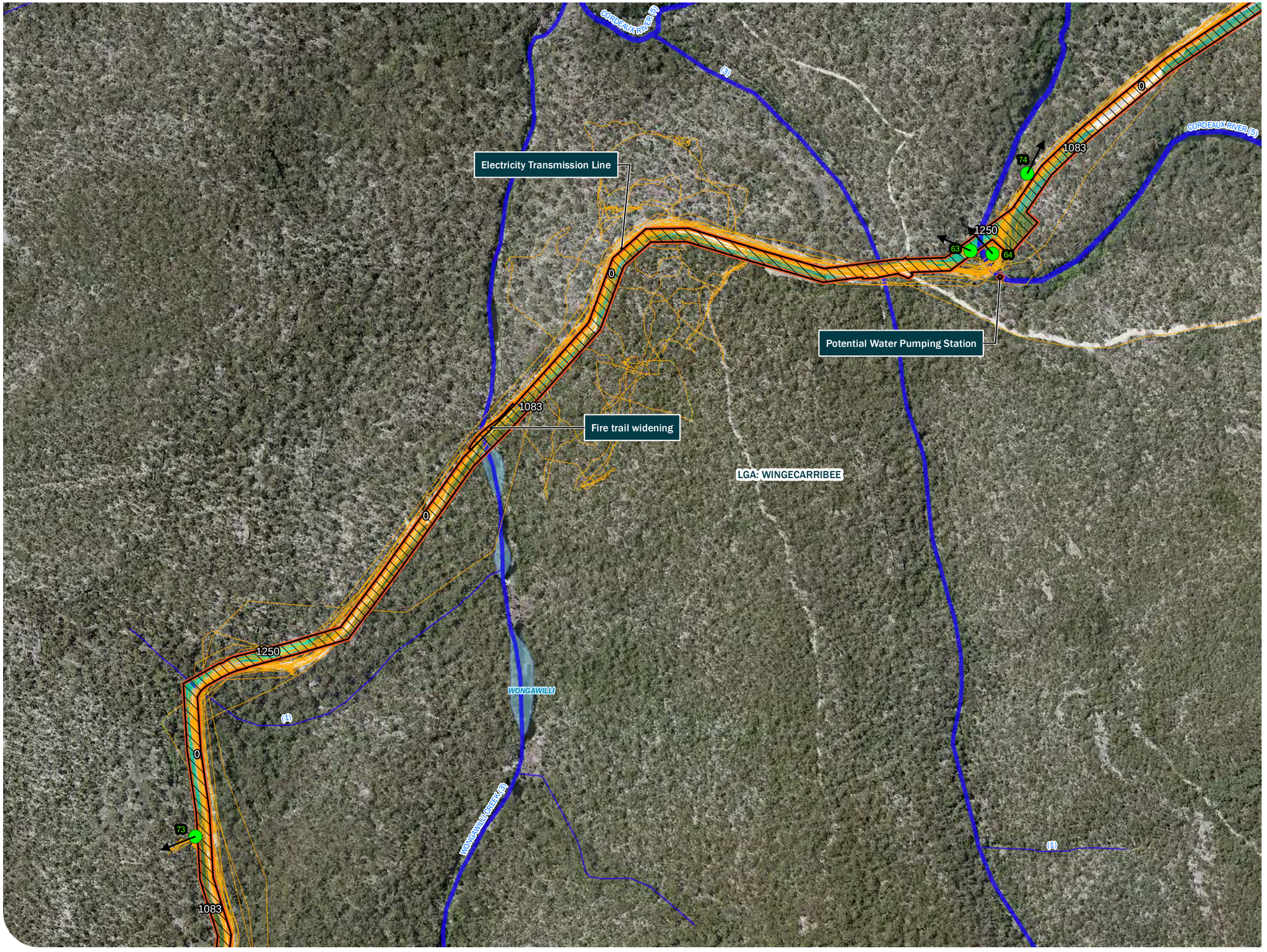
Vegetation survey effort

Dendrobium Mine Extension Project BDAR

Figure 7d

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Bear/YH File: T:\spatial\projects\ia6606\ia6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_7a_h_VegSurveyEffort.mxd Last updated: 14-Feb-22 12:08:01 PM



Subject Land

Biodiversity Assessment Development Footprint

BAM Vegetation Integrity Plot Locations

Threatened Flora and Fauna transects

Strahler Stream Order

1st order (10 m buffer)

3rd order (30 m buffer)

5th order(40m buffer)

Waterbody

Local Government Area

Validated Plant Community Types and Condition

Cleared Land

PCT 1083: Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion - Good

PCT 1083: Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion - Low

PCT 1250: Sydney Peppermint - Smooth-barked Apple - Red Bloodwood shrubby open forest on slopes of moist sandstone gullies, eastern Sydney Basin Bioregion - Good

niche Environment and Heritage

0 100

m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Vegetation survey effort

Dendrobium Mine Extension Project BDAR

Figure 7e

Imagery @ Illawarra-Coal Dec 2018

v2.0

Drawn by: Jess Beer/YH File: T:\spatial\projects\6624\6624_Dendrobium_BDARMaps\report\BDAR\6624_Figure_7a_h_VegSurveyEffort.mxd Last updated: 14-Feb-22 12:08:01 PM

292000

Fire trail widening

Fire trail widening

Fire trail widening

Fire trail widening

Electricity Transmission Line Infrastructure Area

Electricity Transmission Line

LGA: WOLLONDILLY

LGA: WOLLONGONG

LGA: WINGECARRIBEE

1083

1083

1083

0

68

65

LAKE CORDEAUX

CORDEAUX CREEK (2)

CORDEAUX RIVER (5)

6498000

6497500

6497000

6496500

Subject Land

Biodiversity Assessment Development Footprint

BAM Vegetation Integrity Plot Locations

Threatened Flora and Fauna transects

Strahler Stream Order

1st order (10 m buffer)

2nd order (20 m buffer)

5th order(40m buffer)

Waterbody

Local Government Area

Validated Plant Community Types and Condition

Cleared Land

PCT 1083: Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion - Cleared

PCT 1083: Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion - Good

PCT 1083: Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion - Low

niche Environment and Heritage

0 100

m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Vegetation survey effort

Dendrobium Mine Extension Project BDAR

Figure 7f

Imagery @ Illawarra Coal Dec 2018

Drawn by: Jess Bear/YH File: T:\spatial\projects\ia6600\a6624_Dendrobium_BDAR\Maps\ReportBDAR\6624_Figure_7a_h_VegSurveyEffort.mxd Last updated: 14-Feb-22 12:08:01 PM



Subject Land

Biodiversity Assessment Development Footprint

BAM Vegetation Integrity Plot Locations

Threatened Flora and Fauna transects

Strahler Stream Order

1st order (10 m buffer)

Local Government Area

Validated Plant Community Types and Condition

PCT 1083: Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion - Low

niche Environment and Heritage

0 40

m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Vegetation survey effort

Dendrobium Mine Extension Project BDAR

Figure 7g

Imagery @ Illawarra-Coal Dec 2018

v2.0

Drawn by: Jess Bear/YH File: T:\spatial\projects\ab6600\ab6624_Dendrobium_BDAR\MapSheprint\BDAR6624_Figure_7a_h_VegSurveyEffort.mxd Last updated: 14-Feb-22 12:08:01 PM



Subject Land

Biodiversity Assessment Development Footprint

BAM Vegetation Integrity Plot Locations

Strahler Stream Order

1st order (10 m buffer)

2nd order (20 m buffer)

Waterbody

Local Government Area

Validated Plant Community Types and Condition

Cleared Land

PCT 1245: Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion - Moderate

niche Environment and Heritage

0 40

m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Vegetation survey effort

Dendrobium Mine Extension Project BDAR

Figure 7h

Imagery @ Illawarra-Coal Dec 2018

v2.0

Drawn by: Jes S Bear/YH File: T:\spatial\projects\ia6600\ia6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_7a_h_VegSurveyEffort.mxd Last updated: 14-Feb-22 12:08:01 PM

283000 284000 285000 286000 287000 288000 289000 290000

6198000 6197000 6196000 6195000 6194000

FIRETRAIL NO 4

FIRETRAIL NO 6M

FIRETRAIL NO 6X

FIRETRAIL NO 6Z

FIRETRAIL NO 6B

FIRETRAIL NO 6Y

FIRETRAIL NO 6

AVON DAM ROAD

AVON RIVER

WONGAWILLI CREEK

DONALDS CASTLE CREEK

FIRE ROAD NO 6A

niche Environment and Heritage

0 600

m

GDA 1994 MGA Zone 56

- Subject Land
- Biodiversity Assessment Development Footprint
- Predicted Extent of Subsidence - 20 mm Subsidence Contour
- Subsidence Assessment Study Area
- Perennial Stream
- Non-Perennial Stream
- Road

Threatened Ecological Communities

- Coastal Upland Swamps of the Sydney Basin Bioregion (BC Act and EPBC Act listed)
- Shale Sandstone Transition Forest (BC Act & EPBC Act listed)

Threatened Ecological Communities

Dendrobium Mine, Plan for the Future: Coal for Steelmaking BDAR

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Figure 8

Imagery @ Illawarra-Coal Dec 2018

v2.0

Drawn by: Jess Bear/YH File: T:\spatial\projects\6600s\6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_8_TEC.mxd Last updated: 09-Feb-22 11:58:35 AM

283000 284000 285000 286000 287000 288000 289000 290000

6198000 6197000 6196000 6195000 6194000 6193000

FIRETRAIL NO 4
FIRETRAIL NO 6X
FIRETRAIL NO 6M
FIRETRAIL NO 6B
FIRETRAIL NO 6Z
FIRETRAIL NO 6Y
FIRETRAIL NO 6
AVON DAM ROAD
AVON RIVER
FIRE ROAD NO 6A
WONGAWILLI CREEK
DONALDS CASTLE CREEK

Den97
Den120
Den100
Den104
Den105
Den103
Den121
Den122
Den102
Den86
Den101
Den123
Den99
Den98
Den110
Den109
Den114
Den111
Den107
Den108
Den106
Den85

LW506
LW505
LW504
LW503
LW502
LW501
LW510
LW509
LW508
LW507

0 600
m
GDA 1994 MGA Zone 56

- Subject Land
- Biodiversity Assessment Development Footprint
- Predicted Extent of Subsidence - 20 mm Subsidence Contour
- Subsidence Assessment Study
- Proposed Longwalls with 60 m boundary
- Proposed Longwalls
- Perennial Stream
- Non-Perennial Stream
- Road
- Coastal Upland Swamps – within predicted indirect impact buffer
- Coastal Upland Swamps – outside of predicted indirect impact buffer

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coa

Coastal Upland Swamps

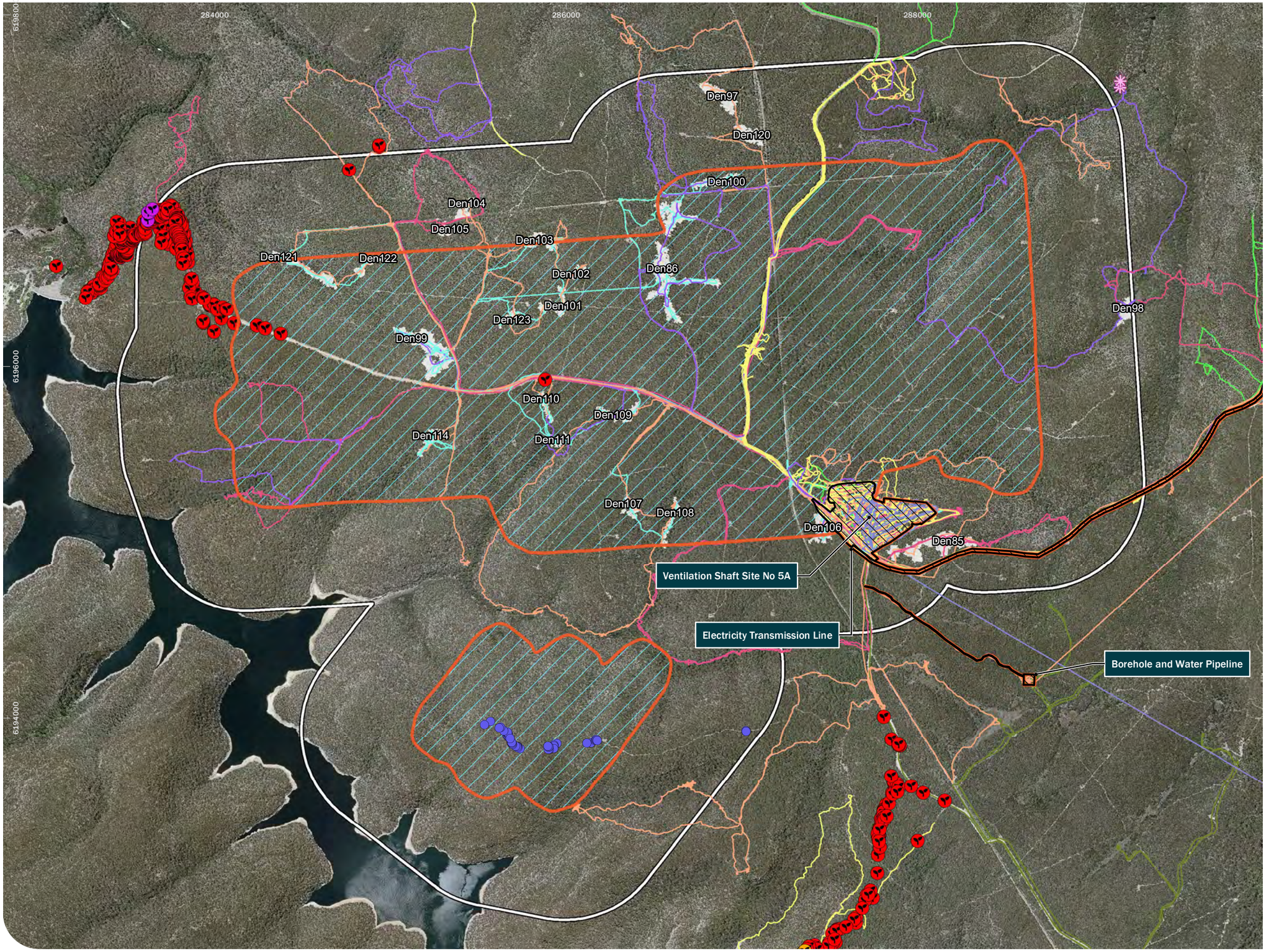
Dendrobium Mine Extension Project BDAR

Figure 9

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Beer/YH File: T:\spatial\projects\a6000\a6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_9_Swamps.mxd Last updated: 14-Feb-22 2:07:17 PM

v2.0



Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Coastal Upland Swamps

Threatened flora recorded by Niche (2016-2020)

- *Leucopogon exolasius*
- *Leucopogon exolasius (Biosis 2016)*

Flora (BioNet 2022) --- no sensitive species displayed*

- Acacia bynoeana
- Grevillea raybrownii
- Leucopogon exolasius

Threatened Flora Fauna Transects

- February
- April
- May
- June
- July
- August
- October
- November

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl); Flora (Hairy Geebung, Lesser Creeping Fern, Netted Bottle Brush).

niche Environment and Heritage

0 500
m
GDA 1994 MGA Zone 56

Threatened Flora

Dendrobium Mine Extension Project BDAR

Sensitive species not displayed*

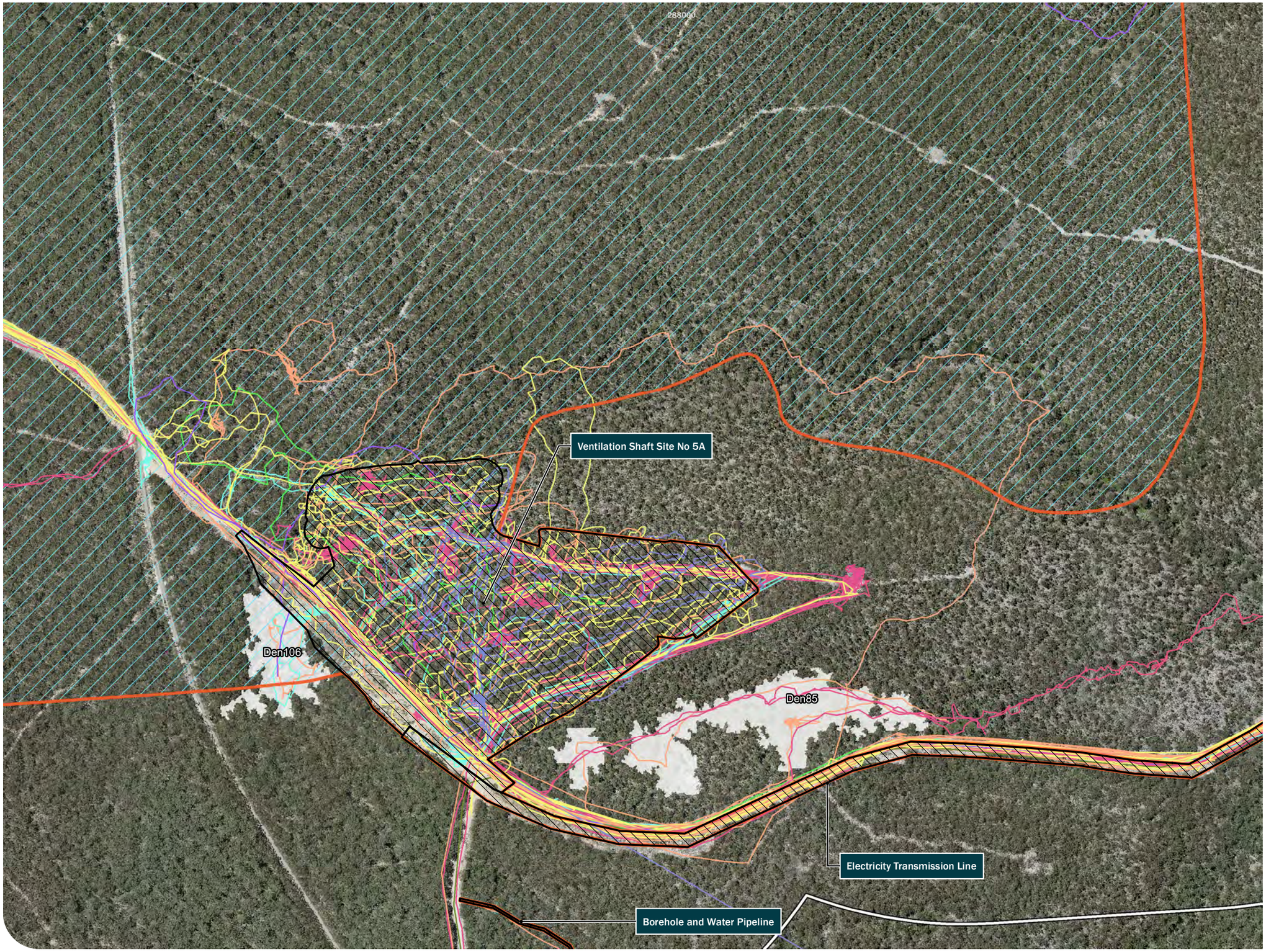
Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Figure 10a

Imagery @ Illawarra-Coal Dec 2018

v2.0

Drawn by: Jess Bear/YH File: T:\spatial\projects\ai6000\ai6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_10a_h_ThreatenedFloraResults.mxd Last updated: 11-Mar-22 4:26:27 PM



- *Subject Land*
- Biodiversity Assessment Development Footprint
- Predicted Extent of Subsidence - 20 mm Subsidence Contour
- Subsidence Assessment Study Area
- Coastal Upland Swamps

Threatened Flora Fauna Transects

- February
- April
- May
- June
- July
- August
- October
- November

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl); Flora (Hairy Geebung, Lesser Creeping Fern, Netted Bottle Brush).

niche Environment and Heritage

0 100
m
GDA 1994 MGA Zone 56

Threatened Flora

Dendrobium Mine Extension Project BDAR

Sensitive species not displayed*

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Figure 10b

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Bear?YH File: T:\spatial\projects\ab6000\ab6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_10a_h_ThreatenedFloraResults.mxd Last updated: 11-Mar-22 4:26:27 PM

Electricity Transmission Line

Subject Land
Biodiversity Assessment Development Footprint
Predicted Extent of Subsidence - 20 mm Subsidence Contour
Subsidence Assessment Study Area
Threatened Flora Fauna Transects
April
May
June
July
August
October
November

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl); Flora (Hairy Geebung, Lesser Creeping Fern, Netted Bottle Brush).

niche Environment and Heritage

0 100
m
GDA 1994 MGA Zone 56

Threatened Flora

Dendrobium Mine Extension Project BDAR

Sensitive species not displayed*

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Figure 10c

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Bear/YH File: T:\spatial\projects\ab600\ab6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_10a_h_ThreatenedFl

290000

6196000

Electricity Transmission Line

Den98

Subject Land

Biodiversity Assessment Development Footprint

Subsidence Assessment Study Area

Coastal Upland Swamps

Threatened flora recorded by Niche (2016-2020)

Acacia bynoeana

Flora (BioNet 2022) --- no sensitive species displayed*

Acacia bynoeana

Threatened Flora Fauna Transects

April

May

June

July

August

October

November

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl); Flora (Hairy Geebung, Lesser Creeping Fern, Netted Bottle Brush).

niche Environment and Heritage

0 100

m

GDA 1994 MGA Zone 56

Threatened Flora

Dendrobium Mine Extension Project BDAR

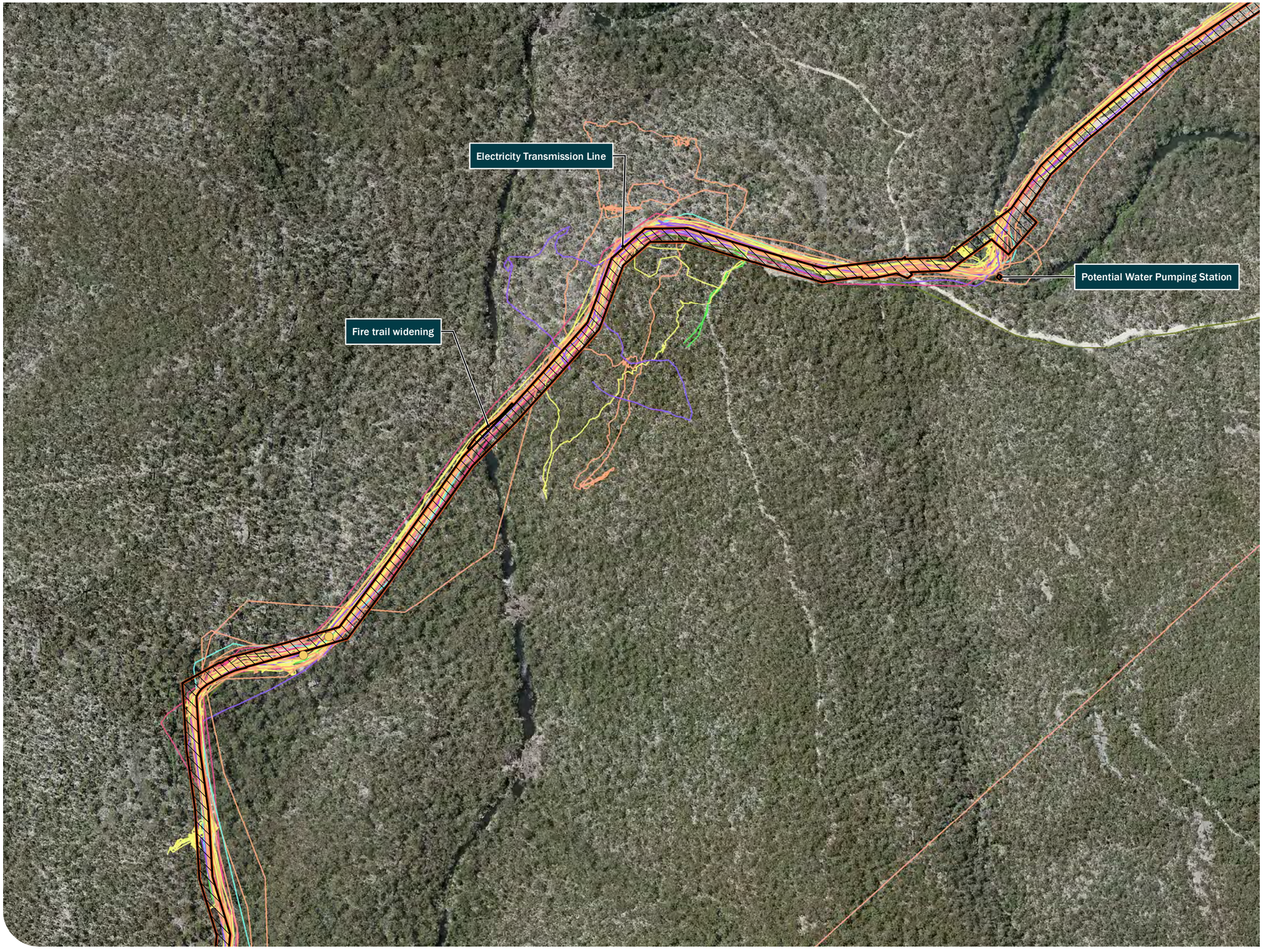
Sensitive species not displayed*

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Figure 10d

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jes.s Bear/YH File: T:\spatial\projects\ad6600\ad6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_10a_h_ThreatenedFloraResults.mxd Last updated: 11-Mar-22 4:26:27 PM



Subject Land

Biodiversity Assessment Development Footprint

Threatened flora recorded by Niche (2016-2020)

Epacris purpurascens var. purpurascens

Threatened Flora Fauna Transects

- April
- May
- June
- July
- August
- October
- November

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl); Flora (Hairy Geebung, Lesser Creeping Fern, Netted Bottle Brush).

niche Environment and Heritage

0 100
m
GDA 1994 MGA Zone 56

Threatened Flora

Dendrobium Mine Extension Project BDAR

Sensitive species not displayed*

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Figure 10e

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Bear/YH File: T:\spatial\projects\ia6600\ia6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_10a_h_ThreatenedFlora_Results.mxd Last updated: 11-Mar-22 4:26:27 PM

292000

6198000

Fire trail widening

Fire trail widening

Fire trail widening

Electricity Transmission Line

Fire trail widening

Electricity Transmission Line Infrastructure Area

Subject Land

Biodiversity Assessment Development Footprint

Threatened flora recorded by Niche (2016-2020)

Epacris purpurascens var. purpurascens

Threatened Flora Fauna Transects

- April
- May
- June
- July
- October
- November

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl); Flora (Hairy Geebung, Lesser Creeping Fern, Netted Bottle Brush).

niche Environment and Heritage

0 100

m

GDA 1994 MGA Zone 56

Threatened Flora

Dendrobium Mine Extension Project BDAR

Sensitive species not displayed*

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Figure 10f

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Beer/YH File: T:\spatial\projects\6600\6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_10a_h_ThreatenedFloraResults.mxd Last updated: 11-Mar-22 4:26:27 PM



Subject Land

Biodiversity Assessment Development Footprint

Threatened Flora Fauna Transects

- April
- May
- June
- July
- October
- November

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl); Flora (Hairy Geebung, Lesser Creeping Fern, Netted Bottle Brush).

niche Environment and Heritage

0 50
m
GDA 1994 MGA Zone 56

Threatened Flora

Dendrobium Mine Extension Project BDAR

Sensitive species not displayed*

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Figure 10g

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Beal YH File: T:\spatial\projects\client\6600\a6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_10b_h_ThreatenedFloraResults.mxd Last updated: 11-Mar-22 4:26:27 PM



Subject Land

Biodiversity Assessment Development Footprint

Threatened Flora Fauna Transects

February

May

August

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl); Flora (Hairy Geebung, Lesser Creeping Fern, Netted Bottle Brush).

niche Environment and Heritage

0 50

m

GDA 1994 MGA Zone 56

Threatened Flora

Dendrobium Mine Extension Project BDAR

Sensitive species not displayed*

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Figure 10h

Imagery @ Illawarra-Coal Dec 2018

v2.0

Drawn by: Jess Bear/YH File: T:\spatial\projects\ia6600\ia6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_10a_h_ThreatenedFloraResults.mxd Last updated: 11-Mar-22 4:26:27 PM

284000
286000
288000
290000
6198000
6196000
6194000

Electricity Transmission Line

Ventilation Shaft Site No 5A

Borehole and Water Pipeline

Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Acacia baueri subsp. aspera species polygon (assumed presence)

niche Environment and Heritage

0 400

m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

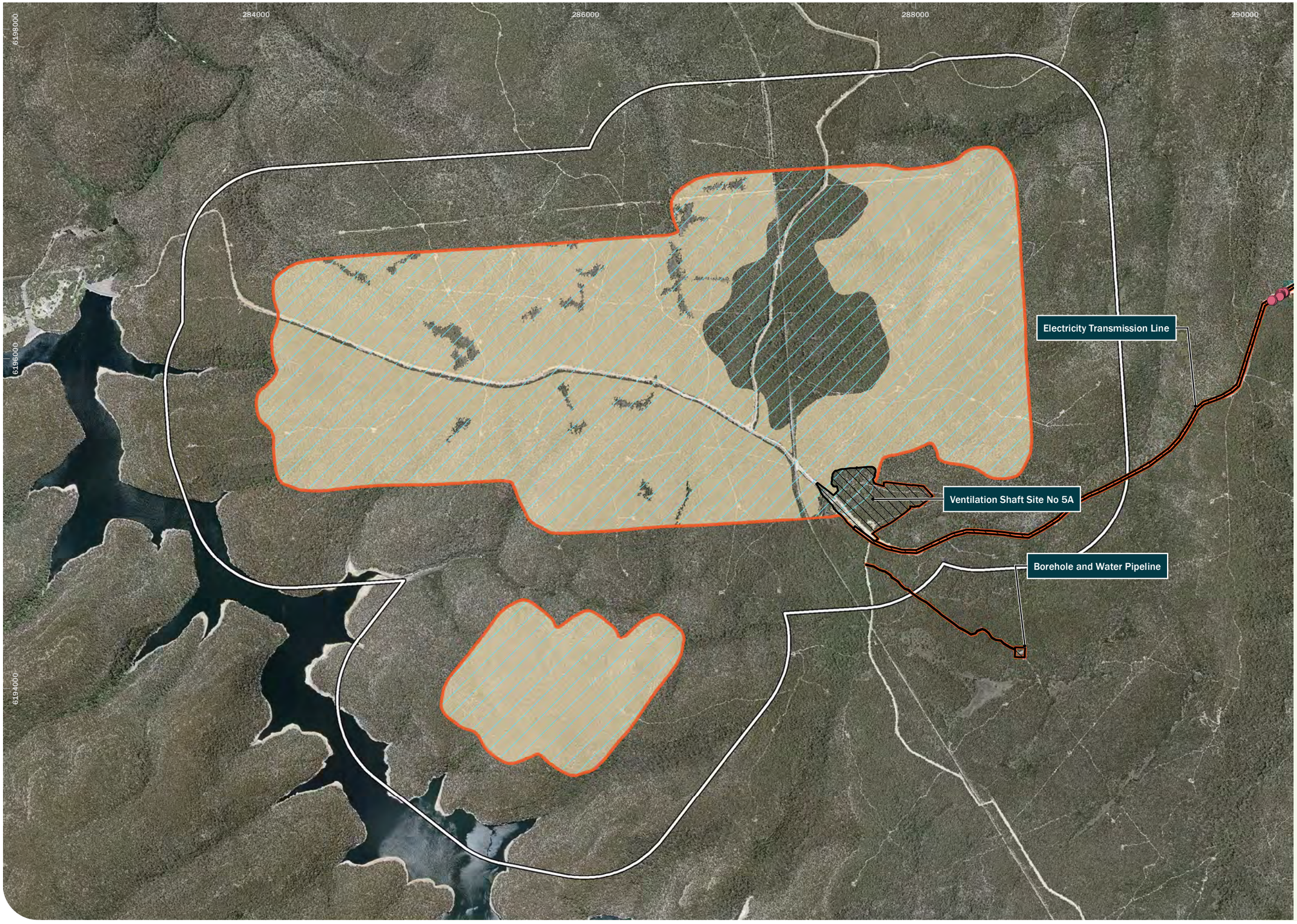
Threatened Flora Species Polygon – *Acacia baueri subsp. aspera*

Dendrobium Mine Extension Project BDAR

Figure 11a

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Baer/YH File: T:\spatial\projects\6600\6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_11a_Acacia_baueri_subsp_SP.mxd Last updated 10-Mar-22 11:51:23 AM



Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Threatened flora recorded by Niche (2016-2020)

Acacia bynoeana

Acacia bynoeana species polygon (assumed presence)

niche Environment and Heritage

0 500

m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Flora Species Polygon – *Acacia bynoeana*

Dendrobium Mine Extension Project BDAR

Figure 11b.1

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Bear/YH File: T:\spatial\projects\ad6600\ad6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_11b_AcaciaBynoeana.mxd Last updated: 10-Mar-22 11:58:17 AM

290000

6196000

Subject Land

Biodiversity Assessment Development Footprint

Subsidence Assessment Study Area

Threatened flora recorded by Niche (2016-2020)

- Acacia bynoeana

Electricity Transmission Line

niche Environment and Heritage

0 100

m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Flora Species Polygon – *Acacia bynoeana*

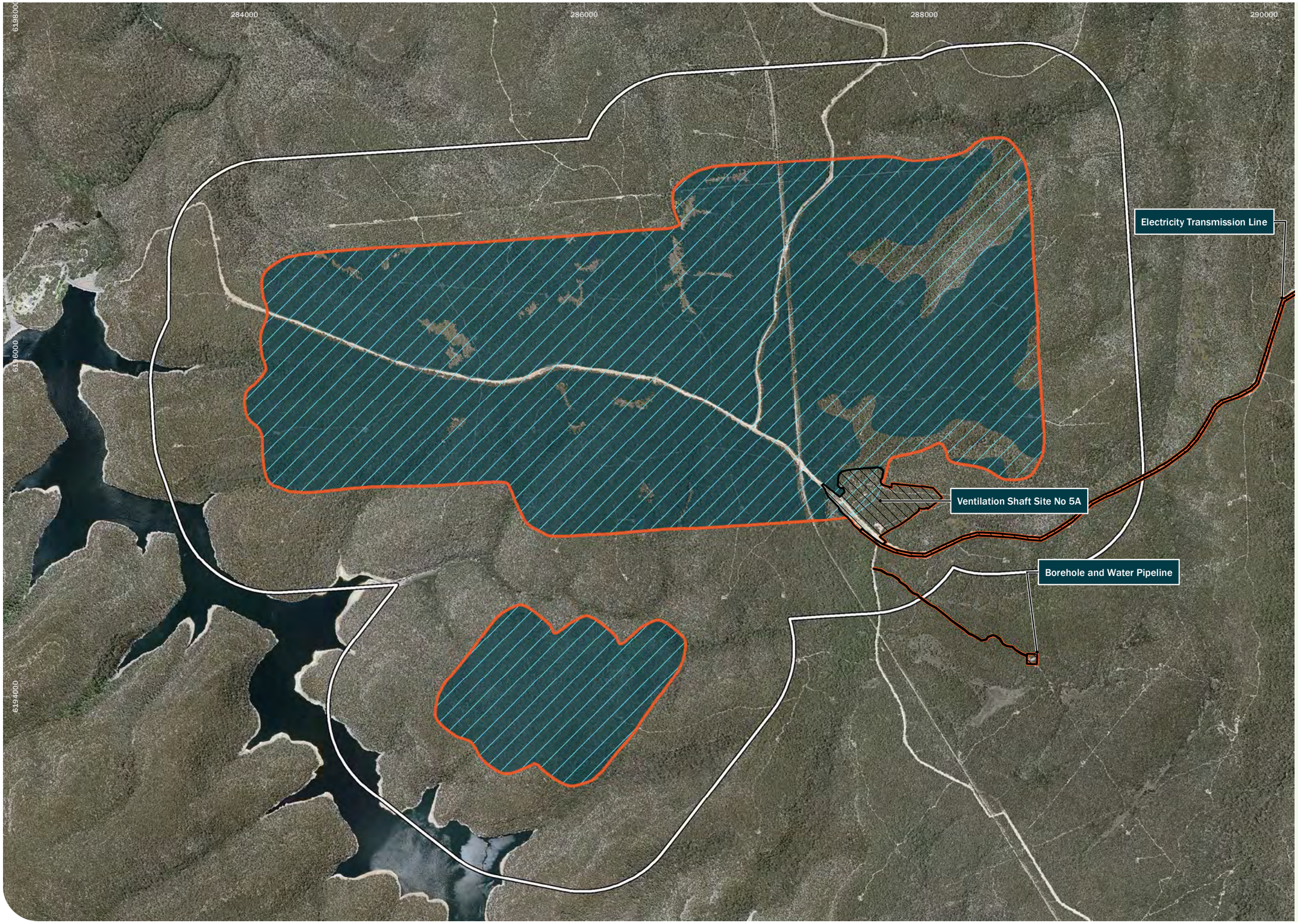
Dendrobium Mine Extension Project BDAR

Figure 11b.2

Imagery @ Illawarra-Coal Dec 2018

v2.0

Drawn by: Jes Bear/YH File: T:\spatial\projects\6600\6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_11b_AcaciaBynoeana.mxd Last updated: 10-Mar-22 11:58:17 AM



Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Species polygon (assumed presence)

Acacia pubescens
Leucopogon fletcheri subsp. fletcheri

niche Environment and Heritage

0 400
m
GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Flora Species Polygon – *Acacia pubescens, Leucopogon fletcheri subsp. fletcheri*

Dendrobium Mine Extension Project BDAR

Figure 11c

Imagery @ Illawarra-Coal Dec 2018

v2.0

Drawn by: Jess Beer/YH File: T:\spatial\projects\6600\6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_11c_Acacia_pubescens.mxd Last updated: 10-Mar-23 12:00:20 PM

284000
286000
288000
290000
6198000
6196000
6194000

Electricity Transmission Line

Ventilation Shaft Site No 5A

Borehole and Water Pipeline

Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Species polygon (assumed presence)

Astrotricha crassifolia
Caladenia tessellata
Callistemon linearifolius
Melaleuca deanei
Persoonia bargoensis
Persoonia hirsuta
Pterostylis saxicola

niche Environment and Heritage

0 400
m
GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Flora Species Polygon
– *Astrotricha crassifolia*, *Caladenia tessellata*, *Callistemon linearifolius*, *Melaleuca deanei*, *Persoonia bargoensis* , *Persoonia hirsuta*, *Pterostylis saxicola*
Dendrobium Mine Extension Project BDAR

Figure 11d

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Beer/YH File: T:\spatial\projects\6624\arcgis\6624_Dendrobium_BDARMaps\report\BDAR\6624_Figure_11d_Astrotricha_crassifolia.mxd Last updated: 10-Mar-22 12:05:06 PM

v2.0

284000
286000
288000
290000
6198000
6196000
6194000

Electricity Transmission Line

Ventilation Shaft Site No 5A

Borehole and Water Pipeline

Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Species polygon (assumed presence)

Caesia parviflora var. minor

niche Environment and Heritage

0 400

m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Flora Species Polygon - *Caesia parviflora var. minor*

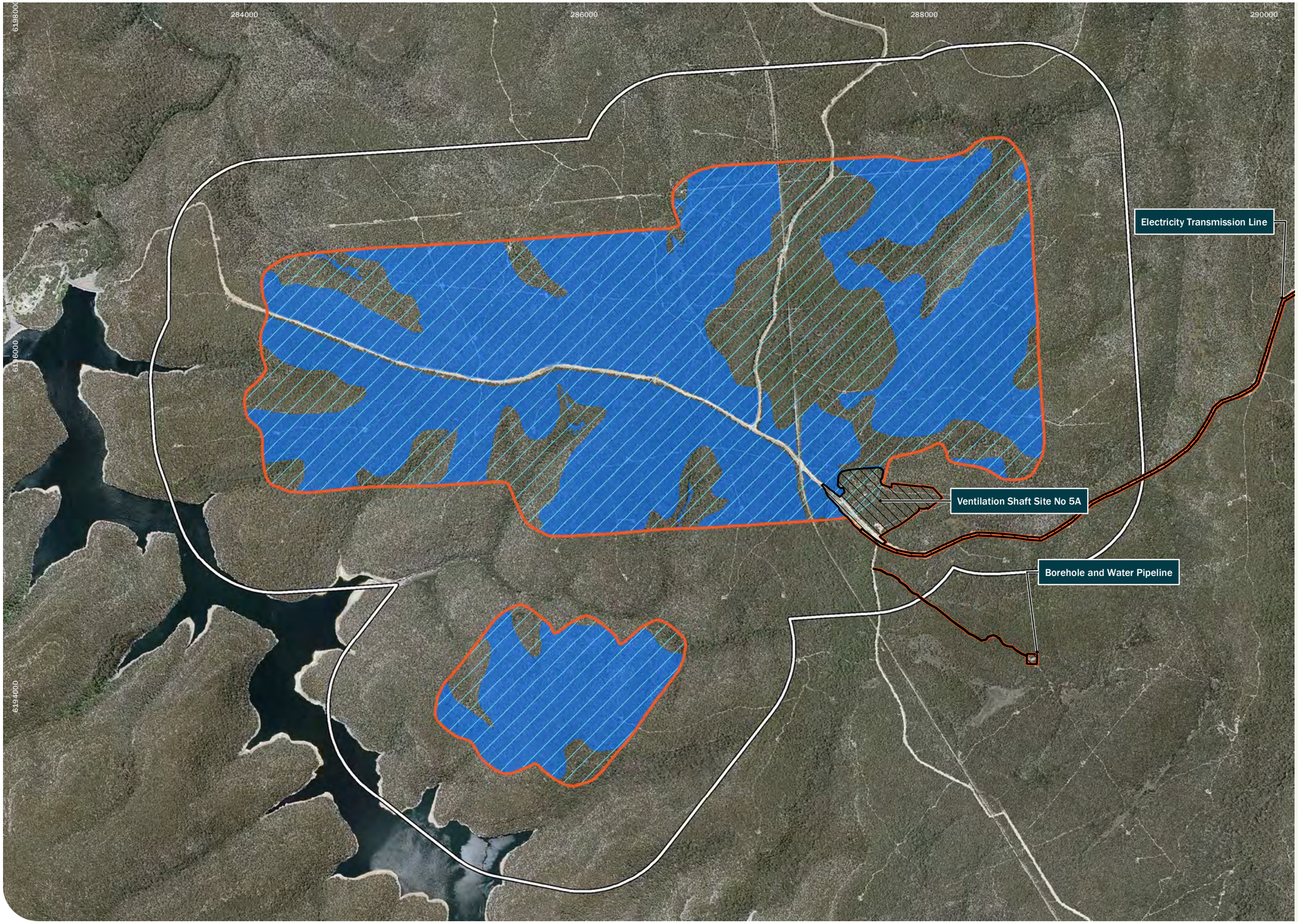
Dendrobium Mine Extension Project BDAR

Figure 11e

Imagery @ Illawarra-Coal Dec 2018

v2.0

Drawn by: Jess Beer/YH File: T:\spatial\projects\6600\6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_11e_Caesia_parviflora_var_minor.mxd Last updated: 10-Mar-22 12:05:55 PM



Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Species polygon (assumed presence)

Cryptostylis hunteriana

niche Environment and Heritage

0 400

m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Flora Species Polygon – *Cryptostylis hunteriana*

Dendrobium Mine Extension Project BDAR

Figure 11f

Imagery @ Illawarra-Coal Dec 2018

v2.0

Drawn by: Jess Beer/YH File: T:\spatial\projects\6600\6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_11f_Cryptostylis_hunteriana.mxd Last updated: 10-Mar-22 12:06:44 PM

6198000
6196000
6194000
284000
286000
288000
290000

Electricity Transmission Line

Ventilation Shaft Site No 5A

Borehole and Water Pipeline

Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Species polygon (assumed presence)

Deyeuxia appressa
Genoplesium baueri
Pomaderris adnata

niche Environment and Heritage

0 400
m
GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Flora Species Polygon – *Deyeuxia appressa, Genoplesium baueri, Pomaderris adnata*

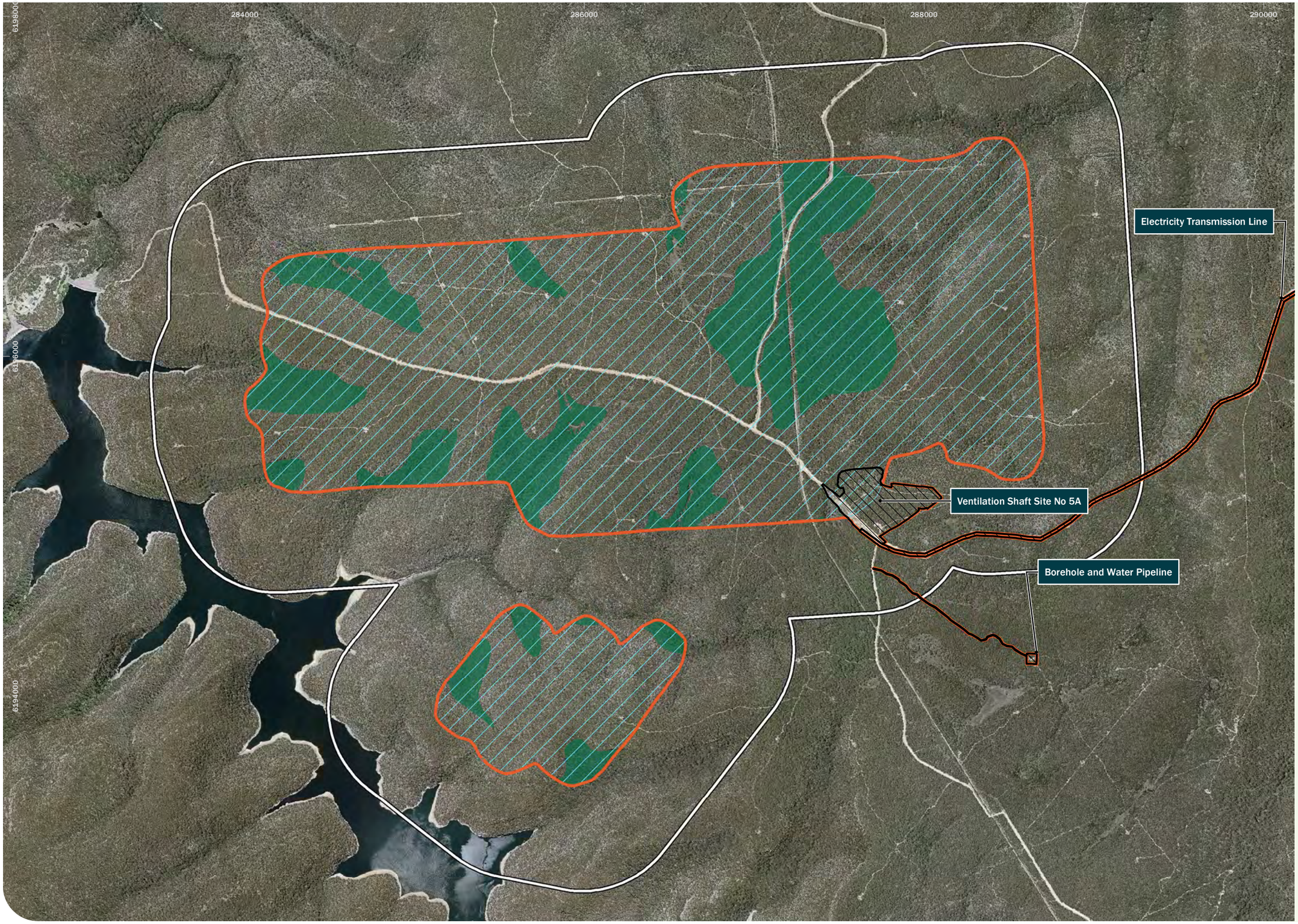
Dendrobium Mine Extension Project BDAR

Figure 11g

Imagery @ Illawarra-Coal Dec 2018

v2.0

Drawn by: Jess Baer/YH File: T:\spatial\projects\6600\6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_11g_Deyeuxia_appressa_Genoplesium_baueri_Pomaderris_adnata.mxd Last updated 11-Mar-22 2:48:26 PM



Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Species polygon (assumed presence)

Epacris purpurascens var. purpurascens

niche Environment and Heritage

0 400

m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

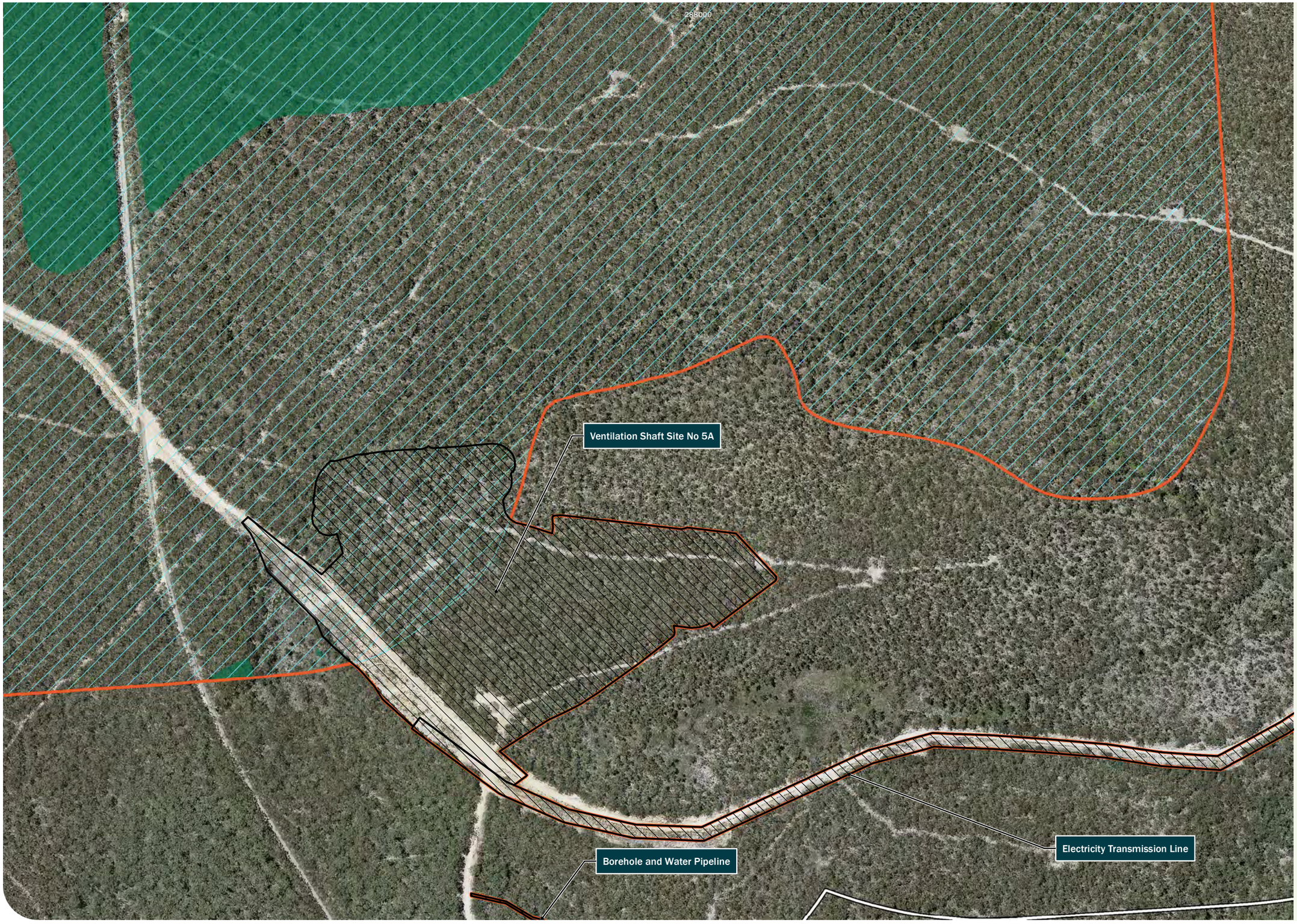
Threatened Flora Species Polygon - *Epacris purpurascens var. purpurascens*

Dendrobium Mine Extension Project BDAR

Figure 11h.1

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Baer/YH File: T:\spatial\projects\6600\6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_11h_Epacris_purpurascens.mxd Last updated: 11-Mar-22 2:48:33 PM



Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Species polygon (assumed presence)

Epacris purpurascens var. purpurascens

niche Environment and Heritage

0 100

m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Flora Species Polygon - *Epacris purpurascens var. purpurascens*

Dendrobium Mine Extension Project BDAR

Figure 11h.2

Imagery @ Illawarra-Coal Dec 2018

v2.0

Drawn by: Jes & Bear/YH File: T:\spatial\projects\ad6624_Dendrobium_BDAR\Maps\Reports\BDAR\6624_Figure_11h_Epacris_pur



Subject Land

Biodiversity Assessment Development Footprint

Threatened flora recorded by Niche (2016-2020)

Epacris purpurascens var. purpurascens

0 100

m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Flora Species Polygon - *Epacris purpurascens var. purpurascens*

Dendrobium Mine Extension Project BDAR

Figure 11h.3

Imagery @ Illawarra Coal Dec 2018

Drawn by: Jess Bear/YH File: T:\spatial\projects\6624\6624_Dendrobium_BDAR\Mapsleport\EBDAR\6624_Figure_11h_Epacris_purpurascens.mxd Last updated: 11-Mar-22 2:48:33 PM

292000

6198000

Fire trail widening

Fire trail widening

Fire trail widening

Electricity Transmission Line

Fire trail widening

Electricity Transmission Line Infrastructure Area

Subject Land

Biodiversity Assessment Development Footprint

Threatened flora recorded by Niche (2016-2020)

Epacris purpurascens var. purpurascens

niche Environment and Heritage

0 100

m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Flora Species Polygon - *Epacris purpurascens var. purpurascens*

Dendrobium Mine Extension Project BDAR

Figure 11h.4

Imagery @ Illawarra-Coal Dec 2018

v2.0

Drawn by: Jess Bear/YH File: T:\spatial\projects\ad6624\6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_11h_Epacris_purpurascens.mxd Last updated: 11-Mar-22 2:48:33 PM

284000
286000
288000
290000
6198000
6196000
6194000

Electricity Transmission Line

Ventilation Shaft Site No 5A

Borehole and Water Pipeline

Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Species polygon (assumed presence)

Eucalyptus camfieldii

niche Environment and Heritage

0 400

m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Flora Species Polygon - *Eucalyptus camfieldii*

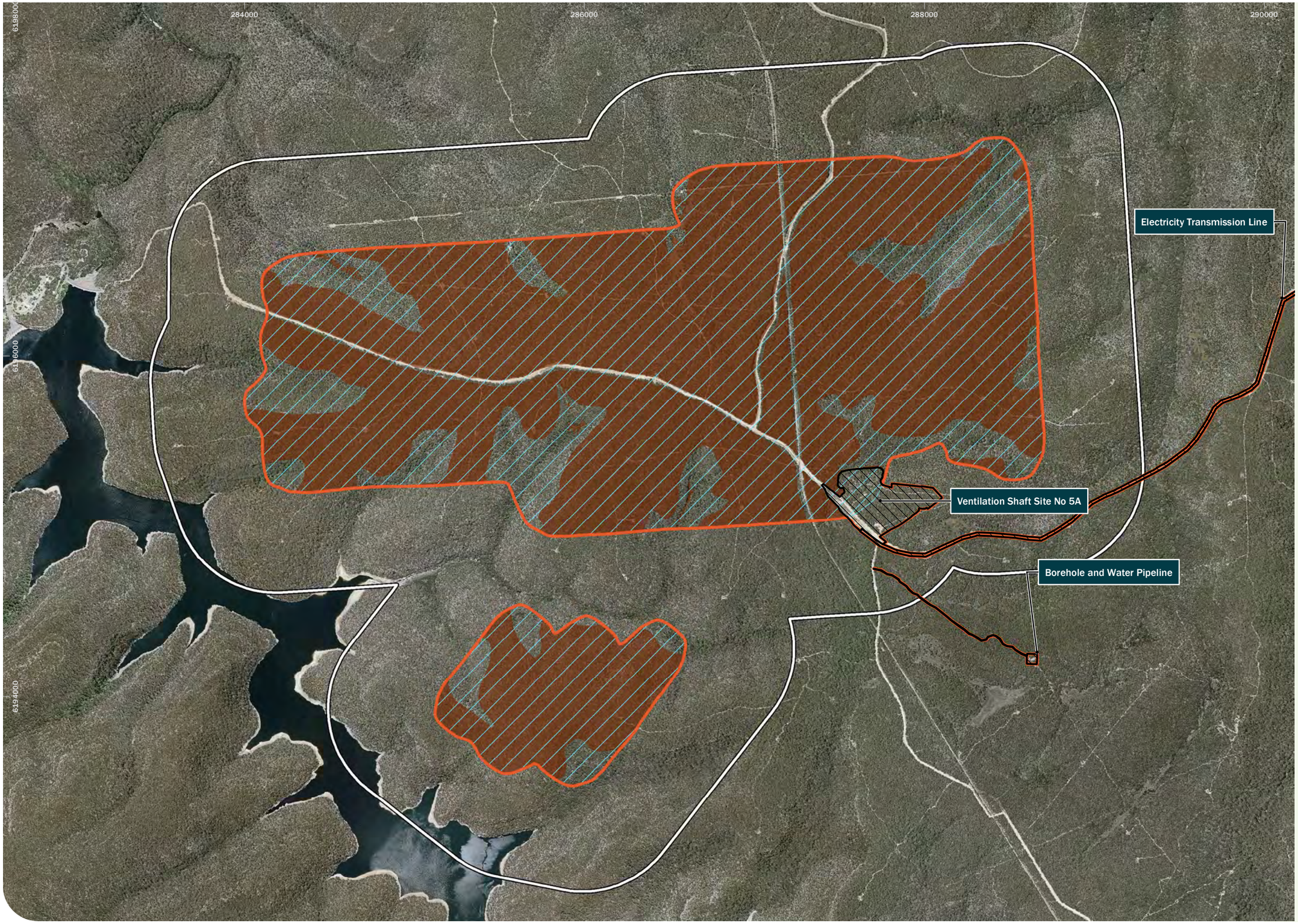
Dendrobium Mine Extension Project BDAR

Figure 11i

Imagery @ Illawarra-Coal Dec 2018

v2.0

Drawn by: Jess Beer/YH File: T:\spatial\projects\6600\6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_11i_Eucalyptus_camfieldii.mxd Last updated: 11-Mar-22 2:49:00 PM



Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Species polygon (assumed presence)

Grevillea parviflora subsp. parviflora

niche Environment and Heritage

0 400

m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

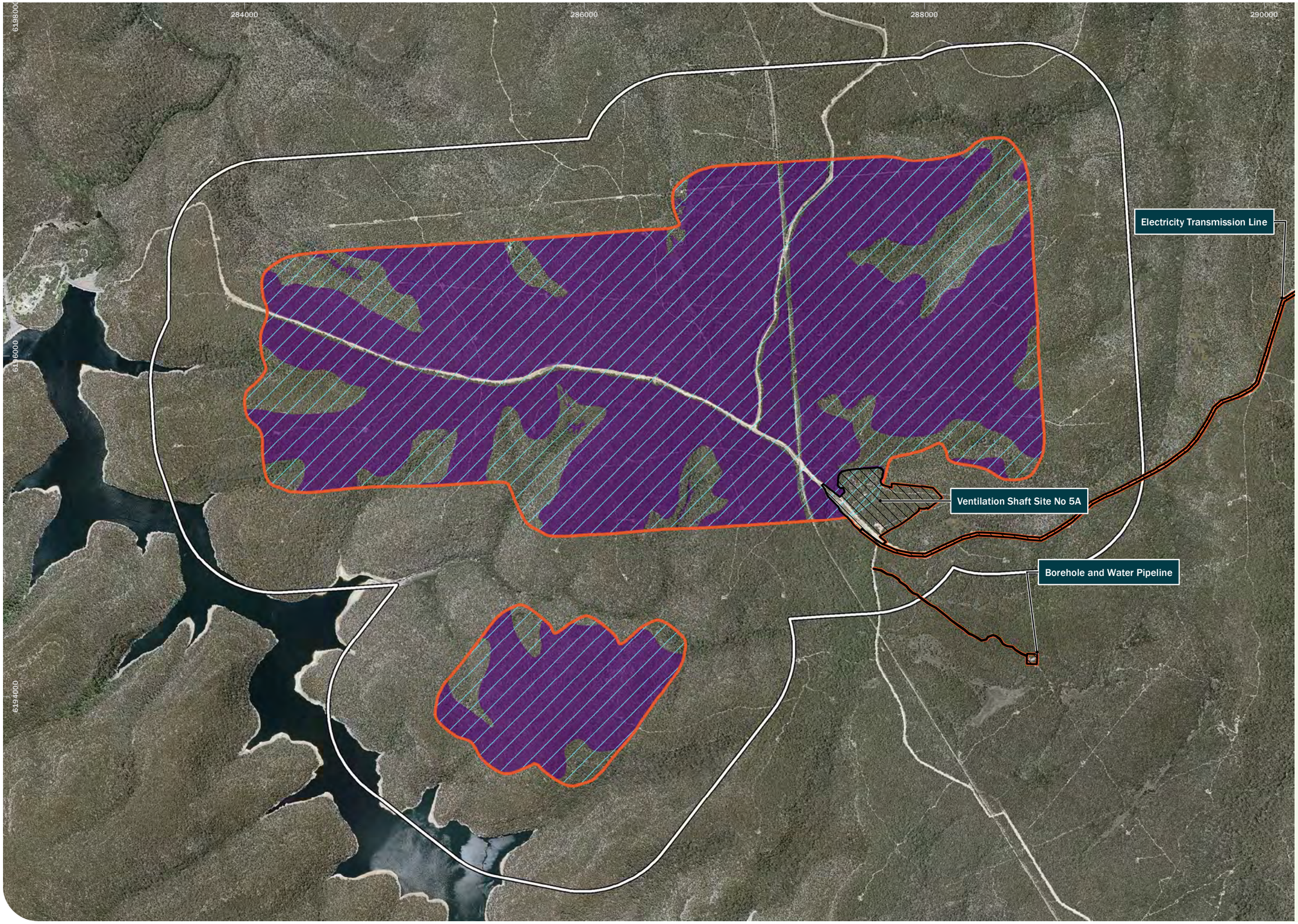
Threatened Flora Species Polygon - *Grevillea parviflora subsp. parviflora*

Dendrobium Mine Extension Project BDAR

Figure 11j

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Beer/YH File: T:\spatial\projects\ie6604\e6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_11j_Grevillea_parviflora_subsp_parviflora.mxd Last updated: 11-Mar-22 2:49:25 PM



Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Species polygon (assumed presence)

Grevillea raybrownii
Helichrysum calvertianum
Persoonia acerosa

niche Environment and Heritage

0 400
m
GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Flora Species Polygon - *Grevillea raybrownii, Helichrysum calvertianum, Persoonia acerosa*

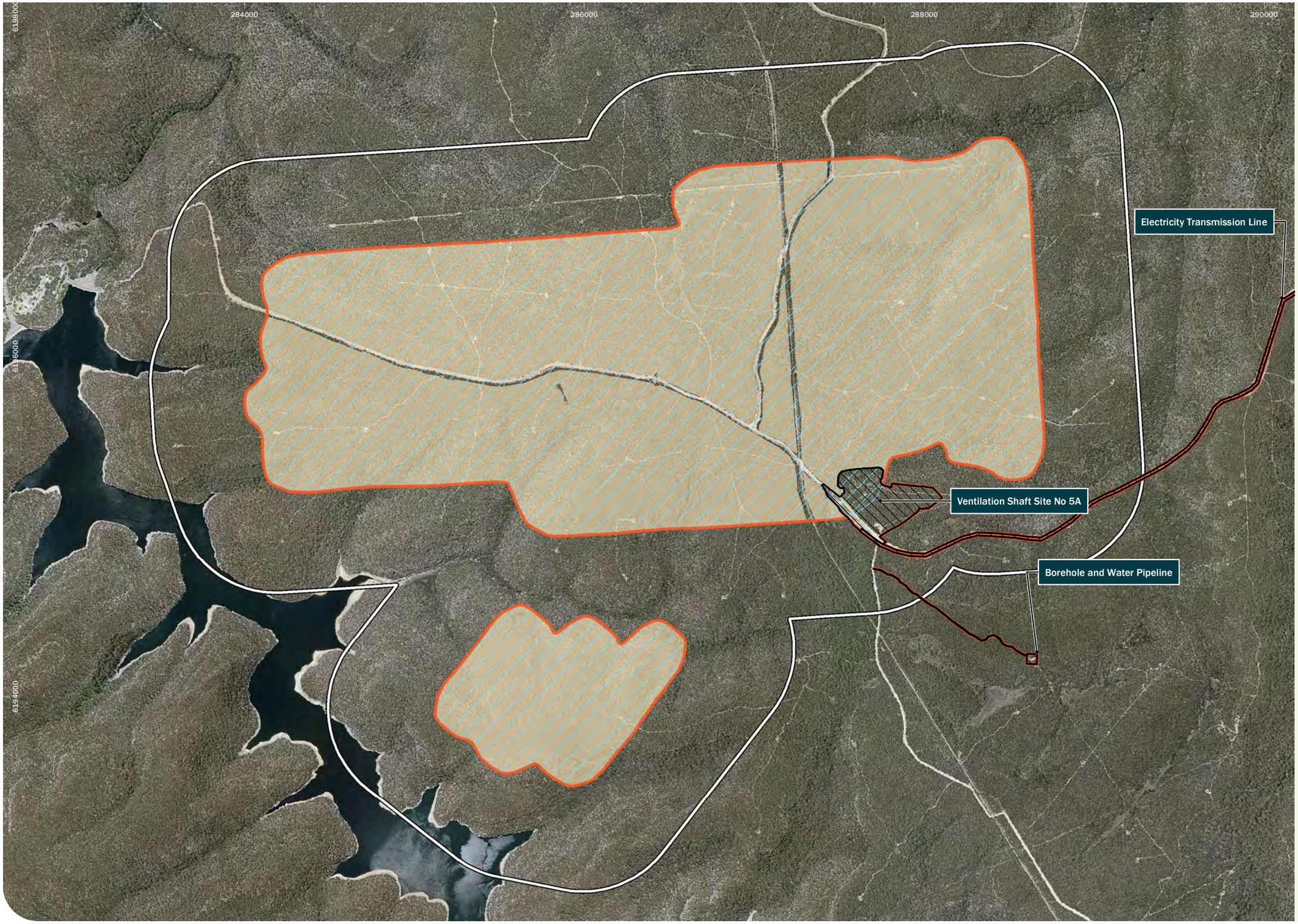
Dendrobium Mine Extension Project BDAR

Figure 11k

Imagery @ Illawarra-Coal Dec 2018

v2.0

Drawn by: Jess Beer/YH File: T:\spatial\projects\6600\6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_11k_Grevillea_raybrownii_Helichrysum_calvertianum_Persoonia_acerosa.mxd Last updated: 11-Mar-22 2:49:50 PM



Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Species polygon (assumed presence)

Hibbertia puberula

niche Environment and Heritage

0 400

m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

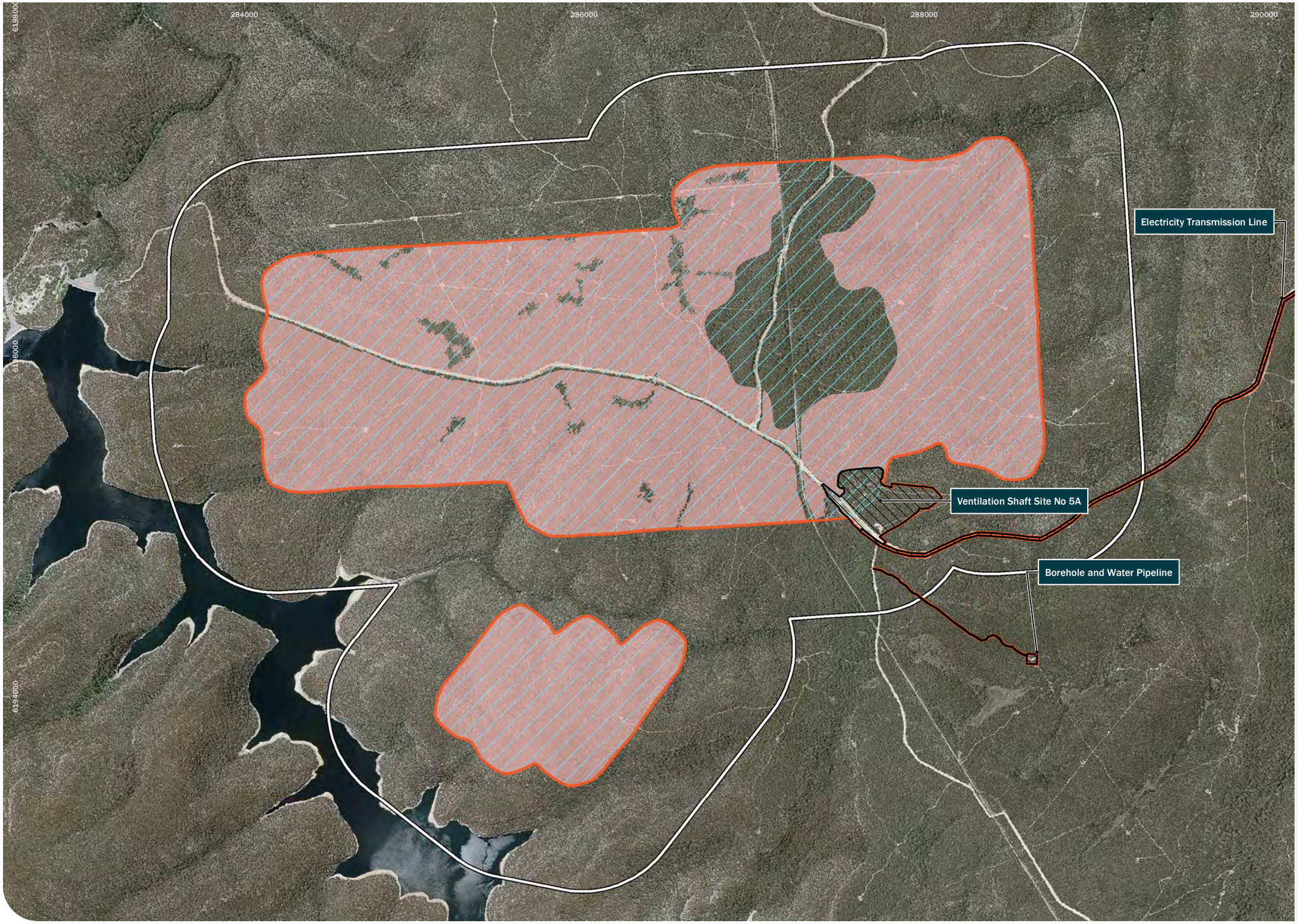
Threatened Flora Species Polygon - *Hibbertia puberula*

Dendrobium Mine Extension Project BDAR

Figure 11l

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Beer/YH File: T:\spatial\projects\6624\6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_11l_Hibbertia_puberula.mxd Last updated: 11-Mar-22 2:50:56 PM



Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Species polygon (assumed presence)

Hibbertia stricta subsp. furcatula
Prostanthera densa

niche Environment and Heritage

0 400
m
GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Flora Species Polygon - *Hibbertia stricta subsp. furcatula*, *Prostanthera densa*

Dendrobium Mine Extension Project BDAR

Figure 11m

Imagery @ Illawarra-Coal Dec 2018

v2.0

Drawn by: Jess Beer/YH File: T:\spatial\projects\6600\6624_Dendrobium_BDARMaps\report\BDAR\6624_Figure_11m_Hibbertia_stricta_subsp_furcatula_Prostanthera_densa.mxd Last updated: 11-Mar-22 2:51:23 PM

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Electricity Transmission Line

Ventilation Shaft Site No 5A

Borehole and Water Pipeline

Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Threatened flora recorded by Niche (2016-2020)

Leucopogon exolasius

Threatened flora recorded by Biosis (2016)

Leucopogon exolasius (Biosis 2016)

Species polygon (assumed presence)

Leucopogon exolasius

niche Environment and Heritage

0 400

m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Flora Species Polygon - *Leucopogon exolasius*

Dendrobium Mine Extension Project BDAR

Figure 11n.1

Imagery @ Illawarra Coal Dec 2018

Drawn by: Jes's Bear/YH File: T:\spatial\projects\ia6606\a6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_11n_Leucopogon_exolasius.mxd Last updated: 11-Mar-22 2:55:43 PM



Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Species polygon (assumed presence)

Leucopogon exolasius

niche Environment and Heritage

0 100

m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Flora Species Polygon - *Leucopogon exolasius*

Dendrobium Mine Extension Project BDAR

Figure 11n.2

Imagery @ Illawarra Coal Dec 2018

v2.0

Drawn by: Jess Bear/YH File: T:\spatial\projects\6600\6624_Dendrobium_BDAR\Maps\report\BDAR6624_Figure_11n_Leucopogon_exolasius.mxd Last updated: 11-Mar-22 2:55:43 PM

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6194000

Electricity Transmission Line

Ventilation Shaft Site No 5A

Borehole and Water Pipeline

Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Species polygon (assumed presence)

Pomaderris brunnea

niche Environment and Heritage

0 400

m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Flora Species Polygon - *Pomaderris brunnea*

Dendrobium Mine Extension Project BDAR

Figure 11o

Imagery @ Illawarra-Coal Dec 2018

v2.0

Drawn by: Jess Beer/YH File: T:\spatial\projects\6600\6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_11o_Pomaderris_brunnea.mxd Last updated: 11-Mar-22 2:52:27 PM

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6196000
6194000

Electricity Transmission Line

Ventilation Shaft Site No 5A

Borehole and Water Pipeline

Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Species polygon (assumed presence)

Pultenaea aristata

niche Environment and Heritage

0 400

m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Flora Species Polygon - *Pultenaea aristata*

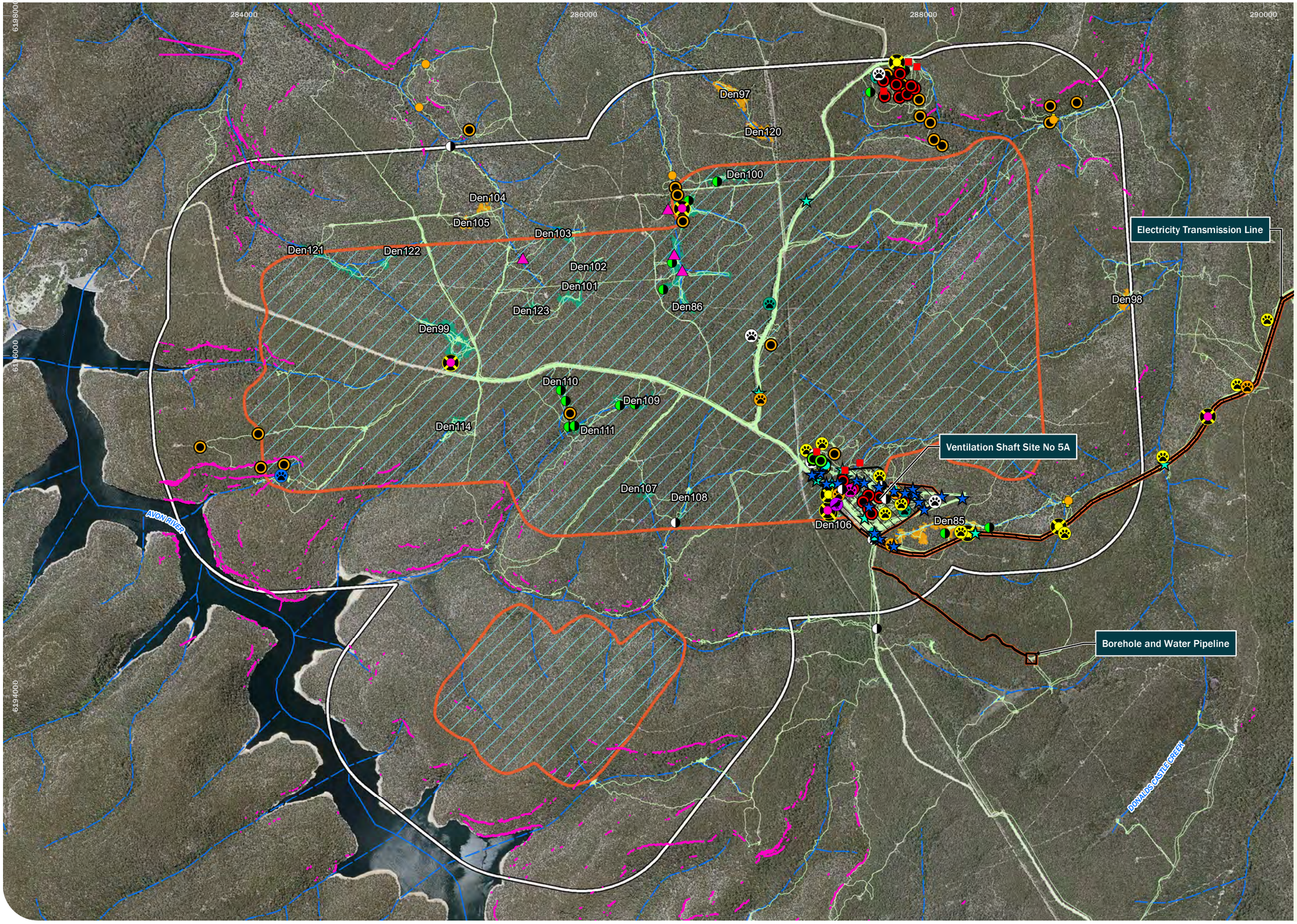
Dendrobium Mine Extension Project BDAR

Figure 11p

Imagery @ Illawarra-Coal Dec 2018

v2.0

Drawn by: Jess Beer/YH File: T:\spatial\projects\6600\6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_11p_Pultenaea_aristata.mxd Last updated: 11-Mar-22 2:53:06 PM



- Subject Land
- Biodiversity Assessment Development Footprint
- Predicted Extent of Subsidence - 20 mm Subsidence Contour
- Subsidence Assessment Study Area
- Cliffs (MSEC Cliffs Mapping - 2021)
- Perennial Stream
- Non-Perennial Stream
- Threatened Flora and Fauna transects

Fauna survey effort

- Audio recording (April 2020)
- Audio recording (Jul 2021)
- Bat Echolocation Recording (Oct-Nov 2016)
- Call Playback - Frogs and Birds (Oct-Dec 2016)
- Call Playback - Frogs, Birds, Koala (Oct-Dec 2016)
- Call playback - Owls, Koala (Jul 2021)
- Diurnal 2 ha bird survey (Oct-Dec 2016)
- Diurnal bird survey other (Jul-Aug 2021)
- Drone and diurnal bird survey (Jul-Aug 2021)
- Harp Traps (Oct-Dec 2016)
- Koala SAT plot (Feb 2021)
- Koala SAT plot (May 2020)
- Koala call playback (Feb 2021)
- Koala scat search (Jul-Aug 2021)
- Koala scat search (May 2018)
- Koala spotlighting surveys (February 2021)
- Nest box (October 2016)
- Noct. search, spotlight, call playback -Frogs and Birds (Oct-Dec 2016)
- Remote camera (Apr-May 2020)
- Remote camera (May 2018)
- Remote camera (Oct-Dec 2016)
- Spotlighting (Apr-May 2020)
- Spotlighting/stag-watch (Jul-Aug 2021)
- Tadpole survey (Jul-Aug 2021)
- Coastal Upland Swamps – within predicted indirect impact buffer
- Coastal Upland Swamps – outside of predicted indirect impact buffer

niche Environment and Heritage

0 400
m
GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

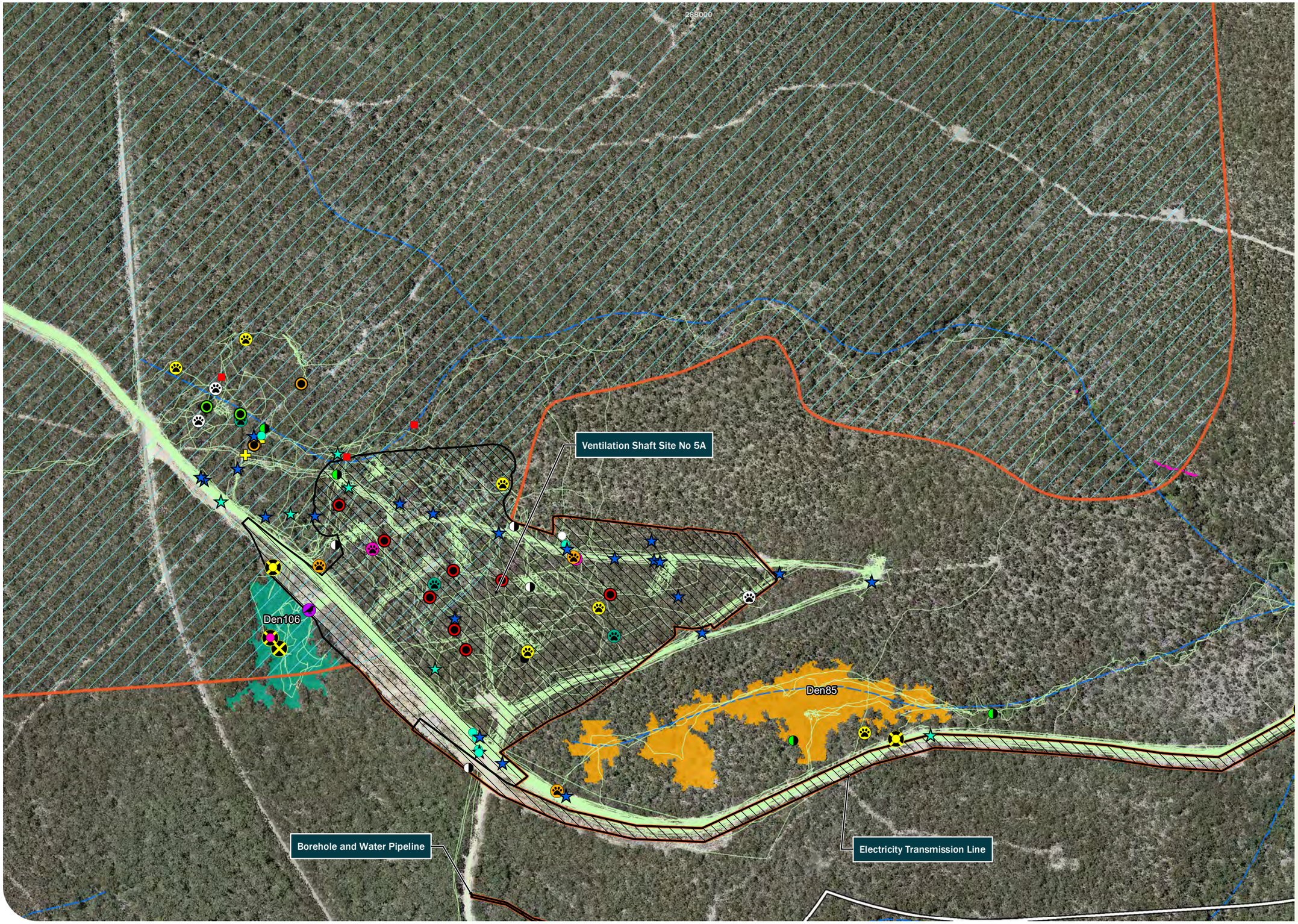
Threatened Fauna Survey Effort

Dendrobium Mine Extension Project BDAR

Figure 12a

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Beer/YH File: T:\spatial\projects\ia6600\a6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_12a_h_ThreatenedFaunaSurveyEffort.mxd Last updated: 16-Feb-22 4:21:12 PM



Subject Land
Biodiversity Assessment Development Footprint
Predicted Extent of Subsidence - 20 mm Subsidence Contour
Subsidence Assessment Study Area
Cliffs (MSEC Cliffs Mapping - 2021)
Non-Perennial Stream
Threatened Flora and Fauna transects

Fauna survey effort

- Audio recording (April 2020)
- Audio recording (Jul 2021)
- Call Playback - Frogs and Birds (Oct-Dec 2016)
- Call Playback - Frogs, Birds, Koala (Oct-Dec 2016)
- Call playback - Owls, Koala (Jul 2021)
- Diurnal 2 ha bird survey (Oct-Dec 2016)
- Diurnal bird survey other (Jul-Aug 2021)
- Drone and diurnal bird survey (Jul-Aug 2021)
- Harp Traps (Oct-Dec 2016)
- Koala SAT plot (Feb 2021)
- Koala SAT plot (May 2020)
- Koala call playback (Feb 2021)
- Koala scat search (May 2018)
- Koala spotlighting surveys (February 2021)
- Nest box (October 2016)
- Noct. search, spotlight, call playback -Frogs and Birds (Oct-Dec 2016)
- Remote camera (Apr-May 2020)
- Remote camera (May 2018)
- Remote camera (Oct-Dec 2016)
- Spotlighting (Apr-May 2020)
- Spotlighting/stag-watch (Jul-Aug 2021)

Coastal Upland Swamps – within predicted indirect impact buffer
Coastal Upland Swamps – outside of predicted indirect impact buffer

niche Environment and Heritage

0 100
m
GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Survey Effort

Dendrobium Mine Extension Project BDAR

Figure 12b

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Bear/YH File: T:\spatial\projects\ab6600\a6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_12b_h_ThreatenedFaunaSurveyEffort.mxd Last updated: 16-Feb-22 4:21:12 PM



Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Cliffs (MSEC Cliffs Mapping - 2021)

Non-Perennial Stream

Threatened Flora and Fauna transects

Fauna survey effort

- Bat Echolocation Recording (Oct-Nov 2016)
- Call Playback - Frogs and Birds (Oct-Dec 2016)
- Call Playback - Frogs, Birds, Koala (Oct-Dec 2016)
- Harp Traps (Oct-Dec 2016)
- Koala SAT plot (Feb 2021)
- Koala call playback (Feb 2021)
- Koala spotlighting surveys (February 2021)
- Noct. search, spotlight, call playback -Frogs and Birds (Oct-Dec 2016)
- Spotlighting (Apr-May 2020)

niche Environment and Heritage

0 100
m
GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Survey Effort

Dendrobium Mine Extension Project BDAR

Figure 12c

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Bear/YH File: T:\spatial\projects\sab66\0a6624_Dendrobium_BDARMapReport\mxd\BDAR6624_Figure_12c_h_ThreatenedFaunaSurveyEffort.mxd Last updated: 18-Feb-22 4:21:12 PM



Subject Land

Biodiversity Assessment Development Footprint

Subsidence Assessment Study Area

Cliffs (MSEC Cliffs Mapping - 2021)

Perennial Stream

Non-Perennial Stream

Threatened Flora and Fauna transects

Fauna survey effort

Koala SAT plot (Feb 2021)

Koala call playback (Feb 2021)

Koala spotlighting surveys (February 2021)

Spotlighting (Apr-May 2020)

Coastal Upland Swamps – outside of predicted indirect impact buffer

niche Environment and Heritage

0 100

m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Survey Effort

Dendrobium Mine Extension Project BDAR

Figure 12d

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Bear/YH File: T:\spatial\projects\6600\6624_Dendrobium_BDAR\Mapsteport\BDAR\6624_Figure_12a_h_ThreatenedFaunaSurvey.mxd Last updated: 16-Feb-22 4:21:12 PM

Subject Land
Biodiversity Assessment Development Footprint
Cliffs (MSEC Cliffs Mapping - 2021)
Perennial Stream
Non-Perennial Stream
Threatened Flora and Fauna transects

Fauna survey effort

- Audio recording (April 2020)
- Bat Echolocation Recording (Oct-Nov 2016)
- Harp Traps (Oct-Dec 2016)
- Koala SAT plot (Feb 2021)
- Koala SAT plot (May 2020)
- Koala call playback (Feb 2021)
- Nest box (October 2016)
- Remote camera (Apr-May 2020)
- Remote camera (Oct-Dec 2016)

Electricity Transmission Line

Potential Water Pumping Station

Fire trail widening

CORDEAUX RIVER

WONGAWILLI CREEK

niche Environment and Heritage

0 100
m
GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Survey Effort

Dendrobium Mine Extension Project BDAR

Figure 12e

Imagery @ Illawarra Coal Dec 2018

Drawn by: Jess Bear/YH File: T:\spatial\projects\da6600\du6624_Dendrobium_BDAR\Mapsheports\BDAR\6624_Figure_12e_h_ThreatenedFaunaSurveyEffort.mxd Last updated: 18-Feb-22 4:21:12 PM

292000

6198000

Fire trail widening

Fire trail widening

Fire trail widening

Electricity Transmission Line

Fire trail widening

Electricity Transmission Line Infrastructure Area

CORDEAUX RIVER

CORDEAUX CREEK

CORDEAUX RIVER

- Subject Land
- Biodiversity Assessment Development Footprint
- Cliffs (MSEC Cliffs Mapping - 2021)
- Perennial Stream
- Non-Perennial Stream
- Threatened Flora and Fauna transects

Fauna survey effort

- Audio recording (April 2020)
- Bat Echolocation Recording (Oct-Nov 2016)
- Call Playback - Frogs, Birds, Koala (Oct-Dec 2016)
- Koala SAT plot (Feb 2021)
- Koala SAT plot (May 2020)
- Koala call playback (Feb 2021)
- Nest box (October 2016)
- Noct. search, spotlight, call playback -Frogs and Birds (Oct-Dec 2016)
- Remote camera (Apr-May 2020)
- Spotlighting (Apr-May 2020)

niche Environment and Heritage

0 100

m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Survey Effort

Dendrobium Mine Extension Project BDAR

Figure 12f

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jes S Bear/YH File: T:\spatial\projects\ad6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_12a_h_ThreatenedFaunaSurveyEffort.mxd Last updated: 18-Feb-22 4:21:12 PM



Subject Land

Biodiversity Assessment Development Footprint

Non-Perennial Stream

Threatened Flora and Fauna transects

Fauna survey effort

Spotlighting/stag-watch (Jul-Aug 2021)

niche Environment and Heritage

0 40

m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Survey Effort

Dendrobium Mine Extension Project BDAR

Figure 12g

Imagery @ Illawarra-Coal Dec 2018

v2.0

Drawn by: Jess Bear/YH File: T:\spatial\projects\ad660\ha6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_12a_h_ThreatenedFaunaSurveyEffort.mxd Last updated: 18-Feb-22 4:21:12 PM



Subject Land

Biodiversity Assessment Development Footprint

Non-Perennial Stream

Fauna survey effort

Spotlighting (Apr-May 2020)

0 40

m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Survey Effort

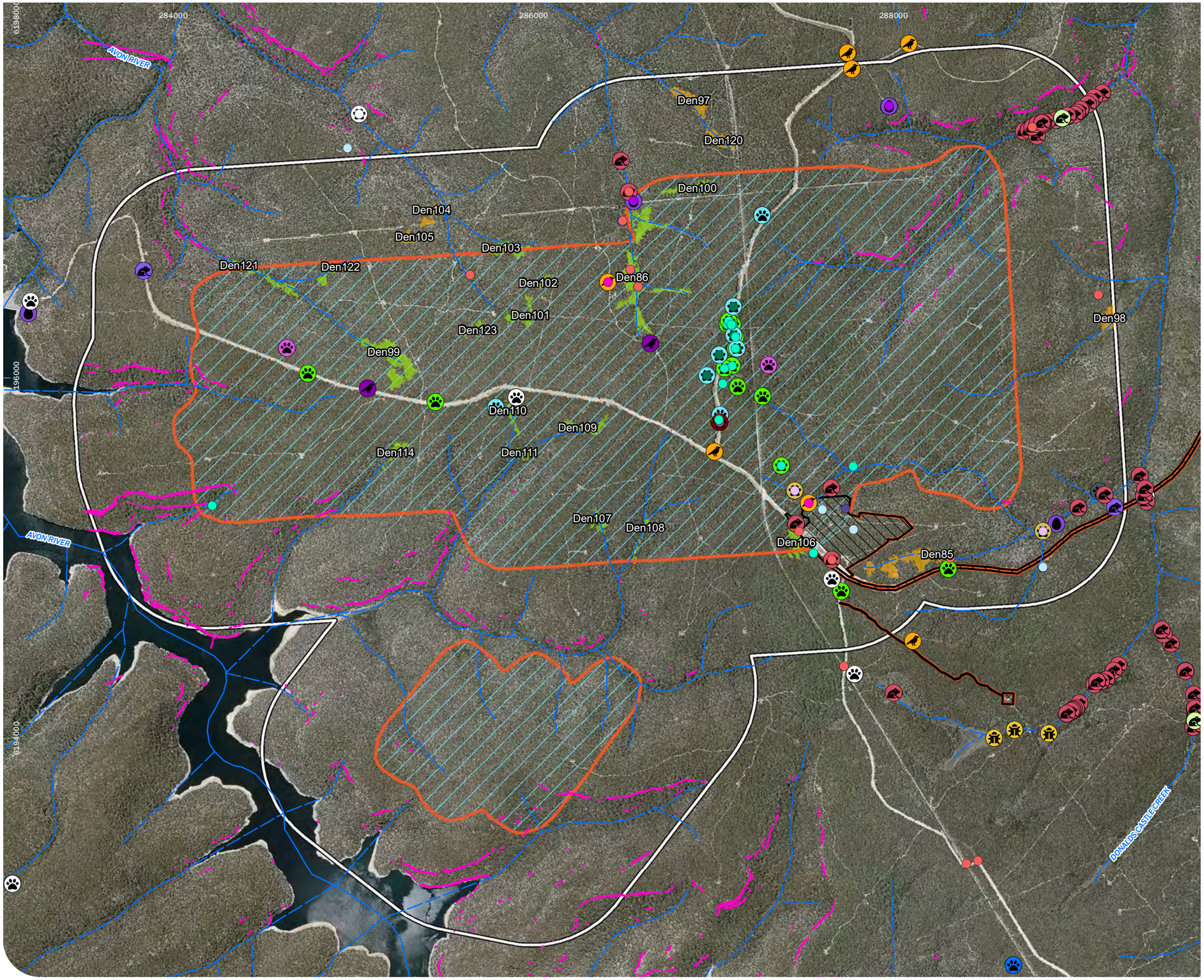
Dendrobium Mine Extension Project BDAR

Figure 12h

Imagery @ Illawarra Coal Dec 2018

v2.0

Drawn by: Jess Bear/YH File: T:\spatial\projects\da6606\a6624_Dendrobium_BDAR\Maps\eps\nr\BDAR\6624_Figure_12a_h_ThreatenedFaunaSurveyEffort.mxd Last updated: 16-Feb-22 4:21:12 PM



Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Threatened fauna recorded by Niche (2016 – 2021)

- Eastern Bentwing-bat (BC Act: V)
- Eastern Pygmy-possum (BC Act: V)
- Gang-gang Cockatoo (BC Act: V)
- Giant Burrowing Frog (BC Act: V, EPBC Act: V)
- Greater Broad-nosed Bat (BC Act: V)
- Greater Glider (BC Act: P, EPBC Act: V)
- Grey-headed Flying-fox (BC Act: V, EPBC Act: V)
- Koala (BC Act: V, EPBC Act: V)
- Littlejohn's Tree Frog (BC Act: V, EPBC Act: V)
- Rosenberg's Goanna (BC Act: V)
- Scarlet Robin (BC Act: V)

Perennial Stream

Non-Perennial Stream

Cliffs (MSEC Cliffs Mapping - 2021)

Coastal Upland Swamps – within predicted indirect impact buffer

Coastal Upland Swamps – outside of predicted indirect impact buffer

Threatned Fauna (Bionet 2022) --- no sensitive species displayed*

Amphibia

- Giant Burrowing Frog
- Littlejohn's Tree Frog
- Red-crowned Toadlet

Aves

- Scarlet Robin
- Varied Sittella

Insecta

- Giant Dragonfly

Mammalia

- Eastern Coastal Free-tailed Bat
- Eastern False Pipistrelle
- Eastern Pygmy-possum
- Greater Broad-nosed Bat
- Greater Glider
- Grey-headed Flying-fox
- Koala
- Large Bent-winged Bat
- Little Bent-winged Bat
- Southern Brown Bandicoot (eastern)
- Squirrel Glider

Reptilia

- Rosenberg's Goanna

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000). This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl); Flora (Hairy Geebung, Lesser Creeping Fern, Netted Bottle Brush).

niche Environment and Heritage

0 400 m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened fauna

Dendrobium Mine Extension Project BDAR

Sensitive species not displayed*

Figure 13a

Imagery @ Illawarra-Coal Dec 2018
*Due to agreement with OEH, sensitive species location won't be revealed in figures at a scale bigger than 250,000.

Drawn by: Jess Bear?H File: T:\spatial\projects\ia6600\a6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_13a_h_ThreatenedFauna.mxd Last updated: 23-Feb-22 8:42:07 PM

288000

Den106

Den85

Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Threatened fauna recorded by Niche (2016 – 2021)

- Eastern Pygmy-possum (BC Act: V)
- Gang-gang Cockatoo (BC Act: V)
- Greater Broad-nosed Bat (BC Act: V)
- Koala (BC Act: V, EPBC Act: V)
- Littlejohn's Tree Frog (BC Act: V, EPBC Act: V)
- Scarlet Robin (BC Act: V)

Non-Perennial Stream

Cliffs (MSEC Cliffs Mapping - 2021)

Coastal Upland Swamps – within predicted indirect impact buffer

Coastal Upland Swamps – outside of predicted indirect impact buffer

Threatned Fauna (Bionet 2022) --- no sensitive species displayed*

Amphibia

- Littlejohn's Tree Frog

Aves

- Scarlet Robin

Mammalia

- Greater Broad-nosed Bat
- Koala
- Large Bent-winged Bat

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl); Flora (Hairy Geebung, Lesser Creeping Fern, Netted Bottle Brush).

niche Environment and Heritage

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GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened fauna

Dendrobium Mine Extension Project BDAR

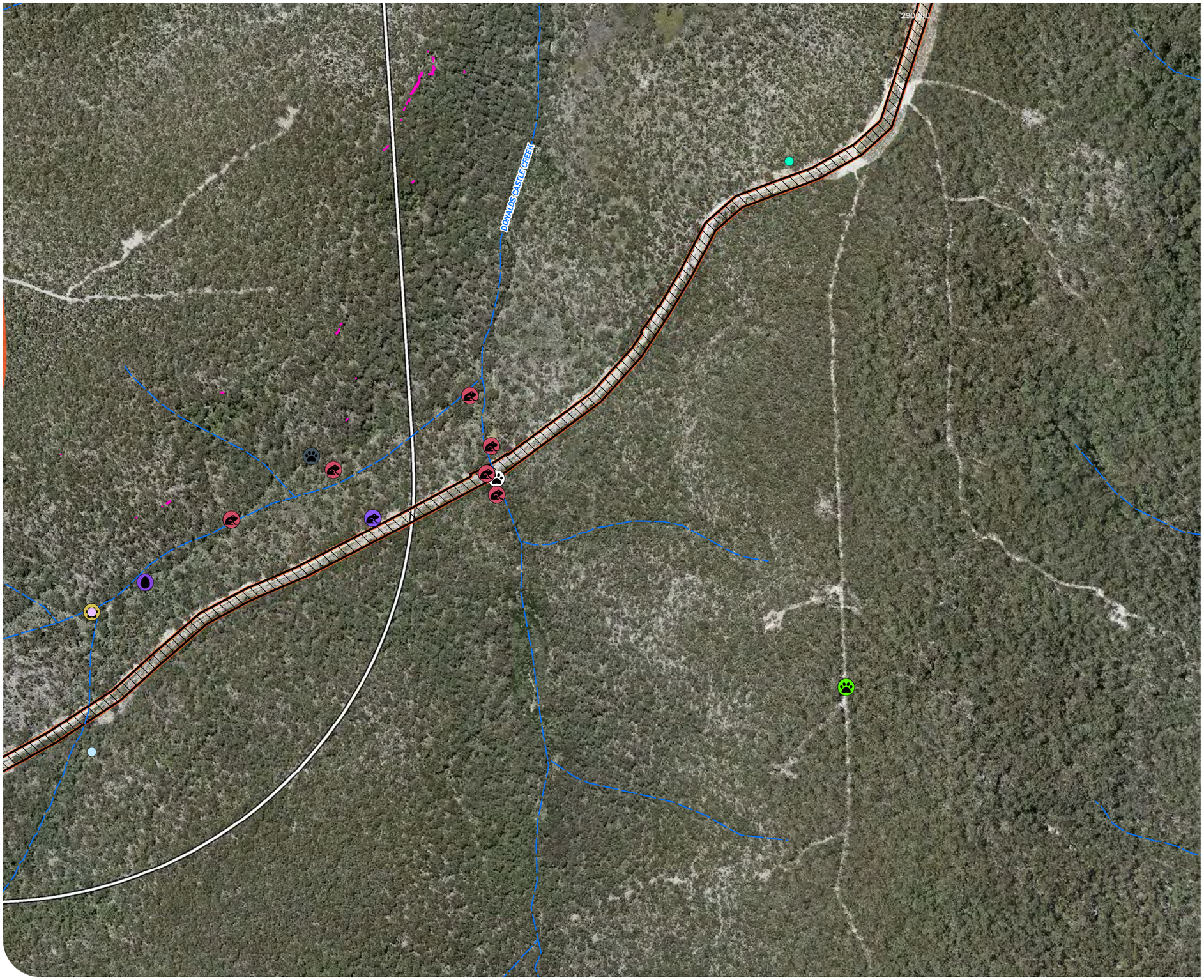
Sensitive species not displayed*

Figure 13b

Imagery @ Illawarra-Coal Dec 2018
*Due to agreement with OEH, sensitive species location won't be revealed in figures at a scale bigger than 250,000.

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Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Threatened fauna recorded by Niche (2016 – 2021)

- Gang-gang Cockatoo (BC Act: V)
- Greater Broad-nosed Bat (BC Act: V)
- Koala (BC Act: V, EPBC Act: V)

Non-Perennial Stream

Cliffs (MSEC Cliffs Mapping - 2021)

Threatned Fauna (Bionet 2022) --- no sensitive species displayed*

Amphibia

- Littlejohn's Tree Frog
- Red-crowned Toadlet

Mammalia

- Eastern Coastal Free-tailed Bat
- Eastern False Pipistrelle
- Greater Broad-nosed Bat
- Koala
- Large Bent-winged Bat

Reptilia

- Rosenberg's Goanna

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl); Flora (Hairy Geebung, Lesser Creeping Fern, Netted Bottle Brush).

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GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened fauna

Dendrobium Mine Extension Project BDAR

Sensitive species not displayed*

Figure 13c

Imagery @ Illawarra-Coal Dec 2018
*Due to agreement with OEH, sensitive species location won't be revealed in figures at a scale bigger than 250,000.

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DOMAINS CASTLE CREEK

WONGAWILLI CREEK

Subject Land

Biodiversity Assessment Development Footprint

Subsidence Assessment Study Area

Threatened fauna recorded by Niche (2016 – 2021)

- Grey-headed Flying-fox (BC Act: V, EPBC Act: V)
- Koala (BC Act: V, EPBC Act: V)
- Littlejohn's Tree Frog (BC Act: V, EPBC Act: V)

Perennial Stream

Non-Perennial Stream

Cliffs (MSEC Cliffs Mapping - 2021)

Coastal Upland Swamps – outside of predicted indirect impact buffer

Threatned Fauna (Bionet 2022) --- no sensitive species displayed*

Amphibia

- Littlejohn's Tree Frog

Mammalia

- Grey-headed Flying-fox

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl); Flora (Hairy Geebung, Lesser Creeping Fern, Netted Bottle Brush).

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GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened fauna

Dendrobium Mine Extension Project BDAR

Sensitive species not displayed*

Figure 13d

Imagery @ Illawarra-Coal Dec 2018

*Due to agreement with OEH, sensitive species location won't be revealed in figures at a scale bigger than 250,000.

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Subject Land

Biodiversity Assessment Development Footprint

Threatened fauna recorded by Niche (2016 – 2021)

- Eastern Bentwing-bat (BC Act: V)
- Eastern Cave Bat (BC Act: V)
- Eastern False Pipistrelle (BC Act: V)
- Eastern Freetail-bat (BC Act: V)
- Eastern Pygmy-possum (BC Act: V)
- Golden-tipped Bat (BC Act: V)
- Greater Broad-nosed Bat (BC Act: V)
- Koala (BC Act: V, EPBC Act: V)
- Little Bentwing-bat (BC Act: V)
- Littlejohn's Tree Frog (BC Act: V, EPBC Act: V)
- Rosenberg's Goanna (BC Act: V)
- Yellow-bellied Sheathtail-bat (BC Act: V)

Perennial Stream

Non-Perennial Stream

Cliffs (MSEC Cliffs Mapping - 2021)

Threatned Fauna (Bionet 2022) --- no sensitive species displayed*

Amphibia

- Littlejohn's Tree Frog

Mammalia

- Eastern Coastal Free-tailed Bat
- Eastern False Pipistrelle
- Golden-tipped Bat
- Greater Broad-nosed Bat
- Grey-headed Flying-fox
- Koala
- Large Bent-winged Bat
- Little Bent-winged Bat
- Southern Myotis
- Yellow-bellied Sheathtail-bat

Reptilia

- Rosenberg's Goanna

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl); Flora (Hairy Geebung, Lesser Creeping Fern, Netted Bottle Brush).

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GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened fauna

Dendrobium Mine Extension Project BDAR

Sensitive species not displayed*

Figure 13e

Imagery @ Illawarra-Coal Dec 2018
*Due to agreement with OEH, sensitive species location won't be revealed in figures at a scale bigger than 250,000.

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Subject Land

Biodiversity Assessment Development Footprint

Threatened fauna recorded by Niche (2016 – 2021)

- Eastern Pygmy-possum (BC Act: V)
- Koala (BC Act: V, EPBC Act: V)

Perennial Stream

Non-Perennial Stream

Cliffs (MSEC Cliffs Mapping - 2021)

Aves

- White-bellied Sea-Eagle

Mammalia

- Eastern Pygmy-possum
- Greater Glider
- Koala

Reptilia

- Rosenberg's Goanna

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl); Flora (Hairy Geebung, Lesser Creeping Fern, Netted Bottle Brush).

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Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened fauna

Dendrobium Mine Extension Project BDAR

Sensitive species not displayed*

Figure 13f

Imagery @ Illawarra-Coal Dec 2018
*Due to agreement with OEH, sensitive species location won't be revealed in figures at a scale bigger than 250,000.

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Subject Land

Biodiversity Assessment Development Footprint

Non-Perennial Stream

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl); Flora (Hairy Geebung, Lesser Creeping Fern, Netted Bottle Brush).

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Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened fauna

Dendrobium Mine Extension Project BDAR

Sensitive species not displayed*

Figure 13g

Imagery @ Illawarra-Coal Dec 2018

*Due to agreement with OEH, sensitive species location won't be revealed in figures at a scale bigger than 250,000.

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Subject Land

Biodiversity Assessment Development Footprint

Non-Perennial Stream

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl); Flora (Hairy Geebung, Lesser Creeping Fern, Netted Bottle Brush).

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Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened fauna

Dendrobium Mine Extension Project BDAR

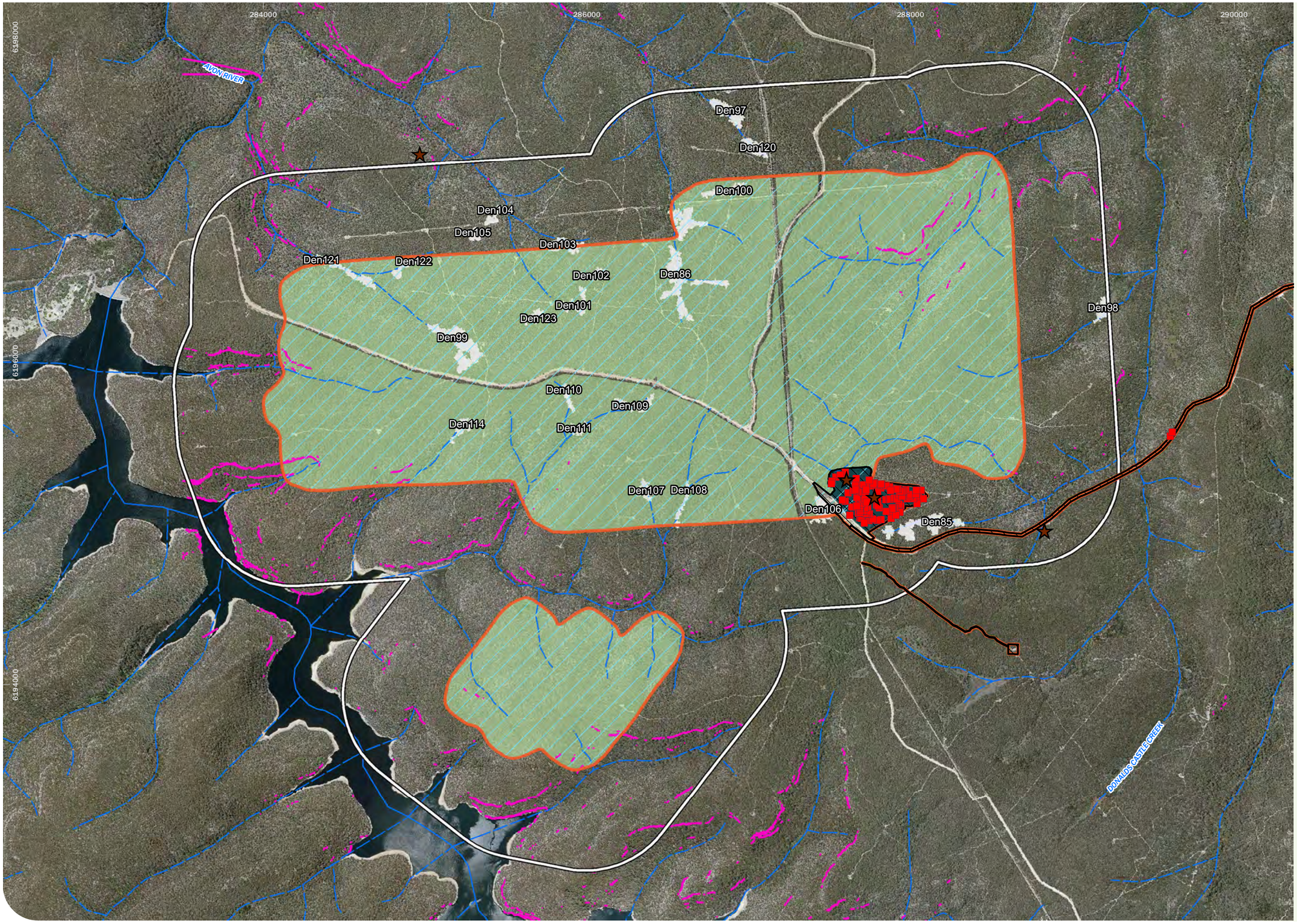
Sensitive species not displayed*

Figure 13h

Imagery @ Illawarra-Coal Dec 2018
*Due to agreement with OEH, sensitive species location won't be revealed in figures at a scale bigger than 250,000.

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Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Gang-gang Cockatoo (Niche)

Hollows suitable for Gang-gang Cockatoo within the Subject Land

Cliffs (MSEC 2021)

Perennial Stream

Non-Perennial Stream

Coastal Upland Swamps

Gang-gang Cockatoo species polygon - species polygon

Gang-gang Cockatoo species polygon - direct impact

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

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GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Species Polygon – Gang-gang Cockatoo *(Callocephalon fimbriatum)*

Dendrobium Mine Extension Project BDAR

Figure 14a.1

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Bear/YH File: T:\spatial\projects\dd6600\a6624_Dendrobium_BDAR\Mapsteport\BDAR\6624_Figure_14a_GanggangCockatoo.mxd Last updated: 10-Mar-22 2:04:01 PM

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- Subject Land
- Biodiversity Assessment Development Footprint
- Predicted Extent of Subsidence - 20 mm Subsidence Contour
- Subsidence Assessment Study Area
- Gang-gang Cockatoo (Niche)
- Hollows suitable for Gang-gang Cockatoo within the Subject Land
- Cliffs (MSEC 2021)
- Non-Perennial Stream
- Coastal Upland Swamps
- Gang-gang Cockatoo species polygon - species polygon
- Gang-gang Cockatoo species polygon - direct impact

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

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GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Species Polygon – Gang-gang Cockatoo *(Callocephalon fimbriatum)*

Dendrobium Mine Extension Project BDAR

Figure 14a.2

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Bear/YH File: T:\spatial\projects\6624\6624_Dendrobium_BDAR\Maps\report\BDAR6624_Figure_14a_GanggangCockatoo.mxd Last updated: 10-Mar-22 2:04:01 PM



Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Gang-gang Cockatoo (Niche)

Hollows suitable for Gang-gang Cockatoo within the Subject Land

Cliffs (MSEC 2021)

Non-Perennial Stream

Gang-gang Cockatoo species polygon - species polygon

Gang-gang Cockatoo species polygon - direct impact

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

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Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Species Polygon – Gang-gang Cockatoo *(Callocephalon fimbriatum)*

Dendrobium Mine Extension Project BDAR

Figure 14a.3

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Beer/YH File: T:\spatial\projects\6600\ta6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_14a_GanggangCockatoo.mxd Last updated: 10-Mar-22 2:04:01 PM

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DONALDS CASTLE CREEK

WONGAWILLI CREEK

- Subject Land
- Biodiversity Assessment Development Footprint
- Subsidence Assessment Study Area
- Cliffs (MSEC 2021)
- Perennial Stream
- Non-Perennial Stream
- Coastal Upland Swamps
- Gang-gang Cockatoo species polygon - direct impact

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

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Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Species Polygon – Gang-gang Cockatoo *(Callocephalon fimbriatum)*

Dendrobium Mine Extension Project BDAR

Figure 14a.4

Imagery @ Illawarra-Coal Dec 2018

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Drawn by: Jess Bear/ YH File: T:\spatial\projects\ak6600\a6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_14a_GangangCockatoo.mxd Last updated: 10-Mar-22 2:04:01 PM



Subject Land

Biodiversity Assessment Development Footprint

Hollows suitable for Gang-gang Cockatoo within the Subject Land

Cliffs (MSEC 2021)

Perennial Stream

Non-Perennial Stream

Gang-gang Cockatoo species polygon - direct impact

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

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Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Species Polygon – Gang-gang Cockatoo *(Callocephalon fimbriatum)*

Dendrobium Mine Extension Project BDAR

Figure 14a.5

Imagery @ Illawarra-Coal Dec 2018

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*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

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Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

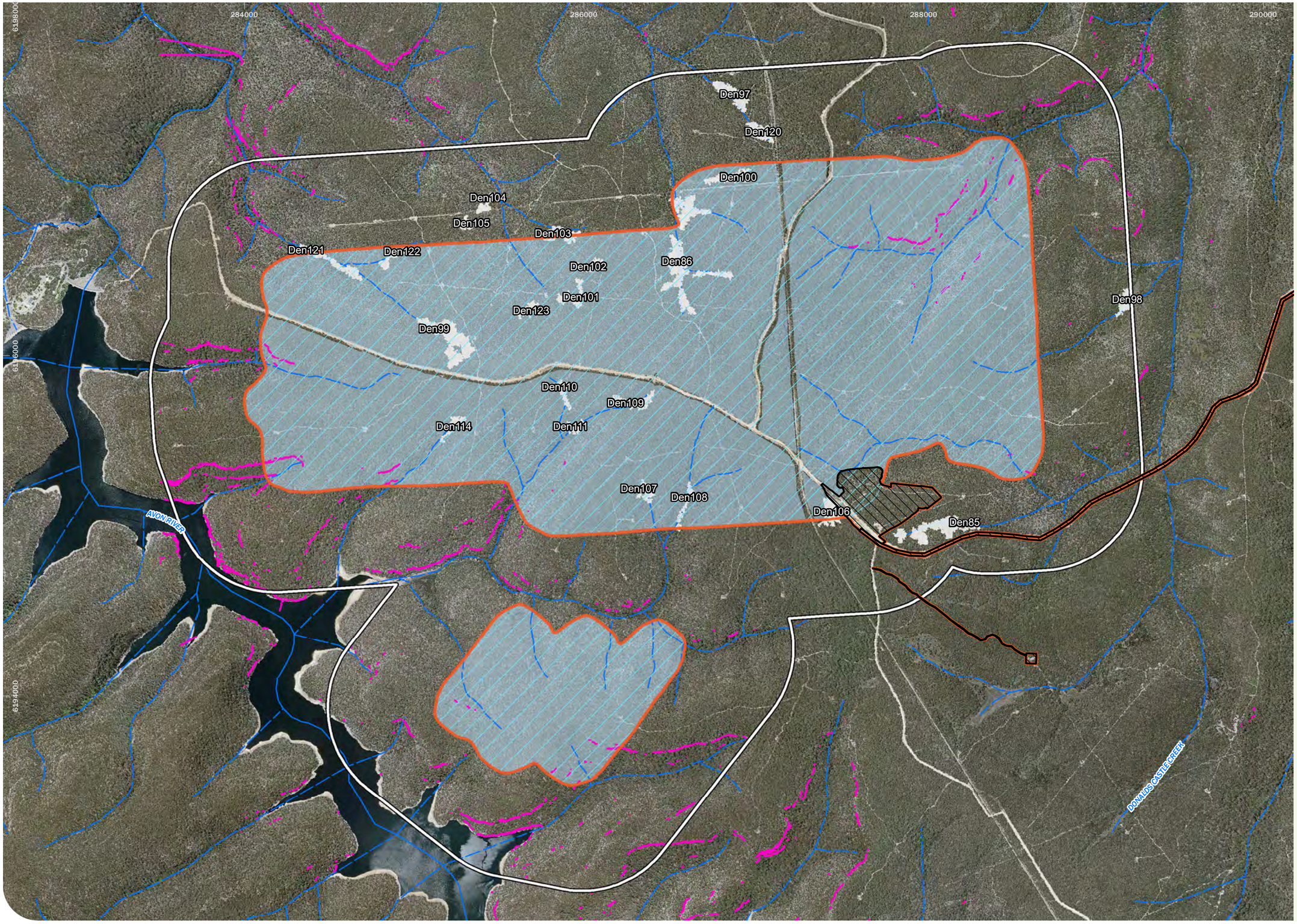
Threatened Fauna Species Polygon – Gang-gang Cockatoo *(Callocephalon fimbriatum)*

Dendrobium Mine Extension Project BDAR

Figure 14a.6

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Beal/YH File: T:\spatial\projects\6600\6624_Dendrobium_BDAR\Mapsforpdf\BDAR6624_Figure_14a_GanggangCockatoo.mxd Last updated: 10-Mar-22 2:04:01 PM



Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Cliffs (MSEC 2021)

Perennial Stream

Non-Perennial Stream

Coastal Upland Swamps

Glossy Black-Cockatoo species polygon

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

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Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

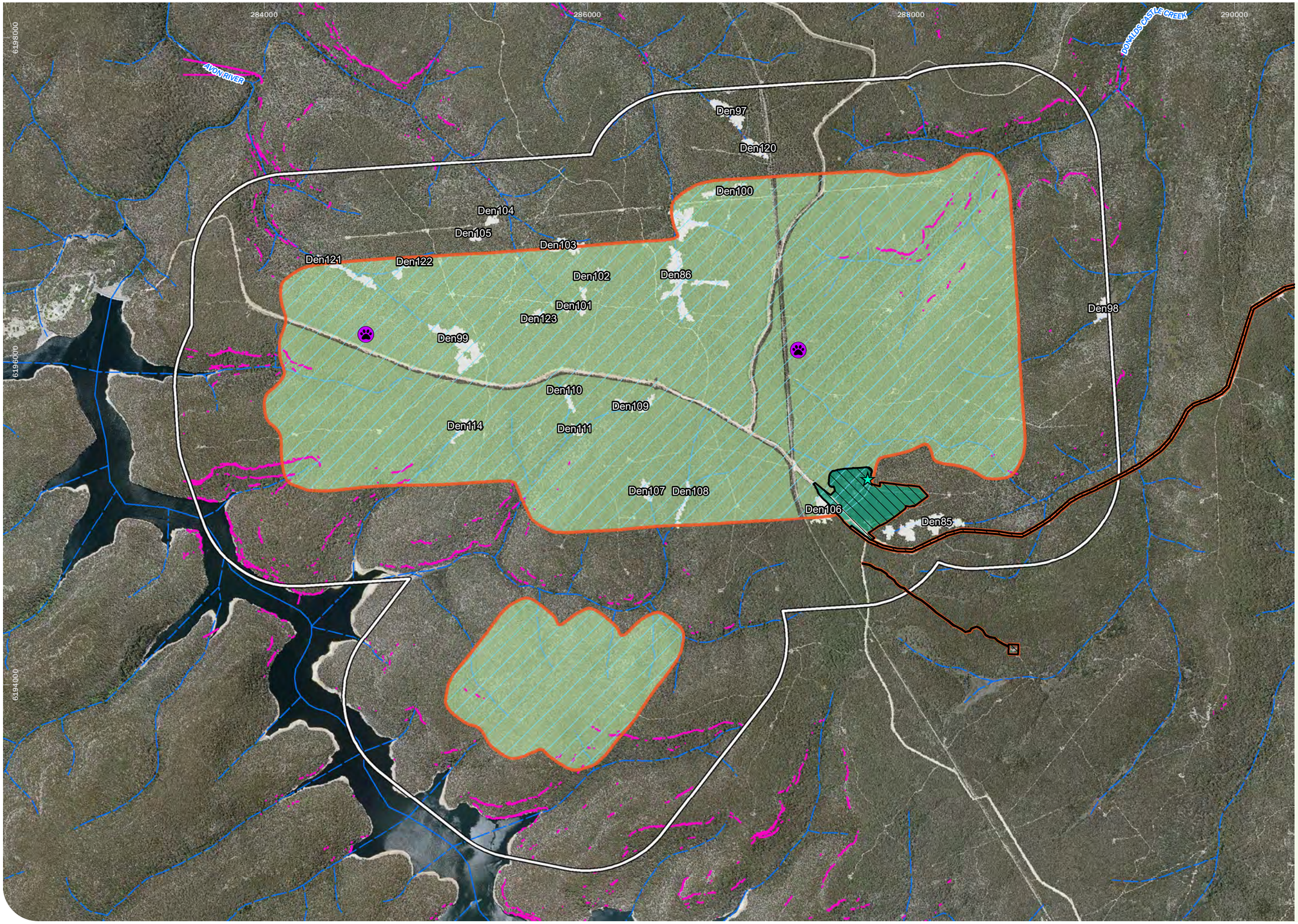
Threatened Fauna Species Polygon – Glossy Black-Cockatoo *(Calyptorhynchus lathami)*

Dendrobium Mine Extension Project BDAR

Figure 14b

Imagery @ Illawarra Coal Dec 2018

Drawn by: Jess Beal/YH File: T:\spatial\projects\ab6600\a6624_Dendrobium_BDAR\Mapsteport\BDAR\6624_Figure_14b_GlossyBlackCockatoo.mxd Last updated: 10-Mar-22 2:05:50 PM



Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Eastern Pygmy-possum (Niche)

Eastern Pygmy-possum (BioNet 2022)*

Cliffs (MSEC 2021)

Perennial Stream

Non-Perennial Stream

Coastal Upland Swamps

Eastern Pygmy-possum species polygon

Eastern Pygmy-possum species polygon - direct impact

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

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GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Species Polygon – Eastern Pygmy-possum *(Cercartetus nanus)*

Dendrobium Mine Extension Project BDAR

Figure 14c.1

Imagery @ Illawarra-Coal Dec 2018

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- Subject Land
- Biodiversity Assessment Development Footprint
- Predicted Extent of Subsidence - 20 mm Subsidence Contour
- Subsidence Assessment Study Area
- Eastern Pygmy-possum (Niche)
- Cliffs (MSEC 2021)
- Non-Perennial Stream
- Coastal Upland Swamps
- Eastern Pygmy-possum species polygon
- Eastern Pygmy-possum species polygon - direct impact

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

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GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Species Polygon – Eastern Pygmy-possum *(Cercartetus nanus)*

Dendrobium Mine Extension Project BDAR

Figure 14c.2

Imagery @ Illawarra Coal Dec 2018

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Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Cliffs (MSEC 2021)

Non-Perennial Stream

Eastern Pygmy-possum species polygon

Eastern Pygmy-possum species polygon - direct impact

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

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GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Species Polygon – Eastern Pygmy-possum *(Cercartetus nanus)*

Dendrobium Mine Extension Project BDAR

Figure 14c.3

Imagery @ Illawarra-Coal Dec 2018

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DONALDS CASTLE CREEK

WONGAWILLI CREEK

- Subject Land
- Biodiversity Assessment Development Footprint
- Subsidence Assessment Study Area
- Cliffs (MSEC 2021)
- Perennial Stream
- Non-Perennial Stream
- Coastal Upland Swamps
- Eastern Pygmy-possum species polygon - direct impact

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

niche Environment and Heritage

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m
GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Species Polygon – Eastern Pygmy-possum *(Cercartetus nanus)*

Dendrobium Mine Extension Project BDAR

Figure 14c.4

Imagery @ Illawarra-Coal Dec 2018

v2.0

Drawn by: Jess Bear/ YH File: T:\spatial\projects\ak6600\ak6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_14c_EasternPygmy.mxd Last updated: 10-Mar-22 3:16:44 PM



Subject Land
Biodiversity Assessment Development Footprint
Eastern Pygmy-possum (Niche)
Cliffs (MSEC 2021)
Perennial Stream
Non-Perennial Stream
Eastern Pygmy-possum species polygon - direct impact

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

niche Environment and Heritage

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GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

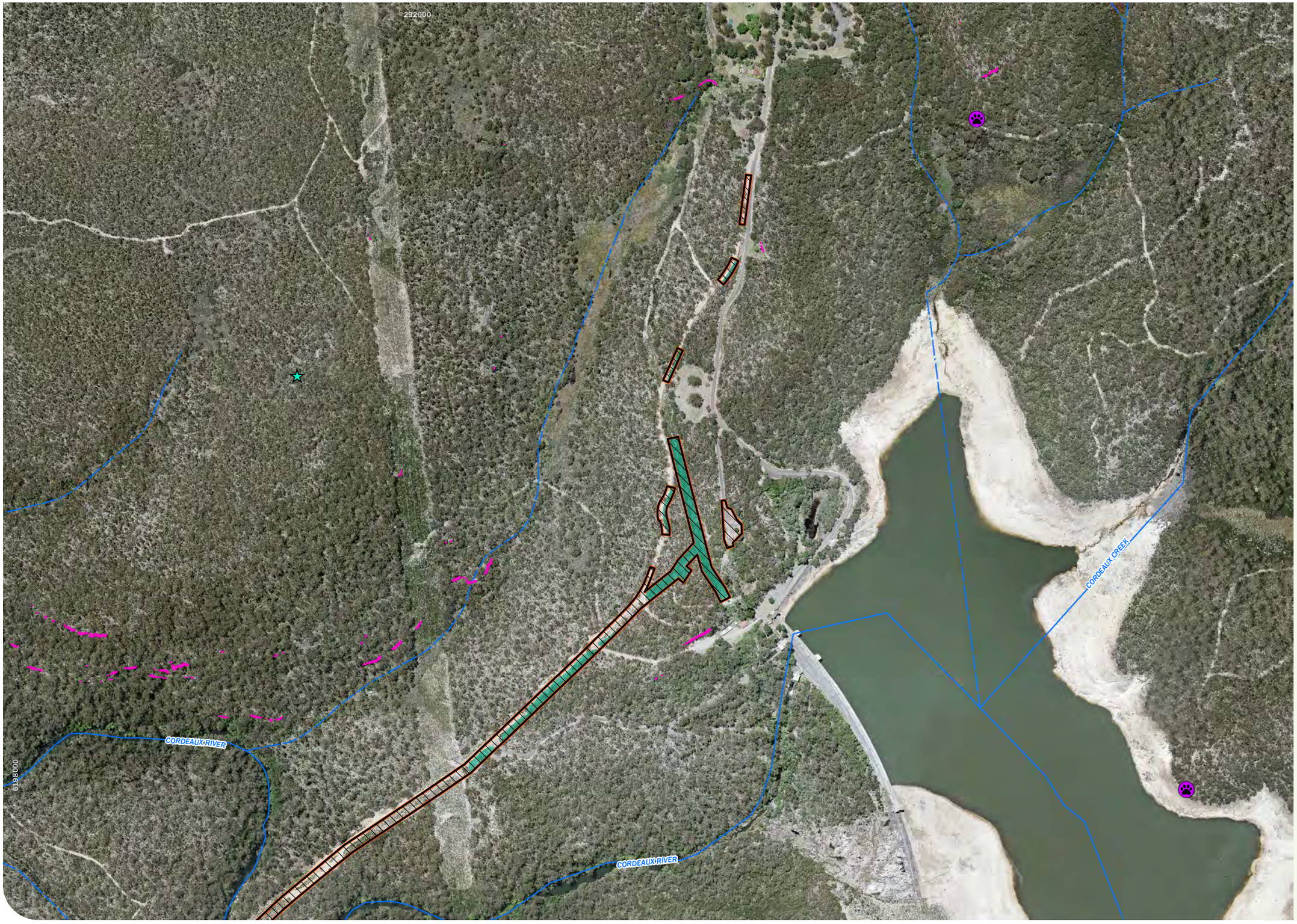
Threatened Fauna Species Polygon – Eastern Pygmy-possum *(Cercartetus nanus)*

Dendrobium Mine Extension Project BDAR

Figure 14c.5

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Bear/YH File: T:\spatial\projects\dbr6600\a6624_Dendrobium_BDAR\Mapsreport\BDAR\6624_Figure_ 14c_EasternPygmy.mxd Last updated: 10-Mar-22 9:16:44 PM



Subject Land

Biodiversity Assessment Development Footprint

Eastern Pygmy-possum (Niche)

Eastern Pygmy-possum (BioNet 2022)*

Cliffs (MSEC 2021)

Perennial Stream

Non-Perennial Stream

Eastern Pygmy-possum species polygon - direct impact

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

niche Environment and Heritage

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m
GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Species Polygon – Eastern Pygmy-possum *(Cercartetus nanus)*

Dendrobium Mine Extension Project BDAR

Figure 14c.6

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Beal/YH File: T:\spatial\projects\6624\6600\a6624_Dendrobium_BDAR\Mapsteport\BDAR\6624_Figure_ 14c_EasternPygmy.mxd Last updated: 10-Mar-22 3:16:44 PM



Subject Land

Biodiversity Assessment Development Footprint

Non-Perennial Stream

Eastern Pygmy-possum species polygon - direct impact

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

niche Environment and Heritage

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m
GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Species Polygon – Eastern Pygmy-possum *(Cercartetus nanus)*

Dendrobium Mine Extension Project BDAR

Figure 14c.7

Imagery @ Illawarra-Coal Dec 2018

v2.0

Drawn by: Jess Bear/ YH File: T:\spatial\projects\ak66\0\ak6624_Dendrobium_BDARMaps\report\BDAR6624_Figure_14c_EasternPygmy.mxd Last updated: 10-Mar-22 3:16:44 PM

282000
284000
286000
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6198000
6196000
6194000
DONALDS CASTLE CREEK
WONGAWILLI CREEK
AVON RIVER
NATIVE DOG CREEK

Subject Land
Biodiversity Assessment Development Footprint
Predicted Extent of Subsidence - 20 mm Subsidence Contour
Subsidence Assessment Study Area
Large-eared Pied Bat (BioNet 2022)*
Cliffs (MSEC 2021)
Perennial Stream
Non-Perennial Stream
Large-eared Pied Bat species polygon

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

niche Environment and Heritage

0 560
m
GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Species Polygon – Large-eared Pied Bat *(Chalinolobus dwyeri)*

Dendrobium Mine Extension Project BDAR

Figure 14d.1

Imagery @ Illawarra-Coal Dec 2018

v2.0

Drawn by: Jess Beer?YH File: T:\spatial\projects\ia6600\a6624_Dendrobium_BDAR\Maps\report\BDAR\a6624_Figure_14d_LargeEaredPiedBat_speciespolygon.mxd Last updated: 1h-Mar-22 2:27:12 PM



Subject Land

Biodiversity Assessment Development Footprint

Non-Perennial Stream

Large-eared Pied Bat species polygon – direct impact

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

niche Environment and Heritage

0 40
m
GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Species Polygon – Large-eared Pied Bat *(Chalinolobus dwyeri)*

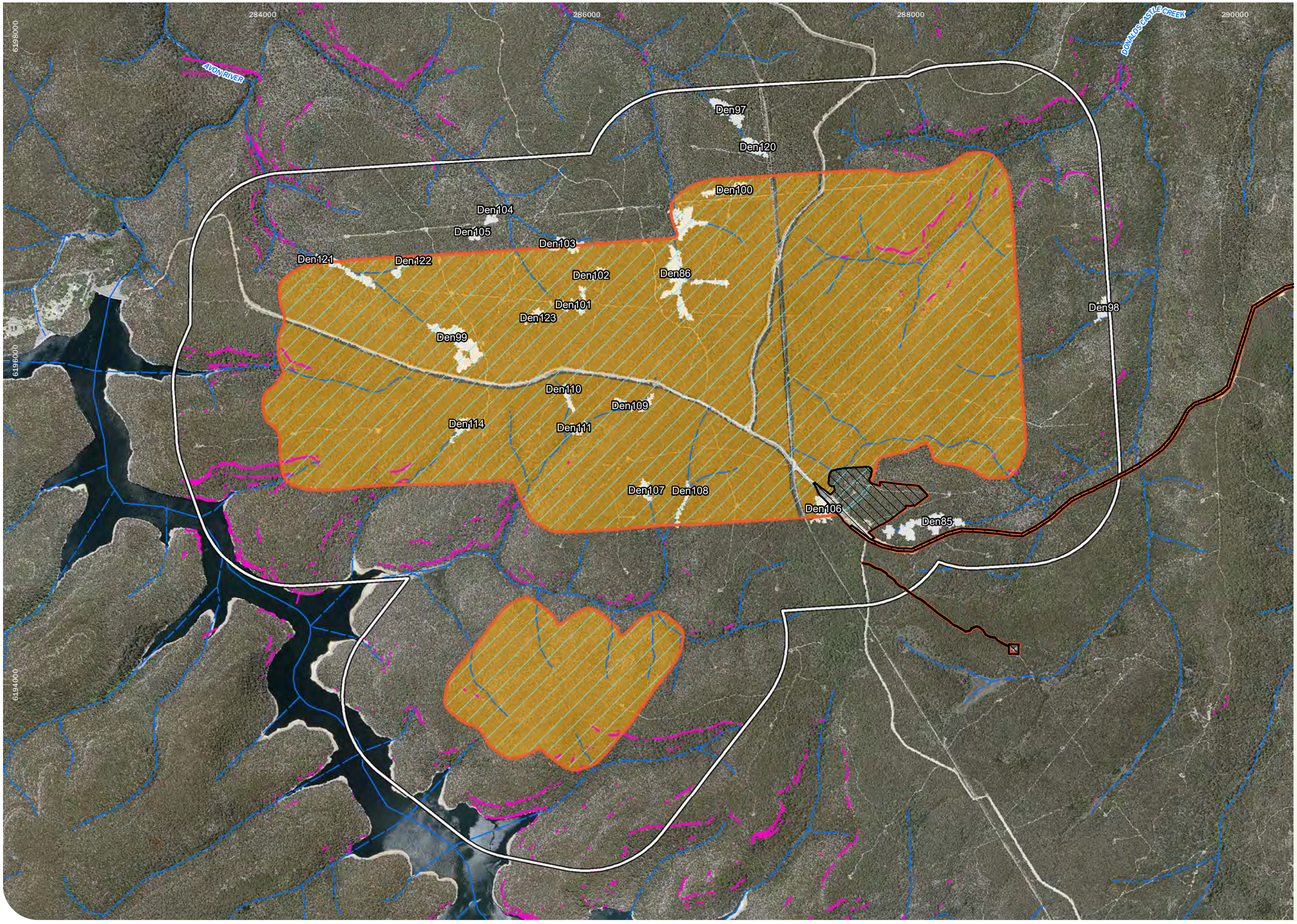
Dendrobium Mine Extension Project BDAR

Figure 14d.2

Imagery @ Illawarra-Coal Dec 2018

v2.0

Drawn by: Jess Beal/YH File: T:\spatial\projects\ab6600\ab624_Dendrobium_BDAR\Mapsreport\BDAR\6624_Figure_14d_LargeearedPiedBat_speciespolygon.mxd Last updated: 1h-Mar-22 2:27:12 PM



Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Cliffs (MSEC 2021)

Perennial Stream

Non-Perennial Stream

Coastal Upland Swamps

White-bellied Sea-Eagle species polygon

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

niche Environment and Heritage

0 500
m
GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Species Polygon – White-bellied Sea-Eagle *(Haliaeetus leucogaster)*

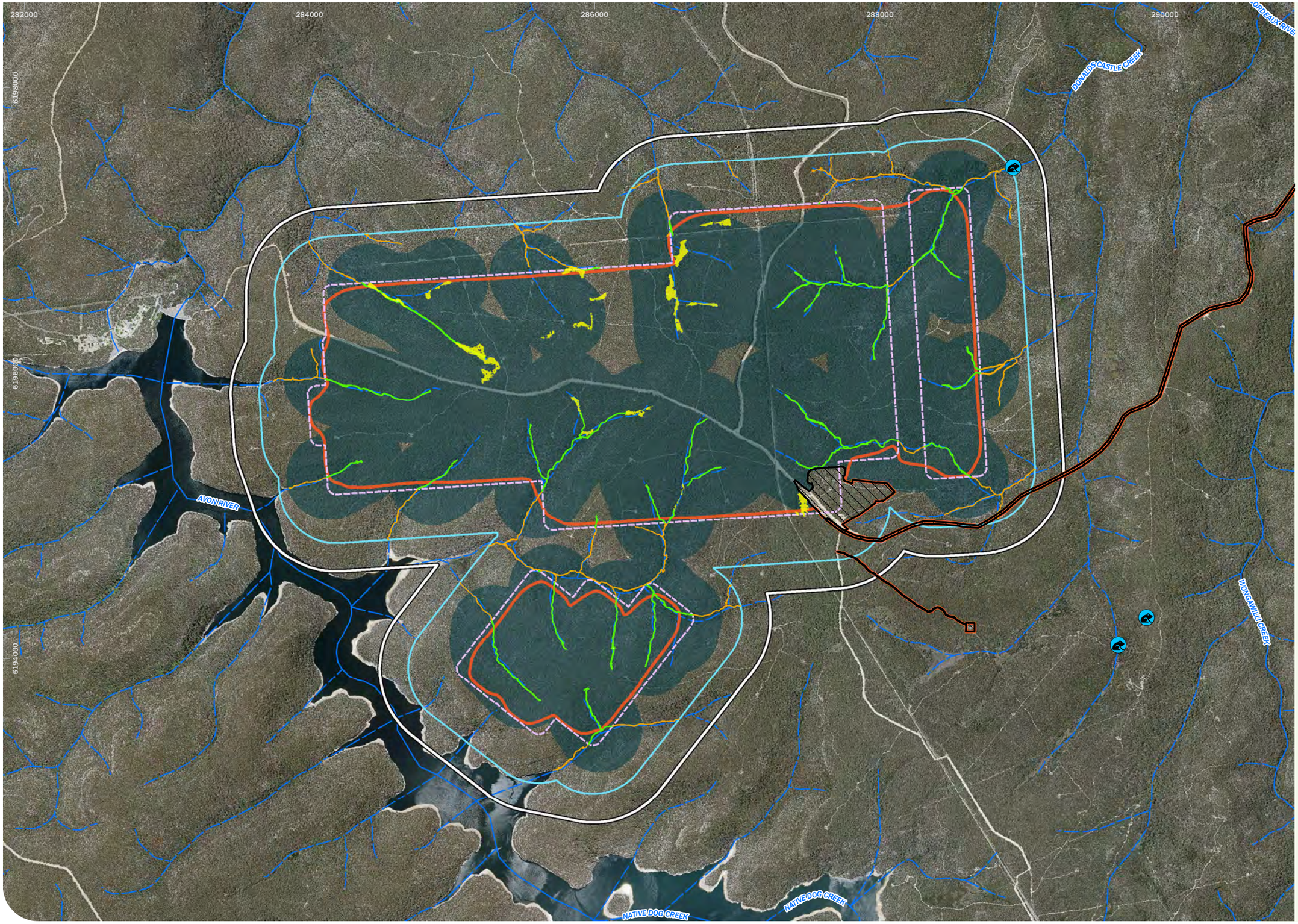
Dendrobium Mine Extension Project BDAR

Sensitive species not displayed*

Figure 14e

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Bear/YH File: T:\spatial\projects\ab6600\a6624_Dendrobium_BDAR\Mapsteport\BDAR\6624_Figure_14e_White_bellied_sea_eagle.mxd Last updated: 10-Mar-22 2:29:11 PM



*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

niche Environment and Heritage

0 500
m
GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Spec ies Polygon – Giant Burrowing Frog (*Heleioporus australiacus*)

Dendrobium Mine Extension Project BDAR

Figure 14f.1

Imagery @ Illawarra-Coal Dec 2018

v2.0

Drawn by: Jes s Bear/YH File: T:\spatial\projects\ad6600\ad6624_Dendrobium_BDARMaps\report\BDAR\6624_Figure_14f_GiantBurrowingFrog.mxd Last updated: 10-Mar-22 2:37:01 PM

6196000

288000

- Subject Land
- Biodiversity Assessment Development Footprint
- Subsidence Assessment Study Area
- Non-Perennial Stream
- Proposed Longwalls with 60 m boundary
- Proposed Longwalls with 400 m boundary
- Giant Burrowing Frog species polygon
- Giant Burrowing Frog potential indiect impact (refer to section 4 of BDAR)
- Swamps 60m
- Watercourses 60m
- Watercourses 400m

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

niche Environment and Heritage

0 100
m
GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Spec ies Polygon – Giant Burrowing Frog (*Heleioporus australiacus*)

Dendrobium Mine Extension Project BDAR

Figure 14f.2

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Beer/YH File: T:\spatial\projects\6600\6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_14f_GiantBurrowingFrog.mxd Last updated: 10-Mar-22 2:37:01 PM



- Subject Land
- Biodiversity Assessment Development Footprint
- Subsidence Assessment Study Area
- Perennial Stream
- Non-Perennial Stream
- Proposed Longwalls with 60 m boundary
- Proposed Longwalls with 400 m boundary
- Giant Burrowing Frog species polygon
- Giant Burrowing Frog potential indiect impact (refer to section 4 of BDAR)
- Watercourses 60m
- Watercourses 400m

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

niche Environment and Heritage

0 100
m
GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Spec ies Polygon – Giant Burrowing Frog (*Heleioporus australiacus*)

Dendrobium Mine Extension Project BDAR

Figure 14f.3

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Bear/YH File: T:\spatial\projects\ad6600\ad6624_Dendrobium_BDARMaps\report\BDAR\6624_Figure_14f_GiantBurrowingFrog.mxd Last updated: 10-Mar-22 2:37:01 PM

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DONALDS CASTLE CREEK

WONGAWILLI CREEK

Subject Land

Biodiversity Assessment Development Footprint

Subsidence Assessment Study Area

Perennial Stream

Non-Perennial Stream

Proposed Longwalls with 400 m boundary

Giant Burrowing Frog species polygon

Giant Burrowing Frog potential indiect impact (refer to section 4 of BDAR)

Watercourses 400m

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

niche Environment and Heritage

0 100
m
GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Spec ies Polygon – Giant Burrowing Frog (*Heleioporus australiacus*)

Dendrobium Mine Extension Project BDAR

Figure 14f.4

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Bear Y:\ File: T:\spatial\projects\da6600\a6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_14f_GiantBurrowingFrog.mxd Last updated: 10-Mar-22 2:37:01 PM

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AVON RIVER
DONALDS CASTLE CREEK

Subject Land
Biodiversity Assessment Development Footprint
Predicted Extent of Subsidence - 20 mm Subsidence Contour
Subsidence Assessment Study Area
Cliffs (MSEC 2021)
Perennial Stream
Non-Perennial Stream
Coastal Upland Swamps
Little Eagle species polygon

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

niche Environment and Heritage

0 400
m
GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Species Polygon – Little Eagle *(Hieraaetus morphnoides)*

Dendrobium Mine Extension Project BDAR

Figure 14g

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Bear/YH File: T:\spatial\projects\ia6600\a6624_Dendrobium_BDAR\Mapsteport\BDAR\6624_Figure_14g_little_eagle.mxd Last updated: 10-Mar-22 2:40:19 PM

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Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Broad-headed Snake species polygon – see BDAR for detailed impact assessment

MSEC (2021) Cliffs and Steep Slope Mapping

Steep Slopes gradient greater than 1in1.5 to 2

Steep Slopes gradient 1in3 to 1in1

Steep Slopes gradient 1in2 to 1in1.5

Steep Slopes gradient 1in1.5 to 1.1

Cliffs

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

niche Environment and Heritage

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m
GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

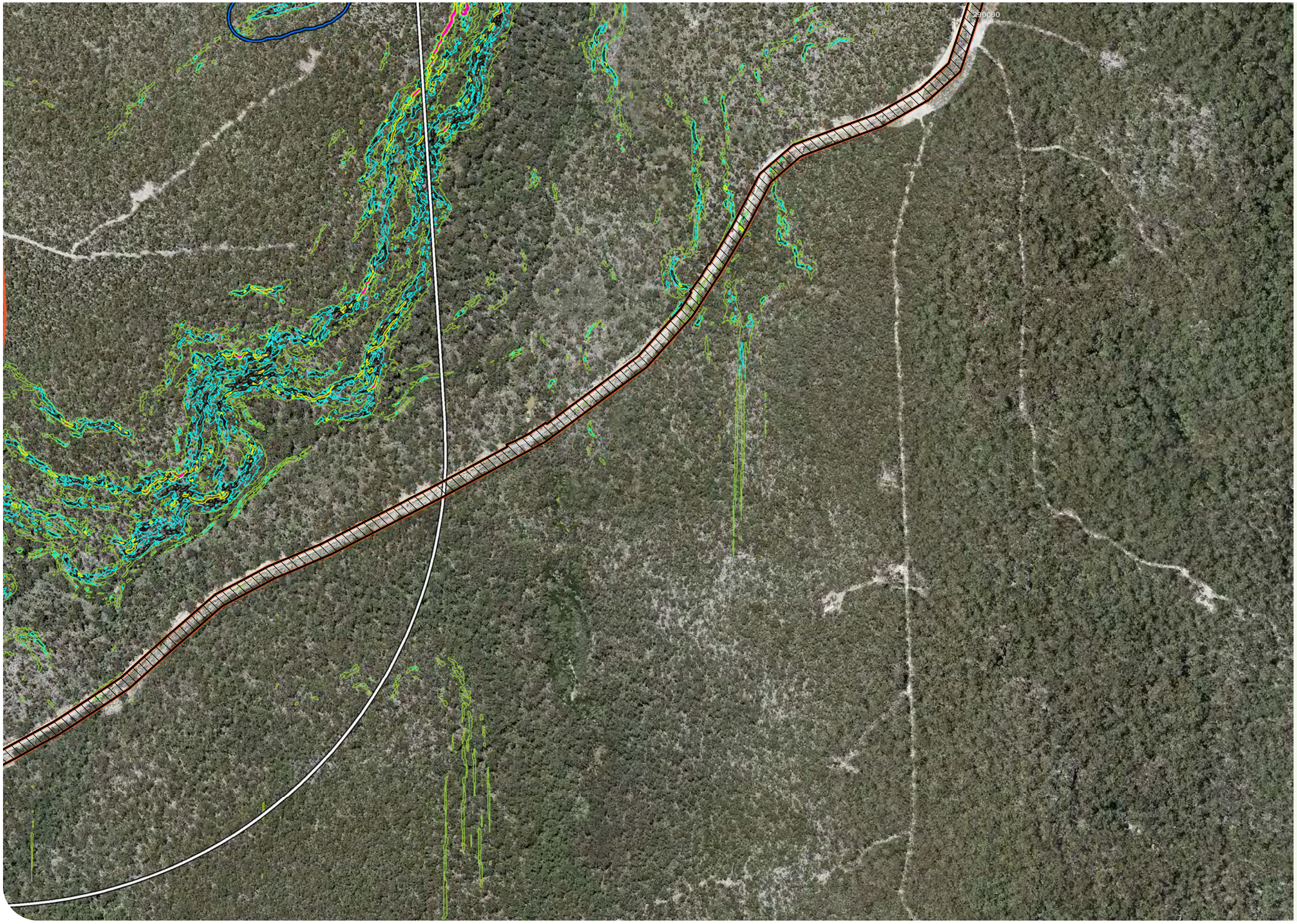
Threatened Fauna Species Polygon – Broad-headed Snake *(Hoplocephalus bungaroides)*

Dendrobium Mine Extension Project BDAR

Figure 14h.1

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Bear/YH File: T:\spatial\projects\ia6600\a6624_Dendrobium_BDAR\Mapsteport\BDAR\6624_Figure_14_BroadheadedSnake.mxd Last updated: 10-Mar-22 2:56:03 PM



Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Broad-headed Snake species polygon – see BDAR for detailed impact assessment

MSEC (2021) Cliffs and Steep Slope Mapping

Steep Slopes gradient greater than 1in1.5 to 2

Steep Slopes gradient 1in3 to 1in1

Steep Slopes gradient 1in2 to 1in1.5

Steep Slopes gradient 1in1.5 to 1.1

Cliffs

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

niche Environment and Heritage

0 100
m
GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Species Polygon – Broad-headed Snake *(Hoplocephalus bungaroides)*

Dendrobium Mine Extension Project BDAR

Figure 14h.2

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Beer/YH File: T:\spatial\projects\6600\6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_14_BroadheadedSnake.mxd Last updated: 10-Mar-22 2:56:03 PM

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6136000

Subject Land

Biodiversity Assessment Development Footprint

Subsidence Assessment Study Area

Broad-headed Snake species polygon – see BDAR for detailed impact assessment

MSEC (2021) Cliffs and Steep Slope Mapping

Steep Slopes gradient greater than 1in1.5 to 2

Steep Slopes gradient 1in3 to 1in1

Steep Slopes gradient 1in2 to 1in1.5

Steep Slopes gradient 1in1.5 to 1.1

Cliffs

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

niche Environment and Heritage

0 100
m
GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Species Polygon – Broad-headed Snake *(Hoplocephalus bungaroides)*

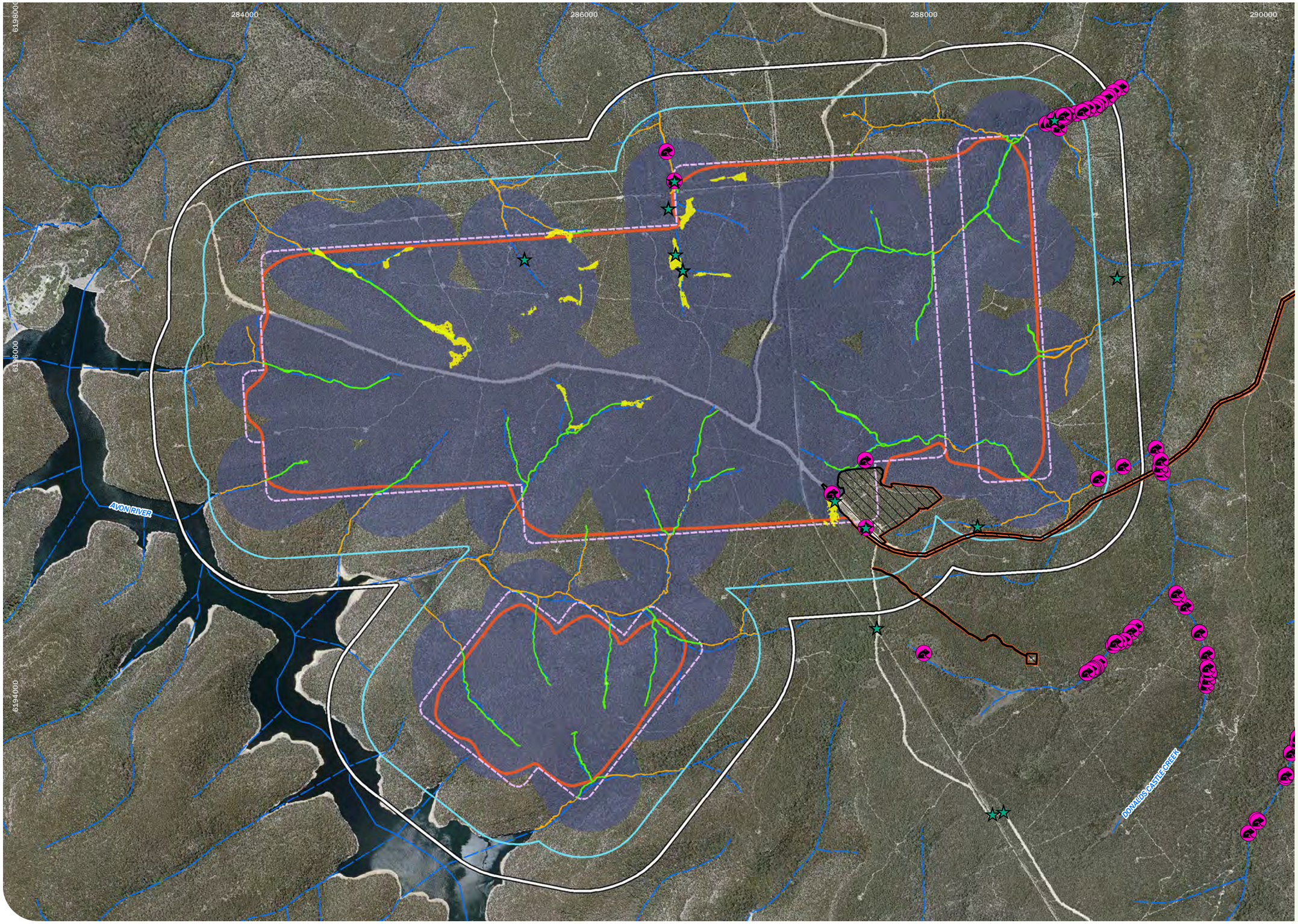
Dendrobium Mine Extension Project BDAR

Figure 14h.3

Imagery @ Illawarra-Coal Dec 2018

v2.0

Drawn by: Jess Bear/ Yif File: T:\spatial\projects\ak6600\a6624_Dendrobium_BDAR\Maps\report\BDAR6624_Figure_14_BroadheadedSnake.mxd Last updated: 10-Mar-22 2:56:03 PM



Subject Land

Biodiversity Assessment Development Footprint

Subsidence Assessment Study Area

Littlejohn's Tree Frog (BioNet 2022)*

Littlejohn's Tree Frog (Niche)

Perennial Stream

Non-Perennial Stream

Proposed Longwalls with 60 m boundary

Proposed Longwalls with 400 m boundary

Littlejohn's Tree Frog species polygon

Littlejohn's Tree Frog potential indirect impact (refer to section 4 of BDAR)

Swamps 60m

Watercourses 60m

Watercourses 400m

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

niche Environment and Heritage

0 400
m
GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Spec ies Polygon – Littlejohn's Tree Frog (*Litoria littlejohni*)

Dendrobium Mine Extension Project BDAR

Figure 14i.1

Imagery @ Illawarra-Coal Dec 2018

v2.0

Drawn by: Jes s Bear/YH File: T:\spatial\projects\a6600\a6624_Dendrobium_BDARMaps\report\BDAR\6624_Figure_14i_LittlejohnsTreeFrog.mxd Last updated: 10-Mar-22 2:45:16 PM

288000

- Subject Land
- Biodiversity Assessment Development Footprint
- Subsidence Assessment Study Area
- Littlejohn's Tree Frog (BioNet 2022)*
- Littlejohn's Tree Frog
- Non-Perennial Stream
- Proposed Longwalls with 60 m boundary
- Proposed Longwalls with 400 m boundary
- Littlejohn's Tree Frog species polygon
- Littlejohn's Tree Frog potential indirect impact (refer to section 4 of BDAR)
- Swamps 60m
- Watercourses 60m
- Watercourses 400m

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

niche Environment and Heritage

0 100
m
GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Spec ies Polygon – Littlejohn's Tree Frog (*Litoria littlejohni*)

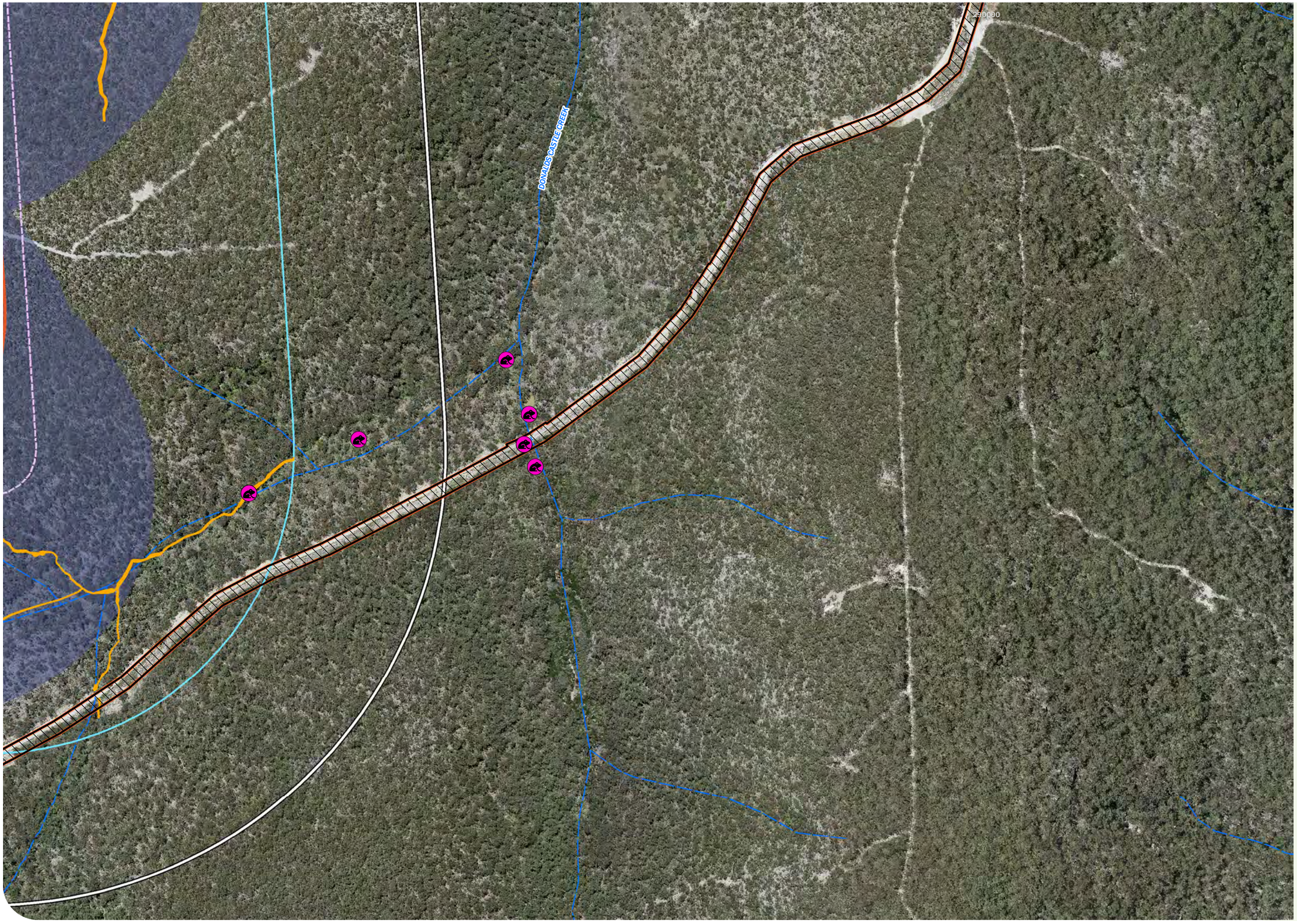
Dendrobium Mine Extension Project BDAR

Figure 14i.2

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Bear/ YH File: T:\spatial\projects\ak6600\a6624_Dendrobium_BDAR\Maps\report\BDAR6624_Figure_14i_LittlejohnsTreeFrog.mxd Last updated: 10-Mar-22 2:45:16 PM

v2.0



Subject Land

Biodiversity Assessment Development Footprint

Subsidence Assessment Study Area

Littlejohn's Tree Frog (BioNet 2022)*

Non-Perennial Stream

Proposed Longwalls with 60 m boundary

Proposed Longwalls with 400 m boundary

Littlejohn's Tree Frog species polygon

Littlejohn's Tree Frog potential indirect impact (refer to section 4 of BDAR)

Watercourses 400m

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

niche Environment and Heritage

0 100
m
GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Spec ies Polygon – Littlejohn's Tree Frog (*Litoria littlejohni*)

Dendrobium Mine Extension Project BDAR

Figure 14i.3

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Bear/YH File: T:\spatial\projects\ab6600\a6624_Dendrobium_BDAR\Maps\report\BDAR6624_Figure_14i_LittlejohnsTreeFrog.mxd Last updated: 10-Mar-22 2:45:16 PM

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DONALDS CASTLE CREEK

- Subject Land
- Biodiversity Assessment Development Footprint
- Subsidence Assessment Study Area
- Littlejohn's Tree Frog
- Perennial Stream
- Non-Perennial Stream
- Proposed Longwalls with 400 m boundary
- Littlejohn's Tree Frog potential indirect impact (refer to section 4 of BDAR)
- Watercourses 400m

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

niche Environment and Heritage

0 100
m
GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Spec ies Polygon – Littlejohn's Tree Frog (*Litoria littlejohni*)

Dendrobium Mine Extension Project BDAR

Figure 14i.4

Imagery @ Illawarra-Coal Dec 2018

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Drawn by: Jess Bear/YH File: T:\spatial\projects\ak6600\ak6624_Dendrobium_BDAR\Maps\report\BDAR6624_Figure_14i_LittlejohnsTreeFrog.mxd Last updated: 10-Mar-22 2:45:16 PM



Subject Land

Biodiversity Assessment Development Footprint

Littlejohn's Tree Frog (BioNet 2022)*

Littlejohn's Tree Frog

Perennial Stream

Non-Perennial Stream

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

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GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

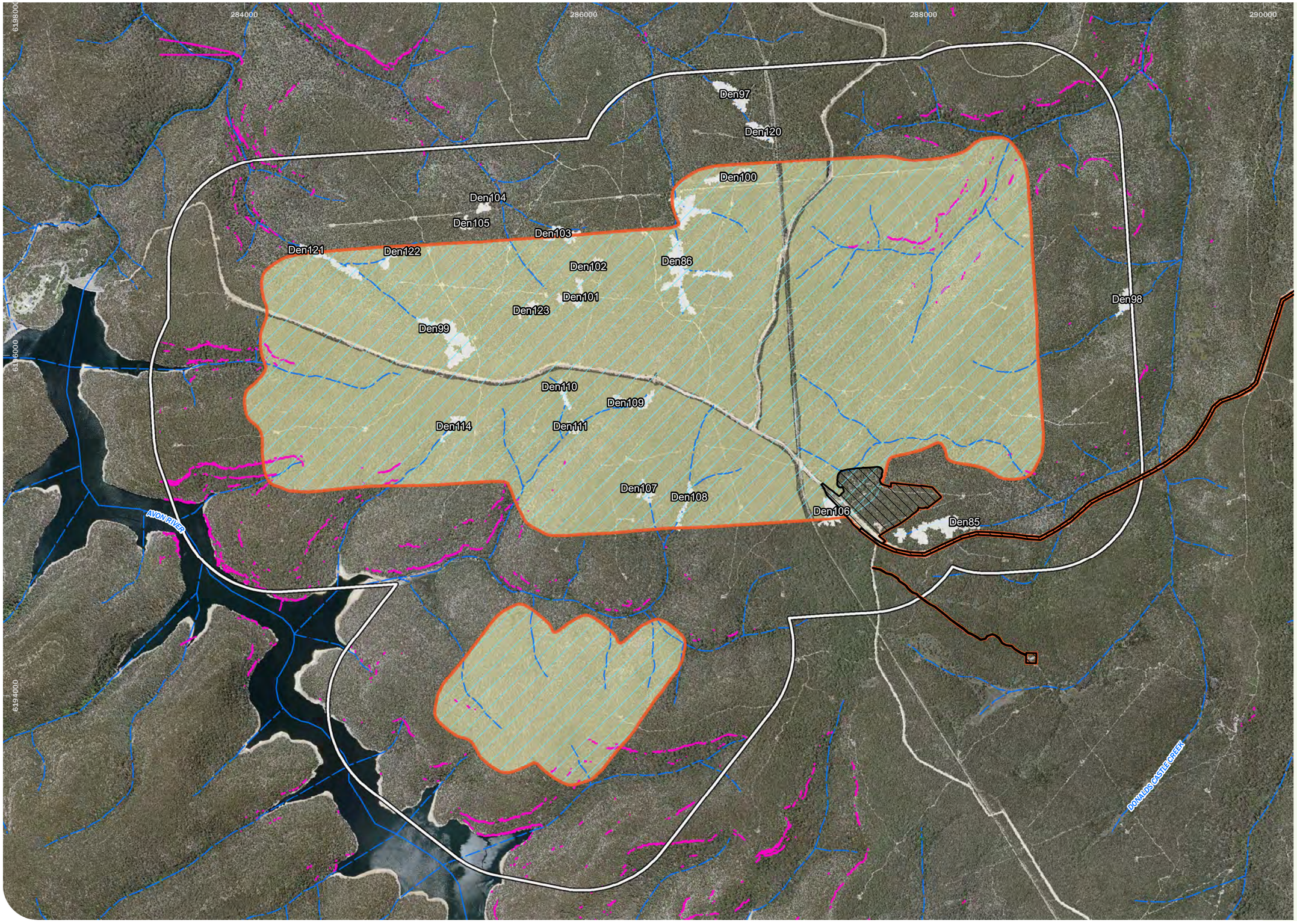
Threatened Fauna Spec ies Polygon – Littlejohn's Tree Frog (*Litoria littlejohni*)

Dendrobium Mine Extension Project BDAR

Figure 14i.5

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Beal/YH File: T:\spatial\projects\ab6600\a6624_Dendrobium_BDAR\Mapsreport\BDAR\6624_Figure_ 14i_LittlejohnsTreeFrog.mxd Last updated: 10-Mar-22 2:45:16 PM



Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Cliffs (MSEC 2021)

Perennial Stream

Non-Perennial Stream

Coastal Upland Swamps

Square tailed kite species polygon

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

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Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

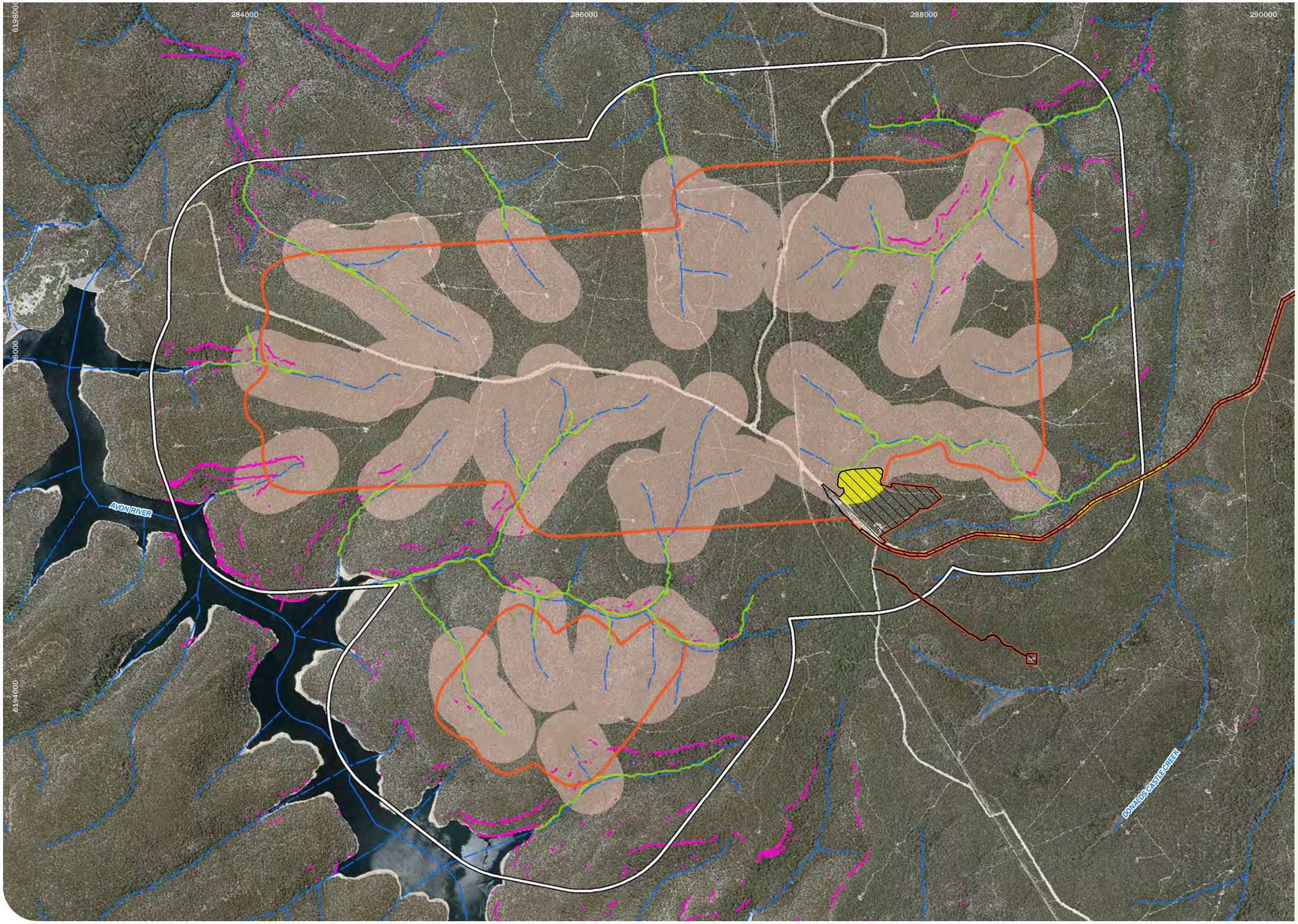
Threatened Fauna Species Polygon – Square-tailed Kite *(Lophoictinia isura)*

Dendrobium Mine Extension Project BDAR

Figure 14j

Imagery @ Illawarra Coal Dec 2018

Drawn by: Jess Bear/YH File: T:\spatial\projects\ia6600\a6624_Dendrobium_BDAR\Mapsteport\BDAR\Figure 14j Square tailed Kite.mxd Last updated: 11-Mar-22 4:26:12 PM



Subject Land

Biodiversity Assessment Development Footprint

Subsidence Assessment Study Area

Cliffs (MSEC 2021)

Perennial Stream

Non-Perennial Stream

Southern Myotis species polygon

Southern Myotis species polgyon - direct impact

Southern Myotis species polygon - potential indirect impact

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

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GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Spec ies Polygon – Southern Myotis (*Myotis macropus*)

Dendrobium Mine Extension Project BDAR

Figure 14k.1

Imagery @ Illawarra-Coal Dec 2018

v2.0

Drawn by: Jess Bear/YH File: T:\spatial\projects\ak660\a6624_Dendrobium_BDAR\Maps\report\BDAR6624_Figure_14k_SouthernMyotis.mxd Last updated: 10-Mar-22 2:58:20 PM

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Subject Land

Biodiversity Assessment Development Footprint

Subsidence Assessment Study Area

Cliffs (MSEC 2021)

Non-Perennial Stream

Southern Myotis species polygon

Southern Myotis species polgyon - direct impact

Southern Myotis species polygon - potential indirect impact

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

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GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Spec ies Polygon – Southern Myotis (*Myotis macropus*)

Dendrobium Mine Extension Project BDAR

Figure 14k.2

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Bear/YH File: T:\spatial\projects\ia6600\a6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_14k_SouthernMyotis.mxd Last updated: 10-Mar-22 2:58:20 PM



- Subject Land
- Biodiversity Assessment Development Footprint
- Subsidence Assessment Study Area
- Cliffs (MSEC 2021)
- Non-Perennial Stream
- Southern Myotis species polygon
- Southern Myotis species polgyon - direct impact
- Southern Myotis species polygon - potential indirect impact

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

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GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Spec ies Polygon – Southern Myotis (*Myotis macropus*)

Dendrobium Mine Extension Project BDAR

Figure 14k.3

Imagery @ Illawarra-Coal Dec 2018

v2.0

Drawn by: Jess Bear/ YH File: T:\spatial\projects\ak6600\ak6624_Dendrobium_BDAR\Maps\report\BDAR6624_Figure_14k_SouthernMyotis.mxd Last updated: 10-Mar-22 2:58:20 PM

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DONALDS CASTLE CREEK

Subject Land

Biodiversity Assessment Development Footprint

Subsidence Assessment Study Area

Cliffs (MSEC 2021)

Perennial Stream

Non-Perennial Stream

Southern Myotis species polygon - potential indirect impact

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

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GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Spec ies Polygon – Southern Myotis (*Myotis macropus*)

Dendrobium Mine Extension Project BDAR

Figure 14k.4

Imagery @ Illawarra-Coal Dec 2018

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Drawn by: Jess Bear/ YH File: T:\spatial\projects\ak6600\ak6624_Dendrobium_BDAR\Maps\report\BDAR6624_Figure_14k_SouthernMyotis.mxd Last updated: 10-Mar-22 2:58:20 PM



Subject Land

Biodiversity Assessment Development Footprint

Cliffs (MSEC 2021)

Perennial Stream

Non-Perennial Stream

Southern Myotis (BioNet 2022)*

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

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GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

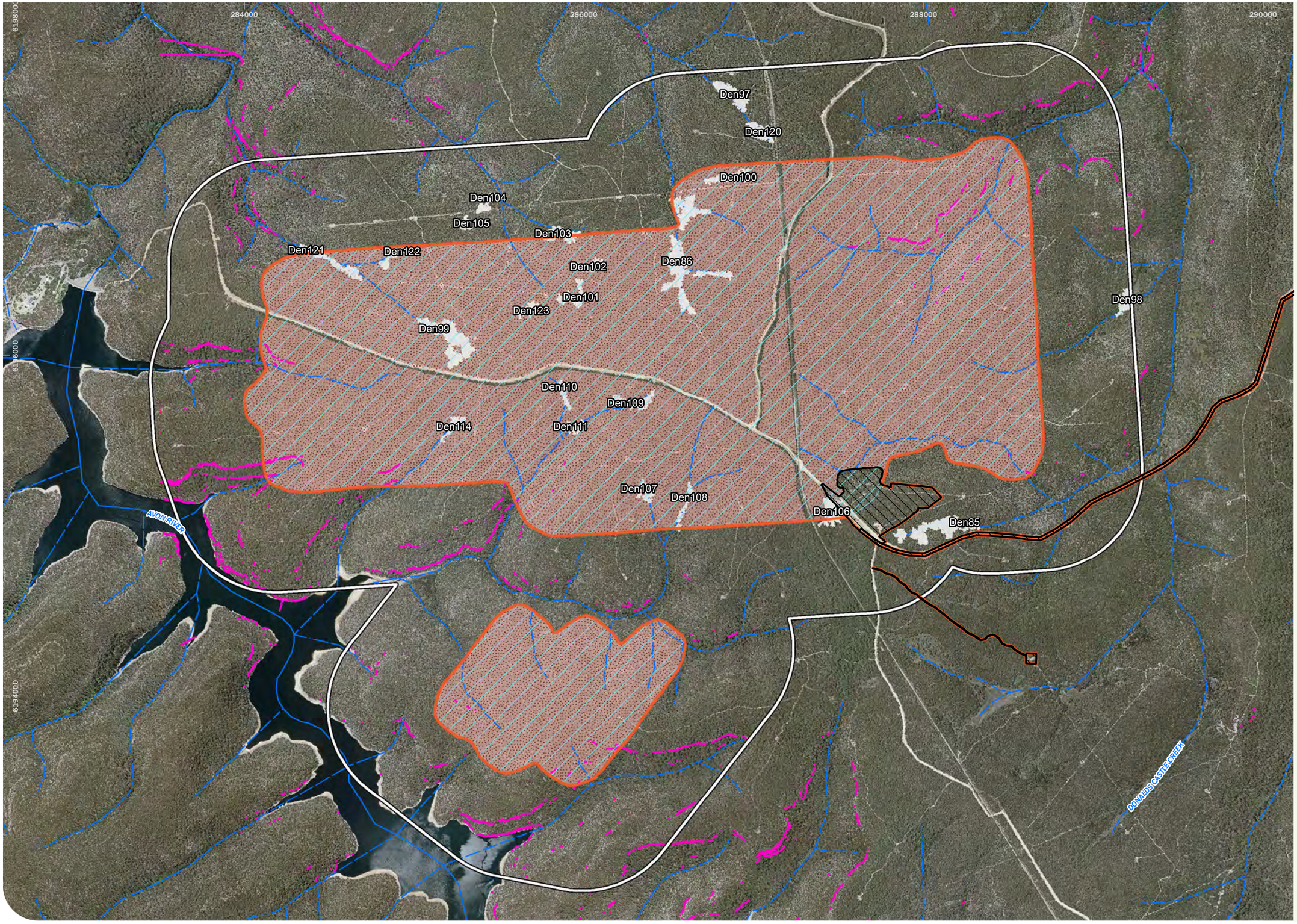
Threatened Fauna Spec ies Polygon – Southern Myotis (*Myotis macropus*)

Dendrobium Mine Extension Project BDAR

Figure 14k.5

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Beal/YH File: T:\spatial\projects\ab6600\a6624_Dendrobium_BDAR\Mapsreport\BDAR\6624_Figure_14k_SouthernMyotis.mxd Last updated: 10-Mar-22 2:58:20 PM



Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Cliffs (MSEC 2021)

Perennial Stream

Non-Perennial Stream

Coastal Upland Swamps

Powerful Owl species polygon

Greater Glider species polygon

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

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Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

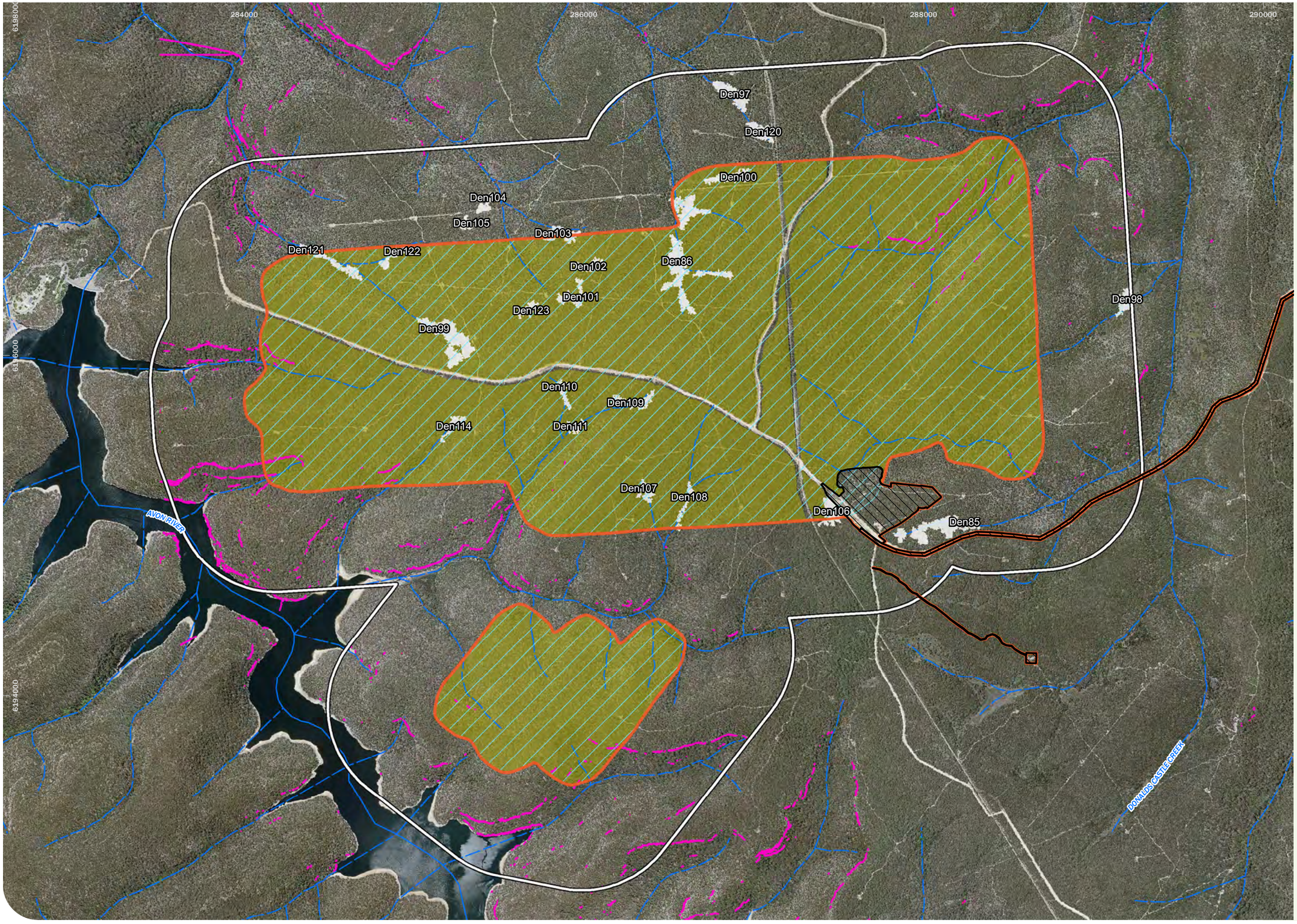
Threatened Fauna Species Polygon – Powerful Owl *(Ninox strenua)*, Greater Glider *(Petauroides volans)*

Dendrobium Mine Extension Project BDAR

Figure 14l

Imagery @ Illawarra Coal Dec 2018

Drawn by: Jess Beal/YH File: T:\spatial\projects\ab6600\a6624_Dendrobium_BDAR\Mapsteport\BDAR\6624_Figure_14l_Powerful_Owl.mxd Last updated: 11-Mar-22 3:08:22 PM



Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Cliffs (MSEC 2021)

Perennial Stream

Non-Perennial Stream

Coastal Upland Swamps

Eastern Osprey species polygon

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

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GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Species Polygon – Eastern Osprey *(Pandion cristatus)*

Dendrobium Mine Extension Project BDAR

Figure 14m

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Beal/YH File: T:\spatial\projects\ab6600\a6624_Dendrobium_BDAR\Mapsteport\BDAR\6624_Figure_14m_Eastern_Osprey.mxd Last updated: 10-Mar-22 5:01:11 PM

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Den85

AVON RIVER
LAKE AVON
DONALDS CASTLE CREEK

Subject Land
Biodiversity Assessment Development Footprint
Predicted Extent of Subsidence - 20 mm Subsidence Contour
Subsidence Assessment Study Area
Giant Dragonfly (BioNet 2022)*
Cliffs (MSEC 2021)
Perennial Stream
Non-Perennial Stream
Waterbody
Coastal Upland Swamps

Giant Dragonfly species polygon - see BDAR for detailed impact assessment

Potential Breeding and Foraging
Potential Foraging
No Habitat

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

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Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

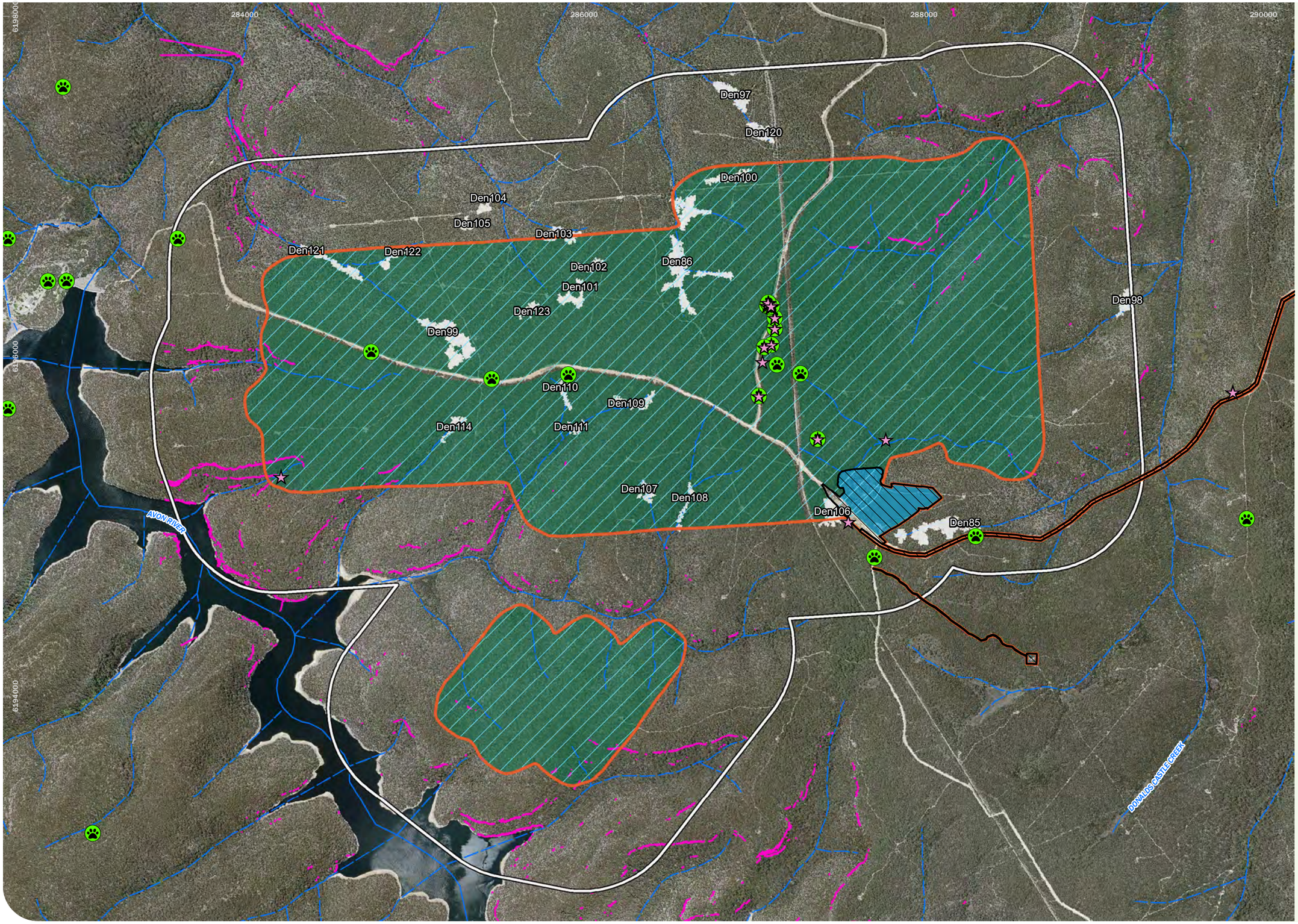
Threatened Fauna Species Polygon – Giant Dragonfly *(Petalura gigantea)*

Dendrobium Mine Extension Project BDAR

Figure 14n

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Beal/YH File: T:\spatial\projects\ia6600\a6624_Dendrobium_BDAR\Mapsteport\BDAR\6624_Figure_14n_GiantDragonfly.mxd Last updated: 10-Mar-22 3:02:06 PM



Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Koala (Niche)

Koala (BioNet

Cliffs (MSEC

Perennial Stream

Non-Perennial Stream

Coastal Upland Swamps

Koala species polygon

Koala species polygon - direct impact

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

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GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Species Polygon – Koala *(Phascolarctos cinereus)*

Dendrobium Mine Extension Project BDAR

Figure 14o.1

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jes s Bear/YH File: T:\spatial\projects\a6600\a6624_Dendrobium_BDAR\Maps\report\BDAR6624_Figure_14o_Koala.mxd Last updated: 10-Mar-22 9:02:58 PM

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- Subject Land
- Biodiversity Assessment Development Footprint
- Predicted Extent of Subsidence - 20 mm Subsidence Contour
- Subsidence Assessment Study Area
- Koala (Niche)
- Koala (BioNet
- Cliffs (MSEC
- Non-Perennial Stream
- Coastal Upland Swamps
- Koala species polygon
- Koala species polygon - direct impact

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
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GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Species Polygon – Koala *(Phascolarctos cinereus)*

Dendrobium Mine Extension Project BDAR

Figure 14o.2

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jes Bear/YH File: T:\spatial\projects\ad660\ba6624_Dendrobium_BDAR\Maps\report\BDAR6624_Figure_14o_Koala.mxd Last updated: 10-Mar-22 15:02:58 PM



Subject Land
Biodiversity Assessment Development Footprint
Predicted Extent of Subsidence - 20 mm Subsidence Contour
Subsidence Assessment Study Area
Koala (Niche)
Koala (BioNet
Cliffs (MSEC
Non-Perennial Stream
Koala species polygon
Koala species polygon - direct impact

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

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GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Species Polygon – Koala *(Phascolarctos cinereus)*

Dendrobium Mine Extension Project BDAR

Figure 14o.3

Imagery @ Illawarra Coal Dec 2018

Drawn by: Jess Bear/YH File: T:\spatial\projects\ab6600\a6624_Dendrobium_BDAR\Maps\report\BDAR6624_Figure_14o_Koala.mxd Last updated: 10-Mar-22, 3:02:58 PM



- Subject Land
- Biodiversity Assessment Development Footprint
- Subsidence Assessment Study Area
- Koala (Niche)
- Cliffs (MSEC
- Perennial Stream
- Non-Perennial Stream
- Coastal Upland Swamps
- Koala species polygon - direct impact

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

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GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Species Polygon – Koala *(Phascolarctos cinereus)*

Dendrobium Mine Extension Project BDAR

Figure 14o.4

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Beal/YH File: T:\spatial\projects\ab6600\a6624_Dendrobium_BDAR\Mapsreport\BDAR\6624_Figure_14o_Koala.mxd Last updated: 10-Mar-22 9:02:58 PM



Subject Land

Biodiversity Assessment Development Footprint

Koala (Niche)

Koala (BioNet 2022)*

Cliffs (MSEC 2021)

Perennial Stream

Non-Perennial Stream

Koala species polygon - direct impact

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

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GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Species Polygon – Koala *(Phascolarctos cinereus)*

Dendrobium Mine Extension Project BDAR

Figure 14o.5

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Bear/YH File: T:\spatial\projects\ia6600\a6624_Dendrobium_BDAR\Mapsreport\BDAR\a6624_Figure_14o_Koala.mxd Last updated: 10-Mar-22 3:02:58 PM

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CORDEAUX RIVER

CORDEAUX CREEK

CORDEAUX RIVER

- Subject Land
- Biodiversity Assessment Development Footprint
- Koala (Niche)
- Koala (BioNet
- Cliffs (MSEC
- Perennial Stream
- Non-Perennial Stream
- Koala species polygon - direct impact

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

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GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Species Polygon – Koala *(Phascolarctos cinereus)*

Dendrobium Mine Extension Project BDAR

Figure 14o.6

Imagery @ Illawarra-Coal Dec 2018

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Drawn by: Jess Baer/YH File: T:\spatial\projects\ad6600\ad6624_Dendrobium_BDARMaps\report\BDAR\6624_Figure_14o_Koala.mxd Last updated: 10-Mar-22 9:02:58 PM



Subject Land

Biodiversity Assessment Development Footprint

Non-Perennial Stream

Koala species polygon - direct impact

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

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GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Species Polygon – Koala *(Phascolarctos cinereus)*

Dendrobium Mine Extension Project BDAR

Figure 14o.7

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Beal/YH File: T:\spatial\projects\ab6600\a6624_Dendrobium_BDAR\Mapsreport\BDAR\6624_Figure_14o_Koala.mxd Last updated: 10-Mar-22 9:02:56 PM



*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

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GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Species Polygon – Red-crowned Toadlet (*Pseudophryne australis*)

Dendrobium Mine Extension Project BDAR

Figure 14p.1

Imagery @ Illawarra-Coal Dec 2018

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Drawn by: Jess Bear/YH File: T:\spatial\projects\ia6600\ia6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_14p_Redcrowned_Toadlet.mxd Last updated: 10-Mar-22 3:14:10 PM



Subject Land
Biodiversity Assessment Development Footprint
Subsidence Assessment Study Area
Proposed Longwalls with 60 m boundary
Proposed Longwalls with 400 m boundary
Red-crowned Toadlet species polygon
Red-crowned Toadlet species polygon - potential indiect impact
Non-Perennial Stream
Cliffs (MSEC 2021)

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

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GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Species Polygon – Red-crowned Toadlet (*Pseudophryne australis*)

Dendrobium Mine Extension Project BDAR

Figure 14p.2

Imagery @ Illawarra-Coal Dec 2018

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Drawn by: Jess Bear/YH File: T:\spatial\projects\ia6000\ia6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_14p_Redcrowned_Toadlet.mxd Last updated: 10-Mar-22 3:14:10 PM



- Subject Land
- Biodiversity Assessment Development Footprint
- Subsidence Assessment Study Area
- Proposed Longwalls with 60 m boundary
- Proposed Longwalls with 400 m boundary
- Red-crowned Toadlet species polygon
- Red-crowned Toadlet species polygon - potential indiect impact
- Red-crowned Toadlet (BioNet 2022)*
- Non-Perennial Stream
- Cliffs (MSEC 2021)

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

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GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Threatened Fauna Species Polygon – Red-crowned Toadlet *(Pseudophryne australis)*

Dendrobium Mine Extension Project BDAR

Figure 14p.3

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Bear/YH File: T:\spatial\projects\ab6600\a6624_Dendrobium_BDAR\Maps\report\BDAR6624_Figure_14p_Redcrowned_Toadlet.mxd Last updated: 10-Mar-22 3:14:10 PM

290000

6136600

DONALDS CASTLE CREEK

- Subject Land
- Biodiversity Assessment Development Footprint
- Subsidence Assessment Study Area
- Proposed Longwalls with 400 m boundary
- Red-crowned Toadlet species polygon - potential indiect impact
- Perennial Stream
- Non-Perennial Stream
- Cliffs (MSEC 2021)

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

niche Environment and Heritage

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GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

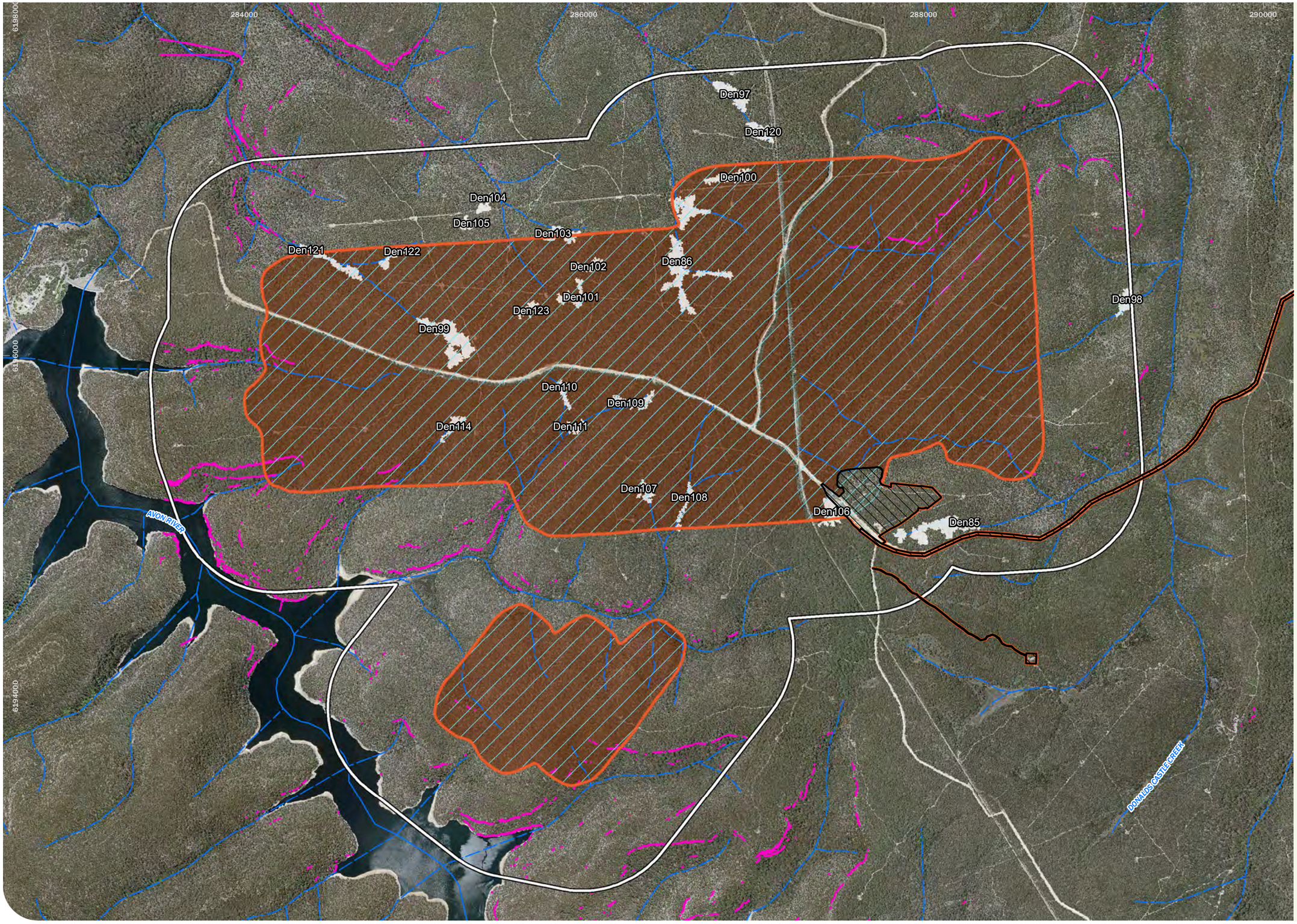
Threatened Fauna Species Polygon – Red-crowned Toadlet *(Pseudophryne australis)*

Dendrobium Mine Extension Project BDAR

Figure 14p.4

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Bear/YH File: T:\spatial\projects\ak6600\ak6624_Dendrobium_BDAR\Maps\report\BDAR6624_Figure_14p_Redcrowned_Toadlet.mxd Last updated: 10-Mar-22 3:14:10 PM



Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Cliffs (MSEC 2021)

Perennial Stream

Non-Perennial Stream

Coastal Upland Swamps

Masked Owl species polygon

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

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GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

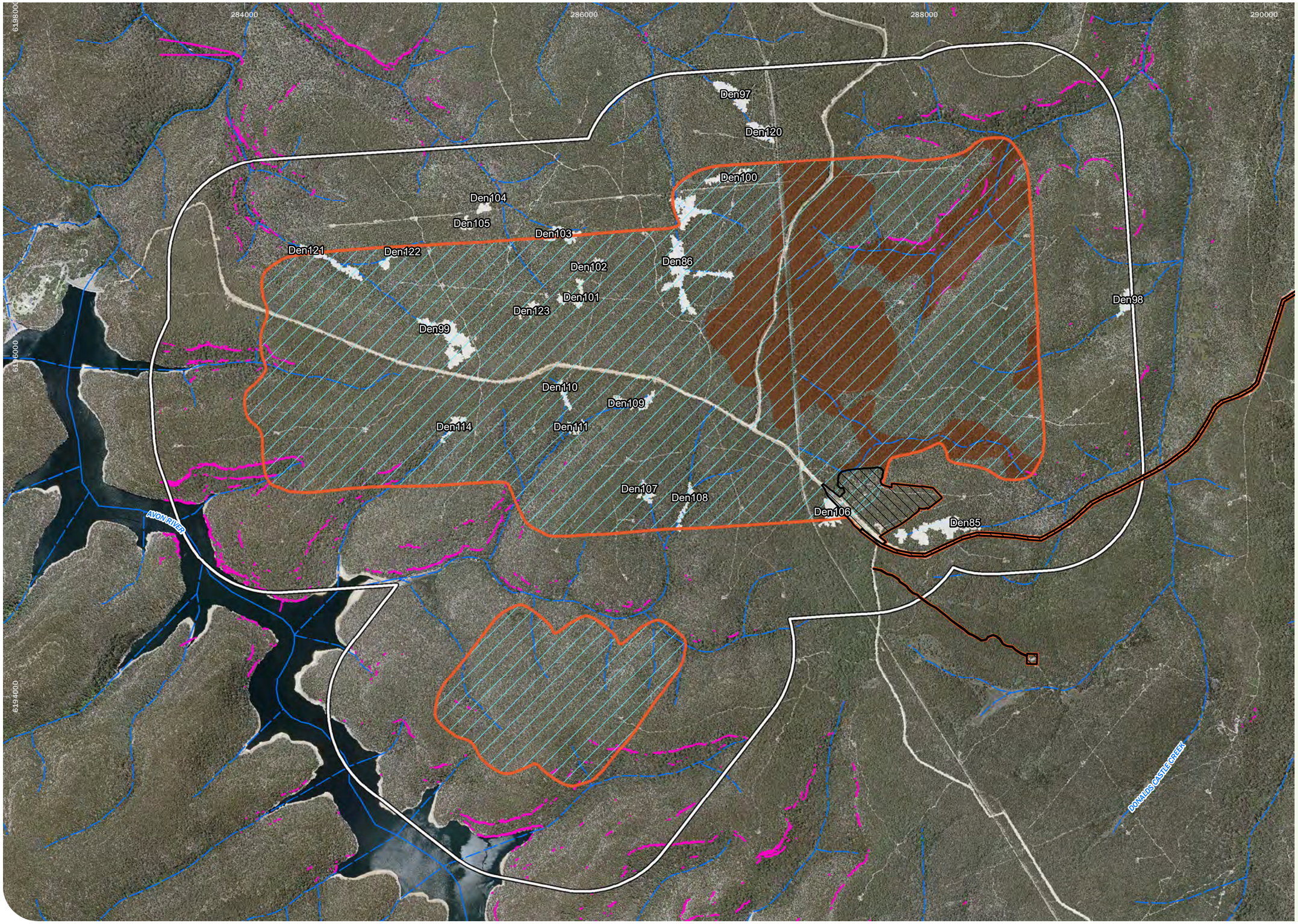
Threatened Fauna Species Polygon – Masked Owl *(Tyto novaehollandiae)*

Dendrobium Mine Extension Project BDAR

Figure 14q

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Beal/YH File: T:\spatial\projects\ab6600\a6624_Dendrobium_BDAR\Mapsteport\BDAR\6624_Figure_14q_MaskedOwl.mxd Last updated: 10-Mar-22 3:15:06 PM



Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Cliffs (MSEC 2021)

Perennial Stream

Non-Perennial Stream

Coastal Upland Swamps

Sooty Owl species polygon

*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl, Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl).

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m
GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

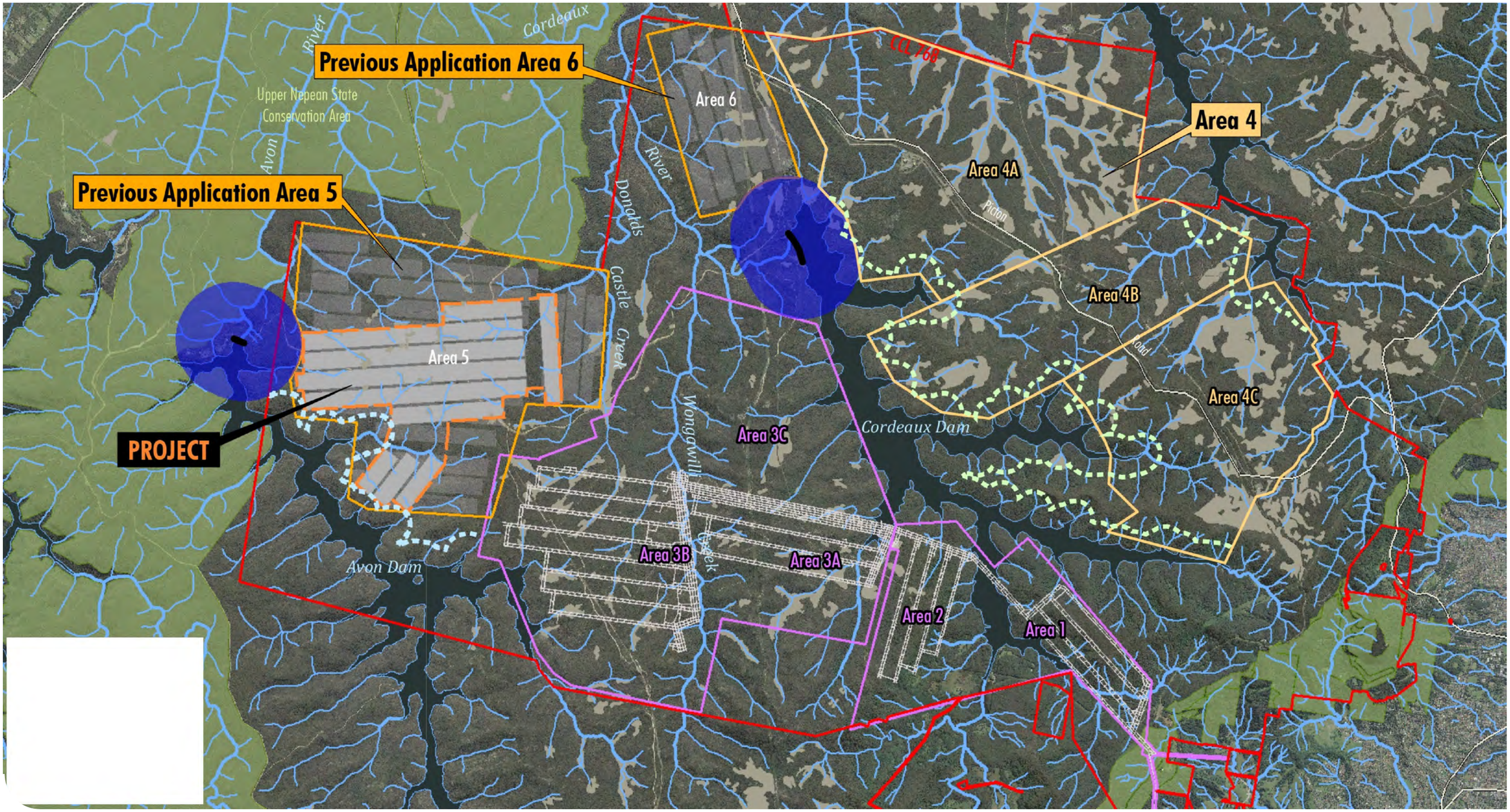
Threatened Fauna Species Polygon – Sooty Owl *(Tyto tenebricosa)*

Dendrobium Mine Extension Project BDAR

Figure 14r

Imagery @ Illawarra Coal Dec 2018

Drawn by: Jess Bear/YH File: T:\spatial\projects\ab6600\a6624_Dendrobium_BDAR\Mapsteport\BDAR\6624_Figure_ 14r_SootyOwl.mxd Last updated: 10-Mar-22 3:16:39 PM



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GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Proj. #: 6624
Client: Illawarra Metallurgical Coal

Project Avoidance and Minimisation
Dendrobium Mine Extension Project BDAR

Figure 15

Imagery@ Illawarra-Coal Dec 2018

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Drawn by: JBYH File: T:\projects\6624\mxd\6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_15_Avoidance.mxd Last updated: 11-Mar-22 2:16:44 PM

280000

300000

6220000

6200000

6180000

Cumberland

Burragorang

Sydney Cataract

Illawarra

Moss Vale

Subject Land

Subsidence Assessment Study

IBRA Subregion

Dendrobium Mine Extraction Areas (maximal)

Dendroboium Mine Lease

Cordeaux Avon

Littlejohn's Tree Frog (BioNet 2022)*

Regional LJTF Habitat Streams (within Area of Occupancy)

Regional LJTF Habitat Streams (outside Area of Occupancy)

0 4

km

GDA 1994 MGA Zone 56

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Niche PM: Luke Baker
Niche Proj. #: 6624
Client: Illawarra Metallurgical Coal

Littlejohns Tree Frog – Regional distribution and habitat

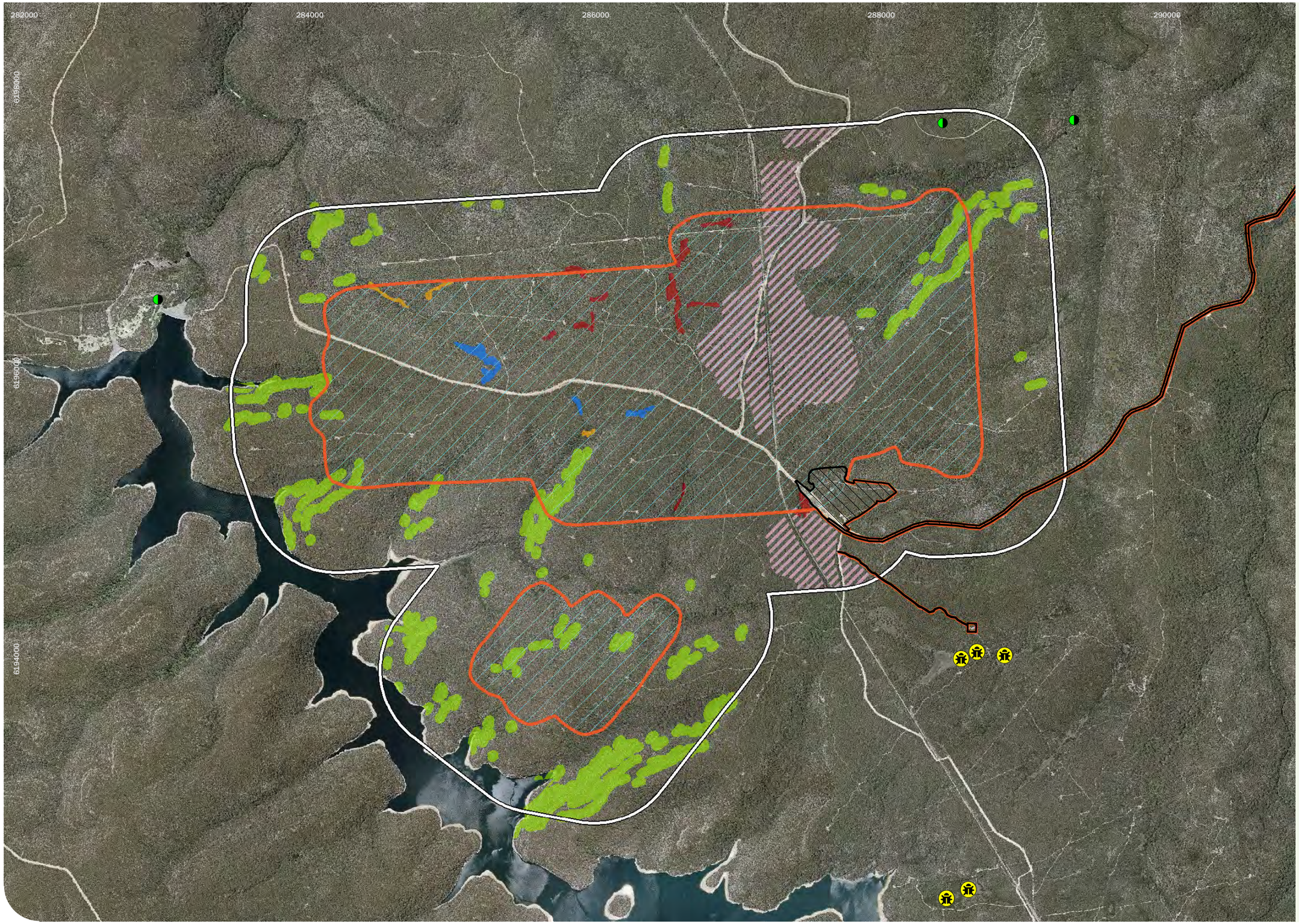
Dendrobium Mine Extension Project BDAR

Figure 16

World Imagery: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
*In accordance with Bionet's Sensitive Species Policy, sensitive species are not displayed on this map series (as scale is < 1:250,000).
This may apply to the following sensitive species for the map series: Fauna (Broad-headed Snake, Eastern Bristlebird, Glossy Black-Cockatoo, Barking Owl Gang-gang Cockatoo, Masked Owl, Powerful Owl and Sooty Owl); Flora (Hairy Geebung, Lesser Creeping Fern, Netted Bottle Brush).

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Drawn by: Jess Bear/YH File: T:\spatial\projects\a6600\a6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_16_LJTF_distribution_habitat.mxd Last updated: 11-Mar-22 4:00:22 PM



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0 500
m
GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Serious and Irreversible Impacts

Dendrobium Mine Extension Project BDAR

Figure 17a

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Bear/YH File: T:\spatial\projects\ad\6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_17_Impacts.mxd Last updated: 08-Feb-22 5:21:32 PM

v2.0



Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Shale/Sandstone Transition Forest (TEC)

Giant Dragonfly species polygon - see BDAR for detailed impact assessment

No Habitat

niche Environment and Heritage

0 100

m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Serious and Irreversible Impacts

Dendrobium Mine Extension Project BDAR

Figure 17b

Imagery @ Illawarra Coal Dec 2018

Drawn by: Jess Beam'YH File: T:\spatial\projects\6600\6624_Dendrobium_BDAR\Mapsreport\BDAR\6624_Figure_17_Impacts.mxd Last updated: 08-Feb-22 5:21:32 PM

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290000

Subject Land

Biodiversity Assessment Development Footprint

Predicted Extent of Subsidence - 20 mm Subsidence Contour

Subsidence Assessment Study Area

Broad-headed Snake species polygonsee - see BDAR for detailed impact assessment

0 100

m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Serious and Irreversible Impacts

Dendrobium Mine Extension Project BDAR

Figure 17c

Imagery @ Illawarra-Coal Dec 2018

Drawn by: Jess Bear/YH File: T:\spatial\projects\ab6600\ab6624_Dendrobium_BDAR\Maps\report\BDAR6624_Figure_17_Impacts.mxd Last updated: 08-Feb-22 5:21:32 PM

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6196000

Subject Land

Biodiversity Assessment Development Footprint

Subsidence Assessment Study Area

Broad-headed Snake species polygonsee - see BDAR for detailed impact assessment

0 100

m

GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Project: 6624
Client: Illawarra Metallurgical Coal

Serious and Irreversible Impacts

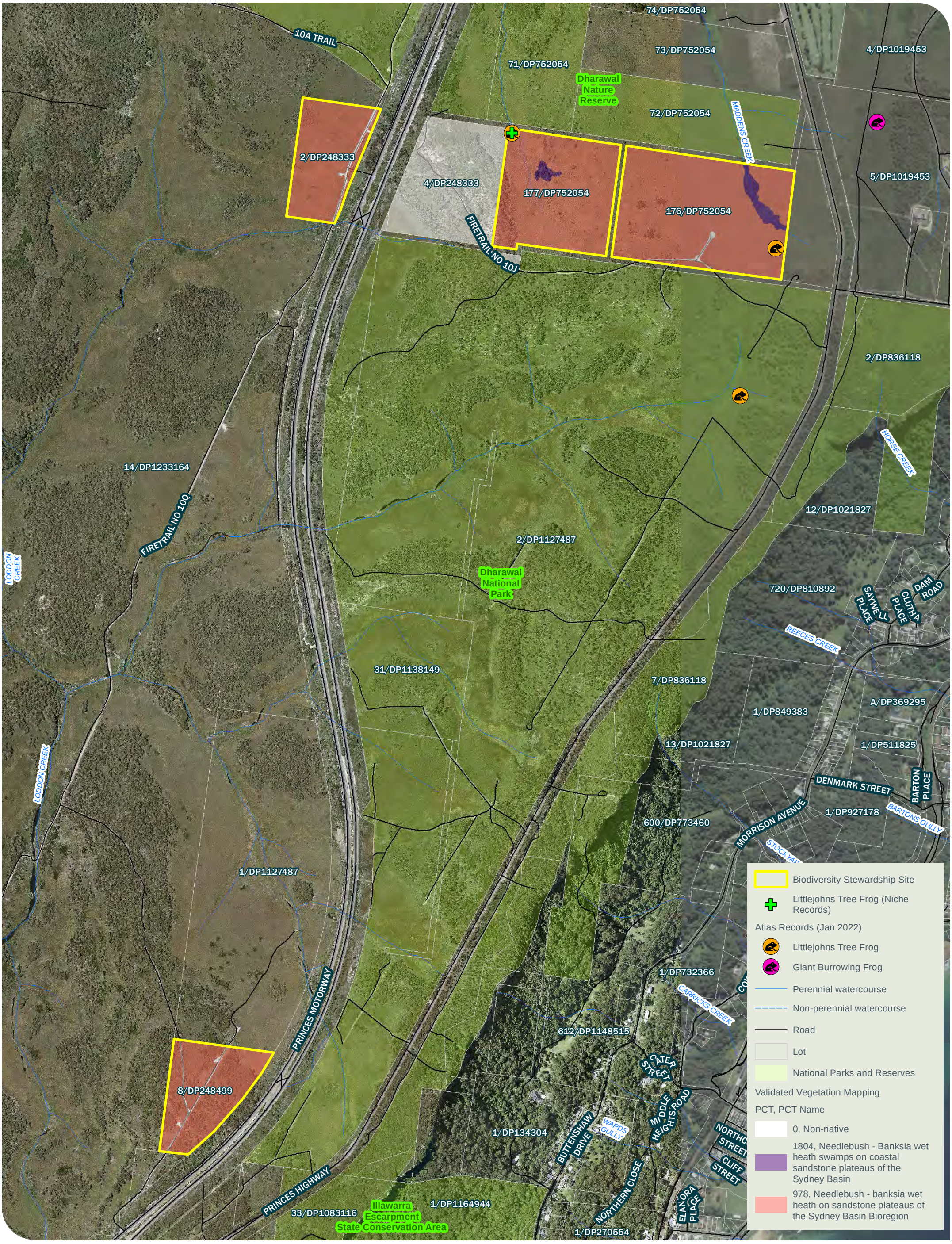
Dendrobium Mine Extension Project BDAR

Figure 17d

Imagery @ Illawarra-Coal Dec 2018

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Drawn by: Jess Bear/YH File: T:\spatial\projects\six60\6624_Dendrobium_BDAR\Maps\report\BDAR\6624_Figure_17_Impacts.mxd Last updated: 08-Feb-22 5:21:32 PM



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GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Proj. #: 6624
Client: Illawarra Metallurgical Coal

Illawarra Coal Biodiversity Stewardship Site

Dendrobium Mine Extension Project BDAR

Figure 18

public/NSW_Imagery: © Department of Customer Service 2020

Drawn by: YH File: T:\spatial\projects\ia66001a6624_Dendrobium_BDARMaps\report\BDAR\6624_Figure_18_IllawarraCoal_BSS.mxd Last updated: 09-Feb-22 12:14:43 PM

296000
298000
300000
6192000
6190000
6188000
6186000
GOONDARRIN CREEK
CORDEAUX RIVER
LAKE CORDEAUX
MURPHYS GULLY
MORANS GULLY
KEMBLA CREEK
CAMP GULLY
MEEMI GULLY
BRANDY AND WATER CREEK
AMERICAN CREEK
YOUNGS GULLY
STAFFORDS GULLY
DAPTO CREEK

Illawarra Coal Landholdings

Fauna (BioNet 2021)

Amphibia

Littlejohn's Tree Frog

Mammalia

Grey-headed Flying-fox

Koala

Perennial watercourse

Non-perennial watercourse

Waterbody

Illawarra Vegetation Mapping (2016)

PCT Id, PCT Name

Assess In Field

PCT 906: Lilly Pilly - Sassafras - Stinging Tree subtropical/warm temperate rainforest on moist fertile lowlands, southern Sydney Basin Bioregion

PCT 905: Lilly Pilly - Coachwood warm temperate rainforest on moist sheltered slopes and gullies, Sydney Basin Bioregion and South East Corner Bioregion

PCT 878: Gully Gum - Sydney Peppermint - Yellow Stringybark moist open forest of coastal escarpments, southern Sydney Basin Bioregion

PCT 1804: Needlebush - Banksia wet heath swamps on coastal sandstone plateaus of the Sydney basin

PCT 1250: Sydney Peppermint - Smooth-barked Apple - Red Bloodwood shrubby open forest on slopes of moist sandstone gullies, eastern Sydney Basin Bioregion

PCT 1245: Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion

PCT 1156: Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion

PCT 1083: Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion

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m
GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Proj. #: 6624
Client: Illawarra Metallurgical Coal

Illawarra Coal Landholdings - offset investigation

Dendrobium Mine Extension Project BDAR

Figure 19

Imagery @ Illawarra-Coal Dec 2018

Drawn by: YH File: T:\spatial\projects\a6600\a6624_Dendrobium_BDARMaps\report\BDAR\6624_Figure_19_IC_Landholdings_offset_investigation.mxd Last updated: 14-Feb-22 4:38:34 PM

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Appendix 1. SEARs Addressed in BDAR

Requirement	Section addressed in the BDAR
Planning Secretary's Environmental Assessment Requirements - section 5.16 of the Environmental Planning and Assessment Act 1979 - SSI-33143123	
4. Biodiversity – including: - 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). The BDAR must have regard to the advice of the BCD (see Attachment 2) and include a strategy to offset any residual impacts of the development, including how required offsets would be achieved;	This BDAR has been completed in accordance with the BAM and associated guidelines. The relevant section of the BDAR that address the BCD advice (Attachment 2) has been provided in this table.
- the BDAR must demonstrate how impacts to biodiversity values have been avoided and detail measures to mitigate and manage impacts from the development in accordance with the BAM;	Avoidance measures have been addressed in section 3 of the BDAR. Mitigation measures have been addressed in section 5 of the BDAR.
- the BDAR must include consideration of the increased risk of bushfire impacts on individual swamps that are predicted to be impacted by the development, and at the landscape scale;	Exposure to bushfire intensity due to loss of inundation within predicated upland swamps has been discussed in Appendix 9 (Swamp Impact Assessment).
- where remediation of impacted swamps and streams is proposed, the BDAR must include evidence to support the likely effectiveness of proposed remediation measures; and	Coastal Upland Swamps have been offset as detailed in section 6 of this BDAR.
- an assessment of the likely impacts of the development on aquatic ecology, including aquatic biodiversity and key fish habitats.	Addressed in the aquatic ecology assessment for the Project.
ATTACHMENT 1 - Environmental Planning Instruments, Policies, Guidelines & Plans	
Biodiversity - Biodiversity Assessment Method (DPIE 2020) - Guidance to assist a decisionmaker to determine a serious and irreversible impact (DPIE 2019) - Policy and Guidelines for Aquatic Habitat Management and Fish Conservation (Fisheries NSW) - Guidelines for developments adjoining Department of Environment, Climate Change and Water (DECCW, 2010) - NSW State Groundwater Dependent Ecosystem Policy (NOW) - Risk Assessment Guidelines for Groundwater Dependent Ecosystems (NOW)	This BDAR has been prepared in accordance with the BAM and associated guidelines. Serious and Irreversible Impacts (SAII) have been addressed in section 4.9 of the report, and Appendix 11.
ATTACHMENT 2- Agency advice on SEARs	
Water NSW - Input into Secretary's Environmental Assessment requirements (SEARs) for Dendrobium Mine Area 5 Extension Project	
Attachment A	

Requirement	Section addressed in the BDAR
WaterNSW made a detailed submission to the IPC in December 2020 on the previous Dendrobium Mine Area 5 and 6 Extension Project. WaterNSW highlighted four key areas of residual concerns as follows: 1. Water quantity: There has been insufficient consideration of an alternative mine design that would prevent the height of free drainage from extending to the surface. Such an alternative mine design would likely result in a reduction in the surface water losses of the project. 2. Water quality: Uncertainty remains about whether the project would meet the NorBE test for water quality, particularly in relation to post-closure groundwater recovery. 3. Stream Impacts: The project would cause significant environmental impacts in various significant watercourses, including nine major streams (third order or above). 4. Ecological integrity: The proposed mine design and predicted fracturing would fundamentally change the hydrological and ecological functions of 25 endangered Coastal Upland Swamps. Within these four areas of concern, WaterNSW also identified 8 specific residual questions in that detailed submission that need to be carefully assessed in determination of the project: 1. Are the predicted catchment water losses accurate and reliable? 2. Are the likely catchment water losses acceptable? 3. Can catchment water losses be avoided or minimised? 4. Is there a viable mine plan with reduced catchment impacts? 5. What are the catchment water losses post-mining? 6. What are post-mining impacts on water quality? 7. What streams should be considered 'significant'? 8. What is the worst-case scenario for swamps? The above matters are recommended for inclusion in the SEARs for the Project.	Swamp 'full loss scenario' has been discussed in Appendix 8 of the BDAR (Swamp Impact Assessment), and biodiversity credits based on this scenario provided in section 6.

Requirement	Section addressed in the BDAR
Department of Planning, Industry and Environment Major Projects – New Request for Advice – Dendrobium Mine Extension Project (SSI-33143123)	
Attachment A lists the suggested environmental assessment requirements (EARs) that will need to be addressed for the project. Attachment B lists the guidance material that will assist the preparation of the environmental assessment. The EARs in Attachment A require the development to be assessed in accordance with the Biodiversity Assessment Method (BAM) 2020. We highlight the following points, in particular, with regards to the abovementioned project: • The biodiversity assessment report (BDAR) must provide a detailed assessment of how all impacts (including direct, indirect, prescribed and uncertain impacts) are to be avoided in accordance with the BAM 2020. We draw the proponent's attention to several recent Land and Environment Court decisions which emphasise the importance of ensuring avoidance is adequately demonstrated in the BDAR. o https://www.caselaw.nsw.gov.au/decision/17cde1089492c806d6d2b34d o https://www.caselaw.nsw.gov.au/decision/179ab71adb5f4873ea223bb5 o https://www.caselaw.nsw.gov.au/decision/179c61f4f6dc498b0e14b86f In addition to the BAM 2020, the proponent should refer to the BAM Operational Manuals for guidance: https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversityoffsets-scheme/accredited-assessors/assessor-resources	Avoidance and project justification has been provided in section 3 of the BDAR. BAM Operational Manual has been used throughout the BDAR.
• The BDAR must demonstrate how various options were considered for mine design, size, location and extraction method. This should be considered in the context of avoidance of impacts on biodiversity.	As above.
• The BDAR must provide detailed analysis on cumulative impacts to threatened entities in accordance with BAM impact assessment and Cumulative Impact Assessment Guidelines for State Significant Projects: https://www.planning.nsw.gov.au/-/media/Files/DPE/Guidelines/Policy-and-legislation/GD1259-RAF-Assessing-Cumulative-Impacts-Guide-final.pdf	Cumulative impacts for the Project assessed in EIS. Cumulative impacts to biodiversity assessed in section 4.7.
• The BDAR must provide detailed discussion on measures to mitigate and manage impacts from the development in accordance with BAM 2020, including, but not limited to, a monitoring framework for assessing uncertain impacts, as well as details on remediation and rehabilitation of impacted areas.	Mitigation measures provided in section 5 of the BDAR. Biodiversity offsets have been provided for uncertain impacts as detailed in section 6. Existing monitoring plans to be updated to reflect the Project (section 5.1)
• The BDAR should outline an offset strategy which details how required offsets will be achieved, taking into consideration the probability that assessment bilateral agreement requirements for offsetting will need to be met. Refer to: https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/assessmentbilateral-agreement It is noted that land previously suggested by the proponent for offsetting at Maddens Plains Strategic Biodiversity site is not available.	Offset strategy provided in section 7 of the BDAR.

Requirement	Section addressed in the BDAR
Attachment A: EES Recommended Environmental Assessment Requirements (EARs) for Dendrobium Mine Extension Project	
1. Biodiversity impacts related to the proposed project are to be assessed in accordance with the Biodiversity Assessment Method 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 Biodiversity Assessment Method.	This BDAR has been prepared in accordance with the BAM and associated guidelines and operational manuals.
2. The BDAR must document the application of the avoid, minimise and offset hierarchy including assessing all direct, indirect and prescribed impacts in accordance with the Biodiversity Assessment Method.	This BDAR documents the avoidance measures (section 3), minimisation measures (section 5) and offsetting requirements (section 6).
3. The BDAR must include details of the measures proposed to address the offset obligation as follows: • The total number and classes of biodiversity credits required to be retired for the project; • The number and classes of like-for-like biodiversity credits proposed to be retired; • The number and classes of biodiversity credits proposed to be retired in accordance with the variation rules; • Any proposal to fund a biodiversity conservation action; • Any proposal to conduct ecological rehabilitation (if a mining project); and • 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.	Offset strategy provided in section 6 of BDAR.
4. 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.	This BDAR has been prepared in accordance with BAM by an Accredited Assessor – section 1.6.
Upland swamps	
5. Regarding impacts to Coastal Upland Swamps, the BDAR should include data and a discussion on results from previous upland swamp impact predictions, actual outcomes and monitoring in adjacent areas assessed under earlier assessments or approvals. This should also provide detail on how predictions and impacts aligned and the implications for the current proposal. Evidence must be included.	A swamp impact assessment has been provided in Appendix 9. This includes a literature review, and analysis of the swamp monitoring results completed as part of the Dendrobium Swamp Monitoring Program.
6. The BDAR must apply the Addendum to NSW Biodiversity Offsets Policy for Major Projects- Upland swamps impacted by longwall mining subsidence to address uncertain impacts and offsetting in accordance with the BAM 2020. https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Biodiversity/addendum-biodiversity-offsets-policy-major-projectsupland-swamps-160766.pdf	NSW Biodiversity Offsets Policy for Major Projects- Upland Swamps has been applied (section 6.3.2).
7. The additional loss of swamp aquifer water, surface water and baseflow due to longwall mining from the Dendrobium mining proposal needs to be properly quantified and assessed for its impacts on threatened/endangered species that rely on this surface water (for habitat/breeding).	Biodiversity impacts associated with threatened biodiversity, including Coastal Upland Swamps, have been addressed in section 4.6 and Appendix 9 and Appendix 10. The impact assessments have considered the potential for impact to rely on surface water for habitat/breeding.

Requirement	Section addressed in the BDAR
8. The projected loss of water as a result of mining must be considered in light of the draft Greater Sydney Water Strategy - https://www.industry.nsw.gov.au/water/plans-programs/metro-water-plans/gsws/readthe-draft	-
9. A scientifically robust assessment of surface to seam fracturing based on IEPMC findings is required.	-
Proximity to Conservation Area	
10. In the case of a development/ project that adjoins, is in the immediate vicinity of a park or upstream, the assessment of impacts must address the matters to be considered outlined in the Guidelines for developments adjoining land and water managed by DECCW (DECCW 2010) and include: a. The nature of the impacts, including direct and indirect impacts. b. The extent of the direct and indirect impacts. c. The duration of the direct and indirect impacts. d. The objectives of the reservation of the land.	Impacts to adjacent conservation reserves assessed in section 4.8.
11. The EIS must include discussion of measures proposed to prevent, control, abate, minimise and manage the direct and indirect impacts including an evaluation of the effectiveness and reliability of the proposed measures.	Mitigation measures discussed in section 5.
Attachment B - Biodiversity	
Biodiversity Assessment Method (OEH, 2017) Guidance and Criteria to assist a decision maker to determine a serious and irreversible impact (OEH, 2017) Fisheries NSW policies and guidelines List of national parks Revocation, recategorisation and road adjustment policy (OEH, 2012) Guidelines for developments adjoining land and water managed by the Department of Environment, Climate Change and Water (DECCW, 2010)	All applicable sources have been considered in BDAR.
Mining, Exploration & Geoscience Secretary's Environmental Assessment Requirements	
Biodiversity offsets MEG requests that the Proponent consider potential resource sterilisation in relation to any proposed biodiversity offsets areas. Biodiversity offsets have the potential to preclude access for future resource discovery and extraction and could also potentially permanently sterilise access to mineral resources. The EIS must clearly illustrate the location (including offsite locations) of any biodiversity offsets being considered for the project and their spatial relationship to known and potential mineral and construction material resources and existing mining & exploration titles. MEG requests consultation with both the Geological Survey of NSW – Land Use Assessment team and holders of existing mining and exploration authorities affected by planned biodiversity offsets. Evidence of consultation should be included in the EIS.	The proposed biodiversity offset site does not occur within a proposed mining lease.

Requirement	Section addressed in the BDAR
Department of Planning and Environment, Dendrobium Mine Extension Project (SSI-33143123) **Amendment to Planning Secretary's Environmental Assessment Requirements (25 January 2022)**	
The EIS must identify each EPBC Act listed threatened species and ecological community likely to be impacted by the action. For any species and communities that are likely to be impacted, the proponent must provide a description of the nature, quantum and consequences of the impacts. For species and communities potentially located in the proposed action area or in the vicinity that are not likely to be impacted, provide evidence why they are not likely to be impacted.	Commonwealth listed threatened biodiversity assessed in section 2.5.5; 2.6.7 and 4.10. Assessments of Significance completed in Appendix 8 for threatened species likely to be impacted by the Project.
For each of the EPBC Act listed species and ecological communities likely to be significantly impacted by the proposed action, the EIS/Biodiversity Development Assessment Report (BDAR) must provide a separate: i. description of the habitat (including identification and mapping of 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 advice, conservation advice and recovery plans; ii. details of the scope, timing and methodology for studies or surveys used and how they are consistent with (or justification for divergence from) published Australian Government guidelines and policy statements; iii. description of the relevant impacts of the action having regard to the full national extent of the species or community's range; iv. description of the specific proposed avoidance and mitigation measures to deal with relevant impacts of the action; v. identification of significant residual adverse impacts likely to occur after the proposed activities to avoid and mitigate all impacts are taken into account; vi. description of any offsets proposed to address residual significant impacts and how these offsets will be established. vii. details of how the current published NSW Biodiversity Assessment Methodology has been applied in accordance with the objects of the EPBC Act to offset significant residual adverse impacts; and viii. details of the offset package to compensate for significant residual impacts including details of the credit profiles required to offset the action in accordance with the NSW Biodiversity Assessment Methodology and/or mapping and descriptions of the extent and condition of the relevant habitat and/or threatened communities occurring on proposed offset sites;	i. Threatened species assessed in section 2 and section 4 of the BDAR. Assessments of Significance provided in Appendix 8. ii. Survey effort detailed in section 2, including reference to relevant survey guidelines. iii. Threatened species assessed in Appendix 8 in relation to locality and species range. iv. Avoidance and mitigation measures discussed in section 3 and 5. v. Mitigation measures addressed in section 5. vi. Biodiversity offsets proposed in section 6. vii. Bilateral agreement discussed in section 7. viii. Offset package discussed in section 7.
17. Any significant residual impacts not addressed by the NSW Biodiversity Assessment Methodology may need to be addressed in accordance with the Environment Protection and Biodiversity Conservation Act 1999 Environmental Offset Policy.	Not proposed for this assessment as residual impacts are unlikely.

There are likely to be significant impacts on the following controlling provisions: • Listed threatened species and communities (sections 18 and 18A) • A water resource, in relation to coal seam gas development and large coal mining development (section 24D and 24E). Listed threatened species and communities (s18 & s18A) • Coastal Upland Swamps in the Sydney Basin Bioregion – endangered ecological community: subsidence events associated with the proposed action may reduce the extent of the ecological community and adversely affect critical habitat. • Shale Sandstone Transition Forest of the Sydney Basin Bioregion – critically endangered: longwall mining is listed as a threatening process, disrupting natural groundwater regimes and discharge patterns associated with mining. • Grey-headed Flying-fox (Pteropus poliocephalus) – vulnerable: there is a nationally important grey headed-flying fox camp located within 20km of the proposed action site. • Littlejohn's Tree Frog (Litoria littlejohni) – vulnerable: the proposed action may lead to a long-term decrease in the size of the population and reduce the area of occupancy of an important population. • Koala (Phascolarctos cinereus) (Combined Population of QLD, NSW and the ACT) – vulnerable: the proposed action could impact important habitat for the species. • Greater Glider (Petauroides volans) – vulnerable: the proposed action could impact important habitat for the species. • Giant Burrowing Frog (Heleioporus australiacus) – vulnerable: the proposed action and associated subsidence could significantly impact breeding habitat. • Broad-headed Snake (Hoplocephalus bungaroides) – vulnerable: the proposed action could impact availability and quality of habitat leading to species decline. • Large-eared Pied Bat, Large Pied Bat (Chalinolobus dwyeri) – vulnerable: the proposed action could impact current and future habitat for the species, which is considered habitat critical to the survival of the species. • Swift Parrot (Lathamus discolor) – critically endangered: the proposed action could clear foraging habitat for the species. • Silver Perch (Bidyanus bidyanus) – critically endangered: subsidence events associated with the proposed action may impact the Cataract Dam, where an important population of the species exists. • Rufous Pomaderris, Brown Pomaderris (Pomaderris brunnea) – vulnerable: the proposed action may impact the small number of NSW subpopulations that exist, leading to long-term decrease in the species. • Woronora Beard-heath (Leucopogon exolasius) – vulnerable: approx. 46% of the species distribution occurs within 10km of the proposed action area, therefore potential negative impacts from clearing or subsidence could negatively impact habitat important to the species. • Bargo Geebung (Persoonia bargoensis) – vulnerable: the proposed action may cause impacts to the species habitat and lead to a long-term decrease in the population size. • Small-flower Grevillea (Grevillea parviflora subsp. parviflora) – vulnerable: the proposed action may impact an important population of the species leading to a long-term decline. • Kangaloon Sun Orchid (Thelymitra kangaloonica) – critically endangered: the species is likely to occur within the project site and impacts to the species could lead to a population decline. • Prickly Bush-pea (Pultenaea aristata) – vulnerable: part of this species' range lies within 10 km of the proposed action area, and is associated with the Upland Swamp vegetation complex, and altered hydrology could negatively impact this species habitat. • Deane's Melaleuca (Melaleuca deanei) – vulnerable: the species is highly fragmented, and all habitat is considered critical habitat, therefore the project could significantly impact this species. • Hairy Geebung, Hairy Persoonia (Persoonia hirsuta) – endangered: the proposed action could fragment an already scattered species leading to a reduction in the area of occupancy.	Threatened biodiversity addressed in section 2.5.5; 2.6.7; 4.10 and Appendix 8.

Requirement	Section addressed in the BDAR
• Scrub Turpentine, Brown Malletwood (Rhodamnia rubescens) – critically endangered: the species has experienced significant decline, and there is the potential for the proposed action to reduce the area of occupancy of this species.	

Appendix 2. Threatened Species and Ecological Communities Likelihood of Occurrence

An assessment of the likelihood for threatened flora to occur within the Subject Land has been completed below.

Five categories for 'likelihood of occurrence' were attributed to the list of threatened species after consideration of criteria such as known records, presence or absence of important habitat features in the Subject Land, results of the field surveys and professional judgement. This process was completed on an individual species basis.

Species considered further were those in the 'Known' to 'Moderate' categories, and where impacts to the species could reasonably occur from the Project.

Table 56: Likelihood of Occurrence Criteria

Likelihood Rating	Threatened Flora Criteria	Threatened and Migratory Fauna Criteria
Known	The species was observed within the Subject Land.	The species was observed within the Subject Land.
High	It is likely that a species inhabits or utilises habitat within the Subject Land.	It is likely that a species inhabits or utilises habitat within the Subject Land.
Moderate	Potential habitat for a species occurs on the site. Adequate field survey would determine if there is a 'high' or 'low' likelihood of occurrence for the species within the Subject Land.	Potential habitat for a species occurs on the site and the species may occasionally utilise that habitat. Species unlikely to be wholly dependent on the habitat present within the Subject Land.
Low	It is unlikely that the species inhabits the Subject Land.	It is unlikely that the species inhabits the Subject Land. If present at the site, the species would likely be a transient visitor. The site contains only common habitat for this species which the species would not rely on for its on-going local existence such as limited breeding habitat resources.
None	The species has not been recorded within the Subject Land and habitat within the Subject Land is unsuitable for the species.	The species has not been recorded within the Subject Land and habitat within the Subject Land is unsuitable for the species.

Table 57: Threatened Ecological Communities likelihood of occurrence

Threatened Ecological Community	Description	BC Act listing	EPBC Act listing	Likelihood of occurrence
Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion	It occurs primarily in the Castlereagh area in the north-west of the Cumberland Plain (also referred to as the Cumberland sub-region), with other known occurrences near Holsworthy (some patches at Holsworthy are just outside the Cumberland sub-region), Kemps Creek and Longneck Lagoon. The ecological community occurs primarily on Tertiary sands and gravels of the Hawkesbury-Nepean river system. The ecological community occurs primarily at low elevations up to 80 m above sea level, including old ridges, dunes and terraces. The canopy is composed of trees with a mature height of 10 m to around 20 m. The canopy contains, and is often dominated by, one or more of the following species: *Angophora bakeri* (narrow leaved apple), *Eucalyptus racemosa* (syn. *E. sclerophylla*) (scribbly gum, narrow-leaved scribbly gum) and *E. parramattensis subsp. parramattensis* (Parramatta red gum). *Melaleuca* species including *M. decora* (paperbark) may also be prominent in the canopy (and/or mid layer) of the ecological community.	Endangered	Endangered	None – Outside of the known distribution of the community. Not recorded during field survey. Not previously mapped within the Subject Land.
Cooks River/ Castlereagh Ironbark Forest	Ranges from open forest to low woodland, with a canopy dominated by Broad-leaved Ironbark (*Eucalyptus fibrosa*) and Paperbark (*Melaleuca decora*). The canopy may also include other eucalypts such as Woolybutt (*E. longifolia*). The dense shrubby understorey consists of Prickly-leaved Paperbark (*Melaleuca nodosa*) and Peach Heath (*Lissanthe strigosa*), with a range of 'pea' flower shrubs, such as *Dillwynia tenuifolia*, Hairy Bush-pea (*Pultenaea villosa*) and Gorse Bitter Pea (*Daviesia ulicifolia*) (can be locally abundant). The sparse ground layer contains a range of grasses and herbs.	Endangered	Critically Endangered	None – Outside of the known distribution of the community. Not recorded during field survey. Not previously mapped within the Subject Land.
Swamp Oak Floodplain Forest on the NSW North Coast, Sydney Basin and South East Corner bioregions	Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions is the name given to the ecological community associated with grey-black clay-loams and sandy loams, where the groundwater is saline or sub-saline, on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains. Swamp Oak Floodplain Forest generally occurs below 20 m (rarely above 10 m) elevation in the NSW North Coast, Sydney Basin and South East Corner bioregions. The structure of the community may vary from open forests to low woodlands, scrubs or reedlands with scattered trees. Typically these forests, woodlands, scrubs and reedlands form mosaics with other floodplain forest communities and treeless wetlands, and often they fringe treeless floodplain lagoons or wetlands with semi-permanent standing water. This community is found on the coastal floodplains of NSW. It has a dense to sparse tree layer in which *Casuarina glauca* (swamp oak) is the dominant species northwards from Bermagui. Other trees including *Acmena smithii* (lilly pilly), *Glochidion* spp. (cheese trees) and *Melaleuca* spp. (paperbarks) may be present as subordinate species, and are found most frequently in stands of the community northwards from Gosford. Tree diversity decreases with latitude, and Melaleuca ericifolia is the only abundant tree in this community south of Bermagui.	Endangered	Not listed	None – Not recorded during the field survey. No vegetation communities dominated by the characteristic species listed were recorded. Not previously mapped within the Subject Land.
River-flat eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	The TEC is found on the river flats of the coastal floodplains. It has a tall open tree layer of eucalypts, which may exceed 40 m in height, but can be considerably shorter in regrowth stands or under conditions of lower site quality. While the composition of the tree stratum varies considerably, the most widespread and abundant dominant trees include *Eucalyptus tereticornis* (forest red gum), *E. amplifolia* (cabbage gum), *Angophora floribunda* (rough-barked apple) and *A. subvelutina* (broad-leaved apple). *Eucalyptus baueriana* (blue box), *E. botryoides* (bangalay) and *E. elata* (river peppermint) may be common south from Sydney, *E. ovat*a (swamp gum) occurs on the far south coast, *E. saligna* (Sydney blue gum) and *E. grandis* (flooded gum) may occur north of Sydney, while E. *benthamii* is restricted to the Hawkesbury floodplain.	Endangered	Not listed	None – Not recorded during the field survey. Not previously mapped within the Subject Land.

Threatened Ecological Community	Description	BC Act listing	EPBC Act listing	Likelihood of occurrence
	A layer of small trees may be present, including *Melaleuca decora, M. styphelioides* (prickly-leaved teatree), *Backhousia myrtifolia* (grey myrtle), *Melia azaderach* (white cedar), *Casuarina cunninghamiana* (river oak) and *C. glauca* (swamp oak). The groundcover is composed of abundant forbs, scramblers and grasses including *Microlaena stipoides, Dichondra repens, Glycine clandestina, Oplismenus aemulus, Desmodium gunnii, Pratia purpurascens, Entolasia marginata, Oxalis perennans* and *Veronica plebeia*.			
Coastal Upland Swamps in the Sydney Basin Bioregion	Coastal Upland Swamp in the Sydney Basin Bioregion is the name given to the ecological community in the Sydney Basin bioregion associated with periodically waterlogged soils on Hawkesbury sandstone plateaus, generally where mean annual rainfall exceeds 950 mm. Coastal Upland Swamp is generally associated with soils that are acidic and vary from yellow or grey mineral sandy loams with a shallow organic horizon to highly organic spongy black peats with pallid subsoils. They vary in depth from a few centimetres (cm) to at least 4 m. The vegetation is dominated by sclerophyll shrubs and/or sedges, with dynamic mosaics of structural forms that may include tall scrub, open heath and/or sedgeland. Although typically treeless, Coastal Upland Swamp may include scattered trees. In NSW all sites are within the Sydney Basin Bioregion.	Endangered	Endangered	Known to occur within the Subject Land. Vegetation units recorded during the field survey that align to the TEC include: Coastal Upland Swamps: Banksia Thicket, Coastal Upland Swamps: Tea-Tree Thicket, and Coastal Upland Swamps: Sedgeland-Heath Complex. Note: Upland Swamp Fringing Eucalypt Woodland is not considered to form part of this EEC.
Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion	The Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion is typically tall open eucalypt forests found on basalt and basalt-like substrates in, or adjacent to, the Sydney Basin Bioregion. The Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion is generally confined to the Sydney Basin bioregion in NSW. However, parts of its southern extent at Sassafras, east of Nerriga, NSW may occur just outside the Sydney Basin bioregion boundary. Similarly, patches of the ecological community in the vicinity of Mt Werong, Boyd Plateau and Jenolan Caves occur immediately west of the Sydney Basin bioregion boundary. The ecological community predominantly occupies the Moss Vale, Ettrema, Burragorang, Sydney Cataract, and Wollemi IBRA sub-regions, and may also be present in the Kanangra and Oberon IBRA sub-regions (South Eastern Highlands bioregion) to the west of the Sydney Basin. The ecological community usually occurs at elevations between 650 m and 1050 m above sea level (a.s.l.), although outliers may occur at elevations as low as 350 m (e.g. closer to the coast) or as high as 1200 m a.s.l. (e.g. on higher plateau areas). The structure of the ecological community varies from tall open forest to woodland depending on aspect, slope, soil conditions, soil depth, and previous disturbance. Typically, the ecological community has a sparse to dense layer of shrubs and vines, and a diverse understorey of native grasses, forbs, twiners and ferns.	Endangered	Endangered	None – Outside of the known distribution of the community. Not recorded during field survey. Not previously mapped within the Subject Land.
Shale Sandstone Transition Forest of the Sydney Basin Bioregion	Occurs at the edges of the Cumberland Plain, where clay soils from the shale rock intergrade with earthy and sandy soils from sandstone, or where shale caps overlay sandstone. The boundaries are indistinct, and the species composition varies depending on the soil influences. The main tree species include Forest Red Gum (*Eucalyptus tereticornis*), Grey Gum (*E. punctata*), stringybarks (*E. globoidea, E. eugenioides*) and ironbarks (*E. fibrosa* and *E. crebra*). Areas of low sandstone influence (more clay-loam soil texture) have an understorey that is closer to Cumberland Plain Woodland. Shale Sandstone Transition Forest in the Sydney Basin Bioregion contains many more species than described for the canopy (above) and other references should be consulted to identify these.	Critically Endangered	Critically Endangered	Known. Recorded within the Subject Land. Vegetation mapping units Transitional Shale Dry Ironbark Forest and Transitional Shale Stringybark Forest align to the TEC.

Threatened Ecological Community	Description	BC Act listing	EPBC Act listing	Likelihood of occurrence
Southern Highlands Shale Forest and Woodland in the Sydney Basin Bioregion	Southern Highlands Shale Woodland is confined to a small area in the Southern Highlands. It occurs roughly within an area bounded by the Illawarra Escarpment in the east, Burrawang and Bundanoon in the south, Canyonleigh in the west and Berrima and Colo Vale in the north. Occurs in the Wingecarribee local government area, but may occur elsewhere in the Sydney Basin Bioregion. Southern Highlands Shale Woodland is a variable community in terms of both structure and composition. The community may exist as tall open forest, grassy woodland or scrub; though it originally existed as woodland. The dominant canopy species vary across the distribution of the community. Common species throughout much of the community's range are Mountain Grey Gum *Eucalyptus cypellocarpa,* Sydney Peppermint *E. piperita,* Swamp Gum *E. ovata*, Narrow-leafed Peppermint *E. radiata* and White Stringybark *E. globoidea*. Brittle Gum *E. mannifera*, Snow Gum *E. pauciflora*, Cabbage Gum *E. amplifolia* and Rough-barked Apple *Angophora floribunda* are less common. Camden Woollybutt *E. macarthurii* occurs throughout, but appears to be most common in the south-west of the distribution of the community, around Bundanoon. The shrub layer is usually open, though there may be denser patches of shrubs in some areas. As with the canopy layer, the shrub layer of this community varies (e.g. typical species in the north-eastern parts of the distribution of the community include *Oxylobium ilicifolium, Melalueca thymifolia* and *Olearia microphylla*, while in south-western areas these species are rare or absent and *Daviesia ulicifolia* may be locally common). The groundlayer is usually diverse and dominated by native grasses such as *Themeda australis, Austrostipa rudis, Microlaena stipoides* and *Austrodanthonia species.* Common herb species include G*onocarpus tetragynus, Veronica plebeia, Hypericum gramineum, Poranthera microphylla* and *Viola hederacea*.	Critically Endangered	Critically Endangered	None – Outside the known occurrence. Not recorded during field survey. Not previously mapped within the Subject Land.
Western Sydney Dry Rainforest and Moist Woodland on Shale	Very restricted and occurs most commonly in the far southern section of the Cumberland Plain, in the Razorback Range near Picton. Outlying occurrences have been recorded at Grose Vale and Cattai. There are 338 ha remaining intact, the majority of these occurring in the Wollondilly local government area, but occurring to a lesser extent in the Baulkham Hills, Camden, Hawkesbury, Parramatta and Ryde local government areas. A small remnant can be seen in Fairfield City Farm. A dry vine scrub community of the Cumberland Plain, western Sydney. Canopy trees include Prickly Paperbark *(Melaleuca styphelioides*), Hickory Wattle (*Acacia implexa*) and Native Quince (*Alectryon subcinereus*). There are many rainforest species in the shrub layer, such as Mock Olive (*Notolaea longifolia*), Hairy Clerodendrum (*Clerodendrum tomentosum*) and Yellow Pittosporum (*Pittosporum revolutum*). The shrub layer combines with vines, such as Gum Vine (*Aphanopetalum resinosum*), Wonga Vine (*Pandorea pandorana*) and Slender Grape (C*ayratia clematidea*) to form dense thickets in sheltered locations. Contains many more species and other references should be consulted to identify these.	Critically Endangered	Critically Endangered	None – Not recorded during the field survey. Not previously mapped within the Subject Land.
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Box-Gum Woodland is found from the Queensland border in the north, to the Victorian border in the south. It occurs in the tablelands and western slopes of NSW. White Box Yellow Box Blakely's Red Gum Woodland (commonly referred to as Box-Gum Woodland) is an open woodland community (sometimes occurring as a forest formation), in which the most obvious species are one or more of the following: White Box *Eucalyptus albens*, Yellow Box *E. melliodora* and Blakely's Red Gum *E. blakelyi.* Intact sites contain a high diversity of plant species, including the main tree species, additional tree species, some shrub species, several climbing plant species, many grasses and a very high diversity of herbs. The community also includes a range of mammal, bird, reptile, frog and invertebrate fauna species. Intact stands that contain diverse upper and midstoreys and groundlayers are rare.	Critically Endangered	Critically Endangered	None – Outside of the known extent of the community. Not recorded during field survey. Not previously mapped within the Subject Land.

Threatened Ecological Community	Description	BC Act listing	EPBC Act listing	Likelihood of occurrence
Turpentine-Ironbark Forest in the Sydney Basin Bioregion	Occurs in Sydney and is heavily fragmented, with only 0.5% its original extent remaining intact. Remnants mostly occur in the Baulkham Hills, Hornsby, Ku-ring-gai, Parramatta, Ryde, Sutherland and Hurstville local government areas. Good examples can be seen in small reserves such as Wallumatta Nature Reserve and Newington Nature Reserve. A similar form of the community occurs more widely (particularly in the Wollondilly and Hawkesbury areas) but this is outside the nominated councils that are included in the determination (Ashfield, Auburn, Canterbury, Concord, Drummoyne, Leichhardt, Marrickville, Bankstown, Ryde, Hunters Hill, Baulkham Hills, Ku-ring-gai, Hornsby, Parramatta, Bankstown, Rockdale, Kogarah, Hurstville and Sutherland). This form could be equated to Blue Mountains Shale Cap Forest, although the correlation is less strong for Wollondilly (which is not mentioned in that determination). Open forest, with dominant canopy trees including Turpentine S*yncarpia glomulifera*, Grey Gum *Eucalyptus punctata,* Grey Ironbark *E. paniculata* and Thin-leaved Stringybark *E. eugenoides.* In areas of high rainfall (over 1050 mm per annum) Sydney Blue Gum *E. saligna* is more dominant. The shrub stratum is usually sparse and may contain mesic species such as Sweet Pittosporum *undulatum* and Elderberry Panax P*olyscias sambucifolia*. Contains many more species and other references should be consulted to identify these.	Endangered	Critically Endangered	None – Not recorded during the field survey. Not previously mapped within the Subject Land.

Table 58. Threatened flora likelihood of occurrence

Common Name	Scientific Name	EPBC Act	BC Act	Habitat	Likelihood of occurrence within sensitive subsidence features within Subject Land	Likelihood of occurrence within areas proposed for surface infrastructure (direct impacts)
Threatened flora						
	Acacia baueri ssp. aspera	-	V	Grows in low heath, often on exposed sandstone ridges. Occurs chiefly in the Blue Mountains, but also near Mount Keira and reported from Royal National Park.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.
Bynoe's Wattle	*Acacia bynoeana*	V	E	Grows mainly in heath and dry sclerophyll forest in sandy soils. Mainly south of Dora Creek-Morisset area to Berrima and the Illawarra region, west to the Blue Mountains, also recorded from near Kurri Kurri in the Hunter Valley and from Morton National Park.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.
	Allocasuarina glareicola	E	E	Primarily restricted to the Richmond (NW Cumberland Plain) district, but with an outlier population found at Voyager Point, Liverpool.	Low –not detected during field survey. No previous records within Subject Land.	None –not detected during field survey. No previous records within Subject Land.
Lesser Creeping Fern	*Arthropteris palisotii*	-	E	May be extinct in NSW. Found in rainforest where it usually grows on tree trunks.	Low –not detected during field survey. No previous records within Subject Land.	None –not detected during field survey. No previous records within Subject Land.
Tessellated Spider Orchid	*Caladenia tessellata*	V	E	The Tessellated Spider Orchid is found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil. Known from the Sydney area (old records), Wyong, Ulladulla and Braidwood in NSW. Populations in Kiama and Queanbeyan are presumed extinct.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.
Dwarf Kerrawang	*Commersonia prostrata*	E	E	Dwarf Kerrawang is a ground-hugging shrub that forms mats to more than 1 m across. Flowering is mainly between October and November. Dwarf Kerrawang occurs on the Southern Highlands and Southern Tablelands (a small population near the Corang and about 2000 plants at Rowes Lagoon), a larger population in the Thirlmere Lakes area, and on the North Coast (less than 100 plants at the Tomago sandbeds north of Newcastle).	Low –not detected during field survey. No previous records within Subject Land.	None –not detected during field survey. No previous records within Subject Land.
Leafless Tongue Orchid	*Cryptostylis hunteriana*	V	V	Grows in swamp-heath on sandy soils, chiefly in coastal districts, south from the Gibraltar Range.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.
White-flowered Wax Plant	*Cynanchum elegans*	E	E	Recorded from rainforest gullies scrub and steep slopes from the Gloucester district to the Wollongong area and inland to Mt Dangar.	Low - not detected during field survey. No previous records within Subject Land.	None –not detected during field survey. No previous records within Subject Land.
Illawarra Socketwood	*Daphnandra sp. C 'Illawarra' (Daphnandra johnsonii)*	E	E	Restricted to rainforest and moist eucalypt forest along rocky hillsides and gullies of the Illawarra lowlands, occasionally extending onto the upper escarpment slopes on the Illawarra lowlands where it has been recorded from the local government areas of Shoalhaven, Kiama, Shellharbour and Wollongong.	Low – relatively conspicuous and not detected during field survey. No previous records within Subject Land.	None – relatively conspicuous and not detected during field survey. No previous records within Subject Land.
	Epacris purpurascens var. purpurascens	-	V	Grows in sclerophyll forest, scrubs and swamps on sandstone from Gosford and Sydney districts.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.

Common Name	Scientific Name	EPBC Act	BC Act	Habitat	Likelihood of occurrence within sensitive subsidence features within Subject Land	Likelihood of occurrence within areas proposed for surface infrastructure (direct impacts)
	Eucalyptus macarthurii	V	E	A moderately restricted distribution, recorded from the Moss Vale District to Kanangra Boyd National Park. In the Southern Highlands it occurs mainly on private land, often as isolated individuals in, or on the edges, of paddocks. Isolated stands occur in the north west part of the range on the Boyd Plateau. The only known record in the conservation estate is within Kanangra Boyd National Park. Occurs on grassy woodland on relatively fertile soils on broad cold flats.	Low – relatively conspicuous and not detected during field survey. No previous records within Subject Land.	None – relatively conspicuous and not detected during field survey. No previous records within Subject Land.
	Genoplesium baueri	E	E	Grows in dry sclerophyll forest and moss gardens over sandstone. Flowers February to March. Has been recorded between Ulladulla and Port Stephens. Currently the species is known from just over 200 plants across 13 sites. The species has been recorded in Berowra Valley Regional Park, Royal National Park and Lane Cove National Park and may also occur in the Woronora, O'Hares, Metropolitan and Warragamba Catchments.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.
Small-flower Grevillea	*Grevillea parviflora ssp. parviflora*	V	V	Grows in heathy associations or shrubby woodland, in sandy or light clay soils usually over shale substrates. Occurs west and south of Sydney from west of Prospect (where now almost certainly extinct), Kemps Creek and lower Georges River south to Camden, Appin and Cordeaux Dam, with disjunct northern populations south of Putty and near Cessnock and Cooranbong, possibly also south of Moss Vale.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.
Grevillea raybrownii	*Grevillea raybrownii*	V	V	Generally, occurs on ridgetops and, less often, slopes and benches of Hawkesbury Sandstone and Mittagong Formation. It occurs in Eucalyptus open forest and woodland with a shrubby understorey on sandy, gravelly loam soils derived from sandstone that are low in nutrients.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.
	Haloragis exalata subsp. exalata	V	V	Occurs in 4 widely scattered localities in eastern NSW. It is disjunct distributed in the central coast, south coast and north-western slopes botanical subdivisions of NSW. The species appears to require protected and shaded damp situations in riparian habitats.	Low –not detected during field survey. No previous records within Subject Land. Outside of known range.	None –not detected during field survey. No previous records within Subject Land. Outside of known range.
Delicate Cress, Illawarra Irene	*Irenepharsus trypherus*	E	E	Typically inhabits steep rocky slopes near cliff lines and ridge tops. The species is less typically found growing out of rock crevices or on narrow benches along cliff lines. The vast majority of sites are recorded from the upper slopes of the ridge systems that extend south and east of the Illawarra escarpment, although the species has also been recorded from the deep sandstone gorges of the Shoalhaven River. Associated vegetation includes moist sclerophyll forest, Ironwood Backhousia myrtifolia thicket, and rainforest.	Low –not detected during field survey. No previous records within Subject Land.	None –not detected during field survey. No previous records within Subject Land
Woronora Beard-heath	*Leucopogon exolasius*	V	V	Grows in woodland on sandstone. Restricted to the Woronora and Grose Rivers and Stokes Creek, Royal National Park.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.
Biconvex Paperbark	*Melaleuca biconvexa*	V	V	Biconvex Paperbark generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects. Scattered and dispersed populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north.	Low – relatively conspicuous and not detected during field survey. No previous records within Subject Land.	None – relatively conspicuous and not detected during field survey. No previous records within Subject Land.
Dean's Melaleuca	*Melaleuca deanei*	V	V	Grows in wet heath on sandstone in coastal districts from Berowra to Nowra.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.

Common Name	Scientific Name	EPBC Act	BC Act	Habitat	Likelihood of occurrence within sensitive subsidence features within Subject Land	Likelihood of occurrence within areas proposed for surface infrastructure (direct impacts)
	Pelargonium sp. Striatellum	E	-	Flowering occurs from October to March. Occurs in habitat usually located just above the high water level of irregularly inundated or ephemeral lakes. During dry periods, the species is known to colonise exposed lake beds. The species is known to form clonal colonies by rhizomatous propagation.	Low – not detected during field survey. No previous records within Subject Land.	None –not detected during field survey. No previous records within Subject Land.
	Persoonia acerosa	V	V	Occurs in heath or dry sclerophyll forest on sandstone, from central Blue Mountains south to Hill Top.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.
Bargo Geebung	*Persoonia bargoensis*	V	E	Occurs in woodland to dry sclerophyll forest, on sandstone and laterite. Restricted to the Bargo area; between Picton, Douglas Park, Yanderra, Cataract River and Thirlmere.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.
	Persoonia glaucescens	V	E	The Mittagong Geebung's historical distribution places the northern and eastern limit at Couridjah (Thirlmere Lakes), the southern limit at Fitzroy Falls and the western limit at High Range. However, recent surveys have indicated that the species no longer extends to Fitzroy Falls or Kangaloon and that the present southern limit is near Berrima. The northern limit appears to have contracted a few km south to Buxton.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.
	Persoonia hirsuta	E	E	The Hairy Geebung is found in sandy soils in dry sclerophyll open forest, woodland and heath on sandstone.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.
Spiked Rice-flower	*Pimelea spicata*	E	E	Grows on the coast from Lansdowne to Shellharbour and inland to Penrith. In western Sydney, restricted to Cumberland Plain, including disturbed areas that do not support native vegetation. In the coastal Illawarra it occurs commonly in Coast Banksia Open Woodland.	Low – relatively conspicuous and not detected during field survey. No previous records within Subject Land.	None – relatively conspicuous and not detected during field survey. No previous records within Subject Land.
Rufous Pomaderris	*Pomaderris brunnea*	V	E	Rufous Pomaderris grows in moist woodland or forest on clay and alluvial soils of flood plains and creek lines in association with Eucalyptus amplifolia, Angophora floribunda, Acacia parramattensis, Bursaria spinosa and Kunzea ambigua.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.
	Prasophyllum fuscum	V	CE	The type specimen is from "moist meadows towards the Georges River" in the Sydney area. The species is likely to be extinct from this area. Harden (1993) states that it is confined to the Blue Mountains area. However, some authorities believe Prasophyllum species from this area are not P. fuscum, but an undescribed species. In addition, some authorities believe it is identical to P. uroglossum which occurs in the Wingecarribee area.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.
Illawarra Greenhood	*Pterostylis gibbosa*	E	E	Grows in open forest or woodland, on flat or gently sloping land with poor drainage. Known from a small number of populations in the Hunter region (Milbrodale), the Illawarra region (Albion Park and Yallah) and the Shoalhaven region (near Nowra).	Regarded as a candidate species in BAM-C. Assessed in section 2.5.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.
Sydney Plains Greenhood	*Pterostylis saxicola*	E	E	Restricted to western Sydney between Freemans Reach in the north and Picton in the south. Most commonly found growing in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. The vegetation communities above the shelves where Pterostylis saxicola occurs are sclerophyll forest or woodland on shale/sandstone transition soils or shale soils.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.
Prickly Bush-pea	*Pultenaea aristata*	V	V	Grows in moist, dry sclerophyll woodland to heath on sandstone, specifically the drier areas of Coastal Upland Swamps. Restricted to the Woronora Plateau, a small area between Helensburgh, south of Sydney, and Mt Keira above Wollongong.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.

Common Name	Scientific Name	EPBC Act	BC Act	Habitat	Likelihood of occurrence within sensitive subsidence features within Subject Land	Likelihood of occurrence within areas proposed for surface infrastructure (direct impacts)
	Pultenaea glabra	V	V	Restricted to the higher Blue Mountains and has been recorded from the Katoomba-Hazelbrook and Mount Victoria areas, with unconfirmed sightings in the Mount Wilson and Mount Irvine areas. All known populations occur within the Blue Mountains Local Government Area	Low – relatively conspicuous and not detected during field survey. No previous records within Subject Land.	None – relatively conspicuous and not detected during field survey. No previous records within Subject Land.
Scrub Turpentine, Brown Mallet wood	*Rhodamnia rubescens*	CE	CE	Found in littoral, warm temperate and subtropical rainforest, and wet sclerophyll forest usually on volcanic and sedimentary soils. Populations of R. rubescens typically occur in coastal regions and occasionally extend inland onto escarpments up to 600 m a.s.l. in areas with rainfall of 1,000-1,600 mm.	Low – associated with rainforest communities. Subject Land not within known locations.	None – not detected during field survey.
Native Guava	*Rhodomyrtus psidiodies*	CE	CE7	Pioneer species found in littoral, warm temperate and subtropical rainforest, and wet sclerophyll forest often near creeks and drainage lines. Populations are typically restricted to coastal and sub-coastal areas of low elevation however the species does occur up to c. 120 km inland in the Hunter and Clarence River catchments and along the Border Ranges in NSW.	Low – habitat is associated with the habitat of R. psidioides is likely to include the following vegetation types: Subtropical Rainforests, Warm Temperate Rainforests, Littoral Rainforest, and Wet Sclerophyll Forests. The species was not detected during field survey.	None- not detected during field survey.
Rainforest Cassia	*Senna acclinis*	-	E	Coastal districts and adjacent tablelands of NSW from the Illawarra in NSW to Queensland. Grows in or on the edges of subtropical and dry rainforest.	Low – relatively conspicuous and not detected during field survey. No previous records within Subject Land.	None – relatively conspicuous and not detected during field survey. No previous records within Subject Land.
	Solanum celatum	-	E	Grows on hills and slopes in eucalypt woodland; commonly found after fire or disturbance. Restricted to an area from Wollongong to a little south of Nowra and west to Bungonia Nature Reserve.	Low – relatively conspicuous and not detected during field survey. No previous records within Subject Land.	None – relatively conspicuous and not detected during field survey. No previous records within Subject Land.
Magenta Lilly Pilly	*Syzygium paniculatum*	V	E	On the south coast the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. The Magenta Lilly Pilly is found only in NSW, in a narrow, linear coastal strip from Upper Lansdowne to Conjola State Forest.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.
Kangaloon Sun-orchid	*Thelymitra sp. Kangaloon*	Z	CE	Recorded from shallow black peaty soil in coastal heath on sandstone. Thelymitra sp. Kangaloon is a terrestrial orchid endemic to New South Wales, and is known from three locations near Robertson in the Southern Highlands.	None – Thelymitra sp. Kangaloon is only known to occur on the southern tablelands of NSW in the Moss Vale / Kangaloon / Fitzroy Falls area. The closest population occurs in Budderoo National Park. It is found in swamps in sedgelands over grey silty grey loam soils and is thought to be a short-lived perennial, flowering in late October and early November. The species has not been previously recorded during any previous surveys within the Dendrobium domain or surrounds. It is unlikely the species occurs within the Subject Land. It was	None –not detected during field survey. No previous records within Subject Land. Outside of known range.

Common Name	Scientific Name	EPBC Act	BC Act	Habitat	Likelihood of occurrence within sensitive subsidence features within Subject Land	Likelihood of occurrence within areas proposed for surface infrastructure (direct impacts)
					not recorded during the field survey despite being undertaken during the flowering time for the species.	
	Thesium australe	V	V	Grows in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania and Queensland and in eastern Asia. Occurs in grassland or grassy woodland. Grows on kangaroo grass tussocks but has also been recorded within the exotic Coolatai grass.	Low – not detected during field survey. No previous records within Subject Land. Outside of known range.	None –not detected during field survey. No previous records within Subject Land. Outside of known range.
Swamp Paper Daisy	*Xerochrysum palustre*	V	-	Swamp Everlasting grows in wetlands including sedge-swamps and shallow freshwater marshes, often on heavy black clay soils. In New South Wales it occurs as far north as the Southern Tablelands and ranges up to about 1300 m altitude. Cited from https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=76215	Low– Outside the known distribution of the species.	None –not detected during field survey. No previous records within Subject Land. Outside of known range.
Hill Zieria, Hilly Zieria, Illawarra Zieria	*Zieria granulata*	E	E	The typical habitat is dry ridge tops and rocky outcrops on shallow volcanic soils, usually on Bumbo Latite. Less frequently found on the moist slopes of the Illawarra escarpment and in low-lying areas on Quaternary sediments.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.	Regarded as a candidate species in BAM-C. Assessed in section 2.5.

