Vickery Coal Project

Environmental Impact Statement

APPENDIX E

ECOLOGICAL ASSESSMENT

Resource Strategies

WHITEHAVEN COAL

niche
Environment and Heritage

Vickery Coal Project
Ecological Assessment

January 2013

DOCUMENT CONTROL

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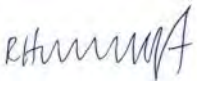
Supervising Manager(s)	Rhidian Harrington		29 January 2013

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Front Cover Photograph: View of the eastern section of the Vickery Coal Project site (foreground) and Vickery State Forest (background), looking north from Bluevale Road.

EXECUTIVE SUMMARY

This ecological assessment has been carried out to satisfy the requirements of Division 4.1 *State significant development* of the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act). It also addresses items in relation to terrestrial ecology as provided by the NSW Department of Planning and Infrastructure in the Director-General's Requirements (DGRs) for the Project dated 19 January 2012.

Whitehaven Coal Limited (Whitehaven) proposes to construct the Vickery Coal Project (herein referred to as the Project), an open cut coal mining operation located approximately 25 kilometres north of Gunnedah, NSW. The Project site is owned by Whitehaven and is located to the immediate west and south of Vickery State Forest. The western boundary of the Project is approximately 350 metres from the Namoi River at its closest point.

Methodology

A preliminary vegetation mapping and validation exercise was conducted from 7 to 9 November 2011 and flora and vegetation surveys within the study area were conducted from 14 November to 19 November 2011, while fauna surveys were conducted between 12 to 26 November 2011. Surveys involved the following:

- full floristic plots;
- threatened flora random meanders;
- threatened fauna habitat assessment; and
- targeted threatened fauna surveys, including the use of traps, hair tubes, spotlighting, Anabat detection, call playback, stag watching and bird census.

Subsequent to the terrestrial ecological survey, additional threatened plant population counts and off-site surveys targeting the Winged Peppercress (*Lepidium monoplocoides*) were conducted on two separate occasions: 16 to 20 December 2011 and 13 to 16 January 2012.

Threatened Biodiversity

Two endangered ecological communities (EECs) listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act) were detected within the study area: Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions; and White Box - Yellow Box - Blakely's Red Gum Woodland.

A population of the threatened plant species *Lepidium monoplocoides* was detected during the field survey. The entirety of this population (46 individuals) cannot be avoided by the Project and would be removed by the Project. An associated population of 420 individuals was located off-site adjacent to the rehabilitated Canyon Coal Mine site.

Six threatened animal species were potentially detected during the current study, including three bird species, Diamond Firetail (*Stagonopleura guttata*), Grey-crowned Babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*), Speckled Warbler (*Chthonicola sagittata*), one probable bat species, Eastern Bentwing-bat (*Miniopterus schreibersii oceansis*), and two possible bat species, Large-eared Pied Bat (*Chalinolobus dwyeri*), and Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*). A Masked Owl (*Tyto novaehollandiae*) was potentially sighted as it responded to a Masked Owl call during a call-playback survey, but the sighting was not sufficient for accurate identification and has been discounted.

Assessment of Impact under Division 4.1 *of the EP&A Act (NSW State significant development)*

The Project would lead to the direct removal of 7 hectares (ha) of EEC and the loss of 46 individuals of a local population of *Lepidium monoplocoides*. The proposed development would result in the removal of 1,748 ha of fauna habitat comprising the following habitat types: Woodland, Cypress Regeneration, Native Grassland, Riparian, Sedgeland, Shrubland and Grassland, and disturbed areas of land including eroded land, exotic grasslands, plantations and previous mining areas.

The proposed Gunnedah Haul Road re-alignment would result in the removal of an additional 3 ha of EEC (White Box – Yellow Box – Blakely's Red Gum Woodland).

The original design layout of the Project and associated infrastructure was adjusted where possible to avoid impact to terrestrial ecology and several mitigation methods have been developed to minimise impacts associated with the Project on terrestrial ecology.

Due to the Project having an unavoidable residual impact to native vegetation, threatened fauna habitat and *Lepidium monoplocoides*, an appropriate offset under an improve/maintain management scenario has been provided.

It is anticipated that the NSW Office of Environment and Heritage would require a Biodiversity Management Plan for both the on-site mitigation measures and the offset area. Such management plans would explicitly state and map appropriate management actions. The Project includes mitigation measures relating to the on-going management of biodiversity within the locality, along with the in-perpetuity conservation and management of approximately 1,671 ha within the biodiversity offset area and conservation of a large occurrence of *L. monoplocoides* as offsets for unavoidable impacts. It is considered that the Project would maintain or improve biodiversity values of the region in the medium to long-term.

State Environmental Planning Policy No. 44 – Koala Habitat Protection

State Environmental Planning Policy No. 44 - Koala Habitat Protection was considered in this assessment as required by the DGRs. While the trees to be removed in the study area constitute potential Koala habitat, these trees are not core Koala habitat as Koalas have not been recorded previously within the Project area. Therefore, a Koala Management Plan is not considered to be necessary.

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1 INTRODUCTION

1.1 Background

The Vickery Coal Mine is owned by Whitehaven Coal Limited (Whitehaven) and is located approximately 25 kilometres (km) north of Gunnedah in New South Wales (NSW) (Figure 1). Whitehaven plans to recommence open cut mining activities at the Vickery Coal Mine which was mined from 1991 to 1996. Whitehaven also owns and operates the Tarrawonga and Rocglen Coal mines which are located approximately 15 km to the north and 5 km east of the Vickery Coal Project (herein referred to as the Project), respectively. Whitehaven also continues to maintain the Canyon Coal Mine site (operations ceased in 2009) located to the immediate north of the Project.

Niche Environment and Heritage has been commissioned by Whitehaven to prepare a flora and fauna assessment (including aquatic ecology) as part of the Environmental Impact Statement (EIS) for the Project.

This document takes into consideration the Director-General's Requirements (DGRs) from the NSW Department of Planning and Infrastructure (DP&I) (SSD-5000; dated 19 January 2012) and the NSW Office of Water DGRs, as well as correspondence received in response to the DGRs from the Namoi Catchment Management Authority (CMA), NSW Department of Primary Industries – Fisheries and NSW Office of Environment and Heritage (OEH). As stipulated by these agencies, the following documents and guidelines have also been considered while preparing this document:

- *Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna - Amphibians* (NSW Department of Environment and Climate Change [DECC] 2009a);
- *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities - Working Draft* (NSW Department of Environment and Conservation [DEC] 2004);
- *Threatened Species Assessment Guidelines: the Assessment of Significance* (DECC 2007);
- *NSW State Groundwater Dependent Ecosystem Policy* (NSW Department of Land and Water Conservation);
- *Policy & Guidelines - Aquatic Habitat Management and Fish Conservation* (NSW Fisheries);
- *Policy & Guidelines - Fish Friendly Waterway Crossings* (NSW Fisheries);
- *State Environmental Planning Policy No. 44 - Koala Habitat Protection* (SEPP 44);
- *Namoi Catchment Action Plan 2010 - 2020* (Namoi CMA 2011a); and
- *Namoi CMA Biodiversity Offsets Policy* (Namoi CMA 2011b).

The main activities associated with the development of the Project would include:

- development and operation of an open cut mine within Coal Lease 316, Authority 406, Mining Lease 1471, Mining Lease Application (MLA) 1, MLA 2 and MLA 3;
- use of conventional mining equipment, haul trucks and excavators to remove up to 4.5 million tonnes per annum of run-of-mine (ROM) coal and approximately 48 million bank cubic metres (Mbcm) of waste rock per annum from the planned open cut;
- placement of waste rock (i.e. overburden and interburden/partings) within external emplacements to the west and east of the planned open cut (i.e. Western Emplacement and Eastern Emplacement) and within mined-out voids;
- construction and use of on-site coal crushing, screening and handling facilities to produce sized ROM coal;
- transport of ROM coal by haulage trucks to the Whitehaven Coal Handling and Preparation Plant (CHPP) on the outskirts of Gunnedah (approximately 20 km to the south of the Project open cut) for processing;
- use of an on-site mobile crusher for coal crushing and screening of up to 150,000 tonnes (t) of domestic specification coal per annum for direct collection by customers at the Project site;
- use an on-site mobile crusher to produce up to approximately 90,000 cubic metres (m3) of gravel materials per annum for direct collection by customers at the Project site;
- construction and use of water supply bores, and a surface water extraction point on the bank of the Namoi River and associated pump and pipeline systems;
- construction and use of new dams, sediment basins, channels, dewatering bores and other water management infrastructure required to operate the mine;
- construction and use of new soil stockpile areas, laydown areas and gravel/borrow areas;
- construction of a 66 kilovolt (kV)/11 kV electricity substation and 11 kV electricity transmission line (ETL);
- transport of coarse rejects generated within the Whitehaven CHPP via truck to the Project for emplacement within an in-pit emplacement area;
- transport of tailings (i.e. fine rejects) generated within the Whitehaven CHPP via truck to the Project for emplacement within co-disposal storage areas in the open cut and/or disposal in existing off-site licensed facilities (e.g. the Brickworks Pit);
- realignment of sections of Blue Vale Road, Shannon Harbour Road and Hoad Lane to the east and south of the open cut;

- realignment of the southern extent of Braymont Road to the south of the open cut;
- construction of an approximately 1 km long section of private haul road (including an overpass over the Kamilaroi Highway) between Blue Vale Road and the Whitehaven CHPP;
- ongoing exploration, monitoring and rehabilitation activities; and
- construction and use of other associated infrastructure, equipment and mine service facilities.

The proposed life of the Project is 30 years, commencing mid-2013. A detailed description of the Project is provided in Section 2 in the Main Report of the EIS.

1.2 Definitions

The following definitions are taken from (DECC 2007) *Threatened Species Assessment Guidelines: The Assessment of Significance* and have been adopted for this assessment:

Subject Site: the area to be directly affected by the Project.

Study Area: is the subject site and any additional areas which may potentially be affected by the Project.

Direct Impacts: those that directly affect the habitat and/or individual plants and animals and cannot be avoided or mitigated.

Indirect Impacts: those that affect species, populations or ecological communities in a manner other than through direct loss or disturbance. These can usually be avoided or mitigated.

Local Population: The local population of resident fauna species comprises those individuals known or likely to occur in the study area, as well as any individuals occurring in adjoining areas (contiguous or otherwise) that are known or likely to utilise habitats in the study area. The local population of a threatened plant species comprises those individuals occurring in the study area or the cluster of individuals that extend into habitat adjoining and contiguous with the study area that could reasonably be expected to be cross-pollinating with those in the study area. The local population of migratory or nomadic fauna species comprises those individuals that are likely to occur in the study area from time to time.

Local Occurrence: refers to the distribution of an ecological community within the study area.

1.3 Legislative Context

1.3.1 State of NSW

The assessment of the Project has been carried out for approval under the provision for State Significant Development within Part 4, Division 1 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). Threatened biodiversity as listed on the NSW *Threatened Species Conservation Act 1995* (TSC Act) and *NSW Fisheries Management Act 1994* (FM Act), have been considered in this assessment.

Other NSW legislation which is relevant to biodiversity conservation and assessment includes the *Native Vegetation Act 2003*, the *National Parks and Wildlife Act 1974* and SEPP 44.

1.3.2 Commonwealth of Australia

A Referral to the Minister for Sustainability, Environment, Water, Population and Communities has been prepared by Whitehaven (Whitehaven, 2011). The Action has been determined by the Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) to be a Non-controlled Action if undertaken in a particular manner.

1.4 The Project and the Study Area

The layout of the Project within the study area is illustrated on Figure 2 and 3. A detailed description of the Project is provided in Section 2 in the Main Report of the EIS.

1.5 Approach of this Assessment

The primary aim of this ecological assessment is to describe the ecological values, identify ecological constraints, assess the impacts of the Project against the guidelines for assessment under Part 4, Division 1 (State significant development) and provide a justification that the Project, and associated management and mitigation measures, maintains or improves biodiversity values of the region in the medium to long-term.

The specific objectives of this assessment include the following:

- undertake a background review of relevant literature and a review of relevant databases;
- undertake vegetation and targeted flora and fauna surveys for threatened species and communities that are known or predicted to occur in the study area;
- describe the ecological values of the site;
- quantify and describe the ecological impacts from the Project;
- assess the significance of the impacts from the Project for threatened species under the state and federal legislation; and
- provide recommendations to avoid, mitigate and offset the impacts of the Project on threatened biodiversity.

1.6 Limitations of this Assessment

The field survey was designed to identify threatened flora and fauna utilising the study area, meeting the requirements of the *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (DEC 2004), both with respect to survey effort and seasonality. However, habitat assessments were also undertaken to assist with assessing impacts from the Project, particularly for cryptic species that are difficult to detect. Using this rationale, a species is assumed to be present if potential habitat for that species is present.

Habitat assessments are considered to be a more conservative method of assessment as a species is assumed to be present if its habitat is present. The alternative is to conduct extensive trapping surveys, and if a species is not detected, assume it is not present. Numerous threatened animal (and plant) species are cryptic or difficult to detect and failure to capture them through trapping surveys (no matter how extensive) does not necessarily mean they are not present. Using a mixture of trapping, observational and habitat-based surveys means that all species that could potentially occur on a site are considered, compared with dismissing some species because they were not detected through survey. It is considered therefore that this approach is more robust and efficient than relying solely upon the results of extensive field surveys.