Table 59: Threatened fauna likelihood of occurrence

Common Name	Scientific Name	EPBC Act	BC Act	Habitat[3]	Likelihood of occurrence within sensitive subsidence features within Subject Land	Likelihood of occurrence within areas proposed for surface infrastructure (direct impacts)
Common Sandpiper	*Actitis hypoleucos*	M	-	The Common Sandpiper utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats. The Common Sandpiper has been recorded in estuaries and deltas of streams, as well as on banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans, and occasionally piers and jetties. The muddy margins utilised by the species are often narrow, and may be steep. The species is often associated with mangroves, and sometimes found in areas of mud littered with rocks or snags (Geering et al. 2007; Higgins & Davies 1996).	Low	Low
Regent Honeyeater	*Anthochaera phrygia*	CE	CE	The Regent Honeyeater mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Birds are also found in drier coastal woodlands and forests in some years. There are only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundarra-Barraba region. In NSW, the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. In some years flocks converge on flowering coastal woodlands and forests.	Regarded as a Candidate species. Assessed in section 2.6.	Regarded as a Candidate species. Assessed in section 2.6.
Fork-tailed Swift	*Apus pacificus*	M	-	The Fork-tailed Swift leaves its breeding grounds in Siberia from August–September and usually arrives in Australia around October. The Fork-tailed Swift is almost exclusively aerial. It does not breed in Australia. The Fork-tailed Swift is an aerial eater, flying anywhere from 1 m to 300 m above the ground to forage. They forage along the edge of low pressure systems and for that reason are considered a precursor to unsettled weather. They often occur over cliffs and beaches and also over islands and sometimes well out to sea.	Moderate. Assessed in section 2.6.	Moderate. Assessed in section 2.6.
Blue Whale	*Balaenoptera musculus*	E	E	No habitat at site	None	None
Silver Perch	*Bidyanus bidyanus*	CE	-	Silver perch are endemic to the Murray-Darling system (including all states and sub-basins). Silver perch are a highly migratory freshwater fish. A translocated population exists within Cataract Dam approximately 15 kilometres north of the Subsidence Assessment Subject Land, unconnected to Avon Dam. Silver Perch is not known from Avon Dam or connected waterways downstream of the Subsidence Assessment Subject Land. In addition, the species habitat requirements, preference for more open water systems and the presence of barriers to passage mean the species would in any case be highly unlikely to occur in the Subsidence Assessment Subject Land.	None	None

Common Name	Scientific Name	EPBC Act	BC Act	Habitat[3]	Likelihood of occurrence within sensitive subsidence features within Subject Land	Likelihood of occurrence within areas proposed for surface infrastructure (direct impacts)
Australasian Bittern	*Botaurus poiciloptilus*	E	E	The Australasian Bittern is widespread but uncommon over south-eastern Australia. In NSW they may be found over most of the state except for the far north-west. Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes and spikerushes.	Low – Not recorded preferred habitat absent.	Low – Not recorded preferred habitat absent.
Sharp-tailed Sandpiper	*Calidris acuminata*	M	-	In Australasia, the Sharp-tailed Sandpiper prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, saltpans and hypersaline saltlakes inland. They also occur in saltworks and sewage farms. They use flooded paddocks, sedgelands and other ephemeral wetlands, but leave when they dry.	Low	Low
Curlew Sandpiper	*Calidris ferruginea*	CE, M	E	It generally occupies littoral and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats of sheltered coasts. It also occurs in non-tidal swamps, lakes, and lagoons on the coast and sometimes inland. It occurs along the entire coast of NSW, particularly in the Hunter Estuary, and sometimes in freshwater wetlands in the Murray-Darling Basin. Inland records are mainly of birds pausing for a few days during migration.	Low– habitat preference is absent.	Low– habitat preference is absent.
Pectoral Sandpiper	*Calidris melanotos*	Mi	-	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.	Low	Low
Red Knot, Knot	*Calidris canutus*	E, M	-	In NSW, the Red Knot mainly occurs in small numbers on intertidal mudflats, estuaries, bays, inlets, lagoons, harbours and sandflats and sandy beaches of sheltered coasts. It is occasionally found on sandy ocean beaches or shallow pools on exposed wave-cut rock platforms and is a rare visitor to terrestrial saline wetlands and freshwater swamps.	None	None
Gang-gang Cockatoo	*Callocephalon fimbriatum*	-	V	In summer, occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. Also occur in subalpine snow gum woodland and occasionally in temperate or regenerating forest. In winter, occurs at lower altitudes in drier, more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas. It requires tree hollows in which to breed.	Regarded as a candidate species. Assessed in section 2.6.	Regarded as a candidate species. Assessed in section 2.6.
Glossy Black-Cockatoo	*Calyptorhynchus lathami*	-	V	Inhabits forest with low nutrients, characteristically with key Allocasuarina spp. Tends to prefer drier forest types with a middle stratum of Allocasuarina below Eucalyptus or Angophora. Often confined to remnant patches in hills and gullies. Breed in hollows stumps or limbs, either living or dead. Endangered population in the Riverina.	Regarded as a candidate species. Assessed in section 2.6.	Regarded as a candidate species. Assessed in section 2.6.

Common Name	Scientific Name	EPBC Act	BC Act	Habitat[3]	Likelihood of occurrence within sensitive subsidence features within Subject Land	Likelihood of occurrence within areas proposed for surface infrastructure (direct impacts)
Grey Nurse Shark (east coast population)	*Carcharias taurus (east coast population)*	CE	CE	No habitat at site.	None	None
White Shark, Great White Shark	*Carcharodon carcharias*	V	-	No habitat at site	None	None
Loggerhead Turtle	*Caretta caretta*	E	E	In NSW they are seen as far south as Jervis Bay and have been recorded nesting on the NSW north coast and feeding around Sydney. Loggerhead Turtles are ocean-dwellers, foraging in deeper water for fish, jellyfish, and bottom-dwelling animals. The female comes ashore to lay her eggs in a hole dug on the beach in tropical regions during the warmer months.	None	None
Eastern Pygmy-possum	*Cercartetus nanus*	-	V	Inhabits rainforest through to sclerophyll forest and tree heath. Banksias and myrtaceous shrubs and trees are a favoured food source. Will often nest in tree hollows, but can also construct its own nest. Because of its small size it is able to utilise a range of hollow sizes including very small hollows. Individuals will use a number of different hollows and an individual has been recorded using up to 9 nest sites within a 0.5ha area over a 5 month period.	Regarded as a Candidate species. Assessed in section 2.6.	Regarded as a Candidate species. Assessed in section 2.6.
Large-eared Pied Bat	*Chalinolobus dwyeri*	V	V	Located in a variety of drier habitats, including the dry sclerophyll forests and woodlands to the east and west of the Great Dividing Range. Can also be found on the edges of rainforests and in wet sclerophyll forests. This species roosts in caves and mines in groups of between 3 and 37 individuals.	Regarded as a Candidate species. Assessed in section 2.6.	Regarded as a Candidate species. Assessed in section 2.6.
Greater Sand Plover, Large Sand Plover	*Charadrius leschenaultii*	V, M	V	Almost entirely restricted to coastal areas in NSW, occurring mainly on sheltered sandy, shelly, or muddy beaches or estuaries with large intertidal mudflats or sandbanks.	None	None
Green Turtle	*Chelonia mydas*	V	V	Ocean-dwelling species spending most of its life at sea.	None	None
Oriental Cuckoo	*Cuculus optatus*	M	-	The Oriental Cuckoo is a regular migrant to Australia, where it spends the non-breeding season (Sept- May) in coastal regions across northern and eastern Australia as well as offshore islands. The species uses a range of vegetated habitats such as monsoon rainforest, wet sclerophyll forest, open woodlands and appears quite often along edges of forests, or ecotones between forest types.	Low	Low
Varied Sittella	*Daphoenositta chrysoptera*	-	V	Inhabits wide variety of dry eucalypt forests and woodlands, usually with either shrubby under storey or grassy ground cover or both, in all climatic zones of Australia. Usually in areas with rough-barked trees, such as	Regarded as a Predicted species. Assessed in section 2.4.	Regarded as a Predicted species. Assessed in section 2.4.

Common Name	Scientific Name	EPBC Act	BC Act	Habitat[3]	Likelihood of occurrence within sensitive subsidence features within Subject Land	Likelihood of occurrence within areas proposed for surface infrastructure (direct impacts)
				stringybarks or ironbarks, but also in paperbarks or mature eucalypts with hollows.		
Eastern Bristlebird	*Dasyornis brachypterus*	E	E	Found in coastal woodlands, dense scrub, and heathlands, particularly where it borders taller woodlands.	Regarded as a Candidate species. Assessed in section 2.6.	Regarded as a Candidate species. Assessed in section 2.6.
Spotted-tailed Quoll	*Dasyurus maculatus maculatus*	E	V	Spotted-tailed Quoll are found on the east coast of NSW, Tasmania, eastern Victoria, and north-eastern Queensland. Only in Tasmania is it still considered common. 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.	Regarded as a Predicted species. Assessed in section 2.4. Unlikley to occur.	Regarded as a Predicted species. Assessed in section 2.4. Unlikley to occur.
Leatherback Turtle, Leathery Turtle, Luth	*Dermochelys coriacea*	E	E	Occurs in inshore and offshore marine waters.	None	None
Antipodean Albatross	*Diomedea antipodensis*	V	V	This species regularly occurs in small numbers off the NSW south coast from Green Cape to Newcastle during winter where they feed on cuttlefish.	None	None
Gibson's Albatross	*Diomedea antipodensis gibsoni*	V	V	This species regularly occurs off the NSW coast from Green Cape to Newcastle. Although representing a small proportion on its total foraging area, potential forage in NSW waters during the winter is nonetheless considered significant for the species.	None	None
Southern Royal Albatross	*Diomedea epomophora*	V	-	No habitat at site.	None	None
Wandering Albatross	Diomedea exulans	E	E	Wandering albatross spend the majority of their time in flight, soaring over the southern oceans.	None	None
Northern Royal Albatross	Diomedea sanfordi	E	-	It is a rare visitor to NSW waters, predominantly visiting southern waters in the winter and early spring period. The Northern Royal Albatross primarily forages in inshore and offshore waters over the continental shelf to the shelf edge.	None	None
Black Rockcod, Black Cod, Saddled Rockcod	*Epinephelus daemelii*	V	-	The NSW coastline forms the species' main range, both in Australia and internationally. Black cod are known to occur to some degree in all six NSW Marine Parks – Lord Howe, Cape Byron, Solitary Island, Port Stephens, Jervis Bay and Batemans Bay. The black cod's entire range includes warm temperate and subtropical waters of the southwestern Pacific, including south-eastern Australia.	None	None
Hawksbill Turtle	*Eretmochelys imbricata*	V	-	Hawksbill Turtles have been seen in temperate regions as far south as northern NSW	None	None

Common Name	Scientific Name	EPBC Act	BC Act	Habitat[3]	Likelihood of occurrence within sensitive subsidence features within Subject Land	Likelihood of occurrence within areas proposed for surface infrastructure (direct impacts)
Southern Right Whale	*Eubalaena australis*	E	E	No habitat at site.	None	None
Grey Falcon	*Falco hypoleucos*	V	E	Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast. The Grey Falcon is sparsely distributed in NSW, chiefly throughout the Murray-Darling Basin, with the occasional vagrant east of the Great Dividing Range.	Low– Outside of the known distribution of the species.	Low– Outside of the known distribution of the species.
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	-	V	Inhabit sclerophyll forests, preferring wet habitats where trees are more than 20 m high. Two observations have been made of roosts in stem holes of living eucalypts. There is debate about whether or not this species moves to lower altitudes during winter, or whether they remain sedentary but enter torpor. This species also appears to be highly mobile and records showing movements of up to 12 km between roosting and foraging sites.	Regarded as a Predicted species. Assessed in section 2.4.	Regarded as a Predicted species. Assessed in section 2.4.
White-bellied Storm-Petrel (Tasman Sea), White- bellied Storm-Petrel (Australasian)	*Fregetta grallaria*	V	V	Marine. In Australia breeds only on offshore islands in the Lord Howe Island group.	None	None
Latham's Snipe	*Gallinago hardwickii*	M	-	In Australia, Latham's Snipe occurs in permanent and ephemeral wetlands up to 2000 m above sea-level. They usually inhabit open, freshwater wetlands with low, dense vegetation (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies). 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.	Low	Low
Little Lorikeet	*Glossopsitta pusilla*	-	V	Distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range in NSW, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. Mostly occur in dry, open eucalypt forests and woodlands. They feed primarily on nectar and pollen in the tree canopy. Nest hollows are located at heights of between 2 m and 15 m, mostly in living, smooth-barked eucalypts. Most breeding records come from the western slopes.	Regarded as a Predicted species. Assessed in section 2.4.	Regarded as a Predicted species. Assessed in section 2.4.
Painted Honeyeater	*Grantiella picta*	V	V	The Painted Honeyeater is nomadic and occurs at low densities throughout its range. The greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria, and southern Queensland. During the winter it is more likely to be found in	Low –Not recorded during present fauna baseline study.	Low –Not recorded during present fauna baseline study.

Common Name	Scientific Name	EPBC Act	BC Act	Habitat[3]	Likelihood of occurrence within sensitive subsidence features within Subject Land	Likelihood of occurrence within areas proposed for surface infrastructure (direct impacts)
				the north of its distribution. Inhabits boree, brigalow and box-gum woodlands and box-ironbark forests.		
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	-	V	Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea.	Regarded as a Candidate species. Assessed in section 2.6.	Regarded as a Candidate species. Assessed in section 2.6.
Giant Burrowing Frog	*Heleioporus australiacus*	V	V	The Giant Burrowing Frog has been recorded breeding in a range of water bodies associated with sandy environments of the coast and adjacent ranges from the Sydney Basin to south of eastern Victoria. It breeds in hanging swamps, perennial non-flooding creeks and occasionally permanent pools, but permanent water must be present to allow its large tadpoles time to reach metamorphosis.	Regarded as a Candidate species. Assessed in section 2.6.	Regarded as a Candidate species. Assessed in section 2.6.
Little Eagle	*Hieraaetus morphnoides*	-	V	Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used.;1|Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter	Regarded as a Candidate species. Assessed in section 2.6.	Regarded as a Candidate species. Assessed in section 2.6.
White's Seahorse, Crowned Seahorse, Sydney Seahorse	*Hippocampus whitei*	E	-	No habitat at site	None.	None.
White-throated Needletail	*Hirundapus caudacutus*	V, M	-	In Australia, the White-throated Needletail is almost exclusively aerial, from heights of less than 1 m up to more than 1000 m above the ground. Although they occur over most types of habitats, they are probably recorded most often above wooded areas, including open forest and rainforest, and may also fly between trees or in clearings, below the canopy, but they are less commonly recorded flying above woodland. Cited from https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=682	Regarded as a Predicted species. Assessed in section 2.4.	Regarded as a Predicted species. Assessed in section 2.4.
Broad-headed Snake	*Hoplocephalus bungaroides*	V	E	Occurs almost exclusively in association with communities occurring on Triassic sandstone within the Sydney Basin. Typically found among exposed sandstone outcrops with vegetation types ranging from woodland to heath. Within these habitats they spend most of the year sheltering in and under rock crevices and exfoliating rock. However, some individuals will migrate to tree hollows to find shelter during hotter parts of summer.	Regarded as a Candidate species. Assessed in section 2.6.	Regarded as a Candidate species. Assessed in section 2.6.
Southern Brown Bandicoot (eastern)	*Isoodon obesulus obesulus*	E	E	Prefers sandy soils with scrubby vegetation and-or areas with low ground cover that are burn from time to time. A mosaic of post fire vegetation is important for this species.	Regarded as a Candidate species. Assessed in section 2.6.	Regarded as a Candidate species. Assessed in section 2.6.
Swift Parrot	*Lathamus discolor*	CE	E	The Swift Parrot occurs in woodlands and forests of NSW from May to August, where it feeds on eucalypt nectar, pollen, and associated insects.	Regarded as a Candidate species. Assessed in section 2.6.	Regarded as a Candidate species. Assessed in section 2.6.

Common Name	Scientific Name	EPBC Act	BC Act	Habitat[3]	Likelihood of occurrence within sensitive subsidence features within Subject Land	Likelihood of occurrence within areas proposed for surface infrastructure (direct impacts)
				The Swift Parrot is dependent on flowering resources across a wide range of habitats in its wintering grounds in NSW. This species is migratory, breeding in Tasmania and nomadic, moving about in response to changing food availability.		
Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit	*Limosa lapponica baueri*	V	-	The subspecies is most frequently recorded along major coastal river estuaries and sheltered embayment's, particularly the Tweed, Richmond, Clarence, Macleay, Hastings, Hunter and Shoalhaven River estuaries, Port Stephens, and Botany Bay. It is found mainly in coastal habitats such as 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.	None	None
Green and Golden Bell Frog	*Litoria aurea*	V	E	Inhabits a very wide range of water bodies including marshes, dams, and streams, particularly those containing emergent vegetation such as bullrushes or spikerushes. It also inhabits numerous types of manmade water bodies including quarries and sand extraction sites. Optimum habitat includes waterbodies that are un-shaded, free of predatory fish such as Plague Minnow, have a grassy area nearby and diurnal sheltering sites available.	Regarded as a Candidate species. Assessed in section 2.6.	Regarded as a Candidate species. Assessed in section 2.6.
Littlejohn's Tree Frog	*Litoria littlejohni*	V	V[22]	Occurs in wet and dry sclerophyll forests and heathland associated with sandstone outcrops between 280 and 1000 m AHD? on the eastern slopes of the Great Dividing Range from the Central Coast down into Victoria. Individuals have been collected from a wide range of water bodies that includes semi-permanent dams, permanent ponds, temporary pools, and permanent streams, with calling occurring from fringing vegetation or on the banks. Individuals have been observed sheltering under rocks on high exposed ridges during summer and within deep leaf litter adjacent to the breeding site. Calling occurs in all months of the year, often in association with heavy rains. The tadpoles are distinctive, being large and very dark in colouration.	Regarded as a Candidate species. Assessed in section 2.6.	Regarded as a Candidate species. Assessed in section 2.6.
Murray Cod	*Maccullochella peelii*	V	-	The Murray Cod utilises a diverse range of habitats from clear rocky streams, such as those found in the upper western slopes of NSW (including the ACT), to slow-flowing, turbid lowland rivers and billabongs.	Low – no known records within wider locality.	Low – no known records within wider locality.
Macquarie Perch	*Macquaria australasica*	E	-	The Macquarie Perch is a riverine, schooling species. It prefers clear water and deep, rocky holes with lots of cover. As well as aquatic vegetation, additional cover may comprise of large boulders, debris, and overhanging	Assessed in Aquatic Ecology Report	Assessed in Aquatic Ecology Report

[22] *Listed as 'Vulnerable' under the EPBC Act at the time of the "controlled action" decision (13 January 2022) and therefore assessed as 'Vulnerable' rather than 'Endangered' (refer section 158A of the EPBC Act).*

Common Name	Scientific Name	EPBC Act	BC Act	Habitat[3]	Likelihood of occurrence within sensitive subsidence features within Subject Land	Likelihood of occurrence within areas proposed for surface infrastructure (direct impacts)
				banks. Macquarie Perch have declined considerably from their historical distribution within NSW, and they are now considered isolated to the upper reaches of the Lachlan and Murrumbidgee Rivers in southern NSW. Cited from https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=66632		
Southern Giant-Petrel, Southern Giant Petrel	*Macronectes giganteus*	E	E	Over summer, the species nests in small colonies amongst open vegetation on Antarctic and subantarctic islands, including Macquarie and Heard Islands and in Australian Antarctic territory.	None	None
Northern Giant Petrel	*Macronectes halli*	V	V	They are a common visitor in NSW waters, predominantly along the south-east coast during winter and autumn.	None	None
Humpback Whale	*Megaptera novaeangliae*	V	V	No habitat at site.	None	None
Little Bentwing-bat	*Miniopterus australis*	-	V	Coastal north-eastern NSW and eastern Queensland. Little Bentwing-bat is an insectivorous bat that roost in caves, in old mines, in tunnels, under bridges, or in similar structures. They breed in large aggregations in a small number of known caves and may travel 100s km from feeding home ranges to breeding sites. Little Bentwing-bat has a preference for moist eucalypt forest, rainforest or dense coastal banksia scrub where it forages below the canopy for insects.	Regarded as a Candidate species. Assessed in section 2.6.	Regarded as a Candidate species. Assessed in section 2.6.
Large Bentwing-bat	*Miniopterus schreibersii oceanensis*	-	V	Large Bent-winged Bats occur along the east and north-west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young.	Regarded as a Candidate species. Assessed in section 2.6.	Regarded as a Candidate species. Assessed in section 2.6.
Stuttering Frog	*Mixophyes balbus*	V	E	Associated with streams in dry sclerophyll and wet sclerophyll forests and rainforests of more upland areas of the Great Dividing Range of NSW and down into Victoria. Breeding occurs along forest streams with permanent water where eggs are deposited within nests excavated in riffle zones by the females and the tadpoles swim free into the stream when large enough to do so. Outside of breeding, individuals range widely across the forest floor and can be found hundreds of metres from water.	Regarded as a Candidate species. Assessed in section 2.6.	Regarded as a Candidate species. Assessed in section 2.6.
Black-faced Monarch	*Monarcha melanopsis*	M	-	The Black-faced Monarch mainly occurs in rainforest ecosystems, including semi-deciduous vine-thickets, complex notophyll vine-forest, tropical (mesophyll) rainforest, subtropical (notophyll) rainforest, mesophyll (broadleaf) thicket/shrubland, warm temperate rainforest, dry (monsoon) rainforest and (occasionally) cool temperate rainforest	Moderate. Assessed in section 2.6.	Moderate. Assessed in section 2.6.

Common Name	Scientific Name	EPBC Act	BC Act	Habitat[3]	Likelihood of occurrence within sensitive subsidence features within Subject Land	Likelihood of occurrence within areas proposed for surface infrastructure (direct impacts)
Spectacled Monarch	*Monarcha trivirgatus*	M	-	The Spectacled Monarch occupies dense vegetation, mainly in rainforest but also in moist or wet sclerophyll forest and occasionally in other densely vegetated habitats such as mangroves, drier forest, woodlands, parks and gardens.	Moderate. Assessed in section 2.6.	Moderate. Assessed in section 2.6.
Eastern Freetail-bat	*Mormopterus norfolkensis*	-	V	Most records are from dry eucalypt forests and woodlands to the east of the Great Dividing Range. Appears to roost in trees, but little is known of this species' habits.	Regarded as an ecosystem species thus a Predicted species. Assessed in section 2.4.	Regarded as an ecosystem species thus a Predicted species. Assessed in section 2.4.
Yellow Wagtail	*Motacilla flava*	M	-	Habitat requirements for the Yellow Wagtail are highly variable, but typically include open grassy flats near water. Habitats include open areas with low vegetation such as grasslands, airstrips, pastures, sports fields; damp open areas such as muddy or grassy edges of wetlands, rivers, irrigated farmland, dams, waterholes; sewage farms, sometimes utilise tidal mudflats and edges of mangroves.	Low	Low
Satin Flycatcher	*Myiagra cyanoleuca*	M	-	Satin Flycatchers are found extensively along the Great Dividing Range along the eastern and south-east seaboard of Australia – from Cape York to eastern South Australia. Satin Flycatchers are eucalypt forest and woodland inhabitants. They are particularly common in tall wet sclerophyll forest, often in gullies or along water courses. In woodlands they prefer open, grassy woodland.	Moderate. Assessed in section 2.6.	Moderate. Assessed in section 2.6.
Flatback Turtle	*Natator depressus*	V	-	Adults inhabit soft bottom habitat over the continental shelf of northern Australia.	None	None
Turquoise Parrot	*Neophema pulchella*	-	V	The Turquoise Parrot's range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Nests in tree hollows, logs or posts, from August to December. It lays four or five white, rounded eggs on a nest of decayed wood dust.	Regarded as a Predicted species. Assessed in section 2.4.	Regarded as a Predicted species. Assessed in section 2.4.
Orange-bellied Parrot	*Neophema chrysogaster*	CE	CE	On the mainland, the Orange-bellied Parrot spends winter mostly within 3 km of the coast in sheltered coastal habitats including bays, lagoons, estuaries, coastal dunes, and saltmarshes. The species also inhabits small islands and peninsulas and occasionally saltworks and golf courses. Birds forage in low samphire herbland or taller coastal shrubland.	Low – No recent records within locality. Outside of OEH's mapped "known distribution".	Low – No recent records within locality. Outside of OEH's mapped "known distribution".
Powerful Owl	*Ninox strenua*	-	V	Occupies wet and dry eucalypt forests and rainforests. Can occupy both un-logged and lightly logged forests as well as undisturbed forests where it usually roosts on the limbs of dense trees in gully areas. It is most commonly recorded within turpentine tall open forests and black she-oak within open forests. Large mature trees with hollows at least 0.5 m deep	Regarded as a Candidate species. Assessed in section 2.6.	Regarded as a Candidate species. Assessed in section 2.6.

Common Name	Scientific Name	EPBC Act	BC Act	Habitat[3]	Likelihood of occurrence within sensitive subsidence features within Subject Land	Likelihood of occurrence within areas proposed for surface infrastructure (direct impacts)
				are required for nesting. Tree hollows are particularly important for the Powerful Owl because a large proportion of the diet is made up of hollow-dependent arboreal marsupials. Nest trees for this species are usually emergent with a diameter at breast height of at least 100 cm.		
Eastern Curlew	*Numenius madagascarensis*	CE, M	-	It generally occupies coastal lakes, inlets, bays, and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats and sometimes saltmarsh of sheltered coasts. In NSW, the species occurs across the entire coast but is mainly found in estuaries such as the Hunter River, Port Stephens, Clarence River, Richmond River and ICOLLs of the south coast.	Low– preferred habitat absent.	Low– preferred habitat absent.
Fairy Prion (southern)	*Pachyptila turtur subantarctica*	V	-	The species as a whole has a circumpolar distribution, and probably frequents subtropical waters during the non-breeding period. It has been recorded breeding on subantarctic and cool temperate islands in the Southern Hemisphere.	None	None
Eastern Osprey	*Pandion cristatus*	M	-	Adult Eastern Ospreys are mostly resident or sedentary around breeding sites within their large territories. They forage more widely but continue to make at least intermittent visits to their breeding grounds in the non-breeding season. Eastern Ospreys occur in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. They are mostly found in coastal areas but occasionally travel inland along major rivers, particularly in northern Australia.	Low	Low
Giant Dragonfly	*Petalura gigantea*	-	E	Live in permanent swamps and bogs with some free water and open vegetation.	Regarded as a Candidate species. Assessed in section 2.6.	Regarded as a Candidate species. Assessed in section 2.6.
Greater Glider	*Petauroides volans*	V	-	The greater glider is an arboreal nocturnal marsupial, largely restricted to eucalypt forests and woodlands. It is primarily folivorous, with a diet mostly comprising eucalypt leaves, and occasionally flowers. It is typically found in highest abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows. The distribution may be patchy even in suitable habitat. The greater glider favours forests with a diversity of eucalypt species, due to seasonal variation in its preferred tree species.	Regarded as a Candidate species. Assessed in section 2.6.	Regarded as a Candidate species. Assessed in section 2.6.
Yellow-bellied Glider	*Petaurus australis*	-	V	Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south. Found along the eastern coast to the western slopes of the Great Dividing Range, from southern Queensland to Victoria.	Regarded as a Predicted species. Assessed in section 2.4.	Regarded as a Predicted species. Assessed in section 2.4.

Common Name	Scientific Name	EPBC Act	BC Act	Habitat[3]	Likelihood of occurrence within sensitive subsidence features within Subject Land	Likelihood of occurrence within areas proposed for surface infrastructure (direct impacts)
Squirrel Glider	*Petaurus norfolcensis*	-	V	Generally occurs in dry sclerophyll forests and woodlands but is absent from dense coastal ranges in the southern part of its range. Requires abundant hollow bearing trees and a mix of eucalypts, banksias and acacias. There is only limited information available on den tree use by Squirrel gliders, but it has been observed using both living and dead trees as well as hollow stumps. Within a suitable vegetation community at least one species should flower heavily in winter and one species of eucalypt should be smooth barked. Endangered population in the Wagga Wagga LGA.	Regarded as a Candidate species. Assessed in section 2.6.	Regarded as a Candidate species. Assessed in section 2.6.
Brush-tailed Rock-wallaby	*Petrogale penicillata*	V	E	Found in rocky areas in a wide variety of habitats including rainforest gullies, wet and dry sclerophyll forest, open woodland, and rocky outcrops in semi-arid country. Commonly sites have a northerly aspect with numerous ledges, caves, and crevices.	Low. Not known from area.	Low. Not known from area.
Scarlet Robin	*Petroica boodang*	-	V	The Scarlet Robin is found from SE Queensland to SE South Australia and also in Tasmania and SW Western Australia. In NSW, it occurs from the coast to the inland slopes. The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs.	Regarded as a Predicted species. Assessed in section 2.4.	Regarded as a Predicted species. Assessed in section 2.4.
Flame Robin	*Petroica phoenicea*	-	V	Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes.Prefers clearings or areas with open understoreys The groundlayer of the breeding habitat is dominated by native grasses.	Regarded as a Predicted species. Assessed in section 2.4.	Regarded as a Predicted species. Assessed in section 2.4.
Ground Parrot	*Pezoporus wallicus*	V	-	The Ground Parrot occurs in high rainfall coastal and near coastal low heathlands and sedgelands, generally below 1 m in height and very dense (up to 90% projected foliage cover).	Regarded as a Candidate species. Assessed in section 2.6.	Regarded as a Candidate species. Assessed in section 2.6.
Koala	*Phascolarctos cinereus*	V	V [23]	Inhabits eucalypt forests and woodlands. The suitability of these forests for habitation depends on the size and species of trees present, soil nutrients, climate, and rainfall.	Regarded as a Candidate species. Assessed in section 2.6.	Regarded as a Candidate species. Assessed in section 2.6.
Long-nosed Potoroo	*Potorous tridactylus*	V	V	Inhabits coastal heath and wet and dry sclerophyll forests. Generally found in areas with rainfall greater than 760 mm. Requires relatively thick ground cover where the soil is light and sandy.	Low. Not generated in BAM-C. no nearby records.	Low. Not generated in BAM-C. no nearby records.
Australian Grayling	*Prototroctes maraena*	V	-	Currently, the Australian Grayling occurs in streams and rivers on the eastern and southern flanks of the Great Dividing Range, from Sydney, southwards to the Otway Ranges of Victoria and in Tasmania. The Australian Grayling is diadromous, spending part of its lifecycle in	Low. Not known from area.	Low. Not known from area.

[23] *Listed as 'Vulnerable' under the EPBC Act at the time of the "controlled action" decision (13 January 2022) and therefore assessed as 'Vulnerable' rather than 'Endangered' (refer section 158A of the EPBC Act).*

Common Name	Scientific Name	EPBC Act	BC Act	Habitat[3]	Likelihood of occurrence within sensitive subsidence features within Subject Land	Likelihood of occurrence within areas proposed for surface infrastructure (direct impacts)
				freshwater and at least part of the larval and/or juvenile stages in coastal seas.		
New Holland Mouse	*Pseudomys novaehollandiae*	V	-	The New Holland Mouse currently has a disjunct, fragmented distribution across Tasmania, Victoria, New South Wales, and Queensland. Across the species' range the New Holland Mouse is known to inhabit open heathlands, open woodlands with a heathland understorey, and vegetated sand dunes.	Regarded as a Predicted species. Assessed in section 2.4.	Regarded as a Predicted species. Assessed in section 2.4.
Red-crowned Toadlet	*Pseudophryne australis*	-	V	Occurs on wetter ridge tops and upper slopes of sandstone formations on which the predominant vegetation is dry open forests and heaths. This species typically breeds within small ephemeral creeks that feed into larger semi-perennial streams. After rain these creeks are characterised by a series of shallow pools lined by dense grasses, ferns and low shrubs and usually contain leaf litter for shelter. Eggs are terrestrial and laid under litter, vegetation or rocks where the tadpoles inside will reach a relatively late stage of development before waiting for flooding waters before hatching will occur.	Regarded as a Candidate species. Assessed in section 2.6.	Regarded as a Candidate species. Assessed in section 2.6.
Kermadec Petrel (western)	*Pterodroma neglecta*	V	V	Marine. No habitat at site.	None.	None.
Grey-headed Flying-fox	*Pteropus poliocephalus*	V	V	This species is a canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, melaleuca swamps and banksia woodlands. Bats commute daily to foraging areas, usually within 15 km of the day roost although some individuals may travel up to 70 km.	None.	Regarded as a Candidate species. Assessed in section 2.6.
Whale Shark	*Rhincodon typus*	V	-	No habitat at site	Regarded as a Candidate species. Assessed in section 2.6.	None
Rufous Fantail	*Rhipidura rufifrons*	M	-	The Rufous Fantail inhabits moist, dense habitats, including mangroves, rainforest, riparian forests and thickets, and wet eucalypt forests. Structural features of suitable habitat include a moderately dense canopy cover often with two lower strata: a 2-6 m high layer and a shrubby or heath understorey 1-2 m high. When on passage a wider range of wooded habitats are used including dry eucalypt forests and woodlands, Brigalow shrublands and domestic gardens and parks and tropical islands.	None	Moderate
Australian Painted Snipe	*Rostratula australis*	E	E	In NSW, this species has been recorded at the Paroo wetlands, Lake Cowell, Macquarie Marshes and Hexham Swamp. Most common in the Murray-Darling Basin. Prefers fringes of swamps, dams, and nearby marshy areas where there is a cover of grasses, lignum, low scrub, or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks, or reeds.	Moderate	None – Not recorded preferred habitat absent.

Common Name	Scientific Name	EPBC Act	BC Act	Habitat[3]	Likelihood of occurrence within sensitive subsidence features within Subject Land	Likelihood of occurrence within areas proposed for surface infrastructure (direct impacts)
Greater Broad-nosed Bat	*Scoteanax rueppellii*	-	V	Prefer moist gullies in mature coastal forests and rainforests, between the Great Dividing Range and the coast. They are only found at low altitudes below 500 m. In dense environments they utilise natural and human-made opening in the forest for flight paths. Creeks and small rivers are favoured foraging habitat. This species roosts in hollow tree trunks and branches.	None – Not recorded preferred habitat absent.	Regarded as a Predicted species. Assessed in section 2.4.
Southern Myotis	*Myotis macropus*	-	V	The Southern Myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage.	Regarded as a Predicted species. Assessed in section 2.4.	Regarded as a Predicted species. Assessed in section 2.4.
Diamond Firetail	*Stagonopleura guttata*	-	V	Feeds exclusively on the ground, on ripe and partly-ripe grass and herb seeds and green leaves, and on insects (especially in the breeding season). Found in grassy eucalypt woodlands, including box-gum woodlands and snow gum woodlands. Also occurs in open forest, mallee, natural temperate grassland, and in secondary grassland derived from other communities.	Regarded as a Candidate species. Assessed in section 2.6.	Regarded as a Candidate species. Assessed in section 2.6.
Australian Fairy Tern	Sternula nereis nereis	V	-	The Fairy Tern (Australian) nests on sheltered sandy beaches, spits, and banks above the high tide line and below vegetation. The subspecies has been found in embayment's of a variety of habitats including offshore, estuarine, or lacustrine (lake) islands, wetlands, and mainland coastline.	None.	None.
Buller's Albatross, Pacific Albatross	*Thalassarche bulleri*	V	-	In NSW waters it is a relatively common visitor between March and October, with few sightings outside this period. Occurs in both inshore and offshore waters, including the continental shelf break and pelagic waters.	Regarded as a Candidate species. Assessed in section 2.6.	Regarded as a Candidate species. Assessed in section 2.6.
Northern Buller's Albatross, Pacific Albatross	*Thalassarche bulleri platei*	V	-	In Australia, the species occurs over inshore, offshore, and pelagic waters.	None	None
Shy Albatross	*Thalassarche cauta*	V	V	This species is circumpolar in distribution, occurring widely in the southern oceans. This pelagic or ocean-going species inhabits subantarctic and subtropical marine waters, spending the majority of its time at sea.	Low	Low
Chatham Albatross	*Thalassarche eremita*	E	V	The Chatham Albatross is a marine species.	None – Not recorded preferred habitat absent.	None – Not recorded preferred habitat absent.
Campbell Albatross, Campbell Black-browed Albatross	*Thalassarche impavida*	V	-	Occurs in both inshore and offshore waters, including the continental shelf break and pelagic waters	Regarded as a Predicted species. Assessed in section 2.4.	Regarded as a Predicted species. Assessed in section 2.4.
Black-browed Albatross	*Thalassarche melanophris*	V	-	The Black-browed Albatross has a circumpolar range over the southern oceans and are seen off the southern Australian coast mainly during winter.	Regarded as a Predicted species. Assessed in section 2.4.	Regarded as a Predicted species. Assessed in section 2.4.

Common Name	Scientific Name	EPBC Act	BC Act	Habitat[3]	Likelihood of occurrence within sensitive subsidence features within Subject Land	Likelihood of occurrence within areas proposed for surface infrastructure (direct impacts)
Salvin's Albatross	*Thalassarche salvini*	V	-	Salvin's Albatross is a marine species occurring in subantarctic and subtropical waters, reaching the tropics in the cool Humboldt Current, off South America.	Regarded as a Candidate species. Assessed in section 2.6.	Regarded as a Candidate species. Assessed in section 2.6.
White-capped Albatross	*Thalassarche steadi*	V	-	Mostly observed in inshore and offshore waters over the continental shelf and less frequently in pelagic waters off the shelf break. May occasionally enter larger bays.	None	None
Eastern Hooded Plover	*Thinornis cucullatus cucullatus*	V	CE	In south-eastern Australia Hooded Plovers prefer sandy ocean beaches, especially those that are broad and flat, with a wide wave-wash zone for feeding, much beachcast seaweed, and backed by sparsely vegetated sand-dunes for shelter and nesting. Occasionally Hooded Plovers are found on tidal bays and estuaries, rock platforms and rocky or sand-covered reefs near sandy beaches, and small beaches in lines of cliffs. They regularly use near-coastal saline and freshwater lakes and lagoons, often with saltmarsh. Presently the Hooded Plover occurs in NSW north to Sussex Inlet.	Low– not detected. Preferred habitat types absent.	Low– not detected. Preferred habitat types absent.
Common Greenshank	*Tringa nebularia*	M	-	The Common Greenshank is found in a wide variety of inland wetlands and sheltered coastal habitats of varying salinity. It occurs in sheltered coastal habitats, typically with large mudflats and saltmarsh, mangroves or seagrass. Habitats include embayments, harbours, river estuaries, deltas and lagoons and are recorded less often in round tidal pools, rock-flats and rock platforms. The species uses both permanent and ephemeral terrestrial wetlands, including swamps, lakes, dams, rivers, creeks, billabongs, waterholes and inundated floodplains, claypans and saltflats. It will also use artificial wetlands, including sewage farms and saltworks dams, inundated rice crops and bores.	Low	Low
Masked Owl	*Tyto novaehollandiae*	-	V	Inhabits a diverse range of wooded habitat that provide tall or dense mature trees with hollows suitable for nesting and roosting. Mostly recorded in open forest and woodlands adjacent to cleared lands. Nest in hollows, in trunks and in near vertical spouts or large trees, usually living but sometimes dead. Nest hollows are usually located within dense forests or woodlands. Masked owls prey upon hollow-dependent arboreal marsupials, but terrestrial mammals make up the largest proportion of the diet.	Regarded as a Candidate species. Assessed in section 2.6.	Regarded as a Candidate species. Assessed in section 2.6.
Sooty Owl	*Tyto tenebricosa*	-	V	Often found in tall old-growth forests, including temperate and subtropical rainforests. In NSW mostly found on escarpments with a mean altitude less than 500 m. Nests and roosts in hollows of tall emergent trees, mainly	Regarded as a Candidate species. Assessed in section 2.6.	Regarded as a Candidate species. Assessed in section 2.6.

Common Name	Scientific Name	EPBC Act	BC Act	Habitat[3]	Likelihood of occurrence within sensitive subsidence features within Subject Land	Likelihood of occurrence within areas proposed for surface infrastructure (direct impacts)
				eucalypts often located in gullies. Nests have been located in trees 125 to 161 cm in diameter.		
Rosenberg's Goanna	*Varanus rosenbergi*	-	V	This species is a Hawkesbury-Narrabeen sandstone outcrop specialist. Occurs in coastal heaths, humid woodlands and both wet and dry sclerophyll forests.	Regarded as a Predicted species. Assessed in section 2.4.	Regarded as a Predicted species. Assessed in section 2.4.

Appendix 3. Plant Community Type descriptions

PCT978 - Needlebush - banksia wet heath on sandstone plateaux of the Sydney Basin Bioregion

Extent: PCT978 occurs on coastal sandstone plateaux on soils with impeded drainage, on seepage and water discharge sites that are periodically waterlogged.

Condition and presence of weeds: PCT978 occurs in the Subject Land as three variants, all of which are considered to be in good condition, with no weeds present:

- Fringing Eucalypt Woodland.
- Restioid heath.
- Banksia Thicket.

None of these areas are to be cleared as part of the Project, however, may be impacted by subsidence.

Conservation status: This PCT aligns to Coastal Upland Swamp in the Sydney Basin Bioregion listed as Endangered under the BC Act and not listed under EPBC Act. However, the Fringing Eucalypt Woodland variant is not included in the TEC listing.

Variants:

Fringing Eucalypt Woodland has been delineated to highlight the ecotone between the Coastal Upland Swamps communities and the surrounding Sandstone Woodlands. The transition between the two can be either abrupt or very gradual. In the case of the latter, a very open woodland with a canopy cover less than 10% consisting of widely spaced *Eucalyptus racemosa, E. oblonga or E. sieberi.* The understorey characteristics are transitional, with some sites sharing greater similarity with the drier components of Restioid Heaths than Exposed Sandstone Scribbly Gum Woodland. Fringing Eucalypt Woodland is not included in the TEC listing associated with this PCT.

Restioid heath was quite common within all Coastal Upland Swamps of the Subject Land. Typically, the community consisted of a low shrub layer of *Banksia oblongifolia, Hakea teretifolia and Epacris obtusifolia* with occasional *B. robur, Melaleuca thymifolia* and *M. squarrosa.* A diverse combination of rushes, herbs and grasses are present forming a dense ground cover. Species recorded include: *Empodisma minus, Lepyrodia scariosa, Leptocarpus tenax, Lindsaea linearis, Xanthorrhoea resinifera, Stackhousia nuda, Mitrasacme polymorpha* and *Schoenus brevifolius*.

Banksia Thicket is described in NPWS (2003a) as a low dense heath that forms on the fringes of the Upland Swamp complex within the O'Hares Creek Catchment. These thickets extend beyond this catchment to cover similar habitat across the Woronora Plateau. Banksia Thickets occur throughout the Woronora Plateau. In some locations *Banksia ericifolia* subsp. *ericifolia* completely dominates the understorey of adjoining stands of Exposed Sandstone Scribbly Gum Woodland. These areas have been included within this Map Unit although the species composition will vary from that found growing within the Upland Swamp complex. Areas of dense *Banksia ericifolia* subsp. *ericifolia* growing on broad rock plates are also included within the Map Unit.

Characteristic species used for identification of PCT:

Niche typically recorded the following species within PCT 978: *Banksia ericifolia* subsp. *ericifolia* and *Hakea dactyloides* and *Dillwynia floribunda.* Common understorey species recorded by Niche include: *Empodisma minus, Dampiera stricta, Entolasia stricta, Selaginella stricta* and *Leptocarpus tenax* and *Lepyrodia scariosa.*

Justification of evidence used to identify the PCT: The stated distribution and habitat information for the PCT, as given in the DPIE VIS Community Profile Report (VIS 2021), is highly consistent with the geographic location, habitat and floristics of the PCT at the Subject Land. The key matching characteristics are:

- its occurrence on humic sandy loams in headwater valleys on sandstones of the Woronora plateaux at altitudes of 50-600 m.
- its open to dense shrub canopy with a dense groundcover of sedges and forbs.
- its occurrence on coastal sandstone plateaux.



Photo 1. Eucalypt fringing Woodland

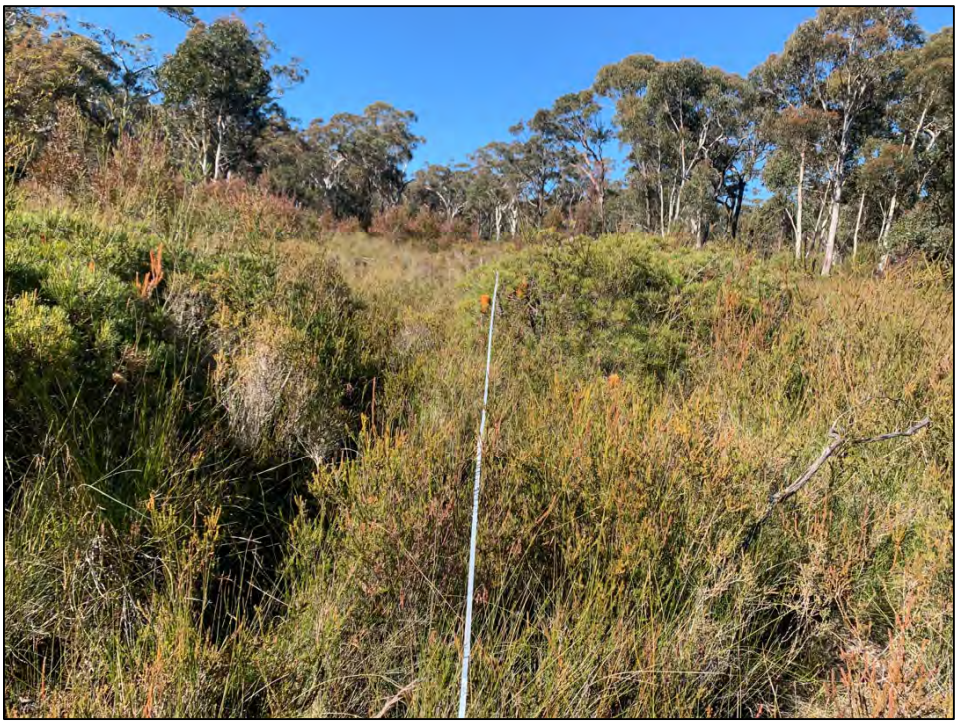


Photo 2. Restioid heath



Photo 3. Banksia thicket

PCT 1804 - Needlebush - Banksia wet heath swamps on coastal sandstone plateaus of the Sydney basin

Extent: PCT 1804 is restricted to the coastal zone where mean annual rainfall exceeds 1200 millimetres or greater. Some examples are found in drier zones (to 1000 millimetres per annum) however invariably these are drainage line swamps. Outside of the Sydney metropolitan area this community extends south from the hinterland of the Central Coast to the southern Woronora Plateau and Jervis Bay.

Condition and presence of weeds: PCT 1804 occurs in the Subject Land as one variant, which is considered to be in good condition, with no weeds present:

- Tea-tree Thicket.

These areas would not be cleared as part of the Project, however may be impacted by subsidence.

Conservation status: This PCT aligns to Coastal Upland Swamp in the Sydney Basin Bioregion listed as Endangered under the BC Act and not listed under EPBC Act.

Characteristic species used for identification of PCT (Niche 2021):

Niche recorded the following species within Coastal Upland Swamps Tea-tree Thicket: *Leptospermum juniperinum, Leptospermum trinervium, and L. polygalifolium* subsp. *polygalifolium*, *Acacia rubida, Banksia ericifolia* subsp. *ericifolia* and *Melaleuca squarrosa*. All these species are diagnostic species discussed in NPWS (2003a).

The thickets of the Tea-trees ranged from may being sparse to absent depending on water table fluctuation and long-term fire history. Occasional individuals of *Banksia robur* and *Conospermum ellipticum* are present in the sparse low shrub layer. Other ground covers included *Lepidosperma laterale, Baumea teretifolia* and *Tetrarrhena juncea*.

Justification of evidence used to identify the PCT: The stated distribution and habitat information for the PCT, as given in the DPIE VIS Community Profile Report (VIS 2021), is highly consistent with the geographic location, habitat and floristics of the PCT at the Subject Land. The key matching characteristics are:

- It is a wet heath-open sedgeland community that has a sparse to dense heath layer.
- The upper stratum usually includes one or more species of banksia, hakea or tea-tree. However it is the distinctive broad hairy leaves of the low-growing shrub swamp banksia (*Banksia robur*) that helps distinguish this community from those in drier locations on the sandstone plateau.
- Typically this community occupies zones in or proximate to drainage lines where water seepage is more constant than it is in more elevated parts of the swamp.
- Soils are peaty and regularly waterlogged.
- A diverse and abundant cover of sedges and ferns is present in the ground layer. Dense patches of pouched coral fern (*Gleichenia dicarpa*) often adjoin drainage lines.



Photo 4. Tea-tree Thicket

PCT 1083 - Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion

Extent: PCT 1083 occurs on crests, ridges and exposed slopes on coastal sandstone plateaux. This vegetation community occurs on skeletal sandy soils of low fertility. On exposed slopes the ground is often rocky, with large boulders outcropping on ridgetop peaks and on slope benches (NPWS 2003a).

Condition and presence of weeds: PCT 1083 occurs as two condition states in the Subject Land:

- Good – recorded along the ETL, at Ventilation Shaft Site No 5A, associated water pipeline along Fire Trail 6. Good condition has all stratum layer intact.
- Low – recorded at the Cordeaux Dam Road Construction Car Park site and at Ventilation Shaft Site No 5A. The low condition class is representative of the vegetation historically being cleared and used as an easement.

Conservation status: This PCT does not align to any listed TECs on the BC or EPBC Act.

Characteristic species used for identification of PCT (Niche 2021):

Niche typically recorded the following species within PCT 1083: *Eucalyptus racemosa , Corymbia gummifera, Persoonia levis, Banksia serrata, B. ericifolia, Cyathochaeta diandra, Patersonia sericea, Platysace linearifolia* and *Banksia spinulosa,* which align with PCT1083.

Justification of evidence used to identify the PCT: The stated distribution and habitat information for the PCT, as given in the DPIE VIS Community Profile Report (VIS 2021), is highly consistent with the geographic location, habitat and floristics of the PCT at the Subject Land. The key matching characteristics are:

- Being a low open forest with a diverse sclerophyll shrub layer and an open groundcover of sedges.
- Landscape position occurring on crests, ridges and exposed slopes on coastal sandstone plateaux.



Photo 5. PCT1083 Good condition



Photo 6. PCT1083 low condition

1181 Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion

Extent: Occurs in dry sandstone gullies up to 650 m in the rainshadow zone surrounding the Cumberland Plain. In the Subject Land, this PCT occurs along drainage lines.

Condition and presence of weeds: PCT 1181 occurs in the Subject Land as one variant, which is in good condition, with no weeds present.

This PCT would not be cleared as part of the Project, however, may be impacted by subsidence.

Conservation status: This PCT does not align to any TEC listed on the EPBC or BC Acts.

Characteristic species used for identification of PCT (Niche 2021):

Niche recorded the following species within PCT 1181, which align with this PCT: *Eucalyptus agglomerata* and *E. punctata, Corymbia gummifera* in the canopy. *Dodonaea triquetra, Banksia spinulosa, Leptospermum trinervium, Xylomelum pyriforme, Persoonia linearis, Lomatia silaifolia* and *Ceratopetalum gummiferum* in the midstorey/shrub layer. *Lepidosperma laterale, Entolasia stricta, Lomandra multiflora subsp. multiflora, Gonocarpus teucrioides* and *Lomandra longifolia* in the ground layer.

Justification of evidence used to identify the PCT: The stated distribution and habitat information for the PCT, as given in the DPIE VIS Community Profile Report (VIS 2021), is highly consistent with the geographic location, habitat and floristics of the PCT at the Subject Land. The key matching characteristics are:

- Species recorded are strongly aligned with those characteristics of PCT 1181.
- Structure of an open eucalypt forest with an abundant sclerophyll shrub stratum and a groundcover dominated by sedges.
- Occurs on lower slopes of dry sandstone gullies up to 600 m ASL where average annual rainfall ranges from 850 to 1300 mm.



Photo 7. PCT1181 Good

PCT 1245 - Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion

Extent: PCT 1245 occurs on escarpment benches, alluvial flats and protected gullies of the Illawarra escarpment.

Condition and presence of weeds: PCT 1245 occurs in the Subject Land as a low condition state.

The area of PCT1245 was in a relatively low condition due to previous clearing. The site generally lacked a canopy layer, however had a sparse scattered midstorey consisting of *Acmena smithii* and *Pittosporum undulatum.* The ground cover was a mixture of native and introduced species. Native species include: *Pteridium esculentum, Doodia aspera , Oplismenus imbecillis , Microlaena stipoides.*

Conservation status: This PCT does not align to any TECs listed on the BC and/or EPBC Acts.

Characteristic species used for identification of PCT (Niche 2021):

Niche typically recorded the following species within PCT 1245 that are associated with this PCT: canopy being dominated by *Eucalyptus botryoides x saligna*, and *Synoum glandulosum* and *Pittosporum undulatum* recorded in the midstorey.

Justification of evidence used to identify the PCT: The stated distribution and habitat information for the PCT, as given in the DPIE VIS Community Profile Report (VIS 2021), is highly consistent with the geographic location, habitat and floristics of the PCT at the Subject Land. The key matching characteristics are:

- The canopy is dominated by the hybrid Sydney blue gum (*Eucalyptus botryoides x saligna*).
- Sub-canopy features tall cabbage tree palm (*Livistona australis*) and bastard rosewood (*Synoum glandulosum*).
- Associated with high rainfall (greater than 1400 millimetres) and deep chocolate clay soils on escarpment benches, alluvial flats and protected gullies of the Illawarra escarpment (NPWS 2002).



Photo 8. PCT1245 low – small area of impact 0.17 ha encompassing areas of highly degraded vegetation, and areas dominated by native.

PCT 1250 - Sydney Peppermint - Smooth-barked Apple - Red Bloodwood shrubby open forest on slopes of moist sandstone gullies, eastern Sydney Basin Bioregion

Extent: PCT 1250 occurs in gullies on coastal sandstone plateaux below 500 m on the Hornsby and Woronora plateaus.

Condition and presence of weeds: PCT 1250 occurs in the Subject Land as two condition classes:

- Good, which has all stratum layers intact.
- Low, which has been historically cleared only leaving ground cover and small shrubs along the existing Fire Trail easement.

Conservation status: This PCT does not align to any TECs listed on the BC and/or EPBC Acts.

Characteristic species used for identification of PCT (Niche 2021):

Niche typically recorded the following species within PCT 1250: canopy being dominated by *Eucalyptus piperita, Corymbia gummifera,* with *Banksia spinulosa, Leptospermum trinervium, Gonocarpus teucrioides, Lomandra longifolia, Caustis flexuosa, Entolasia stricta* and *Pteridium esculentum* in the understorey.

Justification of evidence used to identify the PCT: The stated distribution and habitat information for the PCT, as given in the DPIE VIS Community Profile Report (VIS 2021), is highly consistent with the geographic location, habitat and floristics of the PCT at the Subject Land. The key matching characteristics are:

- It occupies sheltered aspects on infertile Hawkesbury sandstone in areas that receive more than 1000 millimetres of mean annual rainfall.
- Sydney peppermint (*Eucalyptus piperita*) dominance in canopy.
- Occurrence in rocky environments, with the understorey a diverse mix of heath and shrub species such as banksias, tea-trees and wattles.
- The community is found at elevations up to 500 metres above sea level.



Photo 9. PCT 1250 Good



Photo 10. PCT 1250 Low

PCT 1395 - Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion

Extent: PCT 1250 occurs predominantly on the western edge of the Woronora Plateau and above the Nepean and Georges rivers in hinterland areas where mean annual rainfall is relatively low and at altitudes up to 350 metres. This community is associated with the intergrade between clay-rich shale soil and the coarse sandy substrates of the sandstone plateau.

Condition and presence of weeds: PCT 1395 occurs in the Subject Land as a good condition class with all stratum layers intact and no weeds present.

This PCT would not be cleared as part of the Project, however, may be impacted by subsidence.

Conservation status: This PCT aligns to PCT aligns to the Shale Sandstone Transition Forest CEEC which is listed as Critically Endangered under the BC Act (*Shale Sandstone Transition Forest in the Sydney Basin Bioregion*) and EPBC Act (*Shale Sandstone Transition Forest of the Sydney Basin Bioregion*).

Characteristic species used for identification of PCT 1395 (Niche 2021):

Niche typically recorded the following species within PCT 1395: the canopy was dominated by *Eucalyptus punctata*, *E. fibrosa*, *E. eugenioides*, *Allocasuarina littoralis*, and *A. torulosa*. Shrubs included *Acacia decurrens, Bursaria spinosa, Exocarpos cupressiformis, Indigofera australis, Kunzea ambigua, Melaleuca thymifolia, Pultenaea villosa, Olearia microphylla*, and *Ozothamnus diosmifolius*. Grasses included: *Anisopogon avenaceus, Aristida ramosa, Aristida vagans, Entolasia stricta, Eragrostis brownii, Microlaena stipoides and Themeda australis*. Ground Covers included: *Billardiera scandens, Cheilanthes sieberi, Einadia hastata, Lomandra filiformis, Lomandra obliqua, Lepidosperma laterale, Phyllanthus hirtellus, Pratia purpurascens, and Solanum prinophyllum*.

Justification of evidence used to identify the PCT: The stated distribution and habitat information for the PCT, as given in the DPIE VIS Community Profile Report (VIS 2021), is highly consistent with the geographic location, habitat and floristics of the PCT at the Subject Land. The key matching characteristics are:

- The community occurs within the known range of the CEEC.
- Characteristic species are present, as identified in the Scientific Determination and Approved Conservation Advice.
- The presence of diagnostic mature trees including *Eucalyptus punctata, E. eugenioides* and *E. fibrosa* in an open woodland formation.
- The presence of regenerating over-storey species, characterised by the presence or prior occurrence of *Eucalyptus eugenioides* and *E. punctata*.
- A small tree stratum is present in high resilience and intact areas consisting of *Eucalyptus* spp., with *Allocasuarina littoralis* and *Acacia decurrens* also present.
- A shrub layer dominated by *Bursaria spinosa* is present.
- The understorey in intact areas is characterised by native grasses and a high diversity of herbs. Including the presence of diagnostic groundcover plant species such as *Billardiera scandens, Cheilanthes sieberi* and *Pratia purpurascens*.



Photo 11. PCT 1395 Good

Appendix 4. BAM plot data

Table 60: Floristic data for plots 1 - 15

Scientific name	Common name	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15	
		C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
Acacia linifolia	White Wattle			0.2	5													0.2	5			0.1	1	0.5	1						
Acacia longifolia																												0.1	1		
Acacia myrtifolia	Red-stemmed Wattle	0.1	5	0.1	1			0.1	5			0.1	10	0.1	1	0.1	1	0.5	20	0.1	5	0.1	5	0.2	5	0.1	1	0.1	2	0.1	1
Acacia suaveolens	Sweet Wattle	0.1	1			0.1	1																								
Acacia ulicifolia	Prickly Moses	0.1	5	0.2	2							0.1	2					0.1	3							0.1	2	0.1	4		
Allocasuarina littoralis	Black She-Oak	0.2	5																												
Baeckea linifolia	Weeping Baeckea																											0.1	1		
Banksia ericifolia	Heath-leaved Banksia					0.1	10																								
Banksia serrata	Old-man Banksia					0.3	10					0.2	10																		
Banksia spinulosa	Hairpin Banksia					0.1	10			1	0	0.1	5	0.1	1	0.1	1							0.1	1	0.1	1				
Blandfordia nobilis	Christmas Bells																					0.1	1			0.1	1				
Boronia thujona																				0.1	2										
Bossiaea ensata	Sword Bossiaea	0.1	3	0.1	5																										
Bossiaea heterophylla	Variable Bossiaea			0.1	5	0.1	5					0.2	10													0.5	15			0.1	10
Bossiaea obcordata	Spiny Bossiaea			0.2	30	0.1	3	0.1	3			0.1	15					0.2	20	0.2	15	0.2	25	0.3	25	0.1	5			0.1	15
Cassytha glabella						0.1	1					0.1	2													0.1	1				
Caustis flexuosa	Curly Wig					0.2	3	0.4	60	0.1	1	0.1	10	0.1	2									0.1	1					0.1	10
Chloanthes stoechadis																				0.1	5										
Conospermum taxifolium	Variable Smoke-bush																	0.2	10					0.1	1			0.1	1		
Corymbia gummifera	Red Bloodwood	10	0			2	0							5	0			5	0	5	0	5	0			3	0				
Cyathochaeta diandra				1	0	1	0	0.1	5	0.5	20	0.3	20	0.1	10			0.2	25	0.2	5	0.5	20	0.4	25	0.2	15			0.1	10
Cynodon dactylon	Common Couch																											0.1	1		
Dampiera scottiana																		0.1	1												
Dampiera stricta						0.1	5																			0.1	3				
Dillwynia retorta								0.1	2									0.2	20	0.3	5			0.1	1	0.1	1			0.1	10
Dodonaea triquetra	Large-leaf Hop-bush													0.1	2			0.5	10	0.2	2										
Drosera spatulata		0.3	50																												
Entolasia marginata	Bordered Panic							0.1	2																						
Entolasia stricta	Wiry Panic	0.2	15							0.1	3			0.1	5					0.1	5	0.1	2			0.1	5				
Epacris microphylla	Coral Heath	0.5	200																												
Eriostemon australasius				0.1	10	0.1	2			0.1	5	0.1	10			0.1	1	0.1	5	0.1	1			0.2	5	0.1	2			0.2	25
Eucalyptus eugenioides	Thin-leaved Stringybark	10	0	5	0	5	0			40	0	5	0					20	0							5	0				
Eucalyptus globoidea	White Stringybark							5	0																						
Eucalyptus piperita	Sydney Peppermint													5	0																

Scientific name	Common name	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15	
		C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
Eucalyptus racemosa	Narrow-leaved Scribbly Gum			10	0	10	0			10	0									10	0	15	0			40	0				
Eucalyptus sieberi	Silvertop Ash			15	0	25	0	10	0			5	0	15	0	0.5	1			10	0	5	0	25	0	5	0	25	0	40	0
Gahnia aspera	Rough Saw-sedge	0.1	1							0.1	4	0.1	5	0.1	5									0.1	1	0.1	1				
Gompholobium grandiflorum	Large Wedge Pea			0.2	1																										
Gompholobium latifolium	Golden Glory Pea																							0.1	2						
Gonocarpus micranthus																												0.1	5		
Gonocarpus sp.	Raspwort	1	0																												
Gonocarpus teucrioides	Germander Raspwort																	0.4	1									0.1	2		
Goodenia bellidifolia		0.1	1							0.1	1			0.1	10									0.1	1	0.1	2				
Goodenia hederacea	Ivy Goodenia									0.1	1																				
Goodenia sp.												0.1	1																		
Grevillea mucronulata		0.1	1	0.1	5	0.1	2			0.1	5			0.1	2	0.5	20			0.2	3	0.1	10	0.1	10			0.1	1		
Grevillea sphacelata	Grey Spider Flower	0.2	10	0.1	5	0.5	15	0.2	3	0.1	3	0.5	10					2	0							2	0	0.3	2	0.5	3
Hakea dactyloides	Finger Hakea			0.2	5	0.1	1			0.2	1																	0.1	1		
Hardenbergia violacea	False Sarsaparilla																							0.2	1						
Hibbertia circumdans												0.1	10	0.1	10					0.1	5			0.1	1						
Hibbertia riparia														0.1	2			0.5	15					0.1	3						
Hibbertia sp.										0.1	5	0.1	0									0.1	1	0.1	2	0.1	1			0.1	1
Hovea purpurea																		0.1	1	0.1	1					0.1	1				
Isopogon anemonifolius	Broad-leaf Drumsticks	0.5	10	0.5	3	0.2	5			0.2	5	0.1	1			0.1	1	0.1	5	0.1	1			0.4	10	0.1	3			0.2	20
Kunzea ambigua	Tick Bush	2	0																												
Lambertia formosa	Mountain Devil					0.5	2	0.3	1											0.4	10	2	0							2	0
Lasiopetalum ferrugineum																				0.2	15										
Laxmannia sp.				0.1	1																										
Lepidosperma laterale	Variable Sword-sedge	2	0	2	0																					0.2	15				
Leptospermum juniperinum	Prickly Tea-tree											0.5	5																	0.5	10
Leptospermum polygalifolium	Tantoon	2	0	0.2	10	0.4	5	0.5	10	0.5	10					0.2	10	3	0			0.5	2			0.2	1				
Leptospermum trinervium	Slender Tea-tree																							0.5	10						
Lepyrodia scariosa		0.1	5																												
Leucopogon ericoides	Pink Beard-heath	0.1	1							0.1	1													0.1	1						
Leucopogon juniperinus	Prickly Beard-heath							0.1	2											0.1	1			0.2	5			0.1	2	0.1	3
Leucopogon setiger						0.1	2																								
Lindsaea linearis	Screw Fern							0.1	20					0.1	10											0.1	150				
Lomandra cylindrica								0.1	3																			0.1	15	0.1	10
Lomandra multiflora subsp. *multiflora*	Many-flowered Mat-rush	0.3	15	0.2	10	0.2	5	0.4	30	0.8	20	0.3	20	0.2	15	0.1	5			0.1	5			0.3	20	0.5	100	0.1	3		
Lomandra obliqua						0.1	3	0.1	20	0.1	20	0.1	50	0.1	15	0.1	15	0.5	200	0.2	25	0.1	10	0.2	30	0.1	15	0.1	5	0.1	10

Scientific name	Common name	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15	
		C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
Lomatia silaifolia	Crinkle Bush							0.2	5	0.1	2	0.5	10	0.2	30	0.3	10	0.1	5	0.3	5	0.5	15	0.3	15	0.3	5	0.2	3	0.1	5
Patersonia glabrata	Leafy Purple-flag	0.2	10	0.6	50	0.7	30	1	0	3	0	0.1	2			0.1	1	0.1	5			0.1	3	0.1	1	0.1	5	0.1	5	0.1	10
Patersonia longifolia																				0.2	15										
Persoonia levis	Broad-leaved Geebung			0.4	2			0.1	2			0.2	3					1	0			0.5	1			0.5	1	0.1	1		
Petrophile sessilis		0.1	5					0.1	5			0.2	10					0.2	10			0.2	25	0.1	3	0.4	10	0.1	1	0.1	10
Phyllanthus hirtellus	Thyme Spurge							0.1	5	0.1	5							0.1	1												
Phyllota grandiflora	Heath Phyllota			0.3	20	0.1	10	0.1	10			0.1	5					0.1	5					0.1	5	0.2	15				
Phyllota phylicoides	Heath Phyllota													0.1	15	0.1	5					0.1	10	0.1	3	0.1	10				
Phyllota sp.										0.1	8																				
Pimelea linifolia	Slender Rice Flower	0.1	2	0.1	2			0.1	5			0.1	5	0.1	5			0.1	2					0.1	2	0.1	1			0.1	5
Platysace linearifolia		0.1	10	0.1	3	0.1	6	0.1	5	0.1	2	0.1	10	0.1	1			0.1	5							0.1	1			0.3	1
Pomax umbellata	Pomax	0.1	5																												
Pteridium esculentum	Bracken																											0.2	10		
Pultenaea sp.		0.1	1																												
Schoenus apogon	Fluke Bogrush	0.1	2																					0.1	1						
Schoenus sp.		0.1	10													0.2	15														
Stackhousia nuda				0.8	25	0.3	15											0.1	10									0.1	7		
Viola hederacea	Ivy-leaved Violet																											0.1	1		
Xanthorrhoea sp.				0.5	1	0.4	1	0.5	3	2	0	0.5	5									1	0	2	0	0.1	1				
Xanthosia pilosa	Woolly Xanthosia													0.1	1									0.1	1						
Xanthosia tridentata	Rock Xanthosia	0.1	1																	0.1	1										
Xylomelum pyriforme	Woody Pear			0.5	3	0.2	5	0.2	5			0.8	3	0.3	1			2	0	0.5	3	1	0			0.8	4			0.2	2
Acacia linifolia	White Wattle			0.2	5													0.2	5			0.1	1	0.5	1						
Acacia longifolia																												0.1	1		
Acacia myrtifolia	Red-stemmed Wattle	0.1	5	0.1	1			0.1	5			0.1	10	0.1	1	0.1	1	0.5	20	0.1	5	0.1	5	0.2	5	0.1	1	0.1	2	0.1	1
Acacia suaveolens	Sweet Wattle	0.1	1			0.1	1																								
Acacia ulicifolia	Prickly Moses	0.1	5	0.2	2							0.1	2					0.1	3							0.1	2	0.1	4		
Allocasuarina littoralis	Black She-Oak	0.2	5																												
Baeckea linifolia	Weeping Baeckea																											0.1	1		
Banksia ericifolia	Heath-leaved Banksia					0.1	10																								
Banksia serrata	Old-man Banksia					0.3	10					0.2	10																		
Banksia spinulosa	Hairpin Banksia					0.1	10			1	0	0.1	5	0.1	1	0.1	1							0.1	1	0.1	1				
Blandfordia nobilis	Christmas Bells																					0.1	1			0.1	1				
Boronia thujona																				0.1	2										
Bossiaea ensata	Sword Bossiaea	0.1	3	0.1	5																										
Bossiaea heterophylla	Variable Bossiaea			0.1	5	0.1	5					0.2	10													0.5	15			0.1	10
Bossiaea obcordata	Spiny Bossiaea			0.2	30	0.1	3	0.1	3			0.1	15					0.2	20	0.2	15	0.2	25	0.3	25	0.1	5			0.1	15

Scientific name	Common name	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15	
		C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
Cassytha glabella						0.1	1					0.1	2													0.1	1				
Caustis flexuosa	Curly Wig					0.2	3	0.4	60	0.1	1	0.1	10	0.1	2									0.1	1					0.1	10
Chloanthes stoechadis																				0.1	5										
Conospermum taxifolium	Variable Smoke-bush																	0.2	10					0.1	1			0.1	1		
Corymbia gummifera	Red Bloodwood	10	0			2	0							5	0			5	0	5	0	5	0			3	0				
Cyathochaeta diandra				1	0	1	0	0.1	5	0.5	20	0.3	20	0.1	10			0.2	25	0.2	5	0.5	20	0.4	25	0.2	15			0.1	10
Cynodon dactylon	Common Couch																											0.1	1		
Dampiera scottiana																		0.1	1												
Dampiera stricta						0.1	5																			0.1	3				
Dillwynia retorta								0.1	2									0.2	20	0.3	5			0.1	1	0.1	1			0.1	10
Dodonaea triquetra	Large-leaf Hop-bush													0.1	2			0.5	10	0.2	2										
Drosera spatulata		0.3	50																												
Entolasia marginata	Bordered Panic							0.1	2																						
Entolasia stricta	Wiry Panic	0.2	15							0.1	3			0.1	5					0.1	5	0.1	2			0.1	5				
Epacris microphylla	Coral Heath	0.5	200																												
Eriostemon australasius				0.1	10	0.1	2			0.1	5	0.1	10			0.1	1	0.1	5	0.1	1			0.2	5	0.1	2			0.2	25
Eucalyptus eugenioides	Thin-leaved Stringybark	10	0	5	0	5	0			40	0	5	0					20	0							5	0				
Eucalyptus globoidea	White Stringybark							5	0																						
Eucalyptus piperita	Sydney Peppermint													5	0																
Eucalyptus racemosa	Narrow-leaved Scribbly Gum			10	0	10	0			10	0									10	0	15	0			40	0				
Eucalyptus sieberi	Silvertop Ash			15	0	25	0	10	0			5	0	15	0	0.5	1			10	0	5	0	25	0	5	0	25	0	40	0
Gahnia aspera	Rough Saw-sedge	0.1	1							0.1	4	0.1	5	0.1	5									0.1	1	0.1	1				
Gompholobium grandiflorum	Large Wedge Pea			0.2	1																										
Gompholobium latifolium	Golden Glory Pea																							0.1	2						
Gonocarpus micranthus																												0.1	5		
Gonocarpus sp.	Raspwort	1	0																												
Gonocarpus teucrioides	Germander Raspwort																	0.4	1									0.1	2		
Goodenia bellidifolia		0.1	1							0.1	1			0.1	10									0.1	1	0.1	2				
Goodenia hederacea	Ivy Goodenia									0.1	1																				
Goodenia sp.												0.1	1																		
Grevillea mucronulata		0.1	1	0.1	5	0.1	2			0.1	5			0.1	2	0.5	20			0.2	3	0.1	10	0.1	10			0.1	1		
Grevillea sphacelata	Grey Spider Flower	0.2	10	0.1	5	0.5	15	0.2	3	0.1	3	0.5	10					2	0							2	0	0.3	2	0.5	3
Hakea dactyloides	Finger Hakea			0.2	5	0.1	1			0.2	1																	0.1	1		
Hardenbergia violacea	False Sarsaparilla																							0.2	1						
Hibbertia circumdans												0.1	10	0.1	10					0.1	5			0.1	1						
Hibbertia riparia														0.1	2			0.5	15					0.1	3						

Scientific name	Common name	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15	
		C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
Hibbertia sp.										0.1	5	0.1	0									0.1	1	0.1	2	0.1	1			0.1	1
Hovea purpurea																		0.1	1	0.1	1					0.1	1				
Isopogon anemonifolius	Broad-leaf Drumsticks	0.5	10	0.5	3	0.2	5			0.2	5	0.1	1			0.1	1	0.1	5	0.1	1			0.4	10	0.1	3			0.2	20
Kunzea ambigua	Tick Bush	2	0																												
Lambertia formosa	Mountain Devil					0.5	2	0.3	1											0.4	10	2	0							2	0
Lasiopetalum ferrugineum																				0.2	15										
Laxmannia sp.				0.1	1																										
Lepidosperma laterale	Variable Sword-sedge	2	0	2	0																					0.2	15				
Leptospermum juniperinum	Prickly Tea-tree											0.5	5																	0.5	10
Leptospermum polygalifolium	Tantoon	2	0	0.2	10	0.4	5	0.5	10	0.5	10					0.2	10	3	0			0.5	2			0.2	1				
Leptospermum trinervium	Slender Tea-tree																							0.5	10						
Lepyrodia scariosa		0.1	5																												
Leucopogon ericoides	Pink Beard-heath	0.1	1							0.1	1													0.1	1						
Leucopogon juniperinus	Prickly Beard-heath							0.1	2											0.1	1			0.2	5			0.1	2	0.1	3
Leucopogon setiger						0.1	2																								
Lindsaea linearis	Screw Fern							0.1	20					0.1	10											0.1	150				
Lomandra cylindrica								0.1	3																			0.1	15	0.1	10
Lomandra multiflora subsp. *multiflora*	Many-flowered Mat-rush	0.3	15	0.2	10	0.2	5	0.4	30	0.8	20	0.3	20	0.2	15	0.1	5			0.1	5			0.3	20	0.5	100	0.1	3		
Lomandra obliqua						0.1	3	0.1	20	0.1	20	0.1	50	0.1	15	0.1	15	0.5	200	0.2	25	0.1	10	0.2	30	0.1	15	0.1	5	0.1	10
Lomatia silaifolia	Crinkle Bush							0.2	5	0.1	2	0.5	10	0.2	30	0.3	10	0.1	5	0.3	5	0.5	15	0.3	15	0.3	5	0.2	3	0.1	5
Patersonia glabrata	Leafy Purple-flag	0.2	10	0.6	50	0.7	30	1	0	3	0	0.1	2			0.1	1	0.1	5			0.1	3	0.1	1	0.1	5	0.1	5	0.1	10
Patersonia longifolia																				0.2	15										
Persoonia levis	Broad-leaved Geebung			0.4	2			0.1	2			0.2	3					1	0			0.5	1			0.5	1	0.1	1		
Petrophile sessilis		0.1	5					0.1	5			0.2	10					0.2	10			0.2	25	0.1	3	0.4	10	0.1	1	0.1	10
Phyllanthus hirtellus	Thyme Spurge							0.1	5	0.1	5							0.1	1												
Phyllota grandiflora	Heath Phyllota			0.3	20	0.1	10	0.1	10			0.1	5					0.1	5					0.1	5	0.2	15				
Phyllota phylicoides	Heath Phyllota													0.1	15	0.1	5					0.1	10	0.1	3	0.1	10				
Phyllota sp.										0.1	8																				
Pimelea linifolia	Slender Rice Flower	0.1	2	0.1	2			0.1	5			0.1	5	0.1	5			0.1	2					0.1	2	0.1	1			0.1	5
Platysace linearifolia		0.1	10	0.1	3	0.1	6	0.1	5	0.1	2	0.1	10	0.1	1			0.1	5							0.1	1			0.3	1
Pomax umbellata	Pomax	0.1	5																												
Pteridium esculentum	Bracken																											0.2	10		
Pultenaea sp.		0.1	1																												
Schoenus apogon	Fluke Bogrush	0.1	2																					0.1	1						
Schoenus sp.		0.1	10													0.2	15														
Stackhousia nuda				0.8	25	0.3	15											0.1	10									0.1	7		

Scientific name	Common name	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15	
		C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
Viola hederacea	Ivy-leaved Violet																											0.1	1		
Xanthorrhoea sp.				0.5	1	0.4	1	0.5	3	2	0	0.5	5									1	0	2	0	0.1	1				
Xanthosia pilosa	Woolly Xanthosia													0.1	1									0.1	1						
Xanthosia tridentata	Rock Xanthosia	0.1	1																	0.1	1										
Xylomelum pyriforme	Woody Pear			0.5	3	0.2	5	0.2	5			0.8	3	0.3	1			2	0	0.5	3	1	0			0.8	4			0.2	2

Table 61. Floristic data for plots 16 - 30

Scientific name	Common name	16		17		18		19		20		21		22		23		24		25		26		27		28		29		30	
		C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
Acacia binervata	Two-veined Hickory																											0.2	2	0.1	1
Acacia linifolia	White Wattle													0.1	1															0.3	1
Acacia longifolia		0.4	1	0.5	1											0.5	2							0.1	1						
Acacia myrtifolia	Red-stemmed Wattle	0.5	3	0.1	5	0.1	3							0.5	10	0.1	5					0.1	5	0.2	10	0.1	3			0.1	2
Acacia ulicifolia	Prickly Moses					0.1	2															0.1	1	0.1	1	0.1	1			0.1	10
Adiantum aethiopicum	Common Maidenhair																											0.1	5		
Allocasuarina torulosa	Forest Oak																											0.5	3		
Aristida vagans	Threeawn Speargrass																													0.1	10
Banksia ericifolia	Heath-leaved Banksia					0.2	5	0.1	5	0.1	5																				
Banksia serrata	Old-man Banksia							2	0	2	0													0.2	2	0.1	1				
Banksia spinulosa	Hairpin Banksia	0.5	1	0.5	1	0.5	1					0.5	3			2	0	1	0	0.2	5	0.3	2			0.5	1				
Boronia serrulata	Rose Boronia															0.1	5									0.1	1				
Boronia sp.																								0.1	1						
Bossiaea heterophylla	Variable Bossiaea	0.1	5	0.1	5	0.1	15	0.1	1	0.1	1	0.1	5			0.1	5	0.1	1			0.1	1								
Bossiaea obcordata	Spiny Bossiaea			0.1	5	0.2	20	0.1	5	0.1	5	0.1	5	0.1	5			0.1	5	0.1	20			0.1	7	0.1	5			0.1	10
Caesia parviflora	Pale Grass-lily			0.1	1											0.1	1														
Caladenia sp.														0.1	1																
Cassytha glabella						0.1	1					0.1	1																		
Caustis flexuosa	Curly Wig	0.5	50																												
Caustis sp.														0.5	50																
Corymbia gummifera	Red Bloodwood			3	0			5	0	5	0					5	0			3	0	5	0								
Cyathochaeta diandra		0.1	15	0.1	15	0.2	10	0.5	10	0.5	10	0.5	40	0.1	10	0.1	5	0.1	5	0.2	30	0.1	10	0.1	10	0.2	15				
Cynodon dactylon	Common Couch																											20	0	10	0
Dampiera purpurea				0.1	3	0.1	2																								
Dampiera sp.																						0.1	1								
Dampiera stricta				0.1	1	0.1	5	0.1	2	0.1	2	0.1	5			0.1	5	0.1	1	0.1	1			0.1	2	0.1	1				
Daviesia sp.																														0.1	1
Dianella caerulea	Blue Flax-lily																											0.2	15		
Dianella sp.																						0.1	1								
Dillwynia parvifolia														0.1	10																
Dillwynia retorta		0.1	10	0.1	5	0.1	5	0.1	5	0.1	5											0.1	15			0.1	5				

Scientific name	Common name	16		17		18		19		20		21		22		23		24		25		26		27		28		29		30	
		C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
Dillwynia sp.																						0.1	20	0.1	5						
Entolasia marginata	Bordered Panic											0.1	5	0.1	1	0.1	10	0.1	10			0.1	10	0.1	5			0.1	3	0.1	5
Entolasia stricta	Wiry Panic	0.1	10					0.1	5	0.1	5																				
Epacris pulchella	Wallum Heath																													0.1	1
Eriostemon australasius		0.2	20	0.2	10	0.3	10	0.2	20	0.2	20	0.1	5							0.2	25			0.1	5	0.1	1				
Erythrina indica	Indian Coral Tree																											0.1	1		
Eucalpytus sp.																														0.7	2
Eucalyptus eugenioides	Thin-leaved Stringybark					5	0					15	0			25	0					5	0			10	0				
Eucalyptus globoidea	White Stringybark	25	0	5	0			5	0	5	0																				
Eucalyptus racemosa	Narrow-leaved Scribbly Gum	5	0	5	0							40	0			5	0	5	0	20	0	10	0	20	0	5	0				
Eucalyptus sieberi	Silvertop Ash	5	0	30	0	35	0	15	0	15	0	10	0	40	0			20	0			5	0	5	0	5	0				
Eucalyptus sp.														0.1	1													10	0		
Fabaceae sp.																				0.1	1	0.1	1								
Gahnia aspera	Rough Saw-sedge					0.1	1	0.1	1	0.1	1																				
Geranium solanderi	Native Geranium																											0.1	50		
Glycine tabacina	Variable Glycine																											0.1	2		
Gompholobium grandiflorum	Large Wedge Pea							0.1	7	0.1	7																				
Gonocarpus micranthus																												1	0	1	0
Gonocarpus teucrioides	Germander Raspwort																					0.1	4					0.2	100	0.3	100
Goodenia bellidifolia						0.1	1	0.1	1	0.1	1			0.1	1							0.1	1	0.1	5						
Grevillea mucronulata		0.1	1	0.2	10	0.3	5							0.2	10	0.1	5					0.3	15	0.2	15			0.1	3	0.1	2
Grevillea sphacelata	Grey Spider Flower			0.5	1			1	10	1	10	0.1	5	0.5	1	0.5	10	0.2	10	0.5	15	0.3	5	0.2	10	0.1	5				
Hakea dactyloides	Finger Hakea	0.3	1			0.5	10							0.1	2	0.1	1	0.1	1	0.1	1			0.2	1						
Hardenbergia sp.																												0.2	2	0.1	1
Hardenbergia violacea	False Sarsaparilla											0.5	2																		
Hibbertia aspera	Rough Guinea Flower																											0.1	1		
Hibbertia circumdans								0.1	1	0.1	1											0.1	1							0.1	2
Hibbertia sp.						0.1	1							0.1	3													0.1	1	0.1	1
Hovea linearis												0.1	1																		
Isopogon anemonifolius	Broad-leaf Drumsticks	0.2	15	0.1	5	0.3	5	0.3	5	0.3	5	0.1	10	0.2	50			0.1	5					0.2	20						
Isopogon anethifolius	Narrow-leaf Drumsticks																			0.1	5										
Kunzea ambigua	Tick Bush																											1	0	0.5	1

Scientific name	Common name	16		17		18		19		20		21		22		23		24		25		26		27		28		29		30	
		C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
Lambertia formosa	Mountain Devil	1	0	0.3	5			2	0	2	0	1	0			5	0	0.2	5	1	0	0.4	1			0.1	1				
Lepidosperma laterale	Variable Sword-sedge															0.1	10					0.1	5			0.1	1	0.1	3	0.1	3
Leptospermum polygalifolium	Tantoon			0.5	10	0.5	10	3	0	3	0	5	0	2	0	20	0					0.5	20	2	0	1	0			3	0
Leptospermum trinervium	Slender Tea-tree	5	0																												
Lepyrodia scariosa																0.1	1														
Leucopogon ericoides	Pink Beard-heath			0.1	2	0.1	1							0.1	1											0.1	1				
Leucopogon juniperinus	Prickly Beard-heath	0.1	5																												
Lindsaea linearis	Screw Fern											0.1	100			0.1	10														
Lissanthe strigosa	Peach Heath																					0.2	10					0.1	1	0.1	5
Lomandra cylindrica		0.1	10	0.1	5			0.1	3	0.1	3			0.1	10	0.1	10			0.2	100	0.1	5								
Lomandra longifolia	Spiny-headed Mat-rush																									0.1	2				
Lomandra multiflora subsp. *multiflora*	Many-flowered Mat-rush	0.2	20	0.1	5	0.5	25	0.1	10	0.1	10	0.3	50	0.5	30					0.1	7	0.2	10			0.1	10				
Lomandra obliqua		0.1	25	0.1	5	0.1	10	0.1	10	0.1	10	0.1	20	0.1	10	0.1	20			0.1	10	0.1	30	0.1	20					0.1	50
Lomandra sp.	Mat-rush																											0.1	5		
Lomatia silaifolia	Crinkle Bush			0.2	15	0.2	10	0.1	5	0.1	5	1	0	1	0			0.1	5	0.2	30			0.1	5						
Microseris sp.																												0.1	1		
Patersonia glabrata	Leafy Purple-flag	0.2	100	0.1	10	0.2	15					0.1	10	0.2	30	0.1	10	0.1	3	0.1	10			0.1	5	0.1	1			0.3	20
Persoonia levis	Broad-leaved Geebung	0.3	10	0.1	5	0.1	2					0.1	1	0.3	5					1	0	1	0	0.5	1	0.1	1				
Petrophile sessilis		0.1	5	0.2	15	0.1	5	0.2	5	0.2	5	0.1	3	0.1	3			0.1	5	0.1	10					0.1	1				
Phyllota grandiflora	Heath Phyllota			0.1	10	0.2	20					0.1	5	0.1	5									0.1	10						
Pimelea linifolia	Slender Rice Flower	0.1	1	0.1	5	0.1	5	0.1	1	0.1	1	0.1	10	0.1	5			0.1	10	0.1	5	0.1	3	0.1	10					0.1	1
Platysace linearifolia		0.1	5	0.1	5	0.1	5					0.1	10	0.1	20							0.1	1								
Polyscias sambucifolia	Elderberry Panax																			0.2	5										
Pomaderris sp.																												0.1	1		
Pomax umbellata	Pomax																													0.2	200
Pratia purpurascens																														0.1	10
Proteacea sp.												0.1	3																		
Schoenus apogon	Fluke Bogrush							0.1	3	0.1	3																				
Schoenus sp.																0.1	1														
Senecio madagascariensis	Fireweed																													2	0
Solanum mauritianum	Wild Tobacco Bush																											0.1	7		

Scientific name	Common name	16		17		18		19		20		21		22		23		24		25		26		27		28		29		30	
		C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
Stackhousia nuda				0.1	5			0.2	15	0.2	15	0.1	10	0.1	3			0.1	10					0.1	5						
Stylidium graminifolium	Grass Triggerplant																													0.1	10
Themeda triandra	Kangaroo Grass																							0.1	1						
Viola hederacea	Ivy-leaved Violet																											0.1	30	0.1	2
Xanthorrhoea sp.		2	0	1	0	0.2	3	2	0	2	0							0.1	1			0.2	2			0.2	1				
Xanthosia pilosa	Woolly Xanthosia	0.1	10											0.1	1											0.1	3				
Xanthosia tridentata	Rock Xanthosia											0.1	5	0.1	10	0.1	5					0.1	5								
Xylomelum pyriforme	Woody Pear			1	0	0.5	10	0.5	10	0.5	10			0.2	2			0.5	5	0.4	4	0.5	5			0.1	2			0.1	1

Table 62. Floristic data for plots 31 - 45

Scientific name	Common name	31		32		33		34		35		36		37		38		39		40		41		42		43		44		45	
		C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
Acacia fimbriata	Fringed Wattle																							0.1	2						
Acacia linifolia	White Wattle																							0.1	1			0.1	1		
Acacia longifolia		0.2	5	0.1	1							0.1	1			1	0					0.5	1								
Acacia myrtifolia	Red-stemmed Wattle	0.1	1	0.1	1	0.1	1	0.1	3	0.1	10	0.1	5					0.1	2			0.5	10					0.1	2		
Acacia sp.	Wattle			0.1	1																										
Acacia suaveolens	Sweet Wattle																											0.1	2		
Acacia terminalis	Sunshine Wattle									0.2	10																				
Acacia ulicifolia	Prickly Moses	0.1	5	0.1	4			0.1	2	0.1	1	0.1	5	0.1	1			0.1	5	0.1	3	1.5	30	0.2	2						
Allocasuarina littoralis	Black She-Oak																							1	1	0.1	1				
Allocasuarina torulosa	Forest Oak									1	0	0.2	10									1	0								
Almaleea paludosa																														3	500
Anisopogon avenaceus	Oat Speargrass																											2	150		
Aristida ramosa	Purple Wiregrass															0.1	5														
Aristida vagans	Threeawn Speargrass													0.1	10																
Baeckea imbricata																								0.2	5	1	250	0.1	5		
Baeckea linifolia	Weeping Baeckea																							0.1	2					40	0
Banksia ericifolia	Heath-leaved Banksia					0.1	10											0.1	1	0.1	5	2	0								
Banksia marginata	Silver Banksia																			1	0			25	0			0.2	2	0.1	2
Banksia robur	Swamp Banksia																													25	0
Banksia serrata	Old-man Banksia			0.1	1	0.1	2											0.1	1									0.1	2		
Banksia spinulosa	Hairpin Banksia	0.2	5	0.5	1			0.2	5															5	20	10	60	2	10		
Bauera microphylla																										0.1	1	0.1	15	5	0
Baumea rubiginosa																														0.5	30
Billardiera scandens	Hairy Apple Berry																							0.1	1			0.1	1	0.1	2
Blandfordia nobilis	Christmas Bells											0.1	1	0.1	1																
Boronia parviflora	Swamp Boronia																									0.1	1			3	500
Boronia serrulata	Rose Boronia	0.1	3					0.1	5																						
Boronia sp.								0.1	1																						
Bossiaea ensata	Sword Bossiaea					0.1	1					0.1	2			0.1	1			0.1	1										
Bossiaea heterophylla	Variable Bossiaea	0.1	2			0.1	1	0.1	1					0.1	5	0.1	5	0.1	5	0.5	25	0.2	10	0.1	2			0.1	2		
Bossiaea obcordata	Spiny Bossiaea					0.1	3	0.1	5	0.1	1	0.1	10	0.1	1	0.1	2			0.3	10	0.5	15								
Bossiaea scolopendria																								0.1	1						
Bossiaea sp.																								0.1	1						
Brunoniella pumilio	Dwarf Blue Trumpet																							0.1	1	0.1	1	0.1	2		
Caladenia sp.								0.1	2																						
Callistemon citrinus	Crimson Bottlebrush																											0.3	5		

Scientific name	Common name	31		32		33		34		35		36		37		38		39		40		41		42		43		44		45	
		C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
Callistemon rigidus	Stiff Bottlebrush																									0.1	2				
Cassytha glabella										0.1	1													0.1	1	0.1	1	0.1	5	0.1	1
Caustis flexuosa	Curly Wig																	0.1	10												
Chorizandra sphaerocephala	Roundhead Bristle-sedge																													0.1	1
Conospermum tenuifolium	Sprawling Smoke-bush																			0.2	5										
Corybas sp.								0.1	2																						
Corymbia gummifera	Red Bloodwood	5	0	2	1			15	0													1	0					5	0		
Cyathochaeta diandra		0.1	5	0.1	5			0.1	5			0.5	70					0.1	3	0.5	10	0.5	10	0.5	10	0.1	5	15	0		
Cynodon dactylon	Common Couch									0.1	1																				
Dampiera stricta								0.1	10			0.1	5			0.1	10	0.1	10	0.1	5	0.1	5	0.1	5	0.2	25	1	50	0.2	50
Dianella sp.										0.1	1																				
Dillwynia floribunda																										15	350	1	50	3	100
Dillwynia retorta		0.1	1	0.1	5			0.1	1																						
Dodonaea triquetra	Large-leaf Hop-bush					0.1	2																								
Dracophyllum sp.																		0.1	1												
Drosera peltata	A Sundew			0.1	1					0.1	50											0.5	150								
Drosera spatulata																						0.5	10	0.1	5	0.2	100	0.1	1	8	0
Empodisma minus																										5	250			8	0
Entolasia marginata	Bordered Panic	0.1	5			0.1	5	0.1	5	0.1	10			0.1	10			0.1	1			0.2	10								
Entolasia stricta	Wiry Panic																							2	200	5	2500	3	150	0.5	50
Epacris microphylla	Coral Heath																	0.1	3					0.2	5			1	20	0.1	1
Epacris obtusifolia	Blunt-leaf Heath																													0.1	5
Eriostemon australasius		0.1	5	0.1	3	0.1	2	0.1	5											0.1	5	0.1	1								
Eucalpytus sp.														0.1	1																
Eucalyptus eugenioides	Thin-leaved Stringybark							5	0																						
Eucalyptus globoidea	White Stringybark			2	1																										
Eucalyptus piperita	Sydney Peppermint																							8	0						
Eucalyptus racemosa	Narrow-leaved Scribbly Gum	40	0	20	0	8	0	5	0					0.2	2			3	0	5	0			15	0	0.1	5	15	0	0.1	5
Eucalyptus sieberi	Silvertop Ash			5	3	5	0	5	0			5	0					5	0	20	0	3	0								
Gahnia sp.																				0.1	3										
Glycine tabacina	Variable Glycine															0.2	5														
Gompholobium grandiflorum	Large Wedge Pea							0.1	25			0.1	1																		
Gompholobium latifolium	Golden Glory Pea															0.1	1														
Gompholobium sp.																0.2	1	0.1	1					0.1	5	3	100				
Gonocarpus micranthus												0.5	150			0.3	200									0.2	50	0.1	20	1	150
Gonocarpus sp.	Raspwort																					5	0								
Gonocarpus tetragynus	Poverty Raspwort																											0.2	50		

Scientific name	Common name	31		32		33		34		35		36		37		38		39		40		41		42		43		44		45	
		C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
Gonocarpus teucrioides	Germander Raspwort									0.2	100			0.1	10	0.3	20					0.1	3								
Goodenia bellidifolia		0.1	1			0.1	1			0.1	10													1	100	2	250	0.1	20	1	150
Goodenia dimorpha																														0.5	50
Goodenia hederacea	Ivy Goodenia																							0.5	15	2	250				
Goodenia sp.										0.1	10	0.1	1							0.1	1										
Grevillea mucronulata				0.1	1	0.1	2	0.1	5	0.3	10	0.2	5			0.1	1	0.1	5									6	0		
Grevillea speciosa	Red Spider Flower											0.5	2																		
Grevillea sphacelata	Grey Spider Flower	0.3	5			0.1	1	0.3	5							0.1	1	0.2	5									0.2	5		
Grevillea sp.										0.1	2									1	0										
Hakea dactyloides	Finger Hakea																	0.1	1					2	10	5	15	0.5	5		
Hakea teretifolia	Needlebush																			0.1	1					1	3	0.5	5		
Hemarthria uncinata	Matgrass																									0.1	5			0.1	10
Hibbertia circumdans								0.1	5	0.1	15	0.1	5									0.1	10								
Hibbertia riparia																								0.5	25	3	150	1	50		
Hibbertia sp.		0.1	1					0.1	1	0.1	1									0.2	1										
Hovea sp.		0.1	1					0.1	1																						
Isopogon anemonifolius	Broad-leaf Drumsticks	0.1	5	0.1	5	0.1	10					0.1	1					0.1	5					2	10			1	5		
Kunzea ambigua	Tick Bush									1	0	0.1	1	2	0	0.1	1					45	0								
Lambertia formosa	Mountain Devil																			1	0	0.1	1					0.2	2		
Lepidosperma laterale	Variable Sword-sedge	0.1	1			0.1	2					0.1	1							0.2	20			0.1	1						
Lepidosperma neesii																														0.1	5
Leptocarpus tenax																								2	250	3	250	1	50	20	0
Leptomeria acida	Sour Currant Bush																							1	5			0.1	1		
Leptospermum arachnoides																												0.1	1	1	40
Leptospermum continentale	Prickly Teatree																							0.1	1						
Leptospermum juniperinum	Prickly Tea-tree																									1.5	10				
Leptospermum polygalifolium	Tantoon	0.5	25	0.3	20	0.4	10	0.1	5			2	0	1	0			0.3	10			5	0	10	0	0.1	1	2	10		
Leptospermum trinervium	Slender Tea-tree																							8	0			3	10		
Lepyrodia anarthria																														0.1	10
Lepyrodia scariosa																								3	250	1	250	1	150	2	250
Leucopogon ericoides	Pink Beard-heath							0.1	1																			0.1	1		
Lindsaea linearis	Screw Fern	0.1	50	0.1	10																	0.1	5	0.5	50	0.2	50	1	150	0.5	150
Lissanthe strigosa	Peach Heath									5	0	0.1	1							0.1	3	0.5	5					0.1	1		
Lomandra cylindrica						0.1	1																								
Lomandra filiformis	Wattle Matt-rush											0.1	5			0.1	5	0.1	5	0.1	5										
Lomandra filiformis subsp. *coriacea*	Wattle Matt-rush																							0.1	25						

Scientific name	Common name	31		32		33		34		35		36		37		38		39		40		41		42		43		44		45	
		C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
Lomandra gracilis																												0.1	1		
Lomandra longifolia	Spiny-headed Mat-rush											0.2	5																		
Lomandra multiflora subsp. *multiflora*	Many-flowered Mat-rush	0.1	5	0.1	2	0.1	1	0.1	1			0.5	20							0.1	5	0.1	5								
Lomandra obliqua		0.1	20	0.1	15			0.1	20	0.5	1000	0.1	20			0.1	10			0.1	10	0.2	50					0.1	20		
Lomatia silaifolia	Crinkle Bush	0.1	2	0.1	1			0.2	10	0.1	1							0.1	5	0.3	10	0.1	1								
Melaleuca thymifolia	Thyme Honey-myrtle																							0.1	1	10	250			5	0
Mitrasacme pilosa																														0.5	150
Opercularia varia	Variable Stinkweed																											0.1	1		
Orchidacae sp.																								0.1	1						
Patersonia glabrata	Leafy Purple-flag	0.2	50	0.2	20	0.5	25	0.1	5	0.3	10	0.1	5	0.1	5	0.1	10	0.1	5			0.3	10					2	80		
Patersonia sericea	Silky Purple-Flag																							0.5	5	0.1	1	1	50	0.2	5
Persoonia lanceolata	Lance Leaf Geebung																									0.2	1			0.1	1
Persoonia levis	Broad-leaved Geebung	0.3	1			1	1	0.1	3	0.2	1									1	0			0.1	2	0.1	2	0.2	2	0.1	1
Petrophile pulchella	Conesticks																											0.5	5	0.1	2
Petrophile sessilis						0.1	15	0.1	5			0.2	10					0.1	10	0.2	15	0.1	5	1	10	0.1	2	2	10	4	80
Phyllota grandiflora	Heath Phyllota											0.1	5					0.1	10												
Pimelea linifolia	Slender Rice Flower																											0.2	5		
Pimelea sp.								0.2	30			0.2	20					0.1	2			0.1	5								
Platysace linearifolia		0.1	1															0.1	5					0.2	5			1.5	60		
Poaceae sp.																								0.1	1						
Pomaderris sp.										0.1	1					0.1	1														
Pomax umbellata	Pomax									0.2	100	0.1	5	0.3	100	0.2	50							0.1	1						
Poranthera sp.																				0.1	2										
Pteridium esculentum	Bracken					0.1	1																					0.1	5		
Ptilothrix deusta																								2	250	5	2500	5	0	3	1000
Pultenaea sp.		0.1	1											0.1	5																
Schoenus brevifolius																								1	100	8	1500				
Schoenus melanostachys																								5	0						
Schoenus sp.								0.1	1											0.1	5										
Selaginella uliginosa	Swamp Selaginella																									0.1	5			0.5	250
Sphaerolobium sp.																								0.1	1						
Sprengelia incarnata	Pink Swamp Heath																							10	0						
Stackhousia monogyna	Creamy Candles							0.1	2			0.5	100																		
Stackhousia nuda																		0.1	15			1	0								
Stylidium graminifolium	Grass Triggerplant									0.2	50																				
Thelymitra sp.																														0.1	10

Scientific name	Common name	31		32		33		34		35		36		37		38		39		40		41		42		43		44		45	
		C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
Viola hederacea	Ivy-leaved Violet																							0.1	5	0.1	5				
Viola sieberiana																														0.1	5
Xanthorrhoea sp.				0.3	3	0.1	1	0.1	5									0.1	5	1	0										
Xanthosia pilosa	Woolly Xanthosia							0.1	3									0.1	3												
Xanthosia tridentata	Rock Xanthosia															0.1	20	0.1	5			0.1	10	0.1	1			2	100		
Xylomelum pyriforme	Woody Pear	0.1	2					0.1	3			1	0							0.5	5										
Xyris gracilis																										0.1	25				
Xyris operculata																										0.5	25	3	50	6	0
Zieria smithii	Sandfly Zieria							0.1	1																						

Table 63. Floristic data for plots 46 - 60

Scientific name	Common name	46		47		48		49		50		51		53		54		55		56		57		58		59		60	
		C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
Acacia binervata	Two-veined Hickory															10	0												
Acacia linifolia	White Wattle													2	0			0.2	10	0.1	1	0.5	5	0.3	1				
Acacia longifolia				0.2	5					3.5	15							0.5	3										
Acacia myrtifolia	Red-stemmed Wattle																	0.2	10	0.4	20	0.1	1						
Acacia obtusifolia												2	13																
Acacia rubida	Red-stemmed Wattle			0.2	5															0.2	3	0.2	2						
Acacia sp.	Wattle											0.1	5																
Acacia terminalis	Sunshine Wattle									0.5	20	0.1	10																
Acacia ulicifolia	Prickly Moses																	0.1	2	0.5	10			0.1	1			0.1	1
Acianthus fornicatus	Pixie Caps									2	0	0.2	20																
Actinotus minor	Lesser Flannel Flower	0.1	5																										
Allocasuarina torulosa	Forest Oak													5	0	5	0												
Austrostipa pubescens																0.1	3												
Baeckea diosmifolia	Fringed Baeckea																							5	0				
Baeckea imbricata																								2	0				
Baeckea linifolia	Weeping Baeckea					2	50	3	50																				
Banksia ericifolia	Heath-leaved Banksia	3	15																	0.1	10			30	0	0.1	10		
Banksia marginata	Silver Banksia	1	5	35	0	1	10																						
Banksia robur	Swamp Banksia	2	5					5	0																				
Banksia serrata	Old-man Banksia			2	20							25	15	5	0			5	0	2	0	5	0	5	0	1	0		
Banksia spinulosa	Hairpin Banksia	3	15			0.5	5			4	0	5	14	2	0	3	0	10	0	2	0	0.5	3	2	0	1	0	3	0
Bauera microphylla		0.5	50																										
Bauera rubioides	River Rose					0.2	10	3	250																				
Baumea articulata	Jointed Twig-rush							1	50																				
Billardiera scandens	Hairy Apple Berry																	0.1	1	0.1	1							0.1	10
Blandfordia nobilis	Christmas Bells	0.1	1																			0.1	1						
Blandfordia sp.																								0.1	2				
Boronia parviflora	Swamp Boronia	0.1	15																					0.1	1				
Bossiaea ensata	Sword Bossiaea																	0.2	10	0.1	10	0.1	10						
Bossiaea heterophylla	Variable Bossiaea									1	0	0.2	2	0.1	3			0.2	50	0.2	20			0.2	5	0.2	5	0.5	20
Bossiaea obcordata	Spiny Bossiaea			0.1	1					1	0	0.1	10							0.2	50	0.1	10			0.1	5	0.2	10
Bossiaea scolopendria																								0.1	2	0.2	5	0.1	1
Bossiaea sp.														0.1	3					0.1	1	0.5	5						
Brunoniella pumilio	Dwarf Blue Trumpet	0.1	5																										
Callistemon citrinus	Crimson Bottlebrush							10	0																				
Callistemon sieberi	River Bottlebrush																							1	0				

Scientific name	Common name	46		47		48		49		50		51		53		54		55		56		57		58		59		60	
		C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
Callistemon viminalis	Weeping Bottlebrush													2	0														
Cassinia sp.																0.1	1												
Cassytha glabella																				0.1	1			0.1	1				
Cassytha pubescens	Downy Dodder-laurel							0.2	10	0.3	4	3	20																
Caustis flexuosa	Curly Wig																	0.1	3	0.1	5					0.3	100	1	0
Ceratopetalum gummiferum	Christmas Bush									60	0	5	0			3	0												
Chloanthes stoechadis																0.1	2												
Clematis aristata	Old Man's Beard													0.2	3	0.5	20												
Conospermum taxifolium	Variable Smoke-bush																			0.2	2	1	50					0.1	1
Conospermum tenuifolium	Sprawling Smoke-bush			1	20															0.1	2								
Corymbia gummifera	Red Bloodwood									40	8	40	14	5	0	5	0			5	0								
Cryptostylis erecta	Tartan Tongue Orchid									0.1	1																		
Cryptostylis sp.																0.1	1												
Cyathochaeta diandra		10	0	0.5	5	10	0													0.2	15	0.5	10	0.2	10	0.1	5	0.5	20
Dampiera purpurea														0.2	10	0.1	3												
Dampiera stricta		1	80	0.1	25	0.2	50	0.1	5	0.8	40							0.1	5	0.2	20			0.5	100				
Dianella sp.		0.1	2							5	0	1	0	0.1	5	0.2	10												
Dillwynia floribunda		5	0	2	50	25	0	2	25															0.2	50			0.1	5
Dillwynia retorta																				0.1	10								
Dillwynia sp.																												0.1	1
Dodonaea triquetra	Large-leaf Hop-bush															5	0												
Drosera peltata	A Sundew													0.2	100														
Drosera spatulata		3	500					0.1	25															0.5	1000				
Empodisma minus		0.1	5	3	500	0.5	150	10	0																				
Entolasia marginata	Bordered Panic			1	150	0.1	10											0.1	10										
Entolasia stricta	Wiry Panic	2	500							2	0	1	0	0.1	5	0.5	100							0.5	1000				
Epacris microphylla	Coral Heath					0.2	103							0.2	50			0.2	1000					1	0				
Epacris obtusifolia	Blunt-leaf Heath							0.1	1																				
Eriostemon australasius														0.1	3			0.5	20			0.2	10	0.2	5	0.5	5	0.3	5
Eucalyptus agglomerata	Blue-leaved Stringybark															30	0												
Eucalyptus eugenioides	Thin-leaved Stringybark													30	0							10	0					5	0
Eucalyptus globoidea	White Stringybark									10	3					5	0	5	0	10	0								
Eucalyptus piperita	Sydney Peppermint							5	0	45	9	4	2																
Eucalyptus punctata	Grey Gum													10	0	15	0												
Eucalyptus racemosa	Narrow-leaved Scribbly Gum			5	0	5	0							10	0					5	0	45	0	15	0	10	0	10	0
Eucalyptus sieberi	Silvertop Ash																			30	0	15	0			15	0	20	0
Gahnia sieberiana	Red-fruit Saw-sedge							10	0																				

Scientific name	Common name	46		47		48		49		50		51		53		54		55		56		57		58		59		60	
		C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
Gahnia sp.																						0.1	5						
Gleichenia dicarpa	Pouched Coral Fern			75	0			85	0																				
Gompholobium grandiflorum	Large Wedge Pea																			0.5	3								
Gompholobium latifolium	Golden Glory Pea									1	0																		
Gonocarpus micranthus		0.1	5			0.1	10	0.1	25					0.1	10									0.3	100				
Gonocarpus sp.	Raspwort															0.1	1												
Gonocarpus tetragynus	Poverty Raspwort	2	250			0.1	10																						
Gonocarpus teucrioides	Germander Raspwort											0.3	50			0.1	5												
Goodenia bellidifolia		2	250																										
Goodenia dimorpha		2	100	0.2	50	0.1	253																						
Grevillea laurifolia	Laurel-leaf Grevillea																									0.5	10		
Grevillea mucronulata				0.1	1	0.2	5					1	0	0.5	2	0.2	1	1	0	1	0	1	0	1	0	0.2	10	0.5	10
Grevillea speciosa	Red Spider Flower																									2	0		
Grevillea sphacelata	Grey Spider Flower																			10	0	15	0	2	0				
Grevillea sp.																0.2	10												
Haemodorum corymbosum		0.1	10																										
Haemodorum sp.						0.1	5																						
Hakea dactyloides	Finger Hakea	2	25	0.1	1	0.5	15											1	0	0.2	5			0.5	5	0.1	1		
Hakea gibbosa																								0.5	1				
Hakea teretifolia	Needlebush	4	25	3	20			2	5													0.5	10	5	0	2	0	0.1	5
Hakea teretifolia subsp. *teretifolia*						1	10																						
Hardenbergia violacea	False Sarsaparilla											0.1	1																
Hemarthria uncinata	Matgrass			0.1	1	0.1	5	0.1	1																				
Hibbertia aspera	Rough Guinea Flower									0.2	20																		
Hibbertia diffusa	Wedge Guinea Flower													0.1	5	0.1	1												
Hibbertia linearis												0.1	20																
Hibbertia riparia		5	0			0.5	15																						
Hibbertia scandens	Climbing Guinea Flower															0.1	1												
Hibbertia vestita												0.1	15																
Hovea linearis												0.1	5									0.1	1						
Hovea sp.																				0.1	1								
Imperata cylindrica	Blady Grass																											0.1	2
Isopogon anemonifolius	Broad-leaf Drumsticks			2	10	0.1	2							1	0	2	0	1	0	0.3	50			1	0	0.1	10		
Kennedia rubicunda	Dusky Coral Pea											0.1	1																
Lambertia formosa	Mountain Devil			0.1	1					5	15	3	0																
Lepidosperma cf. laterale												0.3	20			2	0												

Scientific name	Common name	46		47		48		49		50		51		53		54		55		56		57		58		59		60	
		C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
Lepidosperma laterale	Variable Sword-sedge													3	0														
Lepidosperma neesii						0.1	10																						
Leptocarpus tenax		8	0	10	0	25	0	5	0									0.1	10					0.3	100				
Leptomeria acida	Sour Currant Bush			0.1	1	0.1	1					0.5	2											0.5	1				
Leptospermum arachnoides		1	25			0.2	153											20	0										
Leptospermum juniperinum	Prickly Tea-tree																					10	0	25	0	0.5	50		
Leptospermum lanigerum	Woolly Teatree	0.1	1					2	0																				
Leptospermum polygalifolium	Tantoon			3	20	1	10	5	15									10	0			0.5	10	1	0	0.5	10	2	0
Leptospermum sp.	Tea-tree																			10	0								
Leptospermum trinervium	Slender Tea-tree			1	5	10	0							15	0	10	0												
Lepyrodia scariosa		2	250			1	150											0.1	10					0.5	100				
Leucopogon ericoides	Pink Beard-heath															0.5	1									0.1	10		
Leucopogon lanceolatus												1	4																
Lindsaea linearis	Screw Fern	0.5	50	0.1	2	2	500	0.1	25			0.1	5	0.1	10			0.1	20					0.2	300				
Lindsaea microphylla	Lacy Wedge Fern			0.1	2					0.1	20																		
Lomandra cylindrica																				0.2	20					0.2	10	0.1	50
Lomandra filiformis subsp. *coriacea*	Wattle Matt-rush	0.5	50			0.1	1																						
Lomandra glauca	Pale Mat-rush													1	0	2	0	0.1	1										
Lomandra longifolia	Spiny-headed Mat-rush			0.1	1					6	0	5	0	1	0	1	0												
Lomandra multiflora subsp. *multiflora*	Many-flowered Mat-rush													0.3	30	0.5	30												
Lomandra obliqua										1	0	0.1	10	0.1	50			0.1	30	0.1	50					0.2	10		
Lomatia ilicifolia	Holly Lomatia											3	0															0.1	1
Lomatia silaifolia	Crinkle Bush			0.1	1					1	0					0.1	5	0.1	1	0.2	10					0.2	10		
Melaleuca thymifolia	Thyme Honey-myrtle	0.5	5	0.1	1	2	70	0.5	5																				
Micromyrtus ciliata	Fringed Heath-myrtle	6	0			0.1	1																						
Mitrasacme pilosa		4	600																										
Notelaea longifolia	Large Mock-olive															0.5	1												
Orchidacae sp.		0.1	5																										
Patersonia glabrata	Leafy Purple-flag			0.1	1																								
Patersonia sericea	Silky Purple-Flag	3	220			0.1	2			2	0							0.1	5			0.2	10	0.1	1			0.2	10
Persoonia levis	Broad-leaved Geebung	0.1	1	0.2	1					2	0	3	5	0.5	1					5	0	3	2	0.2	2	0.1	1		
Persoonia linearis	Narrow-leaved Geebung															5	0												
Persoonia pinifolia	Pine-leaved Geebung					0.1	1																						
Petrophile pulchella	Conesticks									0.8	5																		
Petrophile sessilis		2	50	5	0	30	0	0.1	2									1	0	1	0	0.5	20	20	0	0.2	20	0.2	5

Scientific name	Common name	46		47		48		49		50		51		53		54		55		56		57		58		59		60	
		C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
Phyllota sp.																										0.1	10		
Pimelea linifolia	Slender Rice Flower											1	0																
Pimelea spicata	Spiked Rice-flower									4	0																		
Pimelea sp.														0.1	1			0.2	50	0.5	100	0.3	20	0.1	5	0.1	5	0.1	1
Platysace linearifolia										1	0	0.8	30	0.2	10			1	0	0.5	100	0.5	100	0.5	200	0.5	100	0.5	100
Poaceae sp.		0.1	1																										
Pomaderris sp.																1	0												
Pteridium esculentum	Bracken			0.5	50			0.5	10	1	0	20	0	10	0			0.5	10										
Ptilothrix deusta		5	0			8	350																						
Pultenaea daphnoides	Large-leaf Bush-pea																	0.1	10	0.1	1	5	0	1	0	0.1	1		
Pultenaea divaricata								0.1	1																				
Pultenaea sp.																												0.1	10
Schizaea bifida	Forked Comb Fern																	0.1	5										
Schizaea dichotoma	Branched Comb Fern	0.1	1																										
Schoenus brevifolius																		0.2	100					0.2	5				
Schoenus melanostachys				5	0			3	50					10	0			0.2	1										
Schoenus sp.												0.2	20																
Selaginella uliginosa	Swamp Selaginella							2	150															0.1	1				
Smilax glyciphylla	Sweet Sarsparilla									0.5	5	0.1	5																
Solanum sp.																0.1	5												
Sphaerolobium vimineum		0.1	1																										
Sprengelia incarnata	Pink Swamp Heath							2	50																				
Stackhousia nuda														0.1	1													0.1	5
Stackhousia sp.																								0.1	1				
Stellaria sp.	Prickly Starwort									0.1	10																		
Telopea speciosissima	Waratah									2	0	2	20																
Viola hederacea	Ivy-leaved Violet			0.1	1									0.1	50														
Viola sieberiana		1	80																										
Xanthorrhoea sp.																		0.1	1	0.3	1	0.5	2			0.5	3		
Xanthosia pilosa	Woolly Xanthosia											0.1	10											0.1	1				
Xanthosia tridentata	Rock Xanthosia									1	0	1	0	0.1	1	0.1	3	0.1	10	0.1	5			0.1	1				
Xylomelum pyriforme	Woody Pear			0.2	5					0.2	1			0.3	2	1	5			2	0	1	0			1	0	0.2	2
Xyris operculata		4	100	0.5	10			0.5	25																				
Xyris sp.						5	250																						

Table 64. Floristic data for plots 61 - 76

Scientific name	Common name	61		62		63		64		65		66		67		68		69		70		71		72		73		74		75		76	
		C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
Acacia binervata	Two-veined Hickory											1	30	0.2	50																		
Acacia bynoeana	Bynoe's Wattle																							0.1	10								
Acacia echinula	Hedgehog Wattle																											0.1	5				
Acacia irrorata	Green Wattle					0.1	5	1	20																								
Acacia linifolia	White Wattle					0.1	10	0.5	20	0.1	10									0.1	2					0.1	10						
Acacia longifolia								0.1	5																	5	100						
Acacia longifolia subsp. *longifolia*	Sydney Golden Wattle															0.1	1	0.1	10	0.1	5												
Acacia maidenii	Maiden's Wattle																															3	0
Acacia myrtifolia	Red-stemmed Wattle					0.1	1																			0.3	0						
Acacia obtusifolia								0.1	5																			0.1	5				
Acacia terminalis	Sunshine Wattle							1	50							0.1	2											0.1	2				
Acacia ulicifolia	Prickly Moses					0.1	8													0.1	10			0.1	10			0.1	1				
Acianthus exsertus	Mosquito Orchid																									0.1	5						
Acronychia oblongifolia	White Aspen																													5	0		
Actinotus minor	Lesser Flannel Flower																							0.1	20								
Adiantum aethiopicum	Common Maidenhair																													0.1	10		
Adiantum sp.						0.1	1																										
Ageratina adenophora	Crofton Weed																															0.2	200
Allocasuarina littoralis	Black She-Oak					0.2	20	0.1	2	0.1	1																	5	5				
Allocasuarina torulosa	Forest Oak																	2	5														
Aristida ramosa	Purple Wiregrass									0.5	50																						
Aristida vagans	Threeawn Speargrass									0.1	50																						
Aristida warburgii																								0.2	100								
Arundinella nepalensis	Reedgrass	0.2	100																														
Astrotricha latifolia												0.1	1																				
Baeckea imbricata				0.1	1																												
Banksia ericifolia	Heath-leaved Banksia																									0.1	2	0.1	5				
Banksia serrata	Old-man Banksia															15	20							0.1	5	1	25	0.1	1				
Banksia spinulosa	Hairpin Banksia			0.1	5	0.1	2			0.3	3							0.1	5							5	50	0.1	1				
Banksia spinulosa var. *spinulosa*																0.2	5																
Baumea acuta		0.3	1000																														
Billardiera scandens	Hairy Apple Berry					0.1	15	0.1	1					0.1	5			0.1	10							0.1	10						
Blechnum cartilagineum	Gristle Fern							0.2	10																								
Bolboschoenus sp.																0.1	20																
Boronia parviflora	Swamp Boronia	0.1	10	0.1	10			0.1	1	0.3	30																						

Scientific name	Common name	61		62		63		64		65		66		67		68		69		70		71		72		73		74		75		76	
		C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
Boronia serrulata	Rose Boronia			0.1	5																							0.1	2				
Bossiaea heterophylla	Variable Bossiaea			0.1	5									0.1	10											0.1	10						
Bossiaea obcordata	Spiny Bossiaea																	0.1	10							0.3	50						
Bossiaea prostrata																								0.1	20								
Brunonia australis	Blue Pincushion																	0.1	20														
Brunoniella australis	Blue Trumpet																			0.1	5												
Brunoniella sp.																										0.1	10						
Caesia parviflora	Pale Grass-lily	0.1	10																														
Callistemon sieberi	River Bottlebrush			0.3	30																												
Callitris rhomboidea	Port Jackson Pine							0.1	2																								
Carex appressa	Tall Sedge																													0.2	2		
Carex inversa	Knob Sedge					0.1	30	0.2	50																								
Carex sp.																																0.1	5
Cassytha glabella				0.1	5			2	20																	0.1	10						
Caustis flexuosa	Curly Wig																							0.1	10	0.2	50	2	100				
Centella asiatica	Indian Pennywort											0.3	100																				
Ceratopetalum apetalum	Coachwood							0.5	10																								
Cheilanthes sieberi subsp. *sieberi*	Rock Fern													0.1	0																		
Chloanthes stoechadis																										0.1	10						
Clematis aristata	Old Man's Beard											0.1	10					0.1	10														
Commelina cyanea	Native Wandering Jew																													0.3	1000	0.1	20
Conospermum ellipticum																								0.1	50								
Conospermum longifolium	Long Leaf Smoke-bush																							0.1	10								
Cordyline sp.																														0.5	1		
Correa alba var. *alba*	White Correa					0.1	1	0.1	1																								
Corybas aconitiflorus	Spurred Helmet Orchid																									0.3	40						
Corybas sp.												2	300																				
Corymbia gummifera	Red Bloodwood															1	3	10	10					0.2	20	20	20						
Crassula sp.	Stonecrop			0.1	50																												
Cryptandra spinescens								0.1	15																			0.1	10				
Cryptostylis sp.																0.1	1																
Cyathochaeta diandra		0.2	50			0.1	5			0.2	100					0.1	30							0.5	50			0.1	30				
Cynodon dactylon	Common Couch	5	0																														
Cynodon dactylon var. *dactylon*	Couch													0.5	100					0.1	10												
Dampiera purpurea												0.1	20	0.1	10			0.1	5	0.1	5												
Dampiera stricta		0.2	15													0.1	50			0.1	5			0.1	20								

Scientific name	Common name	61		62		63		64		65		66		67		68		69		70		71		72		73		74		75		76	
		C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
Daviesia ulicifolia	Gorse Bitter Pea																	0.1	5														
Daviesia ulicifolia subsp. *ulicifolia*																				0.1	30												
Delairea odorata	Cape Ivy																															0.1	5
Dendrocnide excelsa	Giant Stinging Tree																															2	1
Desmodium sp.	Tick-trefoil					0.1	20																										
Dianella caerulea	Blue Flax-lily					0.2	150					0.1	10	0.1	10																		
Dianella caerulea var. *caerulea*																										0.1	20						
Dianella revoluta	Blueberry Lily																									0.1	10						
Dianella revoluta var. *revoluta*	A Blue Flax Lily																			0.2	30												
Dichondra repens	Kidney Weed													0.1	10															0.2	1000		
Dillwynia floribunda		0.2	30																														
Dillwynia retorta								0.2	10																								
Dodonaea triquetra	Large-leaf Hop-bush							0.2	5																	0.2	10						
Doodia aspera	Prickly Rasp Fern							0.3	50			5	1000																				
Drosera peltata	A Sundew			0.1	20																												
Drosera spatulata				2	500																												
Echinopogon caespitosus	Bushy Hedgehog-grass											0.1	10	0.1	20																		
Entolasia marginata	Bordered Panic	25	0	0.1	50					0.1	10	0.1	10	0.1	10															0.1	1		
Entolasia stricta	Wiry Panic					0.3	500	0.5	200											0.1	5			0.2	50			0.1	5				
Entolasia whiteana																0.1	20	0.2	50	0.1	10					0.2	150						
Epacris microphylla	Coral Heath			0.2	100																												
Epacris purpurascens var. *purpurascens*										0.1	5																						
Eragrostis brownii	Brown's Lovegrass									0.1	50									0.1	10												
Eriostemon australasius																0.3	20									0.1	5						
Erythrina crista-galli	Cockspur Coral Tree																															5	0
Eucalyptus botryoides <--> saligna																														45	0		
Eucalyptus crebra	Narrow-leaved Ironbark											2	1																				
Eucalyptus eugenioides	Thin-leaved Stringybark			0.1	2							15	0	0.2	40			5	0							0.1	50						
Eucalyptus obliqua	Messmate																											2	1				
Eucalyptus piperita	Sydney Peppermint																	30	14	5	0												
Eucalyptus punctata	Grey Gum											10	0																				
Eucalyptus punctata subsp. *punctata*														0.1	20											10	2						
Eucalyptus racemosa	Narrow-leaved Scribbly Gum	0.1	1							0.1	10											30	0					1	1				

Scientific name	Common name	61		62		63		64		65		66		67		68		69		70		71		72		73		74		75		76	
		C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
Eucalyptus sclerophylla	Hard-leaved Scribbly Gum															10	2							0.1	50								
Eucalyptus sieberi	Silvertop Ash					45	11	30	5																								
Eucalyptus sp.																												1	1				
Gahnia aspera	Rough Saw-sedge											1	100																	0.1	1	0.1	1
Gamochaeta sp.		1	0																														
Geitonoplesium cymosum	Scrambling Lily																													1	0	0.1	5
Genoplesium sp.																0.1	1							0.1	10								
Glycine tabacina	Variable Glycine													0.1	20																		
Gompholobium grandiflorum	Large Wedge Pea			0.1	5																					0.1	3	0.1	5				
Gonocarpus micranthus		0.5	1000																														
Gonocarpus tetragynus	Poverty Raspwort															0.1	15									0.1	1						
Gonocarpus teucrioides	Germander Raspwort					0.1	5					0.1	100	0.1	50					0.1	10												
Goodenia bellidifolia				0.1	1																												
Goodenia hederacea	Ivy Goodenia													0.3	200					0.1	100					0.1	10						
Grevillea mucronulata						0.3	100											0.1	5	0.1	10					0.2	30	0.1	30				
Grevillea oleoides	Red Spider Flower							0.1	10	0.5	50																	0.1	5				
Grevillea sericea	Pink Spider Flower			0.1	1																												
Grevillea sp.																												0.1	3				
Hakea dactyloides	Finger Hakea					0.1	10											0.1	20					0.3	15			0.1	1				
Hakea gibbosa																1	30									0.1	10						
Hakea sericea	Needlebush			0.2	5	0.1	20	0.2	20	0.1	10							0.3	20									0.1	1				
Hakea teretifolia	Needlebush	0.2	10																														
Hardenbergia violacea	False Sarsaparilla					0.1	1											0.1	1							0.1	5						
Hibbertia aspera	Rough Guinea Flower					0.1	20					5	80							0.1	10	0.1	10										
Hibbertia aspera subsp. *aspera*														0.2	20																		
Hovea linearis						0.1	1											0.1	10							0.1	50						
Hypericum gramineum	Small St John's Wort													0.1	10																		
Imperata cylindrica	Blady Grass									0.2	30																	0.1	10				
Isopogon anemonifolius	Broad-leaf Drumsticks			1	100					0.2	20					0.3	10	0.2	20							0.1	2						
Juncus sp.	A Rush																															0.2	10
Kennedia rubicunda	Dusky Coral Pea											0.1	1																				
Kunzea ambigua	Tick Bush									10	250			0.2	30													5	0				
Lagenifera stipitata	Blue Bottle-daisy											0.1	100	0.1	20																		
Lagenophora gracilis	Slender Lagenophora																			0.1	100					0.1	100						
Lambertia formosa	Mountain Devil															0.1	1							0.1	5	0.2	10						

Scientific name	Common name	61		62		63		64		65		66		67		68		69		70		71		72		73		74		75		76	
		C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
Lantana camara	Lantana																													0.5	1		
Lasiopetalum parviflorum						0.1	10	0.1	20																								
Laxmannia gracilis	Slender Wire Lily															0.1	25																
Lepidosperma laterale	Variable Sword-sedge									0.2	30	5	20	0.1	10	0.1	10																
Lepidosperma limicola						0.1	10																										
Lepidosperma sp.																										0.2	100						
Leptocarpus tenax				0.1	15																												
Leptomeria acida	Sour Currant Bush											0.1	1							0.1	2					0.1	1						
Leptospermum arachnoides										1	30					0.2	5							0.1	10								
Leptospermum juniperinum	Prickly Tea-tree	1	1																														
Leptospermum morrisonii								2	50																								
Leptospermum polygalifolium	Tantoon	0.5	20																	0.2	50												
Leptospermum polygalifolium subsp. *polygalifolium*				0.2	10																												
Leptospermum squarrosum										0.2	10																						
Leptospermum trinervium	Slender Tea-tree					0.2	25	0.2	50							10	20							1	30	1	5	2	100				
Lepyrodia scariosa				0.1	5					2	1000					0.1	20																
Leucopogon lanceolatus						0.1	2	0.1	1			0.2	1																				
Leucopogon microphyllus										2	70					0.1	20																
Leucopogon setiger																		0.1	5														
Leucopogon sp.	A Beard-heath									0.1	50																						
Lindsaea linearis	Screw Fern																					0.1	30	0.2	100								
Lindsaea microphylla	Lacy Wedge Fern													0.1	10																		
Lissanthe strigosa	Peach Heath																									0.5	10						
Lissanthe strigosa subsp. *strigosa*																				0.1	20												
Lissanthe strigosa subsp. *subulata*	Peach Heath																	0.1	10														
Livistona australis	Cabbage Palm																													0.2	1		
Lomandra cylindrica																										0.2	100						
Lomandra filiformis	Wattle Matt-rush			0.1	5	0.1	3	0.1	15																			0.1	5				
Lomandra filiformis subsp. *coriacea*	Wattle Matt-rush															0.2	100	0.1	20														
Lomandra glauca	Pale Mat-rush	0.2	200																									0.1	5				
Lomandra longifolia	Spiny-headed Mat-rush	0.5	20			0.1	10	0.5	20					0.1	5	0.1	10	0.2	5	0.1	5					0.1	10	0.2	50	1	5		
Lomandra multiflora subsp. *multiflora*	Many-flowered Mat-rush							0.1	10							0.1	5							0.1	20	0.2	50						

Scientific name	Common name	61		62		63		64		65		66		67		68		69		70		71		72		73		74		75		76	
		C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
Lomandra obliqua		0.1	150	0.1	5									0.1	10	0.1	30	0.1	20	0.1	10			0.1	50	0.1	50	0.2	100				
Lomatia silaifolia	Crinkle Bush																	0.1	10							0.1	10	0.1	5				
Marsdenia rostrata	Milk Vine																													0.1	2		
Melaleuca thymifolia	Thyme Honey-myrtle	0.1	10	1	300																												
Melicope micrococca	Hairy-leaved Doughwood																													5	0		
Microlaena stipoides	Weeping Grass					0.1	10			0.1	50			5	1000			0.1	10	0.1	100												
Microlaena stipoides var. *stipoides*	Weeping Grass											5	1000													0.1	50						
Myrsine variabilis																										0.1	1						
Notelaea longifolia	Large Mock-olive											2	30																				
Nyssanthes diffusa	Barbwire Weed																															1	0
Opercularia aspera	Coarse Stinkweed							0.1	5																								
Opercularia diphylla	Stinkweed													0.1	100																		
Oplismenus aemulus																																0.1	200
Oxalis perennans						0.1	300	0.1	1			0.1	50	0.1	10																		
Pandorea pandorana	Wonga Wonga Vine																													0.1	5	0.5	20
Patersonia glabrata	Leafy Purple-flag																	0.1	5	0.1	10			5	80	0.1	25						
Patersonia sericea	Silky Purple-Flag	0.1	50																														
Pellaea falcata	Sickle Fern																													10	0	0.3	500
Persoonia levis	Broad-leaved Geebung			0.1	1													0.2	5					0.1	10	0.2	20						
Persoonia linearis	Narrow-leaved Geebung											3	15					0.3	5	0.1	1												
Persoonia pinifolia	Pine-leaved Geebung															0.1	1									0.1	5						
Petrophile sessilis				0.2	100					0.5	50					10	100	0.1	20					0.3	50			0.1	5				
Phyllanthus hirtellus	Thyme Spurge															0.1	30			0.1	10					0.1	50						
Pimelea linifolia subsp. *linifolia*																										0.1	20						
Pittosporum multiflorum	Orange Thorn																													10	0	0.2	20
Pittosporum undulatum	Sweet Pittosporum																															10	0
Platysace linearifolia						0.1	30	0.2	100	0.1	10					0.1	10									0.1	30	0.1	10				
Pomaderris sp.																												0.1	1				
Pomax umbellata	Pomax							0.1	5					0.1	20			0.1	5	0.1	10			0.1	10								
Lobelia purpurascens	Whiteroot											0.5	100	0.1	25					0.1	10												
Pteridium esculentum	Bracken					0.2	50	1	80			0.1	10	0.5	100			15	0							0.2	50	5	0			3	0
Pterostylis sp.	Greenhood											5	1000	0.2	50																		
Ptilothrix deusta		0.1	5																														

Scientific name	Common name	61		62		63		64		65		66		67		68		69		70		71		72		73		74		75		76	
		C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
Pultenaea ferruginea																										0.1	10						
Rhytidosporum sp.																												0.1	1				
Roldana petasitis																																25	0
Rytidosperma sp.												0.1	10							0.1	10												
Schoenus brevifolius						0.1	8																										
Selaginella uliginosa	Swamp Selaginella			0.2	500																												
Senecio madagascariensis	Fireweed	0.1	1																														
Smilax glyciphylla	Sweet Sarsparilla															0.1	20																
Solanum capsicoides	Devil's Apple																													0.1	5	0.5	50
Solanum prinophyllum	Forest Nightshade					0.1	1																										
Stephania japonica	Snake vine																													0.2	2	0.5	3
Stylidium graminifolium	Grass Triggerplant															0.1	10																
Stylidium lineare	Narrow-leaved Triggerplant			0.1	5																												
Styphelia tubiflora	Red Five-Corner															0.3	30			0.1	5												
Synoum glandulosum subsp. *glandulosum*	Scentless Rosewood																													10	0	15	0
Tecoma capensis	Cape Honeysuckle																															85	0
Tristaniopsis laurina	Kanooka					0.5	5	2	30																								
Tylophora barbata	Bearded Tylophora											0.1	10																				
Urtica dioica	Giant Nettle																													0.1	1		
Urtica incisa	Stinging Nettle																															0.2	50
Veronica plebeia	Trailing Speedwell													0.1	50																		
Viola hederacea	Ivy-leaved Violet																													0.2	1000		
Viola sp.						0.1	100																										
Xanthorrhoea sp.										0.1	1																						
Xanthosia pilosa	Woolly Xanthosia							0.1	1																	0.1	20						
Xanthosia tridentata	Rock Xanthosia			0.1	20			0.1	5							0.1	20									0.1	30						
Xyris sp.																				0.1	20												