2 NATIVE VEGETATION

2.1 Methodology – Native Vegetation

2.1.1 Existing Vegetation Mapping

Existing vegetation mapping informed the development of the list of native vegetation communities which have been previously mapped in the broader locality. Preliminary field base-maps were derived from these.

The following key sources of native vegetation information were used:

- RPS (2010) *Flora and Fauna Assessment For Proposed Rocglen Coal Mine Extension Project*.
- Benson *et al*. (2010) *New South Wales Vegetation Classification and Assessment: Part 3 Plant communities of the NSW Brigalow Belt South, Nandewar and west New England Bioregions and update of NSW Western Plains and South-western Slopes plant communities, Version 3 of the NSWVCA database*.
- EcoLogical Australia (2009) *A Vegetation Map for the Namoi Catchment Management Authority*.

2.1.2 Aerial Photography Interpretation

Using Geographic Information System (GIS), photo-interpretation from digital ortho-rectified aerial photography was compared to existing vegetation mapping at appropriate scales (typically 1:4,000 – 1:8,000) and global positioning system (GPS) located field vegetation observations. The minimum vegetation polygon size was 0.25 hectares (ha) (50 x 50 metres [m]: longer and narrower polygons were digitised for riparian areas). Photo-interpretation of vegetation communities relies on crown/canopy colour, crown-shadow shape, canopy pattern and topographic association. For the latter, supplied contour data was processed to form elevation and shaded relief surfaces, which are particularly useful for discriminating in-channel and floodplain vegetation.

The digitised polygons were initially codified with a floristic community specific to the site and it was assumed that all vegetated land (apart from obviously rehabilitated areas) was in Moderate/Good condition. These communities were subsequently aggregated and aligned with Revised Biometric Vegetation Types (RBVTs), Keith Formation, Keith Class and Endangered Ecological Community (EEC) type. Updating of the vegetation map layer was done progressively throughout the field survey.

2.1.3 Field Survey

Rapid Data Points

The use of the Rapid Data Point (RDP) survey methodology for ground-truthing vegetation mapping is recognised as best-practice (Sivertsen, 2009).

The collection of RDPs is a method that enables rapid yet accurate vegetation mapping for spatial analysis. Variability in vegetation distribution cannot be fully predicted using remote sensing and GIS and, therefore, ground-truthing vegetation communities through field surveys is essential. Information recorded included:

- dominant species, estimated cover and height for each layer of vegetation present usually including canopy, mid-storey, shrubs and groundcover;
- vegetation condition (Niche use a measure of 'ecosystem resilience' as a function of disturbance), condition (Moderate-Good, Low and Cleared) and other notes regarding habitat and other important features; and
- physical attributes of the site (vegetation structure, soil type, elevation, slope, aspect, physiographical position) are also recorded and photographs taken for later reference.

Initially, all tracks and roads across the study area were driven and mapping units recorded on printed A3 maps. Those areas inaccessible by vehicle were walked on foot to ensure that all vegetated parts of the study area were assessed. Polygons were drawn around areas of vegetation and vegetation community types were assigned. Subsequently, the remaining data for RDPs was collected at each of the plot locations and the digital mapping updated accordingly.

Plots and Transects

Once the vegetation of all areas was validated and mapped, the area was stratified into vegetation zones and detailed floristic data collected.

The method is based on a 20 x 50 m plot with a nested 50 m transect and 20 x 20 m floristic plot for native plant species richness.

Field Survey Effort

The vegetation validation component of the field work was completed by Nathan Smith (botanist) and Rhidian Harrington (ecologist) on 7-9 November 2011.

After field validation was completed, a total of 62 floristic plots were conducted in native vegetation communities within the study area. The field surveys were completed by Nathan Smith and John Hunter over five days between 14-19 November 2011. The floristic plot numbers are presented in Table 1 and flora survey effort is shown on Figure 4.

Niche completed 84 plots in native vegetation communities sampled within the study area and the minimum number of plots was conducted for each of the vegetation zones. The vegetation communities represented in Table 1 are for the whole study area and are mapped on Figures 5a and 5b for the mining area. Figure 6 shows EECs within the Project and Figures 7a and 7b show vegetation communities for the proposed haul road realignment. Figure 7a is based upon regional vegetation mapping and Figure 7b is ground-truthed vegetation communities.

Table 1. Floristic Plot Survey Effort (Full Study Area)

	Vegetation Community	Approximate Area (ha)	Plots Required	Plots Completed
Vickery Mining Area				
2a	White Box - White Cypress Pine - Cypress Regeneration	265	7	9
2b	White Box - White Cypress Pine - Semi-cleared	134	6	6
2c	White Box - White Cypress Pine - Derived Native Pasture	590	7	8
2f	White Box - White Cypress Pine - Mature Cypress Forest	11	3	3
3	White Box Grassy Woodland	8	3	3
7b	Silver-leaved Ironbark - White Box - White Cypress Pine – Semi-cleared	118	6	11
7c	Silver-leaved Ironbark - White Box - White Cypress Pine - Derived Native Pasture	272	7	11
7e	Silver-leaved Ironbark - White Box - White Cypress Pine - Mature Cypress Woodland	38	4	4
19c*	Plains Grass – Blue Grass Derived Native Pasture	1.5	-	-
20a	Poplar Box Grassy Woodland - Derived Woodland	88	5	7
20c	Poplar Box Grassy Woodland - Derived Native Pasture	846	7	14
21	Weeping Myall Low Shrubland	80	4	4
22	Mixed Marsh Sedgeland	28	4	4
	TOTAL	**2,406**	**62**	**84**
Private Haul Road and Highway Overpass				
8	Yellow Box - Blakely's Red Gum Grassy Woodland	3	2	3
-	Disturbed Land	1	1	1
23*	River Red Gum Riverine Woodland	**1**	**-**	**-**
	TOTAL	**2**	**2**	**4**
	GRAND TOTAL	**2,408**	**66**	**88**

*No plots required as these communities not impacted directly by the Project

Floristic Analysis

Cover scores using a rating system of 1 through to 6 were applied to each species recorded in the nested 20 x 20 m plot to acquire the necessary data to run a full floristic cluster analysis. The analysis was carried out using the multivariate software PATN to inform decisions relating to the vegetation communities present within the study area. Combined with the RDPs, this analysis provided a high level of rigor to the assessment.

2.1.4 Limitations

As the site was stratified initially on the basis of vegetation zones, additional sampling of some vegetation communities throughout the study area could be spatially improved in order to improve the geographical extent of the analysis. However, many more plots were conducted than were required and, with the addition of the RDPs, the derivation of the vegetation communities is considered reliable.

2.2 Results – Native Vegetation

2.2.1 Floristic Analysis

Using PATN multivariate analysis the resulting dendrogram grouped the 84 floristic plots into 16 vegetation communities (Appendix A). The resulting vegetation zones are listed in Table 2, with a full vegetation zone alignment included in Appendix B.

EECs within the study area are shown on Figure 6 and listed in Table 2. The area of each vegetation community in Table 2 represents the direct impacts from the development and include the pit, eastern emplacement, western emplacement, re-alignment of Bluevale Road and the Haul Road (Figures 5b and 7b).

Table 2. Vegetation Communities within the Disturbance Area

	Vegetation Community	Status under the TSC Act[1]
Vickery Mining Area		
2a	White Box - White Cypress Pine - Cypress Regeneration	Not an EEC
2b	White Box - White Cypress Pine - Semi-cleared	
2c	White Box - White Cypress Pine - Derived Native Pasture	
2f	White Box - White Cypress Pine - Mature Cypress Forest	
3	White Box Grassy Woodland	White Box – Yellow Box – Blakely's Red Gum Woodland
7b	Silver-leaved Ironbark - White Box - White Cypress Pine – Semi-cleared	Not an EEC
7c	Silver-leaved Ironbark - White Box - White Cypress Pine - Derived Native Pasture	
7e	Silver-leaved Ironbark - White Box - White Cypress Pine - Mature Cypress Woodland	
19c	Plains Grass – Blue Grass Derived Native Pasture	Not an EEC
20a	Poplar Box Grassy Woodland - Derived Woodland	Not an EEC
20c	Poplar Box Grassy Woodland - Derived Native Pasture	
21	Weeping Myall Low Shrubland	Myall Woodland[2]
22	Mixed Marsh Sedgeland	Not an EEC
Private Haul Road and Highway Overpass		
8	Yellow Box - Blakely's Red Gum Grassy Woodland	White Box – Yellow Box – Blakely's Red Gum Woodland
23	River Red Gum Riverine Woodland	Not an EEC

1. Threatened ecological community status under the TSC Act (current as at 24 August 2012).
2. Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverine and NSW South Western Slopes bioregions (herein referred to as Myall Woodland).

2.2.2 Vegetation Community Descriptions

The following descriptions outline the seven parent vegetation communities within the study area and the condition states of each vegetation community. Three vegetation communities occur only within the Haul Road portion of the study area: Vegetation Community 7: River Red Gum Riverine Woodland; Vegetation Community 9, Box – Gum Grassy Woodland; and Vegetation Community 9c, Box – Gum Derived Native Grassland. A detailed description of the vegetation communities recorded within the study area is provided below.

Vegetation Community 2 - White Box - White Cypress Pine Woodland

Condition states: 2a (cypress regeneration), 2b (semi-cleared), 2c (derived grassland), 2f (mature cypress forest)

RBVT Code: NA225

RBVT: White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions

TSC Act Status: Not an EEC

Keith Formation: Dry Sclerophyll Forests (shrub/grass sub-formation)

Keith Class: North-west Slopes Dry Sclerophyll Woodlands

Similarity to previous work

RPS (2010): Unit 1, Narrow-leaved Ironbark (*Eucalyptus crebra*), White Cypress Pine (*Callitris glaucophylla*) Open Forest; and/or Unit 2, Narrow-leaved Grey Box (*E. pilligaensis*), White Cypress Pine (*Callitris glaucophylla*), Narrow-leaved Ironbark (*E. crebra*) Forest

Benson *et al.* (2010): ID 459 Narrow-leaved Ironbark - cypress pine - White Box shrubby woodland in sedimentary hills of the Gunnedah region, BBS Bioregion

EcoLogical Australia (2009): RVC 59, Narrow-leaved ironbark – pine – box woodlands and open forests, Brigalow Belt South and Nandewar

Description

This vegetation community is characterised by a dominant overstorey of White Cypress Pine (*Callitris glaucophylla*), White Box (*Eucalyptus albens*), and Narrow-leaved Ironbark (*E. crebra*). The vegetation community is an open forest with a dense mid-storey and a sparse herbaceous and grassy groundcover. Within the study area, this vegetation community exists as four separate condition states as described below.

1. A semi-cleared woodland (2b) – this is the most advanced regrowth of this vegetation community within the study area (Plate 1).

Plate 1: Vegetation Community 2b

2. Cypress regeneration (2a) – where all overstorey trees have been removed and only a mid-storey and shrub layer of immature White Cypress Pine remain. Native herbs and grasses are sparse in the groundcover (Plate 2).

Plate 2: Vegetation Community 2a

3. A derived native grassland (2c) – interpolated by the proximity of adjacent open forest (type 2b) and floristic similarity. All structural layers have been removed with the exception of the groundcover which retains resilience through native herbs and grasses, low weed cover and some recruitment of overstorey species (Plate 3).

Plate 3: Vegetation Community 2c

4. Mature cypress forest (2f) – a forest 20-25 m high of mature White Cypress Pine with other overstorey species only present as a sparse recruitment layer of sapling and juvenile white box and narrow-leaved ironbark. This vegetation community only occurs in one location within the study area and represents a distinctly older successional stage of regeneration from Vegetation Community 2b (Plate 4).

Plate 4: Vegetation Community 2f

Dominant native species within this vegetation community included: *Abutilon oxycarpum, Aristida personata, Austrodanthonia bipartita, Austrodanthonia racemosa, Austrostipa scabra, Austrostipa verticillata, Boerhavia dominii, Bothriochloa decipiens, Brunoniella australis, Callitris glaucophylla, Calotis lappulacea, Chamaesyce drummondii, Cheilanthes distans, Cheilanthes sieberi, Chloris truncata, Cymbopogon refractus, Cyperus gracilis, Desmodium brachypodum, Desmodium varians, Dichondra* sp. A*, Digitaria brownii, Einadia hastata, Einadia nutans, Enneapogon gracilis, Enteropogon ramosus, Eragrostis leptostachya, Eucalyptus albens, Eucalyptus crebra, Geijera parviflora, Glossocardia bidens, Glycine clandestina, Glycine tabacina, Goodenia hederacea, Lagenifera stipitata, Lomandra multiflora, Maireana microphylla, Myoporum montanum, Oncinocalyx betchei, Oxalis perennans, Panicum effusum, Paspalidium constrictum, Pimelea neo-anglica, Rostellularia adscendens, Sclerolaena birchii, Sida corrugata, Sisymbrium erysimoides, Solanum parvifolium, Sporobolus creber, Stackhousia muricata, Vittadinia cuneata, Vittadinia sulcata, Wahlenbergia communis* and *Xerochrysum bracteatum*.

Whilst weed cover typically remained low throughout this vegetation community, the most common weed species included: *Centaurea solstitialis, Lepidium africanum, Malvastrum americanum, Opuntia stricta, Paronychia brasiliana, Petrorhagia nanteuilii, Sonchus oleraceus* and *Trifolium arvense*.

Vegetation Community 3 - White Box Grassy Woodland

Condition states: 3 (woodland)

RBVT Code: NA226

RBVT: White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions

TSC Act Status: Endangered and listed as White Box - Yellow Box - Blakely's Red Gum Woodland

Keith Formation: Grassy Woodlands

Keith Class: Western Slopes Grassy Woodlands

Similarity to previous work

RPS (2010): No clear equivalent

Benson *et al.* (2010): ID 443, White Box grassy woodland to open woodland on basalt flats and rises in the Liverpool Plains sub-region, BBS Bioregion

EcoLogical Australia (2009): RVC 18, White Box grassy woodlands, Brigalow Belt South and Nandewar

Description

This vegetation community is located in a thin strip along an ephemeral drainage line just north of the Shannon Harbour Road in the east of the study area. It is considered that this vegetation community exists as a relatively natural open woodland dominated by White Box (*Eucalyptus albens*) and Blakely's Red Gum (*E. blakelyi*) and sub-dominant White Cypress Pine (*Callitris glaucophylla*) (Plate 5).

The mid-storey is open with a groundcover dominated by native grasses. Within the study area the type exists in a relatively natural state and therefore as a single condition class.

Plate 5: Vegetation Community 3

Dominant native species within this vegetation community include: *Aristida personata*, *Atriplex spinibractea, Austrodanthonia bipartita, Austrostipa scabra, Austrostipa verticillata, Boerhavia dominii, Bothriochloa decipiens, Callitris glaucophylla, Calotis lappulacea, Carex inversa, Casuarina cristata, Chloris truncata, Cyperus gracilis, Dichondra* sp. A*, Einadia hastata, Einadia nutans, Elymus scaber, Enteropogon ramosus, Eragrostis leptostachya, Eucalyptus albens, E. blakelyi, E. crebra, Maireana microphylla, Oncinocalyx betchei, Paspalidium constrictum, Rumex brownii, Sclerolaena birchii, Sclerolaena muricata, Sida corrugata, Sida spinosa, Sisymbrium erysimoides, Vittadinia cuneata* and *Xerochrysum bracteatum*.

Weed cover typically remained low throughout this vegetation community, but included *Centaurea melitensis, Lepidium africanum, Lolium perenne, Medicago polymorpha, Misopates orontium, Paronychia brasiliana, Petrorhagia nanteuilii, Sonchus oleraceus* and *Vulpia bromoides*.

Vegetation Community 7 - Silver-leaved Ironbark - White Box - White Cypress Pine Woodland and Forest

Condition states: 7b (semi-cleared woodland), 7c (derived grassland) and 7e (mature cypress woodland)

RBVT Code: NA232

RBVT: White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion

TSC Act Status: Not an EEC

Keith Formation: Dry Sclerophyll Forests (shrubby sub-formation)

Keith Class: Western Slopes Dry Sclerophyll Forests

Similarity to previous work

RPS (2010): No equivalent

Benson *et al.* (2010): ID 429, White Cypress Pine - Poplar Box - Silver-leaved Ironbark viney shrub woodland of the BBS Bioregion

EcoLogical Australia (2009): Regional Vegetation Community (RVC) 19, White Cypress Pine – Silver-leaved Ironbark grassy woodland, Nandewar

Description

This vegetation community is characterised by a dominant overstorey of Silver-leaved Ironbark (*Eucalyptus melanophloia*), White Cypress Pine (*Callitris glaucophylla*) and Poplar Box (*E. populnea* subsp. *bimbil*). This vegetation community is a woodland or open forest with a sparse mid-storey and dense herbaceous and grassy groundcover. Within the study area, the vegetation community exists in three separate condition states as described below.

1. A semi-cleared woodland (7b) – recognising that almost all the native vegetation within the study area is regrowth of some form, this is the most advanced regrowth on the site (Plate 6).

Plate 6: Vegetation Community 7b

2. A mature White Cypress Pine Open Woodland (7e) – where all overstorey trees except White Cypress Pine (*Callitris glaucophylla*) have been removed, along with the mid-storey and shrub layer. Native herbs and grasses persist in the groundcover (Plate 7).

Plate 7: Vegetation Community 7e

3. A derived native grassland (7c) – interpolated by the proximity of adjacent woodland (type 1a) and similarity in floristics. All structural layers have been removed with the exception of the groundcover which retains resilience through native herbs and grasses, low weed cover and some recruitment of overstorey species (Plate 8).

Plate 8: Vegetation Community 7c

Dominant native species within this vegetation community included: *Aristida personata, Austrostipa scabra, Boerhavia dominii, Bothriochloa decipiens, Brunoniella australis, Callitris glaucophylla, Calotis lappulacea, Cheilanthes sieberi, Chloris truncata, Cyperus gracilis, Desmodium varians, Dichondra* sp. A*, Einadia hastata, Einadia nutans, Eremophila debilis, Eucalyptus melanophloia, Eucalyptus populnea* subsp. *bimbil, Glossocardia bidens, Goodenia hederacea, Lomandra multiflora, Maireana microphylla, Microlaena stipoides, Paspalidium constrictum, Rostellularia adscendens, Sida corrugata, Vittadinia cuneata* and *Wahlenbergia communis*.

Whilst weed cover typically remained low throughout this vegetation community the most common weed species included: *Centaurea melitensis, Medicago polymorpha, Petrorhagia nanteuilii, Sonchus oleraceus, Anagallis arvensis, Lepidium bonariense, Trifolium arvense, Lepidium africanum and Oxalis pes-caprae*.

Vegetation Community 8 – Yellow Box - Blakely's Red Gum Grassy Woodland

Condition states: 8 (woodland)

RBVT Code: NA237

RBVT: Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion

TSC Act Status: Endangered and listed as White Box - Yellow Box - Blakely's Red Gum Woodland

Keith Formation: Grassy Woodlands

Keith Class: Western Slopes Grassy Woodlands

Similarity to previous work

RPS (2010): No clear equivalent

Benson *et al.* (2010): most like ID 599, Blakely's Red Gum - Yellow Box grassy tall woodland on flats and hills in the Brigalow Belt South and Nandewar Bioregions

EcoLogical Australia (2009): RVC 17, Box-Gum grassy woodlands, Brigalow Belt South and Nandewar

Description

Within the study area, this vegetation community is located along the extent of the proposed Haul Road re-alignment (Figure 7b). It is considered that this vegetation community exists as a relatively natural open woodland dominated by Blakely's Red Gum (*Eucalyptus blakelyi*), Yellow Box (*E. melliodora*) and sub-dominant Poplar Box (*E. populnea subsp. bimbil*) and River Red Gum (*E. camaldulensis*). The mid-storey is open with a groundcover dominated by native grasses. Within the study area the type exists as one condition class, Grassy woodland (8) (Plate 9), as described below.

Plate 9: Vegetation Community 8

Dominant native species within this vegetation community include: *Austrodanthonia bipartita, Austrostipa aristiglumis, Austrostipa verticillata, Calotis lappulacea, Carex inversa, Cynodon dactylon, Einadia hastata, Einadia nutans, Eucalyptus camaldulensis, Eucalyptus melanophloia, Eucalyptus melliodora, Eucalyptus populnea, Maireana microphylla, Oxalis perennans, Paspalidium jubiflorum, Sclerolaena muricata, Sida corrugata, Sida trichopoda, Sisymbrium erysimoides, Vittadinia cuneata, Vittadinia pterochaeta* and *Wahlenbergia communis*.

The most common weed species include: *Ammi majus, Bromus catharticus, Conyza bonariensis, Lactuca serriola, Lepidium africanum, Lolium perenne, Modiola caroliniana, Oxalis pes-caprae, Sonchus oleraceus* and *Verbena bonariensis*.

Vegetation Community 19c - Plains Grass - Blue Grass Derived Native Pasture

Condition states: Not present within study area

RBVT Code: NA181

RBVT: Plains Grass grassland on basaltic black earth soils mainly on the Liverpool Plains in the Brigalow Belt South Bioregion

Red Flag Status: Yes (EEC)

TSC Act Status: Endangered on cracking clays and listed as Native Vegetation on Cracking Clay Soils on the Liverpool Plains. A soil survey of the study area (MacKenzie 2012) has shown that cracking clays are not present within the study area and, therefore, this community is not an EEC.

Keith Formation: Grasslands

Keith Class: Western Slopes Grasslands

Similarity to previous work

RPS (2010): No equivalent

Benson *et al.* (2010): ID 102, Liverpool Plains grassland mainly on basaltic black earth soils, Brigalow Belt South Bioregion

EcoLogical Australia (2009): RVC 29d, Plains grass – blue grass grasslands, Brigalow Belt South and Nandewar – derived occurrence

Description

This vegetation community is characterised by a naturally absent canopy, mid-storey and shrub layer, but a high cover of native grasses, especially Plains Grass (*Austrostipa aristiglumis*) and Blue Grass (*Dichanthium sericeum*) (Plate 10). Poplar Box (*Eucalyptus populnea* subsp. *Bimbil*) and Weeping Myall (*Acacia pendula*) may be present, but are not common or dominant.

Plate 10: Vegetation Community 19c

Vegetation Community 20 - Poplar Box Grassy Woodland

Condition states: 20a (derived woodland) and 20c (derived native grassland)

RBVT Code: NA185

RBVT: Poplar Box grassy woodland on alluvial heavy clay soils in the Brigalow Belt South Bioregion (Benson 101)

TSC Act Status: Endangered (only where occurrence coincides with cracking clays) and listed as Native Vegetation on Cracking Clay Soils on the Liverpool Plains. A soil survey of the study area (MacKenzie 2012) has shown that cracking clays are not present and therefore this community is not an EEC in the study area.

Keith Formation: Dry Sclerophyll Forests (shrubby sub-formation)

Keith Class: Pilliga Outwash Dry Sclerophyll Forests

Similarity to previous work

RPS (2010): No direct equivalent. Indirectly Unit 4, Bimble Box (*E. populnea*), Yellow Box (*E. melliodora*) Inland Grey Box (*E. microcarpa*), Grassy Woodland

Benson *et al.* (2010): Indirectly ID 101, Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion

EcoLogical Australia (2009): RVC 80; Poplar Box grassy woodland on alluvial clay soils

Description

Within the study area, this vegetation community is characterised by an overstorey dominated by Poplar Box (*Eucalyptus populnea* subsp. *bimbil*) and Grey Box (*E. microcarpa*) as an associated species. Belah (*Casuarina cristata*) is also locally common as a tree within this vegetation community. The vegetation community is typically a woodland with a sparse mid-storey and dense herbaceous and grassy groundcover. Within the study area, this vegetation community exists in two separate condition states as described below.

1. A derived grassy woodland (20a) – recognising that almost all the native vegetation within the study area is regrowth of some form, this is the most advanced regrowth within the study area (Plate 11).

Plate 11: Vegetation Community 20a

2. A derived native grassland (20c) – interpolated by the proximity of adjacent woodland (type 3a) and similarity in floristics. All structural layers have been removed with the exception of the groundcover which retains resilience through native herbs and grasses and low weed cover. Recruitment of overstorey species is present though rare (Plate 12).

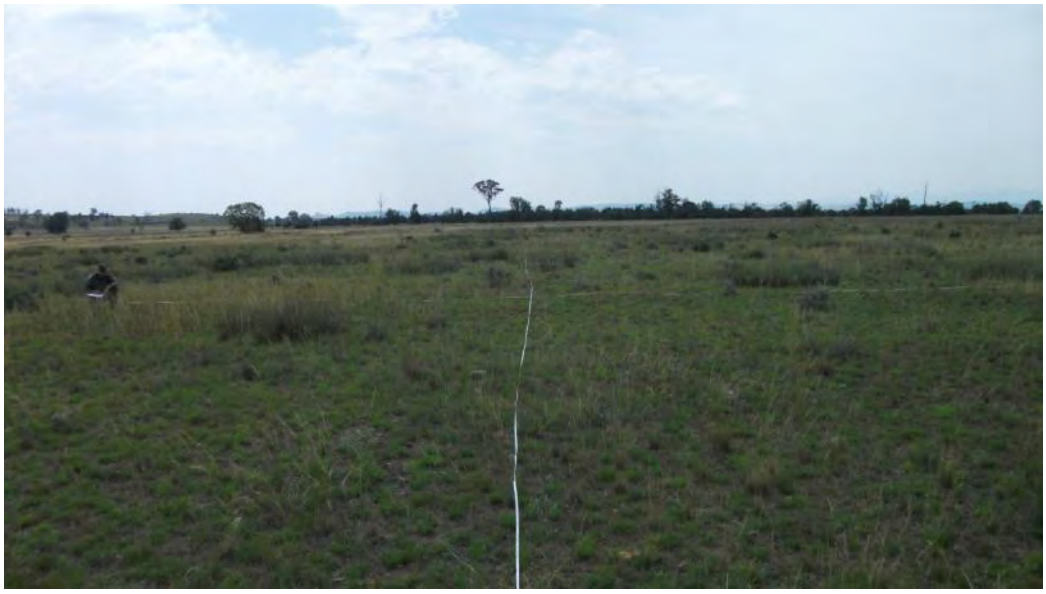

Plate 12: Vegetation Community 20c

Dominant native species within this vegetation community include: *Austrodanthonia bipartita, Austrostipa aristiglumis, Austrostipa verticillata, Calotis lappulacea, Carex inversa, Cynodon dactylon, Einadia hastata, Einadia nutans, Eucalyptus populnea, Maireana microphylla, Oxalis perennans, Paspalidium jubiflorum, Sclerolaena muricata, Sida corrugata, Sida trichopoda, Sisymbrium erysimoides, Vittadinia cuneata, Vittadinia pterochaeta* and *Wahlenbergia communis*.