Table 65. BAM plot transect scores for Subject Land

plotname	pct	patchsize	conditionclass	zone	easting	northing	bearing	compTree	compshrub	compGrass	compForbs	compFerns	compOther	strucTree	strucShrub	strucGrass	strucForbs	strucFerns	strucOther	funLargeTrees	funHollowtrees	funLitterCover	funLenFallenLogs	funTreeStem5to9	funTreeStem10to19	funTreeStem20to29	funTreeStem30to49	funTreeStem50to79	funTreeRegen	funHighThreatExotic
1	1083	101	Low	56	288004.7	6194820.7	58	3	15	7	6	0	0	20.2	6.2	2.9	1.8	0.0	0.0	1	0	54.2	102.0	1	1	0	1	1	1	0.0
2	1083	101	Low	56	286219.9	6193864.2	320	3	18	3	3	0	1	30.0	3.7	3.2	1.5	0.0	0.5	1	1	36.0	28.0	1	1	0	1	1	0	0.0
3	1083	101	Good	56	285688.4	6193563.6	349	5	16	4	3	0	2	42.3	2.9	1.5	1.1	0.0	0.5	1	1	66.0	208.0	0	0	1	1	1	1	0.0
4	1083	101	Low	56	286749	6193880.7	319	2	15	6	1	1	1	15.0	2.4	1.2	1.0	0.1	0.5	1	1	26.0	278.0	1	1	1	1	1	1	0.0
5	1083	101	Good	56	285555.6	6193974.7	101	2	13	6	3	0	1	50.0	2.8	1.7	3.2	0.0	2.0	3	2	49.0	141.0	1	1	0	1	1	0	0.0
6	1083	101	Good	56	284885.2	6196027.8	181	3	18	5	2	0	2	10.2	4.0	0.9	0.2	0.0	0.6	2	1	53.0	326.0	0	0	0	1	1	1	0.0
7	1083	101	Good	56	283875.6	6196195.3	252	3	11	6	2	1	0	25.0	1.4	0.7	0.2	0.1	0.0	2	1	66.0	63.0	1	1	1	0	1	1	0.0
8	1083	101	Good	56	284943.4	6196517.7	185	1	8	3	1	0	0	0.5	1.5	0.4	0.1	0.0	0.0	1	1	55.8	117.0	1	1	0	0	1	0	0.0
9	1083	101	Low	56	284976.3	6196814.1	77	2	21	2	4	0	0	25.0	11.4	0.7	0.7	0.0	0.0	0	0	18.2	20.0	1	1	1	1	0	0	0.0
10	1083	101	Low	56	284965.2	6197279.8	144	3	16	3	2	0	0	25.0	3.1	0.5	0.3	0.0	0.0	2	1	53.8	111.0	1	1	0	1	1	0	0.0
11	1083	101	Low	56	284733.4	6197157.2	310	3	12	3	2	0	1	25.0	5.4	0.7	0.2	0.0	1.0	4	1	76.2	43.0	1	1	0	1	1	1	0.0
12	1083	101	Good	56	285186.5	6196940.6	289	1	21	6	3	0	2	25.0	3.9	1.2	0.3	0.0	2.2	1	1	84.6	124.0	1	0	1	1	1	1	0.0
13	1083	101	Good	56	286066.2	6196432.4	292	4	20	6	4	1	2	53.0	6.1	1.2	0.4	0.1	0.2	1	5	79.0	17.0	1	1	1	1	1	1	0.0
14	1083	101	Good	56	287520.9	6195773.6	241	1	12	4	5	1	0	25.0	1.5	0.4	0.5	0.2	0.0	2	0	36.8	350.0	1	1	1	1	1	1	0.0
15	1083	101	Low	56	289116.6	6195860.8	204	1	16	4	1	0	0	40.0	4.8	0.4	0.1	0.0	0.0	3	0	61.8	130.0	1	1	1	1	1	1	0.0
16	1083	101	Low	56	289229.1	6195996.6	42	3	16	5	2	0	1	35.0	9.1	0.9	0.3	0.0	2.0	2	1	66.8	87.0	1	1	1	1	1	1	0.0
17	1083	101	Low	56	288613	6196703.9	272	4	20	4	5	0	1	43.0	5.1	0.4	0.5	0.0	1.0	1	0	69.8	96.0	1	1	1	1	1	1	0.0
18	1083	101	Low	56	289030.8	6196826.5	265	2	21	3	4	0	2	40.0	4.7	0.4	0.5	0.0	0.3	1	0	78.6	57.0	1	1	1	1	1	1	0.0
19	1083	101	Good	56	288776.3	6196243.9	110	4	15	6	3	0	1	27.0	8.0	1.0	0.4	0.0	2.0	2	1	67.6	88.0	1	1	1	1	1	1	0.0
20	1083	101	Low	56	288776.3	6196243.9	110	4	15	7	3	0	1	27.0	8.0	1.1	0.4	0.0	2.0	1	1	67.6	88.0	1	1	1	1	1	1	0.0
21	1083	101	Low	56	285971.1	6195952.9	270	3	15	4	5	1	2	65.0	8.6	1.0	0.5	0.1	0.6	5	4	79.0	136.0	1	1	1	1	1	1	0.0
22	1083	101	Good	56	286186.2	6197362.9	110	2	18	5	6	0	0	40.1	5.9	0.9	0.7	0.0	0.0	5	5	65.0	88.0	1	1	1	1	1	1	0.0
23	1083	101	Low	56	286363.1	6196704.8	308	3	10	7	4	1	0	35.0	28.5	0.7	0.4	0.1	0.0	2	0	83.0	50.0	1	1	1	0	0	1	0.0
24	1083	101	Good	56	286329.6	6196641.1	153	2	11	2	3	0	1	25.0	2.6	0.2	0.3	0.0	0.1	1	0	77.0	60.0	1	1	1	1	0	1	0.0
25	1083	101	Good	56	286184.6	6196573.7	172	2	14	4	2	0	0	23.0	4.3	0.6	0.2	0.0	0.0	1	1	87.0	150.0	0	1	1	1	1	1	0.0
26	1083	101	Good	56	286343.6	6197198.5	338	4	17	6	5	0	1	25.0	4.4	0.7	0.5	0.0	0.2	2	1	68.0	60.0	0	1	1	1	1	1	0.0
27	1083	101	Good	56	286624.3	6197169.1	183	3	16	4	4	0	0	25.2	4.4	0.4	0.4	0.0	0.0	3	1	80.0	100.0	0	1	1	1	1	1	0.0
28	1083	101	Good	56	286577.5	6197513.8	318	4	14	3	3	0	1	20.1	2.7	0.4	0.3	0.0	0.2	1	1	74.0	5.0	0	1	1	1	1	0	0.0
29	1395	101	Low	56	287113.9	6196265.3	360	3	6	4	6	1	2	10.7	1.5	20.3	1.7	0.1	0.3	0	0	36.0	0.0	0	0	0	0	0	0	0.0
30	1395	101	Low	56	287143.1	6196569.1	178	2	14	5	7	0	1	0.8	4.9	10.4	2.1	0.0	0.1	0	0	12.0	0.0		0	0	0	0	1	0.0
31	1083	101	Good	56	287556.4	6196707.8	80	2	17	5	3	1	0	45.0	2.7	0.5	0.4	0.1	0.0	2	2	81.0	5.0	1	1	1	1	1	0	0.0
32	1083	101	Low	56	287950.2	6196750.8	11	5	11	3	2	1	1	29.1	1.7	0.3	0.3	0.1	0.3	1	1	82.0	5.0	0	1	1	1	1	0	0.0
33	1083	101	Low	56	288158.8	6197094.8	330	3	13	4	2	1	1	13.1	2.5	0.4	0.6	0.1	0.1	0	0	45.0	20.0	0	1	1	0	0	0	0.0
34	1083	101	Low	56	287940.1	6197542	153	4	22	5	7	0	1	30.0	2.7	0.5	0.7	0.0	0.1	0	0	90.0	85.0	1	1	1	0	0	1	0.0
35	1395	101	Low	56	287452.8	6197115	205	1	13	3	8	0	1	1.0	7.5	0.7	1.3	0.0	0.1	0	0	25.0	0.0	1	1	1	0	0	0	0.0
36	1395	101	Low	56	287433.8	6197442.4	190	2	17	6	7	0	0	5.2	5.2	1.5	1.5	0.0	0.0	0	0	24.0	0.0	0	1	1	1	0	0	0.0
37	1083	101	Low	56	287628.3	6194997	315	2	6	2	4	0	0	0.3	3.4	0.2	0.6	0.0	0.0	0	0	1.0	0.0	0	0	0	0	0	1	0.0
38	1083	101	Low	56	287693	6194939.7	303	0	10	3	6	0	1	0.0	2.0	0.3	1.1	0.0	0.2	0	0	5.0	0.0	0	0	0	0	0	0	0.0
39	1083	101	Low	56	288392.5	6195185.4	267	3	17	4	5	0	1	8.1	2.0	0.4	0.5	0.0	0.1	2	0	64.0	55.0	0	1	1	1	1	0	0.0
40	1083	101	Good	56	287846.8	6195166.7	294	2	17	7	3	0	1	25.0	6.8	1.2	0.3	0.0	1.0	4	2	62.0	90.0	1	1	1	1	0	1	0.0
41	1083	101	Low	56	287561.9	6197602.9	230	3	15	3	8	1	0	5.0	56.3	0.9	7.6	0.1	0.0	0	0	56.0	0.0	0	0	0	0	0	0	0.0
42	978	101	Good_Fringing	56	285236.9	6195603.4	205	3	25	10	9	1	3	24.0	66.4	15.8	2.6	0.5	0.3	5	9	69.0	4.0	1	1	1	1	1	1	0.0
43	978	101	Good_Restoid	56	285248.6	6196106.1	120	2	15	10	9	2	1	0.2	50.2	27.8	5.0	0.3	0.1	0	0	48.0	0.0	0	0	0	0	0	1	0.0

plot name	pct	patchsize	conditionclass	zone	easting	northing	bearing	compTree	compshrub	compGrass	compForbs	compFerns	compOther	strucTree	strucShrub	strucGrass	strucForbs	strucFerns	strucOther	funLargeTrees	funHollowtrees	funLitterCover	funLenFallenLogs	funTreeStem5to9	funTreeStem10to19	funTreeStem20to29	funTreeStem30to49	funTreeStem50to79	funTreeRegen	funHighThreatExotic
44	978	101	Good_Restoid	56	285926.8	6196720.4	70	3	29	9	10	2	2	20.1	24.3	30.2	6.7	1.1	0.2	7	6	86.0	15.0	1	1	1	1	1	1	0.0
45	978	101	Good_Restoid	56	286549.9	6196549.7	330	1	14	11	10	2	2	0.1	86.6	40.4	14.6	1.0	0.2	1	0	62.0	3.0	1	1	1	0	0	1	0.0
46	978	101	Good_Restoid	56	286612.5	6196854.4	185	0	16	9	15	2	1	0.0	35.3	31.7	18.7	0.6	0.1	0	0	29.0	0.0	0	0	0	0	0	0	0.0
47	978	101	Good_Fringing	56	286625.2	6195209.9	335	2	19	8	4	4	0	7.0	53.5	20.2	0.5	75.7	0.0	6	6	99.0	24.0	1	1	1	1	1	1	0.0
48	978	101	Good_Banksia	56	285867.5	6195833.8	150	1	19	10	6	1	0	5.0	74.7	49.9	0.7	2.0	0.0	0	0	17.0	9.0	1	1	1	1	0	1	0.0
49	978	101	Good_Fringing	56	285935.2	6195565	60	1	13	7	3	4	1	5.0	34.8	29.6	0.3	87.6	0.2	1	0	88.0	0.0	1	1	1	0	0	0	0.0
50	1250	101	Good	56	287782.4	6195515.7	80	4	15	3	6	2	3	155.0	27.2	9.0	10.9	1.1	0.9	6	9	94.6	59.0	1	1	1	1	1	0	0.0
51	1250	101	Good	56	287746.2	6196597.4	110	4	17	5	6	2	4	74.0	23.0	6.6	2.7	20.1	3.3	5	6	94.0	84.0	1	1	1	1	1	1	0.0
53	1181	101	Good	56	284198.7	6195879.4	345	7	14	7	7	2	1	67.0	22.2	15.5	0.9	10.1	0.2	5	8	76.6	89.0	1	1	1	1	1	1	0.0
54	1181	101	Good	56	284254.6	6195275.1	250	8	14	6	7	0	2	73.5	28.3	6.1	0.8	0.0	0.6	4	10	86.0	129.0	1	1	1	1	1	0	0.0
55	1083	101	Good	56	287552.9	6195232.0	230	2	19	8	3	3	2	10.0	47.5	1.0	0.3	0.7	0.2	1	5	85.2	42.0	1	1	1	1	1	1	0.0
56	1083	101	Good	56	287751.3	6195102.9	120	5	26	4	3	0	3	52.0	35.6	0.6	0.4	0.0	0.5	5	6	88.6	39.0	1	1	1	1	1	1	0.0
57	1083	101	Good	56	287769.3	6195173.7	100	4	20	2	3	0	1	75.0	40.5	0.6	0.4	0.0	0.5	3	6	92.0	12.0	1	1	1	1	1	1	0.0
58	1083	101	Good	56	287687.6	6195212.3	160	2	26	5	9	2	1	20.0	100.4	1.7	1.9	0.3	0.1	2	2	27.8	17.0	1	1	1	1	1	1	0.0
59	1083	101	Good	56	287964.4	6195184.5	200	3	23	4	0	0	1	26.0	10.4	0.8	0.0	0.0	0.5	2	6	48.0	161.0	1	1	1	1	1	1	0.0
60	1083	101	Low	56	288243.7	6195189.3	210	3	18	4	2	0	1	35.0	8.3	1.7	0.3	0.0	0.1	1	6	68.0	2.0	1	1	1	1	0	0	0.0
61	1083	101	Low	56	292434.3	6199982.2	135	1	5	9	5	0	0	0.1	2.0	31.6	1.0	0.0	0.0	0	0	1.6	0.0	0	0	0	0	0	1	0.0
62	1083	101	Good	56	287689.1	6195297.7	260	1	14	5	6	1	2	0.1	3.8	0.5	2.5	0.2	0.2	0	0	90.0	0.0	1	0	0	0	0	1	0.0
63	1250	101	Good	56	291615.4	6197623.5	295	3	14	8	6	2	3	45.7	1.7	1.0	0.7	0.3	0.3	3	3	87.0	5.0	1	1	1	1	1	1	0.0
64	1250	101	Good	56	291645	6197619.6	318	5	15	4	6	3	2	32.7	6.1	1.3	0.6	1.5	2.1	3	1	60.0	5.0	1	1	1	1	1	0	0.0
65	1245	101	low	56	292019.3	6198073.4	345	2	13	9	1	0	1	0.2	15.2	3.5	0.3	0.0	0.1	0	0	3.8	0	0	0	0	0	0	1	0.0
66	1395	101	Good	56	287075.3	6196091.5	87	5	5	6	9	2	3	30.0	8.4	11.3	8.3	5.1	0.3	8	1	22.0	35.0	1	1	1	1	1	1	0.0
67	5	101	Low	56	287038.6	6196088.1	203	3	3	7	13	3	2	0.5	0.5	6.0	1.6	0.7	0.2	0	0	41.0	0.0	0	0	0	0	0	1	0.0
68	1083	101	Good	56	292451.9	6198442.2	30	3	15	9	7	0	1	26.0	23.0	1.0	0.7	0.0	0.1	1	1	39.0	10.0	1	1	1	1	1	1	0.0
69	1250	101	Good	56	289269.3	6195252.9	236	4	14	5	5	1	3	47.0	2.0	0.7	0.5	15.0	0.3	3	2	95.8	64.0	1	1	1	1	1	1	0.0
70	1250	101	Low	56	289191.1	6195251.8	66	1	12	9	10	0	0	5.0	1.3	0.9	1.1	0.0	0.0	0	0	23.6	0.0	0	0	0	0	0	1	0.0
71	1083	101	Good	56	290168.9	6196320.0	60	1	1	0	0	1	0	30.0	0.1	0.0	0.0	0.1	0.0	3	1	31.0	57.0	1	1	1	1	1	1	0.0
72	1083	101	Low	56	290235.4	6196405.0	238	3	10	6	6	1	0	0.4	2.3	1.2	5.5	0.2	0.0	0	0	42.0	0.0	0	0	0	0	0	1	0.0
73	1083	101	Low	56	290566.1	6196831.6	250	4	26	8	12	1	3	31.1	14.5	1.3	1.4	0.2	0.3	4	2	81.0	32.0	1	1	1	1	1	1	0.0
74	1250	101	Good	56	291691.7	6197727.8	28	5	21	8	0	1	0	9.1	8.9	2.9	0.0	5.0	0.0	1	2	79.0	5.0	1	1	1	1	0	1	0.0
75	1245	101	Low	56	298810.7	6187583.5	115	1	4	4	3	2	5	45.0	30.0	1.4	0.7	10.1	1.6	2	0	80.2	20.0	1	1	1	1	1	1	0.5
76	1245	101	Low	56	298804.5	6187656.2	223	2	2	5	3	2	3	5.0	10.2	15.5	1.3	3.3	1.1	3	0	59.4	35.0	1	1	1	1	1	0	5.3
77	1804	101.00	Good	56	285897	6195715	323	0	4	5	4	1	2	0	60	40	10	0.5	5	0	0	0	0	0	0	0	0	0	0	0

Table 66. BAM plots for Biodiversity Assessment Development Footprint

plot	pct	patchsize	conditionclass	zone	easting	northing	bearing	compTree	compshrub	compGrass	compForbs	compFerns	compOther	strucTree	strucShrub	strucGrass	strucForbs	strucFerns	strucOther	funLargeTrees	funHollowtrees	funLitterCover	funLenFallenLogs	funTreeStem5to9	funTreeStem10to19	funTreeStem20to29	funTreeStem30to49	funTreeStem50to79	funTreeRegen	funHighThreatExotic
63	1250	101	Good	56	291615.4	6197623.5	295	3	14	8	6	2	3	45.7	1.7	1.0	0.7	0.3	0.3	3	3	87.0	5.0	1	1	1	1	1	1	0.0
69	1250	101	Good	56	289269.3	6195252.9	236	4	14	5	5	1	3	47.0	2.0	0.7	0.5	15.0	0.3	3	2	95.8	64.0	1	1	1	1	1	1	0.0
74	1250	101	Good	56	291691.7	6197727.8	28	5	21	8	0	1	0	9.1	8.9	2.9	0.0	5.0	0.0	1	2	79.0	5.0	1	1	1	1	0	1	0.0
64	1250	101	Good	56	291645	6197619.6	318	5	15	4	6	3	2	32.7	6.1	1.3	0.6	1.5	2.1	3	1	60.0	5.0	1	1	1	1	1	0	0.0
55	1083	101	Good	56	287552.9	6195232.0	230	2	19	8	3	3	2	10.0	47.5	1.0	0.3	0.7	0.2	1	5	85.2	42.0	1	1	1	1	1	1	0.0
56	1083	101	Good	56	287751.3	6195102.9	120	5	26	4	3	0	3	52.0	35.6	0.6	0.4	0.0	0.5	5	6	88.6	39.0	1	1	1	1	1	1	0.0
57	1083	101	Good	56	287769.3	6195173.7	100	4	20	2	3	0	1	75.0	40.5	0.6	0.4	0.0	0.5	3	6	92.0	12.0	1	1	1	1	1	1	0.0
58	1083	101	Good	56	287687.6	6195212.3	160	2	26	5	9	2	1	20.0	100.4	1.7	1.9	0.3	0.1	2	2	27.8	17.0	1	1	1	1	1	1	0.0
59	1083	101	Good	56	287964.4	6195184.5	200	3	23	4	0	0	1	26.0	10.4	0.8	0.0	0.0	0.5	2	6	48.0	161.0	1	1	1	1	1	1	0.0

plot	pct	patchsize	conditionclass	zone	easting	northing	bearing	compTree	compshrub	compGrass	compForbs	compFerns	compOther	strucTree	strucShrub	strucGrass	strucForbs	strucFerns	strucOther	funLargeTrees	funHollowtrees	funLitterCover	funLenFallenLogs	funTreeStem5to9	funTreeStem10to19	funTreeStem20to29	funTreeStem30to49	funTreeStem50to79	funTreeRegen	funHighThreatExotic
62	1083	101	Good	56	287689.1	6195297.7	260	1	14	5	6	1	2	0.1	3.8	0.5	2.5	0.2	0.2	0	0	90.0	0.0	1	0	0	0	0	1	0.0
68	1083	101	Good	56	292451.9	6198442.2	30	3	15	9	7	0	1	26.0	23.0	1.0	0.7	0.0	0.1	1	1	39.0	10.0	1	1	1	1	1	1	0.0
1	1083	101	Low	56	288004.7	6194820.7	58	3	15	7	6	0	0	20.2	6.2	2.9	1.8	0.0	0.0	1	0	54.2	102.0	1	1	0	1	1	1	0.0
37	1083	101	Low	56	287628.3	6194997	315	2	6	2	4	0	0	0.3	3.4	0.2	0.6	0.0	0.0	0	0	1.0	0.0	0	0	0	0	0	1	0.0
72	1083	101	Low	56	290235.4	6196405.0	238	3	10	6	6	1	0	0.4	2.3	1.2	5.5	0.2	0.0	0	0	42.0	0.0	0	0	0	0	0	1	0.0
73	1083	101	Low	56	290566.1	6196831.6	250	4	26	8	12	1	3	31.1	14.5	1.3	1.4	0.2	0.3	4	2	81.0	32.0	1	1	1	1	1	1	0.0
76	1245	101	Low	56	298804.5	6187656.2	223	2	2	5	3	2	3	5.0	10.2	15.5	1.3	3.3	1.1	3	0	59.4	35.0	1	1	1	1	1	0	5.3

Appendix 5. Fauna species list

Table 67. Fauna species recorded in the Subject Land (2016-2021)

Status codes: P = Protected under BC Act; V = Vulnerable under BC Act or EPBC Act; M = Migratory under EPBC Act

Relative abundance codes: R = Rare; U = Uncommon; O = Occasional; C = Common.

Common Name	Scientific Name	Status		Total Records	Relative Abundance
		BC Act Status	EPBC Act Status		
2016-2018					
Australian Hobby	*Falco longipennis*	P	-	1	U
Australian King-Parrot	*Alisterus scapularis*	P	-	1	O
Australian Magpie	*Cracticus tibicen*	P	-	3	C
Australian Owlet-nightjar	*Aegotheles cristatus*	P	-	2	C
Australian Pelican	*Pelecanus conspicillatus*	P	-	1	U
Australian Raven	*Corvus coronoides*	P	-	3	C
Bearded Dragon	*Pogona barbata*	P	-	1	R
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	P	-	1	O
Blackish Blind Snake	*Ramphotyphlops nigrescens*	P	-	3	U
Bleating Tree Frog	*Litoria dentata*	P	-	2	O
Blue Mountains Tree Frog	*Litoria citropa*	P	-	4	C
Brown Falcon	*Falco berigora*	P	-	1	U
Brown Thornbill	*Acanthiza pusilla*	P	-	2	C
Brown-headed Honeyeater	*Melithreptus brevirostris*	P	-	2	U
Cat	*Felis catus*	-	-	4	O
Channel-billed Cuckoo	*Scythrops novaehollandiae*	P	-	1	U
Chocolate Wattled Bat	*Chalinolobus morio*	P	-	8	C
Common Brushtail Possum	*Trichosurus vulpecula*	P	-	2	O
Common Eastern Froglet	*Crinia signifera*	P	-	14	C
Common Ringtail Possum	*Pseudocheirus peregrinus*	P	-	2	O
Common Wombat	*Vombatus ursinus*	P	-	16	C
Copper-tailed Skink	*Ctenotus taeniolatus*	P	-	16	C
Crimson Rosella	*Platycercus elegans*	P	-	7	C
Eastern Banjo Frog	*Limnodynastes dumerilii*	P	-	4	C
Large Bent-winged Bat	*Miniopterus schreibersii oceanensis*	V	-	2	U
Eastern Broad-nosed Bat	*Scotorepens orion*	P	-	4	U
Eastern Brown Snake	*Pseudonaja textilis*	P	-	2	O
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	V	-	1	U
Eastern Freetail-bat	*Mormopterus norfolkensis*	V	-	1	U

Common Name	Scientific Name	Status		Total Records	Relative Abundance
		BC Act Status	EPBC Act Status		
Eastern Grey Kangaroo	*Macropus giganteus*	P	-	2	O
Eastern Small-eyed Snake	*Cryptophis nigrescens*	P	-	2	U
Eastern Spinebill	*Acanthorhynchus tenuirostris*	P	-	22	C
Eastern Water Dragon	*Physignathus lesueurii*	P	-	1	O
Eastern Water-skink	*Eulamprus quoyii*	P	-	4	C
Eastern Whipbird	*Psophodes olivaceus*	P	-	2	O
Eastern Yellow Robin	*Eopsaltria australis*	P	-	3	O
Fan-tailed Cuckoo	*Cacomantis flabelliformis*	P	-	4	O
Fox	*Vulpes vulpes*	-	-	4	O
Golden Whistler	*Pachycephala pectoralis*	P	-	4	O
Golden-tipped Bat	*Kerivoula papuensis*	V	-	1	R
Gould's Wattled Bat	*Chalinolobus gouldii*	P	-	14	C
Greater Broad-nosed Bat	*Scoteanax rueppellii*	V	-	3	O
Greater Glider	*Petauroides volans*	P	V	3	U
Grey Butcherbird	*Cracticus torquatus*	P	-	1	O
Grey Currawong	*Strepera versicolor*	P	-	2	U
Grey Fantail	*Rhipidura albiscapa*	P	-	19	C
Grey Shrike-thrush	*Colluricincla harmonica*	P	-	11	C
Haswell's Frog	*Paracrinia haswelli*	P	-	1	U
House Mouse	*Mus musculus*	-	-	6	O
Jacky Lizard	*Amphibolurus muricatus*	P	-	4	O
Koala	*Phascolarctos cinereus*	V	V[24]	6	O
Lace Monitor	*Varanus varius*	P	-	6	O
Large Forest Bat	*Vespadelus darlingtoni*	P	-	25	C
Laughing Kookaburra	*Dacelo novaeguineae*	P	-	3	O
Leaden Flycatcher	*Myiagra rubecula*	P	-	1	U
Leaf Green River Tree Frog	*Litoria nudidigita*	P	-	7	C
Lesser Long-eared Bat	*Nyctophilus geoffroyi*	P	-	31	C
Lesueur's Frog	*Litoria lesueuri*	P	-	11	C
Lesueur's Velvet Gecko	*Oedura lesueurii*	P	-	7	O
Little Bentwing-bat	*Miniopterus australis*	V	-	1	U
Little Forest Bat	*Vespadelus vulturnus*	P	-	22	C
Little Wattlebird	*Anthochaera chrysoptera*	P	-	2	O
Littlejohn's Tree Frog	*Litoria littlejohni*	V	V[24]	6	O
Mormopterus ridei	*Mormopterus ridei*	P	-	4	O

[24] *Listed as 'Vulnerable' under the EPBC Act at the time of the "controlled action" decision (13 January 2022) and therefore assessed as 'Vulnerable' rather than 'Endangered' (refer section 158A of the EPBC Act).*

Common Name	Scientific Name	Status		Total Records	Relative Abundance
		BC Act Status	EPBC Act Status		
New Holland Honeyeater	*Phylidonyris novaehollandiae*	P	-	7	C
Noisy Friarbird	*Philemon corniculatus*	P	-	9	C
Peron's Tree Frog	*Litoria peronii*	P	-	3	O
Pied Currawong	*Strepera graculina*	P	-	10	C
Pilotbird	Pycnoptilus floccosus	P		1	R
Rabbit	*Oryctolagus cuniculus*	-	-	1	U
Red Wattlebird	*Anthochaera carunculata*	P	-	2	O
Red-bellied Black Snake	*Pseudechis porphyriacus*	P	-	2	O
Red-throated Skink	*Acritoscincus platynota*	P	-	2	U
Rocket Frog	*Litoria nasuta*	P	-	3	U
Rockwarbler	*Origma solitaria*	P	-	8	C
Rosenberg's Goanna	*Varanus rosenbergi*	V	-	8	O
Rufous Whistler	*Pachycephala rufiventris*	P	-	7	C
Sacred Kingfisher	*Todiramphus sanctus*	P	-	2	O
Satin Bowerbird	*Ptilonorhynchus violaceus*	P	-	1	O
Satin Flycatcher	*Myiagra cyanoleuca*	P	M	2	O
Scarlet Robin	*Petroica boodang*	V	-	2	O
Shining Bronze-Cuckoo	*Chalcites lucidus*	P	-	2	O
Short-beaked Echidna	*Tachyglossus aculeatus*	P	-	10	O
Silvereye	*Zosterops lateralis*	P	-	1	O
Skink sp.	*Scincidae sp.*	P	-	1	N/A
Snake-eyed Skink	*Crytoblephalus virgatus*	P	-	1	U
Southern Boobook	*Ninox novaeseelandiae*	P	-	4	O
Southern Emu-wren	*Stipiturus malachurus*	P	-	2	R
Southern Forest Bat	*Vespadelus regulus*	P	-	4	O
Spotted Grass Frog	*Limnodynastes tasmaniensis*	P	-	2	U
Spotted Pardalote	*Pardalotus punctatus*	P	-	15	C
Spotted Quail-thrush	*Cinclosoma punctatum*	P	-	8	C
Striated Pardalote	*Pardalotus striatus*	P	-	2	O
Striated Thornbill	*Acanthiza lineata*	P	-	14	C
Striped Marsh Frog	*Limnodynastes peronii*	P	-	1	U
Sugar Glider	*Petaurus breviceps*	P	-	3	O
Superb Fairy-wren	*Malurus cyaneus*	P	-	3	O
Superb Lyrebird	*Menura novaehollandiae*	P	-	13	C
Swamp Wallaby	*Wallabia bicolor*	P	-	28	C
Tawny Frogmouth	*Podargus strigoides*	P	-	1	O
Tree Martin	*Petrochelidon nigricans*	P	-	1	O
Unidentified Antechinus	*Antechinus sp.*	P	-	4	O
Varied Sittella	*Daphoenositta chrysoptera*	V	-	1	R

Common Name	Scientific Name	Status		Total Records	Relative Abundance
		BC Act Status	EPBC Act Status		
Variegated Fairy-wren	*Malurus lamberti*	P	-	4	U
Vespadelus sp.	*Vespadelus sp.*	P	-	20	C
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	V	M	1	R
White-browed Scrubwren	*Sericornis frontalis*	P	-	1	O
White-eared Honeyeater	*Lichenostomus leucotis*	P	-	4	O
White-striped Freetail-bat	*Tadarida australis*	P	-	2	U
White-throated Gerygone	*Gerygone albogularis*	P	-	1	U
White-throated Nightjar	*Eurostopodus mystacalis*	P	-	2	O
White-throated Treecreeper	*Cormobates leucophaea*	P	-	12	C
Wonga Pigeon	*Leucosarcia picata*	P	-	3	C
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	V	-	1	U
Yellow-faced Honeyeater	*Lichenostomus chrysops*	P	-	6	O
Yellow-tailed Black-Cockatoo	*Calyptorhynchus funereus*	P	-	1	O
2020					
Littlejohn's Tree Frog	*Litoria littlejohni*	V	V[25]	158	O
Peron's Tree Frog	*Litoria peronii*	P	-	1	O
Striped Marsh Frog	*Limnodynastes peronii*	P	-	1	U
2021				**No. observations**	
Australian Owlet-nightjar	*Aegotheles cristatus*	P	-	2	
Common Brushtail Possum	*Trichosurus vulpecula*	P	-	2	
Common Eastern Froglet	*Crinia signifera*	P	-	12	
Common Ringtail Possum	*Pseudocheirus peregrinus*	P	-	17	
Common Wombat	*Vombatus ursinus*	P	-	4	
Eastern Banjo Frog	*Limnodynastes dumerilii*	P	-	2	
Eastern Spinebill	*Acanthorhynchus tenuirostris*	P	-	4	
Eastern Yellow Robin	*Eopsaltria australis*	P	-	1	
Fox	*Vulpes vulpes*	-	-	1	
Gang-gang Cockatoo	*Callocephalon fimbriatum*	V	-	7	
Greater Glider	*Petauroides volans*	P	V	2	
Grey-headed Flying-fox	*Pteropus poliocephalus*	V	V	4	
Koala	*Phascolarctos cinereus*	V	V[25]	17	
Lewin's Honeyeater	*Meliphaga lewinii*	P	-	2	

[25] *Listed as 'Vulnerable' under the EPBC Act at the time of the "controlled action" decision (13 January 2022) and therefore assessed as 'Vulnerable' rather than 'Endangered' (refer section 158A of the EPBC Act).*

Common Name	Scientific Name	Status		Total Records	Relative Abundance
		BC Act Status	EPBC Act Status		
Little Forest Bat	*Vespadelus vulturnus*	P	-	1	
Littlejohn's Tree Frog	*Litoria littlejohni*	V	V[25]	28	
Peron's Tree Frog	*Litoria peronii*	P	-	1	
Pied Currawong	*Strepera graculina*	P	-	2	
Red Wattlebird	*Anthochaera carunculata*	P	-	2	
Red-browed Finch	*Neochmia temporalis*	P	-	2	
Southern Boobook	*Ninox novaeseelandiae*	P	-	13	
Spotted Grass Frog	*Limnodynastes tasmaniensis*	P	-	1	
Striated Thornbill	*Acanthiza lineata*	P	-	4	
Sugar Glider	*Petaurus breviceps*	P	-	14	
Superb Lyrebird	*Menura novaehollandiae*	P	-	2	
White-striped Freetail-bat	*Austronomus australis*	P	-	5	
White-throated Treecreeper	*Cormobates leucophaea*	P	-	8	
Yellow-faced Honeyeater	*Caligavis chrysops*	P	-	2	
Yellow-tailed Black-Cockatoo	*Calyptorhynchus funereus*	P	-	2	

Appendix 6. Weather Conditions During Field Survey

Table 68. Campbelltown (068257), New South Wales September 2016 Daily Weather Observations (BOM 2017).

Date	Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)	9am relative humidity (%)	9am wind direction	9am wind speed (km/h)	3pm relative humidity (%)	3pm wind direction	3pm wind speed (km/h)
01/09/2016	5.8	22.5	0	72	-	Calm	32	ENE	9
02/09/2016	12.5	17.1	7.4	99	S	4	99	ESE	6
03/09/2016	12.9	20	22.2	54	WNW	17	42	WSW	19
04/09/2016	6.3	19.7	0	54	WSW	9	32	W	13
05/09/2016	4.7	21.3	0	68	SSW	7	30	NE	9
06/09/2016	5.2	23.7	0	74	W	7	30	NE	9
07/09/2016	7.4	23.3	0	82	SW	9	53	ENE	11
08/09/2016	13.6	23.7	0	87	NE	7	47	NE	9
09/09/2016	9.4	25.7	0	79	N	7	52	ENE	13
10/09/2016	12.9	21.9	2	65	NNW	19	35	WSW	15
11/09/2016	6.4	21.3	0	53	WSW	7	34	E	7
12/09/2016	6.2	21.2	0	63	SSW	7	42	NNE	7
13/09/2016	11.8	20.8	0	72	SSE	6	61	N	7
14/09/2016	13.7	23.8	0.8	99	SW	2	60	N	13
15/09/2016	7.6	20.8	0.2	32	NW	19	33	NNW	20
16/09/2016	10.2	20.8	0.2	63	SW	7	30	SW	15
17/09/2016	4.3	22.1	0.2	61	N	4	34	NNW	7
18/09/2016	8.7	16.6	0	79	S	7	95	NE	6
19/09/2016	9.7	19.6	12	60	W	17	35	SW	13
20/09/2016	4.6	19.4	0.2	53	SW	6	32	N	9
21/09/2016	10.7	19.3	0	66	NNW	4	82	N	11
22/09/2016	8.2	18.3	1.6	59	WSW	13	54	WSW	11
23/09/2016	12.9	22	0.2	50	SSW	19	46	S	13
24/09/2016	6.9	23.6	0	63	S	6	47	NE	11
25/09/2016	12.8	23.1	0	65	NW	7	46	S	9
26/09/2016	7.8	22.5	0.4	46	WSW	15	31	SSW	7
27/09/2016	3.3	21.8	0	58	N	9	22	SW	22
28/09/2016	3.7	20.9	0	53	SW	9	34	E	9
29/09/2016	6.9	21.3	3.6	98	-	Calm	60	N	17
30/09/2016	7.4	18.1	1.4	39	NW	17	36	NW	20

Table 69. Campbelltown (068257), New South Wales October 2016 Daily Weather Observations (BOM 2017)

Date	Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)	9am relative humidity (%)	9am wind direction	9am wind speed (km/h)	3pm relative humidity (%)	3pm wind direction	3pm wind speed (km/h)
01/10/2016	6.2	20.1	0	53	W	11	36	WNW	22
02/10/2016	4.7	26.4	0	66	N	6	24	NNE	11
03/10/2016	13.4	24	0	48	N	22	17	WSW	20
04/10/2016	12.7	23	0	37	W	11	22	WNW	20
05/10/2016	8.6	21.6	0	40	WSW	13	15	WSW	22
06/10/2016	11	27.1	0	31	W	11	19	W	19
07/10/2016	9.6	29.7	0	49	NW	9	12	WSW	17
08/10/2016	12.6	22.5	0	55	SE	7	55	S	11
09/10/2016	7.8	23.7	0	56	W	6	36	NNE	15
10/10/2016	9.6	31.4	0	61	NNW	9	32	SW	19
11/10/2016	10.5	19.7	0	32	W	19	23	WSW	13
12/10/2016	3.4	22.3	0	52	WSW	11	25	SW	11
13/10/2016	9.1	19.5	0	54	SSW	15	38	S	13
14/10/2016	3.3	22	0	63	SW	9	18	NE	9
15/10/2016	4.2	26.7	0	64	WSW	6	19	NNW	13
16/10/2016	6	30.2	0	47	NNW	13	18	NW	15
17/10/2016	17.2	19.8	0	53	SW	11	73	NE	6
18/10/2016	5.5	24.7	0.8	45	NNW	9	22	NW	17
19/10/2016	8.7	22.5	0	35	WSW	13	13	SW	13
20/10/2016	9.1	23.4	0	62	NNE	7	44	ENE	17
21/10/2016	8.9	28.1	0	73	N	11	27	N	9
22/10/2016	15.4	21.1	4.6	97		Calm	36	SW	13
23/10/2016	6	20.7	0	45	SSW	19	41	SE	13
24/10/2016	5.5	23.1	0	51	SSW	11	31	SE	13
25/10/2016	4.7	27	0	66	NNW	6	20	N	9
26/10/2016	7.3	29.6	0	51		Calm	13	WNW	11
27/10/2016	10.2	24.2	0	62	SE	9	59	ESE	15
28/10/2016	12.2	19.4	2.2	96	SW	7	73	ESE	6
29/10/2016	12.9	25.3	0.4	80	SE	7	61	ENE	13
30/10/2016	17.6	27.5	0	75	N	13	41	N	22
31/10/2016	12.7	22.1	6.8	24	SW	17	13	WSW	15

Table 70. Campbelltown (068257), New South Wales November 2016 Daily Weather Observations (BOM 2017)

Date	Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)	9am relative humidity (%)	9am wind direction	9am wind speed (km/h)	3pm relative humidity (%)	3pm wind direction	3pm wind speed (km/h)
01/11/2016	5.7	24.7	0	36	SSW	7	17	WNW	15
02/11/2016	5.6	26.9	0	39	W	9	14	SW	13
03/11/2016	8.4	29.6	0	42	SW	6	17	NNW	17
04/11/2016	10.1	30.3	0	49	NW	6	11	SW	19
05/11/2016	13.6	23.8	0	11	WSW	24	14	WSW	20
06/11/2016	7.8	24.9	0	27	W	15	17	SW	15
07/11/2016	7.9	33.9	0	39	NW	7	12	NW	15
08/11/2016	12.8	28.5	0	65	-	Calm	39	E	9
09/11/2016	16.3	24.1	1.6	82	ENE	6	81	ESE	11
10/11/2016	14	28.4	2.2	89	SSW	7	49	ENE	13
11/11/2016	14.8	26.4	0	66	SSE	2	49	ENE	15
12/11/2016	17.3	34.7	8.6	95	N	6	28	WNW	9
13/11/2016	14	28.6	0.2	30	WNW	9	13	WNW	28
14/11/2016	16.2	24.2	0	42	SW	19	44	SE	15
15/11/2016	12.7	24	2.8	72	SSW	7	42	SE	17
16/11/2016	9.3	25.4	0	51	SSW	9	47	ESE	15
17/11/2016	13.1	27.6	0	57	N	7	30	N	11
18/11/2016	11.2	37.4	0.2	62	NNW	7	11	SW	13
19/11/2016	15.1	26.1	0	57	SE	6	60	SE	13
20/11/2016	17.6	30.6	0	71	NNE	9	35	NNE	11
21/11/2016	15.1	34.7	0	60	NNE	7	27	N	15
22/11/2016	15	36.3	0	48	NNE	4	12	N	6
23/11/2016	18.1	32.5	0	62	N	7	78	SE	15
24/11/2016	9.3	24.6	11.2	40	SSW	17	35	E	17
25/11/2016	8.8	27.1	0	42	WSW	7	38	ESE	19
26/11/2016	12.2	30.3	0	61	N	9	20	N	9
27/11/2016	16	26.4	0	70	ESE	9	52	E	17
28/11/2016	18	32.4	0	66	N	9	36	NNE	13
29/11/2016	16.7	26.8	0	61	SSW	7	51	SE	13
30/11/2016	15.9	27.4	0	63	N	9	49	ENE	15

Table 71. Campbelltown (068257), New South Wales December 2016 Daily Weather Observations (BOM 2017)

Date	Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)	9am relative humidity (%)	9am wind direction	9am wind speed (km/h)	3pm relative humidity (%)	3pm wind direction	3pm wind speed (km/h)
01/12/2016	14.9	33.6	0	83	N	7	50	S	9
02/12/2016	14.4	35.8	0.8	40	SSW	6	11	WSW	13
03/12/2016	19.5	29.2	0	61	ESE	7	48	ESE	15
04/12/2016	15.4	31	0	64	N	9	42	ENE	15
05/12/2016	20.6	34.2	0.6	74	N	9	80	NNW	2
06/12/2016	19.8	25.8	3	73	SE	6	93	NNW	4
07/12/2016	15.7	26.8	9.6	72	S	7	50	NE	11
08/12/2016	16.9	33.7	0.2	70	N	7	38	ENE	13
09/12/2016	16.5	26.8	0	31	WSW	24	15	WNW	19
10/12/2016	11.5	25.8	0	58	N	9	42	ENE	17
11/12/2016	16.8	29	0	60	NE	9	42	ESE	17
12/12/2016	16	32.4	0	65	N	11	37	NNE	15
13/12/2016	16.1	38.7	0	52	N	9	8	W	15
14/12/2016	19	35.1	0	18	WNW	11	24	SW	11
15/12/2016	16.1	18.1	6.4	95	SSE	6	85	ESE	9
16/12/2016	15.5	25.2	17.8	99	SSW	6	92	NW	6
17/12/2016	17.2	33.3	7.6	61	NNW	11	25	NW	13
18/12/2016	16.7	21.2	0	58	SE	9	50	SSE	9
19/12/2016	13.1	24.5	0	62	N	11	42	NE	13
20/12/2016	11.6	36.1	0	61	N	7	19	NW	17
21/12/2016	13.9	29.5	0	62	SE	4	46	E	15
22/12/2016	18.2	24.4	0	74	ENE	6	50	E	13
23/12/2016	18.9	27.5	0	63	N	11	49	NNE	13
24/12/2016	15.8	30.1	0	70	N	6	46	N	6
25/12/2016	15.6	30.7	3	69	SSW	2	46	ENE	11
26/12/2016	17	34.5	0.2	70	NNW	6	36	NE	17
27/12/2016	18.7	31.2	3.8	65	E	6	46	ESE	13
28/12/2016	17.6	34.6	0	72	N	6	36	NE	15
29/12/2016	20.8	38.6	0	59	S	6	15	W	11
30/12/2016	22.7	34.7	0	42	WSW	6	32	NW	13
31/12/2016	22.7	32.4	0.8	63	S	7	51	E	15

Table 72. Campbelltown (068257), New South Wales May 2017 Daily Weather Observations (BOM 2017)

Date	Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)	9am relative humidity (%)	9am wind direction	9am wind speed (km/h)	3pm relative humidity (%)	3pm wind direction	3pm wind speed (km/h)
01/05/2017	7.1	23.9	0	83		Calm	46	N	9
02/05/2017	9.5	22.6	0	61	SW	4	44	SSW	9
03/05/2017	10	18.7	0	59	SSW	9	55	S	9
04/05/2017	9.4	18.9	1.4	79	SSW	9	62	ENE	9
05/05/2017	8.2	22.2	0	75	SW	7	35	NE	9
06/05/2017	6.4	24.3	0	86		Calm	42	NNW	13
07/05/2017	8.2	20.8	0	39	WSW	15	19	SW	9
08/05/2017	3.7	19	0	64	SSW	7	45	SE	4
09/05/2017	6.3	21.3	0	72	SW	7	46	SE	13
10/05/2017	4.6	21.2	0	81	SW	7	34	N	6
11/05/2017	5	21.3	0	79	SSW	6	46	SSE	6
12/05/2017	6.8	20	0	87	SW	6	63		Calm
13/05/2017	10	21.9	0	88	WNW	6	53	NNE	9
14/05/2017	9.8	20.1	0	99	SSW	9	64	E	9
15/05/2017	9.1	20.9	0.2	82	SW	9	33	S	13
16/05/2017	5.2	21.2	0	72	SSW	9	33	SSE	6
17/05/2017	5.2	20.4	0	79	SW	6	47	NNE	7
18/05/2017	8.7	22.3	0	85		Calm	69	E	9
19/05/2017	12.2	18.4	0	87	SE	2	81	NNE	11
20/05/2017	15	22.9	6	99	NNW	4	58	ESE	6
21/05/2017	8.9	22.4	0	76	S	4	38	SE	6
22/05/2017	10	21.6	0	92	SSW	9	51	NNE	9
23/05/2017	10	22.9	0	93	SW	6	48	N	9
24/05/2017	9	21.4	7.6	94	S	4	31	W	19
25/05/2017	7.1	20.4	0	69	SSW	9	32	NNE	7
26/05/2017	5.7	20.5	0	71	SSW	7	52	SE	9
27/05/2017	7.5	21	0	88	S	6	52	N	9
28/05/2017	4.8	22	0.2	99	SSW	2	36	WNW	9
29/05/2017	6.5	16.5	0.2	45	WSW	11	29	WSW	11
30/05/2017	0	17.8	0	66	SW	7	36	W	17
31/05/2017	6.8	15.9	0	68	SSW	9	35	S	13

Table 73. Campbelltown (068257), New South Wales June 2017 Daily Weather Observations (BOM 2017)

Date	Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)	9am relative humidity (%)	9am wind direction	9am wind speed (km/h)	3pm relative humidity (%)	3pm wind direction	3pm wind speed (km/h)
01/06/2017	2.7	17.7	0	57	SW	15	36	S	9
02/06/2017	4.6	18.2	0	65	SSW	7	37	S	9
03/06/2017	7.6	18.1	0	67	SW	9	60	S	9
04/06/2017	6	19.8	0	87	SSW	6	42	NE	4
05/06/2017	4.8	18.8	0	86	SSW	7	35	NNW	6
06/06/2017	2.5	17.2	0	65	SW	7	30	SSW	13
07/06/2017	7.7	14.8	22.4	95	SW	11	85	S	11
08/06/2017	10.9	19	17.8	98	SSW	7	67	S	9
09/06/2017	7.2	19.4	0.4	86	SSW	6	62	SSE	11
10/06/2017	11.8	16	29.4	99	SSW	7	84	S	7
11/06/2017	8.1	18.1	4	99	-	Calm	73	-	Calm
12/06/2017	7.6	21.3	0.2	99	SSW	2	67	E	9
13/06/2017	6.2	20	0.4	83	SSW	11	55	SSE	9
14/06/2017	8.7	20.3	0	79	SSW	6	60	NNW	9
15/06/2017	6.1	19.6	0.2	99	S	6	60	N	6
16/06/2017	8.9	16.2	0	90	-	Calm	73	-	Calm
17/06/2017	10.9	18.6	0	79	SSW	9	75	SSW	7
18/06/2017	7.6	18.1	0	87	SSW	9	52	S	13
19/06/2017	8.7	19.7	0	72	WSW	6	50	S	9
20/06/2017	7.2	20.2	0	86	SW	7	53	NNW	6
21/06/2017	2.3	19.2	0	77	S	4	45	SSE	9
22/06/2017	4.7	18.4	0	90	SW	7	45	N	9
23/06/2017	4.1	17.1	0.2	99	S	6	62	NNW	7
24/06/2017	1.7	18.6	0	91	NW	2	32	SW	13
25/06/2017	0.5	17.8	0.2	99	-	Calm	32	WSW	17
26/06/2017	1.9	18	0	90	-	Calm	33	W	6
27/06/2017	2.2	15.7	0	86	SSW	6	64	-	Calm
28/06/2017	6.4	14.4	0	99	S	6	91	N	9
29/06/2017	6.7	17.1	0.6	77	SSW	7	37	SW	11
30/06/2017	2.2	15.5	0	69	S	7	26	SSW	13

Table 74. Campbelltown (068257), New South Wales July 2017 Daily Weather Observations (BOM 2017)

Date	Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)	9am relative humidity (%)	9am wind direction	9am wind speed (km/h)	3pm relative humidity (%)	3pm wind direction	3pm wind speed (km/h)
01/07/2017	1	16.4	0	64	SSW	6	36	SW	7
02/07/2017	0	16	0	87	S	7	29	N	9
03/07/2017	-0.7	13.8	0.2	97	W	2	76	-	Calm
04/07/2017	2.3	21.4	0.4	99	-	Calm	25	SSE	4
05/07/2017	3	20	0.2	80	N	6	39	SW	6
06/07/2017	3	17.6	0	80	-	Calm	30	SW	11
07/07/2017	-1.2	18.2	0	99	-	Calm	26	NW	6
08/07/2017	-0.7	17.1	0	91	-	Calm	35	WSW	13
09/07/2017	-0.5	17	0	84	WNW	6	29	WSW	9
10/07/2017	-0.6	17	0.2	87	SW	2	32	SW	13
11/07/2017	0.8	18	0.2	79	S	6	40	S	11
12/07/2017	2.2	17	0	75	SW	6	51	SSE	9
13/07/2017	2.5	17.1	0	83	SSW	6	50	N	9
14/07/2017	0.6	18.6	0	99	-	Calm	44	N	9
15/07/2017	6.8	18.4	0	78	NNW	6	31	SSW	6
16/07/2017	0	16.6	0	67	SSW	6	28	NNE	9
17/07/2017	1.3	17.9	0	82	SW	6	53	N	4
18/07/2017	1	22.3	0	99	-	Calm	20	WNW	15
19/07/2017	7.2	16.3	0	51	W	13	35	W	19
20/07/2017	3.5	15.3	0	48	SW	9	29	W	19
21/07/2017	2.6	-	0	56	SW	13	-	-	-

Table 75. Campbelltown (068257), New South Wales May 2018 Daily Weather Observations (BOM 2018)

Date	Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)	9am relative humidity (%)	9am wind direction	9am wind speed (km/h)	3pm relative humidity (%)	3pm wind direction	3pm wind speed (km/h)
01/05/2018	7.2	25.4	0	77	S	6	24.7	13	NNE
02/05/2018	7.9	21.8	0	67	SW	6	20.5	51	N
03/05/2018	8.2	27.8	0	73	SW	6	27.1	22	N
04/05/2018	15.3	27.2	0	41	NNW	17	22.9	19	W
05/05/2018	5.5	24	0	42	NNE	7	23.3	14	NNW
06/05/2018	4.5	23.8	0	56	W	6	22.5	19	N
07/05/2018	6.3	25.2	0	70	SW	4	24.2	25	N
08/05/2018	7.6	26.1	0	89		Calm	25.7	19	NE
09/05/2018	7.5	26	0	64	S	6	25.4	21	N
10/05/2018	7.3	24.8	0	80		Calm	23.1	14	WNW
11/05/2018	3.5	16.6	0	42	NNW	13	15.1	27	W
12/05/2018	5	16.5	0	42	SSW	17	16.3	54	WSW
13/05/2018	12.2	19.8	0.6	58	SW	13	18	46	SSW
14/05/2018	11.9	20.9	0	56	SSW	15	19.5	33	S
15/05/2018	6.3	21.6	0	70	SW	6	21	20	ENE
16/05/2018	5.8	20	0	59	SSW	11	17.7	42	ESE
17/05/2018	6.1	20.4	0	70	S	4	19.5	33	N
18/05/2018	2.6	22.3	0	43	SSW	7	21.8	21	SSW
19/05/2018	3.9	21.5	0	74	S	6	20.1	30	ENE
20/05/2018	1.6	22.8	0	59	NW	7	22.1	18	WSW
21/05/2018	5.9	21.5	0	46	SW	9	19.4	28	WSW
22/05/2018	6.1	23.5	0	44	SSW	9	22.2	28	WSW
23/05/2018	10.7	22.7	0	61	S	9	22	29	NNW
24/05/2018	7.1	21.6	0	69	SSW	7	18	63	ESE
25/05/2018	11.5	19.7	0	65	WSW	6	17.3	47	ESE
26/05/2018	4.2	22.2	0	85	S	6	21.4	30	N
27/05/2018	4.7	21.9	0	89	SW	6	19.6	35	N
28/05/2018	6.8	21.7	0	77	SSW	6	20.3	38	NNW
29/05/2018	5.3	24.5	0.2	78		Calm	24.2	26	NNE
30/05/2018	10.1	18.1	4	65	SW	11	16.5	31	WSW
31/05/2018	3.3	18.3	0	57	SSW	7	17	23	SSW

Table 76. Campbelltown (068257), New South Wales June 2018 Daily Weather Observations (BOM 2018)

Date	Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)	9am relative humidity (%)	9am wind direction	9am wind speed (km/h)	3pm relative humidity (%)	3pm wind direction	3pm wind speed (km/h)
01/06/2018	7.8	18.2	0.2	52	WSW	9	36	S	15
02/06/2018	10	16.5	0	50	SSW	15	53	SSW	19
03/06/2018	10.6	19.7	0	68	SW	11	47	S	15
04/06/2018	8.5	19.1	0	71	SSW	13	48	S	13
05/06/2018	6.2	17.6	0	71	SSW	13	89	S	13
06/06/2018	10.2	19.1	23.4	95	SSW	9	82	ESE	7
07/06/2018	5.6	20.1	10.2	99		Calm	45	NE	13
08/06/2018	7.4	14	0.2	99		Calm	77		Calm
09/06/2018	9.1	15.2	8.2	99		Calm	85	SW	6
10/06/2018	5.9	18.3	0.4	86	SSW	11	70	SSW	13
11/06/2018	7.4	19.6	0	79	SW	7	44	SSE	9
12/06/2018	2.7	16.6	0.2	99		Calm	65		Calm
13/06/2018	4.9	19	0	82	N	7	36	WSW	13
14/06/2018	2.1	18.3	0	94	N	6	25	W	17
15/06/2018	3	19.3	0	46	N	19	34	W	26
16/06/2018	5.3	17.6	0	34	W	13	24	NNW	22
17/06/2018	2.4	14.7	0	47	WSW	17	31	WSW	19
18/06/2018	8.2	17.6	0	51	SSW	17	31	SSW	20

Table 77. Campbelltown (068257), New South Wales April 2020 Daily Weather Observations (BOM 2020)

Date	Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)	9am relative humidity (%)	9am wind direction	9am wind speed (km/h)	3pm relative humidity (%)	3pm wind direction	3pm wind speed (km/h)
1/04/2020	16.4	23.3	0	83	N	9	32	NW	15
2/04/2020	16	22.6	2.4	71	WSW	7	51	W	15
3/04/2020	16.9	24.9	6.2	58	SW	11	35	S	13
4/04/2020	17.5	25.6	3	65	SW	7	57	SE	6
5/04/2020	8.1	23.7	0.2	87	S	9	45	NNW	9
6/04/2020	7.9	23.6	0	74	SW	6	52	N	9
7/04/2020	12.7	21	0	99	S	6	82	E	6
8/04/2020	12.2	20.1	0	78	SW	11	52	S	13
9/04/2020	14.4	23.1	0	87	SW	9	62	ESE	7
10/04/2020	13.7	23.1	1.6	97	-	Calm	93	NE	9
11/04/2020	9.2	25.6	9.6	99	SW	9	65	ESE	11
12/04/2020	6.2	22.2	0	97	WSW	2	78	S	6
13/04/2020	6	22.9	0	99	SSW	2	74	NNE	7
14/04/2020	9	26.2	0	99	NNW	6	34	W	13
15/04/2020	10.6	28.9	0	66	SW	7	49	WSW	13
16/04/2020	12.5	23.8	0	99	-	Calm	37	WSW	11
17/04/2020	11.9	26.2	0	71	WSW	6	82	S	15

Date	Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)	9am relative humidity (%)	9am wind direction	9am wind speed (km/h)	3pm relative humidity (%)	3pm wind direction	3pm wind speed (km/h)
18/04/2020	6.1	25.1	0	83	SW	6	48	N	9
19/04/2020	10	23.8	0	99	-	Calm	56	NNE	9
20/04/2020	9.1	18.8	0	99	-	Calm	65	NNE	7
21/04/2020	8.7	25.3	0	98	N	7	67	NNE	4
22/04/2020	7.1	25.1	0	90	S	6	46	SW	15
23/04/2020	6.3	24.7	0	70	SSW	2	51	WSW	9
24/04/2020	10.4	27.6	0	71	SW	6	54	SW	13
25/04/2020	8.6	27.4	0	73	SW	7	47	WSW	15
26/04/2020	7.4	26.3	0	70	SSW	11	40	ESE	9
27/04/2020	9.3	22.8	0	90	SSW	4	57	SE	9
28/04/2020	15.4	22.8	0	79	-	Calm	52	SE	7
29/04/2020	13.1	26	0	91	SSW	7	91	E	6
30/04/2020	14.2	15	17.4	99	S	7	52	N	7

Table 78. Campbelltown (068257), New South Wales May 2020 Daily Weather Observations (BOM 2021)

Date	Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)	9am relative humidity (%)	9am wind direction	9am wind speed (km/h)	3pm relative humidity (%)	3pm wind direction	3pm wind speed (km/h)
1/05/2020	3.7	16.6	10	83	N	9	32	NW	15
2/05/2020	9.1	17.6	0.2	71	WSW	7	51	W	15
3/05/2020	4.9	20	0	58	SW	11	35	S	13
4/05/2020	4.7	20	0	65	SW	7	57	SE	6
5/05/2020	8.4	21.4	0	87	S	9	45	NNW	9
6/05/2020	5.5	22.3	0	74	SW	6	52	N	9
7/05/2020	5.4	22.5	0	99	S	6	82	E	6
8/05/2020	7.8	26.6	0	78	SW	11	52	S	13
9/05/2020	7.7	26.2	0	87	SW	9	62	ESE	7
10/05/2020	3.8	17.9	0	97	-	Calm	93	NE	9
11/05/2020	5	19.5	0	99	SW	9	65	ESE	11
12/05/2020	2.3	20	0	97	WSW	2	78	S	6
13/05/2020	4.8	17.7	0	99	SSW	2	74	NNE	7
14/05/2020	4.5	18.3	0	99	NNW	6	34	W	13
15/05/2020	3.7	18.2	0	66	SW	7	49	WSW	13
16/05/2020	11.1	20.6	2.6	99	-	Calm	37	WSW	11
17/05/2020	6.2	20.4	0.2	71	WSW	6	82	S	15
18/05/2020	7.8	21.3	0	83	SW	6	48	N	9
19/05/2020	9.8	21.4	1	99	-	Calm	56	NNE	9
20/05/2020	7.1	24.3	0	99	-	Calm	65	NNE	7
21/05/2020	11.7	18.3	0.6	98	N	7	67	NNE	4
22/05/2020	8.4	15.8	35.8	90	S	6	46	SW	15
23/05/2020	10.6	17.3	0.8	70	SSW	2	51	WSW	9

Date	Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)	9am relative humidity (%)	9am wind direction	9am wind speed (km/h)	3pm relative humidity (%)	3pm wind direction	3pm wind speed (km/h)
24/05/2020	12.1	18.2	0.6	71	SW	6	54	SW	13
25/05/2020	9.2	17.9	0	73	SW	7	47	WSW	15
26/05/2020	12.3	19.8	0.2	70	SSW	11	40	ESE	9
27/05/2020	8.2	20.9	2	90	SSW	4	57	SE	9
28/05/2020	6.7	22.7	0	79	-	Calm	52	SE	7
29/05/2020	9.1	18.8	0	91	SSW	7	91	E	6
30/05/2020	7.1	20.1	0	99	S	7	52	N	7
31/05/2021	7.6	20.7	0						

Table 79. Campbelltown (068257), New South Wales June 2020 Daily Weather Observations (BOM 2021)

Date	Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)	9am relative humidity (%)	9am wind direction	9am wind speed (km/h)	3pm relative humidity (%)	3pm wind direction	3pm wind speed (km/h)
1/06/2020	5.6	22.5	0	83	N	9	32	NW	15
2/06/2020	3.7	16.7	0.4	71	WSW	7	51	W	15
3/06/2020	5.5	18.7	0	58	SW	11	35	S	13
4/06/2020	7.2	17.9	0	65	SW	7	57	SE	6
5/06/2020	1.6	18.5	0	87	S	9	45	NNW	9
6/06/2020	2.5	18.6	0	74	SW	6	52	N	9
7/06/2020	3.2	18.1	0	99	S	6	82	E	6
8/06/2020	5.1	17.8	2.6	78	SW	11	52	S	13
9/06/2020	8.8	20.3	0.8	87	SW	9	62	ESE	7
10/06/2020	10.2	16.6	1	97	-	Calm	93	NE	9
11/06/2020	10.6	21.6	0.6	99	SW	9	65	ESE	11
12/06/2020	7.6	17	1.8	97	WSW	2	78	S	6
13/06/2020	7.8	19.3	0.6	99	SSW	2	74	NNE	7
14/06/2020	11.8	19.8	9	99	NNW	6	34	W	13
15/06/2020	5.2	20	0	66	SW	7	49	WSW	13
16/06/2020	3.1	20.8	0	99	-	Calm	37	WSW	11
17/06/2020	6.8	16	0	71	WSW	6	82	S	15
18/06/2020	10	19.1	0.4	83	SW	6	48	N	9
19/06/2020	3	19.1	0	99	-	Calm	56	NNE	9
20/06/2020	5.4	18.7	0.2	99	-	Calm	65	NNE	7
21/06/2020	8.7	18.1	11	98	N	7	67	NNE	4
22/06/2020	2.4	15.9	0	90	S	6	46	SW	15
23/06/2020	3	16.3	0	70	SSW	2	51	WSW	9
24/06/2020	2.5	18.9	0.2	71	SW	6	54	SW	13
25/06/2020	5.2	18.1	0	73	SW	7	47	WSW	15
26/06/2020	3.7	19.3	0	70	SSW	11	40	ESE	9
27/06/2020	3.1	16.3	0	90	SSW	4	57	SE	9
28/06/2020	5.4	17.6	0	79	-	Calm	52	SE	7

Date	Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)	9am relative humidity (%)	9am wind direction	9am wind speed (km/h)	3pm relative humidity (%)	3pm wind direction	3pm wind speed (km/h)
29/06/2020	6.7	17.2	0	91	SSW	7	91	E	6
30/06/2020	4	17.9	3	99	S	7	52	N	7

Table 80. Campbelltown (068257), New South Wales July 2020 Daily Weather Observations (BOM 2021)

Date	Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)	9am relative humidity (%)	9am wind direction	9am wind speed (km/h)	3pm relative humidity (%)	3pm wind direction	3pm wind speed (km/h)
1/07/2020	2.5	20.4	0	99	-	Calm	46	N	9
2/07/2020	4.1	23.2	0.2	98	E	6	39	NW	17
3/07/2020	5.9	17.4	0	66	NW	4	37	WSW	13
4/07/2020	5.3	16.4	0	74	WSW	6	30	W	13
5/07/2020	3.2	18.4	0	67	S	9	39	SW	9
6/07/2020	3.5	18.9	0	79	S	9	40	N	2
7/07/2020	5.5	16.6	0	78	SSW	6	57	S	11
8/07/2020	9.1	16.9	0	81	S	9	70	ESE	6
9/07/2020	2.8	18	0	99	SSW	4	60	NNE	9
10/07/2020	5.7	16.3	0	99	WSW	6	70	NNW	6
11/07/2020	9.7	16.2	5.2	98	-	Calm	79	N	7
12/07/2020	3.9	19	0.2	92	SSW	6	66	NNE	9
13/07/2020	4.3	17.7	0.4	96	S	7	61	SSE	11
14/07/2020	7.9	16.6	3	81	SSW	19	68	S	26
15/07/2020	10	16.7	0	62	SSW	17	57	SSW	17
16/07/2020	6.1	17	0	59	SW	13	52	SSW	19
17/07/2020	6.6	17.4	0	66	SW	11	57	S	13
18/07/2020	5.1	18.2	0	70	SW	7	51	NNW	11
19/07/2020	1.4	20.1	0	99	-	Calm	42	NNW	11
20/07/2020	4.2	18.2	0	46	SSE	6	27	W	13
21/07/2020	4	17.6	0	64	SSW	13	39	SE	7
22/07/2020	1.4	18.7	0	92	S	7	44	NNW	7
23/07/2020	2.3	19.8	0.2	77	S	6	43	N	9
24/07/2020	3.3	18.7	0	99	S	7	53	N	13
25/07/2020	3.7	20.2	0	99	SSW	9	66	NNE	7
26/07/2020	10.5	15.5	5.2	99	S	11	98	S	7
27/07/2020	12.1	16.4	51.6	91	SW	11	83	SW	15
28/07/2020	11.9	18.8	17.4	90	SSW	9	63	SSW	20
29/07/2020	5.5	20.5	0	82	S	6	61	ESE	13
30/07/2020	4.4	19	0.2	79	SSW	7	50	SSE	9
31/07/2020	4.7	17.7	0	69	SSW	9	41	NNW	4

Table 81. Campbelltown (068257), New South Wales May 2021 Daily Weather Observations (BOM 2021)

Date	Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)	9am relative humidity (%)	9am wind direction	9am wind speed (km/h)	3pm relative humidity (%)	3pm wind direction	3pm wind speed (km/h)
1/05/2021	10.9	24.3	0	87	SSW	6	54	N	13
2/05/2021	10.3	24.6	0	95	SSE	6	49	NE	9
3/05/2021	10.1	26.1	0	98	WSW	2	43	NNE	7
4/05/2021	11.6	15.3	0.2	87	SW	4	94	SE	4
5/05/2021	12.8	18.9	17.2	96	SSW	7	84	SSW	13
6/05/2021	14.2	21.9	20	95	S	15	89	SE	11
7/05/2021	17	21.2	33	95	SSW	13	76	S	11
8/05/2021	10.6	25.7	1.6	89	WSW	4	35	W	13
9/05/2021	12.5	22.3	0	71	WSW	4	63	N	9
10/05/2021	9.2	24.7	0	77	WNW	6	42	SW	9
11/05/2021	9.9	21.6	1.4	78	NNE	2	69	SSE	7
12/05/2021	9.3	22.9	0.4	74	SSW	9	59	E	9
13/05/2021	10.7	24	4.8	84	SSW	9	42	SW	9
14/05/2021	8.7	19.6	0	48	WSW	11	33	WSW	13
15/05/2021	6	16.8	0	64	N	7	38	W	19
16/05/2021	3.1	18.4	0	58	WSW	9	29	W	9
17/05/2021	4.7	20.5	0	59	SW	11	39	NW	11
18/05/2021	3.7	20.2	0	78	SSW	9	36	NNE	9
19/05/2021	3.3	20.8	0	82	S	6	33	WNW	7
20/05/2021	2.4	22.1	0	81	S	11	32	S	6
21/05/2021	5.9	18.2	0	75	SW	4	64	SSE	9
22/05/2021	5	21.2	0.2	84	SSW	9	47	NNE	7
23/05/2021	6.3	21	0.2	93	SW	7	67	S	7
24/05/2021	10.1	20.8	3	90	SSW	9	71	E	7
25/05/2021	8.4	21.9	0	99	S	2	51	N	9
26/05/2021	10.2	21.3	0	56	SW	13	37	WSW	15
27/05/2021	4	18.7	0	63	SW	6	38	WSW	11
28/05/2021	3.7	17	0	69	SSW	9	30	SSW	19
29/05/2021	4.5	16.4	0	58	SSW	11	51	SSW	15
30/05/2021	8.2	16.5	0	60	SW	13	58	SSW	9
31/05/2021	4.4	19.5	0	78	S	9	44	E	7

Table 82. Campbelltown (068257), New South Wales June 2021 Daily Weather Observations (BOM 2021)

Date	Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)	9am relative humidity (%)	9am wind direction	9am wind speed (km/h)	3pm relative humidity (%)	3pm wind direction	3pm wind speed (km/h)
1/06/2021	3.4	19	0	98	SSW	2	62		Calm
2/06/2021	4.1	22.5	0	76	SSW	4	34	NNE	6
3/06/2021	7.2	13.5	0	95	-	Calm	96		Calm
4/06/2021	5.6	19.4	11.8	98	SW	6	52	SW	11

Date	Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)	9am relative humidity (%)	9am wind direction	9am wind speed (km/h)	3pm relative humidity (%)	3pm wind direction	3pm wind speed (km/h)
5/06/2021	4.3	17.4	0	77	S	7	40	N	9
6/06/2021	2.4	20.2	0	63	SSW	9	39	WSW	6
7/06/2021	2	19.3	0	99	SSW	6	48	NNE	9
8/06/2021	4.2	19.2	0	98	-	Calm	57	NNE	7
9/06/2021	4.5	15.7	4.6	97	S	9	56	WNW	11
10/06/2021	-0.3	8.6	0.2	99	-	Calm	92	N	6
11/06/2021	1.8	15.3	6.4	99	-	Calm	64	W	9
12/06/2021	1.1	17.3	0	99	WNW	4	43	NW	9
13/06/2021	1.6	18.1	0	86	N	7	41	W	13
14/06/2021	4.2	18.1	0	81	SSW	2	59	SSW	2
15/06/2021	8.1	18.7	0	81	SW	7	65	E	4
16/06/2021	3.6	19.8	0	99	SSW	2	56	N	7
17/06/2021	3.9	16.9	9.6	57	WSW	15	43	WSW	15
18/06/2021	5.6	18.7	0	69	-	Calm	48	W	17
19/06/2021	8.9	15.2	2.2	56	SW	17	66	SSW	20
20/06/2021	10.2	16.9	0.4	71	SW	7	81	S	11
21/06/2021	8	17.7	0.4	86	SSW	11	67	S	9
22/06/2021	6	18.4	0	91	-	Calm	74	ENE	7
23/06/2021	5.8	17.1	0	98	SE	4	68	N	9
24/06/2021	8.9	21.9	0.2	78	NNW	9	55	N	15
25/06/2021	5.2	18.9	0.8	98	SSW	2	40	NNW	13
26/06/2021	2.2	18	0	99	-	Calm	45	W	17
27/06/2021	2.9	18.8	0.2	72	-	Calm	35	SW	11
28/06/2021	3.1	17	0	92	SW	6	57	S	9
29/06/2021	4	16.4	0.2	97	WSW	4	80	SSW	7
30/06/2021	7.6	19	9.2	98	S	6	69	N	6

Table 83. Campbelltown (068257), New South Wales July 2021 Daily Weather Observations (BOM 2021)

Date	Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)	9am relative humidity (%)	9am wind direction	9am wind speed (km/h)	3pm relative humidity (%)	3pm wind direction	3pm wind speed (km/h)
1/07/2021	7.5	18	1	98	-	Calm	75	--	Calm
2/07/2021	8.6	18.4	3.2	98	NNW	4	71	N	7
3/07/2021	2.9	18.5	0	99	S	9	59	WNW	9
4/07/2021	1.1	16.1	0.2	69	NNW	9	38	W	9
5/07/2021	2	16.8	0	71	SSW	9	38	WSW	11
6/07/2021	2.1	16.4	0	76	SSW	11	41	N	6
7/07/2021	0.5	16.6	0	85	S	9	53	N	7
8/07/2021	2.1	17.5	0.2	97	S	9	51	N	9
9/07/2021	5.4	12.9	0	94	SSW	9	91	-	Calm
10/07/2021	8.6	15.5	5.8	77	SSW	17	63	SSW	17

Date	Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)	9am relative humidity (%)	9am wind direction	9am wind speed (km/h)	3pm relative humidity (%)	3pm wind direction	3pm wind speed (km/h)
11/07/2021	6.4	18	0.6	92	SSW	7	61	E	4
12/07/2021	3.4	18.4	0.2	98	S	7	50	NNE	13
13/07/2021	1.5	19	0.2	99	SSE	4	41	NNW	9
14/07/2021	5.4	15	0	96	WSW	2	61	N	9
15/07/2021	6.4	21.5	0	95	-	Calm	47	NW	9
16/07/2021	4.9	17.5	2.2	96	NW	7	46	W	17
17/07/2021	6.1	14	0.4	53	W	15	49	WNW	20
18/07/2021	6.1	18.1	0	56	WSW	13	40	SW	17
19/07/2021	1.2	15.5	0	83	SSW	2	45	WSW	9
20/07/2021	2	16	0	55	WNW	15	50	NNW	15
21/07/2021	5.8	15.9	0	46	SW	17	30	S	15
22/07/2021	-0.5	16.7	0.2	78	S	9	31	NNE	9
23/07/2021	4.1	14.7	1	93	-	Calm	83	-	Calm
24/07/2021	6.2	17.7	1	98	-	Calm	40	W	20
25/07/2021	5.3	14.9	0	52	WSW	17	34	WNW	17
26/07/2021	3.1	19.8	0	55	WNW	13	39	W	20
27/07/2021	3.5	20	0	76	-	Calm	41	N	15
28/07/2021	4	24.6	0	72	NE	7	31	NW	19
29/07/2021	6.3	17.8	0	48	WSW	6	30	SSW	11
30/07/2021	-1.1	18.7	0	74	SSW	9	29	NNE	9
31/07/2021	1	21.6	0	60	E	6	37	NNE	11

Table 84. Campbelltown (068257), New South Wales August 2021 Daily Weather Observations (BOM 2021)

Date	Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)	9am relative humidity (%)	9am wind direction	9am wind speed (km/h)	3pm relative humidity (%)	3pm wind direction	3pm wind speed (km/h)
1/08/2021	7.5	18	1	98	-	Calm	75	--	Calm
2/08/2021	8.6	18.4	3.2	98	NNW	4	71	N	7
3/08/2021	2.9	18.5	0	99	S	9	59	WNW	9
4/08/2021	1.1	16.1	0.2	69	NNW	9	38	W	9
5/08/2021	2	16.8	0	71	SSW	9	38	WSW	11
6/08/2021	2.1	16.4	0	76	SSW	11	41	N	6
7/08/2021	0.5	16.6	0	85	S	9	53	N	7
8/08/2021	2.1	17.5	0.2	97	S	9	51	N	9
9/08/2021	5.4	12.9	0	94	SSW	9	91	-	Calm
10/08/2021	8.6	15.5	5.8	77	SSW	17	63	SSW	17
11/08/2021	6.4	18	0.6	92	SSW	7	61	E	4
12/08/2021	3.4	18.4	0.2	98	S	7	50	NNE	13
13/08/2021	1.5	19	0.2	99	SSE	4	41	NNW	9
14/08/2021	5.4	15	0	96	WSW	2	61	N	9
15/08/2021	6.4	21.5	0	95	-	Calm	47	NW	9
16/08/2021	4.9	17.5	2.2	96	NW	7	46	W	17

Date	Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)	9am relative humidity (%)	9am wind direction	9am wind speed (km/h)	3pm relative humidity (%)	3pm wind direction	3pm wind speed (km/h)
17/08/2021	6.1	14	0.4	53	W	15	49	WNW	20
18/08/2021	6.1	18.1	0	56	WSW	13	40	SW	17
19/08/2021	1.2	15.5	0	83	SSW	2	45	WSW	9
20/08/2021	2	16	0	55	WNW	15	50	NNW	15
21/08/2021	5.8	15.9	0	46	SW	17	30	S	15
22/08/2021	-0.5	16.7	0.2	78	S	9	31	NNE	9
23/08/2021	4.1	14.7	1	93	-	Calm	83	-	Calm
24/08/2021	6.2	17.7	1	98	-	Calm	40	W	20
25/08/2021	5.3	14.9	0	52	WSW	17	34	WNW	17
26/08/2021	3.1	19.8	0	55	WNW	13	39	W	20
27/08/2021	3.5		0	76	-	Calm	-	-	Calm

Appendix 7. Hollow-bearing tree register

Tree number	Hollow tree/stag	Number of hollows	Size of hollows	Height above ground (m)
1	Hollow-bearing tree	1	10-15	10
2	Hollow-bearing tree	1	10-15	10
3	Hollow-bearing tree	1	0-5	3
4	Hollow-bearing stag	0		
5	Hollow-bearing tree	1	5-10	20
6	Hollow-bearing tree	1	10-15	15
7	Hollow-bearing tree	1	5-10	15
8	Hollow-bearing tree	1	15-20	5
9	Hollow-bearing tree	1	5-10	10
10	Hollow-bearing stag	0		
11	Hollow-bearing tree	1	5-10	10
12	Hollow-bearing tree	1	10-15,5-10	15, 20
13	Hollow-bearing stag	0		
14	Hollow-bearing stag	0		
15	Hollow-bearing tree	2	20-30,5-10	20
16	Hollow-bearing tree	2	10-15,15-20	20, 25
17	Hollow-bearing tree	1	10-15	15
18	Hollow-bearing stag	0		
19	Hollow-bearing tree	1	5-10	5
20	Hollow-bearing tree	1	15-20	15
21	Hollow-bearing stag	0		
22	Hollow-bearing tree	2	10-15,15-20	10, 11
23	Hollow-bearing tree	1	5-10	8
24	Hollow-bearing tree	1	5-10	6
25	Hollow-bearing tree	2	5-10,10-15	20, 22
26	Hollow-bearing tree	1	10-15	7, 15
27	Hollow-bearing tree	1	10-15	10
28	Hollow-bearing tree	3	10-15,5-10	5, 8, 15
29	Hollow-bearing stag	0		
30	Hollow-bearing tree	1	20-30	5
31	Hollow-bearing stag	0		
32	Hollow-bearing tree	2	10-15,15-20	10, 12
33	Hollow-bearing stag	0		
34	Hollow-bearing tree	1	10-15	5
35	Hollow-bearing tree	1	15-20,10-15	5, 15
36	Hollow-bearing tree	1	20-30	5
37	Hollow-bearing tree	1	20-30	5
38	Hollow-bearing tree	1	20-30	5

Tree number	Hollow tree/stag	Number of hollows	Size of hollows	Height above ground (m)
39	Hollow-bearing tree	1	10-15	10
40	Hollow-bearing tree	1	15-20	5
41	Hollow-bearing tree	1	15-20	10, 10
42	Hollow-bearing tree	1	5-10	10
43	Hollow-bearing tree	3	5-10,10-15	5, 10, 15
44	Hollow-bearing tree	2	15-20,10-15	10, 15
45	Hollow-bearing stag	0		
46	Hollow-bearing tree,Hollow-bearing stag	1	15-20	10
47	Hollow-bearing tree	1	5-10	5
48	Hollow-bearing stag	0		
49	Hollow-bearing tree	1	5-10	10
50	Hollow-bearing stag	0		
51	Hollow-bearing stag	0		
52	Hollow-bearing tree	3	15-20,20-30	10
53	Hollow-bearing tree	1	10-15	10
54	Hollow-bearing tree	1	10-15	15
55	Hollow-bearing tree	1	10-15	15
56	Hollow-bearing tree	1	10-15	10
57	Hollow-bearing tree	1	20-30	5
58	Hollow-bearing tree	1	15-20,10-15,5-10	5, 10, 15
59	Hollow-bearing stag	0		
60	Hollow-bearing stag	0		
61	Hollow-bearing stag	0		
62	Hollow-bearing tree	1	15-20	15
63	Hollow-bearing tree	1	20-30	15
64	Hollow-bearing tree	1	20-30	5
65	Hollow-bearing tree	1	10-15	5
66	Hollow-bearing tree	1	5-10	15
67	Hollow-bearing tree	1	10-15	10
68	Hollow-bearing tree	1	5-10	15
69	Hollow-bearing tree	1	5-10	10
70	Hollow-bearing tree	1	10-15	5
71	Hollow-bearing tree	1	15-20	10
72	Hollow-bearing tree	1	10-15	10
73	Hollow-bearing stag	0		
74	Hollow-bearing stag	0		
75	Hollow-bearing tree	1	20-30	15
76	Hollow-bearing tree	1	15-20	10
77	Hollow-bearing tree	1	15-20	10
78	Hollow-bearing stag	0		
79	Hollow-bearing tree	1	10-15	10

Tree number	Hollow tree/stag	Number of hollows	Size of hollows	Height above ground (m)
80	Hollow-bearing tree	1	5-10	5
81	Hollow-bearing tree	1	20-30	10
82	Hollow-bearing tree	1	15-20	10
83	Hollow-bearing tree	1	5-10	10
84	Hollow-bearing tree	1	10-15	10
85	Hollow-bearing tree	1	5-10	10
86	Hollow-bearing stag	0		
87	Hollow-bearing tree	1	5-10	15
88	Hollow-bearing tree	1	5-10	5
89	Hollow-bearing tree	1	10-15	10
90	Hollow-bearing tree	1	20-30	10
91	Hollow-bearing tree	1	5-10	10
92	Hollow-bearing tree	1	20-30	5
93	Hollow-bearing tree	1	15-20,10-15,5-10	5, 10,15
94	Hollow-bearing tree	1	15-20,10-15	3, 5, 15
95	Hollow-bearing tree	1	5-10,10-15	5, 10
96	Hollow-bearing tree	1	15-20	10
97	Hollow-bearing tree	2	20-30	10
98	Hollow-bearing tree	3	10-15,15-20	10, 10, 15
99	Hollow-bearing stag	0		
100	Hollow-bearing tree	1	15-20,10-15	10, 15
101	Hollow-bearing tree	3	20-30,30-40	5, 15, 15
102	Hollow-bearing tree	1	10-15	10
103	Hollow-bearing tree	1	10-15	10
104	Hollow-bearing stag	0		
105	Hollow-bearing tree	1	5-10	15
106	Hollow-bearing tree	1	10-15	15
107	Hollow-bearing tree	2	10-15	10, 15
108	Hollow-bearing tree	3	10-15	15, 15, 15
109	Hollow-bearing tree	1	10-15	10
110	Hollow-bearing tree	1	10-15	20
111	Hollow-bearing stag	0		
112	Hollow-bearing tree	1	10-15	5
113	Hollow-bearing tree	1	10-15	5
114	Hollow-bearing tree	3	5-10	10, , 10, 15
115	Hollow-bearing tree	1	10-15	10
116	Hollow-bearing tree	1	5-10	5
117	Hollow-bearing stag	0		
118	Hollow-bearing tree	1	5-10	10
119	Hollow-bearing tree	1	10-15	10
120	Hollow-bearing tree	1	15-20	10

Tree number	Hollow tree/stag	Number of hollows	Size of hollows	Height above ground (m)
121	Hollow-bearing tree	1	5-10	10
122	Hollow-bearing tree	1	15-20	10
123	Hollow-bearing tree	1	10-15	5
124	Hollow-bearing tree	1	20-30	10
125	Hollow-bearing stag	0		
126	Hollow-bearing tree	1	15-20	10
127	Hollow-bearing tree	1	5-10	10
128	Hollow-bearing tree	1	20-30	15
129	Hollow-bearing tree	1	10-15	10
130	Hollow-bearing tree	2	15-20,0-5	12, 13
131	Hollow-bearing tree	1	50+	2
132	Hollow-bearing stag	0		
133	Hollow-bearing tree	1	5-10	15
134	Hollow-bearing stag	0		
135	Hollow-bearing tree	1	40-50	10
136	Hollow-bearing tree	1	15-20	10
137	Hollow-bearing tree	1	10-15	8
138	Hollow-bearing stag	0		
139	Hollow-bearing tree	1	5-10	5
140	Hollow-bearing tree	1	20-30	5
141	Hollow-bearing stag	0		
142	Hollow-bearing tree	3	5-10,20-30	8,10,15
143	Hollow-bearing tree	1	30-40	10
144	Hollow-bearing tree	1	5-10	7
145	Hollow-bearing stag	0		
146	Hollow-bearing tree	1	20-30	5
147	Hollow-bearing tree	3	15-20,20-30	10,11,17
148	Hollow-bearing tree	1	15-20	12
149	Hollow-bearing tree	4	10-15,20-30,15-20	8,9,11,12
150	Hollow-bearing tree	1	10-15	15
151	Hollow-bearing tree	1	50+	10
152	Hollow-bearing stag	0		
153	Hollow-bearing tree	1	5-10	10
154	Hollow-bearing tree	2	10-15,15-20	8,10
155	Hollow-bearing tree	2	15-20,10-15	15,16
156	Hollow-bearing stag	0		
157	Hollow-bearing tree	1	5-10	10
158	Hollow-bearing tree	1	15-20	15
159	Hollow-bearing tree	1	10-15	15
160	Hollow-bearing tree	3	0-5,5-10	15
161	Hollow-bearing tree	2	20-30	10, 15

Tree number	Hollow tree/stag	Number of hollows	Size of hollows	Height above ground (m)
162	Hollow-bearing tree	1	5-10	15
163	Hollow-bearing tree	1	5-10	10
164	Hollow-bearing tree	2	10-15	10, 10
165	Hollow-bearing tree	1	5-10	10
166	Hollow-bearing tree	1	20-30	5
167	Hollow-bearing stag	0		
168	Hollow-bearing tree	2	10-15,5-10	10,15
169	Hollow-bearing stag	0		
170	Hollow-bearing tree	1	10-15	15
171	Hollow-bearing tree	1	20-30	5
172	Hollow-bearing tree	5	20-30,10-15,15-20	10, 10, 10, 15, 15
173	Hollow-bearing stag	0		
174	Hollow-bearing tree	1	15-20	10
175	Hollow-bearing tree	1	5-10	15
176	Hollow-bearing tree	1	10-15	15, 15
177	Hollow-bearing tree	1	5-10	15
178	Hollow-bearing tree	1	10-15	15
179	Hollow-bearing tree	2	20-30	15, 15
180	Hollow-bearing tree	4	20-30,15-20,5-10	10, 10, 15,20
181	Hollow-bearing tree	1	10-15	12
182	Hollow-bearing stag	0		
183	Hollow-bearing tree	7	20-30,15-20,30-40,10-15,5-10	10,11,12,14,17,18
184	Hollow-bearing tree	1	15-20	10
185	Hollow-bearing tree	2	15-20,10-15	10, 15
186	Hollow-bearing tree	2	10-15	10, 20
187	Hollow-bearing tree	2	20-30,10-15	15, 15
188	Hollow-bearing tree	1	15-20	10
189	Hollow-bearing tree	2	20-30,15-20	10, 15
190	Hollow-bearing stag	0		
191	Hollow-bearing stag	0		
192	Hollow-bearing stag	0		
193	Hollow-bearing tree	1	20-30	10
194	Hollow-bearing stag	0		
195	Hollow-bearing tree	2	10-15	10, 12
196	Hollow-bearing stag	0		
197	Hollow-bearing tree	1	15-20	1
198	Hollow-bearing stag	0		
199	Hollow-bearing tree	1	0-5	
200	Hollow-bearing tree	1	10-15	6
201	Hollow-bearing tree	1	15-20	3
202	Hollow-bearing tree	1	10-15	6

Tree number	Hollow tree/stag	Number of hollows	Size of hollows	Height above ground (m)
203	Hollow-bearing tree	1	10-15	7
204	Hollow-bearing tree	1	15-20	6
205	Hollow-bearing tree	1	20-30	8
206	Hollow-bearing tree	2	15-20	8
207	Hollow-bearing tree	1	10-15	9
208	Hollow-bearing tree	2	5-10	5
209	Hollow-bearing tree	1	20-30	2
210	Hollow-bearing tree	1	5-10	2
211	Hollow-bearing tree	1	5-10	5
212	Hollow-bearing tree	2	15-20	10
213	Hollow-bearing stag	0		
214	Hollow-bearing tree	1	15-20	10
215	Hollow-bearing stag	0		
216	Hollow-bearing tree	2	10-15	10
217	Hollow-bearing tree	1	5-10	5
218	Hollow-bearing tree	1	5-10	1.2
219	Hollow-bearing tree	3	0-5,5-10	4,5,6
220	Hollow-bearing tree	2	5-10	5,6
221	Hollow-bearing tree	1	5-10	5
222	Hollow-bearing tree	2	0-5	4,5
223	Hollow-bearing tree	2	0-5	5,8
224	Hollow-bearing tree	2	30-40,40-50	3,4
225	Hollow-bearing tree	1	10-15	2
226	Hollow-bearing tree	1	5-10	4
227	Hollow-bearing tree	3	15-20	7,8,9
228	Hollow-bearing tree	3	15-20,0-5	5,7
229	Hollow-bearing tree	1	15-20	5
230	Hollow-bearing tree	2	5-10,0-5	4,5
231	Hollow-bearing tree	2	0-5,5-10	
232	Hollow-bearing tree	3	20-30,10-15	4,6
233	Hollow-bearing tree	1	15-20	7
234	Hollow-bearing tree	4	30-40,20-30,15-20,10-15	3-6
235	Hollow-bearing tree	3	10-15,5-10	3,4,5
236	Hollow-bearing tree	2	5-10,0-5	4,5
237	Hollow-bearing tree	1	15-20,5-10	3,5
238	Hollow-bearing stag	0		
239	Hollow-bearing tree	1	5-10	4
240	Hollow-bearing stag	0		
241	Hollow-bearing tree	1	5-10	4
242	Hollow-bearing tree	3	10-15,5-10	4,5
243	Hollow-bearing tree	3	0-5,5-10,15-20	4,6

Tree number	Hollow tree/stag	Number of hollows	Size of hollows	Height above ground (m)
244	Hollow-bearing tree	6	0-5,5-10,10-15	4-7
245	Hollow-bearing tree	4	20-30,15-20,10-15	1-6
246	Hollow-bearing tree	1	15-20	5
247	Hollow-bearing tree	1	15-20,20-30	12
248	Hollow-bearing tree	1	10-15	5
249	Hollow-bearing tree	1	10-15	12
250	Hollow-bearing tree	1	5-10	15
251	Hollow-bearing tree	1	5-10	15
252	Hollow-bearing tree	1	50+	10
253	Hollow-bearing tree	1	50+	7
254	Hollow-bearing tree	1	10-15	10
255	Hollow-bearing tree	1	5-10	10
256	Hollow-bearing tree	1	10-15	10
257	Hollow-bearing tree	1	15-20	15
258	Hollow-bearing tree	1	10-15	10
259	Hollow-bearing tree	1	30-40	10
260	Hollow-bearing tree	1	10-15	10
261	Hollow-bearing tree	3	20-30,15-20	15, 15, 20
262	Hollow-bearing stag	0		
263	Hollow-bearing stag	0		
264	Hollow-bearing tree	2	15-20,10-15	10, 15
265	Hollow-bearing tree	2	10-15	10
266	Hollow-bearing tree	1	20-30	10
267	Hollow-bearing tree	1	20-30,15-20	10
268	Hollow-bearing tree	1	5-10	8
269	Hollow-bearing stag	0		
270	Hollow-bearing tree	1	20-30,10-15	5,7
271	Hollow-bearing tree	1	15-20,20-30,10-15	5,10,12
272	Hollow-bearing tree	1	,10-15,3,10	
273	Hollow-bearing tree	1	20-30	5
274	Hollow-bearing tree	1	10-15	7
275	Hollow-bearing tree	1	15-20,10-15	10,11
276	Hollow-bearing tree	1	5-10	8
277	Hollow-bearing tree	1	20-30	14,15
278	Hollow-bearing tree	3	50+,30-40	10,12,14
279	Hollow-bearing tree	4	15-20,10-15,5-10	5,10,11,12
280	Hollow-bearing tree	1	30-40	5
281	Hollow-bearing tree	4	10-15,15-20,5-10	10,11,14,14
282	Hollow-bearing tree	1	5-10	5
283	Hollow-bearing tree	1	20-30	6
284	Hollow-bearing tree	2	0-5,15-20	10, 10

Tree number	Hollow tree/stag	Number of hollows	Size of hollows	Height above ground (m)
285	Hollow-bearing tree	1	5-10,20-30	8
286	Hollow-bearing tree	1	10-15	6
287	Hollow-bearing tree	1	20-30,10-15,5-10	8,10,16
288	Hollow-bearing tree	1	10-15	4
289	Hollow-bearing tree	1	0-5	8
290	Hollow-bearing tree	1	15-20	15
291	Hollow-bearing tree	1	15-20	5
292	Hollow-bearing tree	1	10-15	8
293	Hollow-bearing tree	1	15-20	10
294	Hollow-bearing stag	0		
295	Hollow-bearing tree	1	5-10	7
296	Hollow-bearing tree	1	20-30	6
297	Hollow-bearing tree	1	5-10	12
298	Hollow-bearing tree	1	5-10,10-15	8,10
299	Hollow-bearing stag	0		
300	Hollow-bearing tree	1	0-5	6
301	Hollow-bearing tree	1	0-5	8,15
302	Hollow-bearing tree	1	5-10,0-5,20-30	10,10,11
303	Hollow-bearing tree	1	5-10	7
304	Hollow-bearing tree	1	15-20,5-10	8,12
305	Hollow-bearing tree	1	5-10,10-15	5,5
306	Hollow-bearing tree	1	0-5	10
307	Hollow-bearing tree	1	5-10	9
308	Hollow-bearing tree	1	15-20	10
309	Hollow-bearing stag	0		
310	Hollow-bearing tree	1	15-20	10
311	Hollow-bearing stag	0		
312	Hollow-bearing tree	2	15-20,10-15	5, 10
313	Hollow-bearing tree	1	15-20	5
314	Hollow-bearing tree	1	5-10	10
315	Hollow-bearing tree	2	15-20,30-40	5, 5
316	Hollow-bearing tree	2	15-20	5, 10
317	Hollow-bearing tree	1	15-20	10
318	Hollow-bearing tree	1	15-20	10
319	Hollow-bearing stag	0		
320	Hollow-bearing tree	1	5-10	15
321	Hollow-bearing tree	1	10-15	10
322	Hollow-bearing stag	0		
323	Hollow-bearing tree	1	5-10	10
324	Hollow-bearing tree	1	15-20	10
325	Hollow-bearing tree	4	20-30,30-40	10

Tree number	Hollow tree/stag	Number of hollows	Size of hollows	Height above ground (m)
326	Hollow-bearing tree	3	20-30,15-20	15
327	Hollow-bearing tree	2	10-15	15
328	Hollow-bearing tree	1	20-30	10
329	Hollow-bearing tree	1	15-20	10
330	Hollow-bearing tree	1	10-15	5
331	Hollow-bearing tree	2	10-15,5-10	10
332	Hollow-bearing tree	1	15-20	10
333	Hollow-bearing tree	1	20-30	5
334	Hollow-bearing tree	1	5-10	5
335	Hollow-bearing tree	1	10-15	5
336	Hollow-bearing stag	0		
337	Hollow-bearing tree	1	10-15	5
338	Hollow-bearing tree	1	10-15	5
339	Hollow-bearing tree	2	15-20,20-30	5
340	Hollow-bearing tree	2	20-30	5
341	Hollow-bearing tree	1	20-30	5
342	Hollow-bearing tree	1	5-10	5
343	Hollow-bearing tree	1		0
344	Hollow-bearing tree	1		0
345	Hollow-bearing tree	1		0
346	Hollow-bearing stag	0		0
347	Hollow-bearing tree	1		0
348	Hollow-bearing tree	1		0
349	Hollow-bearing tree	1		0
350	Hollow-bearing tree	1		0
351	Hollow-bearing tree	1		0
352	Hollow-bearing tree	1		0
353	Hollow-bearing tree	1		0
354	Hollow-bearing tree	1	30-40	0
355	Hollow-bearing tree	1	0-5	3
356	Hollow-bearing stag	0		0
357	Hollow-bearing stag	0		0
358	Hollow-bearing stag	0		0
359	Hollow-bearing tree	1	15-20	6
360	Hollow-bearing tree	1	20-30,0-5	0
361	Hollow-bearing stag	0		0
362	Hollow-bearing tree	1	5-10	6
363	Hollow-bearing tree	1	10-15	4
364	Hollow-bearing tree	1	20-30	5
365	Hollow-bearing tree	1	5-10	2
366	Hollow-bearing tree	1	5-10	3

Tree number	Hollow tree/stag	Number of hollows	Size of hollows	Height above ground (m)
367	Hollow-bearing tree	1	5-10	6
368	Hollow-bearing tree	2	0-5	4
369	Hollow-bearing stag	0		0
370	Hollow-bearing tree	3	0-5,5-10	5
371	Hollow-bearing tree	2	10-15,5-10	5
372	Hollow-bearing tree	1	20-30	6
373	Hollow-bearing tree	1	10-15	4
374	Hollow-bearing stag	0		
375	Hollow-bearing tree	1	20-30	15
376	Hollow-bearing tree	1	5-10	3, 4
377	Hollow-bearing tree	1	10-15	6
378	Hollow-bearing tree	1	20-30	8
379	Hollow-bearing tree	2	10-15	5, 6
380	Hollow-bearing tree	2	40-50,10-15	6, 7
381	Hollow-bearing tree	2	10-15	5, 6
382	Hollow-bearing tree	2	30-40	20, 30
383	Hollow-bearing stag	0		
384	Hollow-bearing tree	2	15-20,10-15	20
385	Hollow-bearing tree	1	10-15	15
386	Hollow-bearing tree	1	20-30	20
387	Hollow-bearing tree	1	15-20	15
388	Hollow-bearing tree	1	5-10	15

Note: field data was collected in electronic format, therefore raw data sheets have not been provided.

Appendix 8. EPBC Act Significant Impact Assessment

Assessments of Significance and supplementary information (where relevant) are presented for the following MNES in relation to the Project:

- Threatened Ecological Communities:
  - Shale Sandstone Transition Forest of the Sydney Basin Bioregion.
  - Coastal Upland Swamps of the Sydney basin bioregion.
- Threatened flora:
  - *Acacia bynoeana.*
  - *Cryptostylis hunteriana.*
  - *Leucopogon exolasius.*
  - *Pultenaea aristata.*
  - *Pomaderris brunnea.*
- Threatened Fauna:
  - Broad-headed Snake.
  - Littlejohn's Tree Frog.
  - Giant Burrowing Frog.
  - Koala.
  - Grey-headed Flying-fox.
  - Greater Glider.
- Migratory species:
  - Fork-tailed Swift.
  - Black-faced Monarch.
  - Spectacled Monarch.
  - Rufous Fantail.
  - Satin Flycatcher.

Shale Sandstone Transition Forest

Shale Sandstone Transition Forest	**Critically Endangered Ecological Community**	**Likelihood**
An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:		
1. reduce the extent of an ecological community		
Two vegetation communities (Transitional Shale Dry Ironbark Forest and Transitional Shale Stringybark Forest) mapped within the Subject Land would be classified as the Shale Sandstone Transition Forest CEEC under the EPBC Act. These vegetation communities would also meet the classification of 'high condition' (DoE 2014c), due to the vegetation communities being part of an extensive patch of native vegetation. In total, 91.18 ha of the Shale Sandstone Transition Forest CEEC has been mapped within the Subject Land. Shale Sandstone Transition Forest has been identified by DAWE as a subject threatened entity for the Project, as '*Longwall mining is listed as a threatening process, disrupting natural groundwater regimes and discharge patterns associated with mining'*. Subsidence as a result of the Project has the potential to cause cracking of the soil within the community. However, Shale Sandstone Transition Forest occurs within drier soil types and is not solely dependent on groundwater interaction that could be impacted by any surface cracking that may occur. It is		Unlikely

Shale Sandstone Transition Forest	Critically Endangered Ecological Community	Likelihood
acknowledged that in the event of any indirect subsidence impacts occurring, localised changes in community composition towards species less reliant on groundwater interaction may occur. Although this is not anticipated to lead to an overall change in the community. In light of this, it is not anticipated that any indirect impacts associated with subsidence would lead to an overall loss of this community within the Subject Land or reduce of the extent of the ecological community.		
2. fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines		
Shale Sandstone Transition Forest has not been recorded within the areas of direct impact for surface infrastructure. While there is the potential for indirect subsidence impacts to occur, resulting localised changes in community composition towards species less reliant on groundwater interaction, this is not anticipated to lead to an overall change in the community. Given these factors the Project is unlikely to fragment or increase fragmentation of Shale Sandstone Transition Forest.		Unlikely
3. adversely affect habitat critical to the survival of an ecological community		
The Approved Conservation Advice states that '*Areas that meet the minimum (moderate class) condition thresholds or are within the buffer zone are considered critical to the survival of the ecological community*' (DoE 2014c). Under this approach all areas of Shale Sandstone Transition Forest CEEC mapped within the Subject Land would be considered habitat critical to the survival of the ecological community. Previous vegetation mapping by NPWS (2003) has mapped approximately 641 ha of Shale Sandstone Transition Forest as occurring within a 10,000 ha radius of the Subject Land. Therefore the 91.18 ha of Shale Sandstone Transition Forest CEEC mapped within the Subject Land represents approximately 14% of that present in the broader locality. The Shale Sandstone Transition Forest within the Subject Land and broader locality is informally protected within WaterNSW Catchment landholdings. No large-scale clearing events are likely to take place within the surrounding Shale Sandstone Transition Forest given its informal protection.		Unlikely
4. modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns		
Subsidence as a result of the Project has the potential to cause cracking of the soil within the community. However, Shale Sandstone Transition Forest occurs within drier soil types and is not solely dependent on groundwater interaction that could be impacted by any surface cracking that may occur. It is acknowledged that in the event of any indirect subsidence impacts occurring, localised changes in community composition towards species less reliant on groundwater interaction could occur, although this is not anticipated to lead to an overall change in the community. Whilst subsidence can also impact upon surface water flows, and alter hydrology, given Shale Sandstone Transition Forest is not reliant upon waterlogging, or inundation regimes, it is highly unlikely subsidence would result in significant impacts to the CEEC.		Unlikely

Shale Sandstone Transition Forest	Critically Endangered Ecological Community	Likelihood
In addition, any indirect impacts should they occur are anticipated to be localised. The Project would not result in impacts to all Shale Sandstone Transition Forest within the Subject Land or locality: over 641 ha has been mapped by NPWS (2003) as occurring with 10,000 ha of the Subject Land. As such, the Project would not adversely affect all abiotic factors critical to the survival of the community within the locality.		
5. cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting		
The Shale Sandstone Transition Forest within the locality would not impacted directly by the Project. Subsidence as a result of the Project has the potential to cause cracking of the soil within the community. However, Shale Sandstone Transition Forest occurs within drier soil types and is not solely dependent on groundwater interaction that could be impacted by any surface cracking that may occur. It is acknowledged that in the event of any indirect subsidence impacts occurring, localised changes in community composition towards species less reliant on groundwater interaction may occur. Although this is not anticipated to lead to an overall change in the community or result in the loss of functionally important species. Subsidence can also impact upon surface water flows and alter hydrology. However, because Shale Sandstone Transition Forest is not reliant upon waterlogging, or inundation regimes, it is highly unlikely that this potential impact pathway would result in significant impacts to the CEEC or functionally important species. The Conservation Advice for the community (DoE 2014c) identifies 'shale birds' and other nomadic nectarivores, as well as mammal species important for pollination, seed dispersal and soil engineering as important functional species. These fauna groups and their key habitats are generally unlikely to be sensitive to subsidence impacts.		Unlikely
6. cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: **— assisting invasive species, that are harmful to the listed ecological community, to become established, or** **— causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community**		
The Project is not likely to result in the introduction of a disease that may lead to the decline of the EEC. The construction and operation work would not involve direct impacts to the Shale Sandstone Transition Forest EEC. The Project would require the implementation of several environmental management plans which would contain protocols to manage the clearing of native vegetation outside of mapped areas of Shale Sandstone Transition Forest and prevent the potential spread of weeds, fertilisers, herbicides or other chemicals or pollutants into the CEEC.		Unlikely

Shale Sandstone Transition Forest	Critically Endangered Ecological Community	Likelihood
7. interfere with the recovery of an ecological community.		
A National Recovery plan has not been developed but an approved recovery plan exists for Shale Sandstone Transition Forest as part of the recovery plan for the Cumberland Plain (DECCW 2010). The main recovery objectives of this recovery plan include (DECCW 2010): - To build a protected area network, comprising public and private lands, focused on the priority conservation lands. - To deliver best practice management for threatened biodiversity across the Cumberland Plain, with a specific focus on the priority conservation lands and public lands where the priority management objectives are compatible with biodiversity conservation. - To develop and understanding and enhanced awareness in the community of the Cumberland Plain's threatened biodiversity, the best practice standards for its management and the recovery program. - To increase knowledge of the threats to the survival of the Cumberland Plain's threatened biodiversity, and thereby improve capacity to manage these in a strategic and effective manner. While the Project does not specifically align with any of these objectives, it is unlikely to interfere with the undertaking of any of these objectives. The Subject Land has not been identified as part of a priority conservation land in the Cumberland Plain Recovery Plan (DECCW 2010). Given the Project only has the potential to result in indirect impacts to a proportionally small area of Shale Sandstone Transition Forest in the context of that present in the localist, the Project is considered unlikely to interfere significantly with the recovery of Shale Sandstone Transition Forest.		Unlikely
Conclusion: The Project is unlikely to result in a significant impact on the Shale Sandstone Transition Forest CEEC.		

Coastal Upland Swamps

Coastal Upland Swamps	Endangered Ecological Community	Likelihood
An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:		
1. reduce the extent of an ecological community		
A total of 16 Coastal Upland Swamps may be impacted by subsidence based upon the findings of Watershed HydroGeo Pty Ltd (2021). The total area of these 16 Coastal Upland Swamps is 8.6 ha. Each of the Coastal Upland Swamps within the Subsidence Assessment Subject Land have been shown in Figure 9. The impact predictions provided in MSEC (2022) indicate that those Coastal Upland Swamps above longwalls are more susceptible to the effects of subsidence, compared to Coastal Upland Swamps located further away, and that it is unlikely that there would be large-scale adverse changes in the levels of ponding or scouring of the swamps based on the predicted vertical subsidence and tilt.		Possible

Coastal Upland Swamps	Endangered Ecological Community	Likelihood
Using the MSEC (2022) predictions, fracturing could occur within the bedrock beneath the 16 Coastal Upland Swamps within 60 m of longwalls. The remaining Coastal Upland Swamps are predicted by MSEC (2022) to be unlikely to experience significant fracturing. Given the reliance of Coastal Upland Swamps on hydrology it is therefore reasonable to assume that the following key impacts have the potential to occur to Coastal Upland Swamps that have hydrology changes: 1.Reduction in groundwater levels or desaturation of the Coastal Upland Swamp sediments. 2.Transition of the Coastal Upland Swamp to a drier vegetation type. 3.Desaturation of soil particles exposing the swamp to peat desiccation. 4.Exposure to bushfire of greater intensity due to loss of inundation. 5.Scour and erosion events. Each of these impacts and their likelihood of occurrence is described in Appendix 9. In summary, there is the possibility that Coastal Upland Swamps directly above the longwalls, may transition to a drier woodland vegetation type and thus the extent of the ecological community may be reduced.		
2. fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines		
There is the potential for Coastal Upland Swamps, or areas within the swamp to transition to drier vegetation should subsidence-induced cracking result in hydrological changes. To date, this has not been observed in monitoring data (Appendix 9). However, should vegetation transition to Eucalypt Fringing Woodland, or a woodland community, then the area that has transitioned, would no longer meet the EEC determination. There is potential for fragmentation to occur if the transition to a non-EEC vegetation type splits the Coastal Upland Swamp into smaller areas.		Possible
3. adversely affect habitat critical to the survival of an ecological community		
According to the NSW Scientific Committee (2012) approximately 5,360 ha of Coastal Upland Swamps have been mapped based on an amalgamation of best available regional vegetation mapping throughout the range of the community, with approximately 83% of this area occurring on the Woronora Plateau (DECCW 2009, Tozer et al. 2010). The majority of the EEC is within land managed by WaterNSW and is within a benchmark condition. The Project is likely to have impacts upon those Coastal Upland Swamps occurring above longwalls with minor and isolated fracturing possible outside of the longwall areas (MSEC 2022). Whilst not predicted, if at an extreme scale, if all 8.6 ha of Coastal Upland Swamp were to be impacted and transition to non-EEC units, this would account for less than 1% of the known occurrence of Coastal Upland Swamps. As such, the remaining areas of Coastal Upland Swamp, much of which are already informally protected within WaterNSW landholdings, would still persist. The Project is therefore unlikely to adversely affect habitat important to the survival of the Coastal Upland Swamp EEC.		Unlikely

Coastal Upland Swamps	Endangered Ecological Community	Likelihood
4. modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological		
Subsidence from longwall mining may cause the water table to drop from the near surface to below the sandstone base, under the swamp sediments (Young 2017). This in turn impacts upon the natural recharge and discharge system of the Coastal Upland Swamp. This process is described in Young (2017) as involving the following: • Water table within the swamp rises to near surface from rainfall event. • Water is lost from the swamp through evapotranspiration, and during high rainfall the runoff can exceed the storage capacity of the sediments so that water flows out at the swamp exit. • After a swamp is mined beneath and where there is an impact on the groundwater levels, the water table drops rapidly, and even after heavy rain, rises only briefly before sinking again to below the bedrock base. • The swamps inundate occasionally but much less frequently and for a much shorter period than prior to mining. It is known based on existing monitoring data (Appendix 13), that changes to groundwater recession rates occur in Coastal Upland Swamps when a longwall passes beneath. Of the Coastal Upland Swamps in the Subject Land, 16 will be mined directly beneath, and as such are likely to experience some degree of recession change. Estimates of the recovery to natural baseline are not known. A reduction in the water table from subsidence may result in changes to the cohesion of the soils within a Coastal Upland Swamp. The organic matter within the soil may undergo a hydrophobic reaction, which in turn results in the organic matter, which binds the sand grains, becoming loose and resulting in sediments that are highly erodible (Young 2017, DPE 2015). At an extreme range, the effect of this occurring may expose a Coastal Upland Swamp to erosion and scouring events. However, it should be noted that MSEC (2022) state that erosion and scouring events are unlikely to occur in the Subject Land. The associated effect from the groundwater change, is a transition of a Coastal Upland Swamp to a drier woodland vegetation type over time. This process has been discussed in Appendix 9 and has not yet been detected in the monitoring analysis to date. In regard to the Coastal Upland Swamps of the Subject Land, it is therefore likely that swamps located above longwalls (16 are located above longwalls), would experience some degree of groundwater impact, which in turn may change the soil cohesion and vegetation composition of the community.		Possible
5. modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns		
As discussed above, of the Coastal Upland Swamps within the Subject Land, 16 may be mined beneath and therefore may be subject to some degree of fracturing compared to the other Coastal Upland Swamps in the Subject Land. Indirect impacts associated with this include: • change in groundwater recession and flow. • change in surface water flow. • transition of Coastal Upland Swamp to a drier woodland vegetation type. • Soil cohesion changed to erodible particles.		Possible

Coastal Upland Swamps	Endangered Ecological Community	Likelihood
In total the area of impact is likely to be 8.6 ha, which constitutes the Coastal Upland Swamps corresponding to TEC the listing, located above longwalls only. Predicted impacts to Coastal Upland Swamps located outside these areas are considered to be minor and isolated (MSEC 2022).		
6. cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting		
Coastal Upland Swamp vegetation is likely to be relatively resilient to short-term changes in groundwater level and soil moisture, demonstrated by the persistence of the swamp vegetation communities during extended periods of drought. However, it is reasonable to suggest that changes to swamp hydrology that are extensive and persistent may result in a vegetation response. The thresholds that influence such a vegetation transition is unknown. The Coastal Upland Swamps within the Subject Land comprise the predominately drier vegetation types including: approximately 49% of Eucalypt Fringing Woodland, 32% of Restioid heath, and 5% of Banksia Thicket. Wetter vegetation communities consisted of 10% of Teatree Thicket, 0.4% Sedgeland Complex and 3.5% Cyperoid Heath. It is reasonable to suggest that a decrease in species distribution or abundance, or extent of sub-communities, that are reliant on semi-permanent to permanent waterlogging (such as Tea-tree Thicket and Cyperoid Heath) within a swamp that has experienced lower water levels following mining, may signify a vegetative impact from mining. Similarly, an increase in drier vegetation types within swamps that have experienced lower water levels following mining, such as Banksia Thicket or Eucalypt Fringing Woodland, may also serve as an indicator of mining impacts. Given the majority (86%) of Coastal Upland Swamps of the Subject Land are made of up of drier subvegetation communities (Eucalypt Fringing Woodland, Banksia Thicket and Restioid Heath), it is also possible that these communities are more resilient to hydrological changes, given they are not as dependent on waterlogged peat compared to wetter subvegetation communities (Teatree Thicket, and Cyperoid Heath). However to date, no studies have been completed to support this. Within recent years, LiDAR and historic aerial mapping of Coastal Upland Swamps has been incorporated in both Dendrobium and Wollongong Coal monitoring programs, to determine if Coastal Upland Swamp boundaries have changed as a result of longwall mining. The LiDAR and historic aerial mapping analysis completed by Biosis (2015, 2016a, 2017a, 2017b) indicates that there has been a decline in the size of Coastal Upland Swamps and sub-vegetation communities within the Dendrobium and Russell Vale mining domains. This decline in size of swamps was evidenced by the inward contraction of the swamp perimeter, leading to an encroachment of Eucalypt Fringing Woodland. The historical mapping of Coastal Upland Swamps for Dendrobium and Russell Vale showed that a decline in the size of Coastal Upland Swamps has occurred regardless of mining status, although impacted swamps showed a greater decline on average. Monitoring at Russell Vale indicated that the size of Coastal Upland Swamps remained stable between 1951 and 1984, with a significant decline occurring between 1984 and 2012 (Biosis 2015). The decline in swamp size was attributed to rainfall, given a strong relationship between declines in Coastal Upland Swamps and a decline in monthly rainfall since the mid-1980s. LiDAR monitoring at Dendrobium Mine indicates that the size of Coastal Upland Swamps at all control and impact swamps in the Dendrobium 3A and 3B areas in 2014, 2015 and 2016 was		Possible

Coastal Upland Swamps	Endangered Ecological Community	Likelihood
smaller than the extent measured in the baseline year of 2012. There was a substantial decline in swamp extent from 2012 to 2014, followed by a small increase in swamp extent in 2015, relative to the 2014 extent, and a subsequent decline again in 2016 (Biosis 2017a). Similarly, the change in the extent of Coastal Upland Swamp sub-communities typically decreased substantially from 2012 to 2014, then increased or remained stable from 2014 to 2015, and subsequently decreased again between 2015 and 2016. Whilst there are a number of significant limitations associated with the LiDAR and historic mapping analysis (Biosis 2015; 2016a; 2017a), the results are similar to the vegetation monitoring; namely that to date, there insufficient evidence to indicate that any observed decrease in swamp extent is a direct result of mining. It is likely that any large-scale vegetative response of Coastal Upland Swamps within the Subject Land, would be gradual and may take several years to be fully revealed. However, regardless of this, as detailed in the Scientific Determination for the community, longwall mining has the potential to decrease the size of a Coastal Upland Swamp over time. The Coastal Upland Swamps located above the mining areas within the Subject Land therefore have the potential to be impacted and may exhibit such a vegetation change.		
7. cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: **— assisting invasive species, that are harmful to the listed ecological community, to become established, or** **— causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community**		
The Project is not likely to result in the introduction of a disease that may lead to the decline of the EEC. All construction and operation work would not involve direct impacts to the Coastal Upland Swamp EEC. There is potential for increases of iron flocc to occur at fractured areas of bedrock, however no impacts associated with this have been reported at Dendrobium mine.		Unlikely
8. interfere with the recovery of an ecological community.		
There is no Coastal Upland Swamp Recovery Plan, however the Project will result in a key threatening process - *Alteration of habitat following subsidence due to longwall mining*, which may impact upon the longevity of the Coastal Upland Swamp EEC in the Subject Land.		Possible
Conclusion: The Project is likely to result in a significant impact on the Coastal Upland Swamp EEC as the Project may: 1. reduce the extent of an ecological community. 2. cause a substantial change in the species composition of an occurrence of an ecological community. 3. modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community to survive. 4. interfere with the recovery of the EEC.		

Acacia bynoeana

Acacia bynoeana	Vulnerable Species	Likelihood
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:		
1. lead to a long-term decrease in the size of an important population of a species;		
Acacia bynoeana has been recorded within the Subject Land by Niche within the vicinity of the proposed transmission line. This area is managed by WaterNSW on a periodic basis to ensure that the height of the vegetation remains below approximately 0.5 m, and thus acts as a fire break. All recorded plants would be avoided. Associated PCTs for the *Acacia bynoeana* present within the Subject Land include PCT 1083, 1181, 1250 and 1395. No plants of *Acacia bynoeana* were recorded in any other areas of direct impact. *Acacia bynoeana* was not detected in Coastal Upland Swamps, watercourses or on the edge of clifflines during the field survey. The species has therefore been considered unlikely to have habitat within these features within the Subject Land. It is therefore unlikely that subsidence would have an impact on the species. As no known population of *Acacia bynoeana* would be impacted for surface infrastructure associated with the Project, and the species is unlikely to be impacted by subsidence, it is highly unlikely that the Project would result in a long-term decrease in the size of an important population of the species.		Unlikely
2. reduce the area of occupancy of an important population;		
As per the reasons stated above, the Project would not reduce the area of a known *Acacia bynoeana* population. No surface infrastructure is proposed in the area where the species is known to occur, and it is unlikely that subsidence would result in a reduction in the area of occupancy of the population.		Unlikely
3. fragment an existing important population into two or more populations;		
The Project would not result in fragmentation of any known populations of the species. The recorded plants of *Acacia bynoeana* would not be impacted as a result of the Project.		Unlikely
4. adversely affect habitat critical to the survival of a species;		
There is over 1,886 hectares of potential habitat for *Acacia bynoeana* within the Subject Land in the form of associated PCTs. Approximately 19.85 hectares of potential habitat would be removed because of the Project. This does not represent a significant area of potential habitat for the species in comparison to areas of habitat to be retained within the Subject Land and surrounding locality. Potential habitat for *Acacia bynoeana* does not comprise Coastal Upland Swamps, watercourses, or on the edge of clifflines. It is therefore unlikely that subsidence would have an impact on any potential habitat for the species. Furthermore, no *Acacia bynoeana* individuals were recorded within areas of habitat to be removed. Therefore, vegetation to be impacted because of the Project is not considered to be habitat critical to the survival of the species.		Unlikely
5. disrupt the breeding cycle of an important population		

Acacia bynoeana	Vulnerable Species	Likelihood
While *Acacia bynoeana* was recorded within the Subject Land during targeted surveys, the plants will be avoided as a result of the Project. The removal of 19.85 hectares of potential habitat for the species in the form of associated PCTs is unlikely to result in the disruption of the breeding cycle of an important population. It is also considered highly unlikely that the Project would disrupt pollinators of the species, likely to be small native bees and wasps (Bernhardt 1987), such that a pollinating cycle of the species would be disrupted.		Unlikely
6. modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;		
Associated PCTs for the *Acacia bynoeana* present within the Subject Land include PCT 1083, 1181, 1250 and 1395. These associated PCTs cover over 1,886 hectares of the Subject Land. Approximately 19.85 hectares would be removed as a result of the Project. While 86 plants were recorded within the vicinity of the proposed transmission line, all plants would be avoided. No additional plants of *Acacia bynoeana* were recorded in any other areas of direct impact. As discussed above, subsidence is unlikely to impact potential habitat for *Acacia bynoeana.* Therefore, the removal of approximately 19.85 hectares of potential habitat for *Acacia bynoeana* is unlikely to lead to a decrease in the area of potential habitat for the species such that the species is likely to decline.		Unlikely
7. result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;		
The Subject Land is located in an area of extensive intact bushland, with minimal weeds scattered within previously disturbed areas (such as easements, and Fire Trails). An increase in weeds has the potential to occur during the construction and operation phase of the Project, mainly attributed to weed seed being carried into the Subject Land on machinery/personnel. In order to prevent the spread or introduction of weed species into the Subject Land, protocols in regard to control of weeds and pests would be provided in the relevant Biodiversity Management Plans for the Project. Through implementation of the Plans, it is highly unlikely that introduced species would become established in the relatively intact habitat of the Subject Land, so much so that the species would be impacted.		Unlikely
8. Introduce disease that may cause the species to decline, or		
The Project is not likely to result in the introduction of a disease that may lead to the decline of this species. During the construction phases, machinery would be washed down accordingly to reduce the risk of *Phytophthora cinnamomi* becoming established within the Subject Land.		Unlikely
9. Interfere substantially with the recovery of the species.		
Given the species is unlikely to be impacted by the Project, the Project is considered unlikely to interfere with the recovery of the species or with any Approved Conservation Advice for *Acacia bynoeana.*		Unlikely
Conclusion: The Project is unlikely to result in a significant impact on *Acacia bynoeana.*		

Cryptostylis hunteriana

Cryptostylis hunteriana	**Vulnerable Species**	**Likelihood**
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:		
1. lead to a long-term decrease in the size of an important population of a species;		
Cryptostylis hunteriana was not recorded within the Subject Land during targeted surveys. Associated PCTs for the species present within the Subject Land include PCT 978 and 1083 of which PCT 978 comprises Coastal Upland Swamps. The species is unlikely to be present within watercourses, or on the edge of cliffs. While the species was not detected during survey, it has been assessed for impacts precautionarily due to the limitations of surveying within Coastal Upland Swamps. If a population of *Cryptostylis hunteriana* is present within a Coastal Upland Swamp that may be impacted by subsidence, it could impact the species. However, the likelihood of this occurring as a result of the Project is relatively low given the species was not detected, and the likelihood of subsidence impacts is also low. Furthermore, as discussed in Appendix 9, to date, no significant changes to vegetation or habitat as a result of subsidence has been detected within swamps monitored as part of the Dendrobium Mine, Metropolitan Mine and Wollongong Coal monitoring programs within Coastal Upland Swamps. Catastrophic events such as erosion and gullying have only been observed at three Coastal Upland Swamps despite over 500 Coastal Upland Swamps historically mined beneath since the early and mid-1900s, and such events have also been attributed by parties to a number of man-made and natural events independent of subsidence impacts (Appendix 9). Based on the lack of detection of the species within Coastal Upland Swamps in the Subject Land, the low likelihood for catastrophic events, and potential habitat within drier vegetation communities, this assessment concludes that the likelihood of impacts to potential habitat within Coastal Upland Swamps for *Cryptostylis hunteriana* are relatively low. Gas emissions as a result of subsidence are predicted to be rare, and given the species does not occur within watercourses, die back from gas emission would be unlikely and would largely be avoided. It is also highly unlikely that falling cliffs/rocks as a result of subsidence would impact the species. Based on the above, it is considered unlikely that the Project would result in a long-term decrease in the size of an important population, should it occur.		Unlikely
2. reduce the area of occupancy of an important population;		
In line with the reasons stated above, the Project would not reduce the area of any known *Cryptostylis hunteriana* population. The species was not detected during targeted surveys within the Biodiversity Assessment Development Footprint. No records for this species exist within the Subject Land and the species was not recorded during field survey of suitable habitats, the species has been assessed for impacts precautionarily due to the limitations of surveying within Coastal Upland Swamps. It is considered unlikely that subsidence would result in a substantial reduction (if any) in the area of occupancy of the population given the species can also occur within PCT 1083, which is less susceptible to subsidence impacts.		Unlikely
fragment an existing important population into two or more populations;		
The proposal is unlikely to result in fragmentation of any known records of the species. No records for *Cryptostylis hunteriana* occur within the Subject Land, and the species was not detected during targeted survey within the Biodiversity Assessment Development Footprint. Nor is it		Unlikely

Cryptostylis hunteriana	Vulnerable Species	Likelihood
likely that subsidence would result in the species being fragmented as no known records are present within the Subject Land and the species is not wholly reliant on upland swamp habitats.		
3. adversely affect habitat critical to the survival of a species;		
The species was not recorded within the Biodiversity Assessment Development Footprint, and the area of potential habitat in the form of associated PCTs within the Subject Land is over 1,210 hectares (PCTs 1083, 978). In relation to potential habitat within Coastal Upland Swamps, there is the potential for vegetative response in regard to subsidence related impacts. The potential for this to occur is detailed in Appendix 9. At a worst-case scenario there is the potential for vegetation within Coastal Upland Swamps to transition over many years into a dry woodland. As noted in DoE (2022) the species can occur within low nutrient sandstone soils in both moist and dry areas. As such, should the vegetation within Coastal Upland Swamps transition to a drier community type as a result of subsidence, the vegetation community would likely still provide suitable habitat for the species. For these reasons, the Project is considered unlikely to adversely impact habitat critical to the survival of the species.		Unlikely
4. disrupt the breeding cycle of an important population		
As stated above, the Project would not impact upon known records for *Cryptostylis hunteriana* and is unlikely to affect the potential habitat within the Subject Land to such an extent that it would impact upon habitat critical to the survival of the species. It is highly unlikely that the Project would disrupt pollinators of the species so much so that a pollinating cycle of the species would be disrupted.		Unlikely
5. modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;		
As discussed in relation to Coastal Upland Swamp habitat, there is the potential for such habitat types to transition to a drier vegetation community. However, as noted in DoE (2022) the species has been recorded in a wide variety of habitats and can occur within habitat with low nutrient sandstone soils in both moist and dry areas. As such, should the vegetation within Coastal Upland Swamps transition to the drier community type as a result of subsidence, potential habitat for the species would still exist. As such, the Project is unlikely to adversely impact the availability or quality of potential habitat to an extent that the species is likely to decline.		Unlikely
6. result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;		
The Subject Land is located in an area of extensive intact bushland, with minimal weeds scattered within previously disturbed areas (such as easements, and Fire Trails). An increase in weeds has the potential to occur during the construction and operation phase of the Project, mainly attributed to weed seed being carried into the Subject Land on machinery/personnel. In order to prevent the spread of introduced species into the Subject Land, protocols in regard to control of weeds and pests would be provided in relevant Management Plans. Through implementation of the Plan, it is highly unlikely that introduced species would become established in the relatively intact habitat of the Subject Land, so much so that the species would be impacted.		Unlikely
7. introduce disease that may cause the species to decline, or		

Cryptostylis hunteriana	Vulnerable Species	Likelihood
The Project is not likely to result in the introduction of a disease that may lead to the decline of this species. During the construction phases, machinery would be washed down to reduce the risk of *Phytophthora cinnamomi* becoming established within the Subject Land.		Unlikely
8. Interfere substantially with the recovery of the species.		
There is no Recovery Plan for this species. Given the species was not recorded during the field survey, and potential habitat is unlikely to be impacted to such an extent that the species would become adversely affected, it is likely that the Project would not substantially interfere with the recovery of the species.		Unlikely
Conclusion: The Project is unlikely to result in a significant impact on *Cryptostylis hunteriana.*		

Leucopogon exolasius

Leucopogon exolasius	Vulnerable Species	Likelihood
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:		
1. lead to a long-term decrease in the size of an important population of a species;		
Leucopogon exolasius has been recorded within the south of the Subject Land by Niche (2019a) and at two locations outside the Subject Land by Biosis (2016a) (Figure 10). All individuals were recorded within vegetation mapped as Red Bloodwood - scribbly gum heathy woodland on sandstone plateaus, Sydney Basin Bioregion (PCT 1083). No individuals were recorded within the areas proposed for surface infrastructure despite survey. The known records for the species would not be impacted for surface infrastructure associated with the Project, and as such would not impact upon the population. Subsidence is unlikely to impact the known records as: - The species is not anticipated to occur within Coastal Upland Swamps, which are sensitive to subsidence and predicted to be subject to some degree of impacts associated with the Project. - The species is unlikely to be impacted by subsidence given the population of the species does not occur within the riparian inundation area of the creek within the Subject Land. Thus any potential hydrological change in riparian environments as a result of subsidence is unlikely to impact upon *Leucopogon exolasius*. - Gas emissions as a result of subsidence are predicted to be rare, and given the species is known to occur on rock hill slopes, die-back from gas emission would be unlikely and largely be avoided. - It is highly unlikely that falling cliffs/rocks as a result of subsidence would impact the species. Based on the above, it is highly unlikely that the Project would result in a long-term decrease in the size of an important population of the species.		Unlikely
2. reduce the area of occupancy of an important population;		

Leucopogon exolasius	Vulnerable Species	Likelihood
As per the reasons stated above, the Project would not reduce the area of a known *Leucopogon exolasius* population. No surface infrastructure is proposed in the area where the species is known to occur, and it seems unlikely that subsidence would result in a reduction in the area of occupancy of the population.		Unlikely
5. **fragment an existing important population into two or more populations;**		
The Project would not result in fragmentation of the known records. No records for *Leucopogon exolasius* occur within the surface disturbance footprint, nor is it likely that subsidence would result in the records being impacted or fragmented.		Unlikely
3. adversely affect habitat critical to the survival of a species;		
The Project is likely to have a negligible impact on the extent of habitat for *Leucopogon exolasius* within the locality. According to DoE (2018c) the species inhabits woodland on sandstone (and sandy alluvium) and prefers rocky hillsides along creek banks. The area proposed for the surface infrastructure avoids such habitat given the disturbance is located away from creek banks. Approximately 19.85 hectares would be cleared within the Biodiversity Assessment Development Footprint as a result of the Project, however no individuals were recorded within this area. This area of potential habitat does therefore not comprise habitat critical to the survival of the species. Within the Subject Land, potential habitat is present in the form of the associated PCTs 1083, 1181 and 1250. The total area of these communities in the Subsidence Assessment Subject Land is approximately 1749.04 hectares. As discussed above, it is highly unlikely that any substantial impact to vegetation would occur as a result of subsidence. The Project is therefore unlikely to adversely affect habitat critical to the survival of *Leucopogon exolasius.*		Unlikely
4. disrupt the breeding cycle of an important population		
As stated above, it is highly unlikely that the Project would impact upon known records for *Leucopogon exolasius* or affect the potential habitat to the extent that the lifecycle of the species would be impacted. It is considered highly unlikely that the Project would disrupt pollinators of the species, with bees being the major pollinators, with flies, butterflies, wasps and moths being minor but significant pollinators (Ooi 2002), such that a pollinating cycle of the species would be disrupted.		Unlikely
5. modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;		
The species is absent in areas to be cleared as a result of surface infrastructure clearing. Within the Subject Land potential habitat present in the form of associated PCTs includes PCT 1083, 1181 and 1250. The total area of these communities in the Subsidence Assessment Subject Land is 1749.04 ha, however it is unlikely that the species would be impacted by subsidence. Therefore it is highly unlikely that the Project would lead to a decrease in the area of potential habitat for *Leucopogon exolasius* such that the species is likely to decline.		Unlikely
6. result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;		
The Subject Land is located in an area of extensive intact bushland, with minimal weeds scattered within previously disturbed areas (such as easements, and Fire Trails). An increase in weeds has the		Unlikely

Leucopogon exolasius	Vulnerable Species	Likelihood
potential to occur during the construction and operation phase of the Project, mainly attributed to weed seed being carried into the Subject Land on machinery/personnel. In order to prevent the spread or introduction of weed species into the Subject Land, protocols in regard to control of weeds and pests would be provided in the relevant Biodiversity Management Plans for the Project. Through implementation of the Plans, it is highly unlikely that introduced species would become established in the relatively intact habitat of the Subject Land, so much so that the species would be impacted.		
7. Introduce disease that may cause the species to decline, or		
The Project is not likely to result in the introduction of a disease that may lead to the decline of this species. During the construction phases, machinery would be washed down accordingly to reduce the risk of *Phytophthora cinnamomi* becoming established within the Subject Land.		Unlikely
8. Interfere substantially with the recovery of the species.		
Currently there is no recovery plan for the species. Given the species is unlikely to be impacted by the Project, the Project is considered unlikely to interfere with the recovery of the species or with any actions identified in the Approved Conservation Advice (DoE 2008a) for *Leucopogon exolasius*.		Unlikely
Conclusion: The Project is unlikely to result in a significant impact on *Leucopogon exolasius*.		