Weed cover was generally relatively low throughout this vegetation community, but with localised infestations due to past heavy land use and clearing. The most common weed species include: *Ammi majus, Bromus catharticus, Conyza bonariensis, Lactuca serriola, Lepidium africanum, Lolium perenne, Modiola caroliniana, Oxalis pes-caprae, Sonchus oleraceus* and *Verbena bonariensis*.

Vegetation Community 21 - Weeping Myall Low Shrubland

Condition states: 21 (low shrubland)

RBVT Code: NA219

RBVT: Weeping Myall open woodland of the Darling Riverine Plains and Brigalow Belt South Bioregions (Benson 27)

TSC Act Status: Endangered and listed as Myall Woodland (*Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes Bioregions*)

Keith Formation: Semi-arid Woodlands (Grassy subformation)

Keith Class: Riverine Plain Woodlands

Similarity to previous work

RPS (2010): No equivalent

Benson *et al.* (2010): ID 27, Weeping Myall open woodland of the Darling Riverine Plains and Brigalow Belt South Bioregions

EcoLogical Australia (2009): RVC 75, Weeping Myall open woodland, Darling Riverine Plains Brigalow Belt South and Nandewar Bioregions

Description

Within the study area, this vegetation community is characterised by a dominant low overstorey of Weeping Myall (*Acacia pendula*) to 8 m high, an absent mid-storey and shrub layer and a degraded and sparse groundcover. Within the study area, this vegetation community was present only as a low shrubland, probably as regrowth from previous clearance. It is located in pockets along the main flood channel in the southern portion of the study area at the point where the landscape flattens out across the Liverpool Plains.

Dominant native species within this vegetation community include: *Acacia pendula, Alternanthera denticulata, Atriplex spinibractea, Austrodanthonia bipartita, Austrostipa aristiglumis, Boerhavia dominii, Brachyscome melanocarpa, Carex inversa, Chloris truncata, Eclipta platyglossa, Eleocharis pusilla, Enteropogon ramosus, Eryngium paludosum, Goodenia glabra, Juncus aridicola, Maireana microphylla, Oxalis perennans, Portulaca oleracea, Sclerolaena muricata, Senecio prenanthoides, Sida trichopoda, Sisymbrium erysimoides, Solanum esuriale* and *Sporobolus caroli*.

The most common weed species within this vegetation community include: *Centaurea melitensis, Conyza bonariensis, Gamochaeta spicata, Hedypnois rhagadioloides, Lactuca serriola, Lepidium africanum, Lolium perenne, Medicago polymorpha, Rapistrum rugosum* and *Sonchus oleraceus*.

A photograph of this vegetation community is shown on Plate 13.

Plate 13: Vegetation Community 21

Vegetation Community 22 - Mixed Marsh Sedgeland

Condition states: Present as more-or-less original vegetation community

RBVT Code: NA201

RBVT: Shallow freshwater mixed marsh sedgeland of northern-western NSW floodplains (Benson 53)

TSC Act Status: Endangered (only where occurrence coincides with cracking clays) and listed as Native Vegetation on Cracking Clay Soils on the Liverpool Plains. A soil survey of the study area (MacKenzie 2012) has shown that cracking clays are not present and therefore this community is not an EEC within the study area.

Keith Formation: Freshwater Wetlands

Keith Class: Inland Floodplain Swamps

Similarity to previous work

RPS (2010): No equivalent

Benson *et al.* (2010): ID 53, Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains

EcoLogical Australia (2009): RVC 70, Wetlands and Marshes, inland NSW

Description

This vegetation community is characterised by a naturally absent canopy, mid-storey and shrub layer, but has a high cover of native herbs, grasses, sedges and forbs. The vegetation community exists where the landscape on the Liverpool Plains is lowest along flood channels and is likely to be associated with heavy cracking clays. Within the study area, this vegetation community occurred along the southern edge in the east, where it was found to be in a good overall condition and therefore present as a single vegetation community.

Dominant native species within this vegetation community include: *Austrostipa aristiglumis, Carex inversa, Cynodon dactylon, Cyperus concinnus, Eclipta platyglossa, Einadia nutans, Eleocharis plana, Eleocharis pusilla, Enteropogon acicularis, Enteropogon ramosus, Eriochloa pseudoacrotricha, Eryngium paludosum, Eulalia aurea, Juncus aridicola, Juncus pauciflorus, Lachnagrostis filiformis, Marsilea drummondii, Marsilea hirsuta, Paspalidium jubiflorum, Paspalum distichum, Plantago debilis, Pluchea dentex, Portulaca oleracea, Pratia concolor, Rumex brownii, Rumex tenax, Sclerolaena muricata, Senecio prenanthoides* and *Sporobolus caroli*.

Weed cover typically remained low throughout this vegetation community, but included: *Hypochaeris microcephala, Phyla nodiflora, Sonchus oleraceus, Rapistrum rugosum* and *Lolium perenne*.

A photograph of this vegetation community is shown on Plate 14.

Plate 14: Vegetation Community 22

Vegetation Community 23 - River Red Gum Riverine Woodland

Condition states: Original type

RBVT Code: NA 193

RBVT: River Red Gum riverine woodlands and forests in the Nandewar and Brigalow Belt South Bioregions (Benson 78)

TSC Act Status: Not an EEC

Keith Formation: Forested Wetlands

Keith Class: Inland Riverine Forest

Similarity to previous work

RPS (2010): No equivalent

Benson *et al.* (2010): ID 78, River Red Gum riparian tall woodland / open forest wetland in the Nandewar and Brigalow Belt South Bioregions

EcoLogical Australia (2009): RVC 73, River Red Gum riverine woodlands and forests, Darling Riverine Plains, Brigalow Belt South and Nandewar Bioregions

Description

This vegetation community is characterised by a dominant overstorey of River Red Gum (*Eucalyptus camaldulensis*) within 30 m of the top-of-bank along the Namoi River and major tributaries (Plate 15). Yellow Box (*E. melliodora*) and Poplar Box (*E. populnea* subsp. *Bimbil*) may be present, but are not dominant (Plate 16). This vegetation community is present within the Project mining area and the Haul Road west of Gunnedah, but would not be impacted in either location.

Plate 15: Vegetation Community 23

2.2.3 Endangered Ecological Communities

The following EECs as listed on the TSC Act are located within the Project area:

- *White Box - Yellow Box - Blakely's Red Gum Woodland*; and
- *Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes Bioregions* (Myall Woodland).

The area of these EECs impacted by the Project are presented in Table 3 and impact assessments for these EECs are presented in Section 5.2.1.

Table 3. Endangered Ecological Communities Impacted by the Project

EEC		EEC (ha)
Vickery Mining Area		
White Box – Yellow Box – Blakely's Red Gum Woodland		3
Myall Woodland		1
	Total	**4**
Private Haul Road and Highway Overpass		
White Box – Yellow Box – Blakely's Red Gum Woodland		3
	Total	**3**
	Grand Total	**7**

Due consideration must be given to the potential presence of the Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Darling River, which is listed as an EEC on the FM Act. Whilst potential for this EEC to occur within the Project mining area is low, the geomorphological components that require it to be considered are present at the Haul Road site and therefore this EEC has been considered further in this assessment.

3 FLORA SPECIES

3.1 Methodology - Flora

3.1.1 Plant Taxonomy

Plant taxonomy used was consistent with the nomenclature of the *Flora of NSW* (Harden 2000; 2002), except where more recent revisions have been published in recognised scientific journals and accepted by the National Herbarium of New South Wales (as per the PlantNet web site http://plantnet.rbgsyd.nsw.gov.au/) and the Yeti database. Plant specimens of unknown or significant status were collected during the field survey for later identification or lodgement with the National Herbarium in Sydney.

3.1.2 Literature and Database Review

The literature and database review informed the development of the consideration of threatened flora likelihood of occurrence in Appendix C and the subsequent assessment of affected species in Appendix I.

Database searches were conducted in January 2012 and November 2011. The following were used in preparing this review:

- OEH Atlas of NSW Wildlife (OEH 2012a):
    - Search 1 (November 2011): 50 x 50 km around study area; and
    - Search 2 (January 2012): Brigalow Belt South Interim Biogeographic Regionalisation for Australia (IBRA) Bioregion (Search 1 above was considered too restricted for threatened flora with potential habitat within the locality).
- OEH Threatened Species Profile Database. Search (August 2012a): Namoi CMA.
- SEWPaC EPBC Act Protected Matters Search Tool. Search (August 2012): Namoi CMA.
- RPS (2010), *Flora and Fauna Assessment For Proposed Rocglen Coal Mine Extension Project*.

The results of the OEH Atlas of NSW Wildlife database search is shown on Figure 8.

3.1.3 Threatened Flora Likelihood of Occurrence

Five categories for 'likelihood of occurrence' (Table 4) were attributed to species after consideration of criteria such as known records, presence or absence of important habitat features within the study area, results of the field surveys and professional judgement. This process was completed on an individual species basis. The list of target flora and their associated likelihood of occurrence are provided in Appendix C.

Species that would need to be considered as subject species within the study area are those in the Moderate, High or Known categories (see Section 3.2.1). Where impacts on potentially occurring threatened flora species could be reasonably expected to occur, these species are considered further for formal impact assessment as affected threatened flora (see Section 3.2.4).

Table 4: Likelihood of Occurrence Criteria – Threatened Flora

Likelihood Rating	Threatened Flora Criteria
Known	The species was observed within the study area
High	It is likely that a species inhabits or utilises habitat within the study area
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 study area
Low	It is unlikely that the species inhabits the study area
None	The habitat within the study area is unsuitable for the species

3.1.4 Field Survey

Targeted surveys to locate threatened flora species were conducted using the random meander technique as prescribed in Cropper (1993). Where a threatened plant population was found, more extensive searches were conducted and, where necessary, population estimates were made. The field surveys were completed by Nathan Smith and John Hunter over five days between 14-19 November 2011.

Random Meander Survey

Thirty-two person hours of random meander threatened plant surveys were conducted and were consistent with the recommended 0.5 hours per plot (DECC, 2004). The random meander and vegetation validation tracks are represented in Figure 7b.

Lepidium monoplocoides Population Estimates

Winged Peppercress (*Lepidium monoplocoides*) (an Endangered species listed under the TSC Act and *Environmental Planning and Assessment Act 1979* (EPBC Act) was detected during the field survey and therefore population estimates were carried out for these occurrences. Additional surveys for this species were conducted by Nathan Smith and John Hunter on 16-20 December 2011 and 13-16 January 2012.

Two separate population estimates were conducted for:

1. An occurrence within the proposed Vickery mining-area that would be removed by the Project; and
2. An occurrence within the Canyon Coal Mine rehabilitation area to the north.

These two local occurrences are mapped on Figure 9 with regional and local distribution of *Lepidium monoplocoides* from database searches shown on Figures 10 and 11.

These occurrences were located over a relatively small area and therefore total population counts, using appropriate methodology were conducted. The methodology chosen in both cases was to average the counts of both field botanists (Nathan Smith and John Hunter) from adjacent belt transects, advanced in a single direction (south to north) until a zero count was registered by both botanists. For the occurrence within the Project area, the belt transects were 5 m wide and approximately 30 m long, while for the Canyon occurrence the transects were 10 m wide and approximately 60 m long. The length and width of the belt transects was selected based on the estimated extent of each of these populations.

A third population estimate was carried out by Niche in a location in the northern section of the Pilliga National Park, shown on Figure 12.

The results from the population estimates are provided in Section 3.2.2.

3.2 Results – Flora

A total of 307 flora species were recorded within the study area and is provided in Appendix D. Flora species recorded comprised 78 introduced species (25%) and 229 native species (75%) . Winged Peppercress (*Lepidium monoplocoides*), which is listed as Endangered under the TSC Act and EPBC Act, was the only threatened plant species recorded in the study area during the field survey.

3.2.1 Subject Threatened Flora Species

A total of 56 threatened flora species listed on the TSC and/or EPBC Acts, or their habitats, were considered in this assessment (Appendix C). This list was gained from the database queries outlined in Section 3.1.2.

Table 5 provides a list of seven subject threatened flora (i.e. those with an occurrence likelihood rating of Moderate, High or Known).