Pomaderris brunnea

Pomaderris brunnea	Vulnerable Species	Likelihood
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:		
1. lead to a long-term decrease in the size of an important population of a species;		
The Approved Conservation Advice for the species states that currently there is insufficient information available to be able to describe important populations of this species (DAWE 2021d). BioNet records show *Pomaderris brunnea* has previously been recorded at two locations near the north-east corner of the Subject Land (Figure 10). Records occurred within Exposed Sandstone Scribbly Gum Woodland and along the Cordeaux Dam entrance road, however both records are dated (1950s) and the status and accuracy of the records is unknown. The National Recovery Plan (no longer in effect) for the species identifies an Upper Cordeaux Dam subpopulation but note this is based upon an old (1957) record, with low accuracy, and the subpopulation may even be extinct (Sutter 2011). The species has not been recorded within the Biodiversity Assessment Development Area or Subject Land. In the broader locality there are limited clusters of records in the Bargo, Appin and Lower Mittagong areas. The habitat requirements of the species are poorly understood but it has been found to occupy a range of habitats and topographies including ridgetops and plateaus in relatively dry habitats, as well as moist woodland or forest on clay and alluvial soils of floodplains and creek lines in relatively damp habitats (DPIE 2021 cited in DAWE 2021d). The known records for the species would not be impacted for surface infrastructure associated with the Project, and as such would not impact upon the population.		Unlikely

Pomaderris brunnea	Vulnerable Species	Likelihood
As part of a precautionary approach given the scale of the Subject Land, this BDAR has assumed that there may be potential habitat for *Pomaderris brunnea* within swamp, or riparian environments that may be subject to indirect impacts arising from the Project, these are discussed below. Given this is a precautionary assumption and the insufficient level of information available to be able to describe important populations, it is not possible to define the local population of *Pomaderris brunnea.* The Project has the potential to result in enhanced strata gas emissions overlying watercourses which have the potential to cause vegetation dieback in the vicinity of the gas release point. Vegetation dieback as result of gas emissions are a rare event. Where it has previously occurred, these impacts were short term and limited to small areas of vegetation, local to the points of emission. Once the gas emissions declined, the affected areas were successfully restored. No similar impacts have been reported during the mining of Dendrobium Area 3. The limited species detection within the Subject Land and lack of records in the surrounding areas suggest a low or limited occurrence within the Subject Land subject to potential indirect impacts, if any. These potential indirect impacts are not anticipated to occur across the entire area, and in the case of gas emissions would be considered a rare event. Furthermore, these species may occupy a range of habitats and is not restricted to swamp or riparian environments. These factors suggest that any indirect impacts would have an overall limited impact on any subpopulation of *Pomaderris brunnea* that may occur in riparian environments within the Subject Land. In consideration of all factors described above, it is unlikely that the Project would result in a long-term decrease in the size of an important population of the species.		
2. reduce the area of occupancy of an important population;		
No surface infrastructure is proposed in the area where the species has previously been recorded. It is anticipated that the species would have a low or limited occurrence within the Subject Land subject to potential indirect impacts, if any. The potential indirect impacts associated with the Project are not anticipated to occur across the entirety of the Subject Land, and in the case of gas emissions would be considered a rare event. Furthermore, these species may occupy a range of habitats including those not sensitive to subsidence impacts. This combination of factors indicates that it is unlikely that subsidence would result in a reduction in the area of occupancy of an important population of this species.		Unlikely
3. fragment an existing important population into two or more populations;		
The Project would not result in fragmentation of the species records, which have been identified as one subpopulation (Sutter 2011) and are spatially isolated from other Bionet records that occur in the greater locality (Bargo, Appin and Lower Mittagong). Furthermore, *Pomaderris brunnea* does not occur within the vegetation clearing footprint which will not fragment these species records. It is anticipated that the species would have a low or limited occurrence within the Subject Land subject to potential indirect impacts, if any. The potential indirect impacts associated with the Project are not anticipated to occur across the entirety of the Subject Land, and in the case of gas emissions would be considered a rare event. Furthermore, these species may occupy a range of habitats and is not restricted to riparian environments. This combination of factors indicates that it is unlikely that the Project would fragment an existing important population into two or more populations.		Unlikely
4. adversely affect habitat critical to the survival of a species;		

Pomaderris brunnea	Vulnerable Species	Likelihood
To date, no Critical Habitat as defined under section 207A of the EPBC Act has been identified or included in the Register of Critical Habitat, or identified in any Commonwealth conservation documents. The Approved Conservation Advice states that there is insufficient information available to describe areas of habitat that are critical to the survival of the species. The Project is likely to have a negligible impact on the extent of habitat for *Pomaderris brunnea* within the locality. According to DoE (2018d) the species grows in moist woodland or forest on clay and alluvial soils of flood plains and creek lines in association with *Eucalyptus amplifolia, Angophora floribunda, Acacia parramattensis, Bursaria spinosa* and *Kunzea ambigua*. The area proposed for the surface infrastructure avoids such habitat given the disturbance is located away from creek banks. The potential indirect impacts associated with the Project are not anticipated to occur across the entirety of the Subject Land, and in the case of gas emissions would be considered a rare event. The species has not been recorded during the field surveys and does not have either recent or numerous Bionet records within the Subject Land or surrounding areas. On this basis it has been inferred there would be a low or limited occurrence within the Subject Land subject to potential indirect impacts, if any. It has also been noted that this species is not restricted to these subsidence sensitive habitats. This combination of factors suggests that potential habitat within the Subject Land would not be critical to the survival of the species.		Unlikely
5. disrupt the breeding cycle of an important population		
As stated above, it is highly unlikely that the Project would impact upon known records for *Pomaderris brunnea* or affect the potential habitat so much that the lifecycle of the species would be impacted. It is considered highly unlikely that the Project would directly or indirectly impact pollinators of the species such that a pollinating cycle of the species would be disrupted. The assumption that there may be potential habitat for *Pomaderris brunnea* within swamp or riparian environments has been adopted as a precautionary approach. It is difficult to accurately predict where indirect subsidence impacts may occur, and it is also not possible to establish what constitutes an important population of *Pomaderris brunnea*. Acknowledging these uncertainties, it is considered that the Project is unlikely to disrupt the breeding cycle of an important population through the loss of any habitats as result of subsidence. This is given the inferred low or limited occurrence, if any, across the Subject Land, that not all areas would be subject to indirect impacts and the fact that the species is not restricted to swamp or riparian habitats.		Unlikely
6. modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;		
Vegetation clearing will not impact any *Pomaderris brunnea* individuals, or past records of the species. Indirectly, subsidence has the potential to impact potential habitats for this species. It is noted however that not all potential habitats would be indirectly impacted and in the case of gas releases, this would only occur in a rare event. Furthermore, these species may occupy a range of habitats and is not restricted to riparian environments. When taken together, the Project is unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline		Unlikely

Pomaderris brunnea	Vulnerable Species	Likelihood
7. result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;		
The Subject Land is located in an area of extensive intact bushland, with minimal weeds scattered within previously disturbed areas (such as easements, and Fire Trails). An increase in weeds has the potential to occur during the construction and operation phase of the Project, mainly attributed to weed seed being carried into the Subject Land on machinery/personnel. In order to prevent the spread or introduction of weed species into the Subject Land, protocols in regard to control of weeds and pests would be provided in the relevant Biodiversity Management Plans for the Project. Through implementation of the Plans, it is highly unlikely that introduced species would become established in the relatively intact habitat of the Subject Land, so much so that the species would be impacted.		Unlikely
8. introduce disease that may cause the species to decline, or		
The Project is not likely to result in the introduction of a disease that may lead to the decline of this species. During the construction phases, machinery would be washed down accordingly to reduce the risk of *Phytophthora cinnamomi* becoming established within the Subject Land.		Unlikely
9. Interfere substantially with the recovery of the species.		
Given the species is unlikely to be impacted by the Project, the Project is considered unlikely to interfere with the recovery of the species or with any Approved Conservation Advice (DAWE 2021d) for *Pomaderris brunnea*. The National Recovery Plan (Sutter 2011) that was adopted for this species ceased to be in effect from 1/10/21.		Unlikely
Conclusion: The Project is unlikely to result in a significant impact on *Pomaderris brunnea*.		

Pultenaea aristata

Pultenaea aristata	Vulnerable Species	Likelihood
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:		
1. lead to a long-term decrease in the size of an important population of a species;		
Important populations of *Pultenaea aristata* have not been defined in the Approved Conservation Advice for the species (DoE 2008b). Given the species is restricted to the Woronora Plateau and records in the locality would be at the southern limit of the Bionet records available for the species, the local population would be considered an important population. *Pultenaea aristata* was not recorded within the Subject Land but the species is known to be associated with Coastal Upland Swamp vegetation (NSW NPWS, 2003) and known to occur in association with areas of impeded drainage and creek lines within sandstone woodland and gully forest plant communities (NSW NPWS, 2003; B. Smith, 2007, pers. comm.). Associated PCTs present within the Subject Land include PCT 978, 1083 and 1804. The species was not recorded within the Biodiversity Assessment Development Footprint during targeted surveys and will therefore not be impacted by vegetation clearing.		Unlikely

Pultenaea aristata	Vulnerable Species	Likelihood
Large populations of the species have been recorded within Coastal Upland Swamp habitat types in Dendrobium Area 3B by Niche (2012), which occur outside of the Subject Land. Whilst not recorded during the surveys within the Subject Land, it is acknowledged that *Pultenaea aristata* has potential habitat within PCT 978, 1083 and 1804 within the Subject Land, which includes areas of Coastal Upland Swamps. Should a population be present within a Coastal Upland Swamp that may be impacted by subsidence, it could impact the species. However, the likelihood of this occurring as a result of the Project is considered to be relatively low given the species was not detected, and not all areas of upland swamp habitats are anticipated to be impacted. Furthermore, as discussed in Appendix 9, to date, no significant changes to vegetation/habitat as a result of subsidence has been detected within swamps monitored as part of the Dendrobium Mine, Metropolitan Mine and Wollongong Coal monitoring programs within Coastal Upland Swamps. Catastrophic events such as erosion and gullying have only been observed at three Coastal Upland Swamps despite over 500 Coastal Upland Swamps historically mined beneath since the early and mid-1900s, and such events have also been attributed by parties to a number of man-made and natural events independent of subsidence impacts (Appendix 9). It should be noted that species can also inhabit Eucalypt Fringing Woodland or Exposed Sandstone Scribbly Gum vegetation communities which Coastal Upland Swamp could eventually transition to over time in response to hydrological change. Based on the lack of detection of the species within Coastal Upland Swamps in the Subject Land, the low likelihood for catastrophic events, and potential habitat within drier vegetation communities, this assessment concludes that the likelihood of impacts to potential habitat within Coastal Upland Swamps for *Pultenaea aristata* are relatively low. In relation to changes to water flow and standing pools along creekline habitats, this is unlikely to affect *Pultenaea aristata* given the species does not occur submerged, immersed or directly connected via roots to the water within pools. The drying of pools, or predicted changes to the hydrological regime to watercourses within the Subject Land are therefore unlikely to result in impacts to the species. Gas emissions as a result of subsidence are predicted to be rare, and given the species does not occur within the riparian area, die back from gas emission would be unlikely and would largely be avoided. Based on the above, it is considered unlikely that the Project would result in a long-term decrease in the size of an important population, through any indirect impacts to swamp or riparian habitats.		
2. reduce the area of occupancy of an important population;		
As per the reasons stated above, the Project would not reduce the area of a known *Pultenaea aristata* population. No surface infrastructure is proposed in the areas where the species is known to occur, and it is considered unlikely that subsidence would result in a substantial reduction (if any) in the area of occupancy of the population given the species can also occur within sandstone woodland habitats, that are less susceptible to subsidence impacts. Also considering not all Coastal Upland Swamps within the Subject Land would be subject to indirect impacts.		Unlikely
3. fragment an existing important population into two or more populations;		
The proposal would not result in fragmentation of the known records of the species. No records for *Pultenaea aristata* occur within the surface disturbance footprint or Coastal Upland Swamp habitat types. Nor is it likely that subsidence would result in the records being impacted or fragmented.		Unlikely

Pultenaea aristata	Vulnerable Species	Likelihood
Potential habitats within swamps and riparian zones may be indirectly impacted by the Project, however this is unlikely to fragment a population given the lack of records, the fact that the species is not restricted to these environments and consideration that not all areas within the Subject Land would be impacted.		
4. adversely affect habitat critical to the survival of a species;		
To date, no Critical Habitat as defined under section 207A of the EPBC Act has been identified or included in the Register of Critical Habitat, or identified in any Commonwealth conservation documents. The surface infrastructure associated with the proposal is likely to have a negligible impact on the extent of habitat for *Pultenaea aristata* within the locality, as the species was not recorded within the surface infrastructure footprint during targeted survey. The area of potential habitat in the form of associated PCTs within the broader Subsidence Assessment Subject Land is over 1,212 ha (PCTs 1083, 1804, 978). In relation to potential habitat within Coastal Upland Swamps, there is the potential for vegetative response in regard to subsidence related impacts. The potential for this to occur is detailed in Appendix 9. At a worst-case scenario there is the potential for vegetation within Coastal Upland Swamps to transition over many years into a dry woodland. As noted in DoE (2008b) the species can occur within low nutrient sandstone soils in both moist and dry areas. As such, should the vegetation within Coastal Upland Swamps transition to a drier community type as a result of subsidence, the vegetation community would likely still provide suitable habitat for the species. For these reasons, the Project is considered unlikely to adversely impact habitat critical to the survival of the species.		Unlikely
5. disrupt the breeding cycle of an important population		
As stated above, it is unlikely that the Project would impact upon known records for *Pultenaea aristata* or affect the potential habitat to such an extent that it would impact upon habitat critical to the survival of the species. It is highly unlikely that the Project would disrupt pollinators of the species so much so that a pollinating cycle of the species would be disrupted. It is considered that the Project is unlikely to disrupt the breeding cycle of an important population through the loss of any habitats as result of subsidence as not all areas would be subject to indirect impacts and the fact that the species is not restricted to occurring in swamp or riparian habitats.		Unlikely
6. modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;		
As discussed above, it is highly unlikely that any substantial impacts to potential habitat would occur as a result of surface infrastructure clearing as the species was not recorded within the clearing footprint. Approximately 19.85 hectares of potential habitat for the species in the form of associated PCTs would be removed by the Project. This does not represent a significant amount of the potential habitat which exceeds 1,212 hectares within the Subject Land. As discussed in relation to Coastal Upland Swamp habitat, there is the potential for such habitat types to transition to a drier vegetation community. However, as noted in DoE (2018e) the species can occur within habitat with low nutrient sandstone soils in both moist and dry areas, and as such, should the vegetation within Coastal Upland Swamps transition to the drier community type as a result of subsidence, potential habitat for the species would still exist.		Unlikely

Pultenaea aristata	**Vulnerable Species**	**Likelihood**
As such, the Project is unlikely to adversely impact the availability or quality of habitat to an extent that the species is likely to decline.		
7. result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;		
The Subject Land is located in an area of extensive intact bushland, with minimal weeds scattered within previously disturbed areas (such as easements, and Fire Trails). An increase in weeds has the potential to occur during the construction and operation phase of the Project, mainly attributed to weed seed being carried into the Subject Land on machinery/personnel. In order to prevent the spread of introduced species into the Subject Land, protocols in regard to control of weeds and pests would be provided in relevant Management Plans. Through implementation of the Plan, it is highly unlikely that introduced species would become established in the relatively intact habitat of the Subject Land, so much so that the species would be impacted.		Unlikely
8. introduce disease that may cause the species to decline, or		
The Project is not likely to result in the introduction of a disease that may lead to the decline of this species. During the construction phases, machinery would be washed down to reduce the risk of *Phytophthora cinnamomi* becoming established within the Subject Land.		Unlikely
9. Interfere substantially with the recovery of the species.		
There is no Recovery Plan for this species. Given the species was not recorded during the field survey, and habitat is unlikely to be impacted to such an extent that the species would become adversely affected, it is likely that the Project would not substantially interfere with the recovery of the species.		Unlikely
Conclusion: The Project is unlikely to result in a significant impact on *Pultenaea aristata.*		

Broad-headed Snake

Broad-headed Snake (*Hoplocephalus bungaroides*)	Vulnerable species	Likelihood

Distribution and occurrence:

The Broad-headed Snake is distributed from Wollemi National Park south to the Clyde River catchment. It's eastern most occurrence is in the Royal National Park and western limit is the upper Blue Mountains.

While the species was not recorded during habitat surveys for the Project, one record exists at the margin of the north-eastern boundary of Area 5, and records do exist in the surrounding area.

Habitat:

The Broad-headed Snake has a preferred habitat centred on the communities occurring on the Triassic sandstone of the Sydney Basin. The sites where they occur are typified by exposed sandstone outcrops and benching and in these locations the vegetation is mainly woodland, open woodland and/or heath. The Broad-headed Snake seasonally occupies distinctive microhabitats within these broader habitat types. They utilise rock crevices and exfoliating sheets of weathered sandstone during the cooler months and tree hollows during summer (Webb & Shine 1998). Some of the canopy tree species found to regularly co-occur at known sites include: *Corymbia eximia*, C. *gummifera*, *Eucalyptus sieberi*, E. *punctata* and E. *piperita* (NSW NPWS 2001b).

Potential habitat for this species was modelled by mapping areas with a westerly to north-easterly aspect with slopes of 30 degrees or greater and applying a 30 m buffer. Habitat modelling allowed for detection of approximately 11.5 ha of cliffs and steep slopes with a favourable aspect for the species within 600 m of the proposed longwall layout. Habitat modelling assisted in identifying areas in which to conduct field survey, however it was observed that much of the modelled area did not support preferred habitat for the species.

The species has not been detected in areas of direct impact and no breeding habitat has been identified in these areas of direct impact. In addition to this, much of the modelled habitat for the species across the Subject Land has been found not to be preferable for the species.

Potential impacts associated with the Project:

Impact to this species through subsidence are difficult to quantify and therefore difficult to avoid. However, based on the MSEC (2022) assessment, and through mapping of habitat, it is estimated that 0.12 ha of potential sheltering habitat may be impacted the Project.

The Broad-headed Snake may be indirectly impacted by subsidence. These potential indirect impacts include cracking and collapsing of rocky outcrops, overhangs and cliffs, of which the species resides. The potential for these impacts to occur and coincide with occupied breeding/sheltering habitat however is considered to be minor. Based on the experience of mining at Dendrobium, Appin and Tower Collieries, there have been no large-scale cliff instabilities observed outside the extents of longwall mining. There have been small and isolated rockfalls observed outside the extents of mining, but these represent a very small proportion of the total length of cliffline. Given rock falls are likely to be minor and isolated, habitat features and food sources are unlikely to be greatly impacted by subsidence.

Avoidance and mitigation measures:

The location of the surface infrastructure has avoided potential shelter habitat (i.e. cliff faces) and large areas of surface rock. As such, the Project is unlikely to have direct impact upon important habitat features for the species.

Broad-headed Snake (*Hoplocephalus bungaroides*)	Vulnerable species	Likelihood
Clearing associated with surface infrastructure has been positioned away from ridgeline habitat where the species could reside.		
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:		
1. Lead to a long-term decrease in the size of an important population of a species;		
No important populations of the Broad-headed snake have been formally identified in any Commonwealth conservation documents. A recovery plan is required for the species and is included on the commenced list (01/11/2009). While the species was not recorded during habitat surveys for the Project, one record exists at the margin of the north-eastern boundary of Area 5, and records do exist in the surrounding area. Although these records are located well within the known or predicted habitat range for the species, they are along the north-western limit of the records for the species, that occur in a fairly linear corridor running south-west to north-east between Mittagong and the Royal National Park. In light of this, the population that is present in Area 5 and adjoining areas would be considered to be near the limit of the species recorded extent and as such has been conservatively considered part of an important population of the species for this assessment. It is considered unlikely that the proposed action would lead to a long-term decrease in the size of an important population of the Broad-headed Snake. This is given the limited potential for occurrence across the Subject Land, any rock falls as a result of subsidence are likely to be minor and isolated, and both habitat features and food sources are unlikely to be greatly impacted by subsidence. Furthermore, the potential habitat within the species associated PCTs available in the Subject Land and within the Locality which would not be impacted by the Proposal is extensive. These associated PCTs include 978, 1083, 1181, 1245, 1250 and 1804.		Unlikely
2. Reduce the area of occupancy of an important population;		
The species has not been detected in areas of direct impact (vegetation clearing) and no breeding habitat has been identified in these areas. Given rock falls are likely to be minor and isolated, habitat features and food sources are unlikely to be greatly impacted by subsidence. To minimize residual risk to the species, clearing associated with surface infrastructure has been positioned away from ridgeline habitat where the species could reside and rock outcrops with potential habitat for the Broad-headed Snake and its prey species (such as exfoliating sandstone or crevices). When the likely limited occurrence of the species within the subject Land and limited potential for indirect impacts to occur to sheltering habitat for the species are considered in the context of the extensive surrounding habitat available, the Project is considered unlikely to reduce the area of occupancy of an important population.		Unlikely
3. Fragment an existing important population into two or more populations;		

Broad-headed Snake (*Hoplocephalus bungaroides*)	Vulnerable species	Likelihood
It is noted that this species is highly mobile rather than sedentary, capable of dispersing over large distances according to Dubley et al. (2011), with their study indicating significant gene flow over relatively large spatial scales. No breeding habitat has been identified in the areas of direct vegetation clearing and habitat features and food sources for the species in the broader Subject Land are unlikely to be greatly impacted by subsidence. Given the mobility of the species, the lack of direct impacts and limited potential for indirect impacts, the Project is unlikely to fragment an existing important population into two or more populations.		Unlikely
4. Adversely affect habitat critical to the survival of a species;		
To date, no Critical Habitat as defined under section 207A of the EPBC Act has been identified or included in the Register of Critical Habitat, or identified in any Commonwealth conservation documents. The lack of detection of the species and habitat mapping undertaken for the Project may indicate a limited occurrence or low level of occupation and overall sub-optimal habitats within the Subject Land. The potential habitat within the species associated PCTs available in the Subject Land and within the Locality which would not be impacted by the Proposal is extensive. These associated PCTs include 978, 1083, 1181, 1245, 1250 and 1804. It is therefore unlikely that the Project would adversely affect habitat critical to the survival of the Broad-headed Snake.		Unlikely
5. **Disrupt the breeding cycle of an important population**		
In consideration that no direct impacts to breeding habitats for the species are likely to occur, the limited potential for indirect impacts to habitats and steps taken to avoid habitats generally, it is unlikely the Project will disrupt the breeding cycle of an important population.		Unlikely
6. Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;		
No direct impacts to potential habitats are anticipated and there is a limited potential for indirect impacts to occur. The lack of detection and records in the Subject Land may be indicative of a low level of occupancy or limited occurrence within these habitats. Furthermore, the potential habitat within the species associated PCTs available in the Subject Land and broader Locality which would not be impacted by the Proposal is extensive. These associated PCTs include 978, 1083, 1181, 1245, 1250 and 1804. When these factors are considered together, it is unlikely that the Project would reduce the availability and quality of habitat to the extent that the species is likely to decline.		Unlikely
7. Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;		
The Project is not likely to result in the introduction of invasive species that may become established in habitat for the species.		Unlikely

Broad-headed Snake (*Hoplocephalus bungaroides*)	Vulnerable species	Likelihood
8. Introduce disease that may cause the species to decline, or		
Whilst there is some potential for works plant and machinery to transport and disperse soil pathogens throughout the Subject Land, this risk will be managed through the use of vehicle wash down procedures. It is considered unlikely that the proposed action will introduce disease that may cause the Broad-headed Snake to decline.		Unlikely
9. Interfere substantially with the recovery of the species.		
A recovery plan has not yet been prepared for the species. The Approved Conservation Advice (DoE 2014c) for the species lists a number of priority actions that may be undertaken to assist the recovery of the species. The Project will align with the action to investigate formal conservation arrangements, with offset area of 0.12 ha being applied for this species for the potential impacts, which would assist in-perpetuity protection of the species. The actions taken to avoid areas of potential habitat for the species also broadly align with the principals of controlling access routes to avoid areas of habitat for the species. Broad-headed Snake in NSW has been assigned as a site managed species under the Saving Our Species program. Three sites have been identified as management sites for this species. Woronora Plateau is a listed management site which is likely to include the Subject Land. Management actions proposed at this site include: • Reduce bushrock removal from the site. • Minimise illegal collection of the species. • Determine area of occupancy of the species. • Increase understanding of the species ecological requirements. The proposal would not involve removal of bushrock or illegal collection of the species. The proposal is not likely to interfere with the recovery of Broad-headed Snake.		Unlikely
Conclusion: The proposed action is unlikely to have a significant impact on the Broad-headed Snake.		

Giant Burrowing Frog

Giant Burrowing Frog (*Heleioporus australiacus*)	Vulnerable Species	Likelihood
Context: The Giant Burrowing Frog is currently listed as Vulnerable under the EPBC Act. Following recent work by Mahony et al. (2021) the species has been split into two subspecies, with the northern subspecies considered to be *Heleioporus australiacus*, and the southern subspecies as *Heleioporus australiacus flavopunctatus* subsp. nov.). The northern subspecies, relevant to the Project, is distributed from Corrabare State Forest in the Watagan Mountains in the north, with the southern limit of distribution considered to occur around Kiama (or some point within the 90 km between Dharawal National Park and Parma Creek Nature Reserve (the northernmost distribution of *Heleioporus australiacus flavopunctatus* subsp. Nov). The northern population of the species was previously considered to occur as far south as Ulladulla (DoE 2014d).		

Distribution and occurrence:

The Giant Burrowing Frog is distributed across the coast and adjacent ranges of NSW and Victoria, with the northern population of the species generally confined to the sandstone geology of the Sydney Basin (DoE 2014d). The Area of Occupancy of the northern subspecies has been calculated as 312 km^2 (Mahony et al. 2021).

The Giant Burrowing Frog has been recorded in preferred habitats once in the north-east of the Subject Land along a 3rd order tributary to Donalds Castle Creek, as well as south and east of the Subject Land at a distance of approximately 1 km away. Detectability of adults of the species typically requires significant rainfall (DEWHA 2010a) prior to or during survey, which is when most breeding occurs (e.g. DoE 2018b; Penman et. al 2008). Breeding activity has been recorded year round, but mating calls are most commonly heard in late summer or autumn following heavy rainfall (Penman et al. 2004). Tadpole surveys and nocturnal searches in suitable habitat and weather conditions are more effective than call surveys (DEWHA 2010a). While a range of methods to detect the species were employed in the present survey, tadpole surveys were a focus due to limitations in access to the site during and after heavy rain. In addition, it was recognised that tadpole survey is likely to aid in identifying limiting habitat for tadpole development. Tadpoles are present for months after breeding events, however adult frogs do not breed in all years (DEWHA 2010a) and recent monitoring as part of Dendrobium Area 3B subsidence monitoring have highlighted absence of tadpoles in some years versus abundant tadpoles in limited areas in others (Biosis 2016b). Given, these factors, it is assumed that the Giant Burrowing Frog is present throughout the preferred habitats of the Subject Land despite its lack of detection in the present survey.

Habitats

Breeding habitat for the species is generally formed by soaks or pools within first or second order streams (DoE 2014d), although the species spends the majority (at least 97%) of its time away from breeding habitats in areas up to 250 m from the breeding sites, occupying a number of burrows in dry forest areas (Penman et al. 2008).

The Giant Burrowing Frog has been recorded in preferred habitats once in the east of the Subject Land along a 3rd order tributary to Donalds Castle Creek as well as south and east of the Subject Land approximately 1 km away. The species was not detected during survey for the Project, although detectability of the adult life stage of the species is highly variable. While the tadpole life stage of the species is present throughout much of the year, it is acknowledged that the species does not breed in all years. As such, it has been assumed that the Giant Burrowing Frog is present throughout the preferred habitats of the Subject Land, with the total area of potential impact to habitat being 13.26 ha.

Within the Subject Land, the species relies upon semi-permanent pools for tadpole development, with maturation times for tadpoles having been observed to take 3-11 months (Watson and Martin 1973). Pools of sufficient depth and hydroperiod within the catchment area were almost exclusively located along 2nd order or higher streams or else 1st order streams where headwater swamps are positioned upstream.

Swamps act as a buffer allowing for more continuous and even water flows along streams after rain events (e.g. Young 2017) and thus greater hydroperiods (or permanency) within pools along smaller streams. This may influence tadpole development for species with lengthy periods of metamorphosis. Therefore, while swamps are not considered required for tadpole development, they may aid in providing suitable conditions downstream for tadpole development to occur, particularly along 1st and 2nd order streams.

Swamps and heath may aid in providing suitable conditions to forage and shelter, facilitated through moisture availability and abundance of debris. However, the species is known to shelter in a range of habitats. The extent to which drying of swamps might impact the capacity of swamp sites to provide ideal sheltering conditions is unknown, however it seems likely that swamps are more important in regard to enhancing opportunities for tadpole development downstream rather than providing ideal sheltering habitat given the variety of sheltering habitats reportedly used. Also, expected changes in swamp composition due to subsidence is unlikely to prevent

Giant Burrowing Frog (*Heleioporus australiacus*)	Vulnerable Species	Likelihood

their capacity to be used as a sheltering environment although may add some increased risk of desiccation for some swamps.

The species polygon developed for this species comprises potential impacted foraging, sheltering and breeding habitat totalling 13.26 ha. It is intended that these offsetting calculations may be refined during monitoring for the species post-approval (but prior to mining) to confirm the area of habitat occupied by the species within the Subject Land.

Potential impacts associated with the Project

The Project has the potential to result in subsidence that may lead to a reduction in pool water quantity and quality along creek lines and soaks. The area potentially subject to indirect subsidence effects associated with Area 5 according to MSEC (2022) is approximately 1,989 ha. The combined length of all streams within the Subject Land that is prone to subsidence is approximated at 33.25 km which includes all first, second and third order streams within 400 m of proposed longwalls.

There are first and second order streams located directly above the proposed mining area. The streams have exposed bedrock with some standing pools. There are also other controlling features including boulderfields, riffle zones and debris accumulations. The total length of the third order sections of the streams within the 35° angle of draw and the 600 m boundary are approximately 1.3 km and 2.2 km, respectively. Fracturing could occur along the third order sections of the streams located within 400 m of the proposed mining area. The potential for Type 3 impacts (fracturing directly resulting in water loss or pool water level, or a noticeable change in pool water level associated with changes in surface flow further upstream) has been based on the experience from mining in Area 3B. It has been assessed that approximately 15 % of the stream controlling features (i.e. rockbars, steps and other controlling features) located within 400 m of the proposed longwalls could experience Type 3 impacts. This represents approximately five rockbars along the third order sections of the streams. The first and second order sections of the streams located directly above the proposed longwalls are expected to experience the full range of predicted subsidence effects. There is potential for locally increased ponding due to the mining-induced tilt along streams DC8 and, to lesser extents, the other first and second order streams. There could be localised tilt-induced ponding areas along the unnamed streams where the natural gradients are low immediately upstream of the longwall chain pillars or upstream of the perimeter of the proposed mining area. It is expected that fracturing of bedrock would occur along the sections of the streams that are located directly above the proposed longwalls. Fracturing can also occur outside the extents of the proposed longwalls, with fracturing possible at distances up to approximately 400 m. Surface water flow diversions are likely to occur along the sections of streams that are located directly above and adjacent to the proposed longwalls.

The following safeguards will be employed to protect fauna within the catchment:

- All creeks and drainage lines that contain flowing or stagnant water are to be avoided for direct surface disturbance. A 40 m buffer is to be maintained around all 2nd or 3rd order creek lines wherever practical.
- Disturbance to small ephemeral drainage lines is to be minimised, with tracks to run perpendicular to the drainage lines where crossings are necessary. No drilling will occur within creek lines.
- Measures to prevent the spread of Chytrid fungus will be employed in accordance with – Threatened Frog Management – Chytrid Fungus Issues.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. **lead to a long-term decrease in the size of an important population of a species;**

Giant Burrowing Frog (*Heleioporus australiacus*)	Vulnerable Species	Likelihood
There is no adopted or made Recovery Plan for this species, a Recovery Plan is required and is included on the Commenced List (1/11/2009). Important populations of this species have not been identified in any Commonwealth conservation documents. The Giant Burrowing Frog has been recorded in preferred habitats once in the north-east of the Subject Land along a 3rd order tributary to Donalds Castle Creek, as well as south and east of the Subject Land approximately 1 km away. These records are located well within the known habitat range of the species and within the distribution of Bionet records of the species across the state. There is uncertainty around the southern limit of distribution of the northern subspecies of Giant Burrowing Frog although records extend across the divide between the two subspecies there is the potential for hybridisation between the northern and southern subspecies. Previously the southern limit of the northern population was considered to occur at Ulladulla, to the south of the Subject Land. There is also limited understanding of the genetic status and population structure of the Giant Burrowing Frog generally, which presents a challenge to assessing impacts to this species on a population basis. As such it is difficult to confidently assess whether the population within the Subject Land and surrounding areas would be necessary for maintaining the genetic diversity of the species or represent key source populations for breeding or dispersal. Pools of sufficient depth and hydroperiod for breeding within the catchment area were almost exclusively located along second order or higher streams or else first order streams where headwater swamps are positioned upstream. No direct impacts are anticipated to potential Giant Burrowing Frog breeding habitat. Subsidence has the potential to indirectly impact on pool breeding habitat the species may occupy, through a reduction in pool water quantity and quality. Should this coincide with pool breeding habitats utilised by the Giant Burrowing Frog it is likely that a reduction in recruitment of the species would occur. The extent of potential loss of breeding pool habitat is difficult to accurately predict. It is also difficult to quantify the exact effect of any subsequent impact upon the ongoing recruitment of the species and consequences of this for the local population of the species.		Possible
2. reduce the area of occupancy of an important population;		
Given the known habitat range across south-eastern Australia for the species, and area of occupancy for the northern subspecies (312 km^2) (Mahoney at al. 2021), the total area of potential impact to habitats within the Subject Land (13.26 ha) is unlikely to reduce the area of occupancy for the species, including consideration of the surrounding habitat available.		Unlikely
3. fragment an existing important population into two or more populations;		
This species is inherently difficult to detect and there is limited information available on population structures of this species, making assessment difficult. However, based on the available records and availability of potential habitat in the surrounding locality, the 13.26 ha area of potential impacts to habitat is considered unlikely to fragment an existing important population into two or more populations, given the areas of surrounding habitat available.		Unlikely

Giant Burrowing Frog (*Heleioporus australiacus*)	Vulnerable Species	Likelihood
4. adversely affect habitat critical to the survival of a species;		
To date, no Critical Habitat as defined under section 207A of the EPBC Act has been identified or included in the Register of Critical Habitat, or identified in any Commonwealth conservation documents. Given the known habitat range across south-eastern Australia for the species, and area of extent for the northern population of the species, the total area of potential impact to habitats within the Subject Land (13.26 ha) is unlikely to be critical to the survival of the species. In regard to the local population of the species, the area of potential impact is considered to be small, relative to the available habitats throughout the surrounding area.		Unlikely
5. disrupt the breeding cycle of an important population		
The areas of habitat that may be potentially impacted by subsidence, include Coastal Upland Swamps and creek lines totalling 13.26 ha within the Subject Land. The species was not detected during surveys for the Project but has been assumed to be present within potential habitats in the Subject Land. Should subsidence impacts (reductions in pool water quantity or quality) coincide with pool breeding habitats utilised by the Giant Burrowing Frog it is likely that a reduction in recruitment of the species would occur at these locations. However, the limited understanding of the species present a challenge to identifying whether the population of relevant to the Subject Land would meet the definition of an important population.		Possible
6. modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;		
Given the known habitat range across southeaster Australia for the species, and extent of occurrence for the northern subspecies (8502 km^2) (Mahoney et al. 2021), the total area of potential impact to habitats within the Subject Land (13.26 ha) is unlikely to impact habitats to the extent that the species is likely to decline.		Unlikely
7. result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;		
The Project is not likely to result in the introduction of invasive species that may become established in habitat for the species.		Unlikely
8. introduce disease that may cause the species to decline, or		
Whilst there is some potential for works plant and machinery to transport and disperse soil pathogens throughout the Subject Land, this risk will be managed through the use of vehicle wash down procedures. Furthermore, all vegetation clearing does not occur within watercourses, and thus the potential for the spread of Chytrid fungus will be minimised.		Unlikely
9. Interfere substantially with the recovery of the species.		
A Recovery Plan does not exist for Giant Burrowing Frog.		Unlikely

Giant Burrowing Frog (*Heleioporus australiacus*)	Vulnerable Species	Likelihood
The Approved Conservation Advice for the species identifies a number of actions to assist the recovery of the species (DoE 2014d). The Project does not align with any of these specific actions, but also will not interfere with any of these actions.		
Conclusion: The limited understanding of the species populations present a significant challenge to identifying whether the population of relevant to the Subject Land would meet the definition of an important population and how any impacts to recruitment may affect the overall local population of Giant Burrowing Frogs of relevant to the Subject Land. The total area of potential impact to habitats within the Subject Land (13.26 ha) represents a very small fraction of the area of occupancy for the northern subspecies (312 km^2) (Mahoney at al. 2021) and the known habitat range across south-eastern Australia for the species. Nevertheless, given the limited understanding of the species populations, the Project may possibly: • Disrupt the breeding cycle of an important population. • Lead to a long-term decrease in the size of an important population.		

Large-eared Pied Bat

Large-eared Pied Bat *(Chalinolobus dwyeri)*	Vulnerable Species	Likelihood
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:		
1. lead to a long-term decrease in the size of an important population of a species;		
The Conservation Advice for the species states that there is insufficient information available to be able to describe, with spatial information, important populations of this species and that all populations of this species should be considered important (DAWE 2021b). The Large-eared Pied Bat was not detected within Area 5 or the Biodiversity Assessment Development Footprint during ultrasonic call recording surveys or harp trapping surveys in the extensive baseline surveys in 2016 and no records exist within the Subject Land. The species is considered unlikely to be impacted by subsidence associated with the Project. The area proposed for the Dendrobium Pit Top Carpark (located over 10 km away from the Area 5) may include potential foraging habitat, is within 2 km of cliff lines, and has records within close proximity. As such, it is assumed that this may be marginally suitable foraging habitat for the Large-eared Pied Bat. The loss of 0.17 ha of this habitat is not considered an important foraging resource for the species due to the large areas of intact vegetation in the locality. No breeding or roosting habitat would be impacted by the Project. Therefore, the removal of potential foraging habitat from the Dendrobium Pit Top Carpark would not lead to a long-term decrease in the size of an important population of this species.		Unlikely
2. reduce the area of occupancy of an important population;		

Large-eared Pied Bat *(Chalinolobus dwyeri)*	Vulnerable Species	Likelihood
Potential foraging habitat from the Dendrobium Pit Top Carpark would be removed as a result of the Project covering a total of 0.17 hectares. As this does not represent a significant or important area of habitat for the species, and no breeding or roosting habitat would be removed, the removal of this potential habitat is unlikely to reduce the area of occupancy of an important population of this species.		Unlikely
3. fragment an existing important population into two or more populations;		
The Project would not result in the removal of any breeding or roosting habitat. The 0.17 hectares of potential foraging habitat at the Dendrobium Pit Top Carpark to be removed is unlikely to represent significant connecting habitat to any local population. Therefore, the works associated with this Project would not fragment or isolate an existing important population into two or more populations.		Unlikely
4. adversely affect habitat critical to the survival of a species;		
To date, no Critical Habitat as defined under section 207A of the EPBC Act has been identified or included in the Register of Critical Habitat, or identified in any Commonwealth conservation documents. No critical habitat in the form of breeding or roosting habitat would be impacted as a result of the Project. The potential foraging habitat to be removed is not considered to comprise critical habitat to the survival of the species, given the availability of potential foraging habitat in the surrounding area. Therefore, the Project is unlikely to adversely affect habitat critical to the survival of the species.		Unlikely
5. disrupt the breeding cycle of an important population		
No breeding habitat would be removed as a result of the Project. Therefore, disruption to the breeding cycle of an important population is unlikely.		Unlikely
6. modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;		
The proposal would impact on potential foraging habitat for the Large-eared Pied Bat through the clearing of native vegetation at the Dendrobium Pit Top Carpark. No breeding or roosting habitat would be impacted. The removal of 0.17 hectares of potential foraging habitat for the species is unlikely to reduce the extent of habitat such that the species is likely to decline. This is due to the extensive habitat available throughout the locality.		Unlikely
7. result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;		
The Project is not likely to result in the introduction of invasive species that may become established in habitat for the species.		Unlikely
8. introduce disease that may cause the species to decline, or		
Whilst there is some potential for works plant and machinery to transport and disperse soil pathogens throughout the Biodiversity Assessment Development Footprint, this risk will be		Unlikely

Large-eared Pied Bat *(Chalinolobus dwyeri)*	Vulnerable Species	Likelihood
managed through the use of vehicle wash down procedures. It is considered unlikely that the proposed action will introduce disease that may cause the Large-eared Pied Bat to decline.		
9. Interfere substantially with the recovery of the species.		
The National Recovery Plan for the Large-eared Pied Bat (Department of Environment and Resource Management 2011) lists five specific objectives to ensure the persistence of viable populations of Large-eared Pied Bat throughout its geographic range. These include: • Identify priority roost and maternity sites for protection. • Implement conservation and management strategies for priority sites. • Educate the community and industry to understand and participate in the conservation of the large-eared pied bat. • Research the large eared pied bat to augment biological and ecological data to enable conservation management. • Determine the metapopulation dynamics throughout the distribution of the large-eared pied bat. The Project does not interfere with any of these objectives of the National Recovery Plan.		Unlikely
Conclusion: The Project is unlikely to result in a significant impact on the Large-eared Pied Bat.		

Littlejohn's Tree Frog

Littlejohn's Tre*e Frog (Litoria littlejohni)*	Vulnerable Species[26]	Likelihood
Context: The Littlejohn's Tree Frog is currently listed as Vulnerable under the EPBC Act. Following recent work by Mahony et al. (2020) the species has been split, with the northern population considered to be the Littlejohn's Tree Frog, and the southern population now recognised as a new species Watson's Tree Frog *(Litoria watsoni*). The taxonomic review has therefore restricted Littlejohn's Tree Frog to the northern-end of its previously accepted distribution range, halving the species Area of Occupancy (AoO) (Mahony et al. 2020). This revision of the species has not been formally incorporated into the species' EPBC Act or BC Act listing, however, is being considered by the EPBC Act Scientific Committee who have concluded that the species appears to be eligible for listing as Endangered under Criterion 2 of the listing framework (geographic distribution). The Committee states that this conclusion should be considered tentative at this stage, as it may be changed as a result of responses to the current consultation process. As the EPBC Act listing for the species is vulnerable, this assessment applies that criteria, however adopts the revised accepted distribution of the species, given this appears to have been accepted by the Scientific Committee. **Distribution and occurrence** The revised distribution of the Littlejohn's Tree Frog now considers the species as restricted to three regions in the Sydney Basin, being the Watagan Mountains, the Blue Mountains National Park and the Woronora Plateau. It has been suggested that the key driver behind the inferred recent reductions in the extent and occurrence of this species is Chytridiomycosis, although the species has received relatively little study to date (Mahony et al. 2020) and additional threats to the species have also been identified including subsidence from longwall mining. The		

[26] *Listed as 'Vulnerable' under the EPBC Act at the time of the "controlled action" decision (13 January 2022) and therefore assessed as 'Vulnerable' rather than 'Endangered' (refer section 158A of the EPBC Act).*

Littlejohn's Tre*e Frog (Litoria littlejohni)*	Vulnerable Species[26]	Likelihood

Cordeaux area was found to have the highest population size out of three populations surveyed as part of a recent study by Klop-Toker et al. (2021). This study also concluded that under current conditions (i.e. no additional longwall mining) the best estimates of current population demographic information predict continued survival for another 100 years. Klop-Toker et al. (2021) also found that that species is able to disperse significant distances moving between mining and un-mined areas within the Dendrobium Mine lease, however movement throughout catchments is thought to be limited with the study suggesting a high level of site fidelity. Movement across catchments appears to be relatively limited (Klop-Toker et al., 2021), however causal factors are not well known and the level of movement between frogs within the Dendrobium and Avon catchments into adjacent areas has not been tested.

DAWE (2020) has reported the extent of occurrence for the species as approximately 10 000 km^2, and area of occupancy as between 272 and 296 km^2. To address the criteria in this assessment, the area of potential habitat for the regional population of the species has been calculated to be 2,298 km of stream length (see section 4.6.4). This is comprised of potential habitat for the species within the Cataract IBRA subregion, including areas of similar geology and land-use.

Littlejohn's Tree Frog has been recorded within 5 of the 11 tributaries within the Subject Land in at least one pool, occasionally several. Additional survey is likely to result in additional pools being confirmed as breeding habitat for the species, however it is not expected that all pools or all stream sections/tributaries would be occupied by the species. To quantify available habitat at several scales (Figure 16) all first to third order streams have been considered within areas of potential habitat for the species. On this basis, the impact area is calculated at 33.25 km of stream (which includes all first, second and third order streams within 400 m of proposed longwalls); Potential habitat within the Cataract IBRA subregion is 2,298 km (area b, which includes known and potential habitat based on land use, geology and continuity with existing records 27); Regional extent of occurrence is 1,305 km (area c, which is the area made from a polygon bounded by records of the species within the Cataract IBRA subregion); and regional area of occupancy is 520.2 km (area d which is the combined stream length within all 2km grid cells with a species record). The proportion of Littlejohn's Tree Frog habitat impacted by the current proposal in a regional context represents between 1.5 – 2.6% of potential and available habitat within the region.

Following work by Klop-Toker et al. (2021) and Stock et al. (N.D) suggesting movement across catchment boundaries appears to be relatively limited, the same calculations have also been presented for the Cordeaux and Avon catchment only, which represents a potential local population for the species. The proportion of Littlejohn's Tree Frog habitat impacted by the current proposal in this narrower context represents between 5.5 – 13.5% of available habitat within the Cordeaux and Avon catchment. Connection between the Cordeaux and Cataract catchment area to the North of Picton Road is considered moderately likely given the proximity of records, however has not yet been definitely established. Therefore this area has not been included within the local population scenario.

[27] Area (b) represents the combined area of streams within generally intact bushland on primarily sandstone substrates that are west of the Illawarra escarpment. Most of the areas lie within the area bounded by existing Littlejohn's Tree Frog records, however an additional allowance has been made (generally up to 10 km) to cater for limited detection of the species in areas that are potential habitat but are unlikely to have had repeated targeted surveys. Certain areas meeting this description that are more likely to have had targeted surveys (such as the Royal National Park) have been omitted from this area.

Littlejohn's Tree Frog (*Litoria littlejohni*)	Vulnerable Species[26]	Likelihood

Area	Cumulative length of 1st, 2nd and 3rd order streams (km)	Proportion of impact area within the specified area (%)
Impact area		
(a) Proposed impact area (within 400 m of proposed longwalls)	33.25	N/A
Regional habitat: potential and occupied habitat within the Cataract IBRA subregion		
(b) Potential habitat including areas of similar geology, land-use and continuity with existing records	2,298	1.45%
(c) Extent of occurrence minimum convex polygon based upon Bionet records	1,305	2.55%
(d) Area of occupancy based on records within 2 km x 2 km grids within area c above.	520.2	6.39%
Local habitat: potential and occupied habitat within the Cordeaux and Avon catchment		
(e) Potential habitat including areas of similar geology and land-use and continuity with existing records	609.07	5.46%
(f) Min convex polygon based upon Bionet records	246.2	13.51%
(g) Area of occupancy based on 2 km x 2 km grids.	213.8	15.55%

It is recognised that areas within the Dendrobium mine lease have a relatively high concentration of the species and generally low level of disturbance. Other areas that have a similar disturbance profile have been less studied and so their relative concentration of the species and importance to the population is not known. Mining impact assessment and monitoring surveys have led to the majority of species records, at least for areas south of Picton Road, if not throughout the region.

Cumulative impacts should also be considered when assessing the proportional impact from the Project. The areas tabled below have been used as a basis upon which to compare the proposed impact area against areas of potential habitat in other areas of existing or future mining versus protected areas such as National Parks.

Area (as per Figure 16)	Regional habitat: potential and occupied habitat within the Cataract IBRA subregion		Local habitat: potential and occupied habitat within the Cordeaux and Avon catchment	
	Cumulative stream length (km)	Proportion of total area of potential habitat (area b, above)	Cumulative stream length (km)	Proportion of total area of potential habitat (area e, above)
Proposed impact area (within 400 m of proposed longwalls)	33.25	1.45%	33.25	5.46%
Dendrobium Mine extraction areas (maximal)	74.80	3.26%	74.80	12.28%

Littlejohn's Tree *Frog (Litoria littlejohni)*	Vulnerable Species[26]			Likelihood
Approved future mining longwalls - Dendrobium	1.13	0.05%	1.13	0.19%
Southern Coalfield (All Mines)	266.65	11.60%	203.59	33.43%
National parks	688.65	29.97%	19.86	3.26%
Other	880.18	38.30%	30.01%	4.93%
Total (excluding proposed impact area)	**2298.00**	**100%**	**609.07**	**100%**

Habitats

The species typically has a low population density and distribution across the landscape. Occupancy of suitable stream habitats within the Dendrobium Mine lease area has been investigated with modelled estimates of approximately one third of each 50 m stretch of stream examined containing tadpoles (Klop-Toker et al. 2021).

Swamps act as a buffer allowing for more continuous and even water flows along streams after rain events (Young 2017, NSW Scientific Committee 2012) and thus greater hydroperiods (or permanency) within pools along smaller streams. This may influence tadpole development for species with lengthy periods of metamorphosis. Therefore, while swamps are not considered required for tadpole development, they aid in providing suitable conditions downstream for tadpole development to occur, particularly along 1st and 2nd order streams.

Many locations where the species is found do not have upland swamps present (e.g. Watagan Mountains) and there is no known associated vegetation type that the species relies on specifically. The species (as presently listed) has been recorded in coastal woodland, heaths and in disturbed and undisturbed woodlands from Watagans National Park NSW to Buchan Victoria (DoE 2018a). Swamps and heath may aid in providing suitable conditions to forage and shelter, facilitated through moisture availability and abundance of debris. However, the species is known to shelter in a range of habitats. The extent to which drying of swamps might impact the capacity of swamp sites to provide ideal sheltering conditions is unknown, however it seems likely that swamps are more important in regard to enhancing opportunities for tadpole development downstream rather than providing ideal sheltering habitat given the variety of sheltering habitats reportedly used. Also, expected changes in swamp composition due to subsidence is unlikely to prevent their capacity to be used as a sheltering environment although may add some increased risk of desiccation for some swamps.

Within the Dendrobium Mine lease area the species is restricted to smaller streams, below a stream order of 4, within dry sclerophyll or heath forest vegetation, often but not exclusively in association with upland swamps (Biosis 2016b, Klop-Toker et al. 2021). Fine scale pool attributes selected for breeding include water quality that is low in salinity and slightly acidic, sizes between 1 m^2 to 3000 m^2, pools with a depth of < 1.5 m (Klop-Toker et al. 2021). Monitoring of the species undertaken by Niche (2021) has identified a preference for deeper pools over shallower pools within areas 3A and 3B. A preference for pools containing high levels of leaf litter and an absence of algae, fish and iron flocculant have also been established (Klop-Toker et al. 2021). A range of biotic and abiotic factors influence breeding pool selection for this species, with the result that not all pools suitable for breeding within the landscape are in fact occupied by the species, with the pattern of pool occupancy typically not uniform.

Potential impacts associated with the Project

The Project has the potential to result in subsidence that may lead to a reduction in water quantity and quality. The area potentially subject to subsidence effects associated with Area 5 according to MSEC (2022) is approximately 1,989 ha. The combined length of all streams within the Subject Land that is prone to subsidence is approximated

Littlejohn's Tre*e Frog (Litoria littlejohni)*	Vulnerable Species[26]	Likelihood

at 33.25 km which includes all first, second and third order streams within 400 m of proposed longwalls (roughly half of the stream length would be within 60 m of mining and half beyond 60 m). Some level of subsidence is expected to impact a maximum of 50% of streams within 60-400 m of longwall mining rather than all such areas being impacted.

There are first and second order streams located directly above the proposed mining area. The streams have exposed bedrock with some standing pools. There are also other controlling features including boulderfields, riffle zones and debris accumulations. The total length of the third order sections of the streams within the 35° angle of draw and the 600 m boundary are approximately 1.3 km and 2.2 km, respectively. Fracturing could occur along the third order sections of the streams located within 400 m of the proposed mining area. The potential for Type 3 impacts (fracturing directly resulting in water loss or pool water level, or a noticeable change in pool water level associated with changes in surface flow further upstream) has been based on the experience from mining in Area 3B. It has been assessed that approximately 15 % of the stream controlling features (i.e. rockbars, steps and other controlling features) located within 400 m of the proposed longwalls could experience Type 3 impacts. This represents approximately five rockbars along the third order sections of the streams. The first and second order sections of the streams located directly above the proposed longwalls are expected to experience the full range of predicted subsidence effects. There is potential for locally increased ponding due to the mining-induced tilt along streams DC8 and, to lesser extents, the other first and second order streams. There could be localised tilt-induced ponding areas along the unnamed streams where the natural gradients are low immediately upstream of the longwall chain pillars or upstream of the perimeter of the proposed mining area. It is expected that fracturing of bedrock would occur along the sections of the streams that are located directly above the proposed longwalls. Fracturing can also occur outside the extents of the proposed longwalls, with fracturing possible at distances up to approximately 400 m. Surface water flow diversions are likely to occur along the sections of streams that are located directly above and adjacent to the proposed longwalls.

The most recent iteration of ongoing monitoring programs undertaken across Dendrobium Areas 3A and 3B identified that an ecological response had been detected at several Impact sites within Dendrobium Areas 3A and 3B, following a decline in ecological values, with observed impacts most frequent and acute in areas that have been directly mined beneath (Niche 2021). The report described observed patterns of limited water retention at Impact sites post-mining, indicating that mining is having an impact on frog reproduction due to decreased tadpole survivorship (Niche 2021). Similarly, Klop-Toker et al. (2021) found that recruitment has been reduced across the active mine areas 3A and 3B, due to a loss of habitat as a result of subsidence.

Littlejohn's Tree Frogs have been observed consistently from both Control and Impact sites during annual monitoring since monitoring began in 2006 (Niche 2021), indicating breeding habitats may continue to be utilised despite impacts in some areas, at least in the short term (less than 10 years) and albeit in reduced abundances. Previous monitoring reports have also identified instances where locally increasing abundances of adult Littlejohn's Tree Frogs along transects adjacent to acutely impacted transects may be indicative of breeding adults utilising nearby streams in preference to acutely impacted habitats (Biosis 2020). Klop-Toker et al. (2021) have also noted that areas of un-impacted habitat within the mine areas continue to support high numbers of tadpoles and regular recruitment, which are considered vital in maintaining the local populations in the area.

In terms of mining throughout the broader locality, Cardno (2022) reported that collectively, the total length of watercourse that has experienced indirect and direct mining impacts is estimated to be 21% of that present in the upper Avon and Cordeaux River catchments. The majority of these impacts being along first and second order drainage lines.

Population viability was modelled under a future mining scenario, whereby all streams within the Dendrobium Mine Lease area were mined beneath using estimates of reduced tadpole recruitment on the basis of prior surveys. The authors found that under this scenario there was a high risk that the Dendrobium population (consisting of

Littlejohn's Tree *Frog (Litoria littlejohni)*	Vulnerable Species[26]	Likelihood

only those frogs within the lease area rather than inclusion of any connected areas of the population – a scenario governed by the terms of reference for the study) could die out. It is important to note that the entire mine lease area is highly unlikely to be mined beneath (a more realistic scenario is a value of 70% mining for example). Therefore, within the Lease areas there are areas to remain unmined and even within the mined areas it is not expected that all areas will be subject to impacts based upon previous experience.

The areas tabled below have been used as a basis upon which to compare the proposed impact area against other areas of existing or future mining and protected areas such as National Parks.

Area	Cataract IBRA subregion within areas considered moderately likely to known habitat		Cordeaux and Avon catchment within areas considered moderately likely to known habitat	
	Cumulative stream length (km)	**Proportion of total area of potential habitat (area a, above)**	**Cumulative stream length (km)**	**Proportion of total area of potential habitat (area e, above)**
Proposed impact area (within 400 m of proposed longwalls)	33.25	1.45%	33.25	5.46%
Dendrobium Mining Domains - (Dendrobium extract)	74.80	3.26%	74.80	12.28%
Future mining longwalls - Dendrobium	1.13	0.05%	1.13	0.19%
Southern Coalfield (All Mines)	266.65	11.60%	203.59	33.43%
National parks	688.65	29.97%	19.86	3.26%
Other	880.18	38.30%	30.01%	4.93%
Total (excluding proposed impact area)	**2298.00**	**100%**	**609.07**	**100%**

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. lead to a long-term decrease in the size of an important population of a species;	
No important populations of Littlejohn's Tree Frog have been formally identified as to date a recovery plan has not been adopted or made. Recent work has identified that there is no contemporary gene flow between any of the known regional populations of this species (Klop-Toker et al. 2021). Following the split of the Littlejohn's Tree Frog into two species, the populations of Littlejohn's Tree Frog in the Cordeaux, Cataract, and Nepean catchments are now near the limit of the species range. Recent work by (Klop-Toker et al. 2021) concluded that Littlejohn's Tree Frogs within the Dendrobium mine-lease area are part of the largest known population of the species. For these reasons the regional population of the species is considered important.	Likely

Littlejohn's Tre*e Frog (Litoria littlejohni)*	Vulnerable Species[26]	Likelihood
The Littlejohn's Tree Frog has been recorded in preferred habitats across the Subject Lands and surrounds, found mainly in semi-permanent pools. These pools of sufficient depth and hydroperiod within the catchment area were almost exclusively located along first and second order streams downstream of headwater swamps. Within the Subject Land, the species relies upon these semi-permanent pools for tadpole development. The Project has the potential to result in subsidence that may lead to a reduction in stream water quantity and quality, subsequently impacting upon the recruitment success of this species in impacted areas, as has been observed at some impact sites in other active mine areas (Niche 2021, Klop-Toker et al. 2021). It is noted that not all mapped habitat would be impacted, with impacts most likely to occur in areas which would be directly mined beneath and within 60 m of mining. Previous studies have identified that the species is mobile and has the capacity to persist in some habitats post-impact, at least in the short term and albeit at reduced abundances. However, the ability of Littlejohn's Tree Frog to persist on a long-term basis in areas that are directly mined beneath by longwall mining should be considered questionable based on conclusions from recent studies Klop-Toker et al. 2021. The extent to which these impacts affect the overall viability of the regional population or the species overall is not yet clear. The Project is likely to result in a long-term decrease to the size of this important population through reduced recruitment in impacted areas as a result of impacts to stream water quantity and quality due to subsidence. The decrease in population size is likely to be limited based on the proportion of habitat impacted by this proposal which has been estimated at approximately 1.5-2.6%.		
2. reduce the area of occupancy of an important population;		
Area of occupancy is typically calculated using presence of a species within a nominated sized grid (typically 2 km x 2 km) laid over a population or species area of occupancy. A reduction in area of occupancy would occur where grids become vacant due to impacts from a project. It is noted that the Littlejohn's Tree Frog has been recorded throughout the broader locality and is the subject of previous and ongoing monitoring programs undertaken across Dendrobium Areas 2, 3A and 3B to monitor and quantify subsidence impacts on the population in these areas, as part of existing approvals. It has been concluded that the Project is likely to lead to a decrease in tadpole abundance in any impacted streams, reducing recruitment for the species. However, it is unlikely that all potential habitats would be impacted by subsidence, with surrounding suitable habitats identified throughout the locality that would remain unimpacted. The ability of the species to disperse, and a lack of barriers to dispersal in the locality around the Subject Land have been noted. Further, there is evidence from areas 3A and 3B that the species has the capacity to persist in some habitats post-impact, at least in the short term and albeit in reduced abundances. Overall, it is considered unlikely that the Project would reduce the area of occupancy of the population. This is given the low percentage of the calculated area of occupancy subject to potential impacts and understanding that it is unlikely all areas of potential habitats would be impacted by subsidence. This also considers the known habitats in the surrounding locality, and continued detection of the species, albeit in lower abundances, in post-impact areas.		Unlikely
3. fragment an existing important population into two or more populations;		

Littlejohn's Tre*e Frog (Litoria littlejohni)*	Vulnerable Species[26]	Likelihood
The subsidence predicted has the potential to alter a portion of Littlejohn's Tree Frog habitat features within the Subject Land. However, it is unlikely that all potential habitats would be impacted by subsidence. The Littlejohn's Tree Frog is known to occur throughout the locality, including in Dendrobium Area 6 and is the subject of ongoing monitoring programs undertaken across Dendrobium Areas 2, 3A and 3B. The species is able to persist in impacted areas, albeit in reduced abundances and in at least the short term (Niche 2021). The species is mobile and moves freely between mining areas and other un-mined areas within the Dendrobium Mine lease area, with areas of un-impacted habitat continuing to support high numbers of tadpoles and regular recruitment (Klop-Toker et al. 2021). Given these factors, while it is likely that some habitats within the Subject Land will be indirectly impacted by the Project, it is unlikely that this would fragment an existing important population into two or more populations.		Unlikely
4. adversely affect habitat critical to the survival of a species;		
DAWE (2020) states there is insufficient data to define habitat critical to the survival of Littlejohn's Tree Frog. To date, no Critical Habitat as defined under section 207A of the EPBC Act has been identified or included in the Register of Critical Habitat. The subsidence predicted has the potential to alter a portion of Littlejohn's Tree Frog habitat features within the Subject Land, representing 1.5-2.6% of the calculated area of potential habitat for the regional population. It is unlikely that all potential habitats within the Subject Land would be impacted by subsidence, it is also noted that the species typically has a low population density and distribution across the landscape. Overall, it is considered unlikely that the Project will adversely affect habitat critical to the survival of a species to the extent that it would face local or regional extinction. However, the habitat that would be impacted by the proposal is considered of the type required generally to maintain the continued viability of the species.		Possible
5. disrupt the breeding cycle of an important population		
The areas of habitat that may potentially be indirectly impacted by subsidence, include Coastal Upland Swamps and streams through a reduction in water quality or quantity. Previous monitoring in area 3A and 3B has identified a reduction in breeding habitat features for Littlejohn's Tree Frog following mining impacts in some areas, typically where streams are directly mined beneath, leading to reduced abundances of this species within these habitats (Niche 2021). Similarly, Klop-Toker et al. (2021) found that recruitment has been reduced across the active mine areas 3A and 3B, due to a loss of habitat as a result of subsidence. Drainage lines which are directly mined beneath, are likely to incur some fracturing in the uppermost bedrock. Where the bases of the creek and drainage lines have exposed bedrock, there may be some diversion of surface water flows into the dilated strata beneath the beds and the draining of pooled water within their alignments. In times of low flow, surface water flows could be diverted into the dilated strata below the beds and this could affect the quality and quantity of the water flowing in the streams. It is also possible, that surface water flow diversions could occur in some locations along these streams, however, based on the previous experience at the mine, the incidence of this occurring is considered low.		Likely

Littlejohn's Tree Frog (*Litoria littlejohni*)	Vulnerable Species[26]	Likelihood
Overall, it is considered likely that the Project is likely to result in disruptions to breeding through a reduction in the quality and quantity of breeding habitats for the species within the impact area, as a result of indirect impacts associated with subsidence within the Subject Land. Based on previous experience in the area, these reductions are likely to result in a degree of reduced tadpole recruitment following impact.		
6. modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;		
The Project has the potential to impact upon breeding pools, and habitat with Coastal Upland Swamps and streams (Appendix 9) within the Subject Land. Previous studies and monitoring programs have identified a decline in ecological values and tadpole abundances following subsidence impacts (Klop-Toker et al. 2021, Niche 2021). A localised decrease in the availability or quality of habitats within the Subject Land is likely to occur. Given the limited understanding of this species the specific relationship between habitats and recruitment success when considering long term population dynamics and genetic health is difficult to accurately quantify with a confidence. However, it is acknowledged that the extent of potential impacts within the Subject Land represents 1.5-2.6% of the area of potential habitat for the regional population and the species has been able to persist in impacted areas, albeit in reduced abundances and at least in the short term. In addition to this it is unlikely that all habitat will be impacted and there is surrounding habitat available for the species.		Possible
7. result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;		
The Project is not likely to result in the introduction of invasive species that may become established in habitat for the species.		Unlikely
8. introduce disease that may cause the species to decline, or		
Whilst there is some potential for works plant and machinery to transport and disperse soil pathogens throughout the Subject Land, this risk will be managed through the use of vehicle wash down procedures. Furthermore, all vegetation clearing does not occur within watercourses, and thus the potential for the spread of Chytrid fungus will be minimised.		Unlikely
9. Interfere substantially with the recovery of the species.		
To date there is no adopted or Recovery Plan for this species. The Project is unlikely to impact upon any existing recovery actions being undertaken for the species. The Approved Conservation Advice (DoE 2008a) for this species details a number of regional and local priority recovery and threat abatement actions that can be done to support the recovery of this species. Relevant actions that would be associated with the Project include: • Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary. • Undertake survey work in suitable habitat and potential habitat to locate any additional populations/occurrences.		Unlikely

Littlejohn's Tree *Frog (Litoria littlejohni)*	Vulnerable Species[26]	Likelihood
• Investigate formal conservation arrangements such as the use of covenants, conservation agreements or inclusion in reserve tenure.		
Conclusion: The Project is likely to result in a significant impact on Littlejohn's Tree Frog due to the following: • The Project has the potential to impact the Littlejohn's Tree Frog through alteration of known and potential habitat through potential hydrological changes to Coastal Upland Swamps and streams within the impact area, which has been calculated as 1.5-2.6% of potential habitat of the regional population. • This is likely to lead to a long-term decrease in the size of an important population of the species and interfere with the breeding cycle of the population. • The Project may also decrease the availability or quality of habitat to the extent that the species is likely to decline.		

Koala (*Phascolarctos cinereus*)

Koala (*Phascolarctos cinereus)*	Vulnerable Species[28]	Likelihood
An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:		
1. lead to a long-term decrease in the size of a population;		
Koalas were recorded within the Biodiversity Assessment Development Footprint during surveys. A Koala was heard calling from the vicinity of ventilation shaft 5A in response to call playback survey. No preferred feed trees are present within Ventilation Shaft Site 5A, which is dominated by *Corymbia gummifera*, *Eucalyptus haemastoma* and *Eucalyptus racemosa*. Koala SAT surveys and spotlighting did not detect Koalas within Ventilation Shaft Site 5A, however SAT surveys in other areas of the same PCT did, which demonstrates that Koalas may use this area. A known area of resident Koalas occur within Sandstone Transition Forest areas approximately 450 m north of Ventilation Shaft Site 5A. An adult and joey were observed alongside Fire Trail no. 6 during the survey. Koalas were observed within areas mapped as core habitat 450 m north regularly during spotlighting and call playback and Koala scats were relatively dense throughout these areas where searches were done sporadically. Koala scats were also recorded beneath *Eucalyptus punctata* within Sandstone Gully Peppermint Forest approximately 170 m north of Ventilation Shaft Site 5A. Sandstone Gully Peppermint Gully Forest borders the Ventilation Shaft Site but does not occur within it. PCT 1245 has been mapped at the Dendrobium Carpark site, is located adjacent to areas that contains preferred Koala feed trees, and as such, has been included as habitat on a precautionary basis despite not being of ideal habitat quality and despite limited Koala records east of the escarpment. The Project will lead to the clearing of approximately 17.69 hectares of sub-optimal habitat for the Koala across construction for the ventilation shaft, transmission line and Dendrobium Pit Top carpark. Given evidence of Koalas has been detected in all PCT types to be directly impacted, and the Ventilation Shaft Site is positioned between two known key areas of habitat, it is expected to be a corridor between areas of habitat containing Koala food trees (PCT 1395). As such it is considered		Unlikely

[28] *Listed as 'Vulnerable' under the EPBC Act at the time of the "controlled action" decision (13 January 2022) and therefore assessed as 'Vulnerable' rather than 'Endangered' (refer section 158A of the EPBC Act).*

Koala (*Phascolarctos cinereus)*	Vulnerable Species[28]	Likelihood
that the good condition vegetation in the Ventilation Shaft Site has the potential to provide move-through or rarely used foraging habitat for Koalas as they disperse between areas of habitat containing higher densities of preferred Koala food trees. Areas along the proposed transmission line are likely to have slightly higher regularity of use particularly when coinciding with a greater density of preferred feed tree species and higher nutrient soils (typically away from sandstone ridgetop woodland habitat – and associated PCT 1083). Records of the Koala are skewed towards roads within the locality due to higher detection rates, particularly of roaming males. While the Project would result in the removal of some potentially used connecting vegetation, its removal is not anticipated to lead to a long-term decrease in the size of an important population of the species. This is largely due to the fact that Area 5A contains limited preferred feed trees and is evidenced to be used rarely.		
2. reduce the area of occupancy of the species;		
Koalas have been recorded within the Biodiversity Assessment Development Footprint. The Project will lead to the clearing of approximately 17.69 hectares of habitat for the Koala across construction for the ventilation shaft, transmission line and Dendrobium Pit Top carpark. It is anticipated that habitat within direct impact areas comprises limited quality sheltering and connecting habitat for the Koala. Given the large extent of habitat available, the area of impact is not at a scale whereby an important population would be reduced. Given these factors and the extensive areas of native vegetation to be retained, the Project is unlikely to reduce the area of occupancy of the species.		Unlikely
3. fragment an existing important population into two or more populations;		
Clearing within potential sheltering and connecting habitat of approximately 17.69 hectares, most of which is considered to be used very rarely will occur. The works would not lead to fragmentation or isolation of an existing important population into two or more populations due to the restricted scale of the clearing impacts and limited imposition of any features that would act as a local barrier to movement.		Unlikely
4. adversely affect habitat critical to the survival of a species;		
Habitat critical to the survival of a species is defined as: the areas that the species relies on to avoid or halt decline and promote the recovery of the species (DAWE 2022). The area of habitat to be cleared has been identified as part of a corridor for the local population of Koalas since the Ventilation Shaft Site is positioned between two known key areas of habitat. However, vegetation in the Ventilation Shaft Site is rarely used by Koalas and the shaft site would not impact the ability of the Koala to move through the landscape and none of the areas impacted are considered to be habitat critical to the survival of the species.		Unlikely
5. disrupt the breeding cycle of a population		
The Project will lead to the clearing of approximately 17.69 hectares of habitat for the Koala across construction for the ventilation shaft, transmission line and Dendrobium Pit Top carpark. This habitat is anticipated to be used rarely for sheltering and connectivity between other areas of higher quality foraging habitat. Impacted areas would not generally be used for breeding and the Project is not considered to introduce barriers to gene flow/access to breeding areas.		Unlikely

Koala (*Phascolarctos cinereus)*	Vulnerable Species[28]	Likelihood
6. modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;		
The Project may impact on potential habitat for Koalas but in line with the previous discussion of habitats, the lack of species sightings within the area of direct impact and the removal of such a relatively small area of potential habitat is not likely to contribute to decline of the species.		Unlikely
7. result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat;		
The Project is not likely to result in the introduction of invasive species that may become established in habitat for the species.		Unlikely
8. introduce disease that may cause the species to decline, or		
The main diseases affecting Koalas are chlamydial infections. The Project would not increase exposure to such infections as Koalas from the local population would not have increased contact with other Koala populations including infected populations.		Unlikely
9. Interfere with the recovery of the species.		
Currently there is no National Recovery Plan in place for the species and current strategies for recovery of this species are managed at a State level. The Draft National Recovery Plan (DAWE 2021e) and conservation advice (DAWE 2022) for the species identifies a number of Strategies to assist the recovery of the species. While the Project will not specifically align with these, the Project will not directly interfere with the undertaking of any of these strategies.		Unlikely
Conclusion: The Project is unlikely to result in a significant impact on the Koala.		

Grey-headed Flying Fox (*Pteropus poliocephalus*)

Grey-headed Flying Fox (*Pteropus poliocephalus*)	**Vulnerable Species**	**Likelihood**
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:		
1. lead to a long-term decrease in the size of an important population of a species;		
The Grey-headed Flying Fox was observed flying over the Subject Land and foraging in trees within the Subject Land. However, no roost sites or breeding camps are known from the Biodiversity Assessment Development Footprint. No Nationally Important Flying-fox Camps occur in the Biodiversity Assessment Development Footprint or Subject Land (DAWE N.D.). It is therefore considered unlikely that the Biodiversity Assessment Development Footprint supports an important population of this species. Associated PCTs for the species include PCT 1250, 978, 1083, 1181, 1395, 1804 and 1245, covering approximately 892.77 ha within the Subject Land. The removal of 19.85 hectares of potential foraging habitat in the form of these associated PCTs from the Biodiversity Assessment Development Footprint would not lead to a long-term decrease in the size of an important population of this species.		Unlikely
2. reduce the area of occupancy of an important population;		
While the Grey-headed Flying Fox was observed flying overhead and foraging within the Subject Land, there are no breeding camps that exist within the locality and observed foraging within the Subject Land is limited. Given the limited use of the Subject Land for both breeding and foraging, the removal of 19.85 hectares of foraging habitat would not reduce the area of occupancy of any important population of this species.		Unlikely
3. fragment an existing important population into two or more populations;		
The Project would result in potential subsidence impacts to watercourses and swamps, as well as clearing within woodland habitat which the species may use for foraging. The works associated with this Project would not lead to any barriers being introduced that would impact the species limited use of the Subject Land. Therefore fragmentation or isolation of an existing important population into two or more populations would not occur.		Unlikely
4. adversely affect habitat critical to the survival of a species;		
To date, no Critical Habitat as defined under section 207A of the EPBC Act has been identified or included in the Register of Critical Habitat for the species. The National Recovery Plan (CoA 2021) describes habitat critical to the survival of the species, identifying a number of winter and spring flowering species of vegetation and foraging vegetation in proximity to known Nationally Important Camps or productive as foraging habitat during the final weeks of gestation. One Nationally Important Flying-fox Camp is located within 20 km of the Biodiversity Assessment Development Footprint and Subject Land at Thirroul (DAWE N.D.). The Project is likely to have a negligible impact on the extent of habitat for the Grey Headed Flying Fox within the locality, given the small area to be cleared. When the proposed works are considered		Unlikely

Grey-headed Flying Fox (*Pteropus poliocephalus*)	Vulnerable Species	Likelihood
in the context of the abundant habitats in surrounding areas, and habitats to be retained, the Project is unlikely to adversely have a substantial impact upon habitat critical to the survival of the species.		
5. disrupt the breeding cycle of an important population		
As stated above proposed activities within the Biodiversity Assessment Development Footprint or Subject Land are unlikely to have any impacts on breeding sites for the Grey Headed Flying Fox and will therefore not disrupt the breeding cycle of an important population.		Unlikely
6. modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;		
The proposal would impact on potential foraging habitat for the Grey Headed Flying Fox through the clearing of native vegetation for the surface infrastructure. However, the removal of this vegetation is unlikely to reduce the extent of habitat to the extent that the species is likely to decline due to the extensive habitat available throughout the locality.		Unlikely
7. result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;		
The Project is not likely to result in the introduction of invasive species that may become established in habitat for the species.		Unlikely
8. introduce disease that may cause the species to decline, or		
Whilst there is some potential for works plant and machinery to transport and disperse soil pathogens throughout the Biodiversity Assessment Development Footprint, this risk will be managed through the use of vehicle wash down procedures. It is considered unlikely that the proposed action will introduce disease that may cause the Grey Headed Flying Fox to decline.		Unlikely
9. Interfere substantially with the recovery of the species.		
The Project does not interfere with any recovery plan actions for the Grey Headed Flying Fox detailed in the National Recovery Plan (CoA 2021) for the species.		Unlikely
Conclusion: The Project is unlikely to result in a significant impact on the Grey Headed Flying Fox.		

Greater Glider (*Petauroides volans*)

Greater Glider (*Petauroides volans*)	Vulnerable Species	Likelihood
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:		
1. lead to a long-term decrease in the size of an important population of a species;		
There is no adopted or made Recovery Plan for the species and no important populations have been identified in Commonwealth conservation documents. It is considered unlikely that the population of Greater Gliders identified in the Subject Land would be considered part of an important population. This is because the Subject Land is not at the limit of the species range and given the number and distribution of records it is unlikely to be a key source population for breeding or dispersal. The		Unlikely

Greater Glider (*Petauroides volans*)	Vulnerable Species	Likelihood
currently available information is insufficient to assess whether the local population would be necessary for maintaining the genetic diversity of the species, however given the number and distribution of records within the species range, this is considered unlikely. The Greater Glider was recorded during the field survey within a patch of PCT 1395 (Sandstone Transition Forest) on several occasions during spotlighting within the Subject Land, outside the Biodiversity Assessment Development Footprint i.e. the species was not recorded in areas proposed for clearing (predominantly Sandstone Ridgetop Woodland) despite extensive spotlighting surveys over several years and seasons. The species is not considered to use areas proposed for clearing or if so rarely. There are no previous records from the Biodiversity Assessment Development Footprint. Associated PCTs for the species present within the Subject Land, outside the Biodiversity Assessment Development Footprint include PCT 1083, 1181, 1245, 1250, and 1395, however the species is known to prefer tall forests with higher productivity which does not align with the majority of areas proposed for clearing. Approximately 19.85 hectares of potential habitat considered rarely used in the form of these associated PCTs (mostly PCT 1083) would be removed from the Biodiversity Assessment Development Footprint as a result of the Project. This is not considered a substantial area of habitat in comparison to the retained surrounding areas of potential habitat in the Subject Land and locality, nor is the habitat considered important. Measures would be employed to avoid the removal of hollow-bearing trees and mature trees, and all areas of impact would be actively rehabilitated following decommissioning. The Project is unlikely to lead to long-term decrease in the size of an important population of this species given the substantial areas of similar habitat within the Subject Land and locality to be retained as well as limited importance of areas to be impacted as judged by survey.		
2. reduce the area of occupancy of an important population;		
Greater Gliders are expected to occur within the vicinity of the Subject Land and locality. As mentioned above, the clearing associated with the Project may impact approximately 19.85 hectares of unused or rarely used potential habitat in the form of associated PCTs. Measures would be employed to avoid removal of hollow-bearing trees and mature trees, and all areas of impact to be actively rehabilitated following decommissioning associated with the service boreholes.		Unlikely
3. fragment an existing important population into two or more populations;		
Clearing within potential habitat for Greater Glider of approximately 19.85 hectares will occur, although, the works associated with this proposal are unlikely to lead to fragmentation or isolation of an existing population into two or more populations due to the restricted scale of the clearing impacts and limited potential use of areas impacted.		Unlikely
4. adversely affect habitat critical to the survival of a species;		
To date, no Critical Habitat as defined under section 207A of the EPBC Act has been identified or included in the Register of Critical Habitat for the species. Habitat to be impacted for the surface infrastructure would be approximately 19.85 hectares of unused or rarely used potential habitat in the form of associated PCTs. Measures would be employed		Unlikely

Greater Glider (*Petauroides volans*)	Vulnerable Species	Likelihood
to avoid removal of hollow-bearing trees and mature trees, and all areas of impact would be actively rehabilitated following decommissioning associated with the service boreholes. The activity is unlikely to lead to adversely affect habitat to an important population to the survival of the species given over 1,965 hectares of similar habitat in the form of associated PCTs exists within the Subject Land.		
5. disrupt the breeding cycle of an important population		
Tall nutrient rich forest habitat within the Subject Land is thought to be an important breeding habitat for the Greater Glider. Impacted habitat is primarily confined to unused or rarely used open woodland (PCT 1083) and is not considered important breeding habitat. It is unlikely that the removal of areas of unused or rarely used potential habitat of approximately 19.85 hectares would disrupt the breeding cycle of the species, given no individuals or breeding activity were recorded during targeted surveys within the direct impact areas (Biodiversity Assessment Development Footprint). The area to be impacted would constitute a very small proportion of the overall habitat for the local population given the availability of suitable habitat in the surrounding locality.		Unlikely
6. modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;		
The Project may impact on potential habitat for Greater Gliders but as described above, considering the lack of species sightings within the Biodiversity Assessment Development where vegetation removal will take place and relatively small area of potential habitat to be impacted, the Project is not likely to contribute to decline of the species.		Unlikely
7. result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;		
The Project is not likely to result in the introduction of invasive species that may become established in habitat for the species.		Unlikely
8. **introduce disease that may cause the species to decline, or**		
The main diseases affecting Greater Glider is in the feed trees of Eucalypt species. *Phytophthora* a root fungus that is known to impact on the health of eucalypts. Whilst there is some potential for works plant and machinery to transport and disperse soil pathogens throughout the Subject Land, this risk will be managed through the use of vehicle wash down procedures.		Unlikely
9. Interfere substantially with the recovery of the species.		
There is no adopted or made Recovery Plan for this species.		Unlikely
Conclusion: The Project is unlikely to result in a significant impact on the Greater Glider		

Spotted-tailed Quoll (*Dasyurus maculatus maculatus*)

Spotted-tailed Quoll *(Dasyurus maculatus maculatus)*	**Endangered species**	**Likelihood**
An action is likely to have a significant impact on an endangered species if there is a real chance or possibility that it will:		
1. Lead to a long-term decrease in the size of a population of a species;		
The Spotted-tailed Quoll was not recorded during surveys within the Biodiversity Assessment Development Footprint or Subject Land, and no previous records of the species exist within these areas. Potential habitat for the species is present within the associated PCTs 1250, 978, 1083, 1181, 1395, 1804 and 1245. Within the Biodiversity Assessment Development Footprint and Subject Land, this covers approximately 1,989 hectares. Approximately 19.85 hectares (approximately 1%) of this total would be removed from the Biodiversity Assessment Development Footprint as a result of the Project. The Associated PCTs are not considered to be sensitive to indirect subsidence impacts. Due to the fact that no individuals of the Spotted-tailed Quoll were recorded within the Subject land during surveys, and the small area of potential habitat to be removed in comparison to the large surrounding areas it is considered unlikely that the Project would lead to a long-term decrease in the size of a population of the Spotted-tailed Quoll.		Unlikely
2. Reduce the area of occupancy of the species;		
The Spotted-tailed Quoll was not recorded during surveys for the species within the Subject Land and no records of the species exist within the Subject Land. While 19.85 ha of potential habitat for the species would be removed as a result of the Project, the lack of records and species detection may indicate a lack or low level of occupancy. This represents a small proportion of the available associated PCTs (approximately 1%) within the Biodiversity Assessment Development Footprint and Subsidence Assessment Subject Land. As such to the Project is unlikely to reduce the area of occupancy of the species.		Unlikely
3. Fragment an existing population into two or more populations;		
The removal of 19.85 hectares of potential habitat for the Spotted-tailed Quoll does not represent a significant amount of habitat in comparison to the large areas of surrounding habitat and associated PCTs to be retained. Furthermore, there are no known populations of the species within or immediately surrounding the Subsidence Assessment Subject Land. Therefore, the Project is unlikely to fragment an existing population into two or more populations.		Unlikely
4. Adversely affect habitat critical to the survival of a species;		
To date, no Critical Habitat as defined under section 207A of the EPBC Act has been identified or included in the Register of Critical Habitat for the species. The recovery plan for the species notes that currently, it is currently not possible to define (or map) habitat critical to the survival of the Spotted-tailed Quoll (DELWP 2016). Based upon the lack of detection or records of Spotted-tailed Quoll from potential habitat within the Biodiversity Assessment Development Footprint to be removed as a result of the Project, it is unlikely that this habitat is critical to the survival of the species. Furthermore, there are large areas of surrounding potential habitat which would be retained by the Project and the removal of		Unlikely

Spotted-tailed Quoll *(Dasyurus maculatus maculatus)*	Endangered species	Likelihood
19.85 hectares does not represent a significant proportion of this habitat or associated PCTs to be retained. Therefore, the Project is unlikely to adversely affect habitat critical to the survival of the species.		
5. Disrupt the breeding cycle of a population		
It is unlikely that the removal of areas of potential habitat of approximately 19.85 hectares would disrupt the breeding cycle of the species, given no individuals or breeding was recorded during targeted surveys within the direct impact areas. The area to be impacted constitutes a very small proportion of the overall habitat in the locality.		Unlikely
6. Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;		
The Project may impact on potential habitat for the Spotted-tailed Quoll but as described, given the lack of species sightings within the direct impact area and the removal of a relatively small area of potential habitat in the context of significant areas of surrounding habitat, the removal of 19.85 hectares of potential habitat is not likely to contribute to decline of the species.		Unlikely
7. Result in invasive species that are harmful to an endangered or critically endangered species becoming established in the endangered or critically endangered species' habitat;		
The Project is not likely to result in the introduction of invasive species that may become established in habitat for the species.		Unlikely
8. Introduce disease that may cause the species to decline, or		
Whilst there is some potential for works plant and machinery to transport and disperse soil pathogens throughout the Subject Land, this risk will be managed through the use of vehicle wash down procedures. It is considered unlikely that the proposed action will introduce disease that may cause the Spotted-tailed Quoll to decline.		Unlikely
9. Interfere with the recovery of the species.		
The National Recovery Plan for the Spotted-tailed Quoll (DELWP 2016) lists a number of recovery objectives to reduce the rate of decline of the species and ensure that viable populations remain throughout its current range in eastern Australia. These include: • Determine the distribution and status of Spotted-tailed Quoll populations throughout the range, and identify key threats and implement threat abatement management practices. • Investigate key aspects of the biology and ecology of the Spotted-tailed Quoll to acquire targeted information to aid recovery. • Reduce the rate of habitat loss and fragmentation on private land. • Evaluate and manage the risk posed by silvicultural practices. • Determine and manage the threat posed by introduced predators (foxes, cats, wild dogs) and of predator control practices on Spotted-tailed Quoll populations. • Determine and manage the impact of fire regimes on Spotted-tailed Quoll populations. • Reduce deliberate killings of Spotted-tailed Quolls. • Reduce the frequency of Spotted-tailed Quoll road mortality.		Unlikely

Spotted-tailed Quoll *(Dasyurus maculatus maculatus)*	Endangered species	Likelihood
• Assess the threat Cane Toads pose to Spotted-tailed Quolls and develop threat abatement actions if necessary. • Determine the likely impact of climate change on Spotted-tailed Quoll populations. • Increase community awareness of the Spotted-tailed Quoll and involvement in the Recovery Program. The Project is unlikely to interfere with these recovery objectives.		
Conclusion: The proposed action is unlikely to have a significant impact on the Spotted-tailed Quoll		

Swift Parrot (*Lathamus discolor*)

Swift Parrot *(Lathamus discolor)*	Critically Endangered species	Likelihood
Distribution and occurrence: The species is migratory, breeding in Tasmania and migrating to mainland Australian in Autumn (Saunders and Tzaros 2011). The species is nomadic, moving about in response to changing food availability and dispersing widely mainly in Victoria and NSW. In NSW, the species occurs in forests and woodlands throughout the coastal and western slopes. No records for the species occur within the Subject Land, or Biodiversity Assessment Development Footprint, or within 5 km of this area. While the Biodiversity Assessment Development Footprint is within the known range of foraging habitats for the species in south-eastern Australia, it is not mapped within the state based important area mapping for the species. The species has been assumed as present however, due to the identification of suitable habitats within areas that would be subject to vegetation clearing associated with the Project. **Habitats** The Swift Parrot occurs in woodlands and forests of NSW from May to August, where it feeds on eucalypt nectar, pollen, and associated insects. The Swift Parrot is dependent on flowering resources across a wide range of habitats in its wintering grounds in NSW. Associated PCT's supporting potential habitat within the Subject Land include 1250, 1083, 1181, 1395, 1804, 1245, representing a combined total of 1888.41 ha. **Potential impacts associated with the Project** The Project would result in vegetation clearing for surface infrastructure within the Biodiversity Assessment Development Footprint of the following PCT's supporting potential habitat for the species: • 1.1 ha of PCT1250 *Sydney Peppermint - Smooth-barked Apple - Red Bloodwood shrubby open forest on slopes of moist sandstone gullies, eastern Sydney Basin Bioregion.* • 18.58 ha of PCT1083 *Red Bloodwood – scribbly gum heathy woodland* (HN566). In addition to this, the Project has the potential to indirectly impact upon PCT 1804 *Coastal Upland Swamps of the Sydney basin bioregion* present within the Subsidence Assessment Subject Land through subsidence. The other PCT associations identified as potential habitats for the species are not considered to be sensitive to any potential subsidence impacts throughout the broader Subsidence Assessment Subject Land.		

Swift Parrot *(Lathamus discolor)*	Critically Endangered species	Likelihood
The area of potential direct and indirect impacts to foraging habitat as a proportion of all PCT's supporting potential habitat for the species within the Subsidence Assessment Subject Land and Biodiversity Assessment Development Footprint is approximately 1%. **Avoidance and mitigation measures adopted:** • Where possible, the areas proposed for surface infrastructure have utilised existing disturbed areas, to limit or avoid the creation of new edge effected areas and fragmentation of habitats. • Appropriate monitoring and control measures (such as vehicle wash down) would be implemented at the surface infrastructure sites during and after construction, to assist in preventing the introduction or spread of weeds or pathogens in areas of vegetation to be retained.		
An action is likely to have a significant impact on an endangered species if there is a real chance or possibility that it will:		
1. Lead to a long-term decrease in the size of a population of a species;		
Direct impacts may occur to a total of 19.68 ha and indirect impacts may occur to PCTs that are associated with habitat for the Swift Parrot. This is in the context of the total of 1,888.41 ha of PCT's associated with habitat for the Swift Parrot within the Subsidence Assessment Subject Land and Biodiversity Assessment Development Footprint. The Swift Parrot has not been recorded within the Subsidence Assessment Subject Land or Biodiversity Assessment Development Footprint. Due to the fact that no Swift Parrots have been recorded within the Subsidence Assessment Subject Land or Biodiversity Assessment Development Footprint, and the small area of potential habitat to be removed in comparison to the large surrounding areas (approximately 1%), it is considered unlikely that the Project would lead to a long-term decrease in the size of a population of the Swift Parrot.		Unlikely
2. Reduce the area of occupancy of the species;		
The Swift Parrot has not been recorded within the Subsidence Assessment Subject Land or Biodiversity Assessment Development Footprint. When this is considered with the small area of potential habitat to be removed in comparison to the large surrounding areas (approximately 1% within the Subsidence Assessment Subject Land and Biodiversity Assessment Development Footprint), it is considered unlikely that the Project would, as such to the Project is unlikely to reduce the area of occupancy of the species.		Unlikely
3. Fragment an existing population into two or more populations;		
The Swift Parrot occurs as a single, migratory population (Saunders and Tzaros 2011). No records exist for the species within the Subsidence Assessment Subject Land or Biodiversity Assessment Development Footprint, and only approximately 1% of the area of potential habitats has the potential to be impacted by the Project. The species is also highly mobile, moving in response to changing food resource availability. Therefore, the Project is unlikely to fragment an existing population into two or more populations.		Unlikely
4. Adversely affect habitat critical to the survival of a species;		

Swift Parrot *(Lathamus discolor)*	Critically Endangered species	Likelihood
To date, no Critical Habitat as defined under section 207A of the EPBC Act has been identified or included in the Register of Critical Habitat for the species. The National Recovery Plan for the species identifies that "*Habitat critical to the survival of the Swift Parrot includes those areas of priority habitat for which the Swift Parrot has a level of site fidelity or possess phenological characteristics likely to be of importance to the Swift Parrot, or are otherwise identified by the recovery team*" (Saunders and Tzaros 2011). The recovery plan has not identified specific priority sites within NSW. The Biodiversity Assessment Development Footprint is not within a state based mapped important area or Important Bird Area (IBA) (Dutson et al. 2009). No records exist for the species within the Biodiversity Assessment Development Footprint and the species has not been overserved during surveys for the Project. When taken together, these factors indicate that the habitats within Biodiversity Assessment Development Footprint is unlikely to be critical habitat for the species.		Unlikely
5. Disrupt the breeding cycle of a population		
The species does not breed within mainland south-eastern Australia.		Unlikely
6. Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;		
Given the lack of species sightings and the removal of a relatively small area of potential habitat to be directly and potentially indirectly impacted in the context of areas of surrounding habitat. the Project is not likely to contribute to decline of the species.		Unlikely
7. Result in invasive species that are harmful to an endangered or critically endangered species becoming established in the endangered or critically endangered species' habitat;		
The Project is not likely to result in the introduction of invasive species that may become established in habitat for the species.		Unlikely
8. Introduce disease that may cause the species to decline, or		
Whilst there is some potential for works plant and machinery to transport and disperse soil pathogens throughout the Subject Land, this risk will be managed through the use of vehicle wash down procedures. It is considered unlikely that the proposed action will introduce disease that may cause the Swift Parrot to decline.		Unlikely
9. Interfere with the recovery of the species.		
The National Recovery Plan (Saunders and Tzaros) lists a total of six recovery and supporting actions for the species: • Action 1 - Identify the extent and quality of habitat. • Action 2 - Manage and protect Swift Parrot habitat at the landscape scale. • Action 3 - Monitor and manage the impact of collisions, competition and disease. • Action 4 - Monitor population and habitat. • Action 5 - Increase community involvement in, and awareness of, the recovery program. • Action 6 - Coordinate, review and report on recovery process.		Unlikely

Swift Parrot *(Lathamus discolor)*	Critically Endangered species	Likelihood
The Project is unlikely to interfere with these recovery objectives.		
Conclusion: The proposed action is unlikely to have a significant impact on the Swift Parrot.		

White-throated Needletail *(Hirundapus caudacutus)*

White-throated Needletail (*Hirundapus caudacutus*)	Vulnerable Species	Likelihood
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:		
1. lead to a long-term decrease in the size of an important population of a species;		
There is no adopted or made Recovery Plan for the species and no important populations have been identified in Commonwealth conservation documents. It is considered unlikely that any population of White-throated Needletails in the Subject Land would be considered part of an important population. This is because the Subject Land is not at the limit of the species range and given the limited number and distribution of records across the surrounding locality it is unlikely to be a key source population for breeding or dispersal. The currently available information is insufficient to assess whether the local population would be necessary for maintaining the genetic diversity of the species, however given the number and distribution of records within the species range, this is considered unlikely. The White-throated Needletail was not recorded during the field surveys for the Project. There are no previous records from the Biodiversity Assessment Development Footprint or Subject Land, although scattered records do exist in the broader locality and the species may forage within the Subject Land on occasion. Associated PCTs for the species are present within the Biodiversity Assessment Development Footprint (1250, 1083, 1245) and Subject Land (1250, 978, 1083, 1181, 1395, 1804, 1245). Approximately 19.85 hectares of potential habitat for these species would be cleared as a result of the Project. Extensive areas of potential habitat for these species are also present within the Subject Land and locality and would be retained. The habitat within the Subject Land to be impacted is therefore not considered important habitat. Measures would be employed to avoid the removal of hollow-bearing trees and mature trees, and all areas of impact would be actively rehabilitated following decommissioning. The Project is unlikely to lead to long-term decrease in the size of an important population of this species given the substantial areas of similar habitat within the Subject Land and locality to be retained as well as limited importance of areas to be impacted as judged by survey.		Unlikely
2. reduce the area of occupancy of an important population;		
The White-throated Needletail is known to occur across eastern Australia. While the White-throated Needletail was not recorded during the field surveys for the Project and there are no previous records from the Biodiversity Assessment Development Footprint or Subject Land, scattered records do exist in the broader locality. The clearing associated with the Project may impact approximately 19.85 ha of potential habitat in the form of associated PCTs. Measures would be employed to avoid removal of		Unlikely

White-throated Needletail (*Hirundapus caudacutus*)	Vulnerable Species	Likelihood
hollow-bearing trees and mature trees, and all areas of impact to be actively rehabilitated following decommissioning associated with the service boreholes.		
3. fragment an existing important population into two or more populations;		
Clearing within potential habitat for the White-throated Needletail of approximately 19.85 hectares will occur, although, the works associated with this proposal are unlikely to lead to fragmentation or isolation of an existing population into two or more populations due to the restricted scale of the clearing impacts, extensive areas of potential habitat to be retained, extensive range and mobility of the species.		Unlikely
4. adversely affect habitat critical to the survival of a species;		
To date, no Critical Habitat as defined under section 207A of the EPBC Act has been identified or included in the Register of Critical Habitat for the species. The area of habitat to be impacted for the surface infrastructure would be approximately 19.85 hectares of potential habitat in the form of associated PCTs. Measures would be employed to avoid removal of hollow-bearing trees and mature trees, and all areas of impact would be actively rehabilitated following decommissioning associated with the service boreholes. The activity is unlikely to lead to adversely affect habitat to an important population to the survival of the species given over 1,965 hectares of similar habitat within the associated PCTs is present within the Subject Land.		Unlikely
5. disrupt the breeding cycle of an important population		
The species does not breed within Australia.		Unlikely
6. modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;		
The Project may impact on potential habitat for the White-throated Needletail but as described above, considering the lack of species sightings within the Biodiversity Assessment Development Footprint where vegetation removal will take place, the small area of potential habitat to be impacted, and extensive range of the species, the Project is not likely to contribute to decline of the species.		Unlikely
7. result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;		
The Project is not likely to result in the introduction of invasive species that may become established in habitat for the species.		Unlikely
8. introduce disease that may cause the species to decline, or		
Whilst there is some potential for works plant and machinery to transport and disperse soil pathogens throughout the Subject Land that could impact upon roosting habitat, this risk will be managed through the use of vehicle wash down procedures.		Unlikely
9. Interfere substantially with the recovery of the species.		

White-throated Needletail (*Hirundapus caudacutus*)	Vulnerable Species	Likelihood
There is no adopted or made Recovery Plan for this species. The Conservation Advice (Threatened Species Scientific Committee 2019) for the species lists a number of conservation actions that may assist the species. The Project is unlikely to interfere with these conservation actions.		Unlikely
Conclusion: The Project is unlikely to result in a significant impact on the White-throated Needletail		

Migratory birds

Fork-tailed Swift *(Apus pacificus),* Black-faced Monarch *(Monarcha melanopsis),* Spectacled Monarch *(Monarcha trivirgatus),* Rufous Fantail *(Rhipidura rufifrons),* Satin Flycatcher *(Myiagra cyanoleuca), White-throated Needletail (Hirundapus caudacutus)*

Fork-tailed Swift *(Apus pacificus),* Black-faced Monarch *(Monarcha melanopsis),* Spectacled Monarch *(Monarcha trivirgatus),* Rufous Fantail *(Rhipidura rufifrons),* Satin Flycatcher *(Myiagra cyanoleuca), White-throated Needletail (Hirundapus caudacutus)*	**Migratory Species**	**Likelihood**
An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:		
substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species		
The Fork-tailed Swift, Black-faced Monarch, Spectacled Monarch, Rufous Fantail and White-throated Needletail were not recorded within the Subject Land during surveys however they may occasionally utilise the Subject Land for foraging. The Satin Flycatcher was recorded once within the Subject Land. The potential foraging habitat present within the Subject Land is not considered to be important habitat for any of these species. The Fork-tailed Swift and White-throated Needletail are aerial foragers, flying anywhere from 1 m to 300 m above the ground to forage, with the White-throated Needletail able to forage up to more than 1000 m above the ground. The Black-faced Monarch generally forages in rainforest but also utilises open eucalypt forest. The Spectacled Monarch generally occupies rainforest vegetation but also occurs in moist or wet sclerophyll forest and other densely vegetated habitats. The Rufous Fantail generally inhabits wet sclerophyll forests with a dense shrubby understorey as well as subtropical and temperate rainforests and occasionally drier sclerophyll forests and woodlands. The Satin Flycatcher occupies heavily vegetated gullies in eucalypt-dominated forests and taller woodlands. Approximately 19.85 hectares of potential habitat for these species would be cleared as a result of the Project. Extensive areas of potential habitat for these species are also present within the Subject Land and locality and would be retained. The habitat within the Subject Land to be impacted is therefore not considered important habitat for the Satin Flycatcher, Fork-tailed Swift, Black-faced Monarch, Spectacled Monarch or Rufous Fantail. Therefore, the removal of approximately 19.85 hectares of native vegetation as a result of the Project is unlikely to substantially modify, destroy or isolate an area of important habitat for a migratory species.		Unlikely

Fork-tailed Swift *(Apus pacificus),* Black-faced Monarch *(Monarcha melanopsis),* Spectacled Monarch *(Monarcha trivirgatus),* Rufous Fantail *(Rhipidura rufifrons),* Satin Flycatcher *(Myiagra cyanoleuca), White-throated Needletail (Hirundapus caudacutus)*	**Migratory Species**	**Likelihood**
1. result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species		
The Project is not likely to result in the introduction of invasive species to an area of important habitat for the migratory species.		Unlikely
seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.		
The Fork-tailed Swift is a migratory species which breeds in Siberia before travelling south to Australia around October, while the White-throated Needletail breed in eastern Siberia, north-eastern China and Japan, only occurring in Australia between September and April. Therefore, there is no breeding habitat present within the Subject Land for these species. While the species may occasionally utilise the Subject Land for foraging, this is not considered an important area of habitat for the species. Therefore, impacts to this habitat as a result of the Project are unlikely to seriously disrupt the lifecycle of an ecologically significant proportion of the population of the Fork-tailed Swift or White-throated Needletail. The Black-faced Monarch breeds in rainforest habitat and nests near the top of trees and small saplings or in lower shrubs. No breeding habitat is present within the Subject Land. While there is potential foraging habitat for the species present within the Subject Land, this is not considered to be important to the lifecycle of the Black-faced Monarch. No breeding habitat has been recorded within the Subject Land for the Spectacled Monarch, Rufous Fantail or Satin Flycatcher. While there is potential foraging habitat for the species present within the Subject Land, this is not considered to be important to the lifecycle of the species.		Unlikely
Conclusion: The Project is unlikely to result in a significant impact to the Satin Flycatcher, Fork-tailed Swift, Black-faced Monarch, Spectacled Monarch or Rufous Fantail.		

Appendix 9. Coastal Upland Swamp Impact Assessment

Introduction

Coastal Upland Swamps are highly dynamic and variable ecosystems that depend on a range of factors (such as water availability, flow and permeability) that interact to form the specific structure, size and vegetation composition of the community. Subsidence associated with longwall mining has the potential to interrupt such natural interactions due to changes to hydrological processes through tensile cracking, movement of joint and bedding planes, and buckling. There is some concern that these subsidence impacts on Coastal Upland Swamps may result in desiccation, erosion, scouring, changes in floristic composition, loss of important fauna habitat and, ultimately, loss of the swamp and its broader water filtering function.

Predicting and quantifying longwall subsidence related impacts on Coastal Upland Swamps presents a range of challenges, due to the unique nature of each swamp, limitations in the ability to predict strains at point locations, and the dynamic nature of the ecosystem.

Impacts to Coastal Upland Swamps to date that have been observed and those that are widely reported as being mine subsidence related, have been stark and readily observable. Three Coastal Upland Swamps (Swamp 37 [Drillhole Swamp], Swamp 18/19 and Flatrock Swamp) that are represented as being impacted heavily by mine subsidence were also acknowledged to be impacted by activities that were unrelated to subsidence (Table 86). The difference in opinion amongst experts as to the cause of observed changes to the Coastal Upland Swamps is attributed to the unique interactions each swamp has within its natural setting.

IMC, Metropolitan Coal and Wollongong Coal have conducted biodiversity, hydrology and water chemistry monitoring of Coastal Upland Swamps within mining areas, and in control swamps (not subject to mining), since approximately 2003. The monitoring programs incorporate a Before-After Control-Impact (BACI) experimental design to determine whether subsidence associated with longwall mining results in changes to floristics and swamp size. The current monitoring programs typically involve fixed vegetation transects, photo monitoring, groundwater monitoring and vegetation condition observations at mined (impact) and non-mined (control) sites. In recent years, the data collected has been analysed, along with groundwater data, to assist in determining trends in vegetation transition.

From the monitoring programs, impacts to vegetation as a result of subsidence are determined by monitoring the following:

- Changes in Total Species Richness (TSR) or species composition following mining at or near an impact site that does not occur at a control site.
- Changes in TSR or species composition following changes in groundwater levels.
- Observational evidence in relation to vegetation dieback and decline in condition.
- The size of Coastal Upland Swamps or the wetter sub-vegetation communities such as Tea-tree Thicket and Cyperoid Heath communities.

However, detecting change in Coastal Upland Swamp vegetation and habitat change from subsidence is confronted with many limitations and variables, and as such, results have not been conclusive to date. This is largely attributed to the time over which change may be observed in vegetation as a result of subsidence, influences of the surrounding landscape, current limitations of monitoring (in particular current LiDAR and aerial interpretation models), and the unique nature of each swamp and its subsidence impacts.

In determining the potential for impacts associated the Project, MSEC (2022) has predicted a number of potential subsidence impacts that may be experienced in Coastal Upland Swamps within the Subject Land. In order to assess how this may impact upon the extent, floristic composition and habitat with the Coastal Upland Swamps, the results of the existing monitoring campaigns, coupled with relevant studies and discussion of historic erosion events have been used to understand the likely impacts to Coastal Upland Swamps.

Key monitoring programs undertaken at Dendrobium

An overview of the monitoring sites and associated Coastal Upland Swamps within Dendrobium Areas 3A and 3B that were monitored since 2003 is provided in Table 85.

Data and statistical analyses for the seasonal monitoring program is presented in detail in annual monitoring reports, however in summary, the vegetation monitoring techniques that were employed at thirteen Coastal Upland Swamps included:

- Vegetation survey once in autumn and once in spring each year;
- Airborne Laser Scanning (ALS), to collect LiDAR data, at the beginning of each year (typically between February and April); and
- Photo monitoring; once in autumn and once in spring at all flora monitoring locations.

The seasonal data was compared on an annual basis, and analysed using varying methods, with the focus on detecting trends on Total Species Richness (TSR), species composition, swamp size and, more recently, trends in relation to shallow groundwater recession. The latest report which compiles an analysis against 11.5 years of data (from ~2003 to 2016) collected during the monitoring (Biosis 2017).

Table 85. Monitored Coastal Upland Swamps at Dendrobium

Impact Swamp	Year monitoring commenced	Period of Monitoring	Within 400 m of longwall	Mined beneath	Control Swamp
	Dendrobium Area 3A				
Swamp 15B (S15B	2003	Ongoing	18/09/2010	25/08/2012	S15A(1) (Swamp 15A(1)) S33 (Swamp 33) S22 (Swamp 22)
S15A (2) (Swamp 15A(2))	2009	Ongoing	20/10/2012	All monitoring points beyond goaf	S15A(1) (Swamp 15A(1)) S33 (Swamp 33) S22 (Swamp 22)
	Dendrobium Area 3B				
S1A (Swamp 1A)	2012	Ongoing	23/02/2013	11/04/2013	S86 (Swamp 86) S87 (Swamp 87) S88 (Swamp 88) S15A(1) (Swamp 15A(1))
S1B (Swamp 1B)	2005-2009, then 2012-present	Ongoing	08/02/2013	13/02/2013	S86 (Swamp 86) S87 (Swamp 87) S15A(1) (Swamp 15A(1)) S22 (Swamp 22) S33 (Swamp 33)
S5 (Swamp 5)	2012	Ongoing	18/05/2013	25/07/2013	S86 (Swamp 86)

Impact Swamp	Year monitoring commenced	Period of Monitoring	Within 400 m of longwall	Mined beneath	Control Swamp
					S87 (Swamp 87) S88 (Swamp 88) S15A(1) (Swamp 15A(1))
S11	2003	Ongoing	21/05/2016	Beyond goaf. Predicted Longwall 14.	S15A(1) (Swamp 15A(1)) S22 (Swamp 22) S33 (Swamp 33)
S13 (Swamp 13)	2013 (spring only)	Ongoing	10/07/2017	Predicted Longwall 14 Predicted Longwall 15	S86 (Swamp 86) S87 (Swamp 87) S88 (Swamp 88) S15A(1) (Swamp 15A(1))
S14	2017	Ongoing	Predicted Longwall 17 Predicted Longwall 16 Predicted Longwall 15	Mined beneath: Predicted Longwall 17 Predicted Longwall 16 Predicted Longwall 15	S86 (Swamp 86) S87 (Swamp 87) S88 (Swamp 88) S15A(1) (Swamp 15A(1))
S23	2017	Ongoing	Predicted Longwall 15	Mined beneath: Predicted Longwall 15	S86 (Swamp 86) S87 (Swamp 87) S88 (Swamp 88) S15A(1) (Swamp 15A(1))

Predicted Impacts to Coastal Upland Swamps in the Subject Land

Key conclusions from MSEC (2022) in relation to potential impacts to Coastal Upland Swamps within the Subject Land include the following:

- It is unlikely that there would be large-scale adverse changes in the levels of ponding or scouring of the swamps.
- The swamps that are located outside of the extents of the proposed longwalls are predicted to generally experience tensile strains less than 0.5 mm/m and compressive strains less than 2 mm/m due to the proposed mining. It is unlikely, therefore, that the bedrock beneath these swamps would experience significant fracturing.
- The swamps that are located directly above the proposed longwalls are predicted to experience tensile strains greater than 0.5 mm/m and compressive strains greater than 2 mm/m. It is expected, therefore, that fracturing would occur in the bedrock beneath these swamps.
- Based on evidence in the NSW Coalfields, minor and isolated fracturing has been observed up to 400 m from longwalls; however, these have occurred within large river valleys and have not resulted in adverse impacts. Hence, it is possible that minor and isolated fracturing could occur in the bedrock beneath the swamps located outside the extents of the proposed longwalls but it is unlikely to result in adverse surface impacts on these swamps.
- The valley infill swamps have layers of organic soil that overlie the shallow natural surface soils and underlying bedrock along the alignments of the drainage lines. In most cases, cracking would generally not be visible at the surface within these swamps, except where the depths of bedrock are shallow or exposed.

- The headwater swamps have soil layers which overly the bedrock on the valley sides. It is expected that the potential for fracturing in these locations would be less when compared to the bases of the valleys, where higher compressive strains occur due to the valley-related movements, and due to the higher depths of cover along the valley sides.
- The dilated strata beneath the drainage lines, upstream of the swamps, could result in the diversion of some surface water flows beneath parts of the valley infill swamps. It is noted, however, that the drainage lines upstream of the swamps are generally ephemeral and, therefore, surface water flows occur during and shortly after rainfall events. On the basis that there is no connective fracturing to any deeper storage, it is likely that any diverted surface water will re-emerge at the surface further downstream. This would occur at the limit of the mining-induced fracturing along the downstream drainage lines.

The impact predictions provided in MSEC (2022) indicate that those Coastal Upland Swamps above longwalls are more susceptible to the effects of subsidence, compared to Coastal Upland Swamps located further away, and that it is unlikely that there would be large-scale adverse changes in the levels of ponding or scouring of the swamps.

Of the 22 Coastal Upland Swamp recorded within the Subject Land, 16 are located above longwalls, or occur within 60 m from the proposed longwalls. Using the MSEC (2022) predictions, fracturing could occur within the bedrock beneath these Coastal Upland Swamps. The remaining Coastal Upland Swamps are predicted by MSEC (2022) to be unlikely to experience significant fracturing.

The fracturing of bedrock has the potential to result in hydrological regime changes. These indirect impacts associated with the fracturing/cracking are tied to the water regime of Coastal Upland Swamps which is described in the Scientific Determination as (Booth 2006; NSW PAC 2009):

i) water drains into cracks in the bedrock that open beneath or upslope of the swamp as a result of simple tensile strains or complex buckling and shear that enhances connectivity of fractures; and

ii) tilting of the surface results in re-distribution of overland flows, loss of water from swamp margins and/or concentration and channelisation of runoff.

Given the dependence of Coastal Upland Swamps on the presence and persistence of water, the following key impacts have the potential to occur to Coastal Upland Swamps that are subject to hydrological changes as a result of subsidence:

- Reduction in groundwater levels or desaturation of the Coastal Upland Swamp sediments.
- Transition of the Coastal Upland Swamp to a drier vegetation type.
- Desaturation of soil particles exposing the swamp to peat desiccation.
- Exposure to bushfire intensity due to loss of inundation.
- Scour and erosion event.

Each of these potential impacts in relation to the Subject Land are explored in the following sections.

Reduction in Groundwater Levels or Desaturation of Coastal Upland Swamps

Subsidence from longwall mining may cause the water table to drop from the near surface to below the sandstone base, under the swamp sediments (Young 2017). This in turn impacts upon the natural recharge and discharge system of the Coastal Upland Swamp. This process is described in Young (2017) as involving the following:

- Water table within the swamp rises to near surface from rainfall event.
- Water is lost from the swamp through evapotranspiration, and during high rainfall the runoff can exceed the storage capacity of the sediments so that water flows out at the swamp exit.
- After a swamp is mined beneath and where there is an impact on the groundwater levels, the water table drops rapidly, and even after heavy rain, rises only briefly before sinking again to below the bedrock base.
- The swamps inundate occasionally but much less frequently and for a much shorter period than prior to mining.

The OEH (2016a) *Addendum to NSW Biodiversity Offsets Policy for Major Projects, Upland Swamps impacted by Longwall Mining Subsidence* (Swamps Offset Policy)requires that offsets be developed where greater than negligible environmental consequences for Coastal Upland Swamps are predicted.

Negligible environmental consequences as per Swamps Offset Policy (OEH 2016a) is considered to mean one or more of the following:

- Negligible change to the shallow groundwater regime of a swamp compared with control swamps.
- Negligible change to the composition or distribution of swamp dependent vegetation communities and threatened species.

Greater than negligible environmental consequences include one or more of the following:

- A shallow groundwater level within swamp sediments lower than the baseline level at any monitoring site within a swamp (in comparison to control swamps).
- A rate of shallow groundwater level reduction post-mining that exceeds the rate of shallow groundwater level reduction during the baseline period at any monitoring site (measured as average mm per day during the recession curve).

If it is predicted that Coastal Upland Swamps are likely to experience greater than negligible environmental consequences as a result of mining subsidence, conditions of the approval will require that, on the approval of an extraction plan, a proponent must demonstrate a legal ability to secure offsets for the swamps.

Negligible environmental consequences are focused on groundwater as the best and most certain indicator of whether there will be an impact on the ecological community, as swamps are water-dependent ecosystems. The Policy contends that if the shallow groundwater regime within swamp sediments is impacted during, or within 12 months after, mining operations, it is likely that the groundwater-dependent vegetation community and threatened species that comprise the swamp community will also be lost over time.

Piezometers have been installed throughout Coastal Upland Swamps as part of the existing mining monitoring programs, which provide an indicator for changes to the groundwater regime of a Coastal Upland Swamp. Under a natural regime, many swamps demonstrate a relatively constant rate of water level decline following rainfall, which can be mainly attributed to evapotranspiration and possibly some drainage to the underlying sandstone (Advisian 2016). A subsidence impacted swamp would typically exhibit a sharp drop in water level from the piezometer, following a recharge event.

Recent historic analysis completed by Watershed (2021) of Dendrobium Coastal Upland Swamps and swamp piezometers following longwall mining was undertaken to determine the distance at which piezometers have indicated an impact[29] to water table and recession rates. During the analysis, a total of 75 sites were assessed i.e. shallow piezometers located within the updated Coastal Upland Swamp mapping. Of the sites, 30 were considered to show a degree of impact, including 10 which showed effects as water levels falling below pre-mining baseline, while 29 showed increased recession rates. Based on assessments of water levels and recession rates around past mining in Areas 2, 3A and 3B, it was concluded by Watershed (2021) that hydrographs from swamp piezometers within 60 m are likely to exhibit a mining effect and almost certain to exhibit a mining effect when directly mined beneath, be that through a reduction in the water table to below pre-mining levels and/or increased recession (drainage) rate. Effects on swamp water tables were not reported at distances greater than 60 m from a longwall panel.

In regard to the Coastal Upland Swamps of the Subject Land, it is therefore likely that swamps located above longwalls and within 60 m of longwall workings (16 are located directly above or within 60 m of proposed longwalls), may experience some degree of groundwater impact. The severity of impact is uncertain, however based on the historic impacts recorded at Dendrobium, Metropolitan and Russell Vale Colliery, it seems likely that groundwater recession rates may increase following rainfall events, and current levels of waterlogging may become periodic.

[29] As discussed in Watershed (2021) "in other studies at Dendrobium, the definition of 'impact' is consistent with the SIMMCP regarding how an impact or environmental consequence of mining is classified:

1) A shallow groundwater level within swamp sediments lower than the baseline level at any monitoring site within a swamp (in comparison to control swamps).
2) A rate of shallow groundwater level reduction post-mining that exceeds the rate of shallow groundwater level reduction during the baseline period at any monitoring site (measured as average mm per day during the recession curve).

In some instances, both the above modes of impact may be observed at a single site, and in others, just one might be identified from the water level record".

Transition of the Coastal Upland Swamp to a Drier Vegetation Type

Most vegetation studies of Coastal Upland Swamps have reported spatial heterogeneity in floristic composition and structure (Keith and Myerscough 1993; Keith 2004). Species richness and composition of Coastal Upland Swamps are highly correlated with the soil moisture gradient that transitions from the drier margins to a waterlogged core (Keith and Myerscough 1993). The hydrological conditions are maintained due to precipitation and water supply exceeding the rate of evapotranspiration and runoff (Keith et al. 2006), with some sections of some Coastal Upland Swamps supporting a perched water table that maintains species diversity and vegetation communities reliant on semi-permanent to permanent waterlogging. As such, vegetation communities with Coastal Upland Swamps are reflected by moisture and nutrient gradient in the underlying soil, resulting in boundaries that may be discrete or subtly transitional.

Coastal Upland swamp vegetation is likely to be relatively resilient to short-term changes in groundwater level and soil moisture, demonstrated by the persistence of the swamp vegetation communities during extended periods of drought. However, it is reasonable to suggest that changes to swamp hydrology that are extensive and persistent may result in changes in the floristics and structure of the community. The thresholds that influence such a vegetation transition is unknown.

The extent to which subsidence may impact the vegetation or flora within a Coastal Upland Swamp is likely to depend on the extent of groundwater changes in the swamp, and the resilience of a particular vegetation type to such change. The groundwater connectivity in swamps is related to the inundation, soil parameters and water quality, which in turn all influence vegetation composition.

Keith and Myerscough (1993) described the following five vegetation communities that grow within Coastal Upland Swamps:

- Banksia Thickets (PCT978): develops on the edge of larger swamps, often occupying the highest parts of swamp topographical sequences. Its soils are predominantly drier and sandy, yet they have intermediate levels of total phosphorus, conductivity and exchangeable cations. Its higher levels of organic matter might be explained by a greater rate of litterfall, rather than by a slower rate of decay due to poor aeration (Keith and Myerscough 1993). *Banksia ericifolia* subsp. *ericifolia* and *Hakea teretifolia* are the dominant diagnostic species of this assemblage.
- Tea-tree Thicket (PCT1804): occupies major seepage zones of large swamps, which typically have deep, highly organic waterlogged soils. In general, levels of soil nutrients are highest in Tea-tree Thicket compared to the other Coastal Upland Swamp vegetation. Keith and Myerscough (1993) note that waterlogging is continuous and peat development is greatest in Tea-tree Thicket. Young (1986) showed that the soils, termed 'organic fines', have a high silt/ clay content in their mineral fraction, as well as a high organic carbon content. Their high nutrient status may therefore be explained by a large input of nutrient ions from runoff and downwash, and by the abundance of clay and organic particles which provide a large number of exchange sites for mineral cations. Tea-tree Thicket has a tall to short, relatively dense shrub stratum with *Leptospermum juniperinum, Leptospermum grandifolium, Melaleuca squarrosa, Baeckea linifolia* and *Banksia robur*, and a tall, very dense stratum of ferns; Gleichenia spp., and sedges *Gahnia sieberiana* and *Baumea teretifolia*.
- Sedgeland-Heath Complex (PCT978): comprises of three communities, Cyperoid Heath, Restioid Heath and Sedgeland, have been described by Keith (1994):

- Cyperoid Heath prefers the wetter locations on organic sandy soils (Young 1986) within the Coastal Upland Swamp complex, though it is replaced by Tea-tree Thicket in drainage lines. Sedges from the Cyperaceae family, including *Gymnoschoenus sphaerocephalus* and *Lepidosperma limicola*, dominate Cyperoid Heath. Low shrubs of *Banksia robur* and *Leptospermum juniperinum* occur patchily.
- Restioid Heath occupies relatively drier sites within the swamp complex, with sedges from the Restionaceae family forming the dominant ground cover. Species include *Leptocarpus tenax*, *Empodisma minus* and *Lepyrodia scariosa*. A low spreading shrub layer of *Banksia oblongifolia* and *Hakea teretifolia* is common. Restioid heath occupies higher parts of the topographical sequence where soils are periodically dry, preventing the accumulation of large amounts of peat. This, and their low clay content, provide few exchange sites for mineral nutrients which are leached downslope, perhaps to be adsorbed in soils with higher clay and organic fractions.
- Sedgeland occurs on the perimeter of larger Coastal Upland Swamps or on gently sloping 'hanging swamps' in the headwaters of sandstone gully lines. Similar to Restioid Heath, Sedgeland occupies higher parts of the topographical sequence where soils are periodically dry, preventing the accumulation of large amounts of peat. A thick, low cover of sedge species spreads across the extent of the community. Species such as *Leptocarpus tenax*, *Schoenus brevifolius, Schoenus paludosum* and *Lepyrodia scariosa* are frequently recorded. A number of sparsely scattered low shrubs such as *Sprengelia incarnata, Epacris obtusifolia* and *Symphionema paludosum* are also found.

- Eucalypt Fringing Woodland (PCT978): is a transitional area between the Coastal Upland Swamp vegetation and the sandstone woodlands. Essentially this fringing swamp community shares species from both the Restioid Heath Complex and the Sandstone Woodlands with a sparse cover of Eucalypts, usually those from the Scribbly Gum complex, Eucalyptus racemosa/haemastoma.

A further vegetation unit, referred to as Coastal Upland Swamps: Mallee-Heath is not described by Keith and Myerscough (1993), however it is described as part of the Native Vegetation of the Woronora, O'Hares and Metropolitan Catchments mapping project (NPWS 2003a). The vegetation unit is distributed on drier gradients with the Coastal Upland Swamp Complex in the Avon and Nepean Catchments, and only occasionally in the north near Maddens Plains. *Eucalyptus stricta* occurs in dense clumps amongst a low cover of shrubs such as *Banksia ericifolia* subsp. *ericifolia*, *B. paludosa* subsp. *paludosa*, *Allocasuarina nana*, *Petrophile sessilis* and *Leptospermum attenuatum* with ground cover typical of Restioid Heath.

Changes to groundwater may result in changes to vegetation structure and composition within a swamp. A decrease in species distribution or abundance, or extent of sub-communities, that are reliant on semi-permanent to permanent waterlogging (such as Tea-tree Thicket and Cyperoid Heath) within a swamp that has experienced lower water levels following mining, may indicate a vegetative impact from mining. Similarly, an increase in drier vegetation types within swamps that have experienced lower water levels following mining, such as Banksia Thicket or Eucalypt Fringing Woodland, may also serve as an indicator of mining impacts. The extent to which subsidence may impact vegetation or flora within a Coastal Upland Swamp is likely to depend on the extent of groundwater change in the swamp, and the resilience of a particular vegetation type to such change.

The Coastal Upland Swamps within the Subject Land comprise predominately drier swamp vegetation types including: approximately 46% of Eucalypt Fringing Woodland (not part of the threatened community listing), 45% of Restioid Heath, and 0.6% of Banksia Thicket. Wetter swamp communities consisted of 7% of Tea-tree Thicket. It may be reasonable to conclude based on monitoring data and literature review, that a decrease in species distribution or abundance, or extent of sub-communities, that are reliant on semi-permanent to permanent waterlogging (such as Tea-tree Thicket and Cyperoid Heath) within a swamp that

has experienced lower water levels following mining, may indicate an impact from mining. Similarly, an increase in drier vegetation types within swamps that have experienced lower water levels following mining, such as Banksia Thicket or Eucalypt Fringing Woodland, may also serve as an indicator of mining impacts. Thus, given 92% of the vegetation within the Coastal Upland Swamps of the Subject Land are the drier communities, may indicate that for the most part, the swamps are already in a transitioning state to a woodland community, or are less reliant on waterlogging.

The existing monitoring programs are largely centred on this notion, through pre and post mining comparisons between impacted swamps and control swamps. However despite changes in groundwater in some mined swamps, there is no conclusive evidence (or even suggestive correlations) from the monitoring reports to date that indicate that a significant vegetation response has occurred in response to mining. Recorded hydrological and vegetative changes have also been attributed to landscape influences such as increased rainfall, increased temperatures and more-frequent fire.

A review completed by Biosis (2017) of the data collected during the previous 11.5 years of the Dendrobium Area 2, 7.5 years in Dendrobium Area 3A and 4.5 years in Dendrobium Area 3B monitoring did not provide a strong link with subsidence and vegetation response. Key conclusions from Biosis (2017) included:

- Swamp size and the extent of groundwater dependent swamp sub-communities, mapped using LiDAR data, showed a universal decrease across control and impacted swamps.
- All Coastal Upland Swamps (impact and control) continue to show a trending decline in Total Species Richness (TSR).
- Statistically significant yearly and, occasionally, seasonal trends in species composition were detected at most sites, regardless of mining area or treatment. Such widespread trends are indicative of natural turnover of species within Coastal Upland Swamps in response to seasonal and annual variability in climate, competition, disturbance and edaphic factors, including nutrient availability.
- Species composition was found to be changing (increasing or decreasing at sites) every year at both control and impact sites, and this change is statistically significant at most sites.
- Photo monitoring did not detect any conclusive differences between impact and control sites.
- Swamp 15B and Swamp 1A show a small, but statistically significant, decline in TSR following mining.

Similarly, key conclusions were echoed in the latest Wollongong Coal monitoring report (Biosis 2017) and conclusions provided in the Metropolitan Coal Annual monitoring summary reports (Trevor Brown & Associates 2016; Peabody 2013; 2014; 2015).

Wollongong Coal monitoring report (Biosis 2017) key conclusions include:

- TSR is higher in mined swamps compared with un-mined swamps.
- The extent of Coastal Upland Swamps in the Subject Land remained constant between 1951 and 1984. A decline in swamp size occurring between 1984 and 2012 is coincident with a decline in rainfall over the same period.
- No direct relationship between subsidence and vegetation change within Coastal Upland Swamps has been shown.

Metropolitan Coal annual monitoring summary reports (Trevor Brown & Associates 2016; Peabody 2013; 2014; 2015) key conclusions include:

- No statistically significant differences in the variation of species composition and abundance within or between plots were found.
- Analysis of quadrat/transect data indicates that the vegetation in Coastal Upland Swamps overlying the longwalls has not experienced changes significantly different to changes in control swamps.
- Monitoring of Coastal Upland Swamp vegetation has reported some random senescence of individual plants in both control and impact sites.
- Fluctuations in vegetation condition have also been recorded across all sites.
- Dieback was observed in both mined and unmined swamps, but also in areas well outside the current survey area.

The most recent Niche (2021) monitoring report concludes the following:

- Direct comparisons of the 2020 data with previous years data show a decrease in swamp extent in 2020 relative to previous years. The decrease in total swamp extent is a continuation of the trend from previous years monitoring of decreasing swamp extent.
- Areas of drying/die-back were observed in Impact Upland Swamps during the 2020 field survey and in the UAV Imagery. However these areas were still mapped as areas of Upland Swamp in 2020, as it was not clear if vegetation within the swamp was experiencing die-back, or just going through a period of drying.
- The cumulative impact of mining on total swamp extent is represented by the change in swamp extent compared to baseline. Generally, across control and impact swamps, there was a contraction in total swamp extent between 2019 and 2020. This catchment wide effect may be a result of the significant drought that peaked in 2018/2019 impacting moisture availability for swamps across the catchment. Upland Swamps have not yet responded to the increase in rainfall experienced in 2020.
- Trends across swamps indicate declining TSR post-mining for most (but not all) Impact Upland Swamps.
- An assessment of overall trends in Dendrobium Area 3 data reveals highly variable TSR. TSR is highly variable between years, and across each mining status ('Control', 'Pre-mining', 'Post-mining (within RMZ)', or 'Mined beneath'). It appears there is high variability in TSR in all Upland Swamps regardless of year or mining status. However, the TSR in Impact Upland Swamps (mined beneath) appears to be declining over time in comparison to the Controls. It cannot be determined whether this is an artefact of sampling (i.e. some swamps have only been sampled a few times), or actual patterns due to disturbance (e.g. die-back may have reduced species richness initially, followed by colonisation by non-swamp species in disturbed areas) from this plot analysis alone as such analysis of species composition is undertaken to compliment TSR analysis.
- Cumulative impacts have been observed at a number of Impact Upland Swamps, which show trends of significant decline in TSR over time.
- Compositional changes show trends of the loss of wetland flora species, which are either being replaced by species more tolerant of drier soil (suggesting changes toward drier swamp subcommunities) or not being replaced with any new vegetation (suggesting the die-back of swamp vegetation) broadly across monitored Upland Swamps, particularly for those Impact Upland Swamps that have longer post mining impact data available, although it is reasonable to expect natural species turnover to occur at a swamp, especially after an extended drought period.
- Cumulative impacts have been observed at a number of Impact Upland Swamps, which show trends of significant changes to composition, with 'wetter' species becoming less common post impact, suggesting a loss of species that prefer moist soils. Some swamps show species dying out over time, with limited recruitment of new species, suggestive of dieback.

Whilst no definitive links to subsidence and vegetation response have been presented in the available monitoring reports, the time between the impact and vegetative response may not be immediate and not yet detected in monitoring data. Given the persistence of Coastal Upland Swamps throughout periods of

drought, it is likely that the swamps are relatively resilient to short term changes in groundwater level and soil moisture.

Given the Coastal Upland Swamps of the Subject Land are made of up of 92% of drier subvegetation communities (Eucalypt Fringing Woodland, Banksia Thicket and Restioid Heath), it is also possible that these communities are more resilient to hydrological changes, given they are not as dependent on waterlogged peat compared to wetter subvegetation communities (Teatree Thicket, and Cyperoid Heath). However to date, no studies have been completed to support this.

Within recent years, LiDAR and historic aerial mapping of Coastal Upland Swamps has been incorporated in both Dendrobium and Wollongong Coal monitoring programs, to determine if Coastal Upland Swamp boundaries have been changing since longwall mining. The LiDAR and historic aerial mapping analysis completed by Biosis (2015, 2016, 2017) indicates that there has been a decline in the size of Coastal Upland Swamps and sub-vegetation communities within the Dendrobium and Russell Vale mining domains. This decline in size of swamps was attributed to the inward contraction of the swamp perimeter, leading to an encroachment of Eucalypt Fringing Woodland. The historical mapping of Coastal Upland Swamps for Dendrobium and Russell Vale showed that a decline in the size of Coastal Upland Swamps has occurred regardless of mining status, although impacted swamps showed a greater decline on average.

Monitoring at Russell Vale indicated that the size of Coastal Upland Swamps remained stable between 1951 and 1984, with a significant decline occurring between 1984 and 2012 (Biosis 2015). The decline in swamp size was attributed to rainfall, given a strong relationship between declines in Coastal Upland Swamps and a decline in monthly rainfall since the mid-1980s.

LiDAR monitoring at Dendrobium Mine indicates that the size of Coastal Upland Swamps at all control and impact swamps in the Dendrobium 3A and 3B areas in 2014, 2015 and 2016 was smaller than the extent measured in the baseline year of 2012. There was a substantial decline in swamp extent from 2012 to 2014, followed by a small increase in swamp extent in 2015, relative to the 2014 extent, and a subsequent decline again in 2016 (Biosis 2017a). Similarly, the change in the extent of Coastal Upland Swamp sub-communities typically decreased substantially from 2012 to 2014, then increased or remained stable from 2014 to 2015, and subsequently decreased again between 2015 and 2016.

Whilst there are a number of limitations associated with the LiDAR and historic mapping analysis (Biosis 2015; 2016; 2017), the result presented in the reports is a similar outcome to the vegetation monitoring; namely that to date, there is no definitive evidence relating a decrease in swamp extent to the effects of mining.

It seems likely that any large-scale vegetative response to Coastal Upland Swamps within the Subject Land, is not likely to be immediately detected and may take several years to be revealed. However, regardless of this, as detailed in the Scientific Determination, longwall mining has the potential to decrease the size of a Coastal Upland Swamp over time. Impacted Coastal Upland Swamps within the Subject Land therefore may exhibit such a vegetation change.

Desaturation of Soil Particles Exposing the Swamp to Peat Desiccation

A reduction in the water table from subsidence may result in changes to the cohesion of the soils within a Coastal Upland Swamp. The organic matter within the soil may undergo a hydrophobic reaction, which in turn results in the organic matter, which binds the sand grains, becoming loose and resulting in sediments that are highly erodible (Young 2017, DPE 2015).

Long-term studies into the loss of organic sediment and soil cohesion have not been looked at in detail in relation to Coastal Upland Swamps in the Southern Coalfield, however soil moisture monitoring has recently been included in IMC's Dendrobium Mine monitoring program to assist in determining any trends in regard to this.

To date, soil moisture levels of a number of swamps within Dendrobium Area 3B (Swamp 1a, 1b, 5 and 11) have been reported to have soil level moisture below baseline records following mining (DPE 2015).

It is likely that given the correlation between groundwater and soil moisture, should Coastal Upland Swamps in the Subject Land exhibit changes to groundwater recession due to subsidence, they would be likely to have some decline in moisture in parts of the swamp.

The long-term impacts of changed moisture regimes within Coastal Upland Swamps in relation to the drying of the soil is unclear due to the lack of data and studies in this regard. However as a worst case scenario, as noted in Young (2017), eroding sediments may result in a knickpoint forming, or may ultimately facilitate an erosion and gully event in a Coastal Upland Swamp. However, as discussed in later in this section, such catastrophic erosion and gully events have only been observed in three Coastal Upland Swamps (of the more than 500 subject to subsidence) and MSEC (2022) predict that it is unlikely that there would be large-scale adverse changes in the levels of ponding or scouring of the swamps.

Exposure to Bushfire Intensity due to Loss of Inundation

It is unclear the extent to which Coastal Upland Swamps within the Subject Land would have a change in waterlogging as a result of subsidence. However, it is possible that should a decrease in waterlogging occur, it may expose the Coastal Upland Swamp to higher intensive burns resulting in peat desiccation. Determining the likelihood for any one individual swamp to be exposed to such an impact is influenced by many factors, and thus presents significant prediction difficulties. As such, all swamps should be regarded as potentially exposed to this potential risk over time.

Such a potential impact is further exacerbated by climate change, which is predicted to be warmer and drier, with a greater proportion of rain falling during summer, which is likely to result in an increase in frequency of fire (Scientific Committee 2012, Hennessy *et al*. 2004, DECC 2008). OEH (2014b) has produced the Illawarra Climate Change Snapshot, which provides climate change projects specific to the Illawarra. In addition to temperate and rainfall changes, it projects the region is expected to experience an increase in hot days (days over 35°C) per year and changes in projected severe fire weather that are relatively small (up to 1 more day per year of severe fire weather). Mean temperatures in the Illawarra Region are projected to rise by 0.62°C by 2030 and 1.9°C by 2070 (AdaptNSW 2022). South 32 (2022) report that as predicted average temperatures are likely to rise in the Project area, and extreme temperature events may increase in frequency, suggesting that bushfire activity may become more prevalent in the region, due to the potential of prolonged dry periods. Prolonged dry periods and strong winds particularly increase the potential for a bushfire. The degree of the potential impact of a bushfire is dependent on the climatic conditions and the amount of fuel available.

It is suggested by Keith et al (2006) that an increased fire frequency of around 15 years may not be compatible with the persistence of Coastal Upland Swamp vegetation. An increased fire regime from climate change may result in a decline of resprouting shrubs and sedges, which may lead to more prolonged exposure of soils after fires, especially if fires consume all ground fuels. This is because resprouting plants restore groundcover more rapidly than new seedlings. Prolonged or enhanced soil exposure could lead to accelerated decay of organic matter and/or accelerated erosion of surface soils, particularly if heavy rainfall events occur in the early post-fire years (Keith et al 2006). Erosion and

reductions in the organic content of swamp soils are likely to increase the turbidity and mineral content of discharge waters and reduce the water retention capacity of the swamps (Young 1986). Subsidence may have a role in exacerbating the process through drying soils as a result of a changed groundwater regime, however as noted previously, soil monitoring studies are limited.