Table 5. Subject Threatened Flora

Species	Common Name	Conservation Status[1]		Occurrence Likelihood
		TSC Act	EPBC Act	
Desmodium campylocaulon	Creeping Tick-trefoil	-	V	**Moderate** Habitat exists within the study area, however *D. campylocaulon* has not previously been recorded in the locality
Dichanthium setosum	Bluegrass	V	V	**Moderate** Potential habitat exists within the study area, however *D. setosum* has not previously been recorded in the locality and the preferred soil is absent
Digitaria porrecta	Finger Panic Grass	E	E	**Moderate** Potential habitat exists within the study area, however *D. porrecta* has not previously been recorded in the locality
Ipomoea diamantinensis	Desert Cow-Vine	E	-	**Moderate** Habitat exists within the study area, however *I. diamantinensis* has not previously been recorded in the locality
Lepidium monoplocoides	Winged Peppercress	E	E	**Known** Recorded in the study area during the current field survey (Figure 9)
Swainsona murrayana	Slender Darling-pea	V	V	**Moderate** Habitat exists within the study area, however *S. murrayana* has not previously been recorded in the locality
Tylophora linearis	-	V	E	**Moderate** Habitat exists within the study area, however *T. linearis* has not previously been recorded in the locality

1. Threatened flora species status under the TSC Act and/or EPBC Act (current at 23 August 2012).

3.2.2 Threatened Flora Survey

Whilst neither Bluegrass (*Dichanthium setosum*) nor Finger Panic Grass (*Digitaria porrecta*) were recorded within the study area during the field survey, they are both considered to have potential habitat within the study area, a moderate likelihood of occurrence and, as grasses, both are considered relatively cryptic as they are subject to seasonal and perennial variation in presence and abundance. They have therefore been considered further for impact assessment in Section 5.

Winged Peppercress (*Lepidium monoplocoides*), which is listed as endangered on both the TSC and EPBC Acts, was recorded within the northern part of the study area within the proposed Project dump site and outside of the Project mining area in the Canyon Coal Mine rehabilitation area by Lachlan Copeland during the annual monitoring surveys for that area (Figure 9). A whole-of-population count by Niche using the methodology described in Section 3.1.4, estimated the Project mining area occurrence at 46 individuals and the Canyon Coal Mine occurrence at 420 individuals (Table 6).

Off-site surveys for the Winged Peppercress (*Lepidium monoplocoides*) were also conducted in suitable habitat within the broader locality and more widely within the Namoi CMA, including the northern Pilliga National Park, and the property 'Willeroi' adjoining Mt Kaputar National Park (Willeroi East). The survey was restricted to areas either owned by Whitehaven or areas of public land (Council, road-sides, Travelling Stock Routes or National Parks estate). The purpose of these surveys was to ascertain the local and regional significance of the Project population.

The only additional occurrence recorded within the region during the off-site surveys was an extension to the previously recorded population in the northern Pilliga National Park in an area of known habitat for the species (John Hunter had previously recorded the species within this locality). This population was observed to exist in two different habitat types; a) a disturbed Fire Road edge along the northern boundary of the Park and, b) within the native vegetation (Pilliga Box – White Cypress Pine – Bulloke low open forest) to the south of the road. As the two occurrences had clearly different distribution patterns, two separate population estimates were conducted for each.

Table 6. *Lepidium monoplocoides* Counts within the Locality (Vickery Mining Area and the Canyon Mine Rehabilitation Area)

Belt Transect	Operator 1 (John Hunter)	Operator 2 (Nathan Smith)	Average
Vickery Mining Area			
A (south)	0	0	0
B	28	21	24.5
C	4	15	9.5
D	11	0	5.5
E	1	2	1.5
F	4	4	4
G (north)	0	0	0
Additional Individual approximately 10 m to north	1	1	1
Total	49	43	**46**
Canyon Rehabilitation Area			
A (south)	0	0	0
B	28	32	30
C	151	189	170
D	100	59	79.5
E	38	83	60.5
F	21	19	20
G	0	1	0.5
H (north)	0	0	0
Additional population approximately 20 m to north	53	66	59.5
Total	391	449	**420**

A total population count along the Fire Road edge estimated that 2,863 plants existed in this area. Along with the 283 plants counted within the adjacent natural habitat (Table 7), it is considered that at least 3,140 plants are known to exist within this locality.

In relation to the 'background' numbers of plants in the natural habitat within the northern Pilliga, as has been already stated, 283 plants were counted in total from 40 sites of two plots of 10 x 10 m each. Both John Hunter and Nathan Smith counted a single 10 x 10 m plot at each of the 40 locations, resulting in 80 replicate plots. In order to avoid observer bias in the location of plots and thus bias in counting, the plots were placed 50 m apart along four separate transect lines and the transect walked north-south until suitable habitat changed. The results are listed in Table 7.

The population counts in the northern Pilliga resulted in an average of 44% of plots containing at least one individual of Winged Peppercress (*Lepidium monoplocoides*) and the density of the species within the locality being 353.75 plants per ha (Table 7).

Table 7. *Lepidium monoplocoides* Counts, North Pilliga National Park

	Easting	Northing	Nathan Smith	John Hunter	Total	Observed between plots
Transect 1						
Plot 1	725990	6624517	0	0	0	no
Plot 2	725978	6624459	0	0	0	no
Plot 3	725972	6624417	5	0	5	no
Plot 4	725958	6624362	4	1	5	no
Plot 5	725929	6624316	0	0	0	no
Plot 6	725934	6624260	3	7	10	yes
Plot 7	725976	6624198	0	34	34	yes
Plot 8	725994	6624151	0	0	0	no
Plot 9	726009	6624091	2	0	2	no
Plot 10	726010	6624048	4	6	10	no
Plot 11	726005	6623995	0	0	0	no
Transect 2						
Plot 12	725939	6624014	15	1	16	yes
Plot 13	725923	6624073	0	0	0	no
Plot 14	725914	6624127	1	0	1	no
Plot 15	725893	6624160	0	0	0	Yes
Plot 16	725868	6624217	3	36	39	yes
Plot 17	725846	6624277	0	0	0	no
Plot 18	725845	6624336	0	0	0	no
Plot 19	725847	6624388	0	0	0	no
Plot 20	725852	6624449	0	0	0	yes
Plot 21	725877	6624517	0	0	0	no
Transect 3						
Plot 22	725739	6624516	0	0	0	no
Plot 23	725728	6624470	0	1	1	no
Plot 24	725719	6624415	2	6	8	no
Plot 25	725719	6624375	0	0	0	yes
Plot 26	725695	6624331	3	1	4	no

	Easting	Northing	Nathan Smith	John Hunter	Total	Observed between plots
Plot 27	725706	6624289	0	0	0	no
Plot 28	725715	6624235	1	11	12	no
Plot 29	725695	6624198	17	1	18	yes
Plot 30	725698	6624149	1	0	1	no
Plot 31	725678	6624104	2	0	2	yes
Plot 32	725675	6624050	0	0	0	no
Transect 4						
Plot 33	725598	6624161	1	11	12	yes
Plot 34	725576	6624207	0	3	3	no
Plot 35	725581	6624265	6	35	41	yes
Plot 36	725579	6624310	12	0	12	no
Plot 37	725619	6624360	18	0	18	yes
Plot 38	725651	6624409	23	0	23	yes
Plot 39	725636	6624467	4	2	6	no
Plot 40	725623	6624514	0	0	0	no
		Total	127	156	283	
		Per Ha	**317.5**	**390**	**353.75**	

The population of Winged Peppercress (*Lepidium monoplocoides*) within a local occurrence restricted to Pilliga National Park is anticipated to be at least 42,450 based on estimated density of plants and area of potential habitat.

3.2.3 Noxious Weeds

Of the flora species recorded within the study area, five are listed as declared weeds for the Gunnedah Local Government Area (LGA) under the NSW *Noxious Weeds Act 1993* (NW Act) (Table 8). Each of these species is a Category 4 weed under the NW Act which requires that Whitehaven manage these weeds to the extent that "The growth of the plant must be managed in a manner that reduces its numbers, spread and incidence and continuously inhibits its reproduction".

Table 8. Noxious Weeds within the Study Area

Species	Common Name	NW Act Category
Echium plantagineum	Paterson's Curse	4
Heliotropium amplexicaule	Blue Heliotrope	4
Lycium ferocissimum	African Boxthorn	4
Opuntia stricta	Common Prickly Pear	4
Xanthium occidentale	Noogoora Burr	4

3.2.4 Affected Threatened Flora

After consideration of the seven subject threatened flora (Section 3.2.1) and the results of the field survey (Section 3.2.2), Winged Peppercress (*Lepidium monoplocoides*) was determined as the only species with the potential to be affected by the Project (Table 9). A formal impact assessment for *L. monoplocoides* has therefore been provided in Appendix E.

Table 9. Potentially Affected Threatened Flora Species

Species		TSC Act	EPBC Act	Likelihood Of Occurence	Potential for Impact (Reason)
Desmodium campylocaulon	Creeping Tick-trefoil	E	-	Moderate	Not Likely Species not detected within study area during field surveys.
Dichanthium setosum	Bluegrass	V	V	Moderate	Not Likely Species not detected within study area during field surveys and preferred soil habitat not present.
Digitaria porrecta	Finger Panic Grass	E	E	Moderate	Not Likely Species not detected within study area during field surveys, although not surveyed at optimal season for detection.
Ipomoea diamantinensis	Desert Cow-Vine	E	-	Moderate	Not Likely Species not detected within study area during field surveys.
Lepidium monoplocoides	Winged Peppercress	E	E	Known	Known Species detected during field surveys
Swainsona murrayana	Slender Darling-pea	V	V	Moderate	Not Likely Species not detected within study area during field surveys.
Tylophora linearis	-	V	E	Moderate	Not Likely Species not detected within study area during field surveys.

4 FAUNA SPECIES

4.1 Methodology – Fauna

4.1.1 Literature and Database Review

The literature and database review informed the development of the assessment of threatened fauna. Database searches were conducted in January 2012.

The following were used in preparing this review:

- OEH (2012b) Atlas of NSW Wildlife (50 x 50 km and Liverpool Plains [Part B] IBRA sub-bioregion within the Namoi CMA);
- SEWPaC (2012) EPBC Act Protected Matters Search Tool (50 x 50 km);
- Birds Australia (2012) database (50 x 50 km);
- Cenwest Environmental Services (2011) *Vickery Coal Project Baseline Fauna Survey*; and
- RPS (2010) *Flora and Fauna Assessment for Proposed Rocglen Coal Mine Extension Project*.

4.1.2 Threatened Fauna Likelihood of Occurrence

Appendix F contains a list of 43 threatened fauna species and one threatened fauna population as scheduled under the TSC and/or EPBC Acts, derived from a review of the databases and literature as outlined in Section 4.1.1.

Five categories for 'likelihood' are used to determine the final list of subject threatened fauna. Subject threatened fauna considered in the impact assessment are those species in the Moderate, High or Known categories. This likelihood criteria considers known records, presence or absence of important habitat features within the study area, results of the field surveys and professional judgement. The list of affected threatened fauna is determined from this analysis (Section 4.2.4).

The categories are outlined in Table 10 below.

Table 10: Likelihood of Occurrence Criteria – Threatened Fauna

Likelihood rating	Criteria
Known	the species was observed within the study area
High	it is likely that a species inhabits or utilises habitat within the study area
Moderate	potential habitat for a species occurs on the site and the species may occasionally utilise that habitat. Species unlikely to be dependent on the habitat present within the study area
Low	it is unlikely that the species inhabits the study area. If present at the site the species would likely be a transient visitor. The site contains only very common habitat for this species which the species would not rely on for its ongoing local existence
None	the habitat within the study area is unsuitable for the species

4.1.3 Weather Conditions

Surveys were conducted on 12-26 November 2011. Weather conditions during the surveys varied, but conditions were generally warm to hot with intermittent days of heavy rain. A summary of the weather conditions during the survey period is provided in Table 12 and is derived from the Bureau of Meteorology (BoM) station at Gunnedah Airport, which is approximately 20 km south of the study area.

Table 11. Weather Conditions During the Fauna Surveys

Date	Min Temp °C	Max Temp °C	Wind Speed and Direction 9am (km/hr)	Wind Speed and Direction 3pm (km/hr)	Rainfall (mm) 24 hours
12 Nov 2011	16.2	32.9	WNW 9	N 19	0
13 Nov 2011	17.9	29.1	SE 9	ESE 22	0.4
14 Nov 2011	15.2	34.4	S 7	NNW 20	19.6
15 Nov 2011	16.3	38.5	ESE 15	W 9	0.2
16 Nov 2011	19.9	28.6	WNW 9	ESE 15	0
17 Nov 2011	17.4	27.2	ESE 13	ESE 6	4.4
18 Nov 2011	17.5	28.7	Calm	WNW 7	43.8
19 Nov 2011	17.7	32.7	W 6	NW 19	0.2
20 Nov 2011	15.6	33.3	WSW 7	NW 28	0
21 Nov 2011	19.1	26.3	SE 15	ENE 6	1.6
22 Nov 2011	17.1	31.5	N 26	N 20	0
23 Nov 2011	15.5	19.9	E 9	ESE 11	10.6
24 Nov 2011	14.6	25.1	SE 30	SSE 30	42.0
25 Nov 2011	14.7	20.4	SSE 20	ESE 17	8.0
26 Nov 2011	17.1	27.7	NNW 9	NNW 28	64.2

Source: BoM (2011)

N = north, E = east, W = west, S = south.

4.1.4 Field Survey

Fauna surveys were conducted over 14 days between 12 and 26 November 2011 by two zoologists, Rhidian Harrington and Anna Senior. Surveys were conducted across all habitat types within the study area targeting threatened species. Surveys were conducted in the Vickery State Forest immediately adjacent to the study area as this area contained better habitat than that found within the study area and is likely to be the main source of habitat for species located in the study area. All survey locations and data were recorded with the use of a Trimble Nomad GPS (accuracy 2-5 m).

Survey methodology for the current study is described below and survey effort is summarised in Table 12. Survey locations are displayed in Figure 13.

The fauna survey effort was designed to supplement that conducted by Cenwest Environmental Services (2011) between 28 March and 2 April 2011 within the current study area (Table 13). See Cenwest Environmental Services (2011) for details of fauna survey methodology and site locations.

Table 12. Fauna Survey Techniques and Survey Effort

Survey Technique	Number of Sites	Survey Effort Per Site	Survey Dates	Total Survey Effort
Diurnal Bird Surveys	14	30 minute 2 ha census	12/11/11 – 26/11/11	14 Person Hours
Diurnal Herpetological Surveys	14	30 minute Two zoologists	12/11/11 – 26/11/11	14 Person Hours
Call Playback – Owls	6	5 minute playback and listening for each species	12/11/11 – 25/11/11	42 sessions
Call Playback – Mammals	3	5 minute playback and listening for each species	15/11/11 – 17/11/11	9 sessions
Arboreal Elliiot Trapping	10	8 Elliot A and 7 Elliot B Traps at each site	12/11/11 – 26/11/11	600 Trap Nights
Hair Tubes (Ground)	10	7, 50 mm hair tubes	12/11/11 – 26/11/11	665 Trap Nights
Hair Tubes (Arboreal)	10	7, 50 mm hair tubes	12/11/11 – 26/11/11	665 Trap Nights
Camera Traps	8	2 traps	Within period 12/11/11 – 26/11/11	160 Trap Nights
Anabat Detection	4	5 nights per site	Within period 12/11/11 – 25/11/11	20 Recording Nights
Spotlight Search	9 nights	At least 0.5 hours of spotlighting	12/11/11 – 25/11/11	16 Person Hours
Stag Watches	1 hour plus 6 call-playback sites	2 nights	22/11/11 – 23/11/11	2 Person Hours, excluding call-playback sites

Table 13. Fauna Survey Techniques and Effort by Cenwest Environmental Services (2011)

Survey Technique	Combined Effort
Elliot A ground	400 TNs
Elliot A trees	160 TNs
Elliot B ground	160 TNs
Cage Traps	16 TNs
Pit-fall Traps	40 TNs
Anabat Detectors	22 AN
Harp Traps	21 HTNs
Hair Tubes ground	240 HTNs
Hair Tubes tree	160 HTNs
Site spotlighting	15 hours
Track spotlighting	15 km
Herpetological searches	21 hours
Bird surveys	21 hours
Call playback effort for threatened species	7 locations

Elliot Traps – Arboreal

Elliot A and B arboreal traps were used at ten sites for four consecutive nights. Eight type A and seven type B traps were set up at each of the ten trapping sites. Pairs of traps were spaced at 20 m intervals along a transect to make seven separate trapping stations at each site with the last station having three traps (two Elliot A, one Elliott B). Traps were placed on platforms and mounted on trees approximately 2-2.5 m off the ground. Traps were baited with a mixture of peanut butter, rolled oats, honey and truffle oil. The base and trunks of the trees were sprayed with a mixture of honey and water.

Traps were checked each morning and any captured animals were identified and released at the site of capture.

Hair Tubes – Ground

Hair tubes (50 mm) were placed at each of the ten trapping sites. At the trapping sites seven hair tubes were placed at the trapping stations close to the arboreal Elliott traps. Hair tubes were in place for either nine or ten nights.

The hair tubes were baited with dog food, chicken wings or a mixture of peanut butter, rolled oats, honey and truffle oil. The base and trunks of the trees were sprayed with a mixture of honey and water. Double sided tape was only adhered to the upper and lateral inner surface of the tubes so as to limit the incidence of 'by catch'. Hair samples were sent to Barbara Triggs of "Dead Finish" for analysis.

Hair Tubes – Arboreal

Arboreal hair tubes (50 mm) were placed in trees at each of the 10 trapping sites using water resistant electrical tape. Seven arboreal hair tubes were placed alongside ground hair tubes at each trapping transect. The hair tubes were baited with a mixture of peanut butter, rolled oats, honey and truffle oil. Hair samples were sent to Barbara Triggs of "Dead Finish" for analysis.

Camera Traps

Scout Guard SG560DF motion sensing camera traps were placed at ground level. Two camera traps were placed at eight of the ten trapping sites for 10 consecutive nights.

The cameras were set to take three pictures upon sensing motion and placed in front of baited hair tubes. The ground in front of the camera traps was sprayed with a mixture of honey, truffle oil and water. Upon recovery the pictures were individually analysed and animals were identified to the lowest possible taxonomic level.

Nocturnal Call Playback - Owls

Six call playback sites were established at strategic positions in the landscape so that calls would broadcast down in to valleys and achieve maximum coverage. Call-playback was conducted on eight separate nights at the five sites on the east side of Bluevale Road and for two nights on the one site on the western side of Bluevale Road.

After an initial listening period of five minutes, calls of the Barking Owl, Masked Owl, Sooty Owl and Powerful Owl were broadcast through a 10 watt megaphone for five minutes followed by a five minute listening period and a two minute period of spotlighting.

No call playback was performed on the 14, 18, 23 and 24 November 2012 due to rainfall impeding the ability to broadcast.

Nocturnal Call Playback – Mammals

Calls of the Squirrel Glider and Koala were broadcast at three of the owl call playback sites, prior to playing the owl calls, for three consecutive nights on 15-17 November 2011. Calls were broadcast for five minutes followed by a five minute listening period.

Diurnal Bird Surveys

Birds were surveyed within a 2 ha area by two zoologists for at least thirty minutes. Birds were identified with the use of 10 X 42 binoculars or from their calls. Where possible, surveys were conducted as close as possible to dawn or dusk when bird activity is greatest.

Fourteen separate bird surveys were undertaken across the study area for a total survey effort of 14 person hours. Two dawn water bird surveys were conducted in the two largest dams on the site. Incidental observations of birds were recorded throughout the course of the other surveys.

Diurnal Herpetological Surveys

Reptiles were surveyed by two zoologists for at least thirty minutes at each of the diurnal bird survey sites. Surveys were conducted during the warmest time of the day when reptile activity is greatest and involved rock and log turning and bark stripping.

Fourteen separate herpetological surveys were undertaken across the study area for a total survey effort of 14 person hours. Incidental observations of frogs and reptiles were recorded throughout the course of the other surveys.

Anabat Detection

One ultrasonic recording device (Anabat^{TM}) was deployed at four separate sites across the study area. The devices were left in place for five nights and recorded from dusk until dawn.

Spotlighting

Spotlighting took place either on foot or from a slow moving vehicle using one or two handheld 50-watt spotlights. The speed of survey was approximately 1 km per hour on foot or 5 km per hour in the vehicle.

Spotlighting and active listening for frogs was conducted in all the dams that contained water on the site. Weather conditions were ideal for surveying frogs, being warm and wet.

Stag Watching

Stag watches involve observing hollows for fauna occupancy. Stag watches were conducted from 30 minutes before dusk to 30 minutes after dusk on one tree within the study area on the 22 and 23 November 2012. Only one tree encountered contained hollows sufficiently large enough for roosting owls. A total survey effort of 2 person hours was conducted. Additionally, all the call-playback sites were located next to trees with hollows and these were observed carefully using a spotlight during the call-playback surveys.

Habitat Assessment

Habitat assessments were carried out at various locations throughout the course of surveys of the study area and involved an assessment of the type and condition of fauna habitat as well as potential for threatened species to occur. The habitat assessment was guided by plant community structure and the occurrence of important features such as tree hollows, canopy feeding resources, leaf litter, fallen timber, water bodies and specific feeding resources such as koala feed trees.

4.2 Results – Fauna

4.2.1 Threatened Fauna Species

A total of 44 threatened fauna species and one threatened population listed on the TSC Act, or their habitats, have previously been recorded within 50 km of the study area. After considering the habitat present within the study area (Figure 14), and the results of the field survey, 31 potentially threatened fauna species were considered to have a moderate, high or known likelihood of occurrence within the study area (Table 14; Figures 15a to 15e).

Six threatened animal species were potentially detected during the current study, including three bird species, Grey-crowned Babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*) Diamond Firetail (*Stagonopleura guttata*) and Speckled Warbler (*Chthonicola sagittata*) (Figure 16), two possible bat species, Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*) and Large-eared Pied Bat (*Chalinolobus dwyeri*) and one probable bat species, Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*). A Masked Owl (*Tyto novaehollandiae*) was potentially sighted, as it responded to a Masked Owl call-playback survey, but the sighting was not sufficient for accurate identification and was discounted.

Within or immediately adjacent to the study area, the following threatened fauna have been previously recorded (Cenwest Environmental Services, 2011; RPS, 2010):

1. Grey Falcon (*Falco hypoleucos*)
2. Diamond Firetail (*Stagonopleura guttata*)
3. Blue-billed Duck (*Oxyura australis*)
4. Little Eagle (*Hieraaetus morphnoides*)
5. Turquoise Parrot (*Neophema pulchella*)
6. Speckled Warbler (*Chthonicola sagittata*)
7. Hooded Robin (south-eastern form) (*Melanodryas cucullata cucullata*)
8. Grey-crowned Babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*)
9. Varied Sittella (*Daphoenositta chrysoptera*)
10. Gilbert's Whistler (*Pachycephala inornata*)
11. Squirrel Glider (*Petaurus norfolcensis*)
12. Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)
13. Beccari's Freetail-bat (*Mormopterus beccarii*)

Table 14. Subject Threatened Fauna

Common Name	Scientific Name	TSC Act	EPBC Act	Likelihood of Occurrence
Reptiles				
Pale-headed Snake	*Hoplocephalus bitorquatus*	V	-	**Moderate:** Four previous records in Liverpool Plains (Part B) IBRA sub-bioregion
Birds				
Blue-billed Duck	*Oxyura australis*	V	-	**Known** (Cenwest Environmental Services 2011)
Grey Falcon	*Falco hypoleucos*	E	-	**Known** (RPS 2010, although exact location not supplied)
Square-tailed Kite	*Lophoictinia isura*	V	-	**Moderate:** Previously recorded at Tarrawonga mine-site, 10 km to the north
Spotted Harrier	*Circus assimilis*	V	-	**Moderate**: Eight previous records within Liverpool Plains (Part B) IBRA sub-bioregion
Little Eagle	*Hieraaetus morphnoides*	V	-	**Known** (Cenwest Environmental Services 2011)
Glossy Black-cockatoo	*Calyptorhynchus lathami*	V	-	**Moderate:** 11 previous records within the Liverpool Plains (Part B) IBRA sub-bioregion and *Casuarina cristata* present within the study area
Little Lorikeet	*Glossopsitta pusilla*	V	-	**High:** Previously recorded within locality, Atlas of NSW Wildlife (OEH 2012b)
Turquoise Parrot	*Neophema pulchella*	V	-	**Known** (Cenwest Environmental Services 2011, OEH, 2012a)
Superb Parrot	*Polytelis swainsonii*	V	V	**Moderate:** Two previous records within the Liverpool Plains (Part B) IBRA sub-bioregion
Barking Owl	*Ninox connivens*	V	-	**Moderate:** 11 previous records within the Liverpool Plains (Part B) IBRA sub-bioregion
Powerful Owl	*Ninox strenua*	V	-	**Moderate:** Previous records within the Liverpool Plains (Part B) IBRA sub-bioregion
Masked Owl	*Tyto novaehollandiae*	V	-	**Moderate:** Four previous records within the Liverpool Plains (Part B) IBRA sub-bioregion. Possible sighting during current study.
Brown Treecreeper (eastern subspecies)	*Climacteris picumnus victoriae*	V	-	**High:** Previously recorded within locality, Atlas of NSW Wildlife (OEH 2012b)
Speckled Warbler	*Chthonicola sagittata*	V	-	**Known** (current study, Cenwest Environmental Services 2011)
Painted Honeyeater	*Grantiella picta*	V	-	**Moderate:** Four previous records in the Liverpool Plains (Part B) IBRA sub-bioregion
Hooded Robin (south-eastern form)	*Melanodryas cucullata cucullata*	V	-	**Known** (Cenwest Environmental Services 2011)
Grey-crowned Babbler (eastern subspecies)	*Pomatostomus temporalis temporalis*	V	-	**Known** (current study, Cenwest Environmental Services 2011, OEH, 2012s)
Varied Sittella	*Daphoenositta chrysoptera*	V	-	**Known** (Cenwest Environmental Services 2011)
Gilbert's Whistler	*Pachycephala inornata*	V	-	**Known** (RPS 2010, although exact location not supplied)
Diamond Firetail	*Stagonopleura guttata*	V	-	**Known** (current study, Cenwest Environmental Services 2011)
Mammals				
Spotted-tailed Quoll	*Dasyurus maculatus*	V	E	**Moderate:** 18 previous records within the Liverpool Plains (Part B) IBRA sub-bioregion.
Koala	*Phascolarctos cinereus*	V	V	**High:** Previously recorded within locality, Atlas of NSW Wildlife (OEH 2012b)
Squirrel Glider	*Petaurus norfolcensis*	V	-	**Known** (Cenwest Environmental Services 2011)
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	V	-	**Known** (possibly recorded during the current study, Cenwest Environmental Services 2011, OEH, 2012a)
Beccari's Freetail-bat	*Mormopterus beccarii*	V	-	**Known** (RPS 2010, although exact location not supplied)