Bushfire Management Plans have been prepared by the Illawarra Bush Fire Management Committee (2016) and Wollondilly/Wingecarribee BMFC (2016). These plans include a range of measures to reduce the potential for the ignition of bushfires. Key mitigation measures include minimising and controlling ignition sources. IMC has considered the key potential climate change risks to the Project (particularly increased frequency of bushfires) in the design of the Project and would continue to assess climate change risks on an ongoing basis via implementation of an adaptive management approach (South 32 2022).

Erosion Events and Swamp Dewatering

Within the Southern Coalfield, a number of Coastal Upland Swamps have been impacted by a range of man-made and natural occurrences, and subsidence related mechanisms, which have been reported widely (e.g. Tomkins and Humphreys 2006, Krogh 2007, Krogh 2012, DP 2008, Commonwealth of Australia 2014, Pells and Pells 2015, Bower 2015, Advisian 2016). Many of the investigations over the past few decades have focused on those swamps that have experienced episodes of erosion and gullying, notably:

- Swamp 37 (Drillhole Swamp) – which occurs within Avon catchment within the Wongawilli Colliery leases.
- Flatrock Swamp in the Woronora catchment at Darkes Forest, within Metropolitan Coal's mining lease.
- Swamp 18/19 in Avon catchment within the Elouera Colliery lease.

Investigations into these Coastal Upland Swamps present contrasting views on the role of subsidence in the erosion and gullying events that occurred in the swamps, owing to other factors such as the occurrence of rainfall, bushfires, natural erosional phasing of the Coastal Upland Swamps, and direct man-made impacts, which have been summarised in Table 86.

It is apparent based on the conclusions in the investigations that the limited monitoring data prior to initiation of the erosion events, coupled with the lack of understanding of swamp thresholds and resistance to change, has led to great uncertainty in the role subsidence played in the erosion events.

In relation to the Project, MSEC (2022) states that for the Coastal Upland Swamps in the Subject Land it is unlikely there will 'be large-scale adverse changes in the levels of ponding or scouring of the swamps based on the predicted vertical subsidence and tilt'. Given over 500 swamps have been directly mined beneath using varying methods (Richardson and Ryan 2007), with only three exhibiting gully and erosion events, it seems unlikely that such events would be experienced within the Subject Land.

Table 86. Historic impacts to Drillhole Swamp, Flatrock Swamp, and Swamp 18/19

Coastal Upland Swamp	Type of impact	Details regarding impact event
Drillhole Swamp, located on Flying Fox Creek No 1 in the headwaters of the Avon catchment	Cracks in bedrock downstream of Drillhole Swamp Physical disturbance from MWSDB enquiry Gully erosion event	Experienced a gully erosion event in 1978 which eroded a large portion of the Coastal Upland Swamp. The gully event has been attributed by some studies to a subsidence event that occurred as a result of bord and pillar extraction mining methods in the 1960s and 1970s (Kapp 1980), which was noticed in 1971 by cracking in the bedrock downstream of the swamp (Tomkins and Humphrey 2006). An investigation by the Metropolitan Water, Sewerage and Drainage Board (MWSDB) in the early 1970s, as part of the Coal Mining Under Stored Water Inquiry (the Reynolds Inquiry), is known to have caused a significant disturbance to the swamp surface, which could reasonably be attributed to being a major knickpoint for the erosion event. The disturbance to the Coastal Upland Swamp by the MWSDB investigation included the construction of an access track across the centre of the swamp, clearing of a section of the swamp to bedrock, mounding of the spoil along the swamp margins and construction of a small dam on a creek upstream of the swamp, as well as drilling activities into bedrock) (Reynolds 1978, Tomkins and Humphrey 2006). A significant rainfall event occurred in March 1978 which resulted in the collapse of the small dam upstream of the swamp, and triggered erosion of a gully which cut through the swamp (Tomkins and Humphrey 2006). Young (2017) notes that 502 mm of rain fell over three days (19-21 March 1978) which was the fifth highest rainfall event in the area between 1967 and 2005. Young (2017) estimates that 8,250 m^3 of sediment was eroded from the swamp in this event. Young (2017) notes that the mining beneath the swamp had resulted in multi-seam extraction resulting in 2.4 m of subsidence and reduced water table (8 m below the surface and 3-4 m below the bedrock in the swamp). Young (2017) concludes, in her view, that while the dam failure was the trigger for the erosion event, the long period of drying prior to the event left the swamp sediment highly erodible.
Swamp 18/19 located on Native Dog Creek in the headwaters of the Avon catchment	Gully erosion Swamp dewatering Construction of the incomplete Maldon Dombarton railway across the upper reaches of the swamp, including infilling the valley and diversion of the stream into a culvert system.	A major gully in the swamp was discovered on 19 August 2002 following bushfire events in 2001 to 2002. Subsidence: Subsidence related cracks in bedrock were first noticed in the creek downstream of the swamp in late 2001 (Tomkins and Humphrey 2006). Evidence found that bedrock beneath the swamp had cracked and water had drained to within the bedrock layer (Gibbins 2003 cited in Tomkins and Humphrey 2006). The gully that formed in 2002 has been attributed by some to dewatering of the swamp by mining and burning of the swamp surface during the fires, followed by an intense storm. Bushfire events: Swamp 18/19 has experienced two major wildfires and a hazard reduction burn since 1964. The 2001-02 wildfire caused extensive damage to the swamp vegetation in all but the upper part of the swamp and the side swamps. EarthTech (2003) concluded that Swamp 18/19 is subject to periodic erosion events related to disturbance such as fire and subsequent significant flow events, however could not establish links between mining and an increased risk of wildfires, and mining subsidence and gully erosion (Tomkins and Humphrey 2006).

Coastal Upland Swamp	Type of impact	Details regarding impact event
		Biosis Research (2001) discusses that the 2001-02 fires likely resulted in high severity burning of the near surface layers along with the fractured nature of the peat units indicates that dewatering had taken place and the surface of the swamp was dry by late 2001. It is possible that subsidence accelerated dewatering of Swamp 18/19 during the late 1990's which enhanced burning during the 2001-02 wildfires. Alternatively, the gully erosion through the lower part of the swamp prior to 1990 could have drained the swamp sufficiently to cause a similar effect. Existing gully events Tomkins and Humphrey (2006) showed that gully erosion of the lower extension of the swamp had commenced before 1951 and had reached the main body of Swamp 18/19 by 1990. This was well before known underground coal mining and before the 1968 and 2001-02 wildfires. Thus, the gully had been active for over 50 years prior to the erosion event following the 2001-02 fire.
Flatrock Swamp is located on Waratah Rivulet in the headwaters of the Woronora catchment	Gully erosion Swamp dewatering	Flatrock Swamp has had a history of gully erosion pre and post mining. Metropolitan Colliery and Sydney Catchment Authority first noticed cracks in the bedrock in Waratah Rivulet at the end of 2003, however no cracks were observed in Flatrock Swamp. Fracturing below the lower end of Flatrock Swamp may have resulted in possible changes to swamp bed gradients and flow paths (Mills and Huuskes 2004). Tomkins and Humphrey (2006) notes that mine related subsidence may be a contributing factor to the main gully erosion since longwall mining commenced under the lower part of the swamp in September 2002 and surface cracking was noticed in late 2003. However, subsidence does not explain the erosion of the lower part of the swamp between 1990 and 2002, unless the impacts from mining beneath the upper part of the swamp (~ 1970's) extended over a greater area at the surface. In 2002, several changes to the swamp were evident; many of the pools in existence in 1947 in the lower part of the swamp had become linked by gully erosion to form a continuous pool (Tomkins and Humphrey 2006). Historic gully events Tomkins and Humphrey (2006) notes that the gully appears to have formed through the development of channels and connection of pre-existing pools which progressively formed over time, commencing between 1982 and 1990, extending to 2002, and finally connecting throughout the length of the swamp by 2005. The erosion of the main section of the gully occurred progressively in response to several minor to moderate rainfall events which occurred between February 2002 and November 2004. The rainfall events led to failure of litter dams on the bare slopes which increased runoff velocities beyond those of vegetated slopes. The burnt and desiccated peat in the swamp may have facilitated the formation of knickpoints.

Conclusion

Impacts to Coastal Upland Swamps to date that have been observed and those that are widely reported as being mine subsidence related have been stark and readily observable. For reasons discussed above, all of the swamps (Swamp 37 [Drillhole Swamp], Swamp 18/19 and Flatrock Swamp) that are represented as being impacted heavily by mine subsidence were at the very least also impacted by activities that were unrelated to subsidence. The long term more subtle changes in vegetation extent and composition, considered by some commentators as likely to occur as a result of dewatering and drying, have not as yet been definitively recorded, despite some 16 years of monitoring.

The Coastal Upland Swamps of the Subject Land which are to be mined beneath are likely to exhibit degrees of subsidence related impacts as predicted by MSEC (2022), readily detected in the swamp piezometer monitoring for the Project. It is apparent based on the monitoring to date, that any vegetative response is not likely to be detected within the immediate term, and analysis clouded by many natural variables.

Regardless of the monitoring results to date, there is still a risk that the Project would change the natural cycle of Coastal Upland Swamps within the Subject Land. Whilst it is unlikely that a scour and erosion event would occur, it is possible that a change in swamp hydrological function from subsidence exposes Coastal Upland Swamps located above longwalls to a range of indirect impacts.

Appendix 10. Coastal Upland Swamps Offset Liability

Introduction

The OEH (2016a) *Addendum to NSW Biodiversity Offsets Policy for Major Projects, Upland Swamps impacted by Longwall Mining Subsidence* (Swamps Offset Policy) sets a precautionary approach to biodiversity offsetting the uncertain impacts toward Coastal Upland Swamps from longwall mining.

The Addendum requires that offsets be developed where greater than negligible environmental consequences for Coastal Upland Swamps are predicted.

Negligible environmental consequences are defined in Swamps Offset Policy (OEH 2016a) as considered to mean one or more of the following:

- "*negligible change to the shallow groundwater regime of a swamp compared with control swamps*".
- *"negligible change to the composition or distribution of swamp dependent vegetation communities and threatened species"*.

Greater than negligible environmental consequences include one or more of the following:

- *"a shallow groundwater level within swamp sediments lower than the baseline level at any monitoring site within a swamp (in comparison to control swamps)".*
- *a rate of shallow groundwater level reduction post-mining that exceeds the rate of shallow groundwater level reduction during the baseline period at any monitoring site (measured as average mm per day during the recession curve)"* (OEH 2016a).

As discussed in the Swamps Offset Policy (OEH 2016a) "*if it is predicted that upland swamps are likely to experience greater than negligible environmental consequences as a result of mining subsidence, conditions of approval will require that, on the approval of an extraction plan, a proponent must demonstrate a legal ability to secure offsets for the swamps to be mined under in that extraction plan, as calculated using the FBA*".

As the BAM has been introduced since the Swamps Offset Policy (OEH 2016a), the BAM-C would be used as the tool for calculating the offset liability.

Predictions for the Project

Hydrological monitoring is determined in the Swamps Offset Policy (OEH 2016a) to be the most important measure for early detection of subsidence related impacts to Coastal Upland Swamps. Based on the groundwater response, the Project is likely to have a greater than negligible environmental consequence to a portion of Coastal Upland Swamps located in the Subject Land. This is supported by the results of the current groundwater monitoring in Dendrobium Area 3 which indicate that groundwater recession changes are detected following mining in piezometers within Coastal Upland Swamps located above (and within 60 m of) the longwall.

Historic analysis completed by Watershed (2021) of Dendrobium Coastal Upland Swamps and swamp piezometers following longwall mining was undertaken to determine the distance at which piezometer results show a greater than negligible environmental consequence, according to the definitions quoted above. A total of 75 sites were assessed in the analysis i.e. shallow piezometers located within the updated Coastal Upland Swamp mapping. Of the sites, 30 were considered to show a degree of impact, including 10 which showed effects as water levels falling below pre-mining baseline, while 29 showed increased recession rates. Swamp piezometers within 60 m of longwall secondary extraction are likely to exhibit a mining effect and almost certain to exhibit a mining effect when directly mined beneath, be that through a reduction in the water table to below pre-mining levels and/or increased recession (drainage) rate. Effects on swamp water tables were not reported (i.e. effects were considered nil or negligible) at distances greater than 60 m from a longwall panel (Watershed 2022). As such, a similar distance could reasonably be expected with the current Project (Watershed 2022).

From a vegetative response perspective, no conclusive findings have been presented to date in the Dendrobium Terrestrial Ecology Monitoring Program (commenced in 2003) to suggest that subsidence alone has resulted in substantial changes to vegetation within Coastal Upland Swamps. Similarly, monitoring results available from the Metropolitan Coal (Peabody 2013; 2014; 2015; Trevor Brown & Associates 2016) and Wollongong Coal (Biosis 2015; Biosis 2017) monitoring programs also have not presented any findings identifying any substantial vegetation response due to changes in groundwater.

Regardless of the vegetation monitoring, given actions in the Swamps Offset Policy (OEH 2016a) are driven by hydrological response, a greater than negligible environmental consequence for Coastal Upland Swamps within 60 m of longwalls, is predicted for the Project for the purpose of developing an offset strategy.

Approach to the Coastal Upland Swamp Offset Liability

The Swamps Offset Policy (OEH 2016a) requires that the loss of the Coastal Upland Swamp should be assumed e.g. the total area of the Coastal Upland Swamp has essentially been cleared and devoid of ecosystem function. This is summed up in the Addendum as follows -

> '*It is recognised that the impact of altering the hydrological regime within Coastal Upland Swamps is not equivalent to removing all vegetation. However, this impact is likely to result in total loss of the upland swamp ecological community in the long-term as a result of loss of critical ecosystem function. When predicting the offset liability it is the loss of the upland swamp ecological community, including the threatened species that reply on that community, which must be calculated to determine the offset liability'.*

Whist IMC acknowledges that a groundwater change may be experienced in Coastal Upland Swamps in the Subject Land, there is strong evidence that indicates native vegetation and fauna habitat would still persist following mining. In fact there is little evidence to the contrary, and as such IMC propose that this be taken into consideration when determining the biodiversity offset liability associated with Coastal Upland Swamps.

Given that the BAM provides the ability to amend 'site values' scores to reflect an impact, IMC proposes to amend the default 'site value' scores in the BAM-C to reflect a transition to a vegetation type, rather than assuming the area of Coastal Upland Swamp would be completely cleared and devoid of fauna habitat, as would be the case for an open cut mine in the same location. The amendment of scoring is the BAM-C is permissible, and generally occurs when clearing 'partially' impacts a PCT eg., An Asset Protection Zone may only remove trees, but not a shrub and ground cover. The scores in the BAM-C that have been amended are the cover and abundance of the stratum types (eg. Tree, Shrub, Grass & grass like, Forb, Fern, Other) to

represent a score that would be present if the swamp vegetation were to transition to another woodland/forest vegetation type over-time. The BAM-C default scoring, along with the amended scoring is presented in Table 87, with justification for the changes provided.

Table 87. Amended BAM-C 'composition and structure' scores

Attribute	Tree	Shrub	Grass & grass like	Forb	Fern	Other
978_Good_Banksia Composition score						
Benchmark	1	15	9	5	2	2
Future mean (x̄) (default)	**0**	**0**	**0**	**0**	**0**	**0**
Future mean (x̄) *(Amended scoring)	**1**	**10**	**5**	**2**	**1**	**0**
Unweighted composition score (UCSi)	100	84.3	68.8	40	59.1	0
Weighted composition score (WCSi)	2.9	37.2	18.2	5.9	3.5	0
Dynamic weighting (wi)	0.03	0.44	0.26	0.15	0.06	0.06
Justification for amendment	Trees are likely to increase if transition of vegetation occurs.	Shrubs are likely to slightly decrease when going from a Banksia Thicket to a Woodland.	Grasses would still exist in a woodland/forest vegetation type	Forbs would still exist in a woodland/forest vegetation type, and may actually be more than that of Banksia thicket	At least one fern (Cheilanthes seiberi) is likely	Cannot amend the other component in the BAM-C.
978_Good_Banksia Structure score						
	Tree	Shrub	Grass & grass like	Forb	Fern	Other
Benchmark	0	74	114	2	1	1
Future mean (x̄) (default)	**0**	**0**	**0**	**0**	**0**	**0**
Future mean (x̄) * (Amended scoring)	**5**	**30**	**49.9**	**0.1**	**1**	**0**
Unweighted structure score (USSi)	0	41	47.3	0.3	100	0
Weighted structure score (WSSi)	0	15.8	28.1	0	0.5	0
Dynamic weighting (wi)	0	0.39	0.59	0.01	0.01	0.01
Justification for amendment	Trees are likely to increase if transition of vegetation occurs. A cover of 5% is reasonable based on Eucalypt Fringing Woodland attributes	Shrubs are likely to slightly decrease when going from a Banksia Thicket to a Woodland. A cover of 30% is reasonable for woodland / forest	Grasses would still exist in a woodland/forest vegetation type. 50% is reasonable based on dominance of Cyathochaeta	Forbs would still exist in a woodland/forest vegetation type, and may actually be more than that of Banksia thicket. However forb cover is	At least one fern (Cheilanthes seiberi) is likely	Cannot amend the other component in the BAM-C.

Attribute	Tree	Shrub	Grass & grass like	Forb	Fern	Other
			diandra and Aristida in areas.	generally small given size of forbs.		
PCT978_Restioid Composition score						
	Tree	Shrub	Grass & grass like	Forb	Fern	Other
Benchmark	1	15	9	5	2	2
Future mean (x̄) (default)	**0**	**0**	**0**	**0**	**0**	**0**
Future mean (x̄) *(Amended scoring)	**1**	**5**	**5**	**3**	**1**	**1**
Unweighted composition score (UCSi)	100	27.6	68.8	75.7	100	59.1
Weighted composition score (WCSi)	2.9	12.2	18.2	11.1	5.9	3.5
Dynamic weighting (wi)	0.03	0.44	0.26	0.15	0.06	0.06
Justification for amendment	Trees are likely to increase if transition of vegetation occurs.	Shrubs are likely to slightly decrease when going from a Banksia Thicket to a Woodland.	Grasses would still exist in a woodland/forest vegetation type	Forbs would still exist in a woodland/forest vegetation type, and may actually be more than that of Banksia thicket	At least one fern (Cheilanthes seiberi) is likely	A slight decline in other, has been attributed.
PCT978_Restioid Structure score						
	Tree	Shrub	Grass & grass like	Forb	Fern	Other
Benchmark	0	74	114	2	1	1
Future mean (x̄) (default)	**0**	**0**	**0**	**0**	**0**	**0**
Future mean (x̄) *(Amended scoring)	**5**	**30**	**32**	**1**	**0.8**	**0.2**
Unweighted structure score (USSi)	0	41	19	59.1	94.9	8.6
Weighted structure score (WSSi)	0	15.8	11.3	0.6	0.5	0
Dynamic weighting (wi)	0	0.39	0.59	0.01	0.01	0.01
Justification for amendment	Trees are likely to increase if transition of vegetation occurs. A cover of 5% is reasonable based on	Shrubs are likely to slightly decrease when going from a Banksia Thicket to a Woodland. A cover	Grasses would still exist in a woodland/forest vegetation type. 50% is reasonable based	Forbs would still exist in a woodland/forest vegetation type and thus a smaller score has been attributed.	At least one fern (Cheilanthes seiberi) is likely	Cannot amend the other component in the BAM-C.

Attribute	Tree	Shrub	Grass & grass like	Forb	Fern	Other
	Eucalypt Fringing Woodland attributes	of 30% is reasonable for woodland / forest	on dominance of Cyathochaeta diandra and Aristida in areas.			
PCT1804 Composition						
Item	Tree	Shrub	Grass & grass like	Forb	Fern	Other
Benchmark	1	15	9	5	2	2
Future mean (x̄) (default)	**0**	**0**	**0**	**0**	**0**	**0**
Future mean (x̄) *(Amended scoring)	**0**	**4**	**4**	**3**	**1**	**1**
Unweighted composition score (UCSi)	0	16.9	48.6	75.7	59.1	59.1
Weighted composition score (WCSi)	0	7.5	12.9	11.1	3.5	3.5
Dynamic weighting (wi)	0.03	0.44	0.26	0.15	0.06	0.06
Justification for amendment	Trees are likely to increase if transition of vegetation occurs. However, we cannot increase this score in Bam-C.	Shrubs are likely to slightly decrease when going from a Teatree Thicket	Grasses would still exist in a woodland/forest vegetation type	Forbs would still exist in a woodland/forest vegetation type, and may actually be more than that of Teatree Thicket	At least one fern (Cheilanthes seiberi) is likely	Slight decrease attributed.
PCT1804 Structure						
Item	Tree	Shrub	Grass & grass like	Forb	Fern	Other
Benchmark	0	74	114	2	1	1
Future mean (x̄) (default)	**0**	**0**	**0**	**0**	**0**	**0**
Future mean (x̄) *(Amended scoring)	**0**	**30**	**40**	**1**	**0.5**	**1**
Unweighted structure score (USSi)	0	41	30.8	59.1	59.1	100
Weighted structure score (WSSi)	0	15.8	18.3	0.6	0.3	0.5
Dynamic weighting (wi)	0	0.39	0.59	0.01	0.01	0.01
Justification for amendment	Trees are likely to increase if transition	Shrubs are likely to slightly decrease	Grasses would still exist in a	Forbs would still exist in a woodland/forest	At least one fern	Slight decrease

Attribute	Tree	Shrub	Grass & grass like	Forb	Fern	Other
	of vegetation occurs. However, we cannot increase this score in Bam-C.	when going from a Tea-tree Thicket to a Woodland. A cover of 30% is reasonable for woodland / forest	woodland/forest vegetation type. 40% is reasonable based on dominance of Cyathochaeta diandra and Aristida in areas.	vegetation type, and may actually be more than that of Teatree Thicket. However forb cover is generally small given size of forbs.	(Cheilanthes seiberi) is likely	from default attributed.

The justification to support this approach is based on the following:

1. ***Coastal Upland Swamp vegetation would transition into a drier vegetation community***

To date, monitoring has not detected any substantial changes in sub vegetation communities that can be attributed to subsidence (Appendix 9). Given over 500 swamps have been directly mined beneath using varying methods (Richardson and Ryan 2007) with swamp vegetation still persisting (in some cases for 9 years (Swamp 15b)), demonstrates that there may be some degree of resilience to subsidence. Photographs obtained from the Coastal Upland Swamp monitoring have been provided in Table 88 which demonstrates the persistence of swamp vegetation since 2010.

At a worst-case vegetation transition, Coastal Upland Swamps are likely to take on the appearance and function of a drier woodland community, similar to that of Coastal Upland Swamp: Eucalypt Fringing Woodland, which also shares the same PCT as the Coastal Upland Swamp TEC (PCT978); or Exposed Sandstone Scribbly Gum Woodland (PCT1083).

As such, at a worst-case scenario, whilst the ecosystem itself has changed (from swamp to woodland), vegetation is still persistent, and as such site value scores provided in Table 87 reflect a reasonable transition through the site scores.

Table 88. Swamp 15b photo monitoring results

Swamp 15b Photo monitoring site /date	Monitoring photographs
S15b_SO1 18/11/2010	 
11/4/2019	 

S15b_SO2 18/11/2010		
11/4/2019		
S15b_SO3 18/11/2010		
11/4/2019		

S15b_SO4

18/11/2010 (Left), 17/01/2011 (Right)





11/4/2019





S15b_SO5

17/01/2011





11/4/2019





S15b_SO6 11/02/2011 (Left), 18/11/2010 (Right)	
11/4/2019	

2. Candidate threatened species of Coastal Upland Swamps are offset separately

Threatened biodiversity that are listed on the EPBC Act or are regarded as 'species credit' species are offset accordingly if detected within habitat types impacted by subsidence. As such, whilst at a worst-case scenario, a Coastal Upland Swamp transitions to a woodland, through the process of an impact assessment, those threatened biodiversity reliant upon the swamp system are offset separately to the Addendum.

3. Evidence to support impacts directly above and within 60 metres from proposed longwalls

As discussed previously, historic analysis completed by Watershed (2021) of Dendrobium Coastal Upland Swamps and swamp piezometers following longwall mining has indicated that effects on swamps (that could be classified as "greater than negligible environmental consequence") have not been identified at distances greater than 60 m from a longwall panel. Based on the analysis completed by Watershed (2021), of a total of 75 sites assessed in the analysis, 30 were considered to show a degree of impact. Of the piezometers impacted, 10 showed effects of water levels falling below pre-mining baseline, while 29 showed increased recession rates (Table 89).

Based on assessments of water levels and recession rates around past mining in Areas 2, 3A and 3B, swamp piezometers within 60 m are likely to exhibit a mining effect and almost certain to exhibit a mining effect when directly mined beneath, be that through a reduction in the water table to below pre-mining levels and/or increased recession (drainage) rate. Effects on swamp water tables were not reported (i.e. effects were considered nil or negligible) at distances greater than 60 m from a longwall panel. As such, a similar distance could reasonably be expected with the current Project.

Table 89. Frequency of impacts by distance: swamp piezometers (Watershed 2022)

Distance from longwall panel(m)	No. of swamp piezometers affected	
	Impact on baseline	Impact on recession rate
0 (impact occurred above mined goaf)	22	6
0-10 m	1	1
10-20 m	1	1
20-30 m	1	0
30-40 m	1	0
40-50 m	2	1
50-60 m	1	1
60-100 m	0	0
100-150 m	0	0
150-200 m	0	0
200-400 m	0	0
Total affected	29	10

Conclusion

Whist IMC acknowledges that a groundwater change may be experienced in Coastal Upland Swamps in the Subject Land, groundwater impacts have not been identified at a distance greater than 60 m from the proposed longwalls. There is also strong evidence that at worst case, native vegetation (including the listed threatened ecological community) and fauna habitat would still persist following mining. As such, Niche has calculated the required number of ecosystem credits for Coastal Upland Swamps based on the site value scores (partial loss scenario) presented in Table 87, the results of which have been provided in section 6 of this assessment.

Appendix 11. Serious and irreversible impacts

The BAM Support Newsletter (September 2021) states that an Accredited Assessor must request data to support the application of BAM 2020 SAII assessments via the BOS Enquiry Form.

Niche submitted a request for further information on a range of species. The applicable response provided by BAM support (BSM-3659 – 27 October 2021) has been provided below.

The principles applicable to the Giant Dragonfly and the Broad-headed Snake are provided in the SAII criteria response below.

Responses from BAM Support regarding SAII criteria

From: *Kate Tierney <Kate.Tierney@environment.nsw.gov.au>* ***On Behalf Of*** *OEH ROD BAM Support Mailbox*
Sent: *Wednesday, 27 October 2021 3:51 PM*
To: *Jessie Bear <jbear@niche-eh.com>*
Subject: *RE: BSM-3659*

Jessie

The current data that DPIE has for your requested entities is:

Petalura gigantea

Principle 1 SAII = No

Declining but does not meet 80% decline

Principle 2 SAII = No

Population = Data deficient

Extreme fluctuations = No

Principle 3 SAII = No

Number of locations = Data deficient

Estimated AOO = Data deficient

Estimated EOO = Data deficient

Principle 4 SAII = Yes

Justification = Species dependent on habitat attributes: Specific geological features require to maintain suitable swamp habitat

Hoplocephalus bungaroides

Principle 1 SAII = No

Principle 2 SAII = No

Population = No information

Extreme fluctuations = No

Principle 3 SAII = No

Number of locations = 4

Estimated AOO = 940 km²

Estimated EOO = 29,404 km²

Principle 4 SAII = Yes

Justification = Species dependent on habitat attributes: Rock outcrops including pagodas

Shale-sandstone transition forest

Principle 1 SAII = No, 60-80% decline i.e. >threshold

Final Determination: The mapped area of Shale Sandstone Transition Forest is 9600 ha, representing 20-40% of its original extent (Tozer et al 2010). Thus the community has undergone a very large reduction in distribution since European settlement

Principle 2 SAII = Yes

Justification = >= 90% extent and severity since 1970, or >=80% extent and severity over 50-year period. Very large reduction in function due to change in structure composition disruption of processes invasive and degradation.

Final Determination: Shale Sandstone Transition Forest is among the most fragmented of vegetation types occurring in the Sydney region, with an estimated 1115 km of interface with cleared or degraded land." "Identified threats include: clearing associated with urban development, inappropriate fire regimes, anthropogenic climate change, removal of wood, physical damage from recreational activities, rubbish dumping, grazing, mowing and weed invasion." "...weeds have the potential to cause significant structural and compositional changes in Shale Sandstone Transition Forest, resulting in ecosystem collapse

Principle 3 SAII = Yes (SAII status for this principle to be confirmed)

Number of locations = Data deficient

Estimated AOO = 2,600 km²

Estimated EOO = 5,036 km²

Estimated total current extent = 20,181 ha

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.

This call is now closed.

Kind regards

The BAM Support Team

Broad-headed Snake (*Hoplocephalus bungaroides*)

According to the TBDC, the Broad-headed Snake is identified as an SAII entity in NSW based on the level of biodiversity concern. The Broad-headed Snake has been identified by BAM support as at risk of SAII due to Principle 4 of the SAII framework (unlikely to respond to management). Therefore, the Project has been identified as a SAII because it will *impact on species that are unlikely to respond to measures to improve its habitat and vegetation integrity, and therefore its members are not replaceable*.

Potential habitat for this species was modelled by mapping areas with a westerly to north-easterly aspect with slopes of 30 degrees or greater and applying a 30 m buffer. Habitat modelling allowed for detection of approximately 11.5 ha of cliffs and steep slopes with a favourable aspect for the species within 600 m of the proposed longwall layout. Habitat modelling assisted in identifying areas in which to conduct field survey, however it was observed that much of the modelled area did not support preferred habitat for the species.

No specific polygon for this species is presented, as the location of actual habitat is constrained in total area but potentially spread across a large area, however areas of potential habitat have been identified on Figure 17. Similarly, the locations of rockfalls cannot accurately be predicted and they may or may not coincide with actual habitat for the Broad-headed Snake.

An offset area of 0.12 ha (1,200 metres squared (m^2)) has been applied for this species. This area includes the maximum predicted area of cliff face impacts within and outside the extent of the proposed longwalls (600 m^2, MSEC 2022) and a further 600 m^2 to encompass adjacent steep slopes and outcropping areas.

The SAII candidate assessment criteria from the BAM have been assessed in Table 90 for Broad-headed Snake. The information provided is to assist with Determining Authority in determining if the Project is likely to have a SAII toward Broad-headed Snake.

Table 90. Broad-headed Snake SAII assessment

Additional impact assessment provisions for threatened species or populations	Broad-headed Snake (Endangered)
a) the action and measures taken to avoid the direct and indirect impact on the potential entity for a SAII.	The location of the Biodiversity Assessment Development Footprint has avoided potential shelter habitat (ie. cliff faces) and large areas of surface rock. As such, the Project is unlikely to have direct impact upon important habitat features for the species. Impacts to the Broad-headed Snake may occur through subsidence (prescribed impacts). Refinement of the longwall layout has been made to predominantly avoid water resources such as dams and key stream features. Impact to this species through subsidence are difficult to quantify and therefore difficult to avoid. However, based on the MSEC (2022) assessment, and through mapping of habitat, it is estimated that 0.12 ha of potential sheltering habitat may be impacted the Project.
b) The size of the local population directly and indirectly impacted by the	No Broad-headed Snake habitat would be directly impacted. Impacts to any potential habitat for this species would be through subsidence.

Additional impact assessment provisions for threatened species or populations	Broad-headed Snake (Endangered)
development, clearing or biodiversity certification.	No specific polygon for this species is presented, as the location of actual habitat is constrained in total area but potentially spread across a large area. Similarly, the locations of rockfalls cannot accurately be predicted and they may or may not coincide with actual habitat for the Broad-headed Snake. An offset amount of 0.12 ha (1,200 metres squared (m^2)) has been applied for this species. This area includes the maximum predicted area of cliff face impacts within and outside the extent of the proposed longwalls (600 m^2, MSEC 2022) and a further 600 m^2 to encompass adjacent steep slopes and outcropping areas (see section 4.6.2).
c) The extent to which the impact exceeds any threshold for the potential entity.	The threshold specified in the TBCD (2021) for Broad-headed Snake in 0.0 ha. Therefore, any impact to this species would exceed the threshold.
d) The likely impact (including direct and indirect impacts) that the development, clearing or biodiversity certification will have on the habitat of the local population, including but not limited to: i. an estimate of the change in habitat available to the local population as a result of the proposed development ii. the proposed loss, modification, destruction or isolation of the available habitat used by the local population iii. modification of habitat required for the maintenance of processes important to the species' life cycle (such as in the case of a plant – pollination, seed set, seed dispersal, germination), genetic diversity and long-term evolutionary development. BioNet Atlas records or other documented, quantifiable means must be used by the assessor to estimate what percentage of the species' population and habitat is likely to be lost in the long term within the IBRA subregion due to the direct and indirect impacts of the development.	Impacts to any potential habitat for this species is likely to be limited, based on previous observations of subsidence within adjacent mined areas and MSEC predictions of subsidence for the Project. Subsidence may change or modify the habitat important to this species by causing instability and rock falls along cliff-faces, as well as slippages, erosion and rock falls on steep slopes and rock ledges. However, MSEC (2022) predicts subsidence impacts such as rockfalls are limited in their extent. The limited rockfalls would need to be coincident with the restricted sheltering habitat for the Broad-headed Snake, and the subsidence impacts would need to be deleterious for impacts to occur to the species. In addition, previous survey did not detect the Broad-headed Snake, however it has been recorded within the north-eastern boundary of Area 5 previously and in adjacent areas. Survey was not conducted during the optimal season for the species according to the BAM-C (August-September), however was conducted during months where the species period of greatest activity, late spring through to mid-summer (DSEWPC 2011), as well as March and July when the species would be likely to be occupying winter sheltering habitats and detectable in these areas. Given the above information, minimal impacts are predicted to occur for the Broad-headed Snake.
e) The likely impact on the ecology of the local population. At a minimum, address the following: i. for fauna:	As there will be not directly clearing of Broad-headed Snake habitat it is likely the impact to the local population would be minimal. Areas of habitat identified with the potential to be

Additional impact assessment provisions for threatened species or populations	Broad-headed Snake (Endangered)
- breeding - foraging - roosting, and - dispersal or movement pathways ii. for flora, address how the proposal is likely to affect the ecology and biology of any residual plant population that will remain post development including where information is available: - pollination cycle - seedbanks - recruitment, and - interactions with other species (e.g. pollinators, host species, mycorrhizal associations).	impacted by subsidence includes breeding, foraging and shelter for the species.
f) A description of the extent to which the local population will become fragmented or isolated as a result of the proposed development.	Any impacts to Broad-headed Snake habitat through subsidence would be limited to localised cracking and collapsing of rocky outcrops, overhangs and cliffs, of which the species resides. The potential for these to occur is minor and unlikely to modify habitat is such a way as to isolate or fragment populations of the Broad-headed Snake.
g) The relationship of the local population to other population/populations of the species. This must include consideration of the interaction and importance of the local population to other population/populations for factors such as breeding, dispersal and genetic viability/diversity, and whether the local population is at the limit of the species' range.	Impacts to Broad-headed Snake habitat through subsidence is unlikely to restrict the movement of the impacted population with other populations of Broad-headed Snake within the locality. The population within the Subject Land is not located near the limit of known habitat for the species. Given the area contains large areas of contiguous habitat throughout the Sydney catchment area individuals would still be able to disperse and breed with surrounding populations.
h) The extent to which the proposed development will lead to an increase in threats and indirect impacts, including impacts from invasive flora and fauna, that may in turn lead to a decrease in the viability of the local population.	The Project is unlikely to increase the risk of threats and indirect impacts such as invasive species. Areas Broad-headed Snake habitat would only be subject to subsidence related impacts which are unlikely to lead to the promote the introduction of species which would otherwise be present in the area.
i) An estimate of the area, or number of populations and size of populations that is in the reserve system in NSW, the IBRA region and the IBRA subregion.	The Broad-headed Snake is largely confined to Triassic and Permian sandstones, including the Hawkesbury, Narrabeen and Shoalhaven groups, within the coast and ranges in an area within approximately 250 km of Sydney. Large areas of suitable habitat are conserved in national parks and areas of the Sydney Catchment.

Additional impact assessment provisions for threatened species or populations	Broad-headed Snake (Endangered)
j) The measure/s proposed to contribute to the recovery of the species in the IBRA subregion.	Key management sites for this threatened species are being identified by the NSW Government and other program partners, where feasible, cost-effective and beneficial management actions can be undertaken. Currently, 3 management sites have been identified for this threatened species, these include Royal National Park (14,707.59 ha), Morton National Park (75,550.71 ha) and Woronora Plateau (109,310.92 ha). This BDAR has quantified a biodiversity offset for the potential impacts to the Broad-headed Snake. Biodiversity credits would need to be retired as per the BOS which would assist in-perpetuity protection of the species.

Giant Dragonfly (*Petalura gigantea*)

According to the TBDC, the Giant Dragonfly is identified as an SAII entity in NSW based on the level of biodiversity concern. As identified by BAM support the Giant Dragonfly has been identified as at risk of SAII due to Principle 4 of the SAII framework (unlikely to respond to management).

Habitat for the Giant Dragonfly comprises Coastal Upland Swamp subcommunities Banksia Thicket and Restioid heath (PCT 978), as well as Teatree Thicket (PCT 1804), (subcommunities susceptible to hydrological changes) of swamps that are:

- Within or intersecting the 60 m buffer (impacted swamps likely to experience the full range of expected subsidence impacts.)
- deemed as suitable habitat by Invertebrate Identification Australia (2019, 2020) and
- susceptible subcommunities of swamps within the 400 m buffer and within 500 m of impacted swamps.

This approach is conservative given the species likelihood to utilise unsuitable swamps for foraging is unknown, and no individuals were recorded in the Subject Land by Invertebrate Identification Australia (2019, 2020). The total area of potential habitat is 3.68 ha as discussed in section 4.6.2.

The SAII candidate assessment questions from the BAM, have been assessed in Table 91 for Giant Dragonfly. The information provided is to assist with Determining Authority in determining if the Project is likely to have a SAII toward the Giant Dragonfly.

Table 91. Broad-headed Snake SAII assessment

Additional impact assessment provisions for threatened species or populations	Giant Dragonfly (Endangered)
a) the action and measures taken to avoid the direct and indirect impact on the potential entity for a SAII	The Project has considered various measures to avoid and mitigate potential impacts to upland swamps, including to the avoidance of direct disturbance of Coastal Upland Swamps TECs. The location of the surface infrastructure has specifically avoided swamp habitat. As such, the Project is unlikely to

Additional impact assessment provisions for threatened species or populations	Giant Dragonfly (Endangered)
	have direct impact upon important habitat features for the species. Impacts to the Giant Dragonfly may occur through subsidence. Impact to this species through subsidence cannot be entirely avoided, however avoidance measures have been discussed in section 3.
b) The size of the local population directly and indirectly impacted by the development, clearing or biodiversity certification	No Bionet atlas records exist for the species within the Subject Land. Although a limited number of records do exist for the species to the southeast of the Subject Land and the species is known to occur within upland swamps in the region. No Giant Dragonflies were observed within the Subject Land during the extensive survey undertaken by Invertebrate Identification Australia (2019, 2020). As such, the focus of this assessment is on areas within the Subject Land that have been conservatively identified as potential breeding and foraging habitat for the species. Cardno (2022) and Invertebrate Identification Australia (2019, 2020) assessed suitability of swamp habitat and surveyed for the Giant Dragonfly. Of the 22 swamps that occur within the Subject Land, only three swamps are deemed suitable breeding and foraging habitat for the Giant Dragonfly (Den111, Den121 and Den122). A species polygon has been provided for this species. This polygon includes the three swamps deemed suitable breeding and foraging habitat for the Giant Dragonfly by Cardno (2022) and Invertebrate Identification Australia (2019, 2020), as well as swamps within 500 m of potential or known breeding swamps that are considered potential foraging habitat. A total area of 3.68 ha. Indirect impacts to these areas of potential habitat for this species may occur through subsidence altering the hydrology of swamps and subsequently impacting or altering habitats for the species.
c) The extent to which the impact exceeds any threshold for the potential entity	The threshold specified in the TBCD (2021) for the Giant Dragonfly is *'Only proposals that will result in disturbances to swamp hydrology'*. The Project has the potential to result in subsidence that may impact upon swamp hydrology, exceeding this threshold.
d) The likely impact (including direct and indirect impacts) that the development, clearing or biodiversity certification will have on the habitat of the local population, including but not limited to: i. an estimate of the change in habitat available to the local population as a result of the proposed development	Direct impacts to identified areas of potential habitat for the species are not proposed as part of the Project. The Project may result in indirect impacts through subsidence. Subsidence has the potential to result in changes to the hydrology of swamps, subsequently impacting or altering habitats that have been identified as being suitable breeding and foraging habitat for the Giant Dragonfly. The three swamps identified as suitable breeding and foraging

Additional impact assessment provisions for threatened species or populations	Giant Dragonfly (Endangered)
ii. the proposed loss, modification, destruction or isolation of the available habitat used by the local population iii. modification of habitat required for the maintenance of processes important to the species' life cycle (such as in the case of a plant – pollination, seed set, seed dispersal, germination), genetic diversity and long-term evolutionary development. BioNet Atlas records or other documented, quantifiable means must be used by the assessor to estimate what percentage of the species' population and habitat is likely to be lost in the long term within the IBRA subregion due to the direct and indirect impacts of the development.	habitat have been identified as entirely or partially above the proposed longwalls in Area 5. Impacts to Coastal Upland Swamps as a result of subsidence are difficult to predict, but where they may occur they would be long-term. If swamps were to be impacted, and transition to a drier vegetation type, it has the potential result in a long-term impact to the local population of Giant Dragonfly. No Giant Dragonflies were observed within the Subject Land during the extensive survey undertaken by Invertebrate Identification Australia (2019, 2020), although the Giant Dragonfly was recorded in other swamps in the Dendrobium area during these surveys. It is also noted that bionet atlas records occur to the southeast of the Subject Land, but not within the Subject Land itself. As such, it is not clear that the areas of habitat identified for the species are utilised or important for the recruitment of the local populations of the species. On this basis the mapping of suitable habitat for the species is considered conservative.
e) The likely impact on the ecology of the local population. At a minimum, address the following: i. for fauna: o breeding o foraging o roosting, and o dispersal or movement pathways ii. for flora, address how the proposal is likely to affect the ecology and biology of any residual plant population that will remain post development including where information is available: o pollination cycle o seedbanks o recruitment, and o interactions with other species (e.g. pollinators, host species, mycorrhizal associations).	Direct clearing of areas that potentially provide habitat for the Giant Dragonfly are not proposed. Areas of habitat identified with the potential to be indirectly impacted by subsidence altering swamp hydrology includes upland swamps identified as suitable breeding and foraging habitat for the species, totalling an area of 3.68 ha. Subsidence associated with the Project has the potential to alter the hydrology of swamps identified as suitable habitat for the species, impacting or altering these habitats to the point that they may become unsuitable for breeding or foraging. The landscape scale spatio-temporal patterns of population dynamics of this species are highly complex and some areas of habitat may only support occasional breeding activity by a limited number of individuals (Baird & Bungin, 2017). Given that no Giant Dragonflies were observed during the extensive survey undertaken by Invertebrate Identification Australia (2019, 2020) the importance of these habitats for the local population of Giant Dragonfly is difficult to establish, although it is noted that the Giant Dragonfly was recorded in other swamps in the Dendrobium area during these surveys.
f) A description of the extent to which the local population will become fragmented or isolated as a result of the proposed development.	A total of 3.68 ha of habitat has been identified within the Subject Land. However, given that no Giant Dragonflies were observed within the Subject Land during the extensive survey undertaken by Invertebrate Identification Australia (2019, 2020), it is unclear how important this habitat is for the local population of the species, but the

Additional impact assessment provisions for threatened species or populations	Giant Dragonfly (Endangered)
	fact that the Giant Dragonfly was recorded in other swamps in the Dendrobium area during these surveys may suggest that the areas within the Subject Land may not represent core breeding or foraging habitat. Impacts to these areas of habitat may result in reduced connectivity for dispersal of the local population of this species. The dispersal capability of this species is inferred to be considerable (Baird 2012), however the dispersal ecology of the species and spatio-temporal patterns at a landscape scale over which dispersal takes place is poorly understood.
g) The relationship of the local population to other population/populations of the species. This must include consideration of the interaction and importance of the local population to other population/populations for factors such as breeding, dispersal and genetic viability/diversity, and whether the local population is at the limit of the species' range.	Impacts to Giant Dragonfly habitat through subsidence is unlikely to restrict the movement of the impacted population with other populations within the locality. Given the known presence of suitable habitat and records of Giant Dragonflies within the locality outside of the Subject Land, individuals would likely still be able to disperse and breed with surrounding populations.
h) The extent to which the proposed development will lead to an increase in threats and indirect impacts, including impacts from invasive flora and fauna, that may in turn lead to a decrease in the viability of the local population.	The Project is unlikely to increase the risk of threats and indirect impacts such as invasive species. Areas of Giant Dragonfly habitat would only be subject to subsidence related impacts which are unlikely to lead to the introduction of species which would not otherwise be present in the area.
i) An estimate of the area, or number of populations and size of populations that is in the reserve system in NSW, the IBRA region and the IBRA subregion.	The Giant Dragonfly is known to occur along the east coast of NSW, east of the Great Dividing Range. Populations are known to occur in the Blue Mountains and Southern Highlands, as well as the Clarence River catchment and also on a few coastal swamps from north of Coffs Harbour to Nadgee (Department of Planning Industry and Environment 2021). It has been determined that 32% of the species' distribution occurs on reserve (within NSW National Parks and Wildlife Service estate (Department of Planning Industry and Environment N.D.).
j) The measure/s proposed to contribute to the recovery of the species in the IBRA subregion.	The Giant Dragonfly has been identified as at risk of SAII due to Principle 4 of the SAII framework (unlikely to respond to management). Key management sites for this threatened species are being identified by the NSW Government and other program partners, where feasible, cost-effective and beneficial management actions can be undertaken. Currently, two management sites have been identified for this threatened species, these include the

Additional impact assessment provisions for threatened species or populations	Giant Dragonfly (Endangered)
	Newnes (28,255.42 ha) and Blue Mountains (67,015.42 ha) priority management sites. This BDAR has quantified a biodiversity offset for the potential impacts to the Giant Dragonfly. Biodiversity credits would need to be retired from BOS which would assist in-perpetuity protection of the species.

Appendix 12. Ecosystem and species credits required (BAM-C Credit report)

BAM Credit Summary Report

Proposal Details

Assessment Id
00030230/BAAS17033/21/00030231

Proposal Name
6624 Dendrobium Extension Project - Direct Impact

BAM data last updated *
24/11/2021

Assessor Name
Luke Baker

Report Created
28/03/2022

BAM Data version *
50

Assessor Number
BAAS17033

BAM Case Status
Finalised

Date Finalised
28/03/2022

Assessment Revision
1

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

Coastal sandstone gully forest												
1	1250_Good	Not a TEC	42.4	42.4	1.1	PCT Cleared - 30%	High Sensitivity to Potential Gain			1.50		17
											Subtotal	**17**
Illawarra Escarpment Blue Gum wet forest												
4	1245_Low	Not a TEC	26.2	26.2	0.17	PCT Cleared - 43%	High Sensitivity to Potential Gain			1.50		2
											Subtotal	**2**
Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion												
2	1083_Good	Not a TEC	52.5	52.5	16.6	PCT Cleared - 17%	High Sensitivity to Potential Gain			1.50		327
3	1083_Low	Not a TEC	26	26.0	2	PCT Cleared - 17%	High Sensitivity to Potential Gain			1.50		19
											Subtotal	**346**
											Total	**365**

Species credits for threatened species

BAM Credit Summary Report

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
Callocephalon fimbriatum / Gang-gang Cockatoo (Fauna)									
1250_Good	42.4	42.4	0.39			Vulnerable	Not Listed	False	8
1083_Good	52.5	52.5	14.9			Vulnerable	Not Listed	False	391
								Subtotal	**399**
Cercartetus nanus / Eastern Pygmy-possum (Fauna)									
1250_Good	42.4	42.4	1			Vulnerable	Not Listed	False	21
1083_Good	52.5	52.5	16.5			Vulnerable	Not Listed	False	433
1083_Low	26.0	26.0	1.3			Vulnerable	Not Listed	False	16
1245_Low	26.2	26.2	0.17			Vulnerable	Not Listed	False	2
								Subtotal	**472**
Chalinolobus dwyeri / Large-eared Pied Bat (Fauna)									
1245_Low	26.2	26.2	0.17			Vulnerable	Vulnerable	True	3
								Subtotal	**3**
Myotis macropus / Southern Myotis (Fauna)									
1250_Good	42.4	42.4	0.37			Vulnerable	Not Listed	False	8
1083_Good	52.5	52.5	4.5			Vulnerable	Not Listed	False	118
								Subtotal	**126**
Phascolarctos cinereus / Koala (Fauna)									
1250_Good	42.4	42.4	1			Vulnerable	Vulnerable	False	21
1083_Good	52.5	52.5	16.5			Vulnerable	Vulnerable	False	433
1245_Low	26.2	26.2	0.17			Vulnerable	Vulnerable	False	2

								Subtotal	**456**

BAM Credit Summary Report

Proposal Details

Assessment Id
00031189/BAAS17033/22/00031190

Proposal Name
6624 Dendrobium Extension Project - Indirect Impact Swamp full loss Giant Dragonfly

BAM data last updated *
24/11/2021

Assessor Name
Luke Baker

Report Created
28/03/2022

BAM Data version *
50

Assessor Number
BAAS17033

BAM Case Status
Finalised

Date Finalised
28/03/2022

Assessment Revision
0

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

Coastal upland wet heath swamp												
3	1804_Good_Teatree	Coastal Upland Swamp in the Sydney Basin Bioregion	52.8	52.8	0.18	PCT Cleared - 10%	High Sensitivity to Potential Gain	Endangered Ecological Community	Endangered	2.00		5
											Subtotal	**5**
Needlebush - banksia wet heath on sandstone plateaux of the Sydney Basin Bioregion												
1	978_Good_Banksia	Coastal Upland Swamp in the Sydney Basin Bioregion	78.6	78.6	0.15	PCT Cleared - 48%	High Sensitivity to Potential Gain	Endangered Ecological Community	Endangered	2.00		6
2	978_Good_Restoid	Coastal Upland Swamp in the Sydney Basin Bioregion	67.3	67.3	8.3	PCT Cleared - 48%	High Sensitivity to Potential Gain	Endangered Ecological Community	Endangered	2.00		279
											Subtotal	**285**
											Total	**290**

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

Petalura gigantea / Giant Dragonfly (Fauna)									
978_Good_Banksia	78.6	78.6	0.04			Endangered	Not Listed	True	2
978_Good_Restoid	67.3	67.3	3.5			Endangered	Not Listed	True	177
1804_Good_Teatree	52.8	52.8	0.18			Endangered	Not Listed	True	7
								Subtotal	**186**

BAM Credit Summary Report

Proposal Details

Assessment Id
00030234/BAAS17033/21/00030235

Proposal Name
6624 Dendrobium Coal Extension Project BDAR - Indirect impacts

BAM data last updated *
24/11/2021

Assessor Name
Luke Baker

Report Created
17/02/2022

BAM Data version *
50

Assessor Number
BAAS17033

BAM Case Status
Open

Date Finalised
To be finalised

Assessment Revision
2

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
Coastal sandstone gully forest												
8	1250_Good	Not a TEC	62.3	62.3	68.7	PCT Cleared - 30%	High Sensitivity to Potential Gain			1.50		1605

9	1250_Low	Not a TEC	9.9	9.9	0.43	PCT Cleared - 30%	High Sensitivity to Potential Gain			1.50		0
											Subtotal	**1605**
Coastal upland wet heath swamp												
11	1804_Good	Coastal Upland Swamp in the Sydney Basin Bioregion	52.8	15.9	0.18	PCT Cleared - 10%	High Sensitivity to Potential Gain	Endangered Ecological Community	Endangered	2.00		1
											Subtotal	**1**
Cumberland shale - sandstone Ironbark forest												
10	1395_Good	Shale Sandstone Transition Forest in the Sydney Basin Bioregion	67.6	67.6	91.2	PCT Cleared - 80%	High Sensitivity to Potential Gain	Critically Endangered Ecological Community	Critically Endangered	2.50	TRUE	3851
											Subtotal	**3851**
Illawarra Escarpment Blue Gum wet forest												
7	1245_Low	Not a TEC	43.6	43.6	0.17	PCT Cleared - 43%	High Sensitivity to Potential Gain			1.50		3
											Subtotal	**3**

Needlebush - banksia wet heath on sandstone plateaux of the Sydney Basin Bioregion												
1	978_Good_Banksia	Coastal Upland Swamp in the Sydney Basin Bioregion	78.6	23.8	0.26	PCT Cleared - 48%	High Sensitivity to Potential Gain	Endangered Ecological Community	Endangered	2.00		3
2	978_Good_Fringing	Coastal Upland Swamp in the Sydney Basin Bioregion	62.6	24.6	8.4	PCT Cleared - 48%	High Sensitivity to Potential Gain	Endangered Ecological Community	Endangered	2.00		103
3	978_Good_Restoid	Coastal Upland Swamp in the Sydney Basin Bioregion	67.3	28.4	7.3	PCT Cleared - 48%	High Sensitivity to Potential Gain	Endangered Ecological Community	Endangered	2.00		103
											Subtotal	**209**
Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion												
4	1083_Good	Not a TEC	51.8	51.8	607.6	PCT Cleared - 17%	High Sensitivity to Potential Gain			1.50		11795
5	1083_Low	Not a TEC	43.8	43.8	4.9	PCT Cleared - 17%	High Sensitivity to Potential Gain			1.50		81
											Subtotal	**11876**

Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion												
6	1181_Good	Not a TEC	68.7	68.7	109.1	PCT Cleared - 20%	High Sensitivity to Potential Gain			1.50		2811
											Subtotal	**2811**
											Total	**20356**

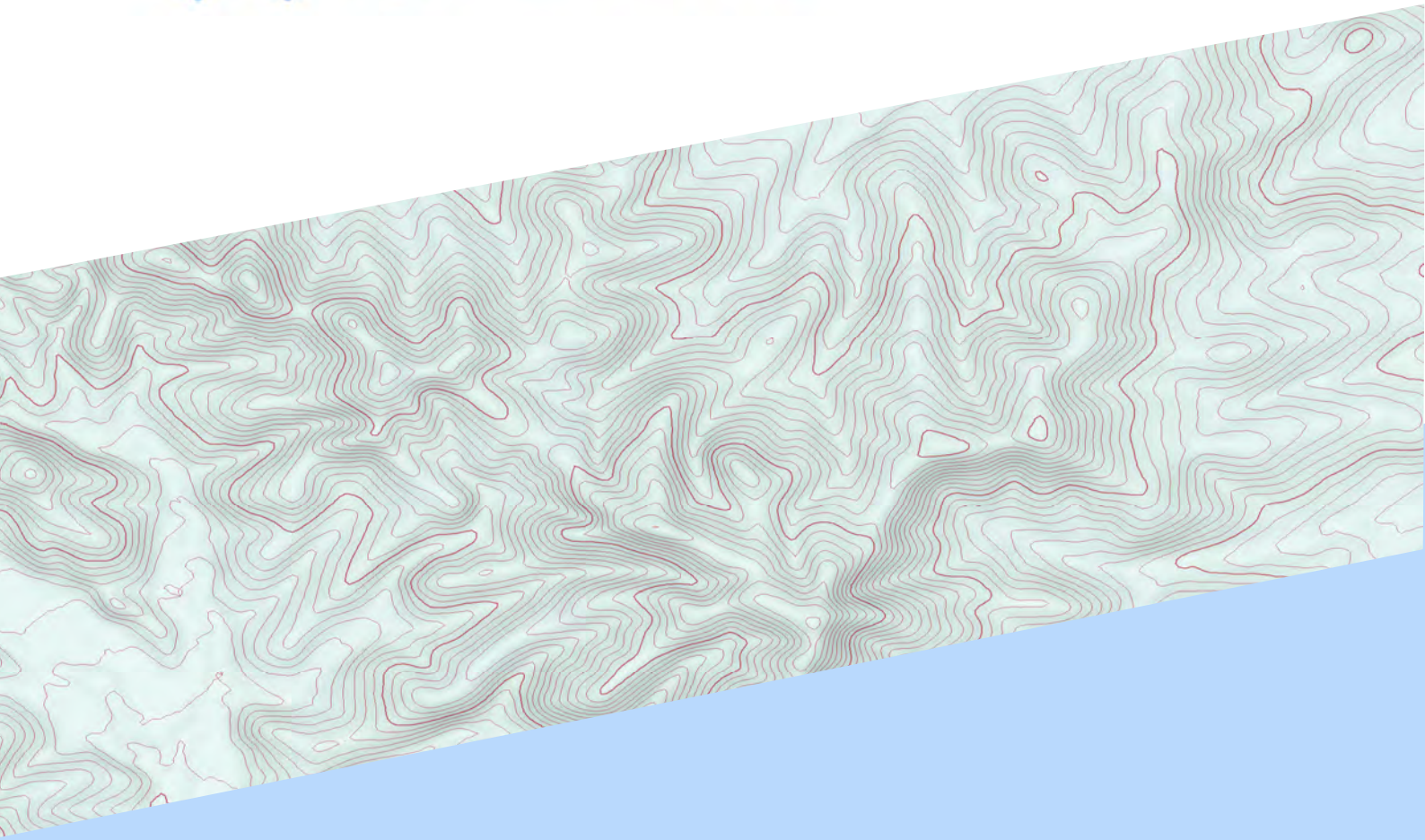
Species credits for threatened species

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
Heleioporus australiacus / Giant Burrowing Frog (Fauna)									
1083_Good	51.8	51.8	13.3			Vulnerable	Vulnerable	False	257
								Subtotal	**257**
Hoplocephalus bungaroides / Broad-headed Snake (Fauna)									
1083_Good	51.8	51.8	0.12			Endangered	Vulnerable	True	5
								Subtotal	**5**
Litoria littlejohni / Littlejohn's Tree Frog (Fauna)									
1083_Good	51.8	51.8	13.3			Vulnerable	Vulnerable	False	343
								Subtotal	**343**
Myotis macropus / Southern Myotis (Fauna)									
1083_Good	51.8	51.8	4.8			Vulnerable	Not Listed	False	123
								Subtotal	**123**

Pseudophryne australis / Red-crowned Toadlet (Fauna)									
1083_Good	51.8	51.8	3.5			Vulnerable	Not Listed	False	68
								Subtotal	**68**

9. Appendix 13. Watershed (2021) Geographic review of mining effects on Upland Swamps at the Dendrobium Mine

WATERSHED HYDROGEO



South32 Illawarra Metallurgical Coal

Dendrobium Mine Extension Project

Update to geographic review of mining effects on Upland Swamps at the Dendrobium Mine

September 2021

DOCUMENT REGISTER

Rev/Issue	Description	Date	Comments
A	1st Draft	16/06/2021	First draft. Updated review following previous study (r008i5, March 2019)
B	Final	02/09/2021	Final

FILE

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QUALITY CONTROL

Function	Staff	Signature	Date
Authors	Stuart Brown, Will Minchin		02/09/2021
Approved	Will Minchin		

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ABBREVIATIONS

Abbreviation/Term	Meaning
DPIE	NSW Department of Planning, Industry and Environment
DPIE-Water	DPIE-Water division
EPA	NSW Environment Protection Authority
GIS	Geographic Information Systems
IMC	Illawarra Metallurgical Coal
IMCEFT	IMC's Environmental Field Team
IAPUM	Independent Advisory Panel for Underground Mining (formerly IEPMC)
IEPMC	Independent Expert Panel for Mining in the Catchment (advising DPIE)
km	kilometre
m	metre
mAHD	metres above Australian Height Datum (effectively elevation as metres above sea level)
mBG	metres below ground
ML/d	megalitres per day
MSEC	Mine Subsidence Engineering Consultants
NSW	New South Wales
OEH	Office of Environment and Heritage
PSM	Pells Sullivan Meynink
SIMMCP	Swamp Impact Monitoring, Management and Contingency Plan

1 Introduction

Dendrobium Mine is located 10 kilometres (km) west of Wollongong within the Sydney Basin, and specifically within the Southern Coalfield of New South Wales (NSW). The Dendrobium Mine is operated by Illawarra Metallurgical Coal ('IMC'), and mining is done using longwall methods. The Dendrobium Mine workings are located approximately 200-400 metres (m) beneath a plateau located inland (west) of the Illawarra Escarpment. **Figure 1** shows the location of Areas 2, 3A and 3B at the Dendrobium Mine.

The shallow geology of the area around the Dendrobium Mine is primarily outcropping Triassic Hawkesbury Sandstone, with some exposures of older Narrabeen Formation units. Isolated deposits of unconsolidated sediments have accumulated in some areas, and this different geology has led to the development of specific ecological communities, known as Coastal Upland Swamps. These swamps typically capture water from direct rainfall infiltration or runoff from upgradient.

Longwall mining is known to affect the ability of these shallow swamps to hold or store water. As a longwall is extracted, the strata above it subside, causing vertical movement as well as lateral movement, including valley closure. "*The mining-induced compression due to valley closure effects can also result in dilation and the development of bed separation in the topmost bedrock, as it is less confined. This valley-related dilation is expected to develop predominately within the top 10 m to 20 m of the bedrock. Compression can also result in buckling of the topmost bedrock resulting in heaving in the overlying surface soils.*" (Mine Subsidence Engineering Consultants [MSEC], 2021). These processes may crack the rock base of the swamp features, resulting in more rapid drainage of the swamps and/or modifying the ability to store water.

NSW Office of Environment and Heritage's (OEH, 2016) *Addendum to NSW Biodiversity Offsets Policy for Major Projects Upland Swamps impacted by longwall mining subsidence* (Swamp Offset Policy) used 400 m as the specific distance to which effects on swamp hydrology are likely or possible.

PSM Consulting (PSM) (2017) concluded that mining-related effects on swamp hydrology have occurred at the Dendrobium Mine at distances of up to 900 m. The Independent Expert Panel for Mining in the Catchment (IEPMC) (2018) note that at the Springvale Mine in the Western Coalfield, swamps have been observed to be affected at distances of 700-1,200 m from longwalls in cases where a lineament intersects the relevant panel and the swamp.

End of Panel reports prepared to date for Areas 2, 3A and 3B (the most recent of which is HGEO Pty Ltd [HGEO], 2021 [for Longwall 16]) have assessed when piezometers monitoring swamp water tables at the Dendrobium Mine show an effect of mining, in line with the *Dendrobium Area 3B Swamp Impact, Monitoring, Management and Contingency Plan* (SIMMCP) (South32, 2020).

1.1 Scope

In 2018, IMC requested that Watershed HydroGeo ("WatershedHG") review the complete Dendrobium Mine shallow piezometer water level dataset and previous assessments of impacts at piezometers falling within IMC's latest mapping of Upland Swamps[1]. This included consideration and documentation of the distance to the previous or concurrent longwall(s) either causing an impact at a

[1] Swamps_Master.shp (provided by IMC on 17/06/2021) – upland swamp features extracted from Vegetation Map for the Woronora, O'Hares and Metropolitan Catchments. Derived from API and Survey Points. Consultants Biosis and Niche have refined this data for selected swamps.

piezometer, as noted in **Section 1.2** (below), or where no environmental effect is discerned. That analysis was document in WatershedHG (2019).

Since that analysis was carried out, it has been used to define the distance to which hydrological impacts are likely to be discerned at swamp sites in a short timeframe following longwall extraction. IEPMC (2021) noted that despite other water features (creeks, pools) showing impacts to longwall mining at greater distances than 60 m, "*The Panel considers that the (Watershed HydroGeo, 2019) report (which concluded that no changes to swamp hydrology have been observed greater than 60 m horizontal distance from a longwall panel in the Dendrobium mining area) is the most relevant available evidence regarding potential hydrological impacts to*" swamps.

In 2021, IMC considered that the earlier study (WatershedHG, 2019) should be updated because three additional longwalls had been extracted near several more Upland Swamps. The bulk of this document remains unchanged from WatershedHG (2019), however the identification of impacts has been updated to reflect mine progression, the analysis of the number of impacted sites revised and the previous findings have been reviewed.

In light of IEPMC (2019a and 2019b) comments about the role of geological structures, specifically lineaments, in transmitting effects at greater distances from mine workings to water features such as swamps, the position of lineaments in relation to groundwater monitoring sites was reviewed in a specific study for IMC (HGEO, 2020). The findings of that study, and the position of lineaments in relation to shallow (swamp) piezometers, have been considered in this current study.

1.2 Impact definition

As in other studies at the Dendrobium Mine, the definition of 'impact' is consistent with the SIMMCP regarding how an impact or "greater than negligible environmental consequence" of mining is classified:

1. A shallow groundwater level within swamp sediments lower than the baseline level at any monitoring site within a swamp (in comparison to control swamps).
2. A rate of shallow groundwater level reduction post-mining that exceeds the rate of shallow groundwater level reduction during the baseline period at any monitoring site (measured as average millimetres per day during the recession curve).

In some instances, both the above modes of impact may be observed at a single site, and in others, just one might be identified from the water level record.

2 Method

For this review, WatershedHG completed the following:

- Reviewed the dataset of shallow piezometers installed around Areas 2, 3A and 3B (**Appendix A** and **Figure 1**), identifying those that are within the boundaries of the latest mapping of Upland Swamp vegetation at the Dendrobium Mine.
- Review of the *Dendrobium Mine End of Panel Surface Water and Shallow Groundwater Assessment: Longwall 16 (Area 3B)* HGEO (2021) and IMC's shallow piezometer data to confirm or identify impacts on swamps within and around Areas 2, 3A and 3B. Hydrographs, as used in HGEO's End of Panel reporting have been updated with recent data from IMC and reproduced in **Appendix B**.

- Impact date identified: reviewed piezometer data to identify impact (i.e. change in recession curve and water level dropping lower than observed during baseline conditions). Noted longwall number that caused this impact.
- WatershedHG obtained spatial data to compare piezometer position with mine layout and weekly longwall face position. GIS was used to measure and record minimum distances between relevant piezometers and longwalls where no impact was recorded or inferred. Measurement is to the inside edge of the relevant pillar or gate road, i.e. to the edge of the longwall void.
- Used GIS to measure and record distance from monitoring sites to longwalls at the time of the identified impact (for both changes in recession curve and drop in water level). This included reviewing the position of the longwall face at the time of impact, although the position of the nearest part of an extracted longwall was used, which may or may not have been the position of the face at the time, or some other part of the longwall.
- For selected sites where impacts are 'unclear' (as per HGEO, 2021), additional analysis was undertaken, which compared water table records and recession curves with reference or unaffected sites such as 05_05 or 23_02 (as of 2021). Other sites were used as 'Reference sites', depending on the similarity of their hydrograph to the pre-mining hydrograph of sites being assessed.
- Identification of piezometers that fall within 100 m of IMC's mapping of lineaments (shown on **Figure 1**). We have not considered further the orientation of the lineaments in relation to the mine footprint and whether these lineaments are correlated with other structures identified in the underground mine.

3 Discussion

The following sections discuss the distribution of piezometers where impacts have been identified and those where no effect from historical mining has been discerned. The effects of mining on some piezometers remains unclear, e.g. 05_05 (between Longwalls 11 and 12, which had a very short baseline record), and at other site impacts could not be clearly identified until after the severe drought conditions of 2018-19 had eased with the onset of wetter conditions in 2020-21. This is in addition to piezometers that have not been instrumented with loggers and the record of periodic manual dips can make identification of effects uncertain.

3.1 Upland Swamp piezometers

There were 73 shallow piezometers located within the updated Upland Swamp mapping assessed in this review. Thirty seven of which were considered to show one or both of the modes of impact (as defined in **Section 1.2**). Sixteen showed effects as water levels falling below pre-mining baseline, while 31 showed increased recession rates (**Table 1**).

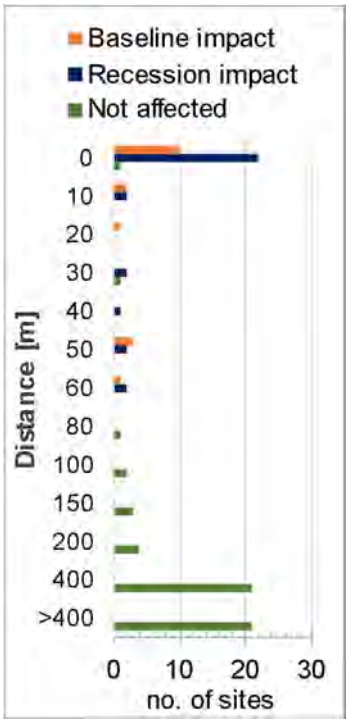
The results have been summarised and charted on **Figure 2**. This shows distances between piezometers and the nearest longwall when an impact occurred (based on inspection of the hydrograph). The date on which an impact is detected is recorded in **Appendix A**. More importantly, **Figure 2** shows distances to longwalls at the time an impact was observed, noting that two series are presented for the two modes of impact (**Section 1.2**).

Figure 2 and **Table 1** illustrate that the majority of the impacts (shown in orange and purple on **Figure** 2) occur at piezometers that are undermined by a longwall. The green series shows the distance to the nearest longwall where no impact was observed. Some sites have both no-impact and impact

information populated, e.g. **Figure 2** shows that piezometer 05_01 was approached to 180 m by Longwall 10 without effect and then subsequently mined under and impacted by Longwall 11.

Table 1 Frequency of impacts by distance: swamp piezometers

Distance [m] from longwall panel when impact first observed	No. of swamp piezometers affected		No. of swamp piezometers unaffected
	Impact: baseline water level	Impact: recession rate	
0 (impact occurred above mined goaf)	9	22	1
0-10 m	1	1	0
10-20 m	2	1	0
20-30 m	0	2	1
30-40 m	0	1	0
40-50 m	3	2	0
50-60 m	1	2	0
60-80 m	0	0	1
80-100 m	0	0	2
100-150 m	0	0	3
150-200 m	0	0	4
200-400 m	0	0	21
>400 m	0	0	21
Total	**16**	**31**	**54**



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Of the impacted sites within mapped Upland Swamps, most of the effects occur following the passing of a longwall, either directly beneath the site or just offset (i.e. within 60 m, as shown in **Table 1**).

The maximum distance at which an impact has been observed at a piezometer within a mapped Upland Swamp area is 50-60 m, being at:

- piezometer 15bH3 - this piezometer showed both modes of impact as Longwall 7 passed (at a distance of 55 m);
- piezometer LC3_02 - this piezometer showed an increase in recession rate when Longwall 6 passed to the south (also 55 m); and
- piezometer 13_01 – this piezometer showed a reduction below baseline water level as Longwall 14 approached (at 50 m), and later showed an increase in recession rate.

Four more piezometers showed impacts as nearby longwalls passed within 40-50 m.

Only one site within 30 m of an extracted panel at the Dendrobium Mine showed no effects (15b_37, at a distance of 25 m from Longwall 8) (**Figure 2**).

Figure 2 shows that there are 29 piezometers which are within mapped Upland Swamp communities and that did not show an impact from mining while mining was 100-400 m away, and another unaffected at 95 m and another at 72 m (11_H2). No such piezometer displayed an impact at that distance. Of these 30 piezometers, approximately two thirds were later undermined and showed an impact at that time.

3.2 Piezometers in non-swamp sediments

WatershedHG carried out the same analysis for piezometers that are located outside of mapped Upland Swamp communities (shown as yellow symbols on **Figure 1**). Not all the shallow piezometers have geological logs available. Of those that do, many of these piezometers are installed in weathered rock or regolith, however some are either in or likely to be in shallow deposits of unconsolidated sediments. For instance, piezometer 08_01 lies outside the limits of mapped Upland Swamp communities, but the geological log from this site indicates approximately 2 m of organics, dark sand, somewhat similar to the deposits in an Upland Swamp. It seems however that the different setting (swamp versus non-swamp) leads to some differences in how (and the distance to which) water table effects occur, as described below.

Table 2 summarises the distance at which effects were observed. **Table 2** and **Figure 3** show most non-swamp piezometers located between 60-400 m from longwalls are unaffected, with the exception of four piezometers.

The most distant site for which an effect was observed was 08_01). As Longwall 10 passed to the north, water levels in this piezometer did not initially show any effect (hydrograph in **Appendix B**). However, as Longwall 11 approached (but before reaching the piezometer) water levels showed an impact, with the previously extracted Longwall 10 being 125 m to the north.

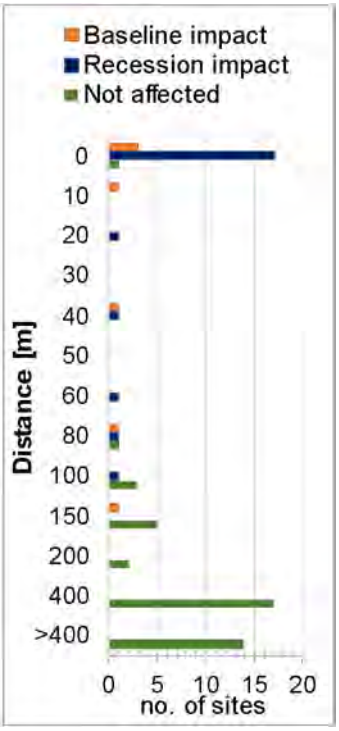
Similarly, an impact at piezometer 08_04 was observed at 95 m as Longwall 9 approached (see hydrograph in **Appendix B**). No geological log is available for this piezometer, which is also outside mapped Upland Swamp areas.

While these piezometers are not technically within Upland Swamp communities, some (especially 08_01) appear geomorphologically similar to the lithological setting of swamp communities.

Table 2 Frequency of impacts by distance: non-swamp piezometers

Distance [m] from longwall panel when impact first observed	No. of shallow piezometers affected		No. of shallow piezometers unaffected
	Impact: baseline water level	Impact: recession rate	
0 (impact occurred above mined goaf)	3	17	2
0-10 m	1	0	0
10-20 m	0	1	0
20-30 m	0	0	0
30-40 m	1	1	0
40-50 m	0	0	0
50-60 m	0	1	0
60-80 m	1	1	1
80-100 m	0	1	3
100-150 m	1	0	5
150-200 m	0	0	2
200-400 m	0	0	16
>400 m	0	0	14
Total affected	**7**	**22**	**43**

DEN_SwampBH_Impact_Distance_Analysis_20210902.xlsx



Considering other piezometers outside mapped Upland Swamps at similar distances to the two above:

- In many cases, it is more difficult to clearly identify impacts at piezometers that are not equipped with data loggers. Piezometers such as 01a_03, 05_06, 08_02, 08_05 and 08_06 are monitored manually, and is too difficult to state whether affected or not (noted as 'unclear' in End of Panel assessments and in **Figure 4**). Of these, the first three are located 120-140 m from Longwall 9, while the latter two are above the goaf of Longwall 12.
- One piezometer, 12_04, did not show an impact when mined under by Longwall 7, but then was affected by secondary subsidence when nearby Longwall 8 passed within 60 m).

Figure 3 shows that there are 23 piezometers outside mapped Upland Swamp communities that did not show an impact from mining while mining was 100-400 m of the extracted longwall panels, compared to one such piezometer (08_01, described above) that was impacted at that distance (125 m), and a further 3 at <140 m where impact or non-impact has not been clearly identified (see above). Of these 23, 11 were later directly mined under and showed an impact at that time.

3.3 Comparison to other studies

Effects on swamp hydrology at the Dendrobium Mine has been discussed in three recent studies. The key points, including review of any swamp piezometers identified as impacted in those studies, is presented below.

PSM (2017)

PSM indicated "a consistent pattern of rapid drawdown of shallow groundwater within all swamps as they have been undermined, with no piezometer above or closely adjacent to a longwall having a response that was considered 'normal or unchanged'". The analysis here supports that statement, i.e. that piezometers above or closely adjacent to a longwall have exhibited an impact.

However, PSM (2017) stated that impacts at piezometers in Upland Swamps at the Dendrobium Mine could occur at up to 900 m. This distance is not supported by analysis of data in this report. Further analysis of the relevant piezometers identified as being impacted at significant distances by PSM is as follows:

- 01a_02 and 01b_01 do not show the effects of mining (either type of impact defined in **Section 1.2**).
- 03_01 does respond to mining, but impacts occur at a distance of 40 m (i.e. mining was not 250 m away).
- D1-1 and D1-2 (now re-named as "01_01" and "01_02") are affected by mining but this occurred when Longwalls 4 and 5 mined beneath them (i.e. mining is not 350 m away as stated by PSM).
- All other D1 piezometers (re-named "01_03", "01_04" and "01_05") are not in mapped Upland Swamps. They do respond to mining, but this occurs when Longwalls 4 and 5 undermine them (i.e. mining is not 350 m away by PSM).
- "D3" piezometers (which have been re-named to refer to nearby Swamp 84 as per **Appendix A**) are not located within mapped Upland Swamps, and nor do they show either of the defined responses [impacts] to mining) (see hydrographs in **Appendix B**).
- D5 piezometers (**Appendix A**) are not in mapped Upland Swamp communities, nor do they show a response to mining (as defined in **Section 1.2**) (see hydrographs in **Appendix B**).

IEPMC (2019)

The role of geological structures in transmitting effects over greater distances, over 700 m, at Springvale Mine (noted in IEPMC, 2019a) is not evident at the Dendrobium Mine to date. On-going review of this aspect is recommended in monitoring plans (part of the SIMMCP) and in future End of Panel reports [**Section 4.1**]). Further analysis by SRK Consulting (SRK) (2020) and MSEC (2019) describe and contrast the different geological environments of the Western Coalfield (which was the basis for IEPMC's statements) and the Southern Coalfield, where effects over such distances have not been observed.

3.4 Role of lineaments

A total of 13 shallow piezometers were identified as falling within 100 m of mapped lineaments. For conservatism, we have selected piezometers within 100 m of a mapped lineament, no matter whether that lineament is mapped as potentially connecting the piezometer location to the mine footprint. Of these, 2 have not been assessed due to a lack of data (they are within Area 5). These piezometers have been circled on **Figure 2** and **Figure 3**. The small number of piezometers associated with lineaments means that definitive conclusions are difficult to make, however the shallow piezometers 01a_02, 01b_01 and 05_06 have had no impact recorded at distances of 270, 275 and 140 m to the nearest panel respectively. Further, considering piezometers slightly further away, piezometer LC4_04 had no impact recorded at a distance of 340 m from the nearest panel. Piezometer 23_02 shows an impact (where in WatershedHG, 2019 no impact had yet occurred), and this was at a distance of 45 m from Longwall 15. The lack of impacts at these piezometers suggests that lineaments do not appear to provide either a pathway or responsive medium that can exacerbate the distance or occurrence of impacts compared to sites which are >100 m from lineaments. In addition, this suggests that ground movement or transmission of drawdown to these features has not occurred at distances of up to 385 m, which is less than half the 700 m or more at Springvale Mine (as noted in IEPMC, 2019). This finding is consistent with the brief discussion in Section 3.3 (above), which references SRK (2020) and MSEC (2019).

The implication of this is that the governing factor for impacts on shallow piezometers at Areas 2, 3A and 3B has been the distance to the panel footprint, not the presence of lineaments.

Further analysis of the potential correlation of geological structures and observed groundwater drawdown has been carried out at the Dendrobium Mine (HGEO, 2020), considering both shallow piezometers (as in this study) and 'deep' groundwater monitoring in hard-rock strata. HGEO (2020) concluded "analysis of piezometric responses indicates that anomalous drawdown responses are not correlated with mapped structural features".

4 Conclusions

WatershedHG has carried out a review of effects on shallow piezometers at the Dendrobium Mine around Areas 2, 3A and 3B to late 2018. This is based on historical mine geometry (panel widths, cutting heights and depth of cover) and geological conditions. The spatial distribution of impacted piezometers is shown on **Figure 4**.

Based on the assessments of water levels and recession rates around existing mining in Areas 2, 3A and 3B, almost all hydrographs from Upland Swamp piezometers within 60 m are likely to exhibit a response to mining (i.e. hydrogeological response), be that through a reduction in the water table to below pre-mining levels and/or increased recession (drainage) rate:

- 25 of 26 piezometers (96%) within the longwall footprint show such an impact; and

- 11 of 12 piezometers (92%) at 1-60 m from longwall edge have shown an impact.

This is in agreement with IEPMC (2019a) and PSM (2017). PSM indicated “a consistent pattern of rapid drawdown of shallow groundwater within all swamps as they have been undermined, with no piezometer above or closely adjacent to a longwall having a response that was considered ‘normal or unchanged’”.

Effects on water tables in mapped Upland Swamp have not been observed at distances greater than 60 m from a longwall panel. This finding remains consistent with the previous analysis (WatershedHG, 2019), which IEPMC (2021) stated was “*the most relevant available evidence regarding potential hydrological impacts*” to swamps. Recommendations for future monitoring, to refine this or to improve the confidence in this finding, are presented in Section 4.1.

It is possible that the position of the swamp in relation to the long side of panels, the commencing end or the finishing end of panels also has an influence on the distance, however that is not considered further here.

When considering piezometers that are screened in weather rock or regolith, but lying outside of mapped Upland Swamp communities, impacts have been observed at 95 and 125 m in two piezometers in Area 3B. Most other such shallow piezometers within that distance (i.e. <125 m) have continued to record without showing effects.

The role of geological structures, specifically lineaments, in transmitting effects over greater distances (as noted in IEPMC, 2019a with respect to effects observed near the Springvale Mine) has not been evident at the Dendrobium Mine, but on-going review of this is recommended, i.e. considered in the placement of piezometers and in future End of Panel reports (below).

4.1 Recommendations

Sufficient baseline monitoring before mining approaches a swamp/piezometer improves the confidence in the identification of an impact or no impact. The NSW *Aquifer Interference Policy* (NSW Government, 2012) recommends 2 years of baseline data for groundwater monitoring prior to an activity commencing, and this is recommended for future swamp monitoring at the Dendrobium Mine.

IMCEFT map swamp features and define their boundaries prior to commissioning shallow piezometers. The aim of this is to confirm that a monitoring location is within an Upland Swamp ecological community. WatershedHG understands that this process was less rigorous earlier in the mine life (i.e. approximately 10 years ago, during Areas 2 and 3A), but has improved significantly, and we recommend that this practice continue.

WatershedHG understand that the distance from longwalls to likely hydrological effects at swamp sites (i.e. 60 m) has been used to determine the Biodiversity Offset requirement for Upland Swamps. If future monitoring indicates hydrogeological impacts to Upland Swamps beyond this distance, then it is recommended the methodology to determine these offsets be revised.

In regard to this, we note that there are few sites in the range 60-100 m from historical longwalls that have not subsequently been approached to shorter distances or even mined under. Within the constrains of the mine plan, swamp boundaries and site access, monitoring at piezometers around forthcoming longwalls should be undertaken at distances >60 m, preferably in the range 60-80 m, which would improve the confidence in the key conclusion stated in this report. WatershedHG has provided recommendations for possible locations, near to Swamp 35a, Swamp 15a, and Swamp 07, as well as the reasoning for these sites to IMCEFT.

Future End of Panel reporting of effects on shallow piezometers should specify the nearest distance to an extracted longwall at the point when an impact is identified, and the location of any mapped geological structures that may connect workings with (or may exacerbate ground movements near) swamp features. This will allow for the dataset compiled here to be updated.

5 References

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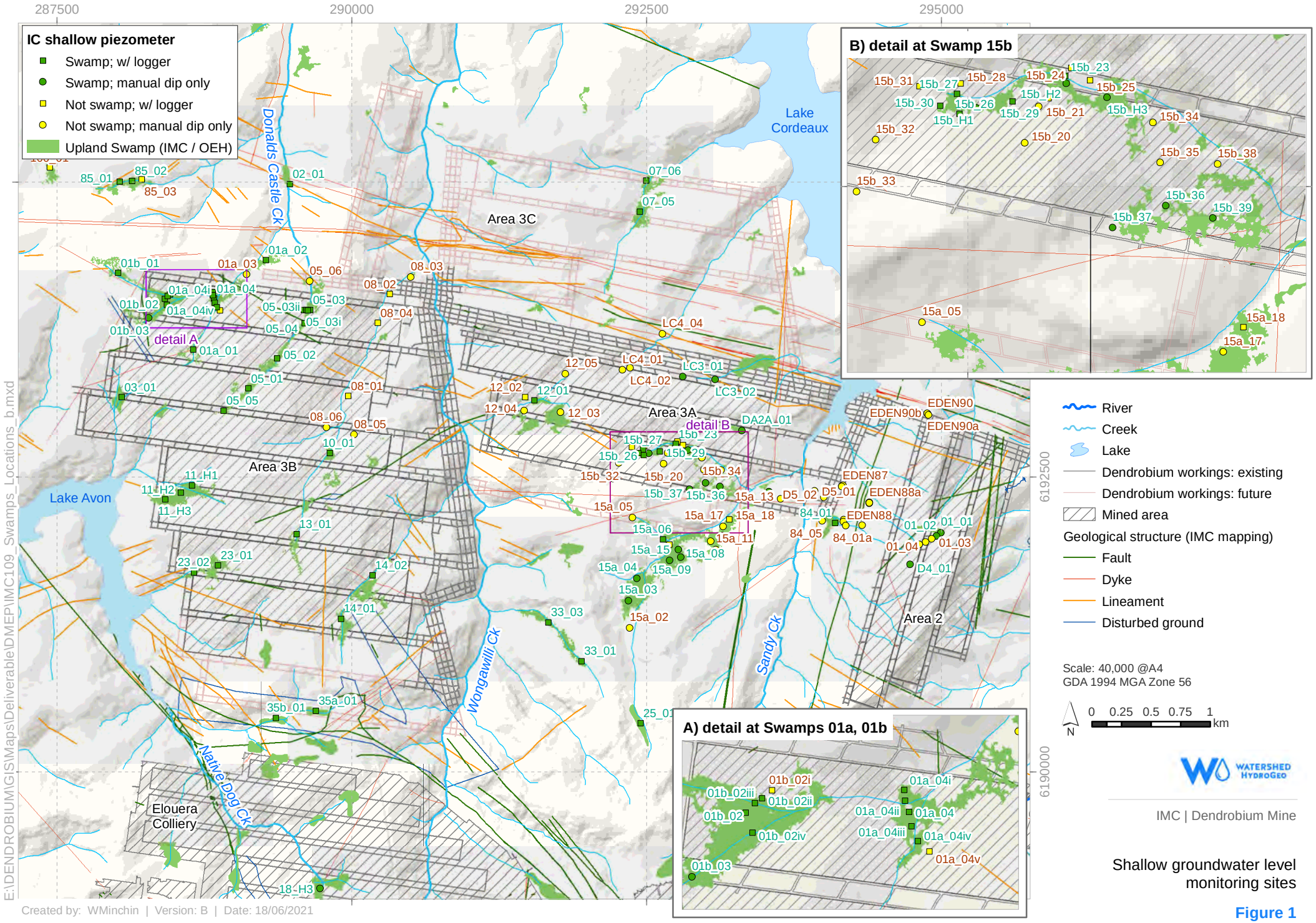
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SRK, 2020. *Geological Structures Comparison Investigation*. Report STH055, June 2020.

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Shallow groundwater level monitoring sites

Figure 1

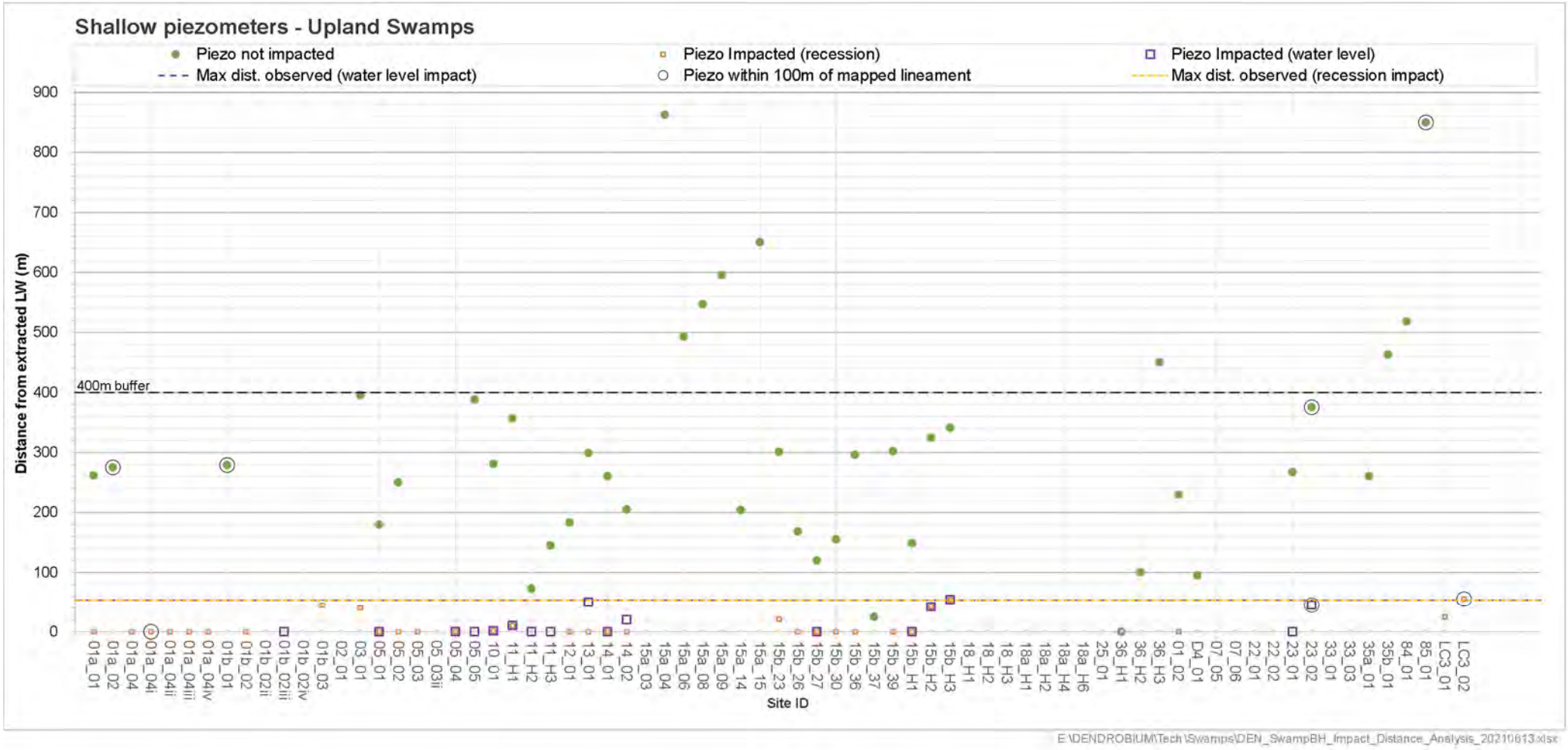


Figure 2 Summary of distances from longwall mining for impacts and unaffected piezometers within mapped Upland Swamps

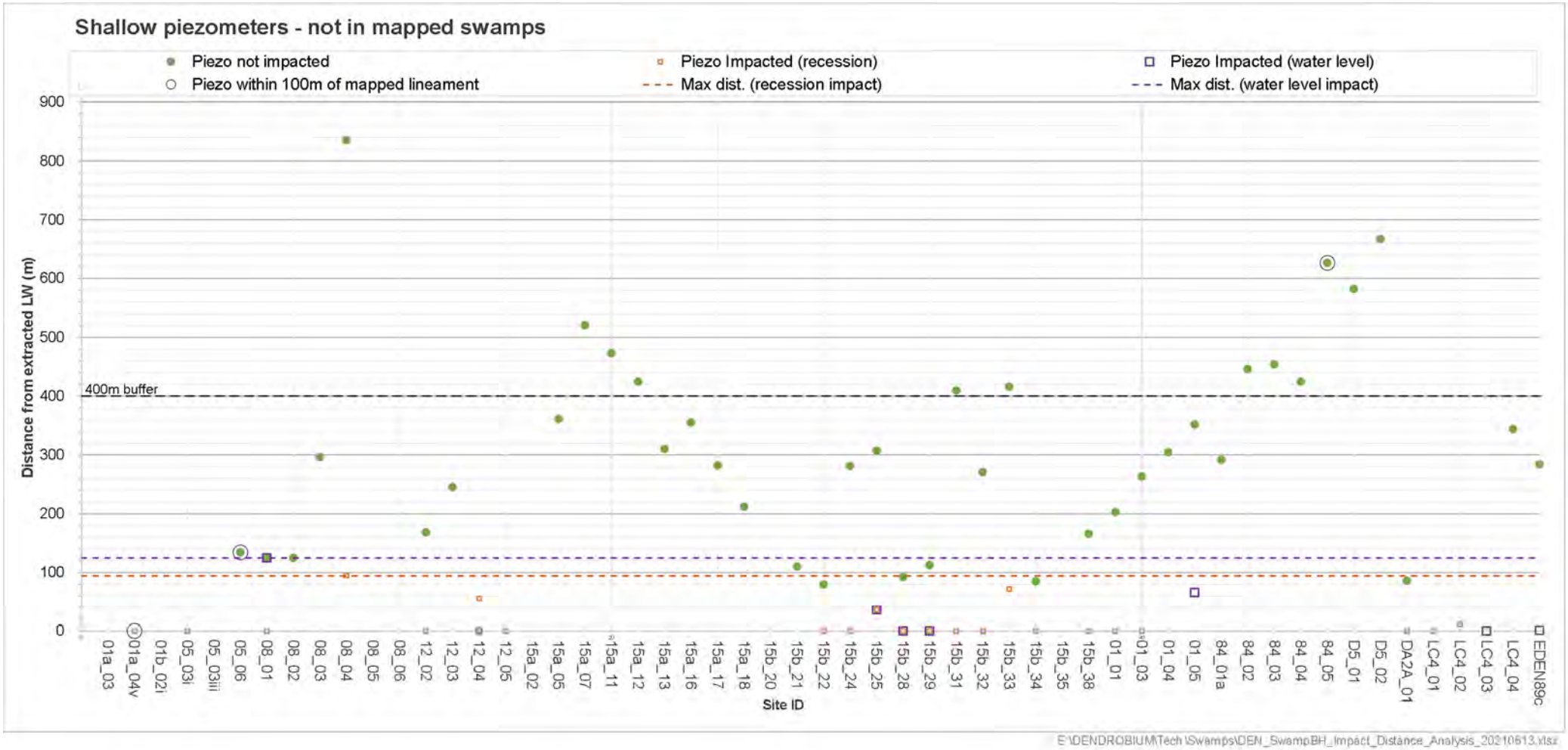
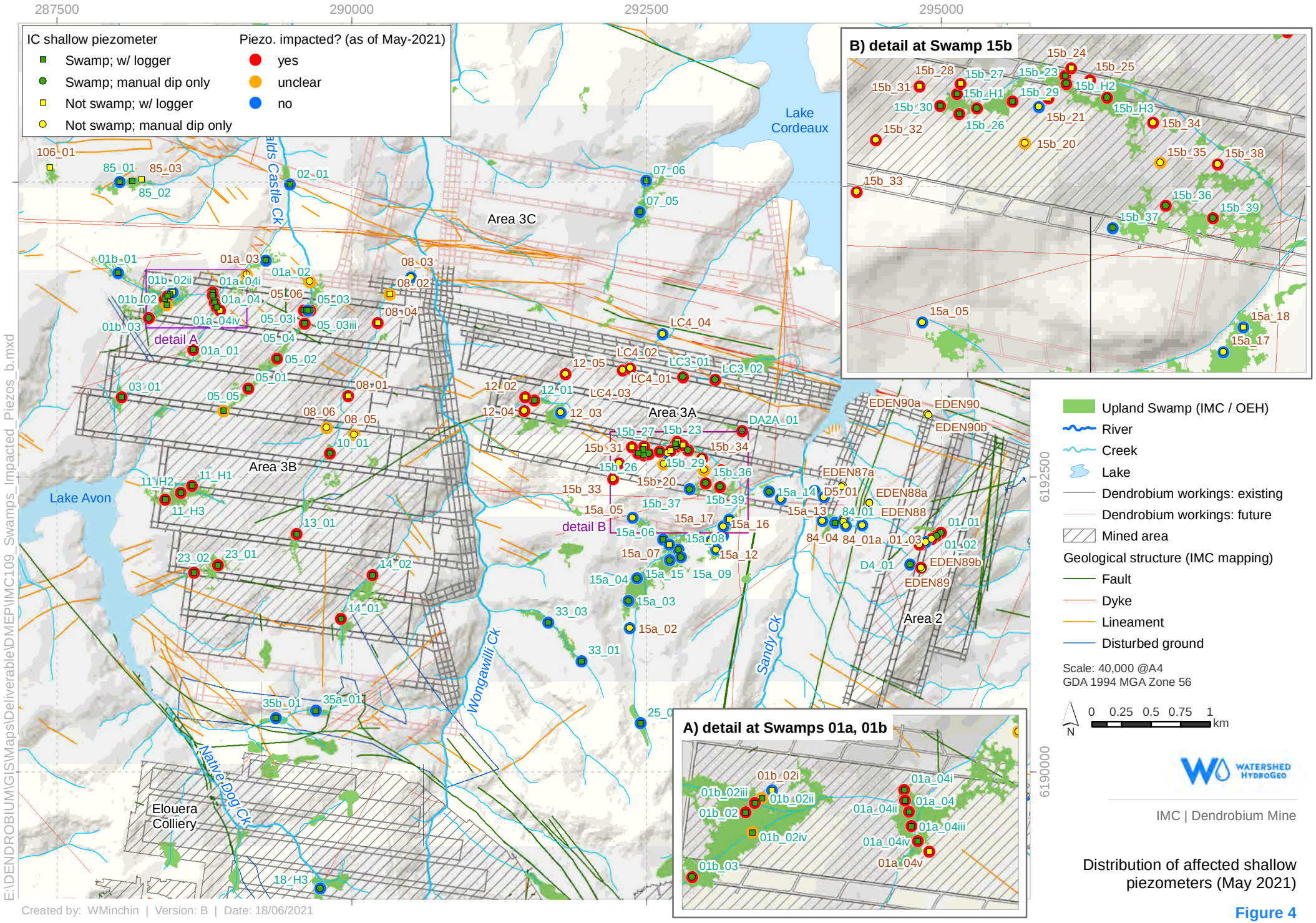


Figure 3 Summary of distances from longwall mining for impacts and unaffected piezometers: sites outside mapped swamps


287500
290000
292500
295000
IC shallow piezometer
Swamp; w/ logger
Swamp; manual dip only
Not swamp; w/ logger
Not swamp; manual dip only
Piezo. impacted? (as of May-2021)
yes
unclear
no
B) detail at Swamp 15b
A) detail at Swamps 01a, 01b
Lake Cordeaux
Lake Avon
Area 3C
Area 3A
Area 3B
Area 2
detail A
detail B
Elouera Colliery
Wongawilli Ck
Sandy Ck
Native Dog Ck
Upland Swamp (IMC / OEH)
River
Creek
Lake
Dendrobium workings: existing
Dendrobium workings: future
Mined area
Geological structure (IMC mapping)
Fault
Dyke
Lineament
Disturbed ground
Scale: 40,000 @A4
GDA 1994 MGA Zone 56
0 0.25 0.5 0.75 1 km
N
6192500
6190000
E:\DENDROBIUM\GIS\Maps\Deliverable\DMEP\IMC109_Swamps_Impacted_Piezos_b.mxd
Created by: WMinchin | Version: B | Date: 18/06/2021
IMC | Dendrobium Mine
Distribution of affected shallow piezometers (May 2021)
Figure 4

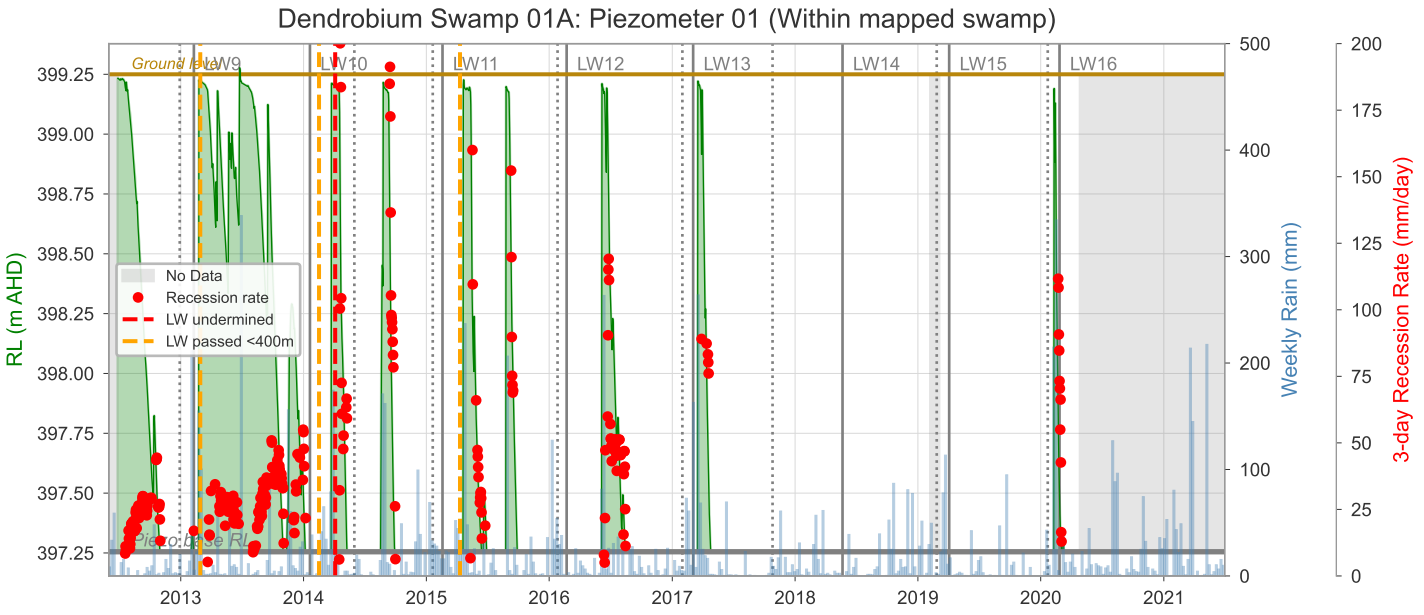
Appendix A – Piezometer sites

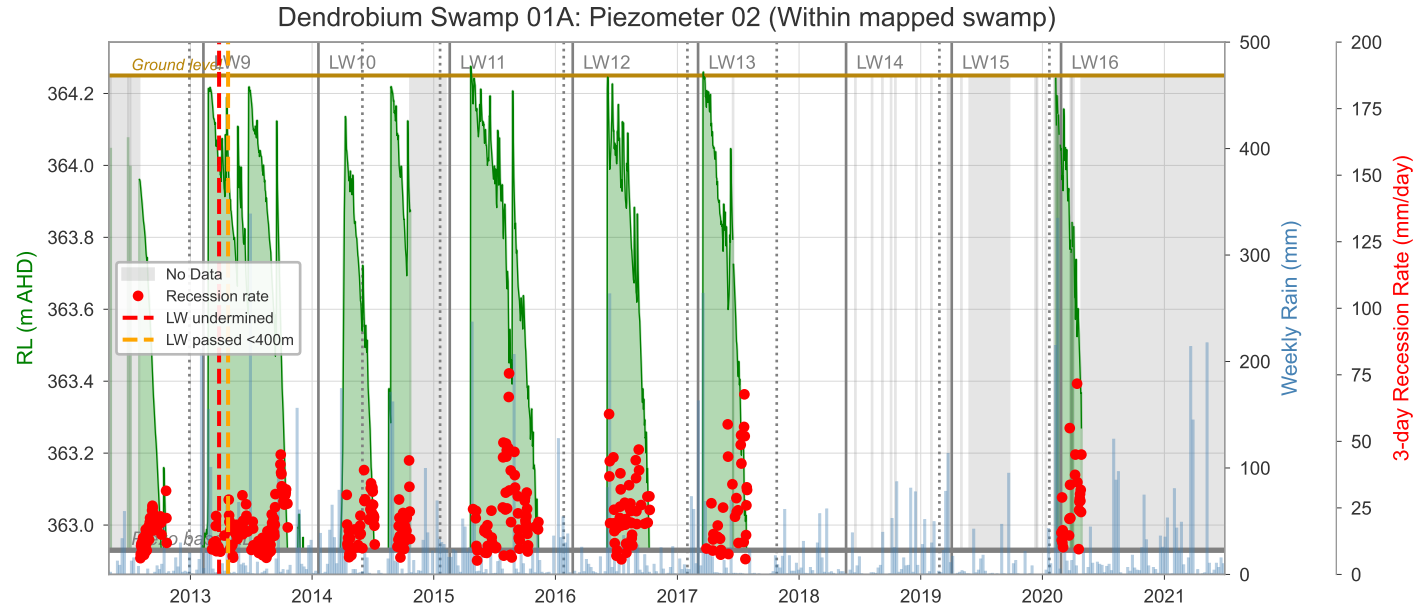
Site ID	Swamp	MGA_E	MGA_N	Elev (m)	Depth (m)	RL Bottom (m)	Total Casing (m)	Screen (m)	Stick-up (m)	Piezo RL(m)	Monitoring status
01a_01	Swamp 1a	288659.0	6193580.0	399.25	2.16	397.09	2.70	1.45	0.55	397.26	active
01a_02	Swamp 1a	289274.0	6194338.0	364.25	1.66	362.59	2.30	1.40	0.78	362.93	active
01a_03	Swamp 1a	289113.0	6194218.0	370.40	1.15	369.25	1.71	0.97	0.58	-	no instrumentation
01a_04	Swamp 1a	288834.0	6194013.0	381.70	1.37	380.33	2.00	1.01	0.70	380.53	active
01a_04i	Swamp 1a	288822.2	6194069.5	380.90	1.98	378.92	2.70	1.41	0.75	379.15	active
01a_04ii	Swamp 1a	288823.8	6194041.7	380.95	1.10	379.85	1.80	0.73	0.70	380.00	active
01a_04iii	Swamp 1a	288840.3	6193977.1	383.17	1.21	381.96	1.90	0.76	0.69	382.11	active
01a_04iv	Swamp 1a	288856.2	6193938.6	384.00	1.36	382.64	2.02	0.66	0.67	382.81	active
01a_04v	Swamp 1a	288885.6	6193912.9	385.66	1.44	384.22	2.26	0.69	0.86	384.42	active
01b_01	Swamp 1b	288021.0	6194231.0	406.00	1.76	404.24	2.40	0.82	0.70	404.47	active
01b_02	Swamp 1b	288418.0	6194011.0	394.50	1.80	392.70	2.29	1.50	0.51	392.86	active
01b_02i	Swamp 1b	288485.5	6194068.0	394.10	0.97	393.14	1.70	0.80	0.74	393.26	active
01b_02ii	Swamp 1b	288460.3	6194047.9	394.00	1.42	392.58	2.32	0.77	0.90	392.71	active
01b_02iii	Swamp 1b	288441.3	6194035.5	394.30	1.90	392.40	2.61	1.42	0.82	392.66	active
01b_02iv	Swamp 1b	288435.5	6193960.4	393.43	1.43	392.00	2.23	0.66	0.82	392.16	active
01b_03	Swamp 1b	288282.6	6193847.7	398.60	1.40	397.20	2.00	1.02	0.63	-	no instrumentation
02_01	Swamp 2	289477.0	6194981.0	334.00	1.85	332.15	2.10	1.33	0.39	332.44	active
03_01	Swamp 3	288052.0	6193177.0	396.05	1.51	394.54	2.11	1.00	0.60	394.70	active
05_01	Swamp 5	289125.4	6193253.3	398.80	2.60	396.20	3.02	1.43	0.53	396.43	active
05_02	Swamp 5	289370.3	6193505.1	391.30	1.87	389.43	2.50	1.48	0.73	389.56	active
05_03	Swamp 5	289651.0	6193915.4	379.50	1.77	377.73	2.40	1.27	0.83	378.04	active
05_03i	Swamp 5	289594.2	6193915.6	379.80	1.62	378.18	2.42	1.45	0.82	378.34	active
05_03ii	Swamp 5	289617.0	6193914.5	378.33	2.06	376.27	2.76	1.42	0.76	376.49	active
05_03iii	Swamp 5	289630.0	6193914.1	377.83	1.31	376.52	1.93	1.11	0.62	376.65	active
05_04	Swamp 5	289602.1	6193803.9	380.70	1.57	379.13	2.13	1.00	0.81	379.52	active
05_05	Swamp 5	288916.2	6193061.5	403.30	1.17	402.13	1.81	0.92	0.81	402.46	active
05_06	Swamp 5	289647.9	6194159.2	366.40	1.65	364.75	2.30	1.44	0.66	-	no instrumentation
08_01	Swamp 8	289973.0	6193188.0	341.20	2.31	338.89	2.98	1.41	0.66	339.07	active
08_02	Swamp 8	290323.3	6194051.3	308.60	1.02	307.59	1.60	0.86	0.59	307.79	active
08_03	Swamp 8	290503.5	6194193.4	296.80	1.59	295.21	2.20	1.25	0.61	-	no instrumentation
08_04	Swamp 8	290223.1	6193808.9	323.90	1.93	321.98	2.50	1.40	0.58	322.18	active
08_05	Swamp 8	290021.3	6192859.4	358.10	1.32	356.78	2.20	1.31	0.88	-	no instrumentation
08_06	Swamp 8	289788.7	6192918.7	358.80	1.07	357.73	1.70	1.00	0.63	-	no instrumentation
10_01	Swamp 10	289816.0	6192702.3	364.80	1.51	363.29	2.40	1.22	0.89	363.49	active
11_H1	Swamp 11	288647.0	6192427.6	393.28	1.82	391.47	3.10	n/a	1.29	391.47	active
11_H2	Swamp 11	288554.1	6192367.7	389.41	1.29	388.12	2.21	n/a	1.03	388.14	active
11_H3	Swamp 11	288420.2	6192311.1	382.40	0.55	381.85	1.58	n/a	1.05	381.85	active
12_01	Swamp12	291548.5	6193151.9	368.00	1.61	366.40	2.14	1.00	0.53	366.73	active
12_02	Swamp12	291470.9	6193177.5	366.45	1.08	365.37	1.53	0.50	0.46	365.56	active
12_03	Swamp12	291774.3	6193048.2	390.70	0.53	390.17	1.02	0.50	0.49	390.43	end monitoring 25/02/2015
12_04	Swamp12	291464.1	6193062.8	365.40	0.84	364.56	1.32	0.50	0.50	364.75	end monitoring 10/01/2013
12_05	Swamp12	291814.5	6193372.6	398.50	1.57	396.93	2.01	0.50	0.52	397.27	end monitoring 22/06/2014
13_01	Swamp 13	289535.0	6192016.0	403.30	2.60	400.70	3.25	1.50	0.65	400.95	active
15a_02	Swamp 15a	292360.3	6191218.6	382.61	3.63	378.98	4.04	1.00	0.90	-	no instrumentation
15a_03	Swamp 15a	292348.9	6191451.1	378.00	2.12	375.88	2.49	1.00	0.45	376.15	end monitoring 22/09/2012
15a_04	Swamp 15a	292418.5	6191638.5	373.05	1.93	371.12	2.53	1.00	0.60	-	no instrumentation
15a_05	Swamp 15a	292384.3	6192154.9	387.70	1.45	386.25	1.85	1.00	0.40	-	no instrumentation
15a_06	Swamp 15a	292639.8	6191972.9	366.83	2.64	364.19	3.11	1.00	0.75	364.60	active
15a_07	Swamp 15a	292692.9	6191927.0	365.77	2.21	363.56	2.50	1.00	0.70	364.10	active
15a_08	Swamp 15a	292773.0	6191885.6	368.76	2.75	366.01	3.30	1.00	0.85	-	no instrumentation
15a_09	Swamp 15a	292793.5	6191818.0	371.13	2.39	368.75	3.26	1.00	0.88	-	no instrumentation
15a_11	Swamp 15a	293092.2	6191882.4	371.15	1.13	370.03	1.49	0.55	0.37	-	no instrumentation
15a_12	Swamp 15a	293045.3	6191956.5	367.33	1.50	365.84	1.99	0.50	0.50	-	no instrumentation
15a_13	Swamp 15a	293639.6	6192312.7	349.30	0.68	348.62	1.20	0.50	0.52	-	no instrumentation
15a_14	Swamp 15a	293540.2	6192376.3	343.70	0.79	342.91	1.39	0.50	0.62	-	no instrumentation
15a_15	Swamp 15a	292698.6	6191792.9	370.90	3.17	367.73	3.70	1.20	0.60	-	no instrumentation
15a_16	Swamp 15a	293148.8	6192001.5	366.00	0.62	365.38	1.10	0.50	0.48	-	no instrumentation
15a_17	Swamp 15a	293150.0	6192079.5	360.90	1.00	359.90	1.75	0.50	0.75	360.15	end monitoring 27/02/2012
15a_18	Swamp 15a	293200.9	6192142.1	358.50	0.60	357.90	1.12	0.50	0.53	358.00	active
15b_20	Swamp 15b	292645.4	6192610.5	393.30	0.92	392.38	1.45	0.50	0.55	-	no instrumentation
15b_21	Swamp 15b	292680.5	6192703.4	384.48	1.21	383.27	1.71	0.67	0.50	383.75	end monitoring 20/11/2012
15b_22	Swamp 15b	292705.0	6192723.9	383.21	2.12	381.09	2.51	1.00	0.43	381.34	active
15b_23	Swamp 15b	292747.6	6192780.7	380.96	2.65	378.31	3.07	1.00	0.42	378.44	active
15b_24	Swamp 15b	292762.5	6192801.0	382.37	3.22	379.15	3.52	1.00	0.73	379.69	active
15b_25	Swamp 15b	292810.5	6192770.2	381.10	3.19	377.91	3.03	1.00	0.74	378.99	active
15b_26	Swamp 15b	292478.4	6192685.0	390.50	1.56	388.94	2.03	0.50	0.50	389.17	active
15b_27	Swamp 15b	292472.2	6192735.4	390.65	3.23	387.42	3.75	1.50	0.52	387.67	active
15b_28	Swamp 15b	292480.9	6192761.8	391.40	3.73	387.67	4.31	1.50	0.74	388.04	active
15b_29	Swamp 15b	292613.5	6192715.9	386.53	2.00	384.53	2.51	1.00	0.52	384.72	active
15b_30	Swamp 15b	292429.6	6192704.6	391.86	1.83	390.03	2.49	0.50	0.68	390.24	active
15b_31	Swamp 15b	292376.6	6192754.5	395.20	1.36	393.84	2.05	1.00	0.75	394.05	active
15b_32	Swamp 15b	292266.3	6192618.3	399.80	1.24	398.56	1.72	1.00	0.48	398.73	end monitoring 10/12/2013
15b_33	Swamp 15b	292217.2	6192486.1	415.44	0.86	414.58	1.36	0.50	0.52	-	no instrumentation
15b_34	Swamp 15b	292971.2	6192662.6	369.60	1.06	368.54	1.60	1.00	0.57	-	no instrumentation
15b_35	Swamp 15b	292989.1	6192560.3	371.32	0.70	370.62	1.14	0.50	0.49	-	no instrumentation
15b_36	Swamp 15b	293003.0	6192450.9	369.37	0.71	368.66	1.20	0.50	0.55	-	no instrumentation
15b_37	Swamp 15b	292867.9	6192395.0	380.90	2.39	378.51	2.93	1.00	0.54	-	no instrumentation
15b_38	Swamp 15b	293135.5	6192556.4	360.85	1.93	358.92	2.51	1.00	0.58	-	no instrumentation
15b_39	Swamp 15b	293123.4	6192419.4	361.89	0.70	361.19	1.17	0.50	0.47	-	no instrumentation
15b_H1	Swamp 15b	292523.3	6192698.8	388.72	1.30	387.42	2.35	n/a	1.05	387.65	end monitoring 05/08/2015
15b_H2	Swamp 15b	292750.5	6192762.3	380.69	1.74	378.95	2.77	n/a	1.03	379.12	end monitoring 05/07/2015
15b_H3	Swamp 15b	292854.6	6192726.5	379.03	0.86	378.17	1.70	n/a	0.84	378.32	end monitoring 24/05/2015
18_H1	Swamp 18	289681.0	6188572.0	392.70	0.32	392.39	1.30	n/a	0.98	392.48	end monitoring 09/10/2012
18_H2	Swamp 18	289708.0	6188795.0	387.18	1.55	385.64	2.51	n/a	0.96	385.74	end monitoring 18/01/2013
18_H3	Swamp 18	289734.0	6189012.0	381.55	1.17	380.38	2.15	n/a	0.98	380.44	end monitoring 12/04/2011
18a_H1	Swamp 18a	290090.4	6188128.4	425.16	1.18	423.98	2.30	n/a	1.12	424.08	end monitoring 23/02/2012
18a_H2	Swamp 18a	290042.1	6188146.8	423.19	1.80	421.39	2.87	n/a	1.07	421.49	end monitoring 16/06/2012
18a_H4	Swamp 18a	290000.9	6188066.3	422.20	1.48	420.72	2.60	n/a	1.13	420.82	end monitoring 07/06/2012
18a_H6	Swamp 18a	289922.9	6188075.8	418.80	1.80	417.00	2.90	n/a	1.10	417.10	end monitoring 21/10/2011
25_01	Swamp 25	292451.3	6190412.5	415.80	2.46	413.34	3.02	1.50	0.75	413.65	active
36_H1	Swamp 36	289239.7	6188048.2	432.41	1.02	431.39	1.56	n/a	0.55	431.50	end monitoring 16/05/2012
36_H2	Swamp 36	289135.3	6188144.3	423.06	0.24	422.82	1.21	n/a	0.97	422.93	end monitoring 19/04/2011

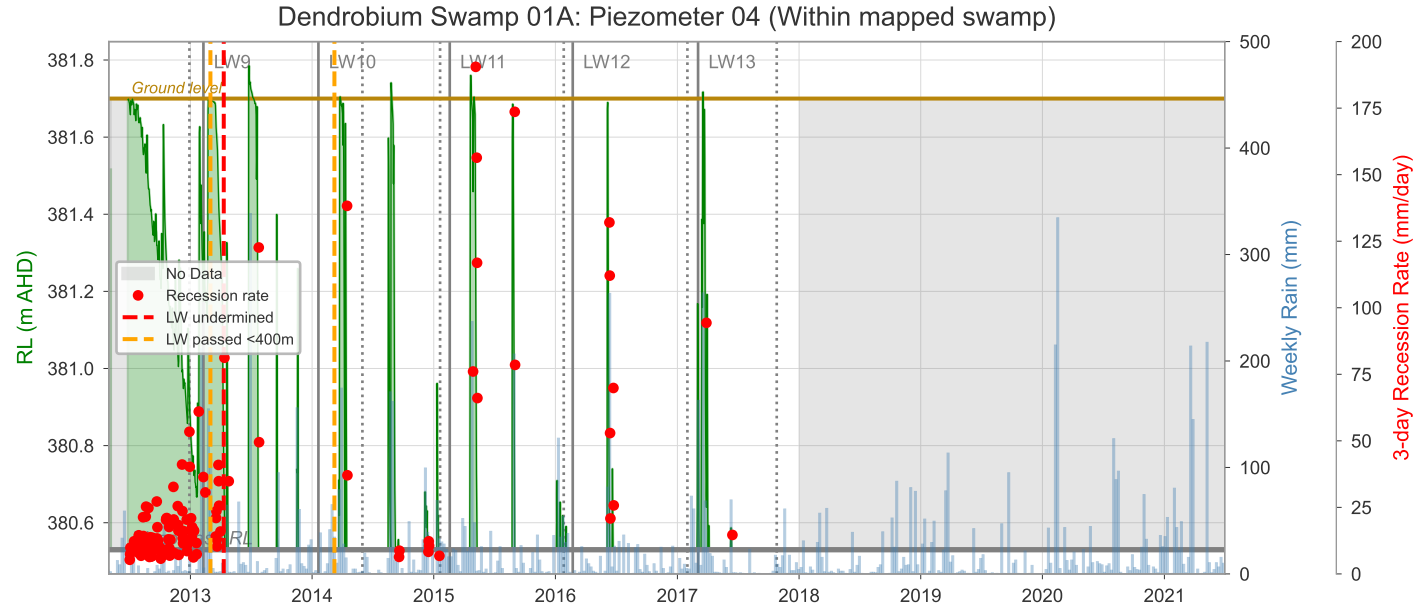
Site ID	Swamp	MGA_E	MGA_N	Elev (m)	Depth (m)	RL Bottom (m)	Total Casing (m)	Screen (m)	Stick-up (m)	Piezo RL(m)	Monitoring status
36_H3	Swamp 36	288776.8	6188174.7	404.44	0.74	403.70	1.77	n/a	1.03	403.87	end monitoring 29/12/2011
01_01	Swamp 1	294996.9	6192027.6	437.24	1.32	435.92	n/a	n/a	0.56	436.05	end monitoring 11/10/2014
01_02	Swamp 1	294961.5	6191998.2	437.42	0.84	436.58	n/a	n/a	0.50	436.72	end monitoring 12/10/2014
01_03	Swamp 1	294919.7	6191975.9	437.42	0.62	436.80	n/a	n/a	0.44	436.91	end monitoring 17/07/2014
01_04	Swamp 1	294869.4	6191947.9	438.44	0.32	438.12	n/a	n/a	0.29	438.19	end monitoring 03/09/2014
01_05	Swamp 1	294814.7	6191928.1	435.31	1.65	433.66	n/a	n/a	0.24	433.90	end monitoring 04/09/2014
84_01a	Swamp 84	294330.3	6192090.0	367.55	0.80	366.75	n/a	n/a	0.43	366.88	end monitoring 12/09/2011
84_02	Swamp 84	294175.3	6192139.3	352.42	1.83	350.59	n/a	n/a	0.59	351.01	end monitoring 07/08/2012
84_03	Swamp 84	294170.5	6192120.2	352.44	1.80	350.64	n/a	n/a	0.63	351.06	end monitoring 17/05/2012
84_04	Swamp 84	294190.9	6192085.8	353.90	1.27	352.63	n/a	n/a	0.33	352.78	end monitoring 17/05/2012
84_05	Swamp 84	293991.1	6192126.8	340.27	0.66	339.61	n/a	n/a	0.41	339.73	end monitoring 20/07/2012
D4_01	n/a	294737.5	6191757.0	442.88	1.21	441.67	n/a	n/a	0.20	441.83	end monitoring 19/02/2013
D5_01	n/a	293928.0	6192382.8	338.88	0.80	338.08	n/a	n/a	0.34	338.24	end monitoring 14/01/2012
D5_02	n/a	294006.6	6192328.0	345.27	1.00	344.27	n/a	n/a	0.30	344.42	end monitoring 08/08/2012
DA2A_01	n/a	293311.9	6192892.6	373.00	1.97	371.03	2.51	1.00	0.66	371.26	end monitoring 30/08/2012
EDEN87	n/a	294163.4	6192426.2	363.86	155.80	208.06	1.00	n/a	n/a	214.06	end monitoring 06/08/2012
EDEN87a	n/a	294167.4	6192427.9	363.96	9.60	354.36	7.00	n/a	0.37	-	no instrumentation
EDEN87b	n/a	294158.5	6192420.5	363.46	26.00	337.46	22.00	n/a	0.29	-	no instrumentation
EDEN88	n/a	294391.7	6192283.7	377.93	155.60	222.33	1.10	n/a	n/a	247.93	end monitoring 23/11/2009
EDEN88a	n/a	294389.6	6192275.6	378.43	10.00	368.43	7.00	n/a	0.22	-	no instrumentation
EDEN88b	n/a	294392.3	6192279.3	378.13	28.00	350.13	26.00	n/a	0.21	-	no instrumentation
EDEN89	n/a	294835.1	6191721.9	455.46	165.10	290.36	2.70	n/a	n/a	332.46	end monitoring 18/06/2008
EDEN89a	n/a	294839.7	6191727.4	455.46	9.70	445.76	7.00	n/a	0.31	-	no instrumentation
EDEN89b	n/a	294836.8	6191719.2	455.46	41.50	413.96	38.00	n/a	0.35	-	no instrumentation
EDEN89c	n/a	294829.3	6191731.0	454.71	1.12	453.59	1.69	n/a	0.62	453.75	end monitoring 19/02/2013
EDEN90	n/a	294886.8	6193033.8	386.30	141.00	245.30	2.00	n/a	n/a	250.50	end monitoring 28/08/2012
EDEN90a	n/a	294882.9	6193038.8	386.30	5.20	381.10	2.50	n/a	0.37	-	no instrumentation
EDEN90b	n/a	294891.3	6193024.3	386.70	11.00	375.70	9.00	n/a	0.19	-	no instrumentation
EGW2	n/a	289473.6	6188026.0	452.80	45.67	407.13	n/a	n/a	0.54	411.07	end monitoring 15/08/2011
EGW3	n/a	289796.7	6187751.7	450.23	35.10	415.13	n/a	n/a	0.37	418.42	end monitoring 04/09/2012
EGW4a	n/a	290132.9	6188351.6	462.22	48.45	413.77	n/a	n/a	0.58	415.34	end monitoring 20/03/2011
EGW5	n/a	290541.1	6187884.7	475.58	51.51	424.07	n/a	n/a	0.69	425.80	end monitoring 04/09/2012
EGW6	n/a	290460.0	6188056.6	463.39	39.55	423.84	n/a	n/a	0.64	425.67	end monitoring 04/09/2012
LC3_01	n/a	292809.4	6193350.1	401.40	1.67	399.73	2.24	1.00	0.57	399.94	end monitoring 13/09/2012
LC3_02	n/a	293084.2	6193327.4	384.80	1.58	383.22	2.08	1.00	0.51	383.41	end monitoring 14/05/2012
LC4_01	n/a	292297.0	6193409.0	402.90	1.85	401.05	2.55	0.50	0.93	401.49	end monitoring 22/05/2012
LC4_02	n/a	292364.0	6193425.1	401.00	2.34	398.66	3.03	0.50	0.77	398.96	end monitoring 26/01/2012
LC4_03	n/a	292449.3	6193336.9	406.10	1.76	404.34	2.32	0.50	0.60	404.48	end monitoring 27/08/2012
LC4_04	n/a	292638.3	6193713.7	381.90	3.00	378.90	3.52	1.00	0.53	379.13	end monitoring 13/09/2012
07_05	Swamp 7	292442.8	6194750.6	351.03	2.82	348.21	3.69	1.42	0.87	348.35	active
07_06	Swamp 7	292498.6	6195011.8	340.82	2.65	338.17	3.02	1.60	0.50	338.42	active
14_01	Swamp 14	289911.7	6191296.7	393.72	2.28	391.44	2.60	1.06	0.73	391.95	active
14_02	Swamp 14	290178.6	6191668.0	375.44	1.64	373.80	2.33	0.84	0.72	373.96	active
22_01	Swamp 22	292796.3	6188139.5	457.92	1.98	455.94	2.93	1.36	1.00	456.12	active
22_02	Swamp 22	293188.7	6188171.8	450.04	2.93	447.11	3.71	1.41	0.78	447.22	active
23_01	Swamp 23	288867.1	6191751.8	392.43	1.22	391.21	2.02	0.50	0.80	391.33	active
23_02	Swamp 23	288663.2	6191690.4	368.89	2.57	366.33	3.00	1.50	0.60	366.64	active
33_01	Swamp 33	291948.8	6190939.7	389.28	1.19	388.09	2.01	0.49	0.82	388.25	active
33_03	Swamp 33	291668.1	6191267.1	365.13	1.10	364.03	1.98	0.50	1.10	364.33	active
35a_01	Swamp 35a	289698.4	6190520.1	380.26	2.18	378.08	3.00	1.50	0.98	378.35	active
35b_01	Swamp 35b	289359.8	6190458.7	352.24	3.66	348.58	4.02	1.47	0.80	349.14	active
84_01	Swamp 84	294101.0	6192112.0	348.54	1.82	346.72	2.20	0.75	0.63	347.07	active
85_01	Swamp 85	288032.8	6195001.8	395.70	1.26	394.44	2.00	0.50	0.76	394.56	active
85_02	Swamp 85	288140.6	6195011.3	391.19	1.22	389.97	2.17	0.72	0.99	390.13	active
86_01	Swamp 86	286624.9	6196836.4	383.66	1.64	382.02	2.52	1.00	0.89	382.15	active
86_02	Swamp 86	286534.0	6196551.6	389.58	3.80	385.78	4.54	1.50	0.75	385.93	active
87_01	Swamp 87	290857.0	6180951.6	539.65	2.97	536.68	3.82	0.80	0.99	536.94	active
87_02	Swamp 87	290879.3	6181182.7	535.52	1.85	533.67	2.48	0.96	0.68	533.85	active
88_01	Swamp 88	289219.0	6180106.7	537.99	1.64	536.35	2.30	0.74	0.86	536.60	active
88_02	Swamp 88	289368.4	6180460.6	527.25	1.20	526.05	1.87	0.90	0.87	526.37	active

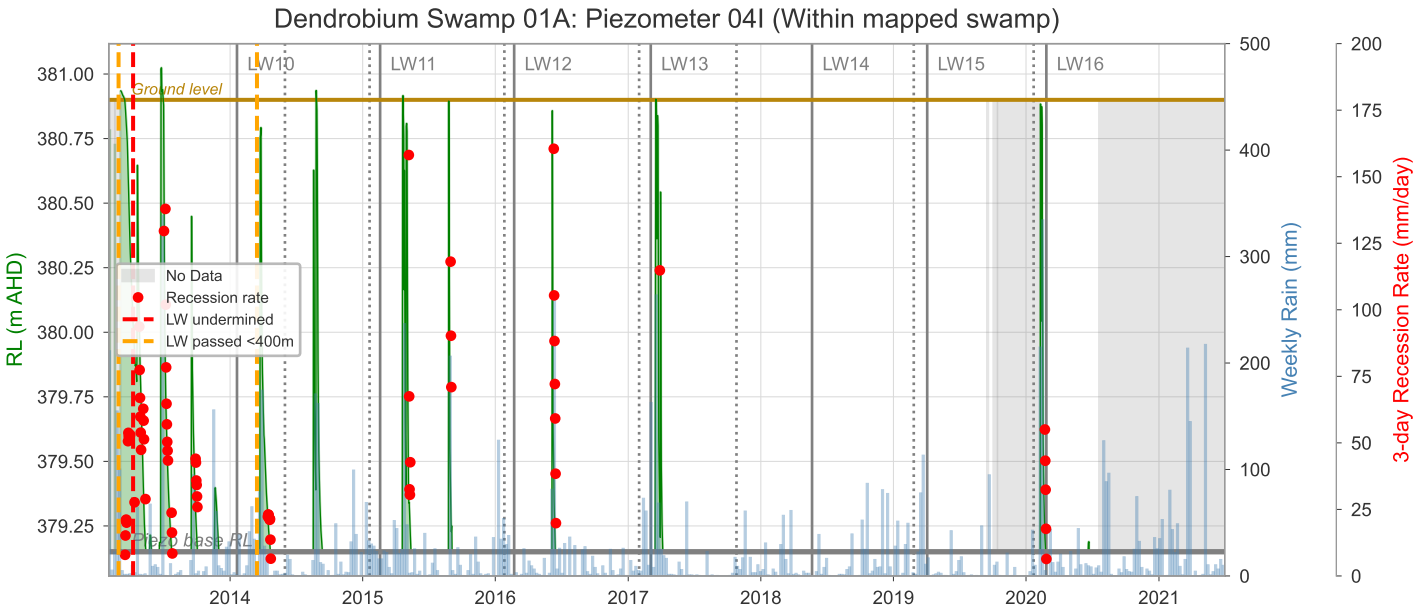
Appendix B – Piezometer hydrographs

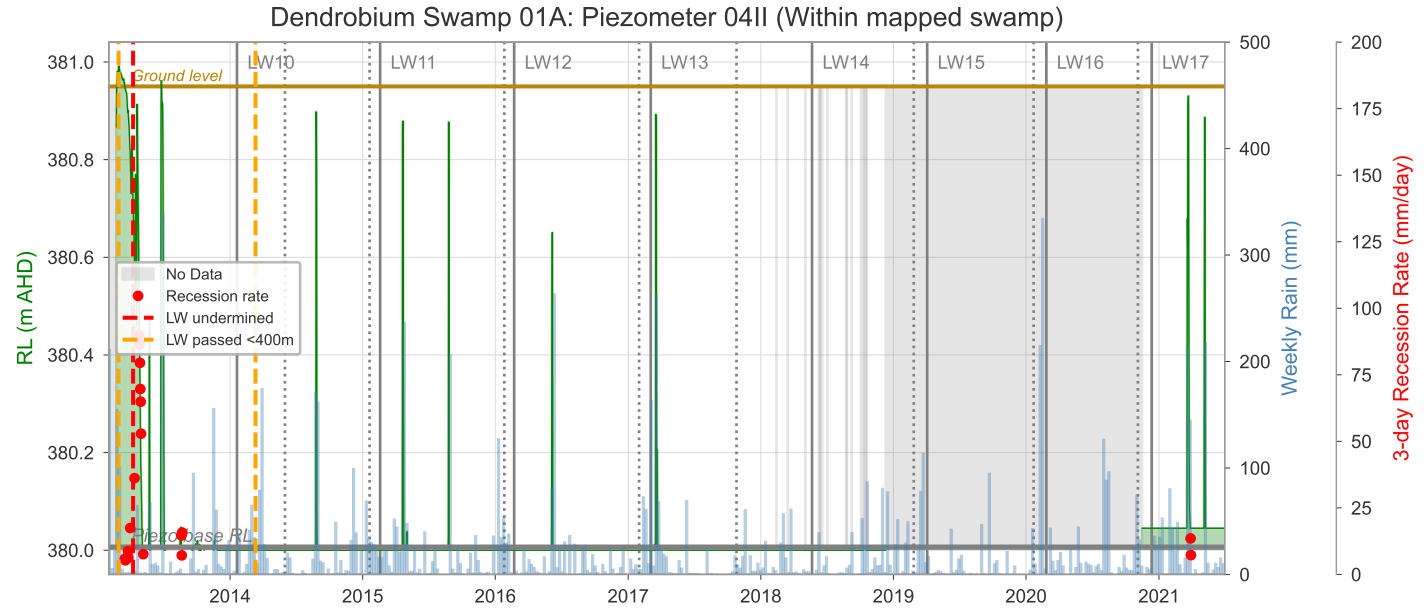
Hydrographs for all logged shallow piezometer sites presented on following pages (by HGEO)

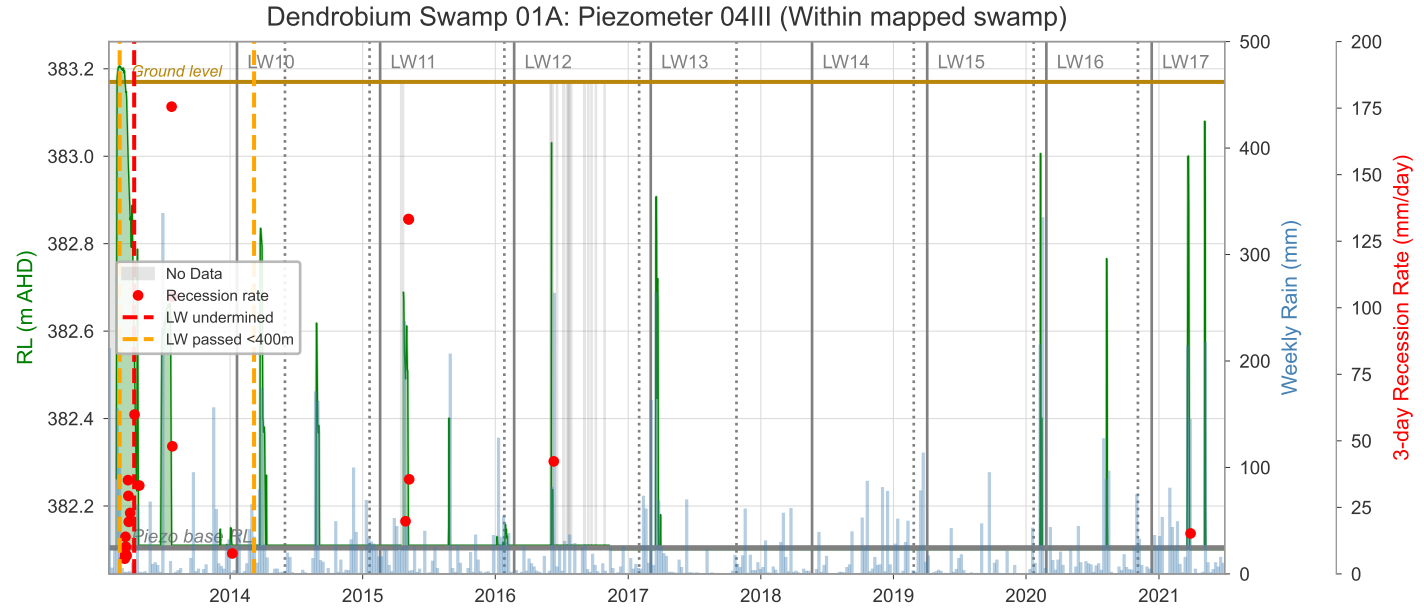

Dendrobium Swamp 01A: Piezometer 01 (Within mapped swamp)
Ground level
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

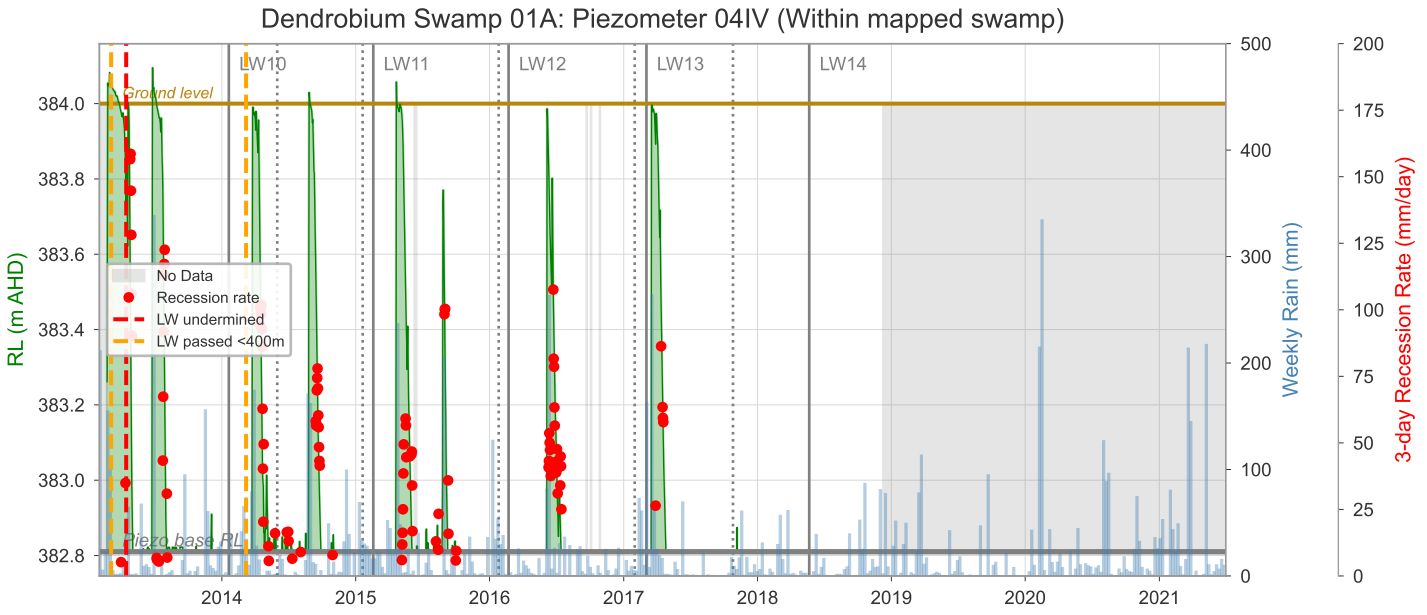

Dendrobium Swamp 01A: Piezometer 02 (Within mapped swamp)
Ground level
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

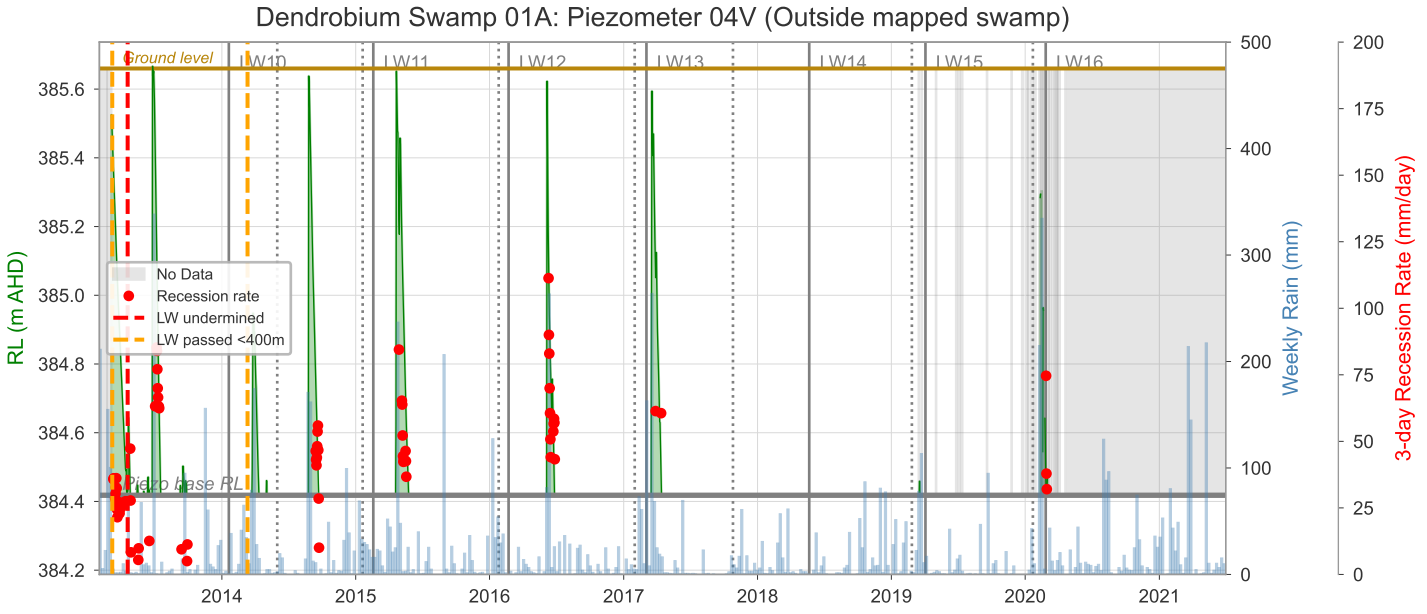

Dendrobium Swamp 01A: Piezometer 04 (Within mapped swamp)
Ground level
LW9
LW10
LW11
LW12
LW13
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

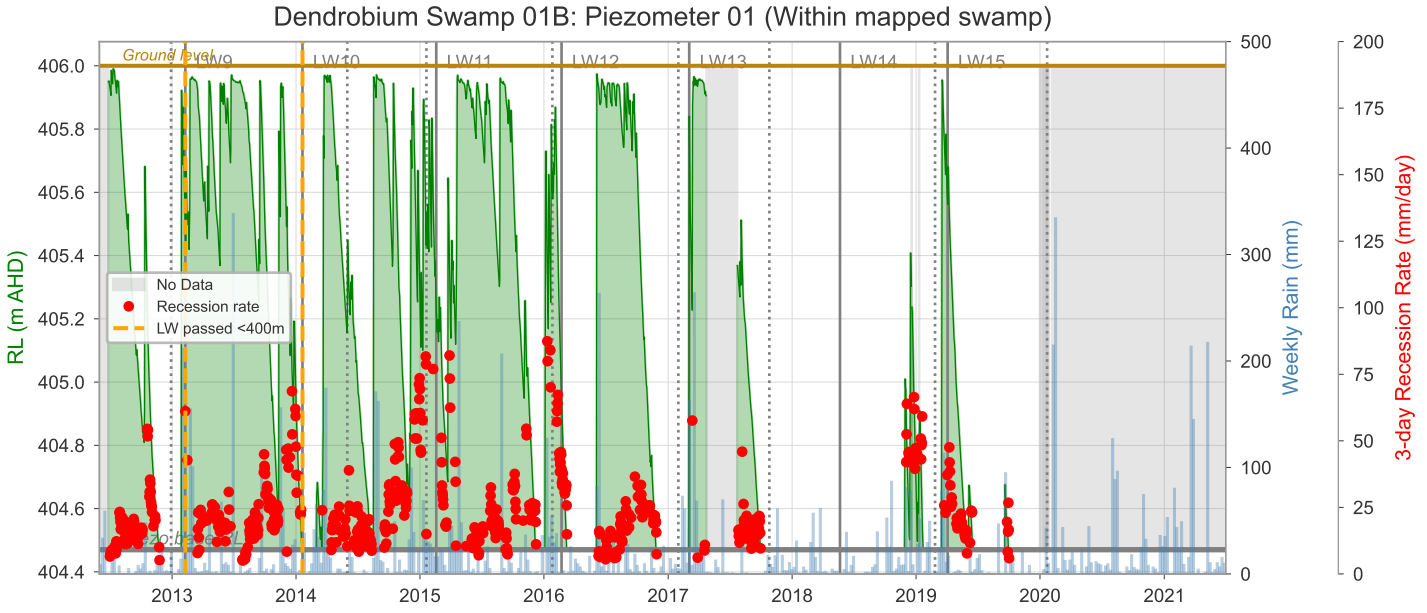

Dendrobium Swamp 01A: Piezometer 04I (Within mapped swamp)
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
Ground level
Piezo base RL
LW10
LW11
LW12
LW13
LW14
LW15
LW16
No Data
Recession rate
LW undermined
LW passed <400m

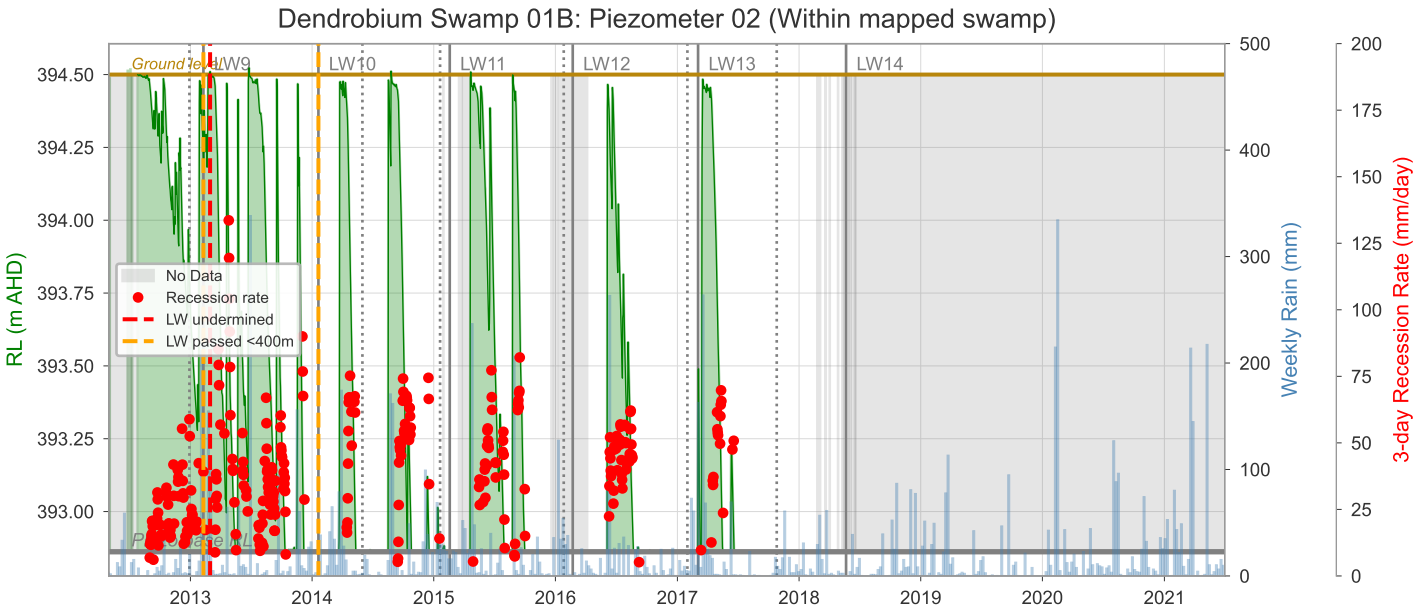

Dendrobium Swamp 01A: Piezometer 04II (Within mapped swamp)
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
Ground level
Piezo base RL
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
No Data
Recession rate
LW undermined
LW passed <400m

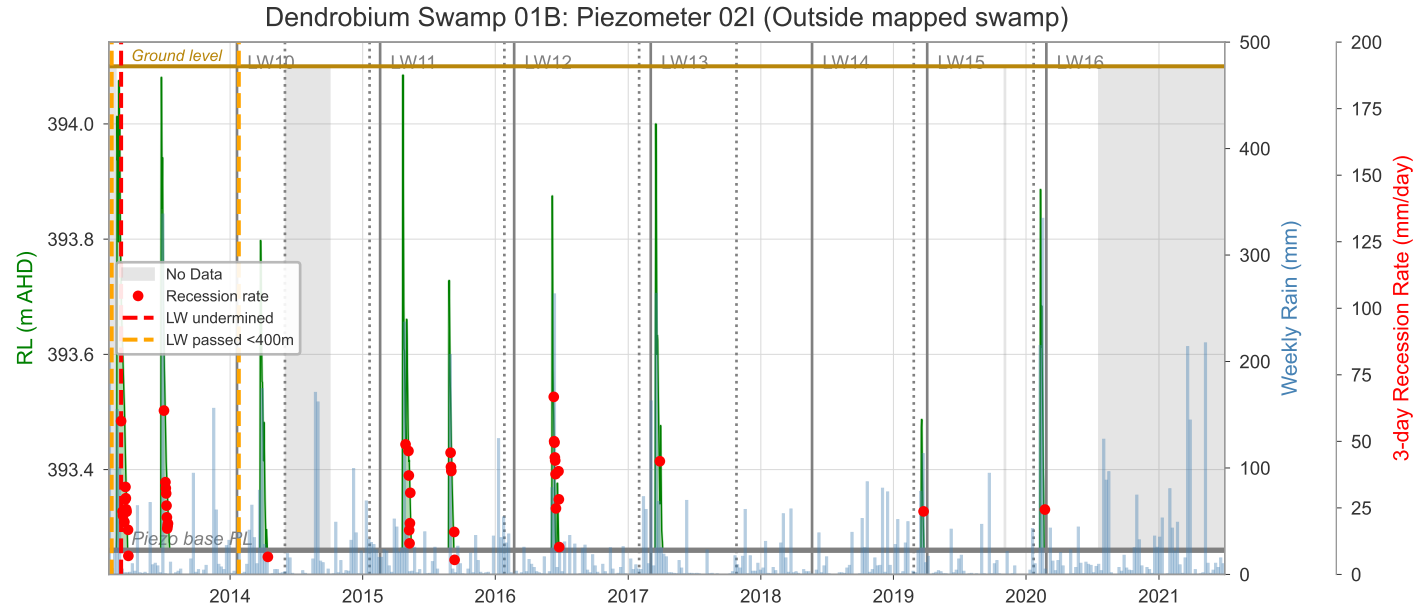

Dendrobium Swamp 01A: Piezometer 04III (Within mapped swamp)
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
Ground level
Piezo base RL
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
No Data
Recession rate
LW undermined
LW passed <400m

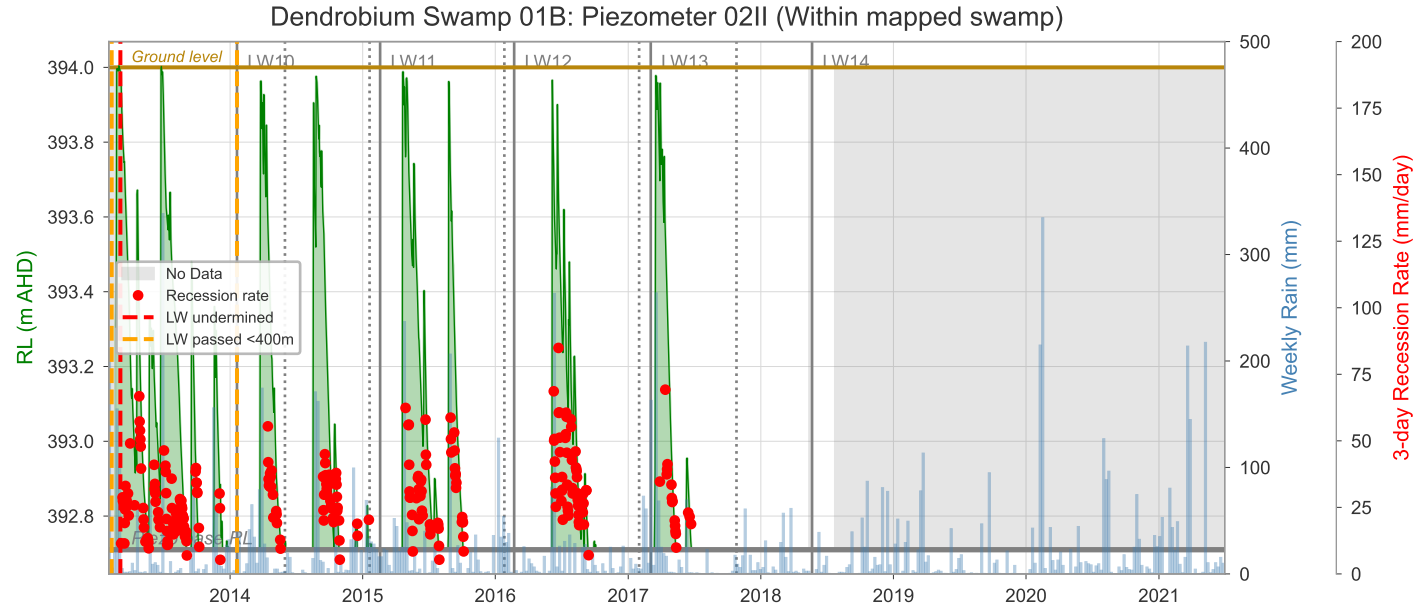

Dendrobium Swamp 01A: Piezometer 04IV (Within mapped swamp)
LW10
LW11
LW12
LW13
LW14
Ground level
Piezo base RL
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
384.0
383.8
383.6
383.4
383.2
383.0
382.8
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2014
2015
2016
2017
2018
2019
2020
2021

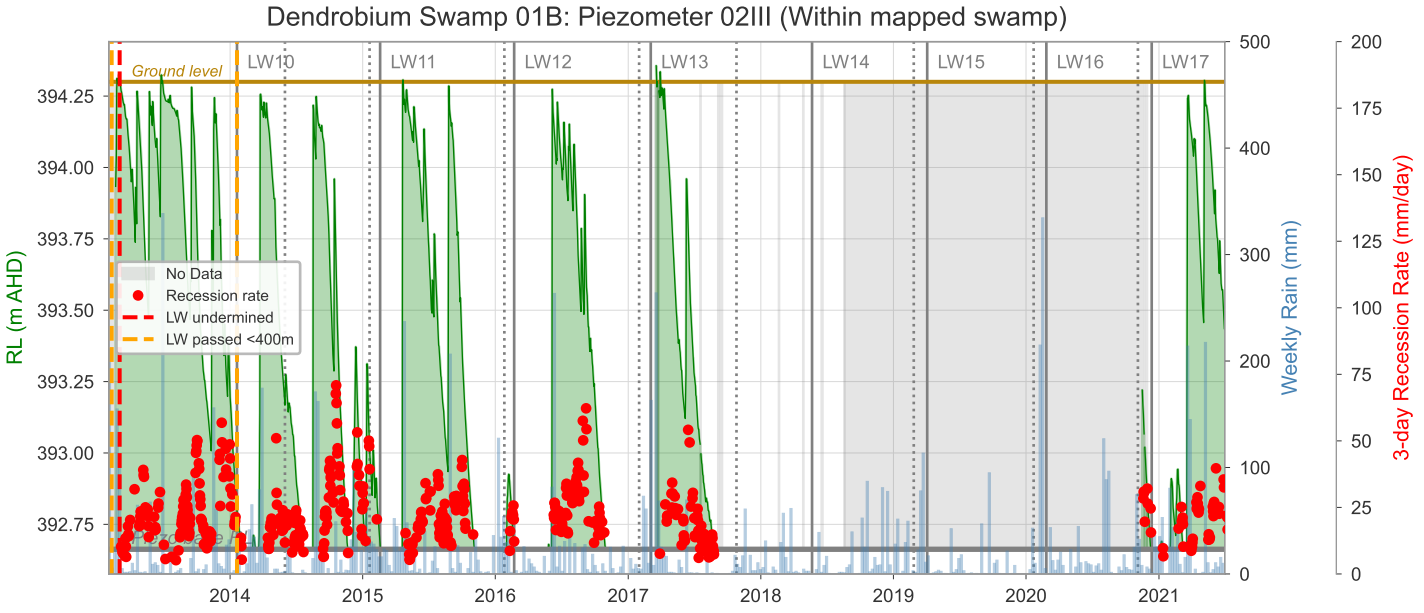

Dendrobium Swamp 01A: Piezometer 04V (Outside mapped swamp)
LW10
LW11
LW12
LW13
LW14
LW15
LW16
Ground level
Piezo base RL
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
385.6
385.4
385.2
385.0
384.8
384.6
384.4
384.2
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2014
2015
2016
2017
2018
2019
2020
2021

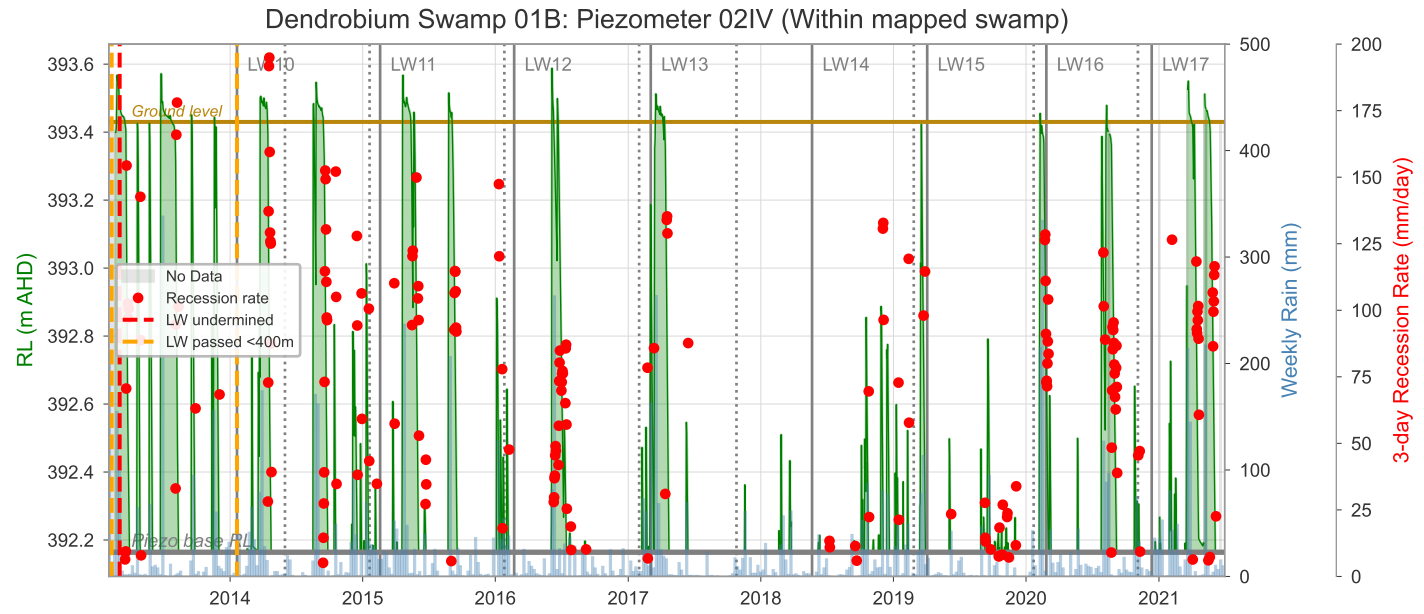

Dendrobium Swamp 01B: Piezometer 01 (Within mapped swamp)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
Ground level
Piezo base RL
No Data
Recession rate
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
406.0
405.8
405.6
405.4
405.2
405.0
404.8
404.6
404.4
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2013
2014
2015
2016
2017
2018
2019
2020
2021

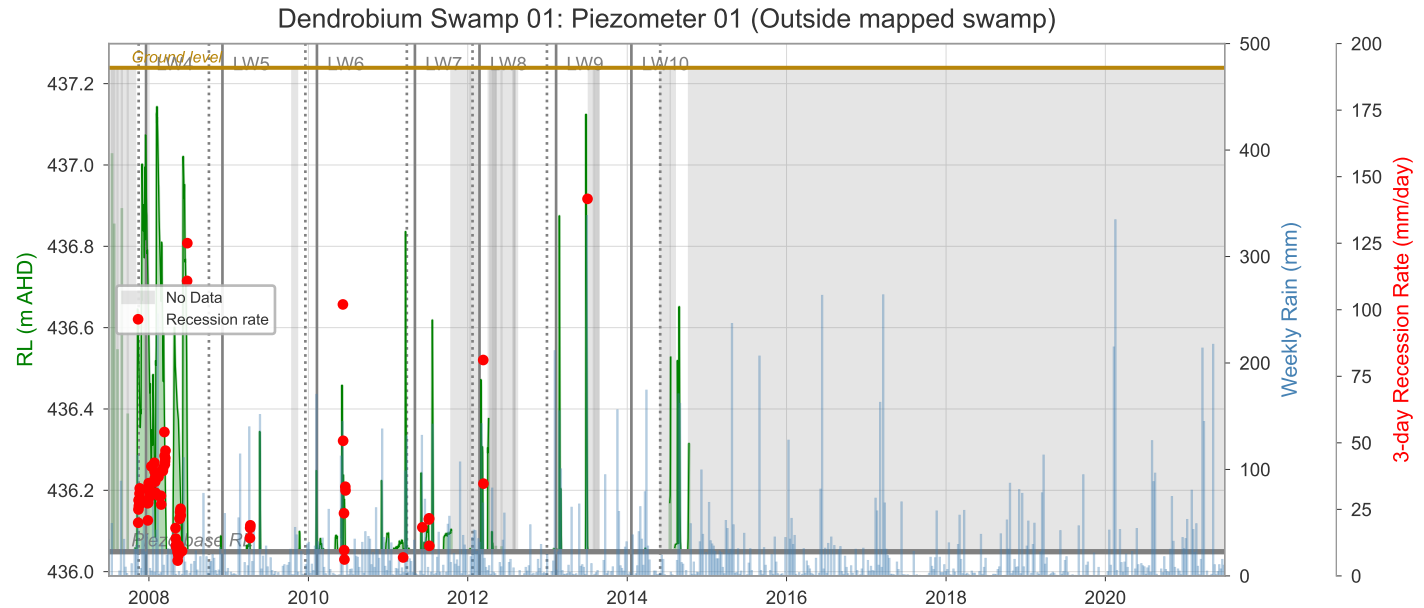

Dendrobium Swamp 01B: Piezometer 02 (Within mapped swamp)
Ground level
LW9
LW10
LW11
LW12
LW13
LW14
No Data
Recession rate
LW undermined
LW passed <400m
Piezo base RL
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

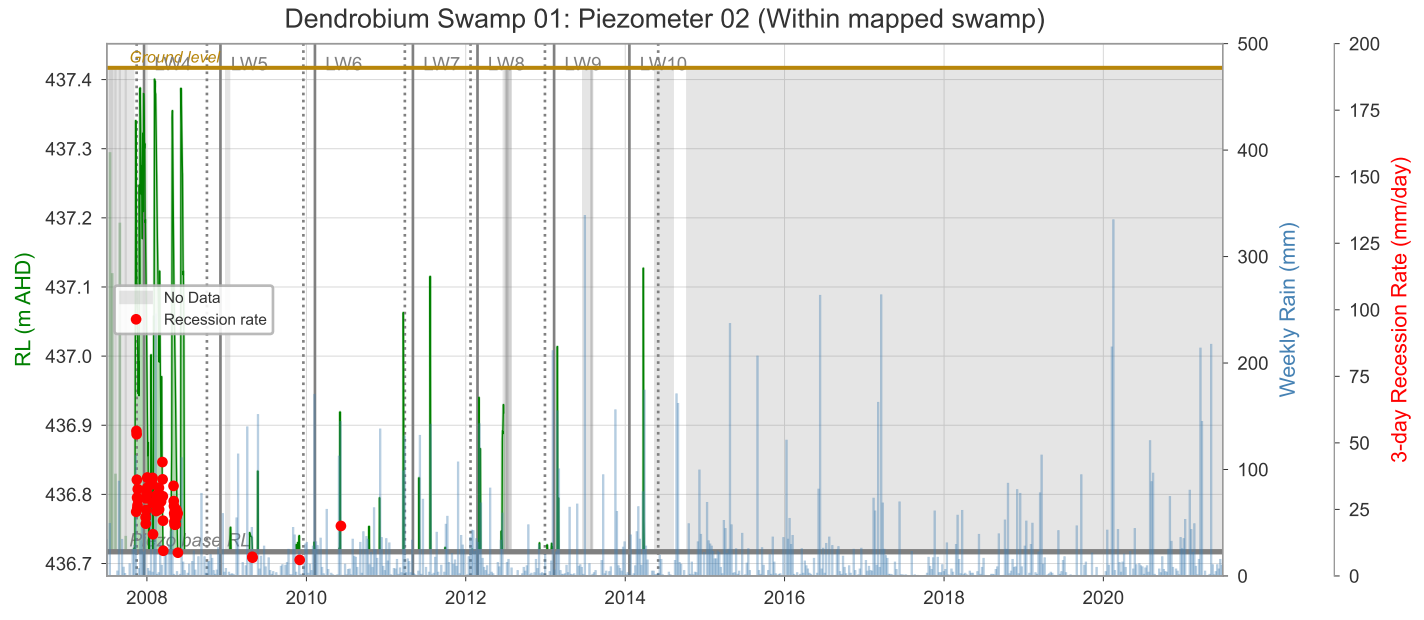

Dendrobium Swamp 01B: Piezometer 02I (Outside mapped swamp)
Ground level
LW10
LW11
LW12
LW13
LW14
LW15
LW16
No Data
Recession rate
LW undermined
LW passed <400m
Piezo base RL
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

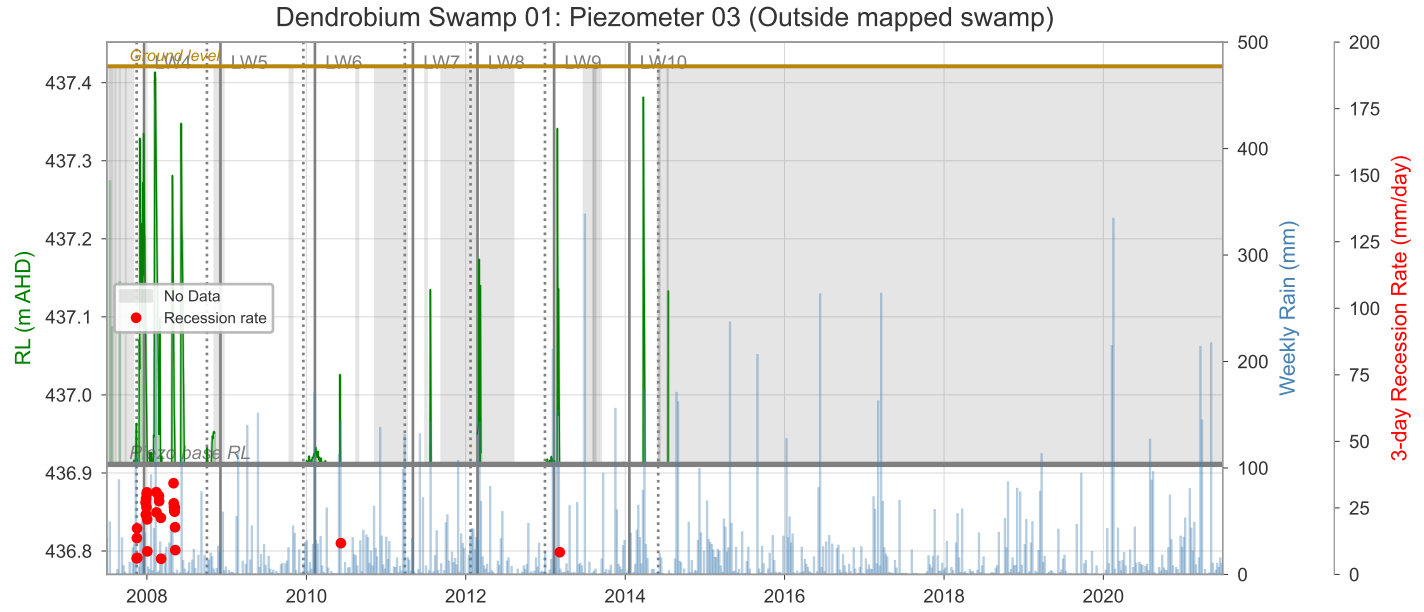

Dendrobium Swamp 01B: Piezometer 02II (Within mapped swamp)
Ground level
LW10
LW11
LW12
LW13
LW14
No Data
Recession rate
LW undermined
LW passed <400m
Piezo base RL
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

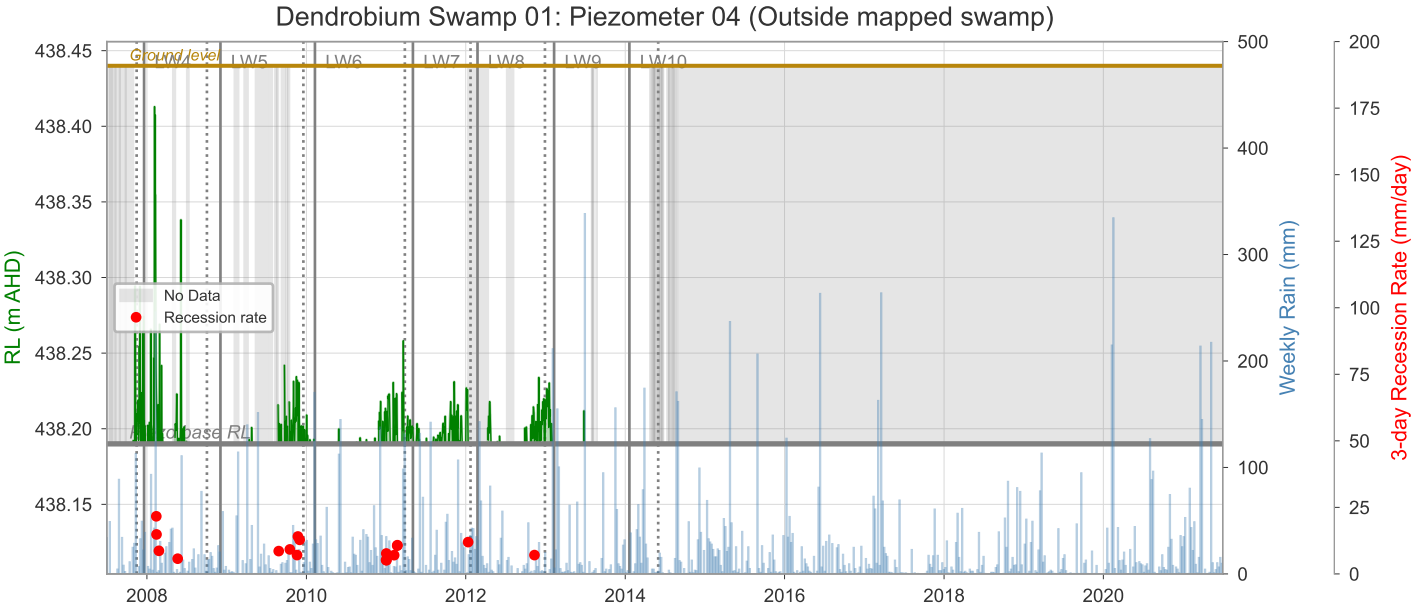

Dendrobium Swamp 01B: Piezometer 02III (Within mapped swamp)
Ground level
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
394.25
394.00
393.75
393.50
393.25
393.00
392.75
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2014
2015
2016
2017
2018
2019
2020
2021

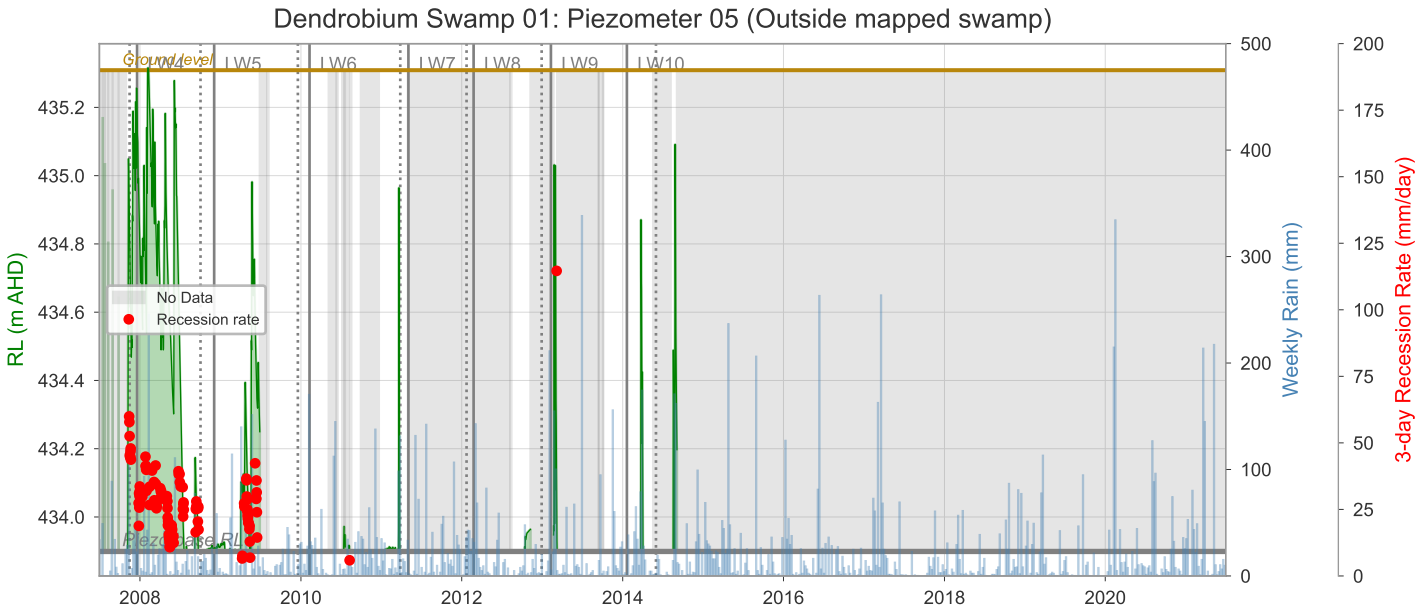

Dendrobium Swamp 01B: Piezometer 02IV (Within mapped swamp)
Ground level
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
No Data
Recession rate
LW undermined
LW passed <400m
Piezo base RL
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
393.6
393.4
393.2
393.0
392.8
392.6
392.4
392.2
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2014
2015
2016
2017
2018
2019
2020
2021

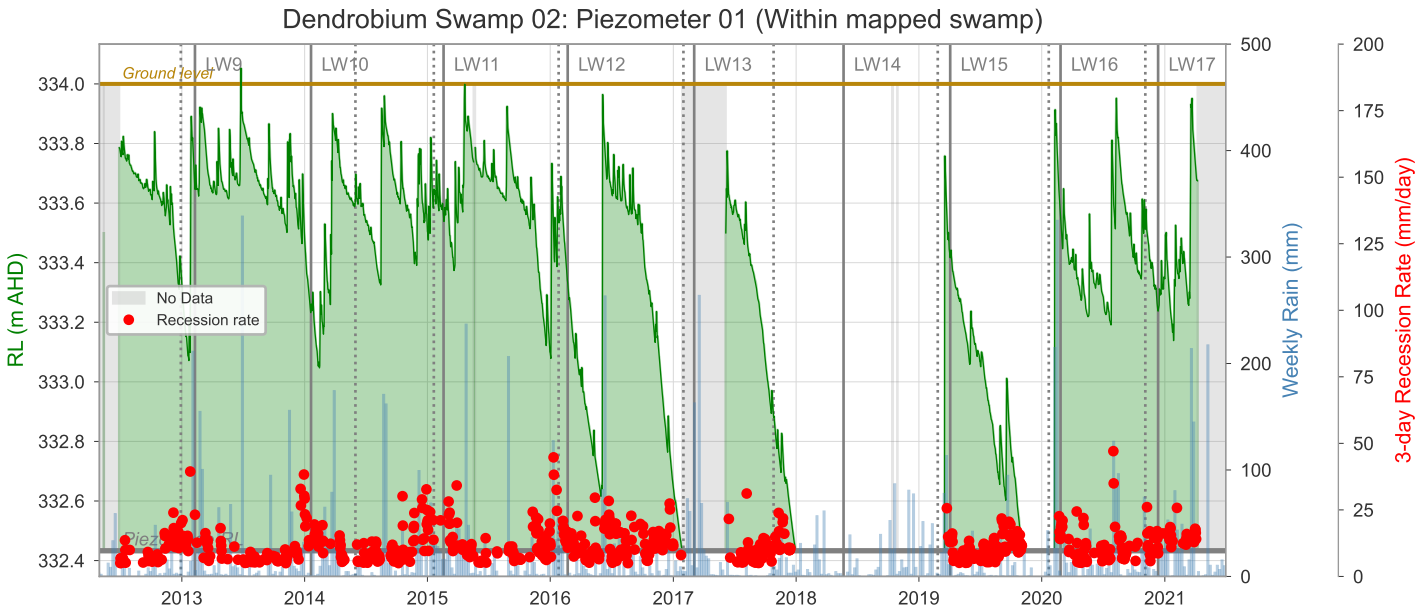

Dendrobium Swamp 01: Piezometer 01 (Outside mapped swamp)
Ground level
LW5
LW6
LW7
LW8
LW9
LW10
No Data
Recession rate
Piezo base RL
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
437.2
437.0
436.8
436.6
436.4
436.2
436.0
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2008
2010
2012
2014
2016
2018
2020

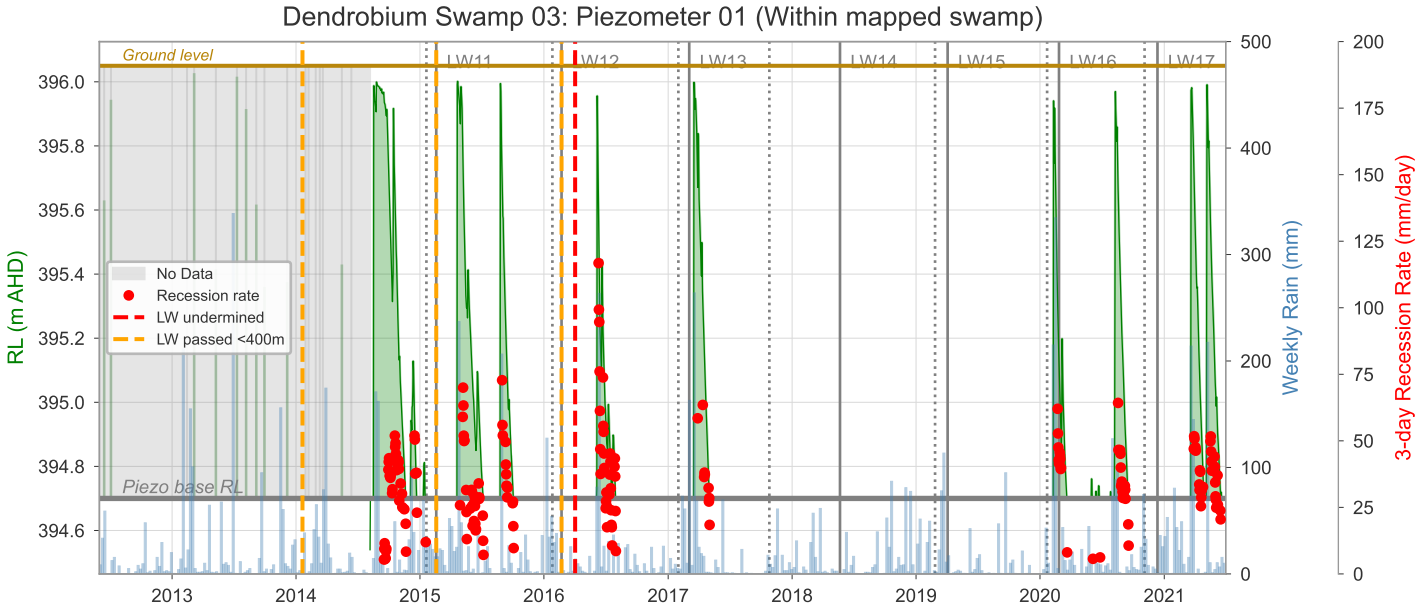

Dendrobium Swamp 01: Piezometer 02 (Within mapped swamp)
Ground level
LW4
LW5
LW6
LW7
LW8
LW9
LW10
No Data
Recession rate
Piezo base RL
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
437.4
437.3
437.2
437.1
437.0
436.9
436.8
436.7
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2008
2010
2012
2014
2016
2018
2020

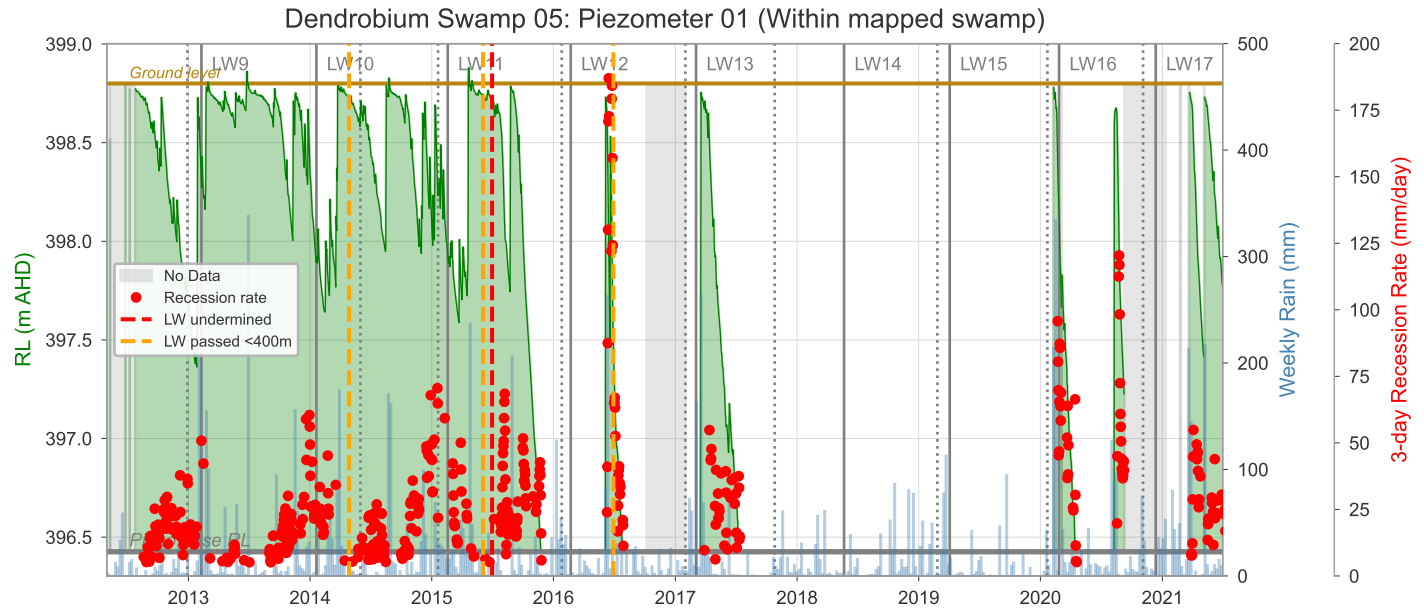

Dendrobium Swamp 01: Piezometer 03 (Outside mapped swamp)
Ground level
LW4
LW5
LW6
LW7
LW8
LW9
LW10
No Data
Recession rate
Piezo base RL
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
437.4
437.3
437.2
437.1
437.0
436.9
436.8
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2008
2010
2012
2014
2016
2018
2020

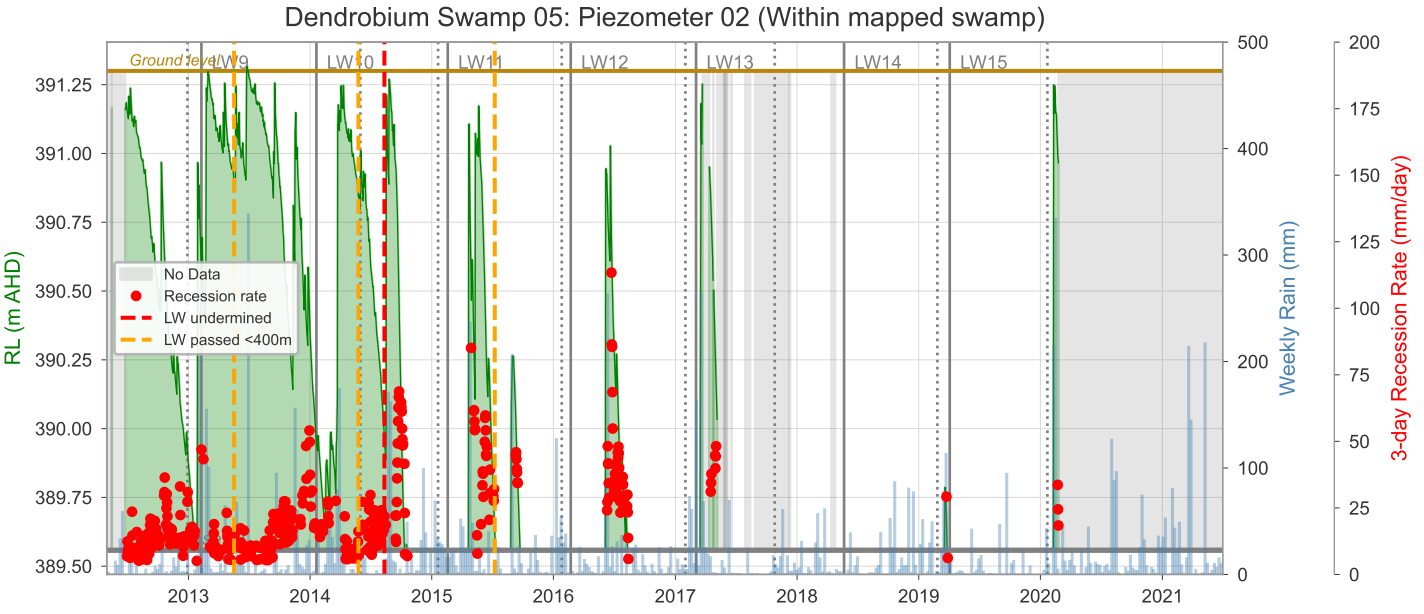

Dendrobium Swamp 01: Piezometer 04 (Outside mapped swamp)
Ground level
LW4
LW5
LW6
LW7
LW8
LW9
LW10
No Data
Recession rate
Piezo base RL
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
438.45
438.40
438.35
438.30
438.25
438.20
438.15
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2008
2010
2012
2014
2016
2018
2020

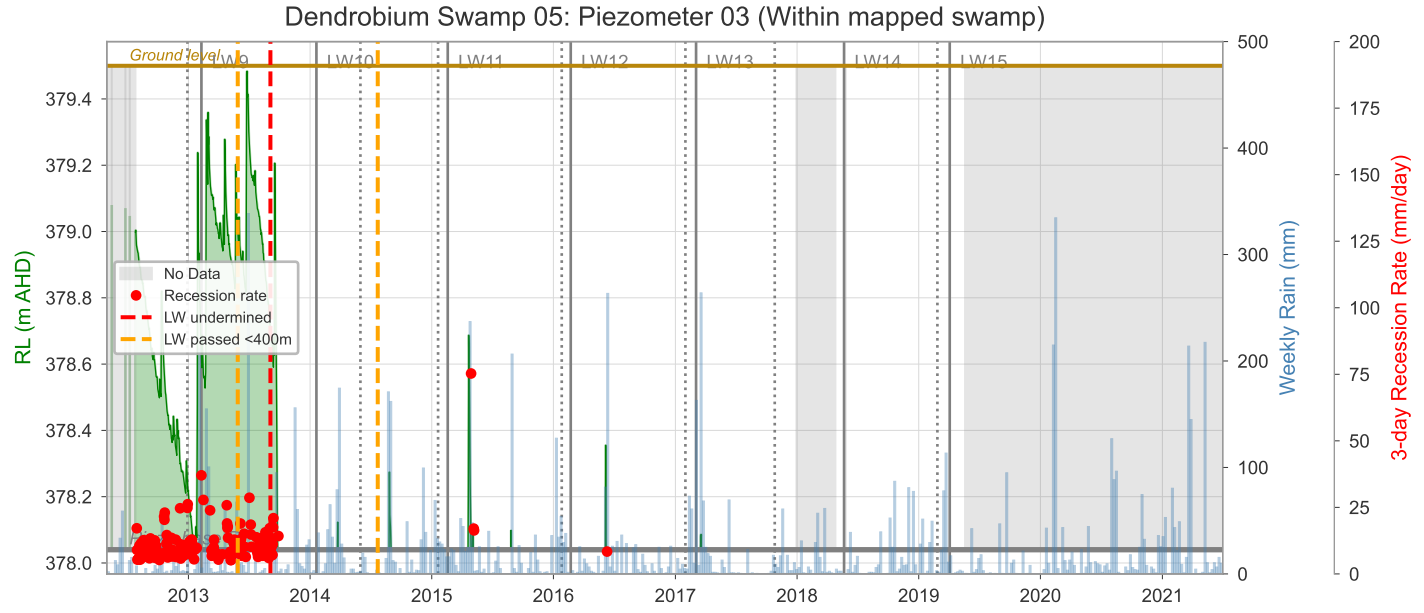

Dendrobium Swamp 01: Piezometer 05 (Outside mapped swamp)
Ground level
LW4
LW5
LW6
LW7
LW8
LW9
LW10
No Data
Recession rate
Piezo base RL
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

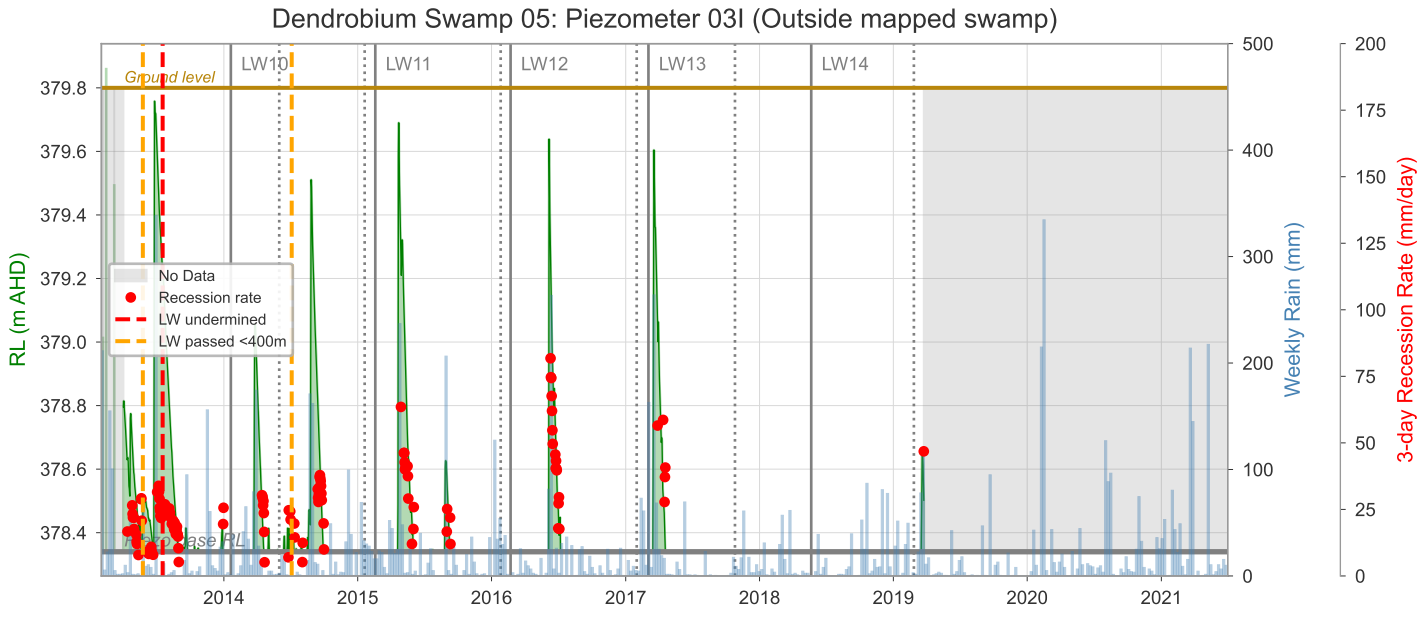

Dendrobium Swamp 02: Piezometer 01 (Within mapped swamp)
Ground level
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
No Data
Recession rate
Piezo base RL
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

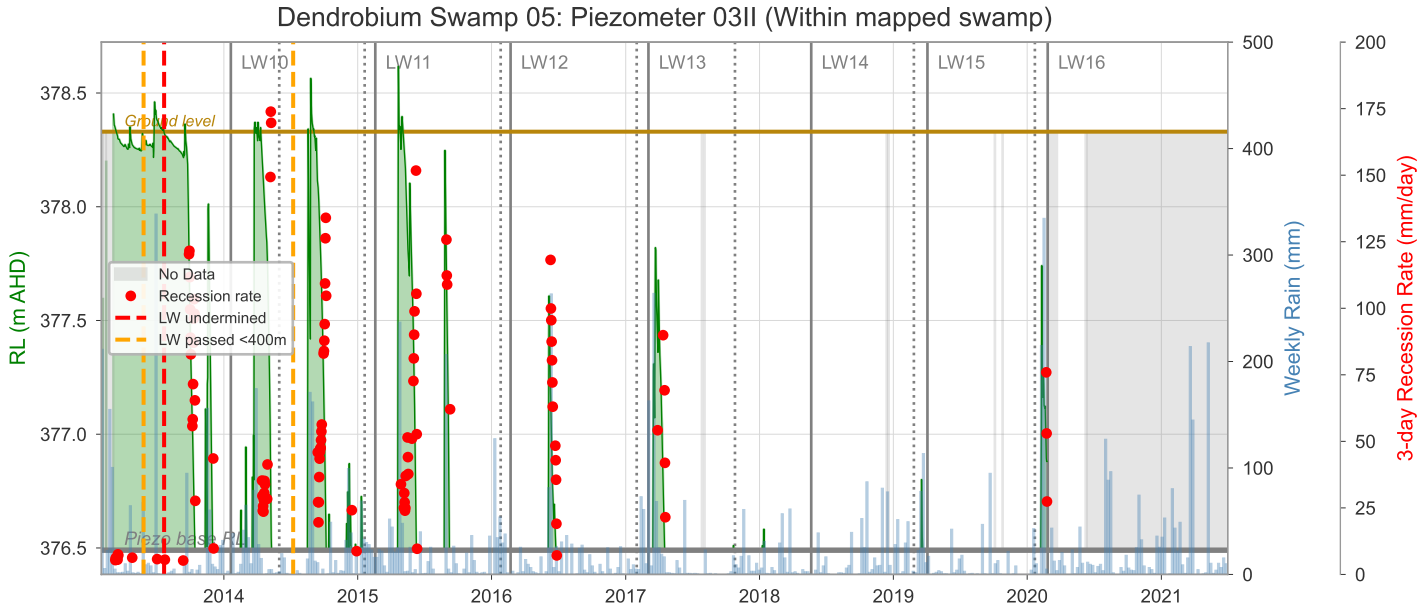

Dendrobium Swamp 03: Piezometer 01 (Within mapped swamp)
Ground level
LW11
LW12
LW13
LW14
LW15
LW16
LW17
No Data
Recession rate
LW undermined
LW passed <400m
Piezo base RL
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

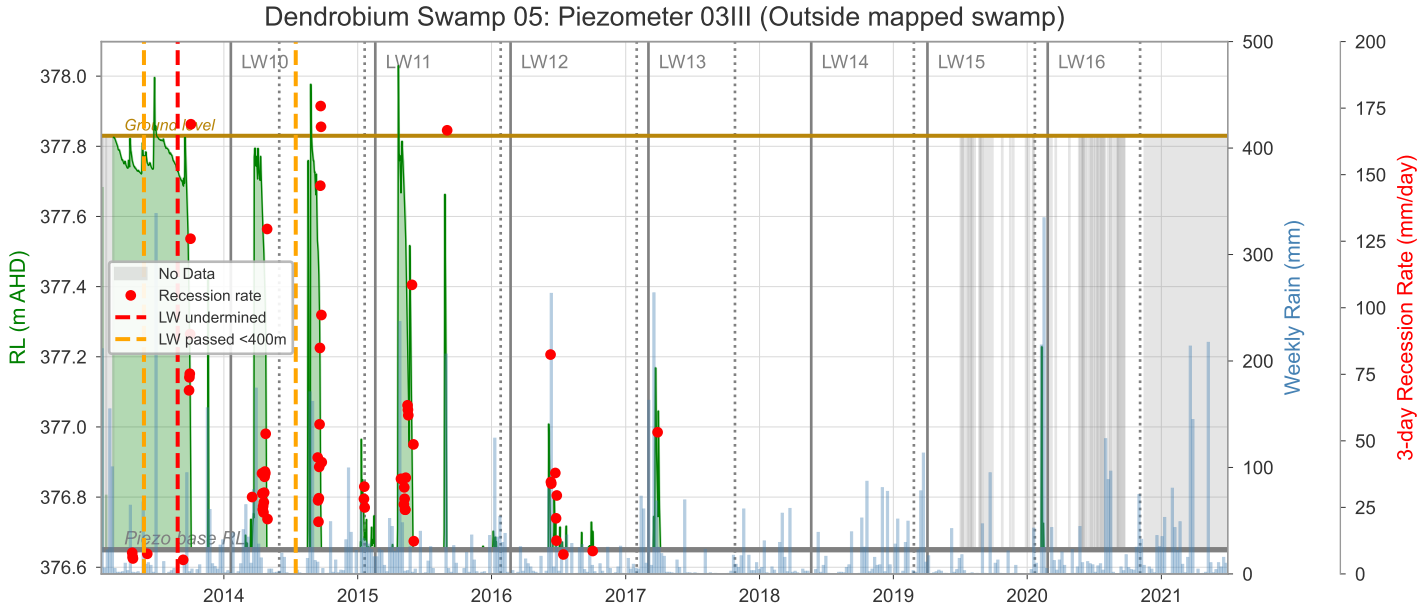

Dendrobium Swamp 05: Piezometer 01 (Within mapped swamp)
Ground level
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

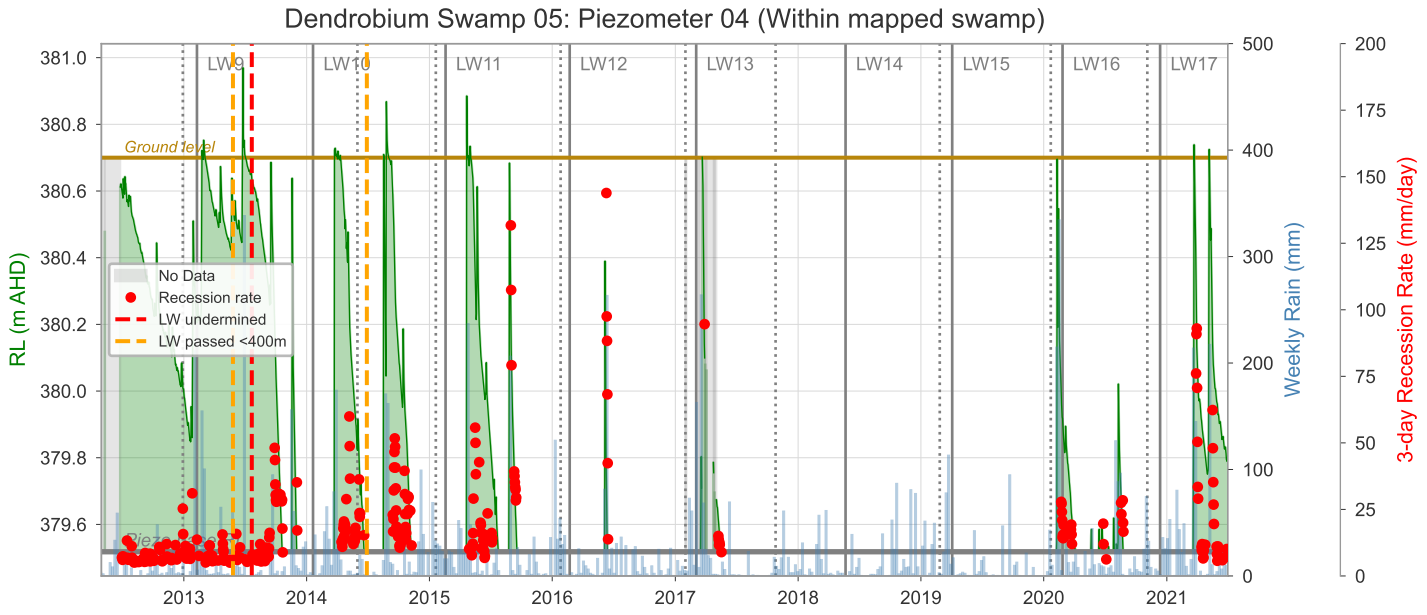

Dendrobium Swamp 05: Piezometer 02 (Within mapped swamp)
Ground level
LW9
LW10
LW11
LW12
LW13
LW14
LW15
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

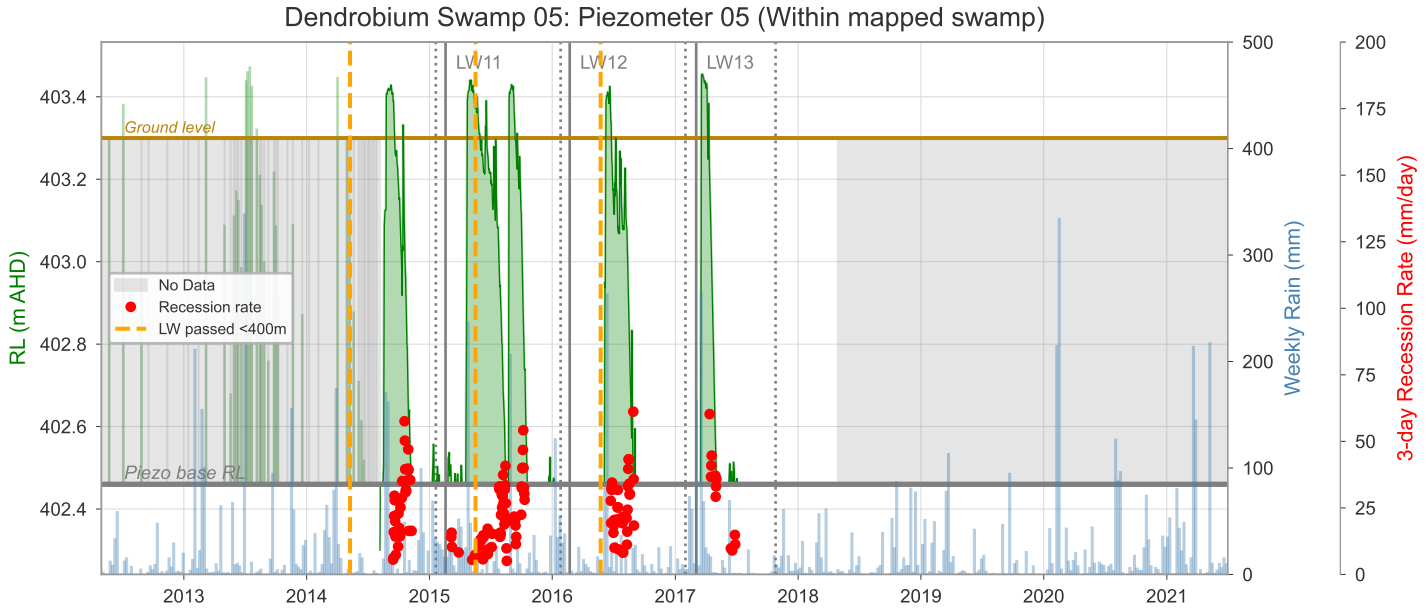

Dendrobium Swamp 05: Piezometer 03 (Within mapped swamp)
Ground level
LW9
LW10
LW11
LW12
LW13
LW14
LW15
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

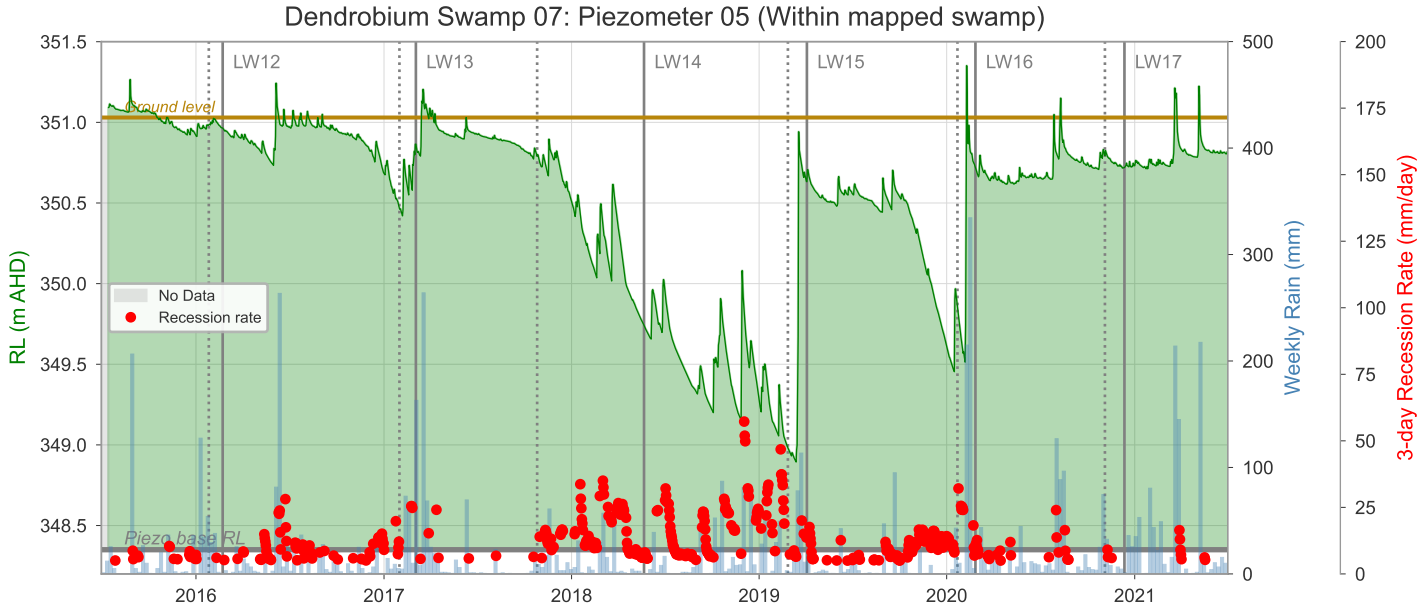

Dendrobium Swamp 05: Piezometer 03I (Outside mapped swamp)
LW10
LW11
LW12
LW13
LW14
Ground level
Piezo base RL
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

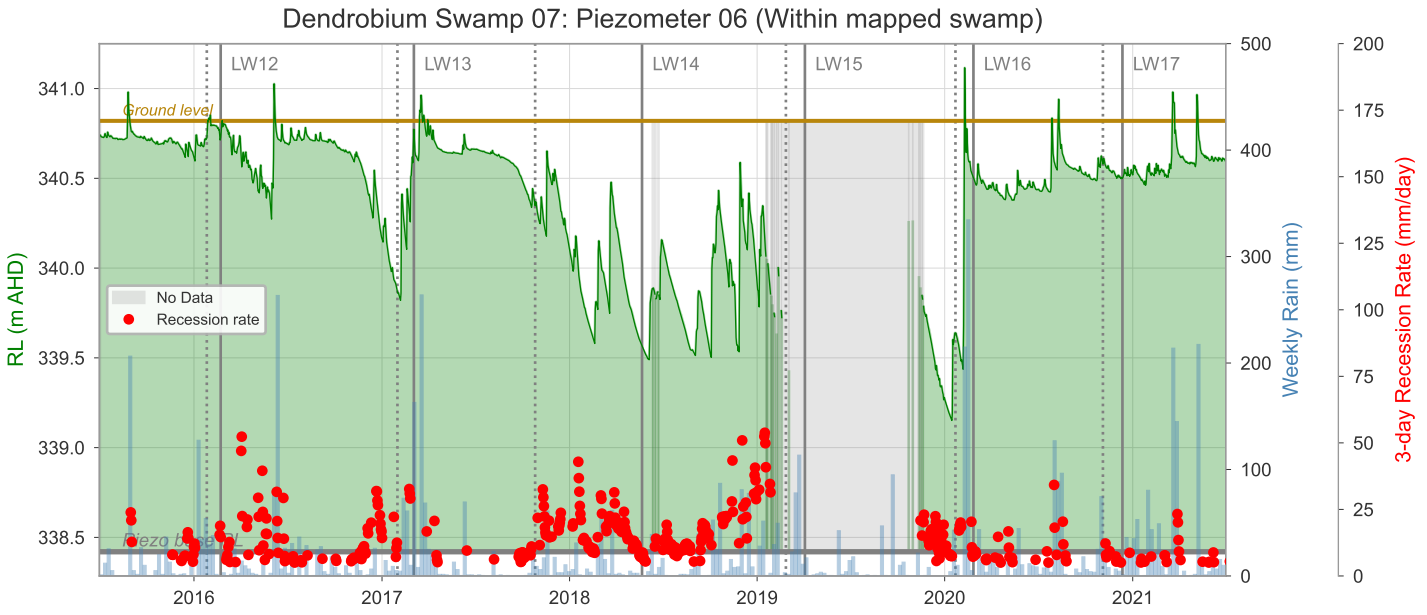

Dendrobium Swamp 05: Piezometer 03II (Within mapped swamp)
LW10
LW11
LW12
LW13
LW14
LW15
LW16
Ground level
Piezo base RL
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

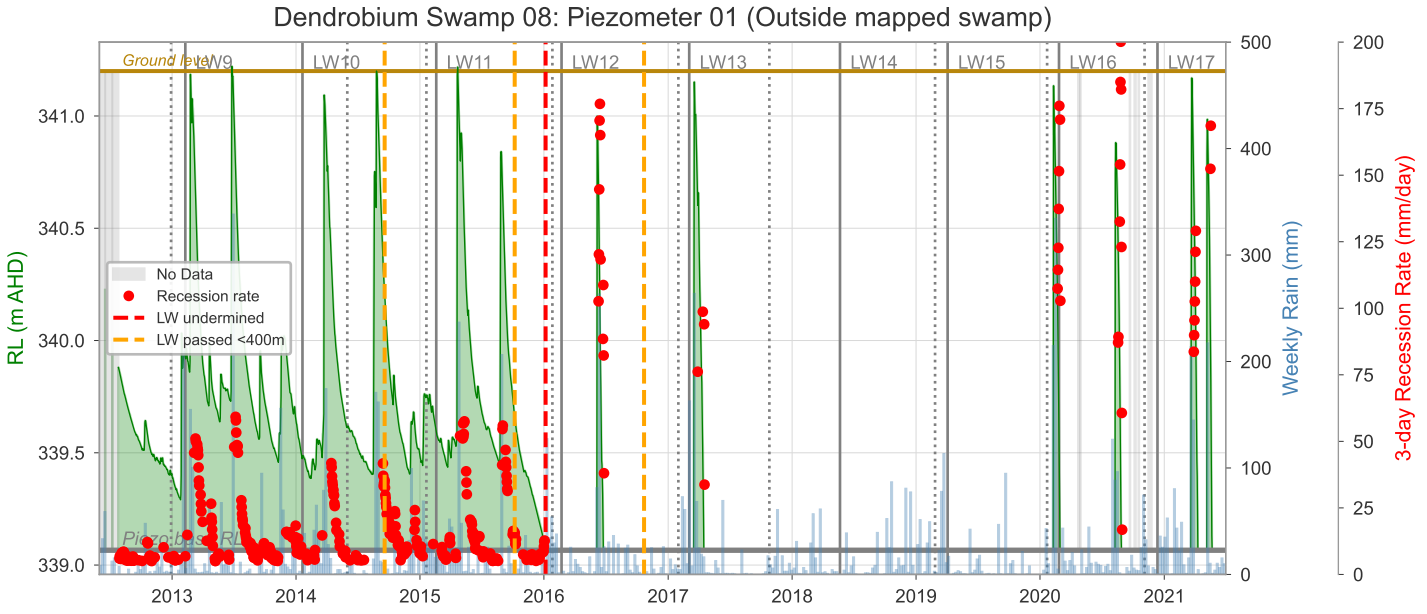

Dendrobium Swamp 05: Piezometer 03III (Outside mapped swamp)
LW10
LW11
LW12
LW13
LW14
LW15
LW16
Ground level
Piezo base RL
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

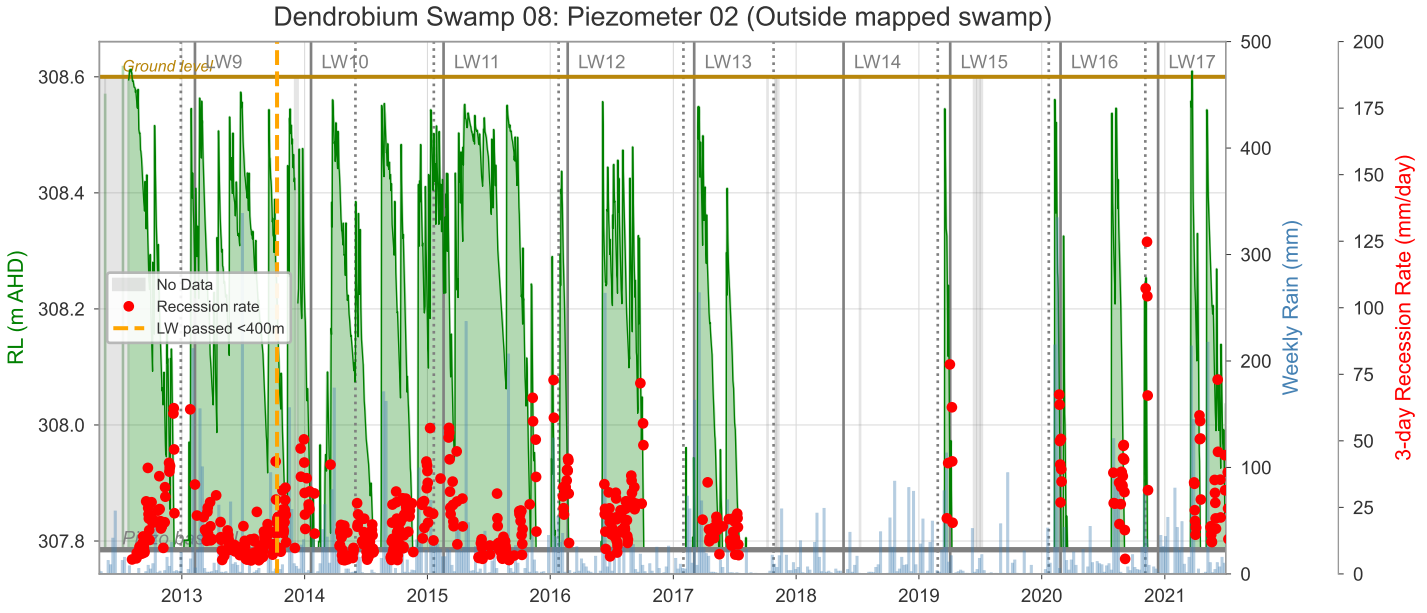

Dendrobium Swamp 05: Piezometer 04 (Within mapped swamp)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Ground level
Piezo base RL
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

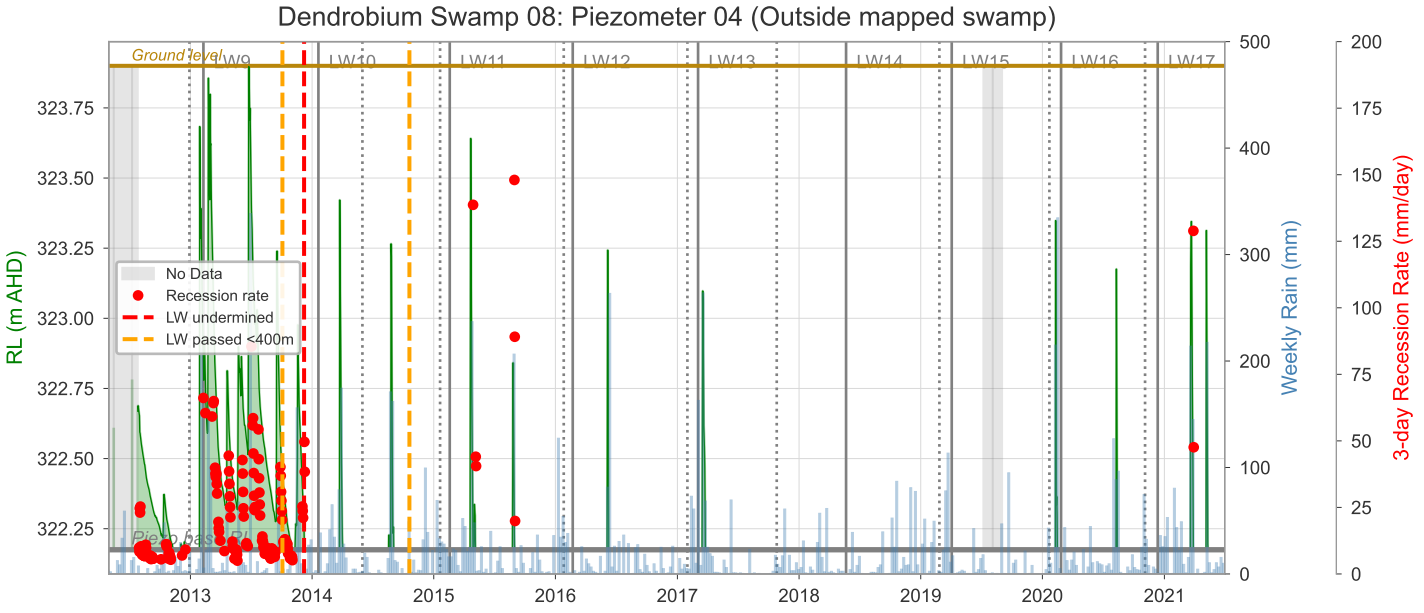

Dendrobium Swamp 05: Piezometer 05 (Within mapped swamp)
LW11
LW12
LW13
Ground level
Piezo base RL
No Data
Recession rate
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

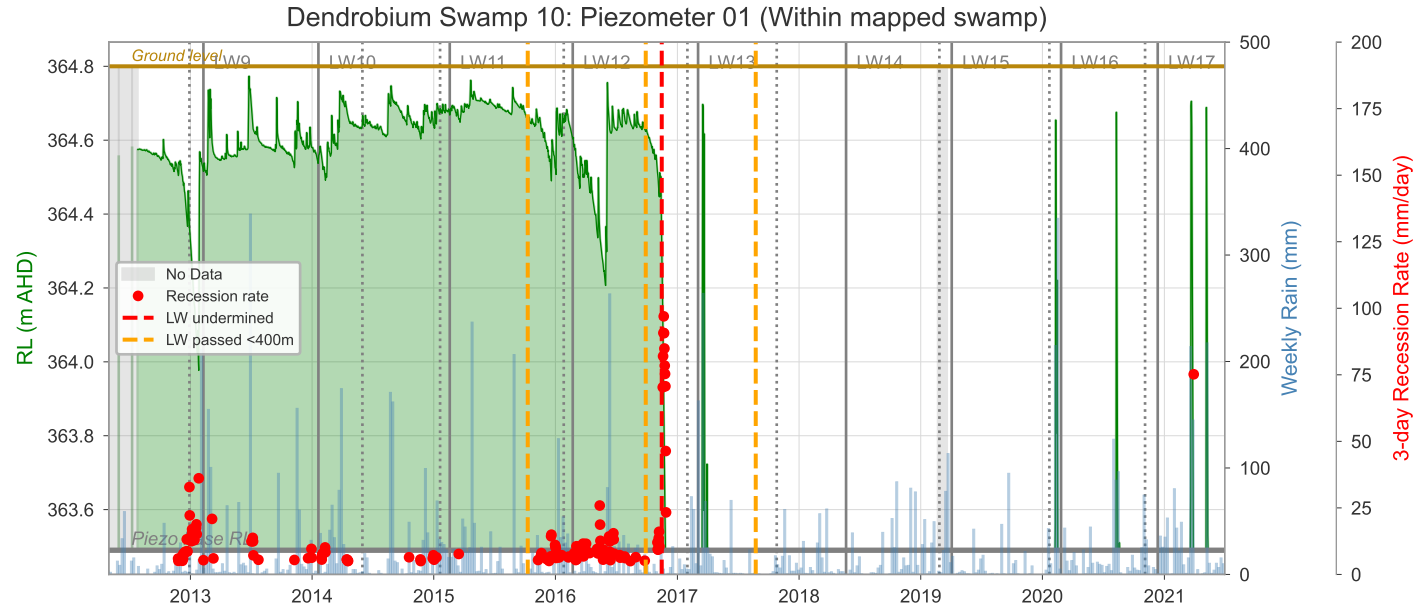

Dendrobium Swamp 07: Piezometer 05 (Within mapped swamp)
LW12
LW13
LW14
LW15
LW16
LW17
Ground level
Piezo base RL
No Data
Recession rate
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

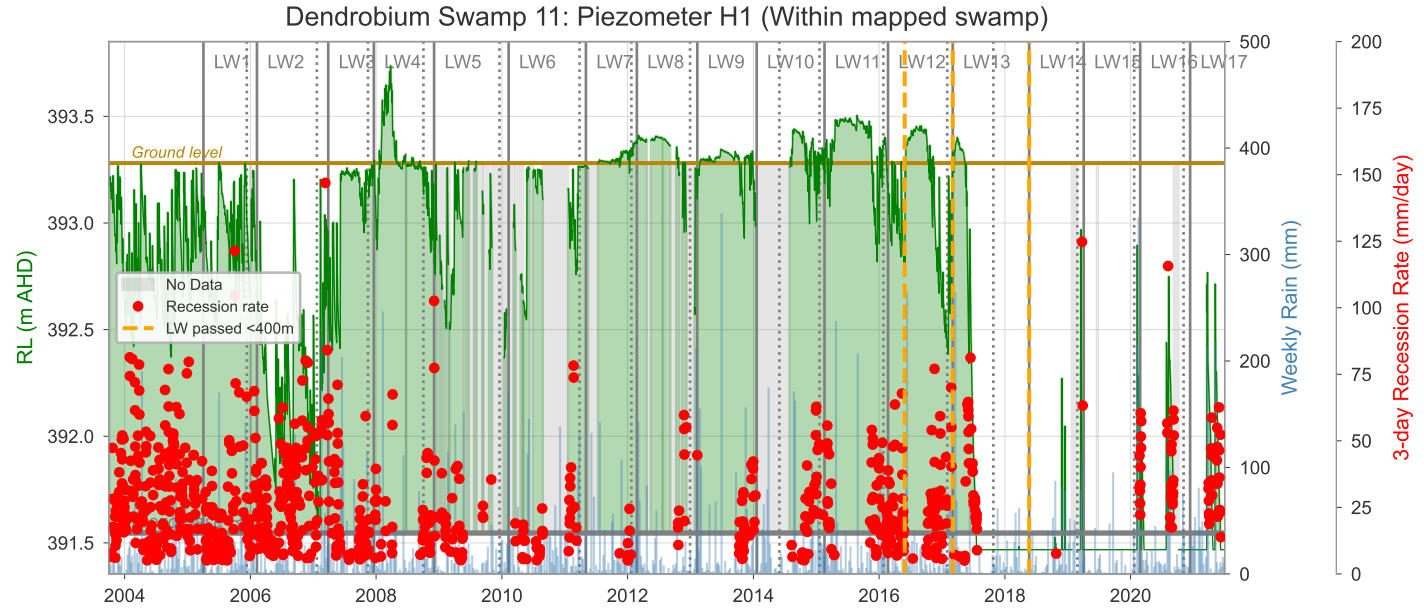

Dendrobium Swamp 07: Piezometer 06 (Within mapped swamp)
LW12
LW13
LW14
LW15
LW16
LW17
Ground level
No Data
Recession rate
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
341.0
340.5
340.0
339.5
339.0
338.5
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2016
2017
2018
2019
2020
2021

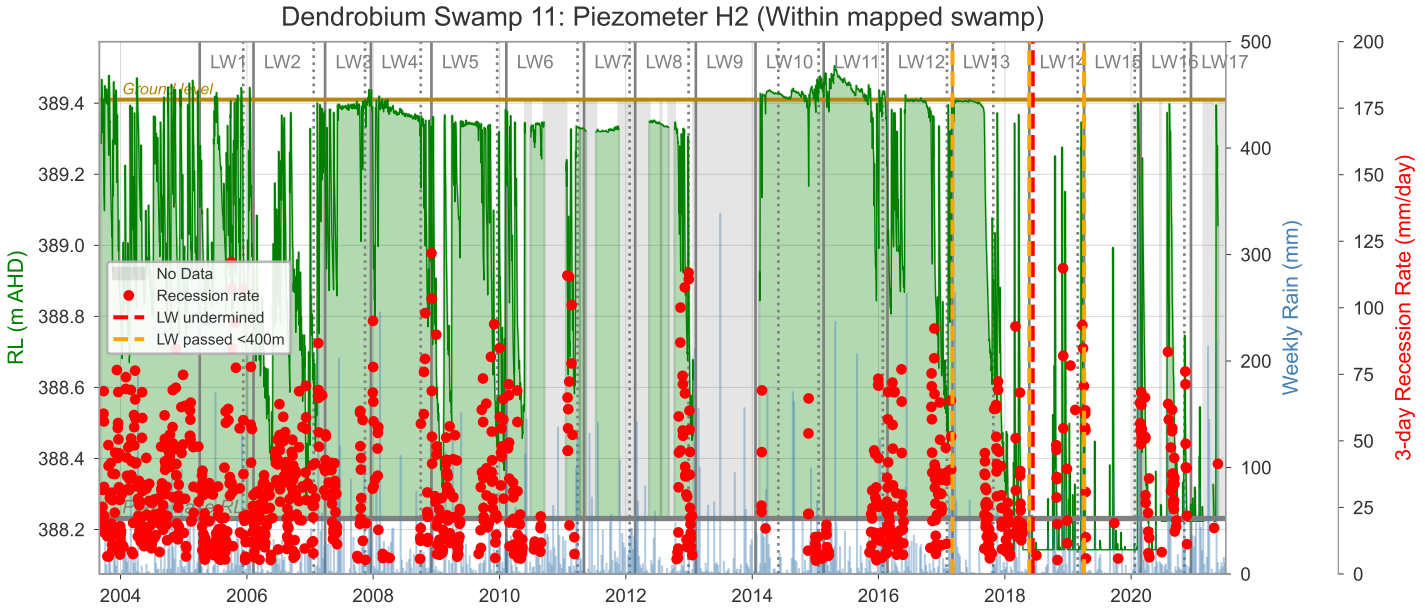

Dendrobium Swamp 08: Piezometer 01 (Outside mapped swamp)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Ground level
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
341.0
340.5
340.0
339.5
339.0
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2013
2014
2015
2016
2017
2018
2019
2020
2021

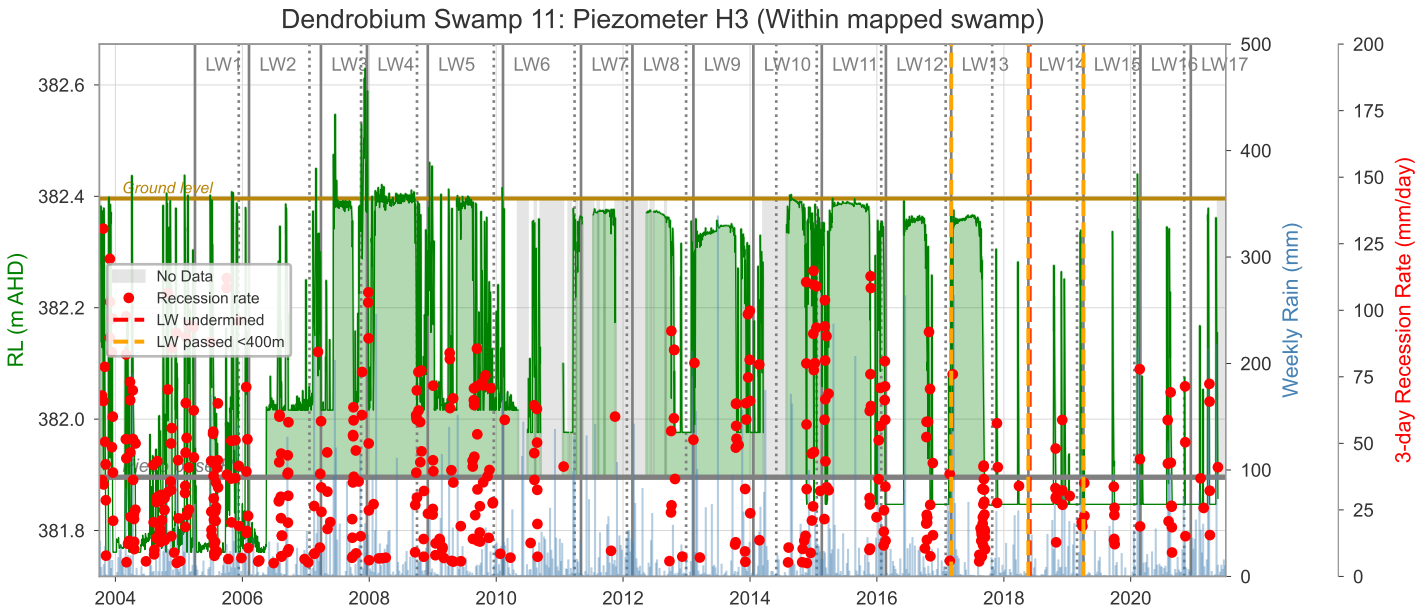

Dendrobium Swamp 08: Piezometer 02 (Outside mapped swamp)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Ground level
No Data
Recession rate
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
308.6
308.4
308.2
308.0
307.8
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2013
2014
2015
2016
2017
2018
2019
2020
2021

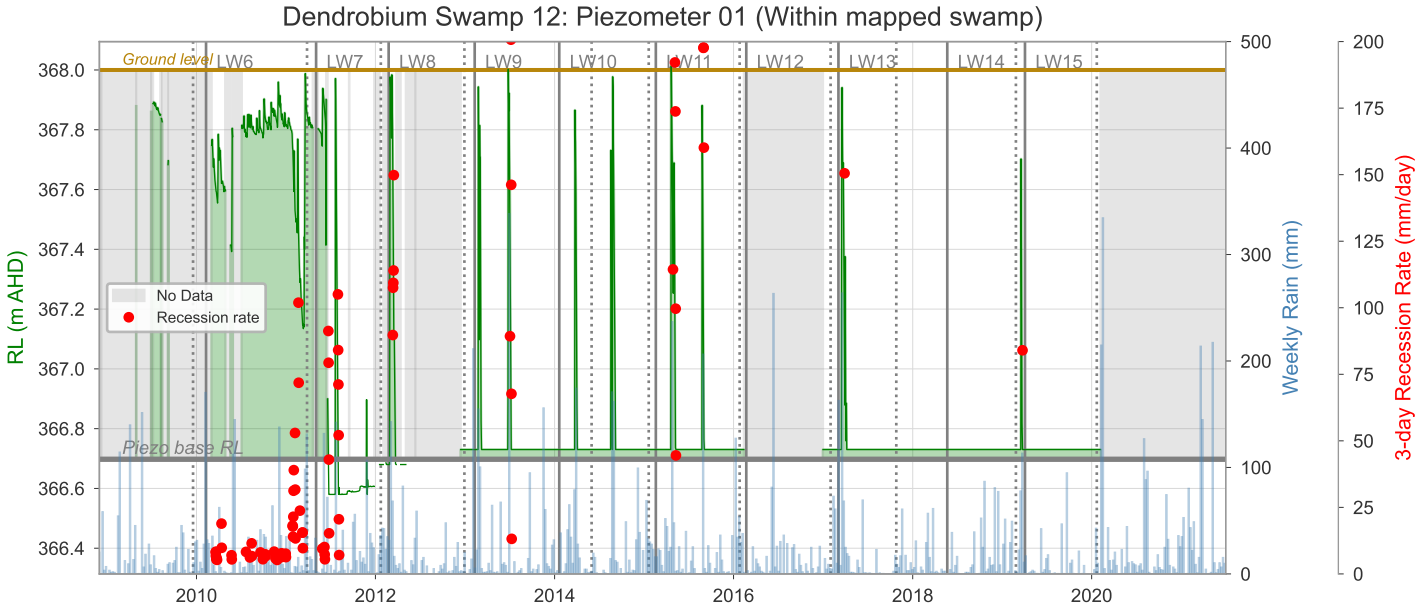

Dendrobium Swamp 08: Piezometer 04 (Outside mapped swamp)
Ground level
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

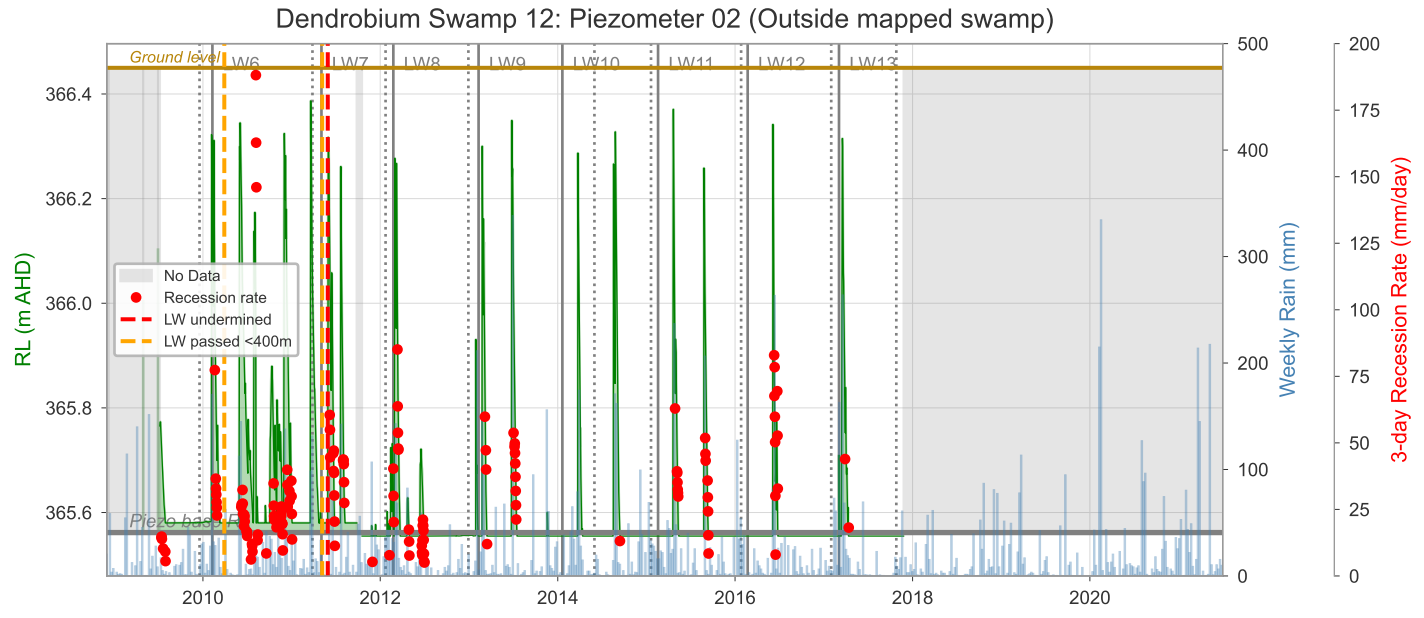

Dendrobium Swamp 10: Piezometer 01 (Within mapped swamp)
Ground level
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

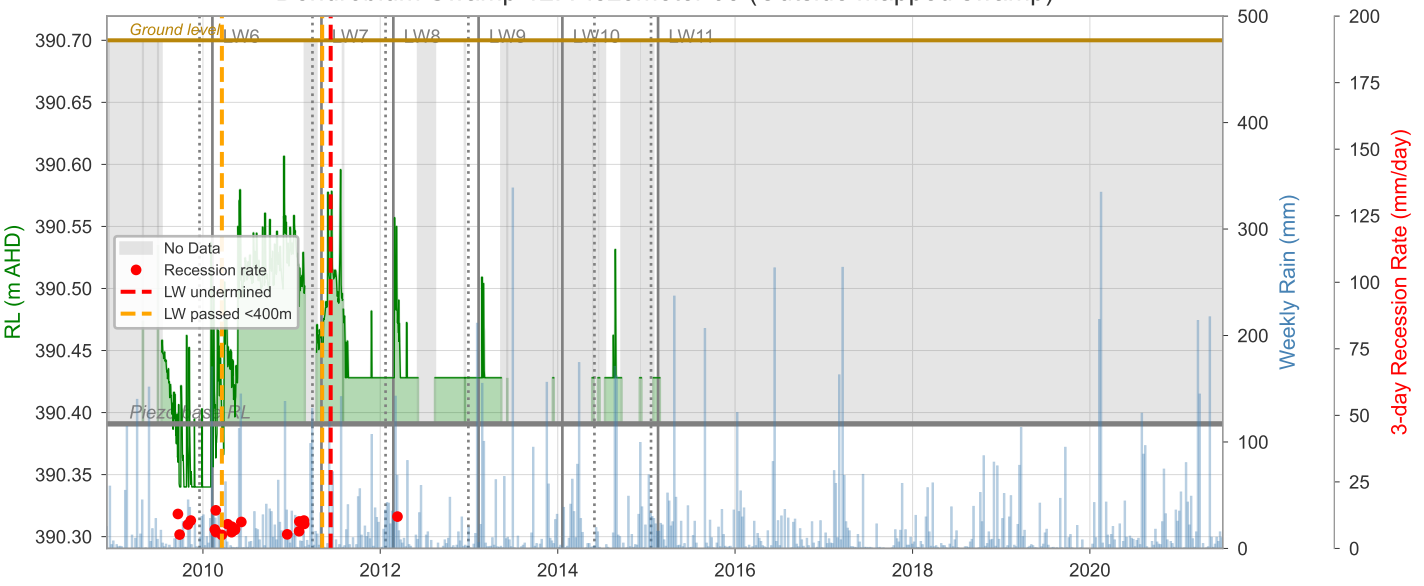

Dendrobium Swamp 11: Piezometer H1 (Within mapped swamp)
Ground level
LW1
LW2
LW3
LW4
LW5
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
No Data
Recession rate
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

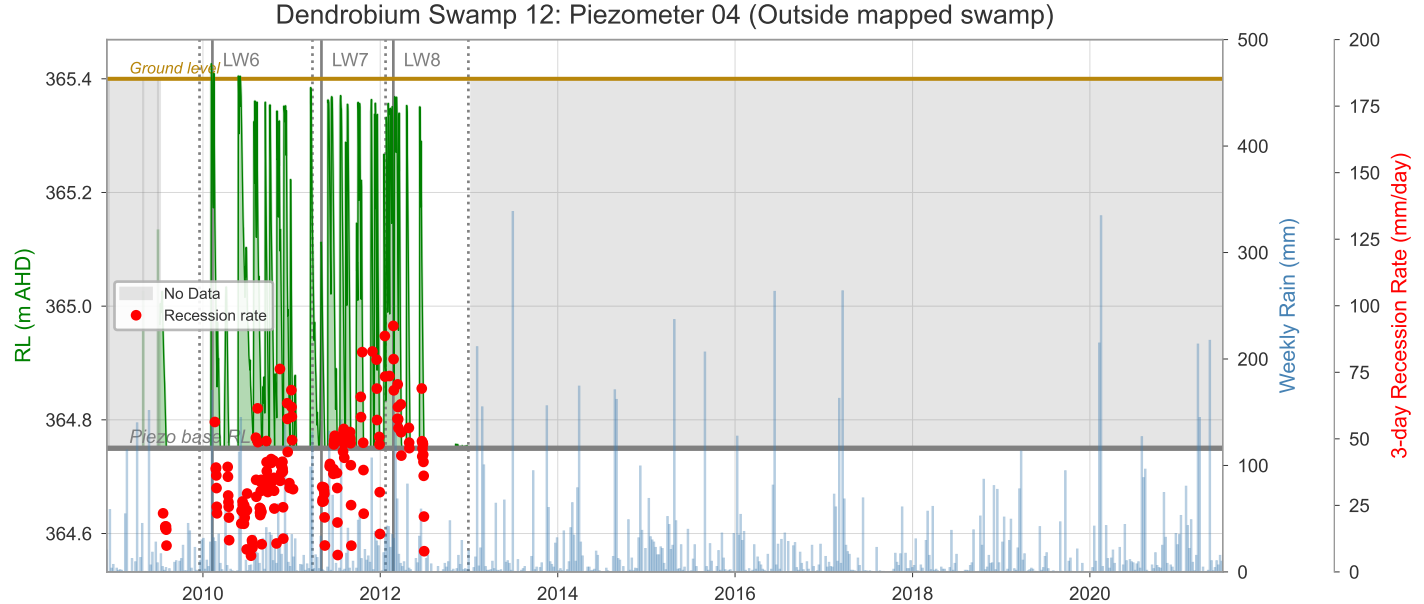

Dendrobium Swamp 11: Piezometer H2 (Within mapped swamp)
LW1
LW2
LW3
LW4
LW5
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Ground level
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

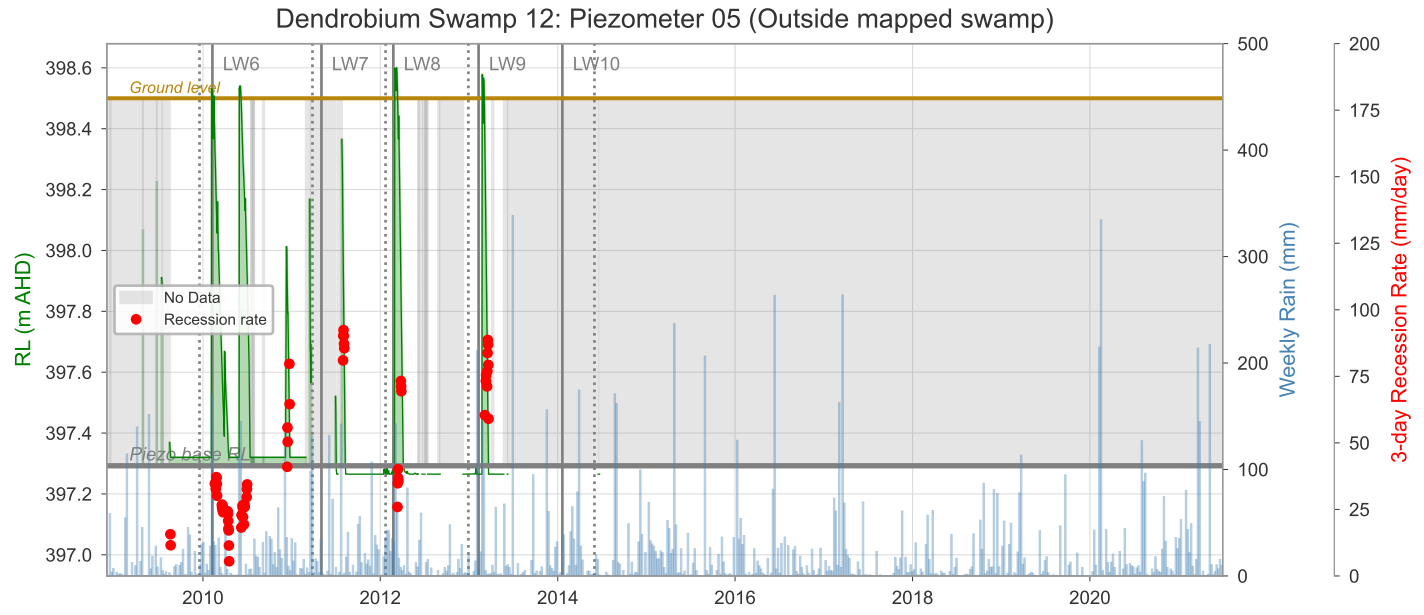

Dendrobium Swamp 11: Piezometer H3 (Within mapped swamp)
LW1
LW2
LW3
LW4
LW5
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Ground level
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

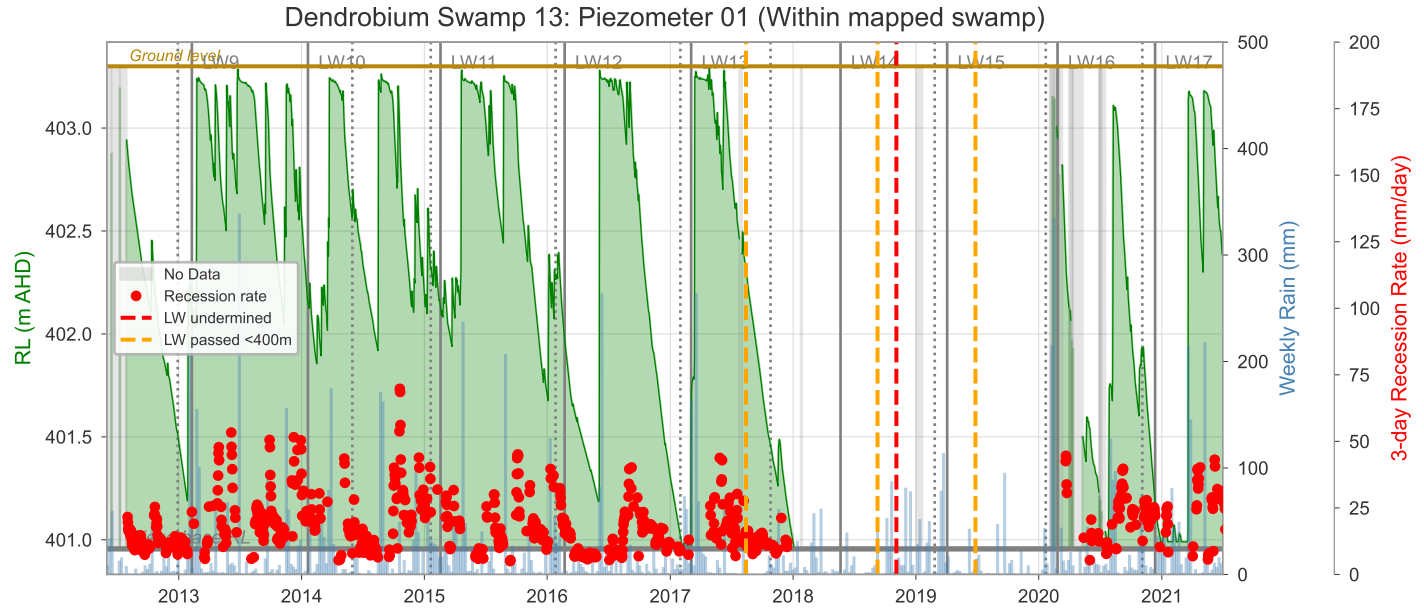

Dendrobium Swamp 12: Piezometer 01 (Within mapped swamp)
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
Ground level
Piezo base RL
No Data
Recession rate
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

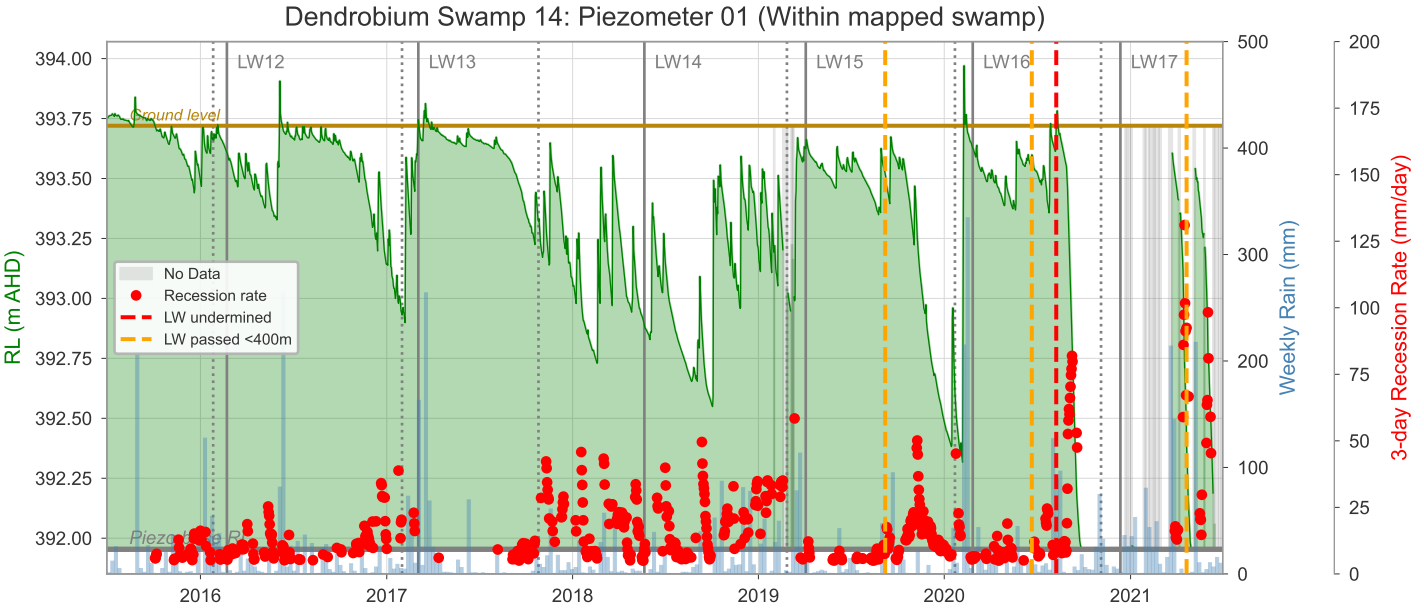

Dendrobium Swamp 12: Piezometer 02 (Outside mapped swamp)
Ground level
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
No Data
Recession rate
LW undermined
LW passed <400m
Piezo base RL
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
366.4
366.2
366.0
365.8
365.6
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2010
2012
2014
2016
2018
2020

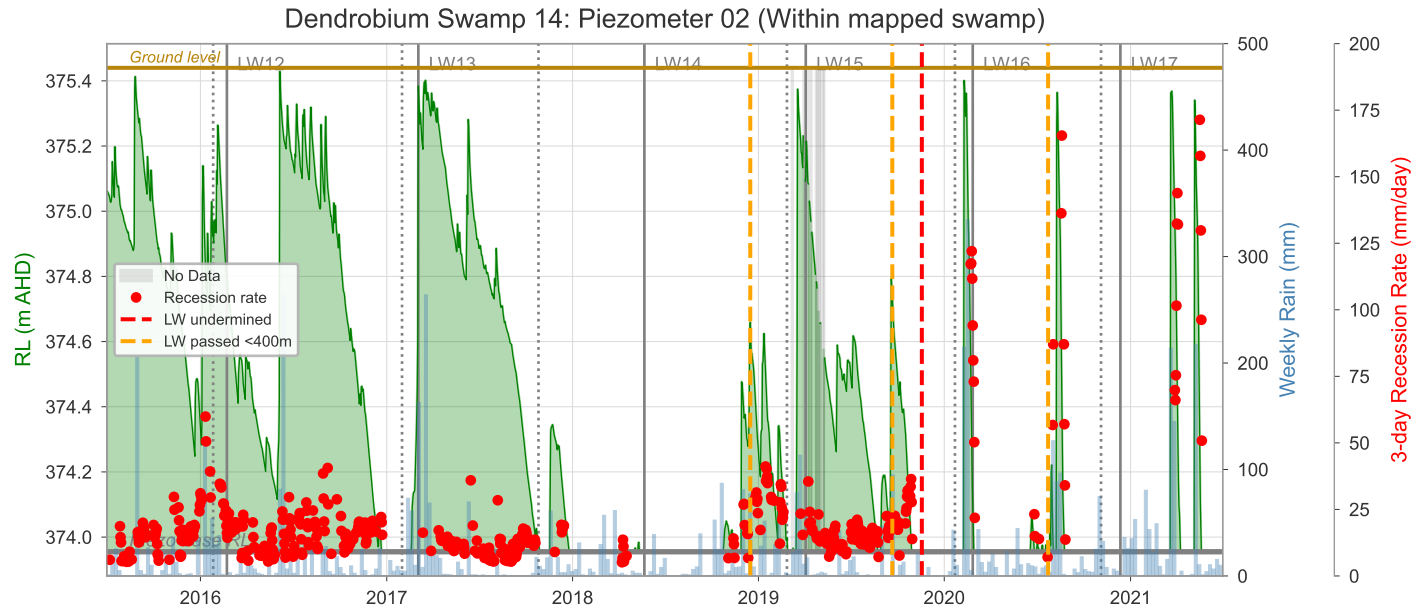

Dendrobium Swamp 12: Piezometer 03 (Outside mapped swamp)
Ground level
LW6
LW7
LW8
LW9
LW10
LW11
No Data
Recession rate
LW undermined
LW passed <400m
Piezo base RL
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
390.70
390.65
390.60
390.55
390.50
390.45
390.40
390.35
390.30
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2010
2012
2014
2016
2018
2020

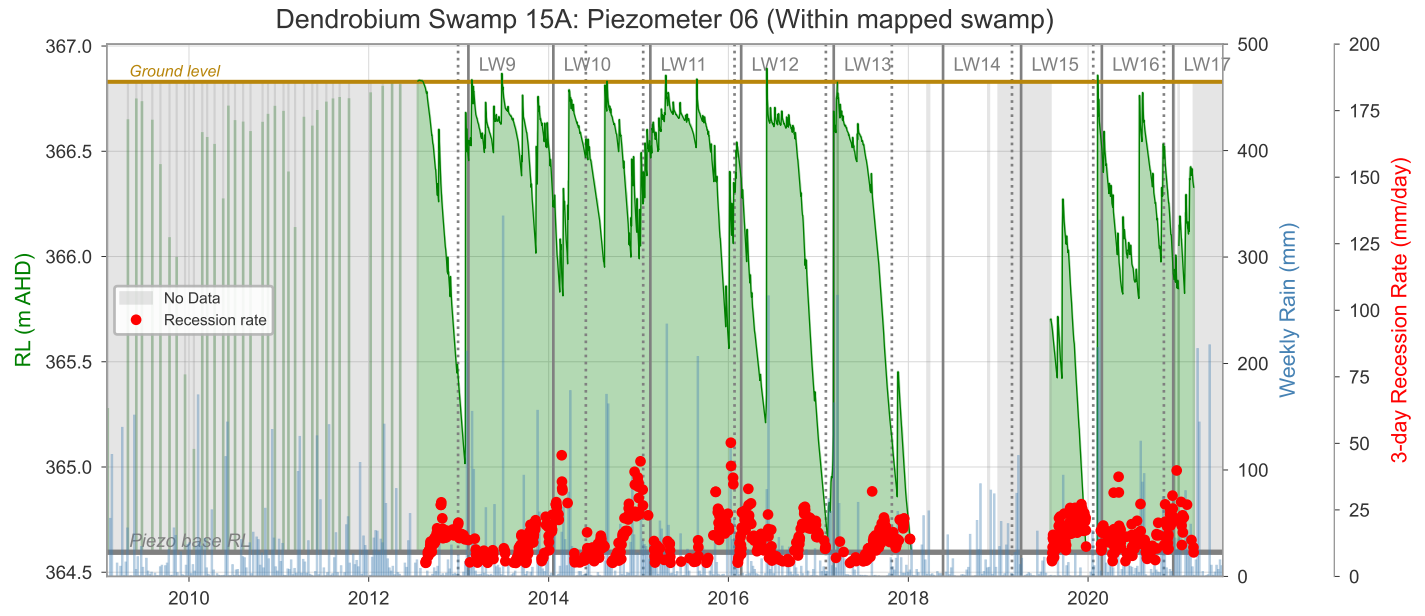

Dendrobium Swamp 12: Piezometer 04 (Outside mapped swamp)
Ground level
LW6
LW7
LW8
No Data
Recession rate
Piezo base RL
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
365.4
365.2
365.0
364.8
364.6
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2010
2012
2014
2016
2018
2020

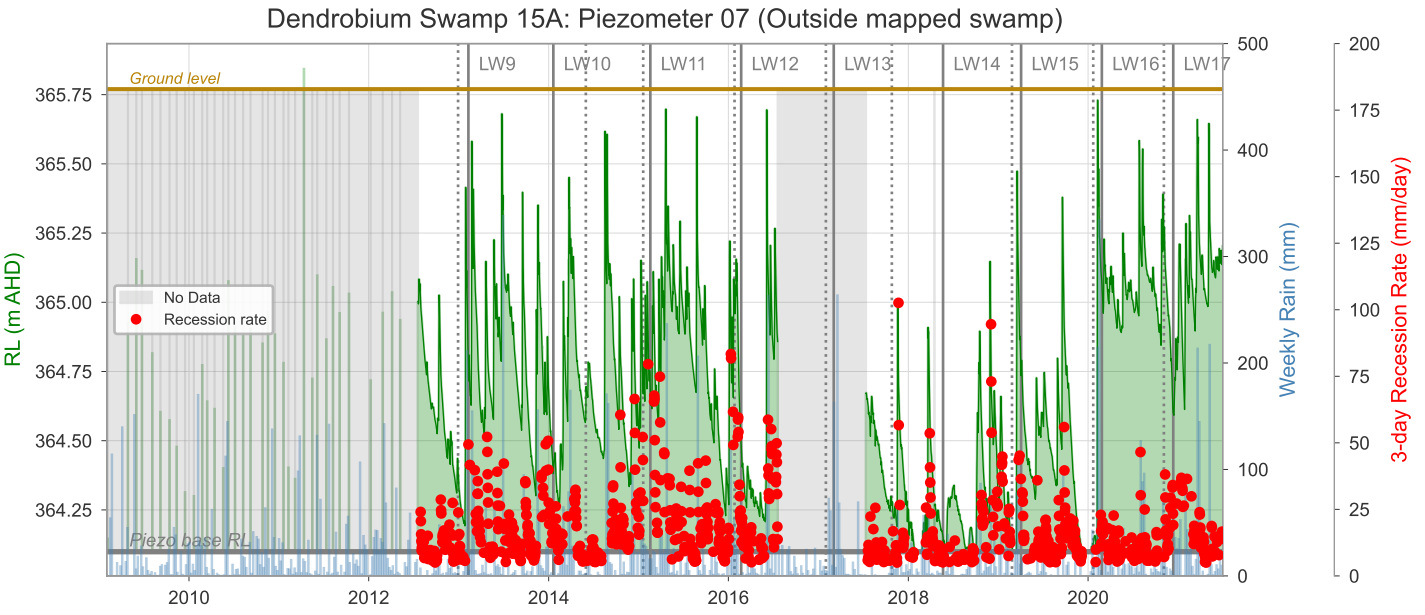

Dendrobium Swamp 12: Piezometer 05 (Outside mapped swamp)
LW6
LW7
LW8
LW9
LW10
Ground level
Piezo base RL
No Data
Recession rate
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

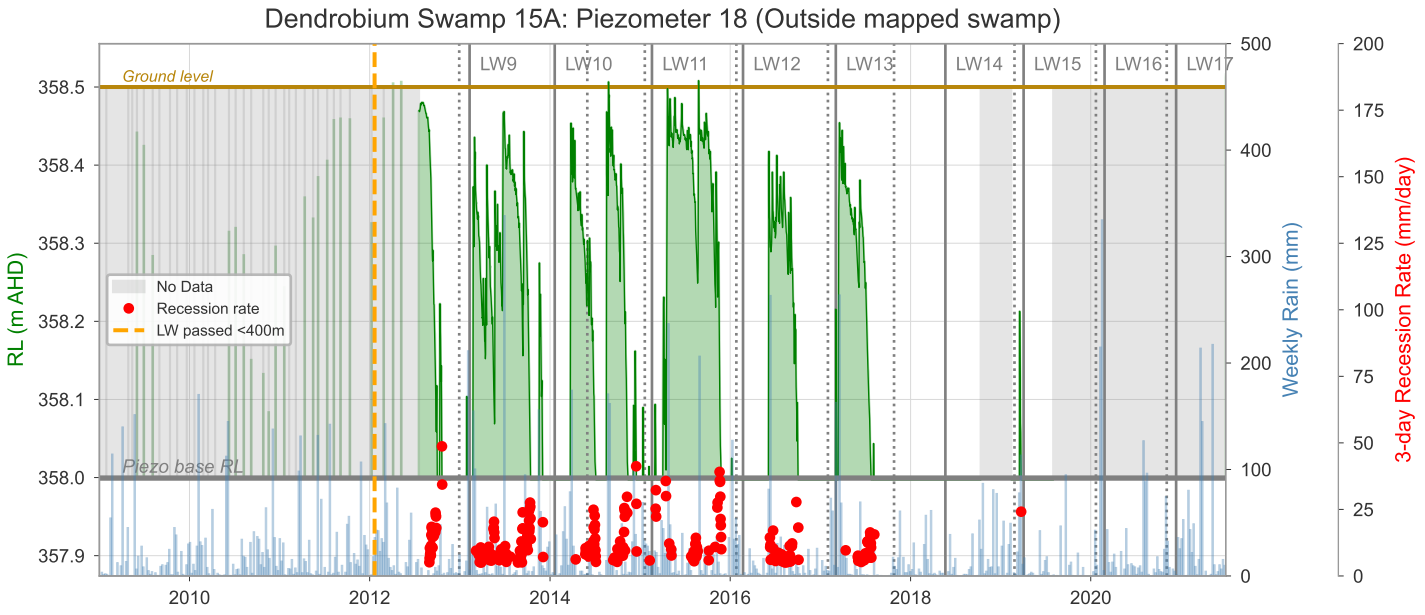

Dendrobium Swamp 13: Piezometer 01 (Within mapped swamp)
Ground level
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

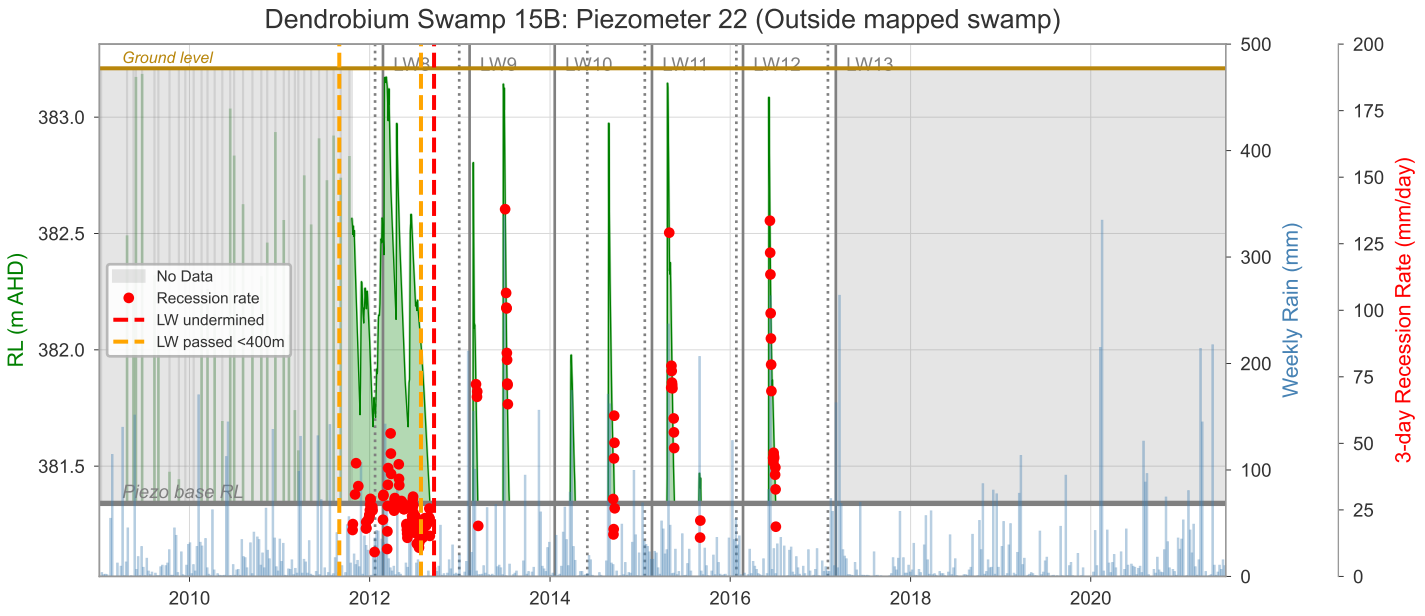

Dendrobium Swamp 14: Piezometer 01 (Within mapped swamp)
LW12
LW13
LW14
LW15
LW16
LW17
Ground level
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

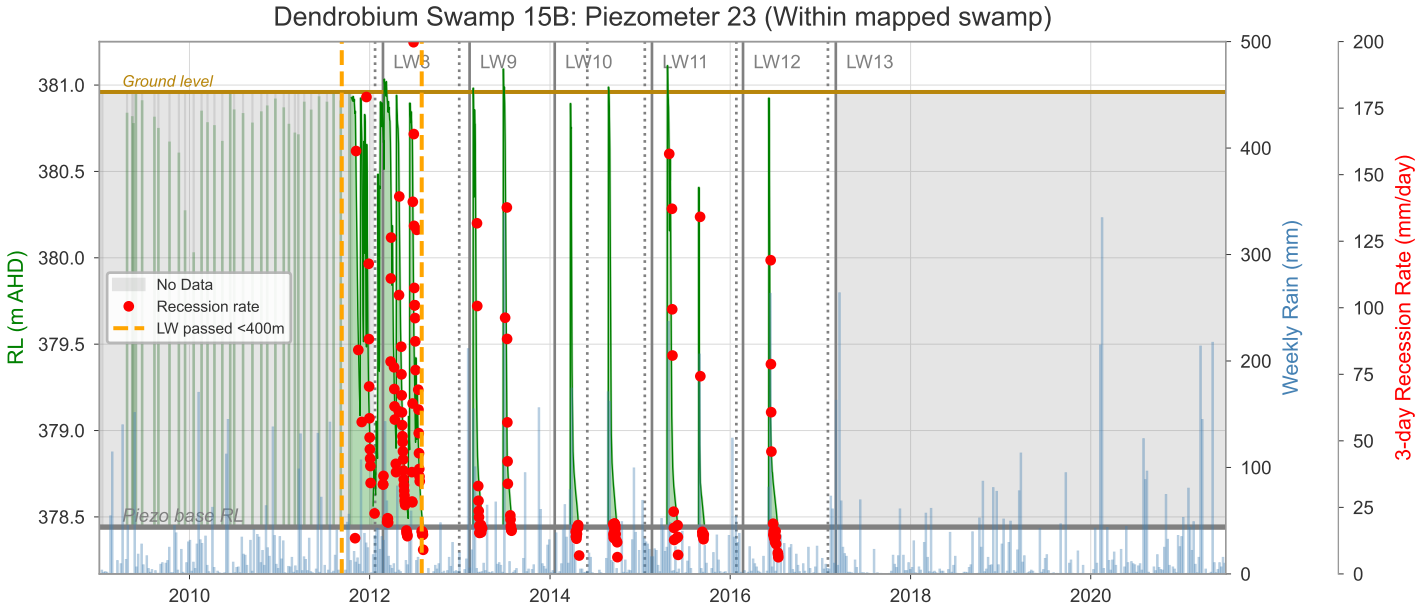

Dendrobium Swamp 14: Piezometer 02 (Within mapped swamp)
Ground level
LW12
LW13
LW14
LW15
LW16
LW17
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