Common Name	Scientific Name	TSC Act	EPBC Act	Likelihood of Occurrence
Eastern Freetail-bat	*Mormopterus norfolkensis*	V	-	**High:** Previously recorded within the locality, Atlas of NSW Wildlife (OEH 2012b)
Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*	V	-	**Known** (recorded with probable certainty during current survey)
Large-eared Pied Bat	*Chalinolobus dwyeri*	V	V	**Moderate:** 34 previous records within the Liverpool Plains (Part B) IBRA sub-bioregion
Little Pied Bat	*Chalinolobus picatus*	V	-	**Known** (OEH 2012a)
Corben's Long-eared Bat	*Nyctophilus corbeni*	V	-	**Moderate:** 19 previous records within the Liverpool Plains bio-region)

4.2.2 Field Survey - Fauna

A total of 132 vertebrate fauna species were recorded during the field surveys including one fish, 10 frogs, six reptiles, 89 birds and 26 mammals (Appendix G). A total of 10 introduced species were observed, including two birds and eight mammals.

The Koala feed tree species River Red Gum (*Eucalyptus camaldulensis*) was present in the study area, although no trees of this species would be removed by the Project.

4.2.3 Fauna Habitat

The study area comprised mostly of derived woodlands and grasslands that had been affected previously by clearing and/or grazing. The most undisturbed woodland occurred immediately (within 50 m) adjacent to Vickery State Forest in the eastern section of the site, although these areas are subject to grazing and tree thinning. The fauna habitat types within the study area included (Figure 14): Woodland, Native Grassland, Cypress Regeneration, Riparian, Shrubland and Sedgeland. Much of the grassland in the western section of the study area contained a post-mining rehabilitated landscape. Waterbodies are present in the Project area, however are not shown on Figure 14. Disturbed areas, such as plantation, previous mining works, erosion and infrastructure provide limited habitat and are not considered natural fauna habitats.

Many of the larger paddock trees provide sheltering habitat (in the form of hollows or nesting opportunities) and may also provide a food source for some threatened and common fauna. Based on tree hollow density recorded during flora plots, it is estimated that the total number of hollow-bearing trees to be removed by the Project is approximately 1,900, including up to 51 trees with hollows from the Haul Road near the Whitehaven CHPP. The number of trees to be removed was calculated by multiplying the average number of hollow-bearing trees recorded in each floristic plot (0.1 ha) in each vegetation community by the area of each vegetation community. Only one tree contained a hollow large enough for owl roosting habitat and was located at the site of the stag watch survey (Figure 13). This hollow showed no signs of occupation by any species. For the purposes of this assessment it has been assumed that all trees within the development footprint would be removed although this is unlikely to be the case.

The number of hollow-bearing trees observed within the study area is considered typical of an agricultural landscape where the majority of native vegetation has been previously cleared. Based on the average number of trees with hollows within the Woodland habitat type within the study area (4.6 hollow trees per ha), it is estimated that approximately 26,000 trees with hollows are present within the locality: Vickery State Forest (9,000); woodland adjacent to Vickery State Forest (1,800); Boonalla CCA Zone 3 State Conservation Area (previously Kelvin State Forest) (10,500); and, woodland adjacent and to the north of Boonalla CCA Zone 3 State Conservation Area (4,700). This is likely to be an under-estimate of hollow trees in the locality given that it does not consider small patches of woodland, road reserves or isolated paddock trees. Based on these conservative figures, the Project would remove a small proportion of potential habitat within the locality.

The majority of the smaller (0-10 centimetres [cm]) and medium (10-20 cm) hollows occurred in the branches of the larger trees. At the time of the hollow inspection, many of these hollows were occupied by nesting cockatoos and parrots, particularly at the Haul Road site.

The above estimate of hollow-bearing tree numbers is based on the area of Woodland habitat within the study area and locality. It is estimated that approximately 5,643 ha of Woodland is present within the locality based on the following: Vickery State Forest (1,942 ha); Woodland adjacent to Vickery State Forest (381 ha); Boonalla CCA Zone 3 State Conservation Area (2,300 ha); and, woodland adjacent and to the north of Boonalla CCA Zone 3 State Conservation Area (1,020 ha). This is likely to be an under-estimate of Woodland habitat in the locality given that it does not consider small patches of vegetation, road reserves or scattered paddock trees. Based on these conservative figures, the Project would remove up to 4.8% of Woodland habitat within the locality.

There was no outcropping rock in the study area, although scattered rocks were present at higher elevations.

Woodland

This habitat type occurred scattered throughout the Project area, mostly in the east of the study area adjacent to Vickery State Forest and west, along the Namoi River (Figure 14). It is directly linked to Vickery State Forest, which, although relatively large (1,942 ha), has very limited connectivity with other vegetation in the region.

The Woodland habitat is dominated by mixed mature and regrowth White Box, Ironbark, Grey Box and White Cypress Pine trees to 20 m. Tree density ranges from approximately 15-20 in grassy woodland areas, and 30 - 45 trees per ha with regrowth white pine patches present at very much higher densities.

Structural layers present within this habitat type include litter, logs, scattered rocks, grasses and herbs, regenerating mid-storey tree, and upper canopy trees. Shrubs are absent or in very low density. Tree hollows are relatively scarce and limited to scattered mature trees.

The major disturbances observed within this habitat type were clearing for agriculture, sheet erosion, evidence of over-grazing, logging and the presence of farm tracks. Groundcover was mostly dominated by native grasses.

Native Grassland

Grassland was the dominant habitat present within the study area, generally occurring at lower elevations on the floodplains and lower slopes. This habitat type consisted of derived grasslands resulting from land clearing and exotic grasslands resulting from mine rehabilitation. Exotic grassland is present in the study area, however it has limited habitat value and is not considered a natural habitat.

Cypress Regeneration

This habitat type occurred as small isolated patches adjacent to Grassy Woodlands. Cypress Regeneration is dominated almost entirely by thick stands of immature (3-5 m) White Cypress Pine. Connectivity is limited and structural layers and groundcover was mostly absent.

Dams

Thirty-four farm dams and an old mine diversion dam all containing water were scattered across the study area and ranged in size from 0.03 to 2 ha. The largest dam (mine diversion dam), which was located in the central southern area of the study area, approximately 200 m east of Bluevale Road, provided the best habitat as it had small areas of fringing macrophytic vegetation. Most of the dams are surrounded by agricultural or rehabilitated land that is dominated by grasslands with some scattered trees present. Most of the dams had limited habitat value for vertebrate fauna, mostly frogs and waterbirds, as they lacked fringing or macrophytic vegetation.

Shrubland

Shrubland habitat was restricted to a small area in the south-east of the study area. Within the study area, this habitat type is characterised by a dominant low over-storey of *Acacia pendula* (weeping myall) to 8 m high, an absent mid-storey and shrub layer and a degraded and sparse groundcover. Within the study area this type was present only as a low shrubland, probably as regrowth from previous clearance. It is located in pockets along the main flood channel in the southern portion of the study area at the point where the landscape flattens out across the Liverpool Plains.

Riparian

Riparian habitat is characterised by a dominant over-storey of *Eucalyptus camaldulensis* (River Red Gum) within 30 m of the top-of-bank along the Namoi River and major tributaries. This habitat type is present within the mapped study areas for the main Vickery mining area and the Private Haul Road and Highway Overpass, but would not be directly impacted in either location.

Sedgeland

Sedgeland habitat is characterised by a naturally absent canopy, mid-storey and shrub layer, but has a high cover of native herbs, grasses, sedges and forbs. The association exists where the landscape on the Liverpool Plains is lowest along flood channels and is likely to be associated with heavy cracking clays. Within the study area, this habitat type occurred along the southern edge in the east, where it was found to be in a good overall condition.

Other Habitat Types

Areas of disturbed land are present within the study area, consisting of exotic grassland, plantations, roads, infrastructure, erosion and previous mining works (Figure 14). These are not considered natural fauna habitats.

4.2.4 Affected Threatened Fauna

The fauna habitat types to be impacted by the Project include:

- Woodland – 273 ha;
- Native Grassland – 1,284 ha;
- Cypress Regeneration – 188 ha;
- Shrubland – 1 ha; and
- Sedgeland – 2 ha.

Based on the findings of the field surveys and the habitat present, it is considered that 25 of the 31 subject threatened fauna species listed in Table 15 could potentially be affected by the Project. Further detailed consideration of the impacts of the Project on these threatened species, including formal impact assessments, are provided in Section 5.2.3 and Appendix I. Potentially affected threatened fauna and their potential habitat within the Project area is shown on Figures 17 to 26.

Table 15. Affected Threatened Fauna

Species	TSC Act	EPBC Act	Likelihood of Occurrence	Potential for Impact
Reptiles				
Pale-headed Snake *Hoplocephalus bitorquatus*	V	-	**Moderate**	Not likely: Species not recorded within locality.
Birds				
Blue-billed Duck *Oxyura australis*	V	-	**Known**	Not likely: Highly mobile species not wholly dependent on highly limited habitat within the study area for survival.
Grey Falcon *Falco hypoleucos*	E	-	**Known**	**Potential:** Known habitat would be impacted.
Square-tailed Kite *Lophoictinia isura*	V	-	**Moderate**	**Potential**: Potential foraging habitat would be impacted.
Spotted Harrier *Circus assimilis*	V	-	**Moderate**	**Potential**: Potential habitat would be impacted.
Little Eagle *Hieraaetus morphnoides*	V	-	**Known**	**Potential**: Known habitat would be impacted.
Glossy Black-cockatoo *Calyptorhynchus lathami*	V	-	**Moderate**	**Potential**: Potential foraging and breeding habitat would be impacted.
Little Lorikeet *Glossopsitta pusilla*	V	-	**High**	**Potential**: Potential habitat would be impacted.
Turquoise Parrot *Neophema pulchella*	V	-	**Known**	**Potential**: Known habitat would be impacted.
Superb Parrot *Polytelis swainsonii*	V	V	**Moderate**	**Potential**: Potential habitat would be impacted.
Barking Owl *Ninox connivens*	V	-	**Moderate**	**Potential**: Potential foraging and roosting habitat would be impacted.

Species	TSC Act	EPBC Act	Likelihood of Occurrence	Potential for Impact
Masked Owl *Tyto novaehollandiae*	V	-	Moderate	Potential: Potential foraging and roosting habitat would be impacted.
Powerful Owl *Ninox strenua*	V	-	Moderate	Potential: Potential foraging and roosting habitat would be impacted.
Brown Treecreeper (eastern subspecies) *Climacteris picumnus victoriae*	V	-	High	Potential: Potential foraging and breeding habitat would be removed by the development.
Speckled Warbler *Chthonicola sagittata*	V	-	Known	Potential: Known habitat would be impacted.
Painted Honeyeater *Grantiella picta*	V	-	Moderate	Potential: Potential habitat would be impacted.
Hooded Robin (south-eastern form) *Melanodryas cucullata cucullata*	V	-	Known	Potential: Known habitat would be impacted.
Grey-crowned Babbler (eastern subspecies) *Pomatostomus temporalis temporalis*	V	-	Known	Potential: Known habitat would be impacted.
Varied Sittella *Daphoenositta chrysoptera*	V	-	Known	Potential: Known habitat would be impacted.
Gilbert's Whistler *Pachycephala inornata*	V	-	Known	Potential: Potential habitat would be impacted.
Diamond Firetail *Stagonopleura guttata*	V	-	Known	Potential: Potential foraging habitat would be removed by the development.
Mammals				
Spotted-tailed Quoll *Dasyurus maculatus*	V	E	Moderate	Not likely: Species not recorded within study area; Habitat within the study area fragmented and sub-optimal; no breeding habitat present; sub-optimal foraging habitat present
Koala *Phascolarctos cinereus*	V	V	High	Not likely: Species not recorded within study area; Habitat within the study area fragmented and sub-optimal
Squirrel Glider *Petaurus norfolcensis*	V	-	Known	Potential: Potential foraging and nesting habitat would be impacted.
Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris*	V	-	Known	Potential: Known habitat would be impacted.
Beccari's Freetail-bat *Mormopterus beccarii*	V	-	Known	Potential: Roosting habitat (hollows) would be impacted.
Eastern Freetail-bat *Mormopterus norfolkensis*	V	-	High	Potential: Potential foraging and breeding habitat would be impacted.
Corben's Long-eared Bat *Nyctophilus corbeni*	V	-	Moderate	Potential: Nineteen previous records within the Liverpool Plains (Part B) IBRA sub-bioregion.
Eastern Bentwing-bat *Miniopterus schreibersii oceanensis*	V	-	Known	Not likely: Highly mobile species not wholly dependent on habitat within the study area for survival. Breeding habitat (i.e. caves) not impacted.
Large-eared Pied Bat *Chalinolobus dwyeri*	V	V	Moderate	Not likely: Possibly recorded in study area. Highly mobile species not wholly dependent on habitat within the study area for survival. Breeding habitat not impacted.
Little Pied Bat *Chalinobolus picatus*	V	-	Known	Potential: One previous record from Vickery State Forest and potential foraging and breeding habitat would be impacted.