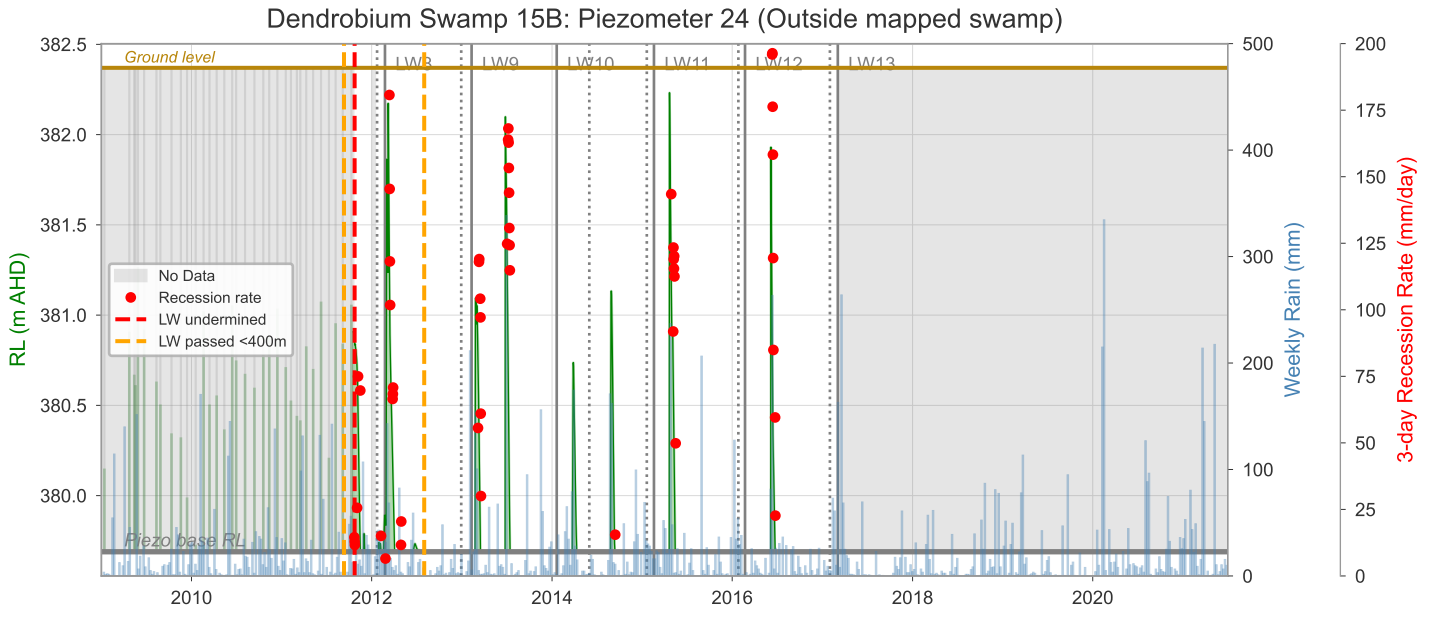

Dendrobium Swamp 15A: Piezometer 06 (Within mapped swamp)
Ground level
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
No Data
Recession rate
Piezo base RL
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

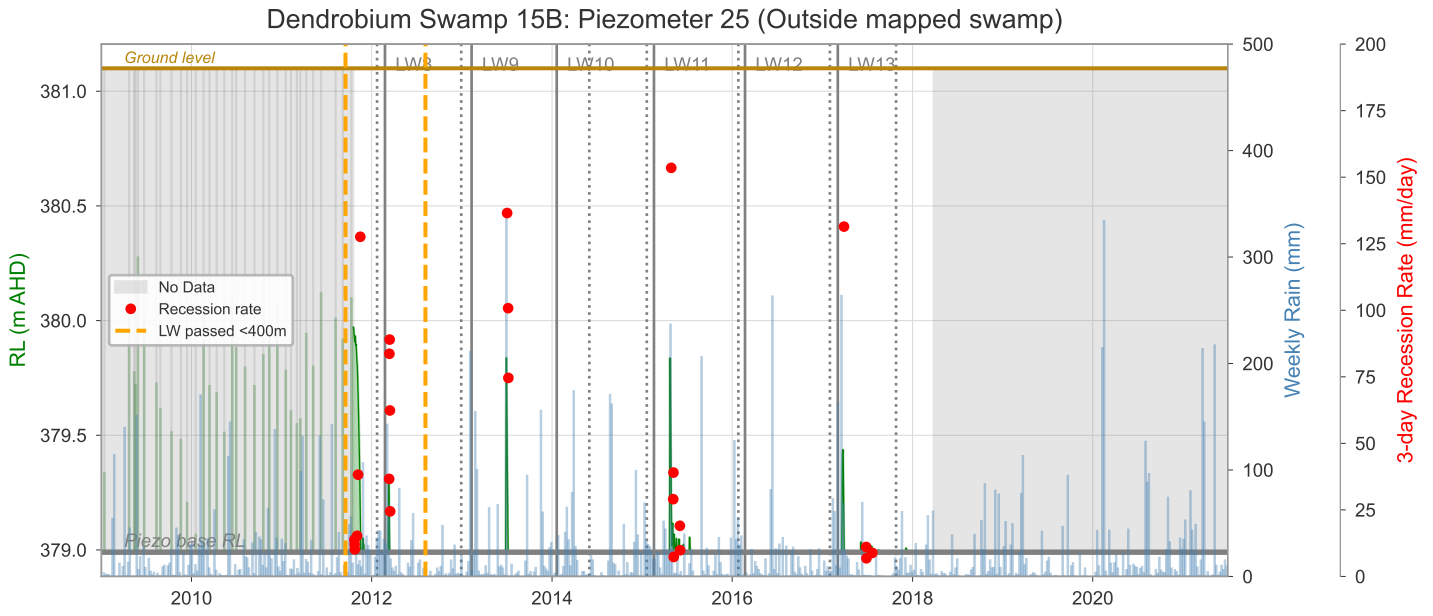

Dendrobium Swamp 15A: Piezometer 07 (Outside mapped swamp)
Ground level
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
No Data
Recession rate
Piezo base RL
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

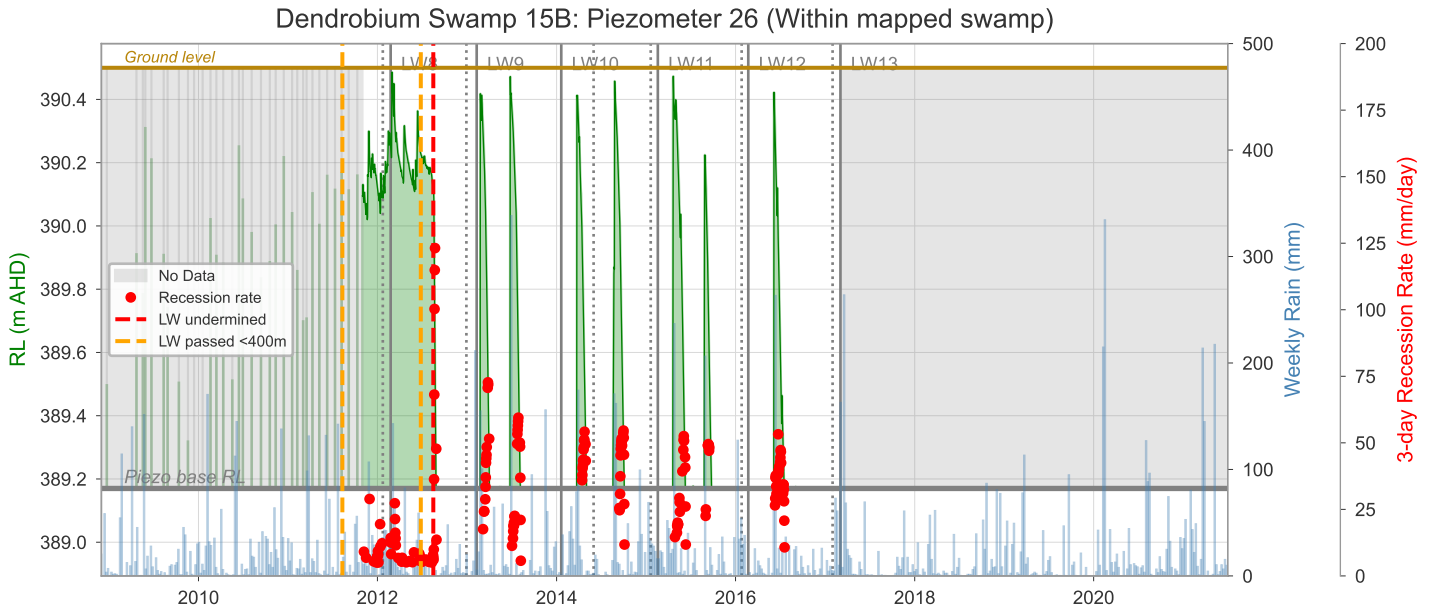

Dendrobium Swamp 15A: Piezometer 18 (Outside mapped swamp)
Ground level
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
No Data
Recession rate
LW passed <400m
Piezo base RL
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
358.5
358.4
358.3
358.2
358.1
358.0
357.9
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2010
2012
2014
2016
2018
2020

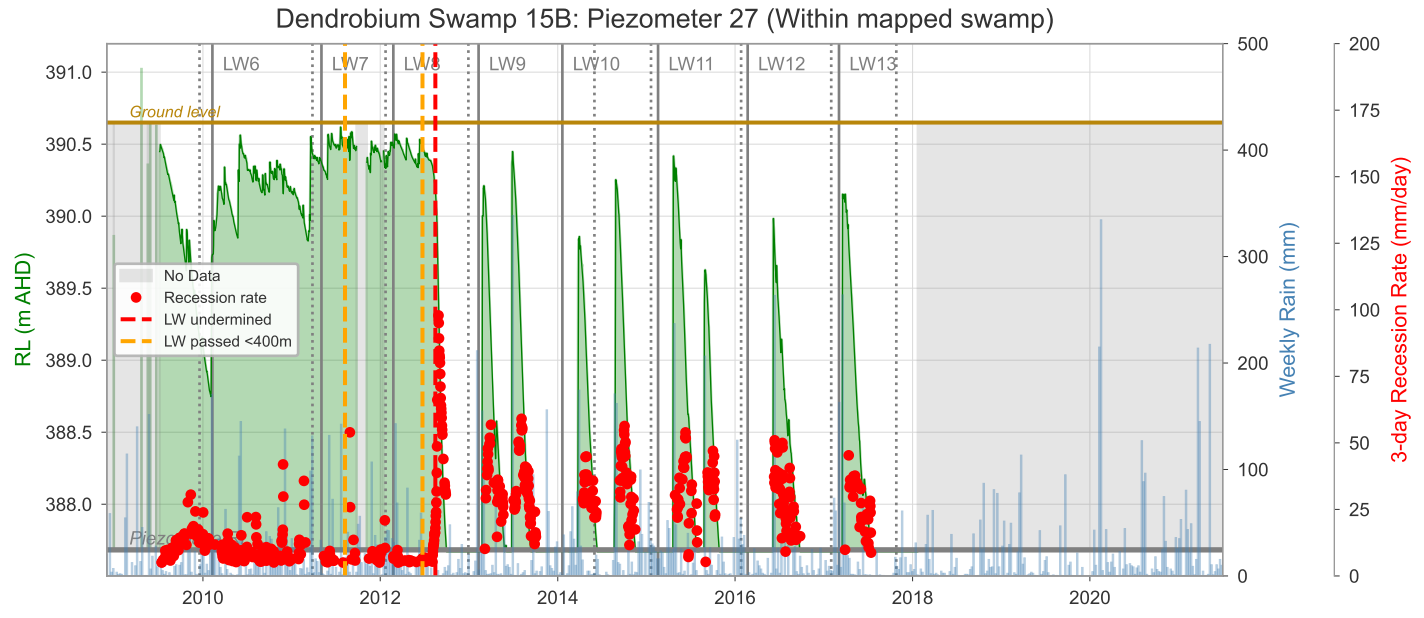

Dendrobium Swamp 15B: Piezometer 22 (Outside mapped swamp)
Ground level
LW8
LW9
LW10
LW11
LW12
LW13
No Data
Recession rate
LW undermined
LW passed <400m
Piezo base RL
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
383.0
382.5
382.0
381.5
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2010
2012
2014
2016
2018
2020

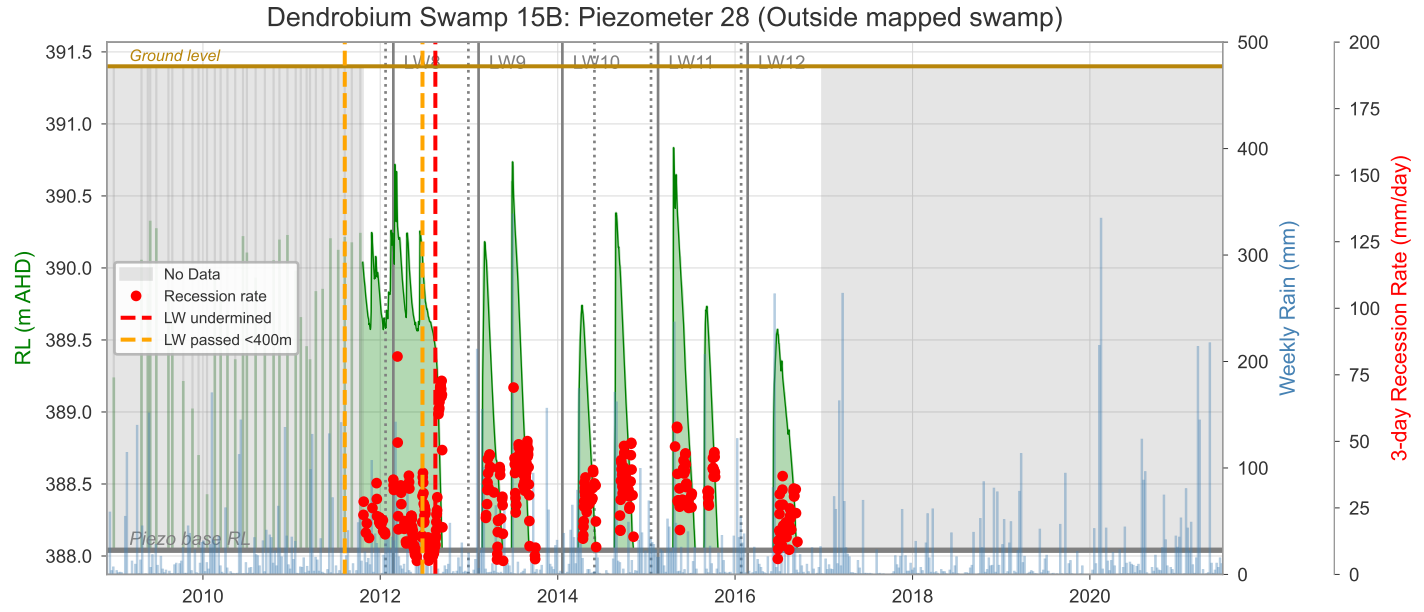

Dendrobium Swamp 15B: Piezometer 23 (Within mapped swamp)
Ground level
LW8
LW9
LW10
LW11
LW12
LW13
No Data
Recession rate
LW passed <400m
Piezo base RL
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
381.0
380.5
380.0
379.5
379.0
378.5
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2010
2012
2014
2016
2018
2020

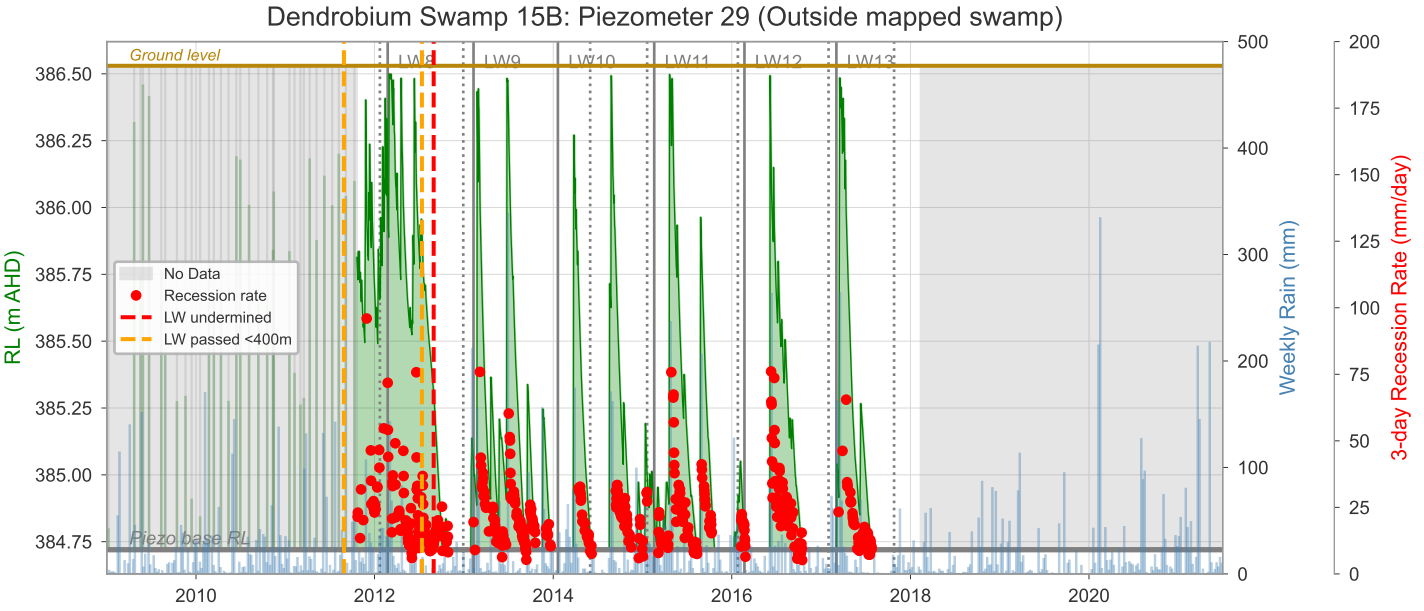

Dendrobium Swamp 15B: Piezometer 24 (Outside mapped swamp)
Ground level
LW8
LW9
LW10
LW11
LW12
LW13
No Data
Recession rate
LW undermined
LW passed <400m
Piezo base RL
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
382.5
382.0
381.5
381.0
380.5
380.0
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2010
2012
2014
2016
2018
2020

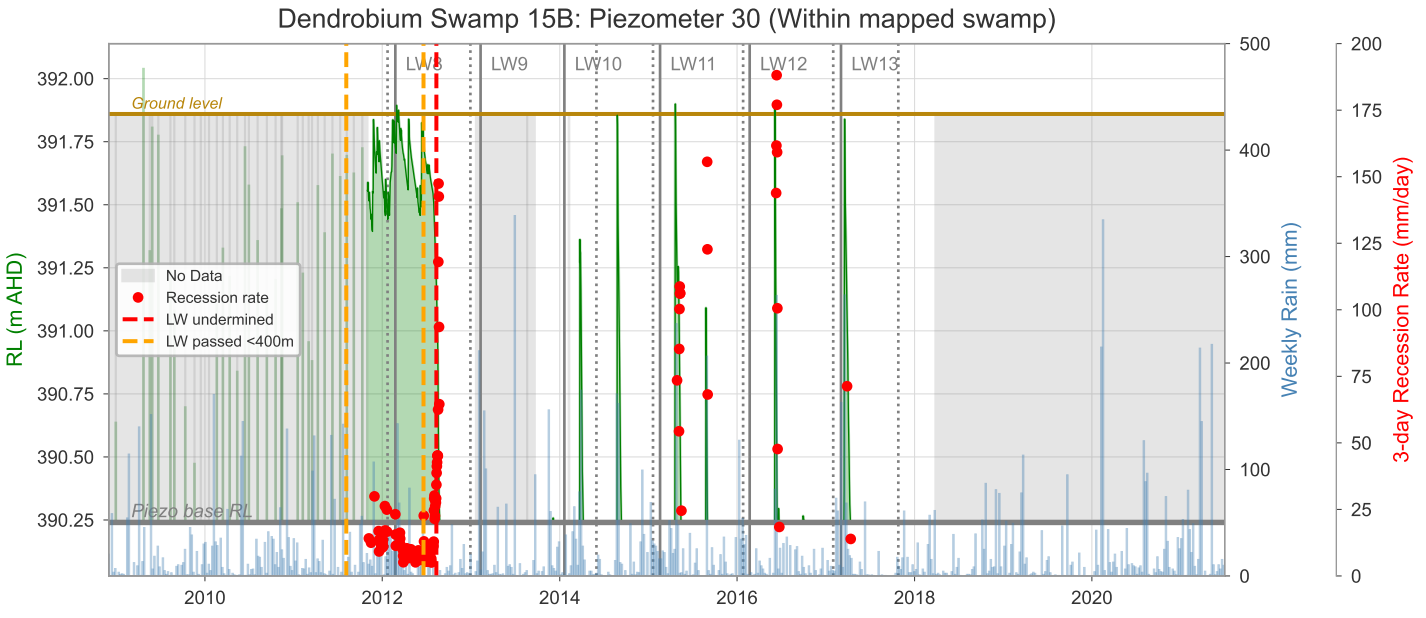

Dendrobium Swamp 15B: Piezometer 25 (Outside mapped swamp)
Ground level
LW8
LW9
LW10
LW11
LW12
LW13
No Data
Recession rate
LW passed <400m
Piezo base RL
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
381.0
380.5
380.0
379.5
379.0
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2010
2012
2014
2016
2018
2020

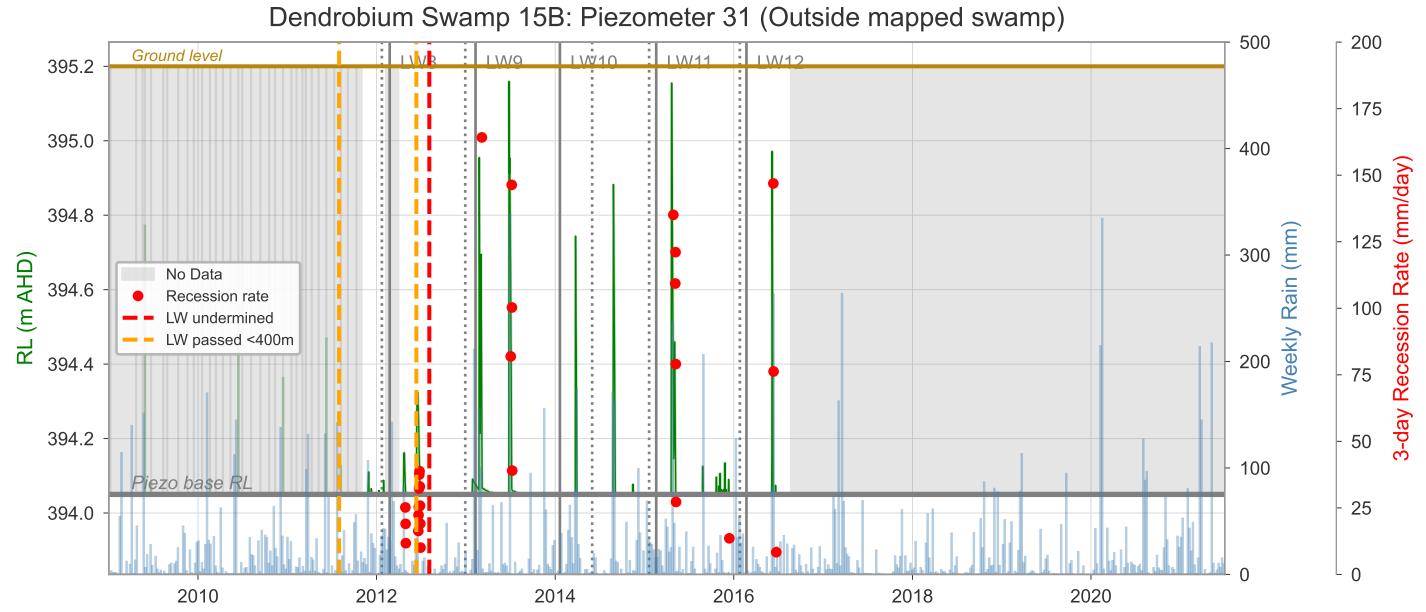

Dendrobium Swamp 15B: Piezometer 26 (Within mapped swamp)
Ground level
LW8
LW9
LW10
LW11
LW12
LW13
No Data
Recession rate
LW undermined
LW passed <400m
Piezo base RL
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
390.4
390.2
390.0
389.8
389.6
389.4
389.2
389.0
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2010
2012
2014
2016
2018
2020

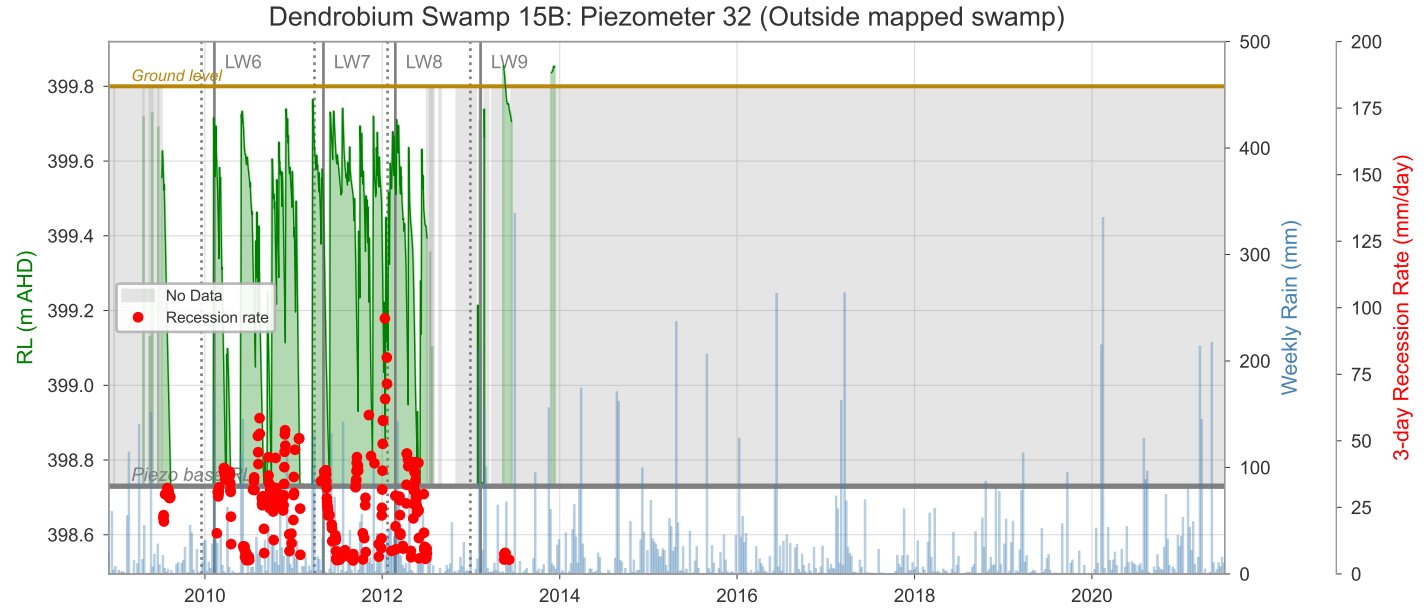

Dendrobium Swamp 15B: Piezometer 27 (Within mapped swamp)
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
Ground level
Piezo base RL
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
391.0
390.5
390.0
389.5
389.0
388.5
388.0
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2010
2012
2014
2016
2018
2020

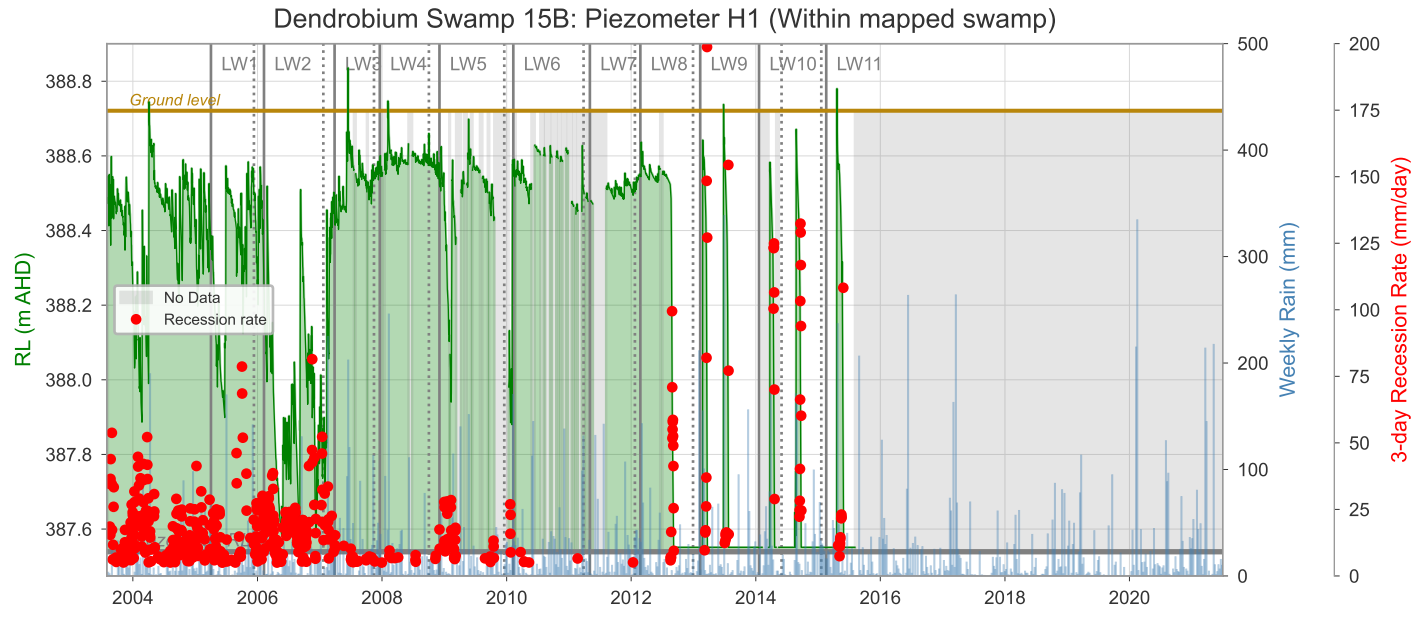

Dendrobium Swamp 15B: Piezometer 28 (Outside mapped swamp)
LW8
LW9
LW10
LW11
LW12
Ground level
Piezo base RL
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
391.5
391.0
390.5
390.0
389.5
389.0
388.5
388.0
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2010
2012
2014
2016
2018
2020

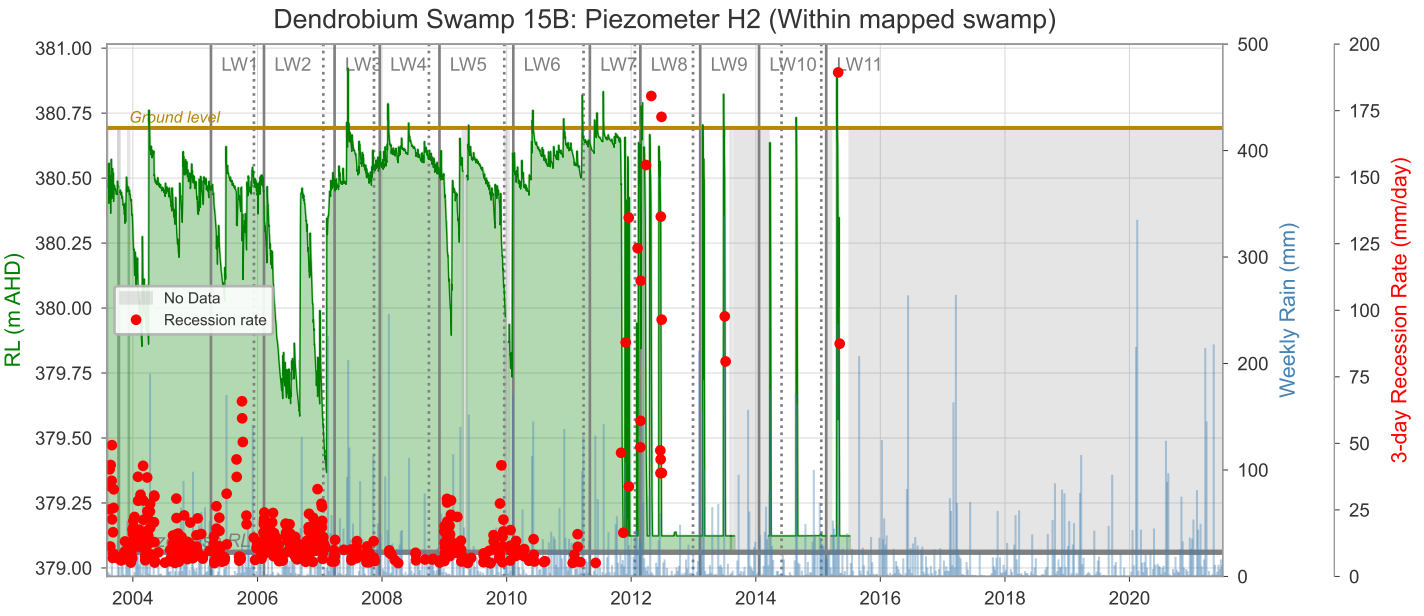

Dendrobium Swamp 15B: Piezometer 29 (Outside mapped swamp)
LW8
LW9
LW10
LW11
LW12
LW13
Ground level
Piezo base RL
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
386.50
386.25
386.00
385.75
385.50
385.25
385.00
384.75
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2010
2012
2014
2016
2018
2020

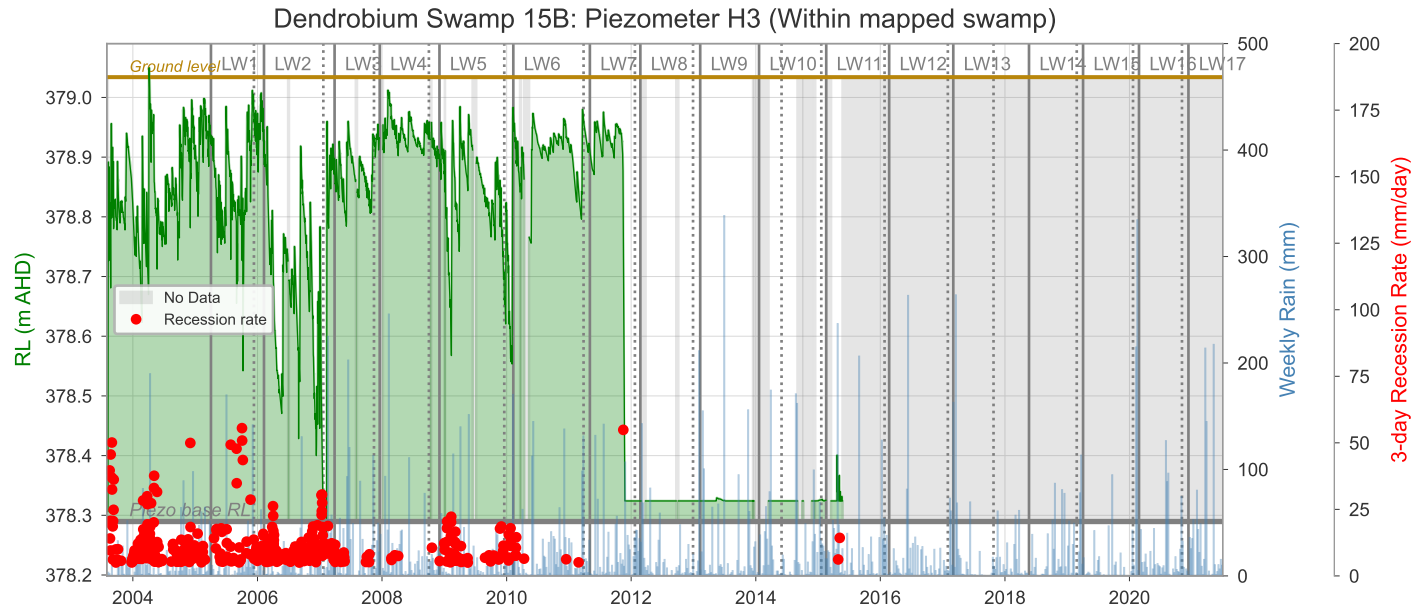

Dendrobium Swamp 15B: Piezometer 30 (Within mapped swamp)
LW8
LW9
LW10
LW11
LW12
LW13
Ground level
Piezo base RL
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

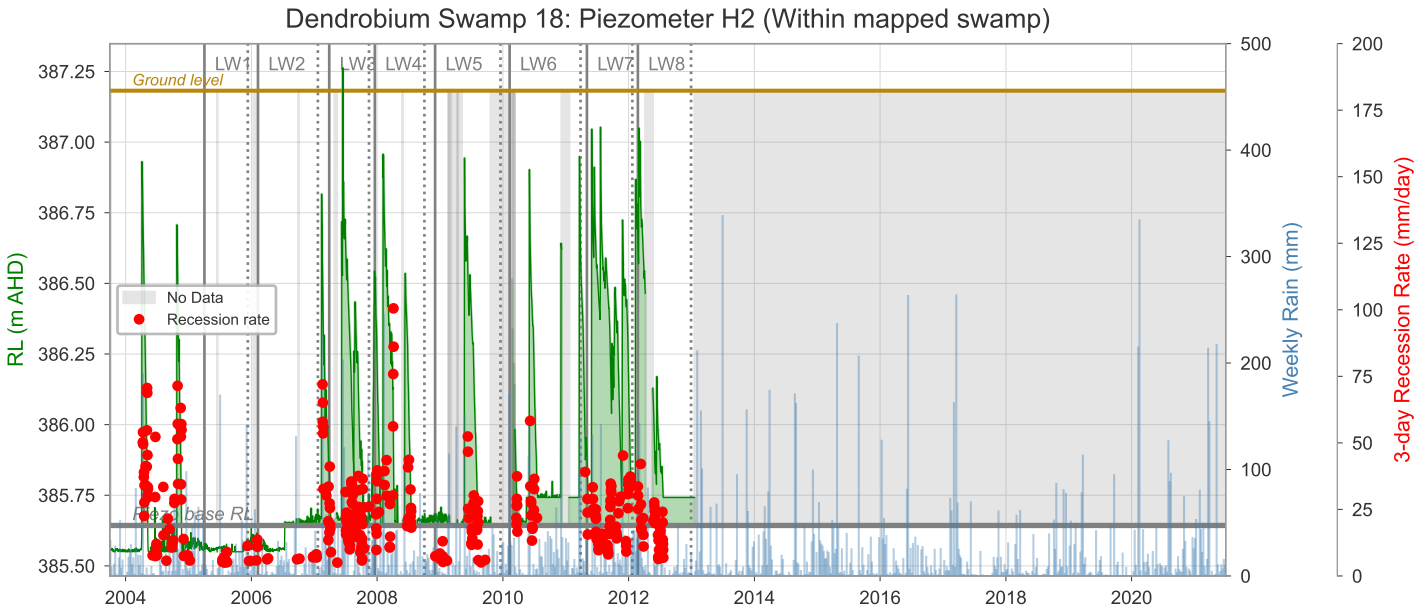

Dendrobium Swamp 15B: Piezometer 31 (Outside mapped swamp)
Ground level
LW8
LW9
LW10
LW11
LW12
Piezo base RL
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

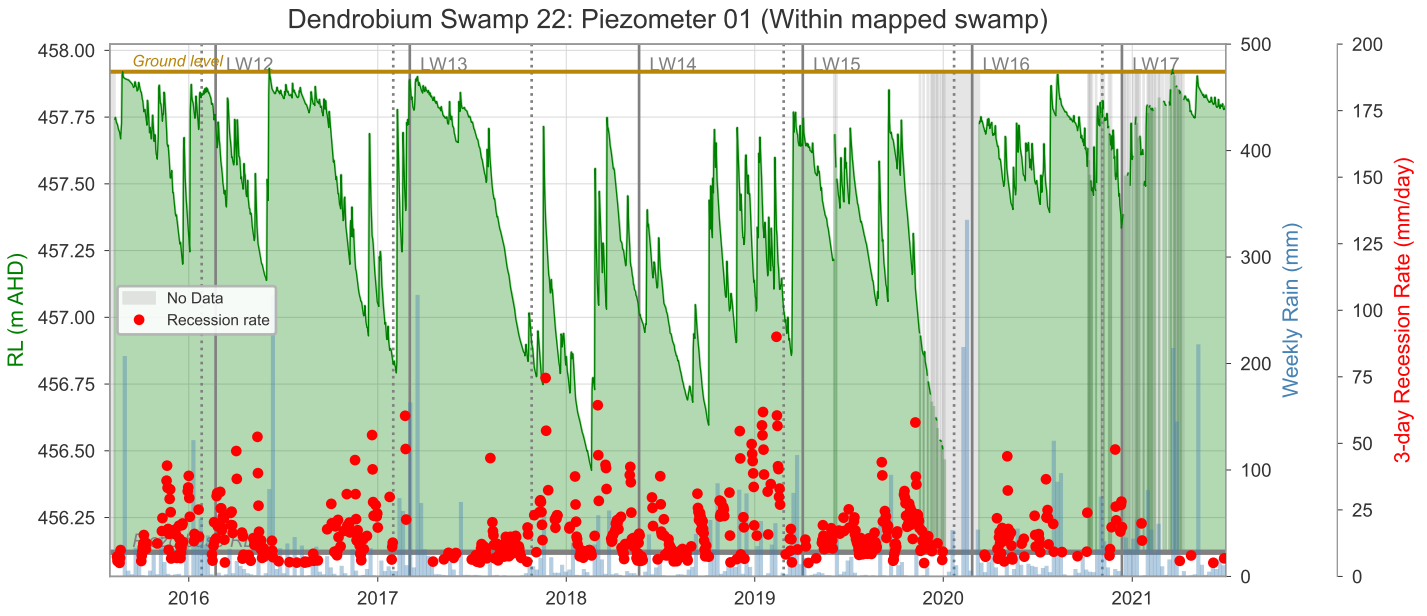

Dendrobium Swamp 15B: Piezometer 32 (Outside mapped swamp)
LW6
LW7
LW8
LW9
Ground level
Piezo base RL
No Data
Recession rate
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

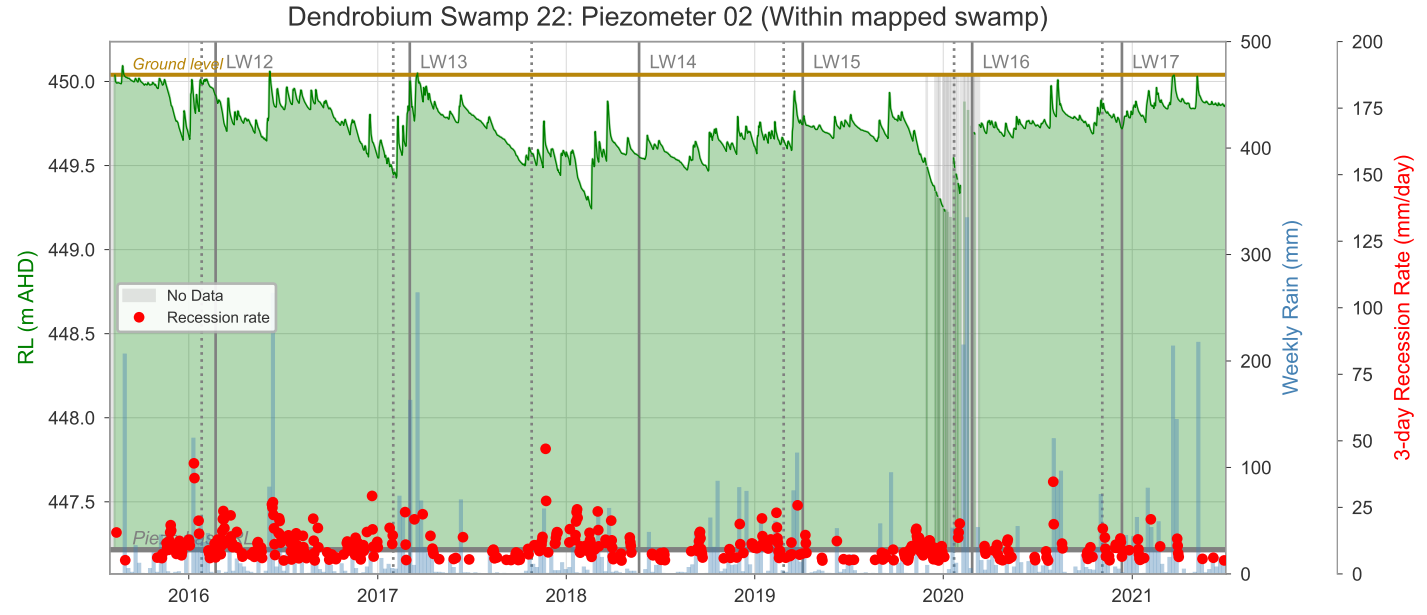

Dendrobium Swamp 15B: Piezometer H1 (Within mapped swamp)
LW1
LW2
LW3
LW4
LW5
LW6
LW7
LW8
LW9
LW10
LW11
Ground level
No Data
Recession rate
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
388.8
388.6
388.4
388.2
388.0
387.8
387.6
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2004
2006
2008
2010
2012
2014
2016
2018
2020

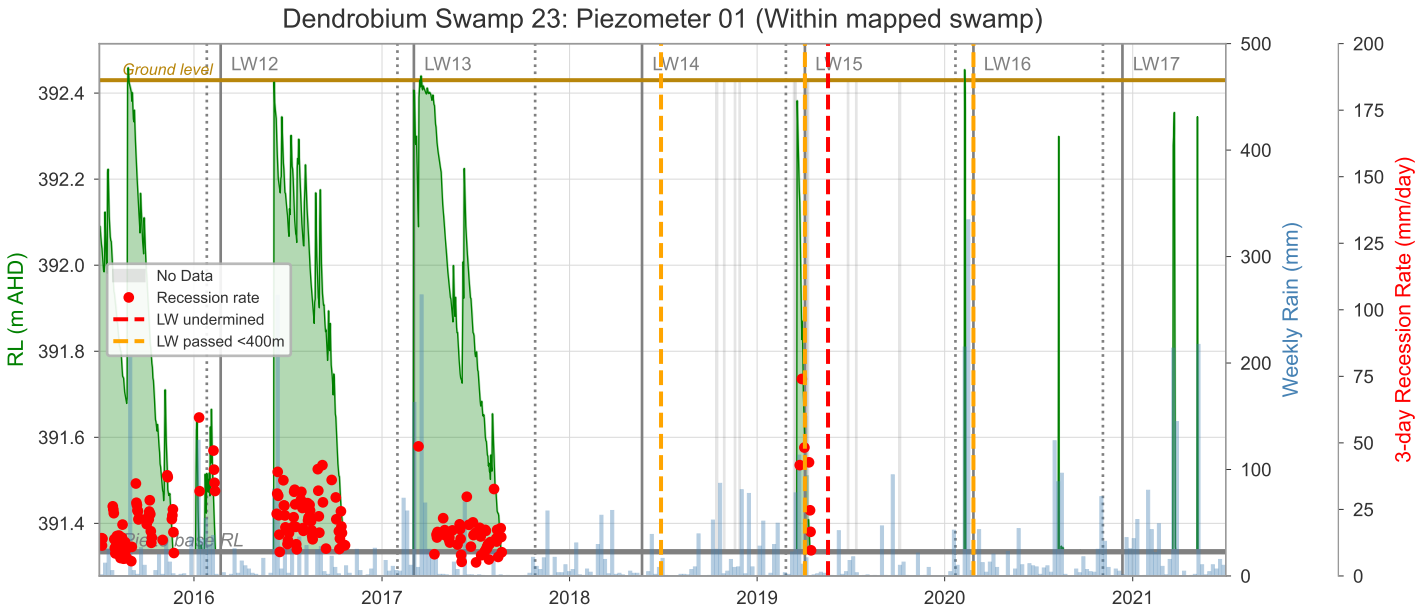

Dendrobium Swamp 15B: Piezometer H2 (Within mapped swamp)
LW1
LW2
LW3
LW4
LW5
LW6
LW7
LW8
LW9
LW10
LW11
Ground level
No Data
Recession rate
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
381.00
380.75
380.50
380.25
380.00
379.75
379.50
379.25
379.00
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2004
2006
2008
2010
2012
2014
2016
2018
2020

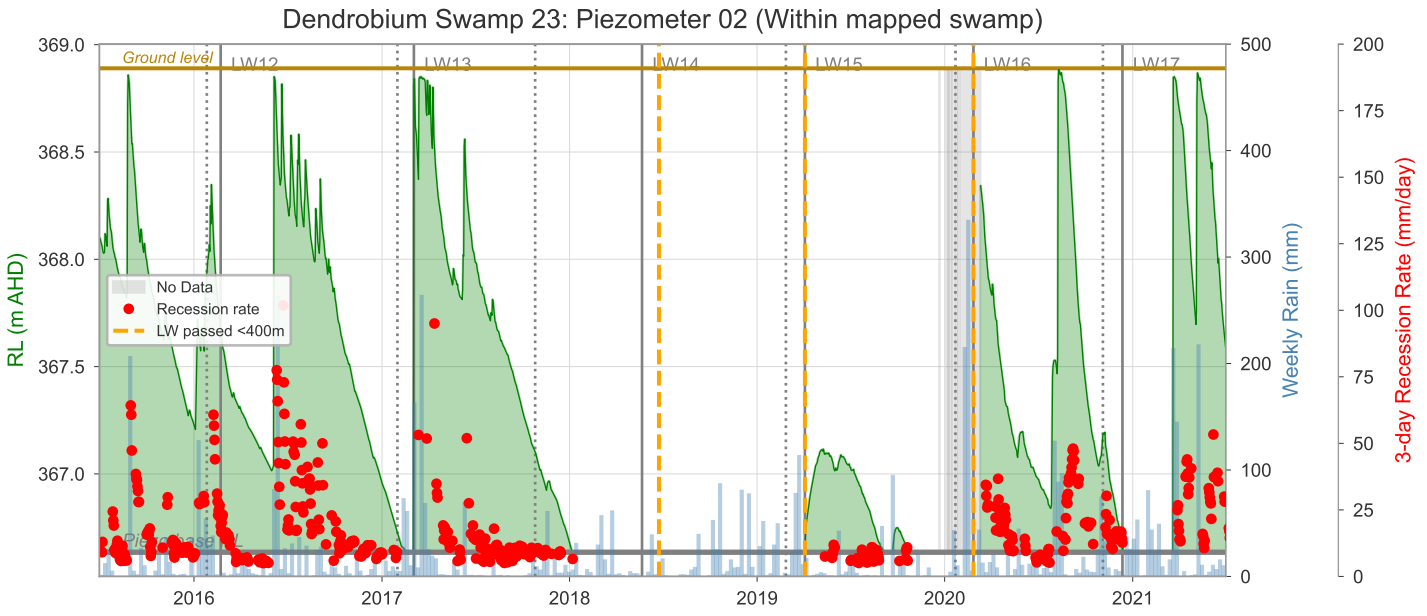

Dendrobium Swamp 15B: Piezometer H3 (Within mapped swamp)
Ground level
LW1
LW2
LW3
LW4
LW5
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
No Data
Recession rate
Piezo base RL
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
379.0
378.9
378.8
378.7
378.6
378.5
378.4
378.3
378.2
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2004
2006
2008
2010
2012
2014
2016
2018
2020

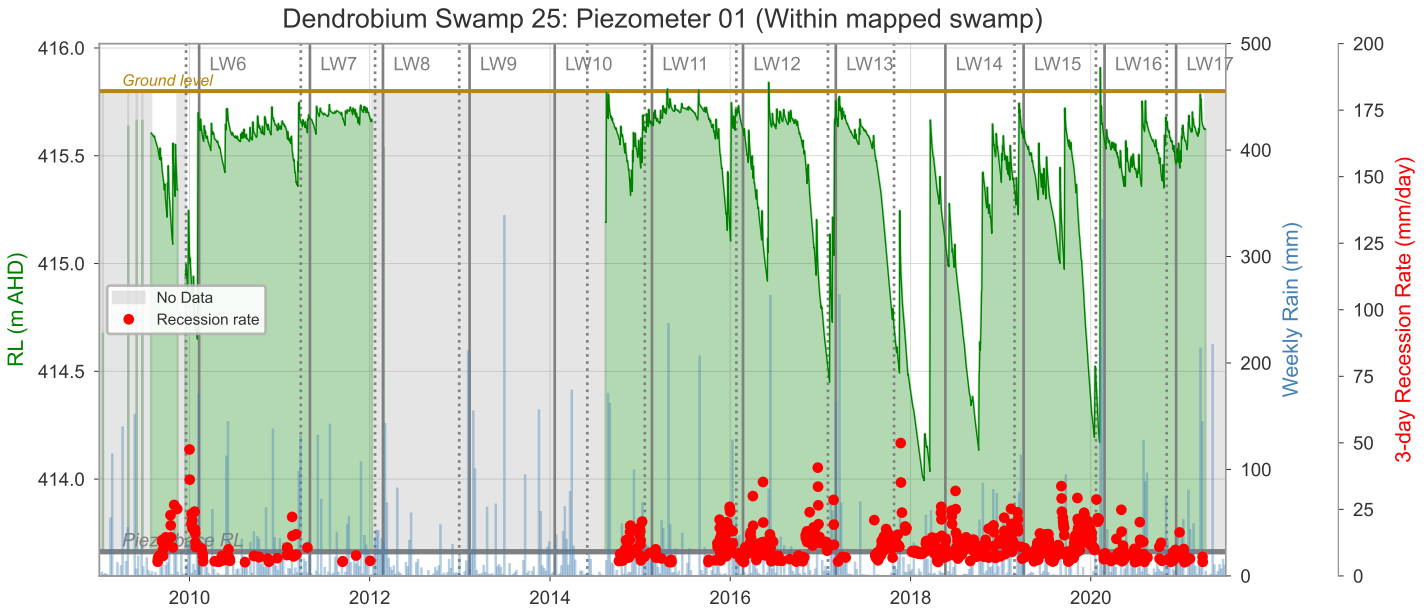

Dendrobium Swamp 18: Piezometer H2 (Within mapped swamp)
LW1
LW2
LW3
LW4
LW5
LW6
LW7
LW8
Ground level
No Data
Recession rate
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

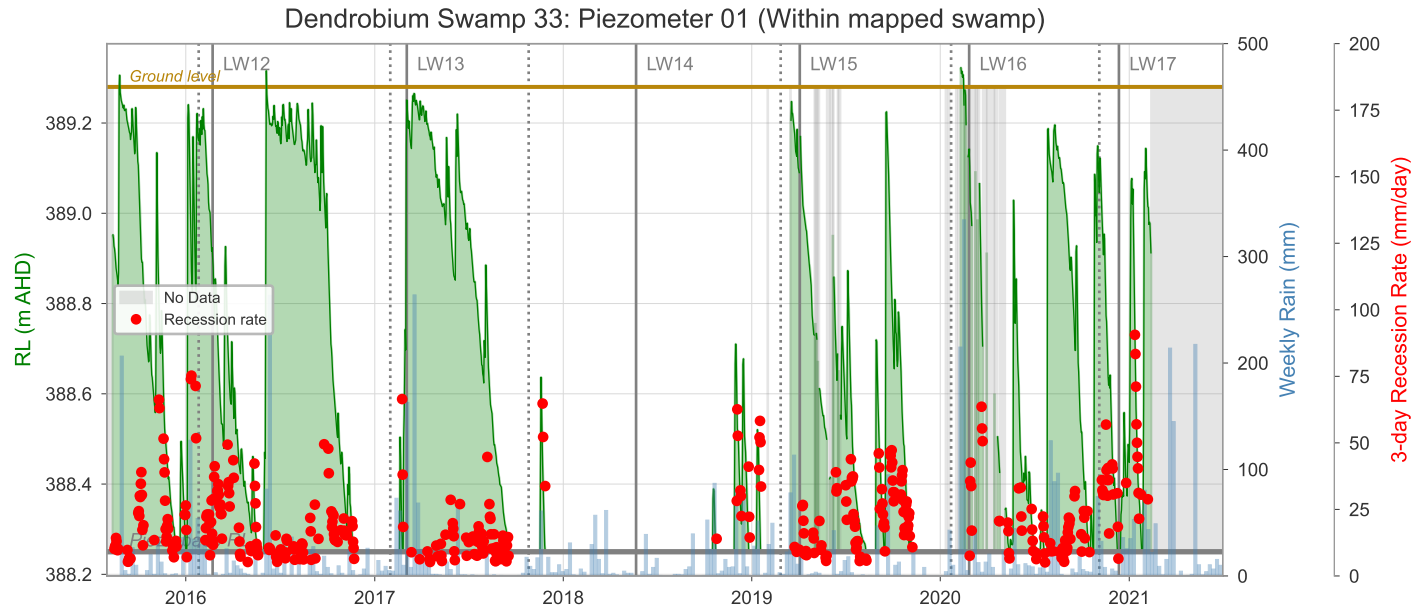

Dendrobium Swamp 22: Piezometer 01 (Within mapped swamp)
LW12
LW13
LW14
LW15
LW16
LW17
Ground level
No Data
Recession rate
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

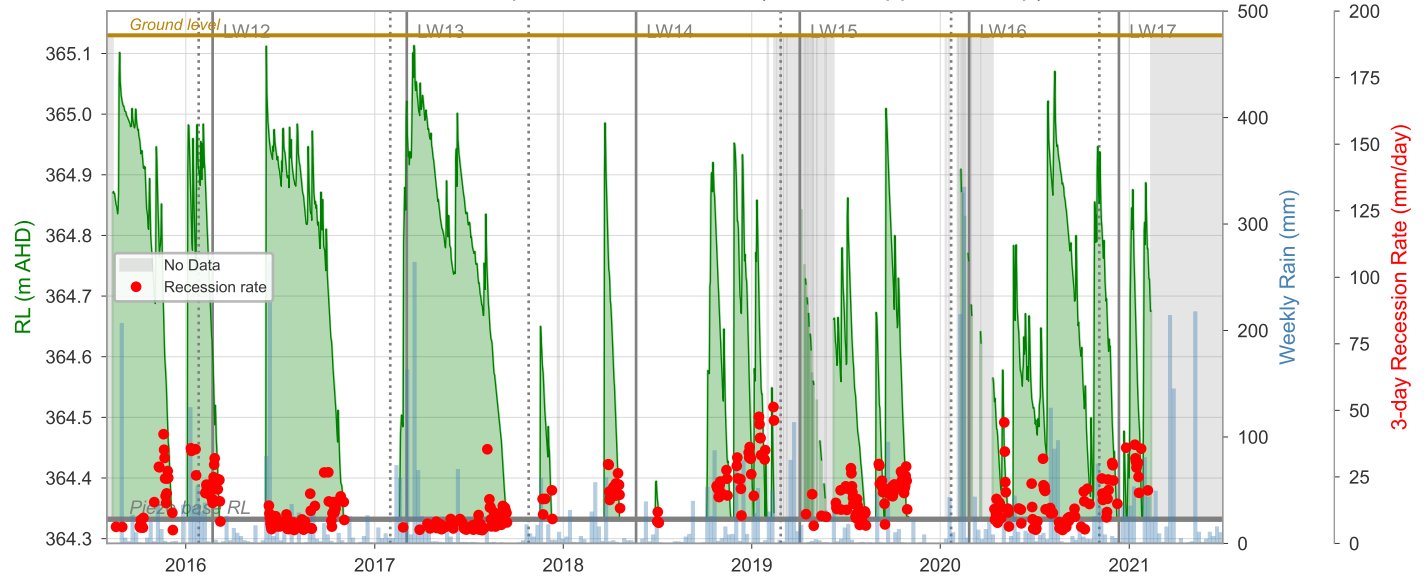

Dendrobium Swamp 22: Piezometer 02 (Within mapped swamp)
LW12
LW13
LW14
LW15
LW16
LW17
Ground level
No Data
Recession rate
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

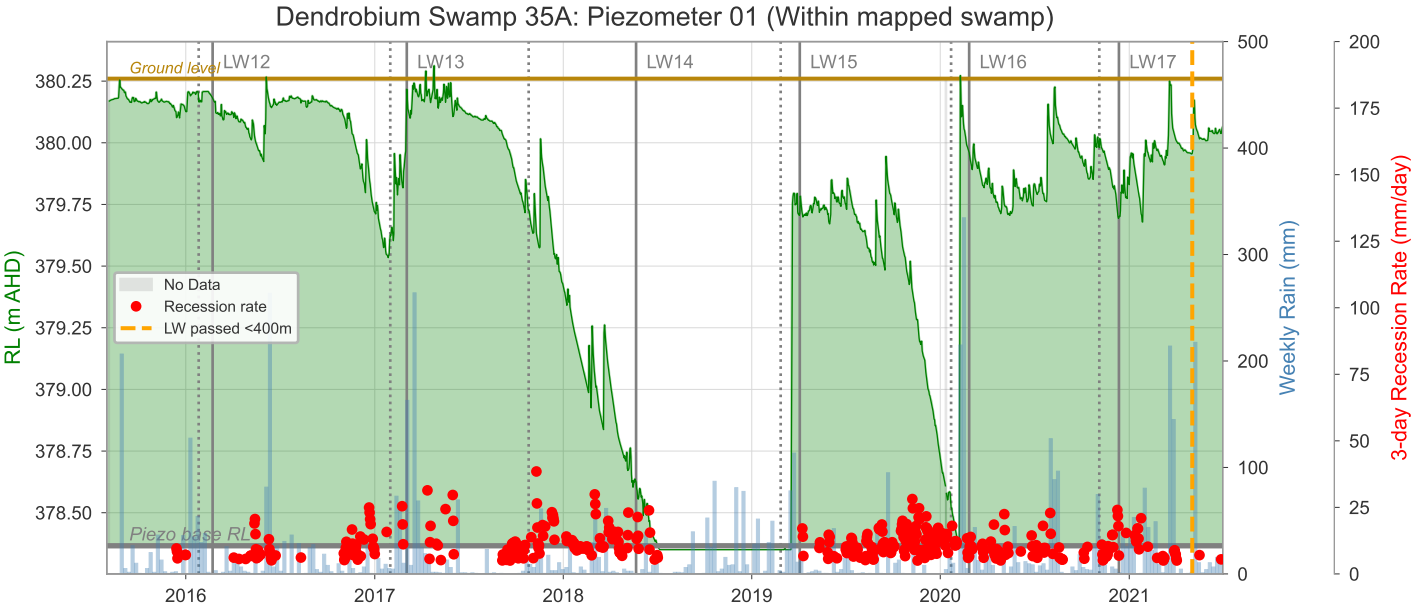

Dendrobium Swamp 23: Piezometer 01 (Within mapped swamp)
Ground level
LW12
LW13
LW14
LW15
LW16
LW17
No Data
Recession rate
LW undermined
LW passed <400m
Piezometer RL
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

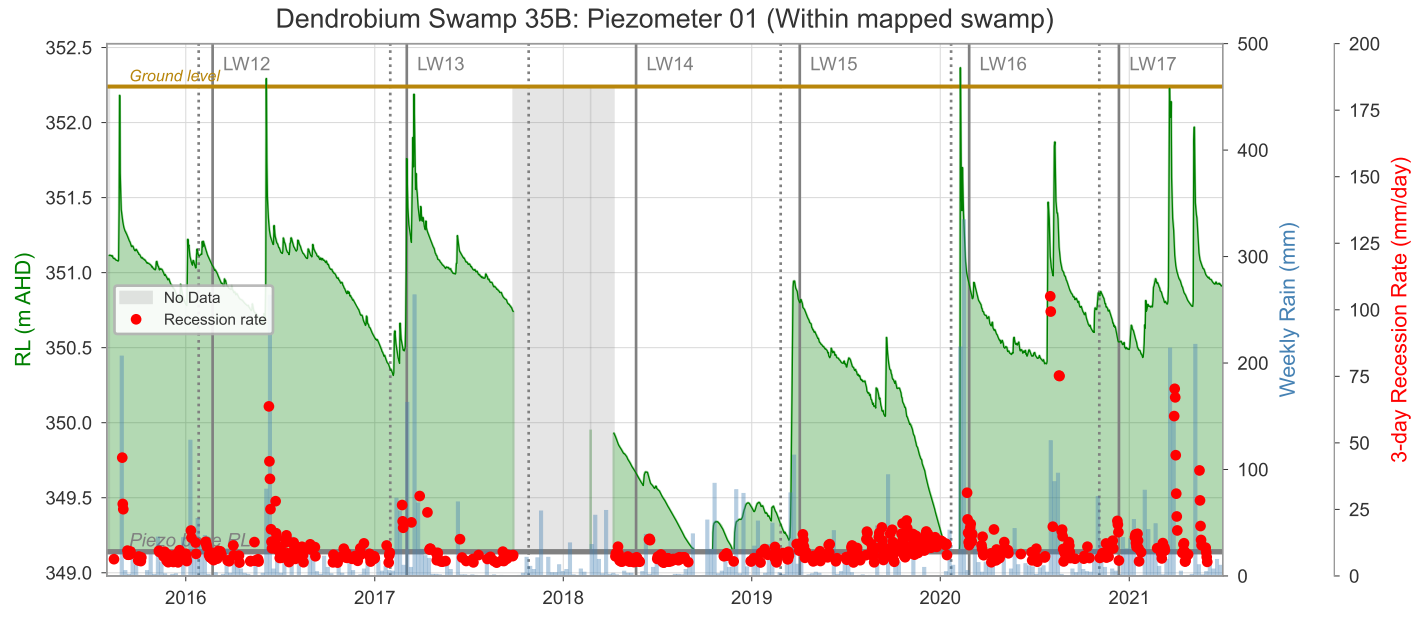

Dendrobium Swamp 23: Piezometer 02 (Within mapped swamp)
Ground level
LW12
LW13
LW14
LW15
LW16
LW17
No Data
Recession rate
LW passed <400m
Piezometer RL
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

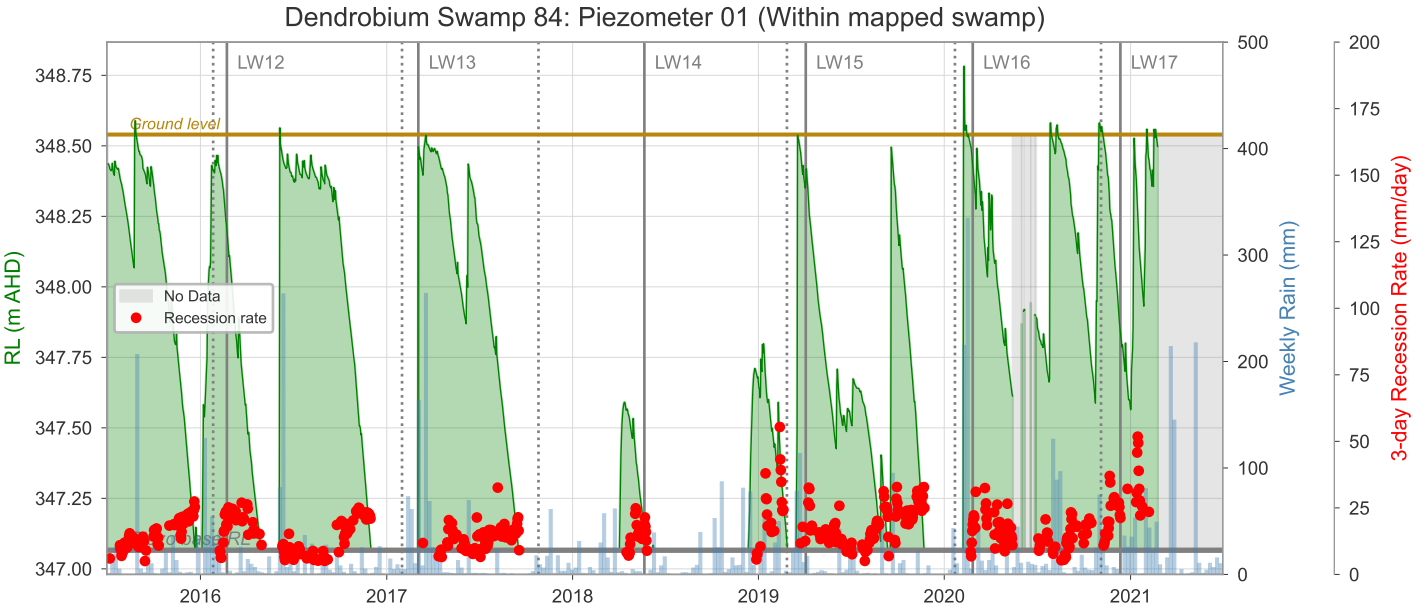

Dendrobium Swamp 25: Piezometer 01 (Within mapped swamp)
Ground level
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
No Data
Recession rate
Piezometer RL
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

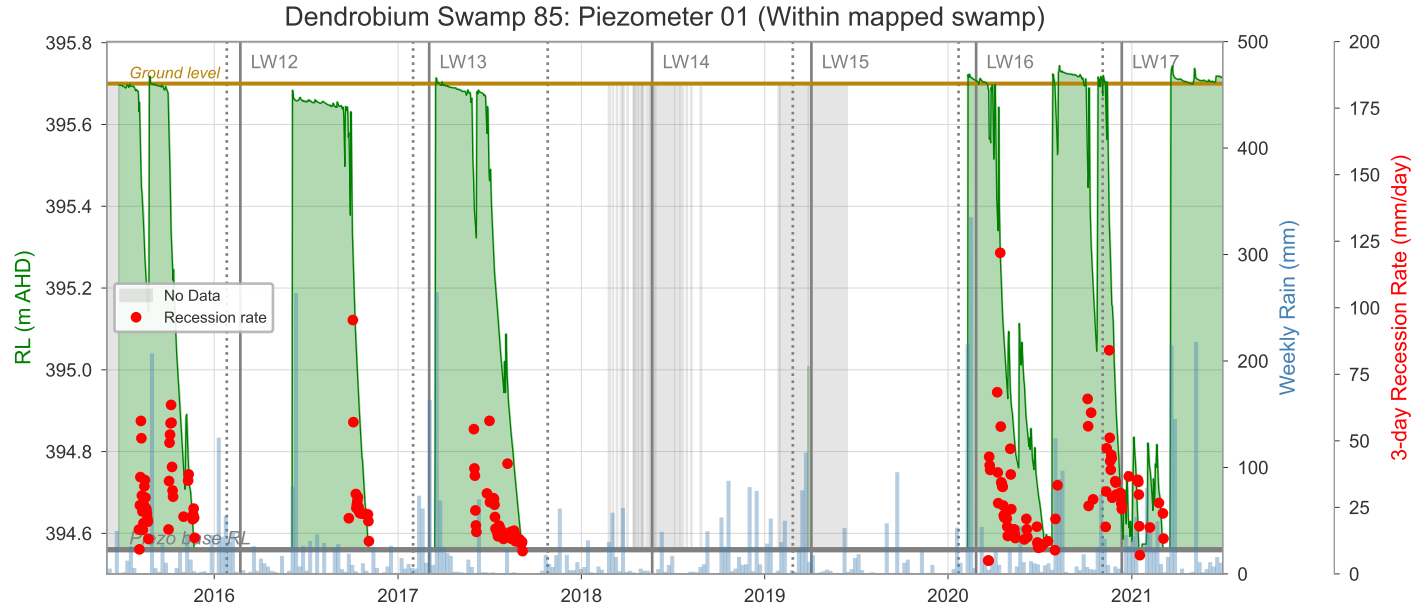

Dendrobium Swamp 33: Piezometer 01 (Within mapped swamp)
Ground level
LW12
LW13
LW14
LW15
LW16
LW17
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
No Data
Recession rate
Piezo base RL
2016
2017
2018
2019
2020
2021

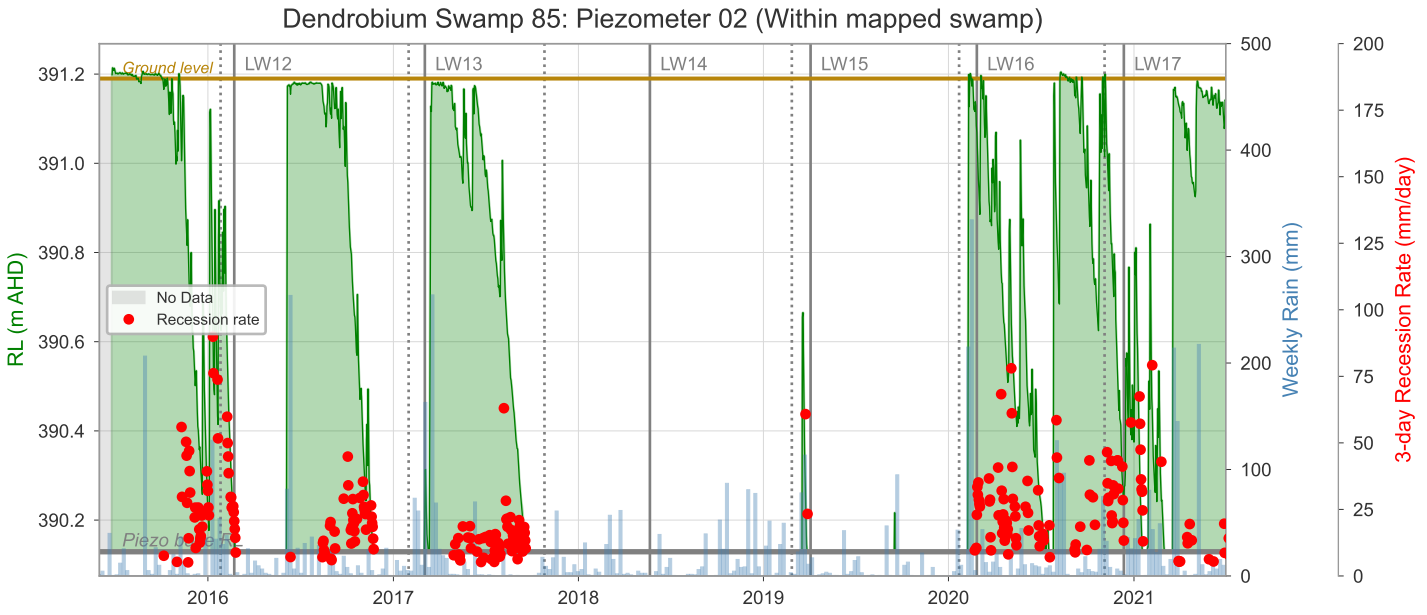

Dendrobium Swamp 33: Piezometer 03 (Within mapped swamp)
Ground level
LW12
LW13
LW14
LW15
LW16
LW17
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
No Data
Recession rate
Piezo base RL
2016
2017
2018
2019
2020
2021

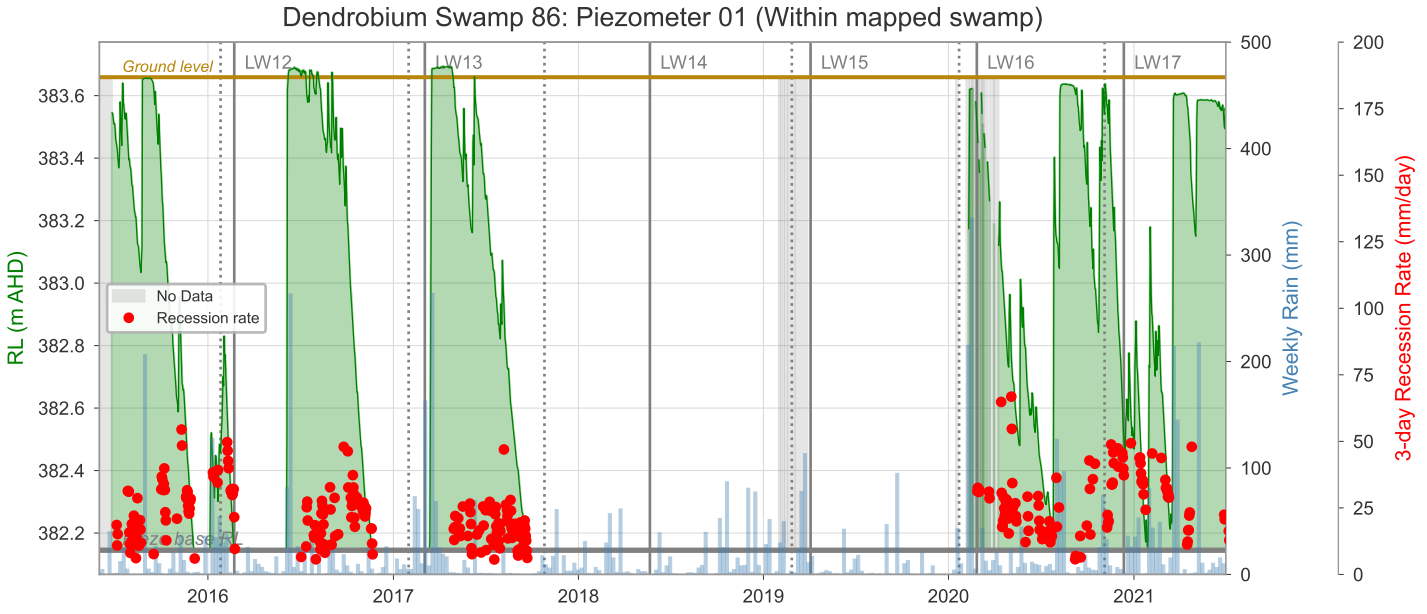

Dendrobium Swamp 35A: Piezometer 01 (Within mapped swamp)
Ground level
LW12
LW13
LW14
LW15
LW16
LW17
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
No Data
Recession rate
LW passed <400m
Piezo base RL
2016
2017
2018
2019
2020
2021

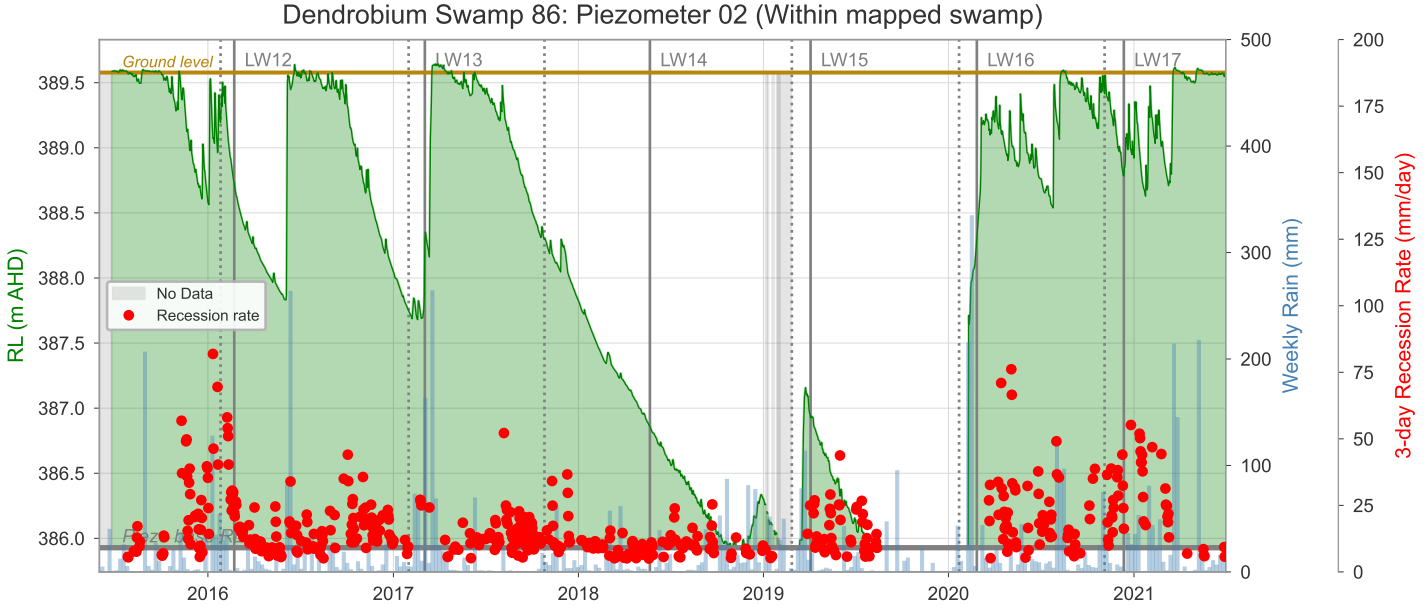

Dendrobium Swamp 35B: Piezometer 01 (Within mapped swamp)
LW12
LW13
LW14
LW15
LW16
LW17
Ground level
Piezo Base RL
No Data
Recession rate
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

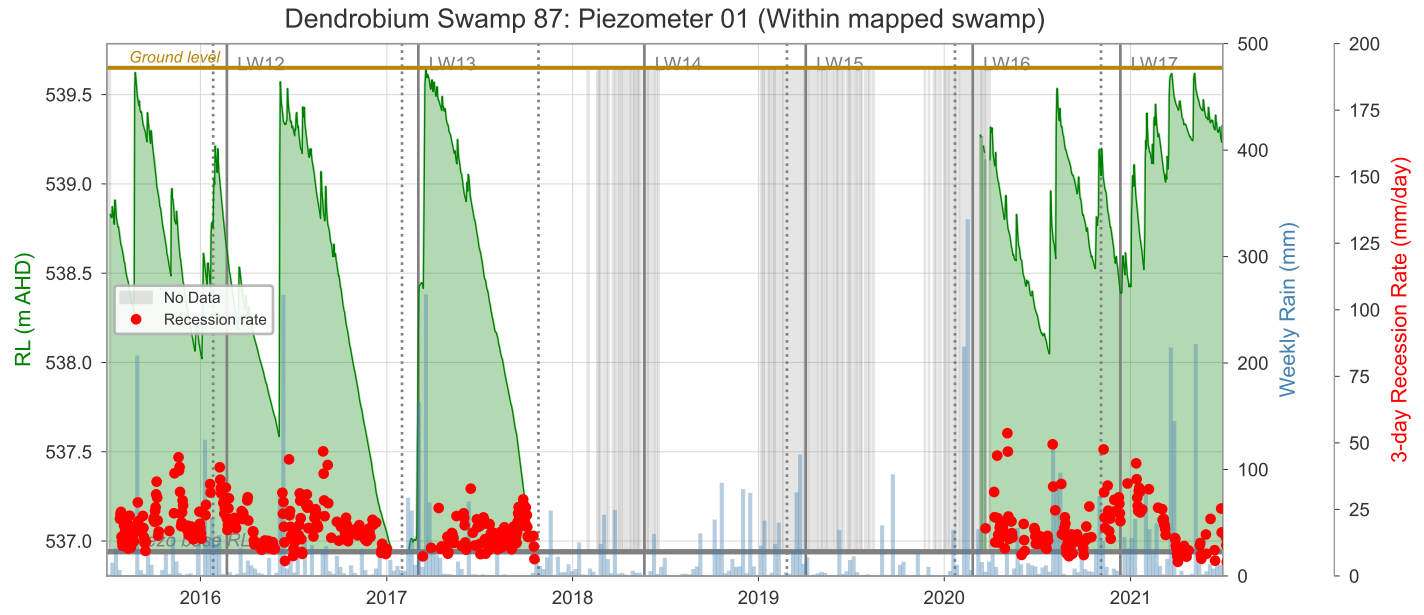

Dendrobium Swamp 84: Piezometer 01 (Within mapped swamp)
LW12
LW13
LW14
LW15
LW16
LW17
Ground level
Piezo Base RL
No Data
Recession rate
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

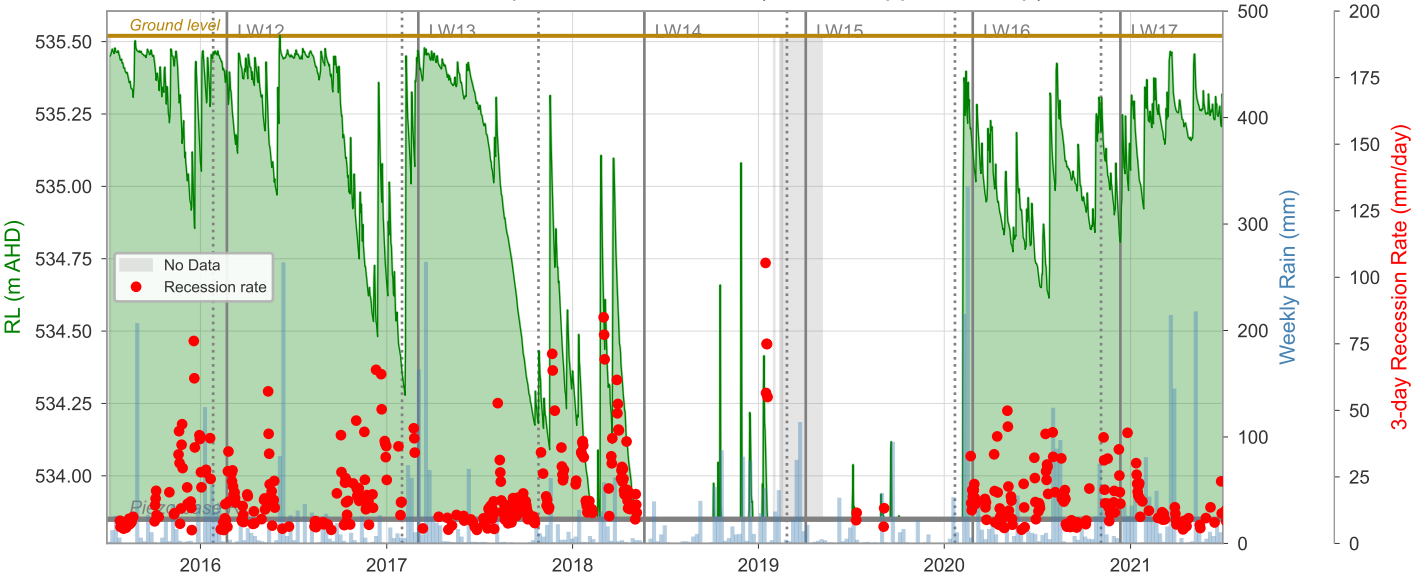

Dendrobium Swamp 85: Piezometer 01 (Within mapped swamp)
LW12
LW13
LW14
LW15
LW16
LW17
Ground level
Piezo Base RL
No Data
Recession rate
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

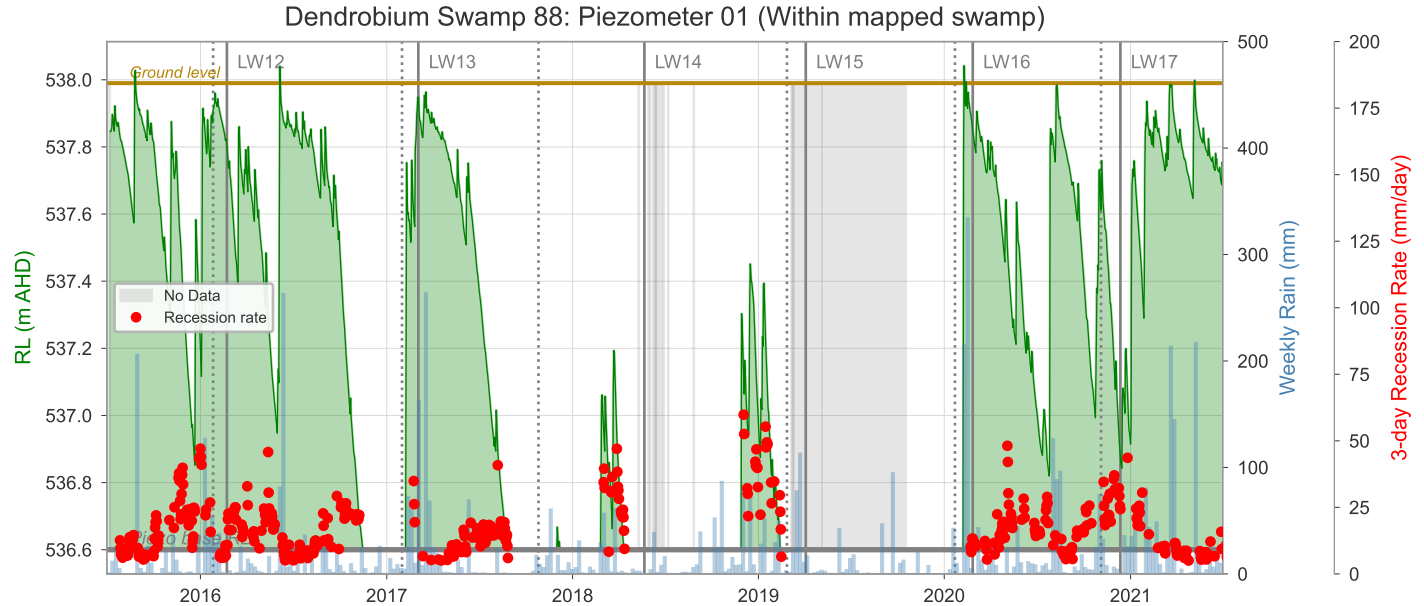

Dendrobium Swamp 85: Piezometer 02 (Within mapped swamp)
Ground level
LW12
LW13
LW14
LW15
LW16
LW17
No Data
Recession rate
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
391.2
391.0
390.8
390.6
390.4
390.2
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2016
2017
2018
2019
2020
2021

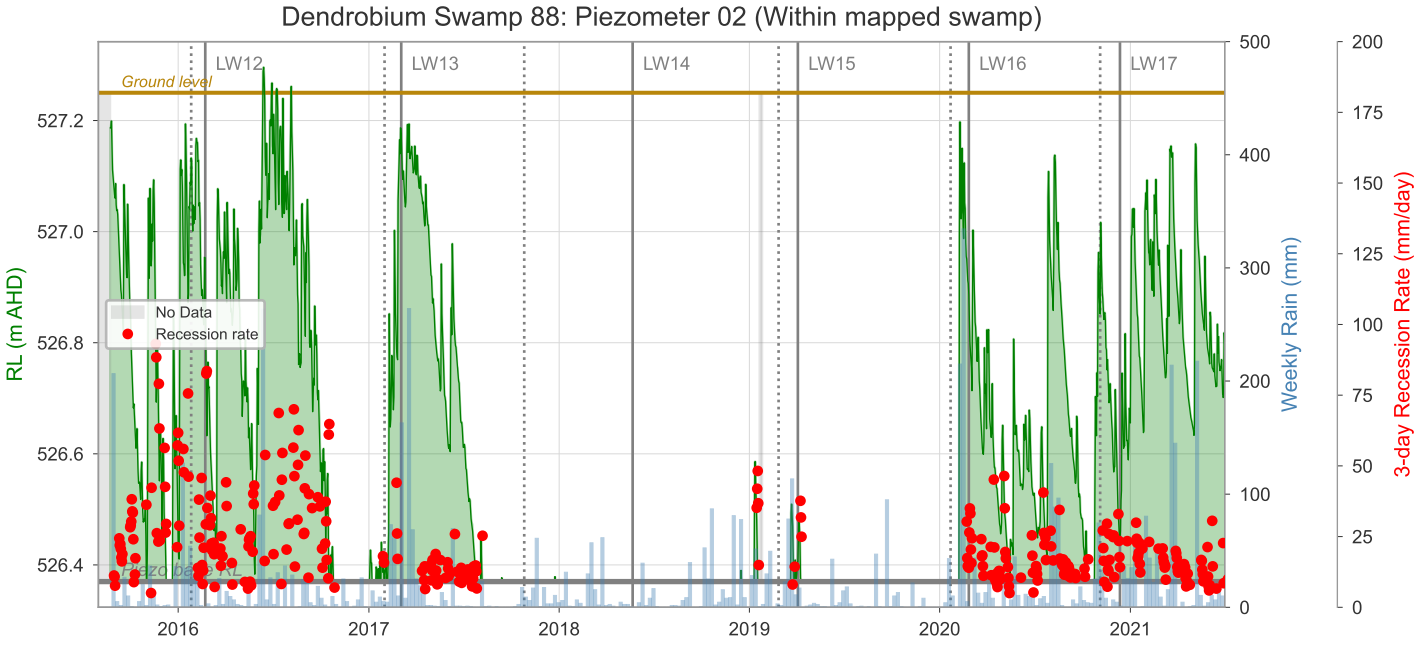

Dendrobium Swamp 86: Piezometer 01 (Within mapped swamp)
Ground level
LW12
LW13
LW14
LW15
LW16
LW17
No Data
Recession rate
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
383.6
383.4
383.2
383.0
382.8
382.6
382.4
382.2
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2016
2017
2018
2019
2020
2021


Dendrobium Swamp 86: Piezometer 02 (Within mapped swamp)
Ground level
LW12
LW13
LW14
LW15
LW16
LW17
No Data
Recession rate
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
389.5
389.0
388.5
388.0
387.5
387.0
386.5
386.0
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2016
2017
2018
2019
2020
2021


Dendrobium Swamp 87: Piezometer 01 (Within mapped swamp)
Ground level
LW12
LW13
LW14
LW15
LW16
LW17
No Data
Recession rate
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
2016
2017
2018
2019
2020
2021


Dendrobium Swamp 87: Piezometer 02 (Within mapped swamp)
Ground level
LW12
LW13
LW14
LW15
LW16
LW17
No Data
Recession rate
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
2016
2017
2018
2019
2020
2021


Dendrobium Swamp 88: Piezometer 01 (Within mapped swamp)
Ground level
LW12
LW13
LW14
LW15
LW16
LW17
No Data
Recession rate
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
2016
2017
2018
2019
2020
2021


Dendrobium Swamp 88: Piezometer 02 (Within mapped swamp)
LW12
LW13
LW14
LW15
LW16
LW17
Ground level
Piezo base RL
No Data
Recession rate
RL (m AHD)
527.2
527.0
526.8
526.6
526.4
Weekly Rain (mm)
500
400
300
200
100
0
3-day Recession Rate (mm/day)
200
175
150
125
100
75
50
25
0
2016
2017
2018
2019
2020
2021

Appendix 14. MNES Protected Matters Search Results

Australian Government

Department of Agriculture, Water and the Environment

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.

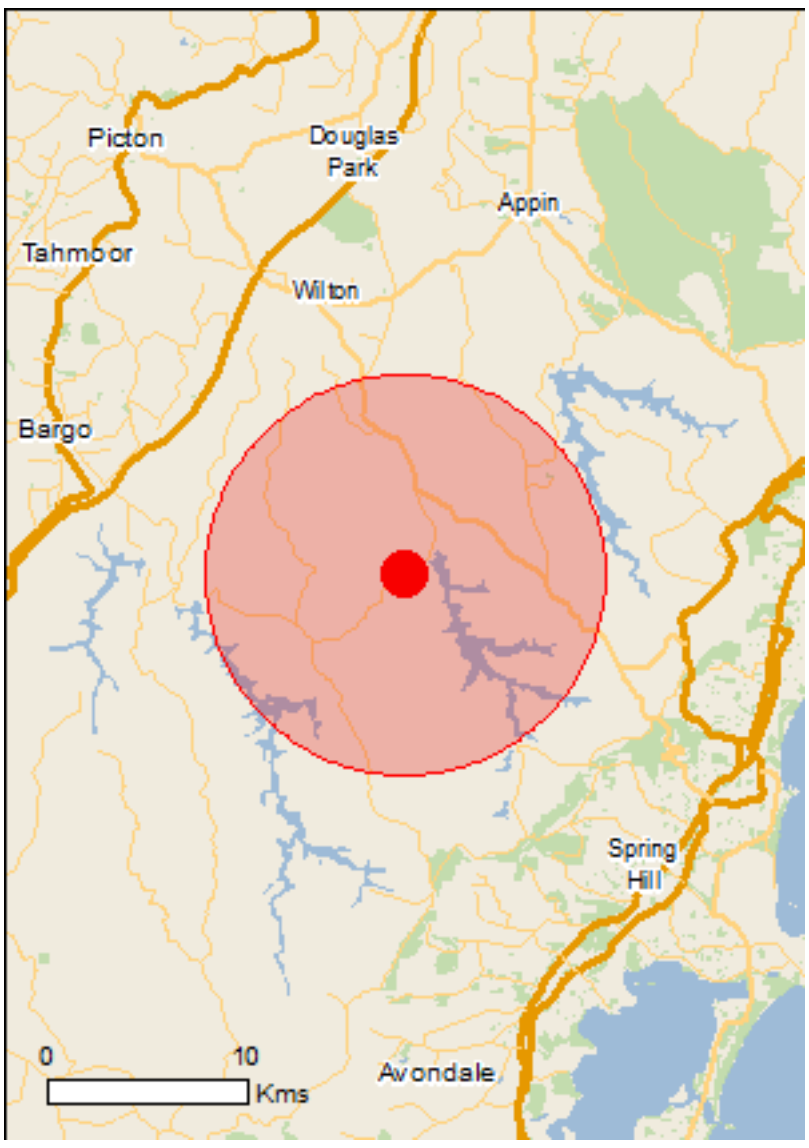
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 06/09/21 10:58:23

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

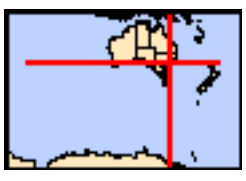
Caveat
Acknowledgements



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2015

Coordinates

Buffer: 10.0Km



Summary

Matters of National Environmental 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:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	11
Listed Threatened Species:	61
Listed Migratory Species:	18

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 http://www.environment.gov.au/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 Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	24
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	1
Regional Forest Agreements:	None
Invasive Species:	47
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

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.

Name	Status	Type of Presence
Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion	Endangered	Community may occur within area
Coastal Upland Swamps in the Sydney Basin Bioregion	Endangered	Community likely to occur within area
Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion	Critically Endangered	Community may occur within area
Illawarra-Shoalhaven Subtropical Rainforest of the Sydney Basin Bioregion	Critically Endangered	Community likely to occur within area
River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria	Critically Endangered	Community may occur within area
Shale Sandstone Transition Forest of the Sydney Basin Bioregion	Critically Endangered	Community likely to occur within area
Southern Highlands Shale Forest and Woodland in the Sydney Basin Bioregion	Critically Endangered	Community may occur within area
Turpentine-Ironbark Forest of the Sydney Basin Bioregion	Critically Endangered	Community likely to occur within area
Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion	Endangered	Community may occur within area
Western Sydney Dry Rainforest and Moist Woodland on Shale	Critically Endangered	Community may occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community may occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Foraging, feeding or related behaviour likely to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat likely to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area
Dasyornis brachypterus Eastern Bristlebird [533]	Endangered	Species or species habitat likely to occur

Name	Status	Type of Presence within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Species or species habitat may occur within area
Thinornis cucullatus cucullatus Eastern Hooded Plover, Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat may occur within area
Fish		
Bidyanus bidyanus Silver Perch, Bidyan [76155]	Critically Endangered	Translocated population known to occur within area
Maccullochella peelii Murray Cod [66633]	Vulnerable	Translocated population known to occur within area
Macquaria australasica Macquarie Perch [66632]	Endangered	Species or species habitat known to occur within area
Frogs		
Heleioporus australiacus Giant Burrowing Frog [1973]	Vulnerable	Species or species habitat known to occur within area
Litoria aurea Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat may occur within area
Litoria littlejohni Littlejohn's Tree Frog, Heath Frog [64733]	Vulnerable	Species or species habitat known to occur within area
Mixophyes balbus Stuttering Frog, Southern Barred Frog (in Victoria) [1942]	Vulnerable	Species or species habitat likely to occur within area
Mammals		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat known to occur within area
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

Name	Status	Type of Presence
Isoodon obesulus obesulus		
Southern Brown Bandicoot (eastern), Southern Brown Bandicoot (south-eastern) [68050]	Endangered	Species or species habitat known to occur within area
Petauroides volans		
Greater Glider [254]	Vulnerable	Species or species habitat known to occur within area
Petrogale penicillata		
Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat likely to occur within 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]	Vulnerable	Species or species habitat known to occur within area
Potorous tridactylus tridactylus		
Long-nosed Potoroo (SE Mainland) [66645]	Vulnerable	Species or species habitat likely to occur within area
Pseudomys novaehollandiae		
New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat likely to occur within area
Pteropus poliocephalus		
Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Plants		
Acacia bynoeana		
Bynoe's Wattle, Tiny Wattle [8575]	Vulnerable	Species or species habitat known to occur within area
Allocasuarina glareicola		
[21932]	Endangered	Species or species habitat may occur within area
Caladenia tessellata		
Thick-lipped Spider-orchid, Daddy Long-legs [2119]	Vulnerable	Species or species habitat likely to occur within area
Commersonia prostrata		
Dwarf Kerrawang [87152]	Endangered	Species or species habitat may occur within area
Cryptostylis hunteriana		
Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat likely to occur within area
Cynanchum elegans		
White-flowered Wax Plant [12533]	Endangered	Species or species habitat likely to occur within area
Genoplesium baueri		
Yellow Gnat-orchid, Bauer's Midge Orchid, Brittle Midge Orchid [7528]	Endangered	Species or species habitat likely to occur within area
Grevillea parviflora subsp. parviflora		
Small-flower Grevillea [64910]	Vulnerable	Species or species habitat known to occur within area
Grevillea raybrownii		
[65665]	Vulnerable	Species or species habitat known to occur within area
Haloragis exalata subsp. exalata		
Wingless Raspwort, Square Raspwort [24636]	Vulnerable	Species or species habitat may occur within area
Leucopogon exolasius		
Woronora Beard-heath [14251]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Melaleuca biconvexa Biconvex Paperbark [5583]	Vulnerable	Species or species habitat may occur within area
Melaleuca deanei Deane's Melaleuca [5818]	Vulnerable	Species or species habitat likely to occur within area
Persicaria elatior Knotweed, Tall Knotweed [5831]	Vulnerable	Species or species habitat likely to occur within area
Persoonia acerosa Needle Geebung [7232]	Vulnerable	Species or species habitat may occur within area
Persoonia bargoensis Bargo Geebung [56267]	Vulnerable	Species or species habitat likely to occur within area
Persoonia hirsuta Hairy Geebung, Hairy Persoonia [19006]	Endangered	Species or species habitat known to occur within area
Persoonia nutans Nodding Geebung [18119]	Endangered	Species or species habitat may occur within area
Pomaderris brunnea Rufous Pomaderris, Brown Pomaderris [16845]	Vulnerable	Species or species habitat known to occur within area
Pomaderris cotoneaster Cotoneaster Pomaderris [2043]	Endangered	Species or species habitat may occur within area
Prasophyllum affine Jervis Bay Leek Orchid, Culburra Leek-orchid, Kinghorn Point Leek-orchid [2210]	Endangered	Species or species habitat may occur within area
Pterostylis saxicola Sydney Plains Greenhood [64537]	Endangered	Species or species habitat may occur within area
Pultenaea aristata [18062]	Vulnerable	Species or species habitat likely to occur within area
Rhizanthella slateri Eastern Underground Orchid [11768]	Endangered	Species or species habitat may occur within area
Rhodamnia rubescens Scrub Turpentine, Brown Malletwood [15763]	Critically Endangered	Species or species habitat known to occur within area
Rhodomyrtus psidioides Native Guava [19162]	Critically Endangered	Species or species habitat may occur within area
Syzygium paniculatum Magenta Lilly Pilly, Magenta Cherry, Daguba, Scrub Cherry, Creek Lilly Pilly, Brush Cherry [20307]	Vulnerable	Species or species habitat may occur within area
Thelymitra kangaloonica Kangaloon Sun Orchid [81861]	Critically Endangered	Species or species habitat likely to occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Xerochrysum palustre		
Swamp Everlasting, Swamp Paper Daisy [76215]	Vulnerable	Species or species habitat likely to occur within area
Reptiles		
Hoplocephalus bungaroides		
Broad-headed Snake [1182]	Vulnerable	Species or species habitat known to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Cuculus optatus		
Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Hirundapus caudacutus		
White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Monarcha melanopsis		
Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus		
Spectacled Monarch [610]		Species or species habitat may occur within area
Motacilla flava		
Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca		
Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons		
Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat likely to occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat likely to occur within area
Charadrius leschenaultii		
Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat likely to occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area
Pandion haliaetus		
Osprey [952]		Species or species habitat likely to occur within area
Tringa nebularia		
Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat likely to occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat likely to occur within area
Charadrius leschenaultii		
Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area
Chrysococcyx osculans		
Black-eared Cuckoo [705]		Species or species habitat likely to occur within area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Thinornis rubricollis rubricollis Hooded Plover (eastern) [66726]	Vulnerable*	Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Upper Nepean	NSW

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Lonchura punctulata Nutmeg Mannikin [399]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Pycnonotus jocosus Red-whiskered Bulbul [631]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Alternanthera philoxeroides Alligator Weed [11620]		Species or species habitat likely to occur within area
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Cabomba caroliniana Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera subsp. rotundata Bitou Bush [16332]		Species or species habitat likely to occur within area
Cytisus scoparius Broom, English Broom, Scotch Broom, Common		Species or species

Name	Status	Type of Presence
Broom, Scottish Broom, Spanish Broom [5934]		habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Nassella neesiana Chilean Needle grass [67699]		Species or species habitat likely to occur within area
Nassella trichotoma Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ) [18884]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area
Ulex europaeus Gorse, Furze [7693]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

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.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for 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 reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-34.34118 150.73362

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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Australian Government

Department of Agriculture, Water and the Environment

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.

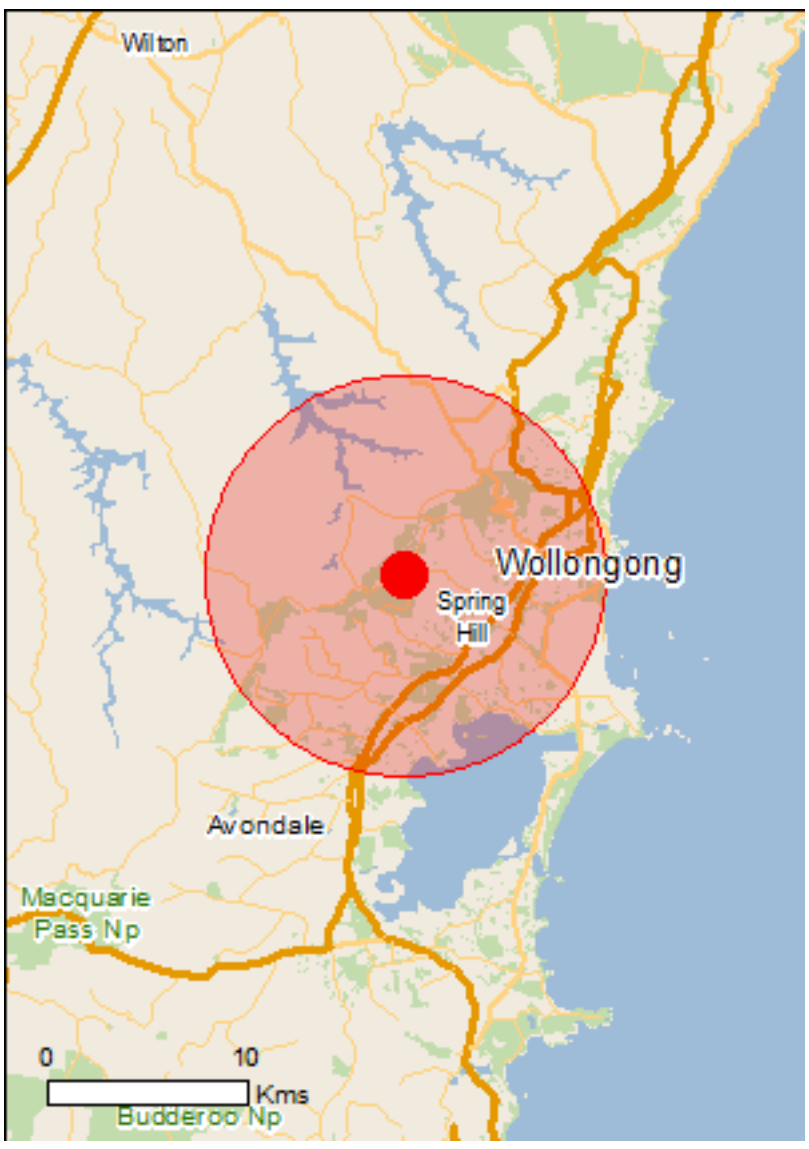
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 21/10/21 13:47:22

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

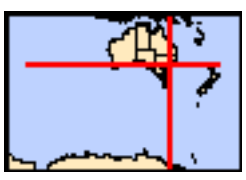
Caveat
Acknowledgements



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2015

Coordinates

Buffer: 10.0Km



Summary

Matters of National Environmental 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:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	7
Listed Threatened Species:	95
Listed Migratory Species:	55

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 http://www.environment.gov.au/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 Land:	11
Commonwealth Heritage Places:	None
Listed Marine Species:	76
Whales and Other Cetaceans:	12
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	2
Regional Forest Agreements:	None
Invasive Species:	50
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

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.

Name	Status	Type of Presence
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community	Endangered	Community likely to occur within area
Coastal Upland Swamps in the Sydney Basin Bioregion	Endangered	Community likely to occur within area
Illawarra and south coast lowland forest and woodland ecological community	Critically Endangered	Community likely to occur within area
Illawarra-Shoalhaven Subtropical Rainforest of the Sydney Basin Bioregion	Critically Endangered	Community likely to occur within area
River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria	Critically Endangered	Community likely to occur within area
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area
Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion	Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Species or species habitat known to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area
Dasyornis brachypterus Eastern Bristlebird [533]	Endangered	Species or species habitat known to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea antipodensis gibsoni Gibson's Albatross [82270]	Vulnerable	Foraging, feeding or

Name	Status	Type of Presence
		related behaviour likely to occur within area
[Diomedea epomophora](#) Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
[Diomedea exulans](#) Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
[Diomedea sanfordi](#) Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
[Falco hypoleucos](#) Grey Falcon [929]	Vulnerable	Species or species habitat may occur within area
[Fregetta grallaria grallaria](#) White-bellied Storm-Petrel (Tasman Sea), White-bellied Storm-Petrel (Australasian) [64438]	Vulnerable	Species or species habitat likely to occur within area
[Grantiella picta](#) Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area
[Hirundapus caudacutus](#) White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
[Lathamus discolor](#) Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
[Limosa lapponica baueri](#) Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat known to occur within area
[Macronectes giganteus](#) Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
[Macronectes halli](#) Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
[Neophema chrysogaster](#) Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat may occur within area
[Numenius madagascariensis](#) Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
[Pachyptila turtur subantarctica](#) Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area
[Pterodroma neglecta neglecta](#) Kermadec Petrel (western) [64450]	Vulnerable	Foraging, feeding or related behaviour may occur within area
[Rostratula australis](#) Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
[Sternula nereis nereis](#) Australian Fairy Tern [82950]	Vulnerable	Breeding likely to occur within area
[Thalassarche bulleri](#) Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
Thalassarche bulleri platei Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thinornis cucullatus cucullatus Eastern Hooded Plover, Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat likely to occur within area
Fish		
Bidyanus bidyanus Silver Perch, Bidyan [76155]	Critically Endangered	Translocated population known to occur within area
Epinephelus daemelii Black Rockcod, Black Cod, Saddled Rockcod [68449]	Vulnerable	Species or species habitat likely to occur within area
Hippocampus whitei White's Seahorse, Crowned Seahorse, Sydney Seahorse [66240]	Endangered	Species or species habitat likely to occur within area
Maccullochella peelii Murray Cod [66633]	Vulnerable	Translocated population known to occur within area
Macquaria australasica Macquarie Perch [66632]	Endangered	Species or species habitat known to occur within area
Prototroctes maraena Australian Grayling [26179]	Vulnerable	Species or species habitat likely to occur within area
Frogs		
Heleioporus australiacus Giant Burrowing Frog [1973]	Vulnerable	Species or species habitat known to occur within area
Litoria aurea Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat known to occur within area
Litoria littlejohni Littlejohn's Tree Frog, Heath Frog [64733]	Vulnerable	Species or species habitat known to occur within area
Mixophyes balbus Stuttering Frog, Southern Barred Frog (in Victoria) [1942]	Vulnerable	Species or species habitat likely to occur

Name	Status	Type of Presence within area
Mammals		
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat known to occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat likely to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat known to occur within area
Isoodon obesulus obesulus Southern Brown Bandicoot (eastern), Southern Brown Bandicoot (south-eastern) [68050]	Endangered	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Petauroides volans Greater Glider [254]	Vulnerable	Species or species habitat known to occur within area
Petrogale penicillata Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat likely to occur within 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]	Vulnerable	Species or species habitat known to occur within area
Potorous tridactylus tridactylus Long-nosed Potoroo (SE Mainland) [66645]	Vulnerable	Species or species habitat likely to occur within area
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat likely to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area
Plants		
Acacia bynoeana Bynoe's Wattle, Tiny Wattle [8575]	Vulnerable	Species or species habitat may occur within area
Allocasuarina glareicola [21932]	Endangered	Species or species habitat may occur within area
Caladenia tessellata Thick-lipped Spider-orchid, Daddy Long-legs [2119]	Vulnerable	Species or species habitat likely to occur within area
Cryptostylis hunteriana Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat likely to occur within area
Cynanchum elegans White-flowered Wax Plant [12533]	Endangered	Species or species habitat known to occur within area
Daphnandra johnsonii Illawarra Socketwood [67186]	Endangered	Species or species habitat likely to occur

Name	Status	Type of Presence within area
Genoplesium baueri Yellow Gnat-orchid, Bauer's Midge Orchid, Brittle Midge Orchid [7528]	Endangered	Species or species habitat likely to occur within area
Grevillea raybrownii [65665]	Vulnerable	Species or species habitat known to occur within area
Haloragis exalata subsp. exalata Wingless Raspwort, Square Raspwort [24636]	Vulnerable	Species or species habitat known to occur within area
Irenepharsus trypherus Delicate Cress, Illawarra Irene [14664]	Endangered	Species or species habitat may occur within area
Leucopogon exolasius Woronora Beard-heath [14251]	Vulnerable	Species or species habitat likely to occur within area
Melaleuca biconvexa Biconvex Paperbark [5583]	Vulnerable	Species or species habitat may occur within area
Melaleuca deanei Deane's Melaleuca [5818]	Vulnerable	Species or species habitat may occur within area
Persicaria elatior Knotweed, Tall Knotweed [5831]	Vulnerable	Species or species habitat likely to occur within area
Persoonia acerosa Needle Geebung [7232]	Vulnerable	Species or species habitat may occur within area
Persoonia hirsuta Hairy Geebung, Hairy Persoonia [19006]	Endangered	Species or species habitat known to occur within area
Persoonia nutans Nodding Geebung [18119]	Endangered	Species or species habitat known to occur within area
Pimelea spicata Spiked Rice-flower [20834]	Endangered	Species or species habitat likely to occur within area
Prasophyllum affine Jervis Bay Leek Orchid, Culburra Leek-orchid, Kinghorn Point Leek-orchid [2210]	Endangered	Species or species habitat may occur within area
Pterostylis gibbosa Illawarra Greenhood, Rufa Greenhood, Pouched Greenhood [4562]	Endangered	Species or species habitat known to occur within area
Pterostylis saxicola Sydney Plains Greenhood [64537]	Endangered	Species or species habitat may occur within area
Pultenaea aristata [18062]	Vulnerable	Species or species habitat likely to occur within area
Rhizanthella slateri Eastern Underground Orchid [11768]	Endangered	Species or species habitat may occur within area
Rhodamnia rubescens Scrub Turpentine, Brown Malletwood [15763]	Critically Endangered	Species or species habitat known to occur within area

Name	Status	Type of Presence
[Rhodomyrtus psidioides](#) Native Guava [19162]	Critically Endangered	Species or species habitat may occur within area
[Syzygium paniculatum](#) Magenta Lilly Pilly, Magenta Cherry, Daguba, Scrub Cherry, Creek Lilly Pilly, Brush Cherry [20307]	Vulnerable	Species or species habitat known to occur within area
[Thelymitra kangaloonica](#) Kangaloon Sun Orchid [81861]	Critically Endangered	Species or species habitat likely to occur within area
[Thesium australe](#) Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat likely to occur within area
[Xerochrysum palustre](#) Swamp Everlasting, Swamp Paper Daisy [76215]	Vulnerable	Species or species habitat likely to occur within area
[Zieria granulata](#) Hill Zieria, Hilly Zieria, Illawarra Zieria [17147]	Endangered	Species or species habitat likely to occur within area
Reptiles		
[Caretta caretta](#) Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area
[Chelonia mydas](#) Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
[Dermochelys coriacea](#) Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
[Eretmochelys imbricata](#) Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
[Hoplocephalus bungaroides](#) Broad-headed Snake [1182]	Vulnerable	Species or species habitat known to occur within area
[Natator depressus](#) Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sharks		
[Carcharias taurus (east coast population)](#) Grey Nurse Shark (east coast population) [68751]	Critically Endangered	Species or species habitat likely to occur within area
[Carcharodon carcharias](#) White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
[Rhincodon typus](#) Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
[Anous stolidus](#) Common Noddy [825]		Species or species habitat likely to occur within area
[Apus pacificus](#) Fork-tailed Swift [678]		Species or species

Name	Threatened	Type of Presence
		habitat likely to occur within area
[Ardenna carneipes](#) Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area
[Ardenna grisea](#) Sooty Shearwater [82651]		Species or species habitat likely to occur within area
[Calonectris leucomelas](#) Streaked Shearwater [1077]		Species or species habitat known to occur within area
[Diomedea antipodensis](#) Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
[Diomedea epomophora](#) Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
[Diomedea exulans](#) Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
[Diomedea sanfordi](#) Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
[Fregata ariel](#) Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area
[Macronectes giganteus](#) Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
[Macronectes halli](#) Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
[Sternula albifrons](#) Little Tern [82849]		Species or species habitat may occur within area
[Thalassarche bulleri](#) Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
[Thalassarche cauta](#) Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
[Thalassarche eremita](#) Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area
[Thalassarche impavida](#) Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
[Thalassarche melanophris](#) Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
[Thalassarche salvini](#) Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
[Thalassarche steadi](#) White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely

Name	Threatened	Type of Presence to occur within area
Migratory Marine Species		
[Balaena glacialis australis](#) Southern Right Whale [75529]	Endangered*	Species or species habitat known to occur within area
[Balaenoptera edeni](#) Bryde's Whale [35]		Species or species habitat may occur within area
[Balaenoptera musculus](#) Blue Whale [36]	Endangered	Species or species habitat may occur within area
[Caperea marginata](#) Pygmy Right Whale [39]		Foraging, feeding or related behaviour may occur within area
[Carcharhinus longimanus](#) Oceanic Whitetip Shark [84108]		Species or species habitat may occur within area
[Carcharodon carcharias](#) White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
[Caretta caretta](#) Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area
[Chelonia mydas](#) Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
[Dermochelys coriacea](#) Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
[Eretmochelys imbricata](#) Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
[Lagenorhynchus obscurus](#) Dusky Dolphin [43]		Species or species habitat may occur within area
[Lamna nasus](#) Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area
[Manta birostris](#) Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
[Megaptera novaeangliae](#) Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
[Natator depressus](#) Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
[Orcinus orca](#) Killer Whale, Orca [46]		Species or species habitat likely to occur within area
[Rhincodon typus](#) Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Migratory Terrestrial Species		
[Cuculus optatus](#) Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat likely to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -
Commonwealth Land - Australian Postal Commission
Commonwealth Land - Australian Postal Corporation
Commonwealth Land - Australian Telecommunications Commission
Commonwealth Land - Commonwealth Trading Bank of Australia
Commonwealth Land - Defence Service Homes Corporation
Defence - AIRTC WOLLONGONG
Defence - Graovac House
Defence - HYDROGRAPHIC OFFICE
Defence - LAKE ILLAWARRA CADET FACILITY
Defence - WOLLONGONG MULTI-USER DEPOT

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Name	Threatened	Type of Presence
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea gibsoni Gibson's Albatross [64466]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Neophema chrysostoma Blue-winged Parrot [726]		Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Foraging, feeding or related behaviour likely to occur within area
Puffinus griseus Sooty Shearwater [1024]		Species or species habitat likely to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Sterna albifrons Little Tern [813]		Species or species habitat may occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche sp. nov. Pacific Albatross [66511]	Vulnerable*	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thinornis rubricollis rubricollis Hooded Plover (eastern) [66726]	Vulnerable*	Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area
Fish		
Acentronura tentaculata Shortpouch Pygmy Pipehorse [66187]		Species or species habitat may occur within area
Festucalex cinctus Girdled Pipefish [66214]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus abdominalis Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]		Species or species habitat may occur within area
Hippocampus whitei White's Seahorse, Crowned Seahorse, Sydney Seahorse [66240]	Endangered	Species or species habitat likely to occur within area
Histiogamphelus briggsii Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish [66242]		Species or species habitat may occur within area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Solenostomus paradoxus Ornate Ghostpipefish, Harlequin Ghost Pipefish, Ornate Ghost Pipefish [66184]		Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Syngnathoides biaculeatus		
Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus		
Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Urocampus carinirostris		
Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer		
Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Mammals		
Arctocephalus forsteri		
Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area
Arctocephalus pusillus		
Australian Fur-seal, Australo-African Fur-seal [21]		Species or species habitat may occur within area
Reptiles		
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Eretmochelys imbricata		
Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata		
Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera edeni		
Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus		
Blue Whale [36]	Endangered	Species or species habitat may occur within area
Caperea marginata		
Pygmy Right Whale [39]		Foraging, feeding or related behaviour may occur within area
Delphinus delphis		
Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis		
Southern Right Whale [40]	Endangered	Species or species habitat known to occur within area

Name	Status	Type of Presence
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Berkeley	NSW
Illawarra Escarpment	NSW

Invasive Species	[Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Lonchura punctulata Nutmeg Mannikin [399]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Pycnonotus jocosus Red-whiskered Bulbul [631]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat may occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Plants		
Alternanthera philoxeroides Alligator Weed [11620]		Species or species habitat likely to occur within area
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Asparagus scandens Asparagus Fern, Climbing Asparagus Fern [23255]		Species or species habitat likely to occur within area
Cabomba caroliniana Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera subsp. rotundata Bitou Bush [16332]		Species or species habitat likely to occur within area
Cytisus scoparius Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Nassella neesiana Chilean Needle grass [67699]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Nassella trichotoma Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ) [18884]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area
Ulex europaeus Gorse, Furze [7693]		Species or species habitat likely to occur within area

Nationally Important Wetlands	[Resource Information]
Name	State
Lake Illawarra	NSW

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

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.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for 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 reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-34.43334 150.81021

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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Appendix 15. BAM Support Correspondence

From: Kate Tierney <Kate.Tierney@environment.nsw.gov.au> On Behalf Of OEH ROD BAM Support Mailbox

Sent: Monday, 22 November 2021 1:31 PM
To: Luke Baker <lbaker@niche-eh.com>; Simon Tweed <stweed@niche-eh.com>
Cc: Freya Gordon <fgordon@niche-eh.com>
Subject: RE: BSM-3668

Hi Luke,

Thanks for your query. We apologise for the delay in responding.

The subject matter expert has provided the following response:

Below we have provided responses to the statements for which you were seeking confirmation.

1. **The Subject Land whilst defined in the BAM as 'the land subject to a development, activity, clearing, biodiversity certification or a biodiversity stewardship proposal' should be interpreted to be the 'vegetation/habitat directly impacted by the proposal'.**

Where it applies to a development or clearing site, the 'Subject Land' means the total operational and construction footprint of the development/activity. This includes any clearing and ancillary works which support the operation and/or construction.

2. **Species polygons are associated with the vegetation/habitat that is 'directly impacted' by the proposal, and**
3. **The area specified by the species polygon is used to quantify the area of direct impact, and thus BAM-C calculations for a development site.**

As per our previous advice, for development/clearing sites, where fauna and flora species credit species assessed by area are determined or assumed present, the species polygon is used to measure the area of suitable habitat on the Subject Land (BAM 2020, paragraph 5.2.5(2.)). Calculation of the required species credits for direct impacts uses the area and condition of the suitable habitat identified by the species polygon (BAM 2020, paragraph 10.1.3(2.)). Therefore, your understanding is correct. For a development/clearing site, based on the above clarification of Subject Land, the species polygon will cover areas directly impacted by the development/clearing.

4. **Species polygons are not required for vegetation/habitat that is not subject to 'direct impacts' associated with the proposal.**

A species polygon is not required, but can be used to identify indirect and/or prescribed impacts, where offsetting these impacts with biodiversity credits is proposed. For example, if a proposal were to indirectly lead to vegetation losses outside the Subject Land, section 8.6 (2) provides that "the assessor may use the vegetation integrity data from vegetation zones within the Subject Land (section 4.3). The assessor can then use the BAM-C to attribute a partial loss by reducing the current observed value of the attributes for the vegetation zone.

5. **In regards to our mining subsidence scenario presented, extensive surveys and species polygons are not required for areas that are not 'directly impacted' by the proposal. Thus, for a proposed mining domain, species polygons and extensive surveys are not required for areas where**

subsidence has no impact to biodiversity (ie. Woodland/Forest areas that are not ground-water dependent). However, field surveys would need to be carried out to assess prescribed impacts from subsidence which are relevant to a proposal (eg. Subsidence impacts to riparian areas, steep slopes, clifflines) or as per the Coastal Upland Swamp Policy.

In relation to a longwall mining proposal there will be direct impacts to biodiversity that must be assessed in accordance with the BAM. Residual direct impacts that cannot be avoided must be offset by the generation of ecosystem and species credits. Species credits for those species with area as the unit of measure, will be determined in accordance with Equation 2 in the BAM, incorporating consideration of the species polygon area and condition. Species polygons are generated from the BAM habitat suitability assessment in stage 1 of the BAM and may be based on targeted species surveys conducted on the Subject Land (or assumed presence or expert report).

There may also be indirect, uncertain or prescribed impacts on biodiversity as a result of long wall mining that must also be assessed in accordance with Stage 2 of the BAM. The BAM is not prescriptive about survey requirements or quantification of offsets because of the wide range of these types of impacts. However, some form of survey will be necessary to appropriately determine the likely impacts, seek to avoid, minimise and mitigate them and determine any residual to be offset.

Subsidence impacts may be considered uncertain. However, are generally predicted for offsetting purposes to occur within the angle of draw (the area at the surface falling within 26.5 degrees projected from the mine workings below). It may also be reasonable to expect that impacts to hydrology may result from long wall mining, constituting a prescribed impact on the BAM. There may be further additional indirect, uncertain or prescribed impacts relevant to your proposal that will need to be identified by you as part of your BAM assessment and preparation of your BDAR.

Kind regards

The BAM Support Team

From: Kate Tierney On Behalf Of OEH ROD BAM Support Mailbox
Sent: Friday, 22 October 2021 9:09 AM
To: Luke Baker <lbaker@niche-eh.com>; Simon Tweed <stweed@niche-eh.com>
Cc: Freya Gordon <fgordon@niche-eh.com>
Subject: BSM-3668

Luke

Your email has been forwarded to the subject matter expert for attention.

Kind regards
The BAM Support Team

From: Luke Baker <lbaker@niche-eh.com>
Sent: Thursday, 21 October 2021 11:22 AM
To: OEH ROD BAM Support Mailbox <bam.support@environment.nsw.gov.au>; Simon Tweed <stweed@niche-eh.com>
Cc: Freya Gordon <fgordon@niche-eh.com>
Subject: Re: BSM- 3573

Hi Kate

Thank you for sending through a response.

The response does not address Simon's comment relating to subsidence related lands, so I do not think the 'call should be closed'.

We would normally go through an assessing officer but we keep getting told to go through BAM Support. It is very hard to even quote for projects where we do not have an assessing officer and must go through BAM support.

To assist answering Simon's question, I have provided this scenario:

The 'Subject Land' in the case of a longwall mining domain could be 1,000 ha, and be subject to three different impact profiles:
1. Areas with direct impacts from clearing (for surface infrastructure eg. 10 hectares)
2. Areas with indirect impacts from longwall subsidence (impacts being generally confined to waterbodies and areas impacted by a change in water-table. This could be 100 ha.)
3. Areas that are part of the wider nominated Subject Land but will not be impacted in any meaningful way by subsidence (in this example, 890 ha).

The question in relation to the above is:
1. As Simon mentions, we assume the 'species polygon' to be only related to the habitat subject to the areas of impact (10ha direct impact +100ha indirect impact). This species polygon is then used to ultimately form the basis for generating species credits. Given the wider nominated land is also part of the 'Subject Land' are we required to extend the 'species polygon' to include such areas (eg. 890 ha) even though subsidence related impacts are negligible and no credits would be required?
As Simon mentions – the BAM is very confusing/encompassing with the term 'Subject Land'. Providing species polygons/individual species polygon maps for habitat that are not impacted by the Proposal (as per the 890 ha above) seems to be quite excessive when it is not used to generate credits.

Can I please discuss the response directly with the subject matter expert to receive further clarity? Can direct contact mobile please be provided?

Thanks again

Luke Baker
Discipline Manager - Ecology
Sydney

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A PO Box 2443 North Parramatta NSW 1750
E lbaker@niche-eh.com W niche-eh.com

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From: Kate Tierney <Kate.Tierney@environment.nsw.gov.au> on behalf of OEH ROD BAM Support Mailbox <bam.support@environment.nsw.gov.au>
Sent: Thursday, October 21, 2021 09:09

To: Simon Tweed
Cc: Luke Baker; Freya Gordon
Subject: RE: BSM- 3573

Hello Simon,

Thank you for your enquiry.

The subject matter expert has provided the following response.

Where it applies to a development or clearing site, the 'Subject Land' means the total operational and construction footprint of the development/activity. This includes any clearing and ancillary works which support the operation and/or construction, for example:

- building envelopes
- landscaping
- access and easements
- asset protection zones
- utilities and services
- landscaping
- fence lines, and
- effluent management areas.

Please note, in applying the avoid and minimise requirements, selecting a final proposal location may be an iterative process (BAM 2020, paragraph 7.1.1(2.)).

For development/clearing sites, where fauna species and flora species assessed by area are determined or assumed present, the species polygon is used to measure the area of suitable habitat on the Subject Land (BAM 2020, paragraph 5.2.5(2.)). Calculation of the required species credits for direct impacts uses the area and condition of the suitable habitat identified by the species polygon (BAM 2020, paragraph 10.1.3(2.)). Therefore, your understanding is correct. For a development/clearing site, based on the above clarification of Subject Land, the species polygon will cover areas directly impacted by the development/clearing. A species polygon can also be used to identify indirect and/or prescribed impacts, particularly where offsetting these impacts is proposed.

This call is now closed.

Kind regards

The BAM Support Team

From: Simon Tweed <stweed@niche-eh.com>
Sent: Thursday, 23 September 2021 9:16 AM
To: OEH ROD BAM Support Mailbox <bam.support@environment.nsw.gov.au>
Subject: RE: BSM- 3573

Hi there Kate,

We have a number of projects that this situation might apply to so it is somewhat of a generic question.

One project involves a housing development within a lot, where clearing is proposed within a relatively small section of the lot. Retention of bushland would occur within the remainder of the lot. The entire lot is subject to the DA however, clearing is confined to a portion of it. The Subject Land could be considered as the entire lot, however impacts are restricted to a corner of the lot. Indirect impacts would be managed such that they are minimal so a polygon would not be extended to these areas even if species are assumed

present for the retained areas. We wouldn't propose to provide a species polygon for each species that might occur within the retained section of the lot, however the BAM can be interpreted as requiring this.

Another scenario is for projects impacted by subsidence related impacts of which we are working on a number of.
The Subject Land would be considered in this case to constitute a large area with three different impact profiles:
1. Areas with direct impacts from clearing
2. Areas with indirect impacts from subsidence (impacts being generally confined to waterbodies and areas impacted by a change in water-table)
3. Areas that are part of the wider nominated Subject Land but will not be impacted in any meaningful way by subsidence.

There are many species of relevance but consider the following and our proposed approach to a polygon based on impacts NOT just assumed presence/potential occurrence within the wider Subject Land including unimpacted areas:
- Greater Glider/Koala/Squirrely Glider – Species only impacted by clearing not by subsidence. Polygon confined to those areas. We would not consider a need to provide polygons for both impacted and non-impacted areas.
- Frog species – Species impacted by clearing and also subsidence along creeks and other water features. Polygon would include cleared areas and areas impacted by subsidence.

I have not contacted regional teams in regard to this specific issue however they are typically aware of the project/s. This is a question we need answered for range of projects across our organisation rather than just an individual project.

Thanks!

From: Kate Tierney <Kate.Tierney@environment.nsw.gov.au> On Behalf Of OEH ROD BAM Support Mailbox
Sent: Thursday, 23 September 2021 8:45 AM
To: Simon Tweed <stweed@niche-eh.com>
Subject: RE: BSM- 3573

Hello Simon,

Thank you for your enquiry. For further context, could you please provide the following information:
- Where is the project located?
- What species credit species does this relate to?
- Have you had contact with any of the Department's regional planning teams in regard to this project and/or this particular issue? And if yes, who have you spoken with?

Kind regards,

The BAM Support Team

From: Kate Tierney <Kate.Tierney@environment.nsw.gov.au> On Behalf Of OEH ROD BAM Support Mailbox
Sent: Wednesday, 22 September 2021 7:49 AM
To: Simon Tweed <stweed@niche-eh.com>
Cc: Luke Baker <lbaker@niche-eh.com>; Freya Gordon <fgordon@niche-eh.com>
Subject: BSM- 3573

Simon,

Thank you for contacting the BAM Support Team. Your reference number is BSM- 3573. Your enquiry has been forwarded to a subject matter expert for attention.

Please note that response times will be impacted by the current school holidays and the changeable COVID-19 situation we are experiencing across NSW currently. We appreciate your patience at this time.

Subject Matter Expert
Please respond to the bam.support@environment.nsw.gov.au mailbox

Kind regards
The BAM Support Team

From: Simon Tweed <stweed@niche-eh.com>
Sent: Tuesday, 21 September 2021 8:43 PM
To: OEH ROD BAM Support Mailbox <bam.support@environment.nsw.gov.au>
Cc: Luke Baker <lbaker@niche-eh.com>; Freya Gordon <fgordon@niche-eh.com>
Subject: Species polygons requirements

Dear support crew,

I am seeking to clarify requirements for species polygons at development sites as part of a BDAR.

For development sites, my understanding of the purpose of a species polygon is for the assessor to demonstrate the area in which they consider a species credit species to occur AND which is impacted by a development and therefore requires offsetting. We would generally provide a species polygon for direct clearing impacts, and indirect impacts where considered appropriate (due to sufficient prescribed or indirect impacts), the latter, potentially as a separate polygon or polygon part.

However, it has been suggested by a client intermediary (not BAM accredited) that we should provide a species polygon for every species credit species regardless of whether or not the species would be impacted by a proposal. This interpretation is due to the wording of the BAM and the broad/poor definition of Subject Land within the BAM. The Subject Land definition can be interpreted as the whole area subject to a development application (even when this includes non-impacted land) or only those areas to be cleared or impacted. This lack of definition is problematic given instructions for species polygons reference the term “Subject Land”:

Often an area will be subject to a development proposal ‘Subject Land’ despite part of the land not being impacted by a proposal (e.g. areas retained for conservation). It has always been our interpretation and understanding that an area retained for conservation (or otherwise not impacted) would not need to form part of a species polygon - as the role of a polygon is the quantify an area of impact and therefore calculation of offsets. This is evident via various references within the BAM and operational manuals (see below as examples).

Could you please confirm that species polygons only need to extend to parts of a development site that are impacted by development (be these direct or indirect impacts) and not all potential areas of habitat within a development site when the development encompasses areas that clearly will not be impacted (e.g. retained or otherwise not impacted). The alternative will mean we need to provide a large amount of effort and time generating species polygons for areas that are to be retained or otherwise not impacted as part of a development, do not need to be offset and have no real purpose.

Many Thanks

Simon Tweed B. Env.Sc (Hons), Accredited BAM & Biobanking Assessor
Discipline Manager - Ecology

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Fairy Meadow NSW 2519

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