4.3 Aquatic Ecology Assessment

A habitat assessment and aquatic survey (macroinvertebrates, amphibians and fish) of the Project mining area was undertaken on 29 February and 1 March 2012 along with a desktop study by CoastEcology (see Appendix H for the full report).

The Project mining area contains a number of 1st and 2nd order drainage lines, however none are named watercourses and most are low lying areas with no defined channel or creek bed. The drainage lines are ephemeral, only holding water following flooding events (as occurred in February, 2012). Only two ephemeral drainage lines were identified with adequate aquatic habitat and water to warrant sampling.

Three threatened species listed under the FM Act have previously been recorded in the Namoi CMA: Freshwater catfish endangered population; Murray Hardyhead (*Craterocephalus fluviatiris*) and Silver Perch (*Bidyanus bidyanus*). In addition, the Murray Cod (*Maccolluchella peelii peelii*), listed as threatened under the EPBC Act has also been recorded in the Namoi CMA.

The Olive perchlet endangered population and Purple-spotted gudgeon (*Mogurnda adspersa*), listed as threatened under the FM Act, have been recorded in the Border Rivers/Gwydir CMA to the north of the Namoi CMA. Following the habitat assessment, none of these threatened species were considered to have potential habitat within the study area. This was attributed to a lack of specific habitat requirements for some species, and the highly ephemeral nature of the creeks located in the study area.

Notwithstanding, management measures to reduce the risk of impact from the Project on threatened fish species are proposed (Section 6.1).

5 IMPACT ASSESSMENT

5.1 Predicted Impacts

Direct Impacts of the Project include the removal of 1,748 ha of native vegetation present as either intact or derived forest or woodland or derived native grassland (Table 16). This is represented as per vegetation community in Table 2 and the area of each fauna habitat type impacted by the Project is as follows:

- Woodland – 273 ha;
- Native Grassland – 1,284 ha;
- Cypress Regeneration – 188 ha;
- Shrubland – 1 ha; and
- Sedgeland – 2 ha.

Table 16. Vegetation Communities within the Project Area

	Niche Vegetation Zone Community	EEC	Area (ha)
Vickery Mining Area			
2a	White Box - White Cypress Pine - Cypress Regeneration	Not an EEC	188
2b	White Box - White Cypress Pine - Semi-cleared		107
2c	White Box - White Cypress Pine - Derived Native Pasture		488
2f	White Box - White Cypress Pine - Mature Cypress Forest		9
3	White Box Grassy Woodland	White Box – Yellow Box – Blakely's Red Gum Woodland	3
7b	Silver-leaved Ironbark - White Box - White Cypress Pine – Semi-cleared	Not an EEC	80
7c	Silver-leaved Ironbark - White Box - White Cypress Pine - Derived Native Pasture	Not an EEC	165
7e	Silver-leaved Ironbark - White Box - White Cypress Pine - Mature Cypress Woodland	Not an EEC	25
19c	Plains Grass – Blue Grass Derived Native Pasture	Not an EEC	3
20a	Poplar Box Grassy Woodland - Derived Woodland	Not an EEC	46
20c	Poplar Box Grassy Woodland - Derived Native Pasture		628
21	Weeping Myall Low Shrubland	Myall Woodland	1
22	Mixed Marsh Sedgeland	Not an EEC	2
Private Haul Road and Highway Overpass			
8	Yellow Box - Blakely's Red Gum Grassy Woodland	White Box – Yellow Box – Blakely's Red Gum Woodland	3
23	River Red Gum Riverine Woodland	Not an EEC	-

As part of the Project, a number of fauna habitat features are expected to be removed or modified, including hollow-bearing trees, dead wood and dead trees, however these impacts would be reduced given the proposed management measures (Section 6).

Indirect impacts of the Project on flora and fauna would largely be mitigated by the on-site management actions, but may include:

- increased edge effect;
- hydrology impacts;
- habitat fragmentation;
- dust;
- increased frequency of bushfires;
- exotic animals;
- fauna and noise; and
- fauna and artificial lighting.

Increased Edge Effects

Indirect impacts from vegetation disturbance can also include edge effects which extend into the retained vegetation from the 'new' edge of the vegetation which is left after clearing has occurred. Edge effects have been calculated based on a 30 m impact from the boundary of the Project but only within intact or derived woodland and forest. Derived native grassland is ecologically subject to the same functional processes that are created by new edges and therefore the creation of edges in derived pasture is considered unlikely to exacerbate the effects of newly created edges. Consideration of the impact of new edges through native woodland or forest is incorporated into the detailed assessments in Appendix E.

Hydrology Impacts

Based on the results from the surface water and groundwater impact assessments (Evans & Peck, 2012; Heritage Computing, 2012 respectively), the likely water related impacts relevant to ecology include:

- No change to baseflow inputs or water quality in the Namoi River.
- Negligible drawdown in the near surface aquifers surrounding the Project (i.e. some impact to deep aquifers but not to alluvial aquifers possibly used by vegetation).
- No diversion of South Creek (the creek flowing south out of the southern edge of Vickery State Forest). The creek with EEC is being avoided.
- Release of water from sediment dams (rainfall runoff) around mine. Releases in accordance with Environmental Protection Licences.
- No release of mine pit water or run-off from hard stands/the infrastructure area.
- Water extraction from the Namoi River using standard pump and pipe system. Fish friendly pipe inlet (i.e. fish guard).
- Diversion of the north-west drainage line (flows west out of the western side of Vickery State Forest) to the north and into Driggle Draggle Creek catchment.

Based on these changes it is not expected that the surrounding vegetation would be impacted by potential hydrological impacts. This includes groundwater-dependent ecosystems associated with the Namoi River.

The Spread of Weeds

Soil disturbance related to vegetation clearance is likely to create opportunities for weed establishment around the margins of the open cut, increasing the potential for weed incursion into the native habitats of Leard State Forest. Some 78 introduced flora species occur on the study area (Appendix D), five of which are listed as Noxious in Narrabri Shire (Table 8). Most of the weeds are associated with previously disturbed areas, especially cleared farmland, derived native grasslands and riparian habitats. The potential for weed establishment and spread in Vickery State Forest is considered to be low due to the predominantly poor soils that are unfavourable for most weed species in these areas.

Whitehaven undertakes weed control programs to ensure noxious weeds are kept in check on all of its properties. With the continued implementation of these measures, it is considered that the Project is unlikely to significantly increase weed incursion into Vickery State Forest.

Habitat Fragmentation

The study area is situated on the southern and western edge of a large remnant of native vegetation, of the order of 1,942 ha (mostly comprising of Vickery State Forest). This remnant is surrounded by predominantly agricultural lands, which physically isolate it from other large remnants to the east (the Whitehaven Regional Biobanking Site and Boonalla CCA Zone 3 State Conservation Area) and north (Mount Kaputar National Park and Leard State Forest), and the riparian corridor along the Namoi River to the west and south (Figure 1).

There are no significant or continuous vegetated corridors linking the study area in any direction, although revegetation works by Whitehaven Coal are improving the link to the east between Vickery State Forest and Boonalla State Conservation Area. There is limited connectivity within road reserves, such as Bluevale Road north of the study area, Shannon Harbour Road south and east of the study area and Wean Road east of the study area, although the sections of these road reserves with remnant vegetation would not be directly impacted by the development. Even in these road reserves, the large spacing between vegetation patches and scattered trees means that connectivity only exists for highly mobile species such as birds and large mammals (kangaroos and wallabies).

The Project is located between Vickery State Forest and the Namoi River. Current connectivity between these two areas is highly limited, consisting of strips of vegetation along drainage lines leading out of Vickery State Forest which end in grasslands with widely scattered trees. In these areas, spacing between the trees is up to 300 metres.

A large part of the study site is a rehabilitated mine (i.e. the Canyon Coal Mine and Namoi Valley Coal Project) and consists of non-native grassland, thus providing no habitat or woodland/forest connectivity. The limited connectivity that is currently present between Vickery State Forest and the Namoi River would be partly maintained through vegetation patches and scattered trees: north of the study area running west from Vickery State Forest and then south; and, east of the study area running south from Vickery State Forest and then west. Connectivity to the north and west would be unaffected by the development.

Once mining areas are no longer active, these areas would be rehabilitated to either native woodland/forest or land suitable for agricultural uses. The northern section of the Western Emplacement would be revegetated with native tree, shrub and grass species, creating a native woodland/forest corridor that would connect the existing native vegetation in the Vickery State Forest with the Namoi River (Figure 28) (Section 6.1).

Further, the Project would include riparian restoration along Stratford Creek (Figure 28) (Section 6.1).

Considering the above, the Project would not lead to a significant reduction in habitat connectivity in the locality or region.

Dust

Project activities such as blasting, materials handling and vehicle movements, may result in the generation and dispersion of atmospheric dust. Excessive dust generation can impact on the health and viability of surrounding vegetation by inhibiting physiological processes such as photosynthesis, respiration and transpiration, and may allow penetration of phytotoxic gaseous pollutants (e.g. Eller 1977; Farmer 1993, 2002). In dry periods when there is limited rainfall to wash dust from leaf surfaces, plants close to working areas of the open cut, up to several hundred meters away, may receive significant loads of dust on plant surfaces. This can cause physiological damage resulting in reduced growth and reproduction (Eller 1977; Farmer 1993, 2002), which may in turn result in changes to the composition of plant communities (reviewed by Farmer 2002).

Any impact from dust on fauna or their habitat is likely to be localised and comparatively minor compared to the main impact of habitat loss.

Dust effects would be mitigated by a rigorous suppression regime through regular watering of roads and the implementation of other dust reduction techniques within the study area (e.g. enclosure of crushing and screening facility, minimal vegetation clearance, minimising active areas, progressive rehabilitation etc.). However, drift of dust into surrounding bushland in very dry conditions and following blasting is difficult to mitigate and may result in some residual deleterious effects to vegetation adjacent to the study area boundary. It is concluded that sporadic physiological damage to native plants may occur in areas adjacent to the working open cut although this is not expected to be significant.

The management approach is to minimise dust where relevant. This is further described in Section 6.

Increased Frequency of Bushfires

Project activities, including exploration, construction and environmental management and monitoring, may increase the risk of fire ignition (e.g. via increased vehicle traffic through dry vegetation). High frequency fire is listed as a key threatening process in the TSC Act (NPWS 2000). Whitehaven would implement strategies to minimise fire risk including the use of diesel vehicles, prohibition of smoking in fire prone areas and rapid response to any outbreak of fire. The overall risk of increased bush fire frequency due to the Project is likely to be very low.

Exotic Animals

The Rabbit, Brown Hare, Red Fox, European Cattle, Goat, Domestic Dog, Feral Cat, Feral Pig, Common Starling and Common Mynah have been recorded during surveys undertaken in the Project area. These exotic animals relate to the following key threatening processes under the TSC Act:

- Competition and grazing by the feral European Rabbit;
- Predation by the European Red Fox;
- Competition and habitat degradation by Feral Goats, *Capra hircus* Linnaeus 1758;
- Predation and hybridisation by Feral Dogs, *Canis lupus familiaris;*
- Predation by Feral Cats; and
- Predation, habitat degradation, competition and disease transmission by Feral Pigs (*Sus scrofa*).

The land clearance associated with the Project is likely to displace any resident foxes and cats. If not controlled, there is a potential for an increase in the pressure on native fauna in surrounding agricultural properties and the Vickery State Forest. Control programmes, trapping and/or baiting of animal pests (e.g. Rabbits and Red Foxes) would be undertaken to reduce this risk. A feral animal control programme is described in Section 6.

Fauna and Noise

A number of recent literature reviews have been conducted on the effects of noise on wildlife (Radle, 2007; Kaseloo, 2005; Institute for Environmental Monitoring and Research, 2001). Noise can potentially adversely impact certain fauna species, although studies on the effect of noise on wildlife have shown very variable responses to potential impacts.

The Project would result in an increase in noise during the day and during the night (Wilkinson Murray, 2011). It is not known what effect the increased noise would have on native fauna surrounding the Project. However, many Australian fauna readily habituate to increases in noise levels, particularly when they are repeated at intervals. Any impact from noise on fauna or their habitat is likely to be localised and comparatively minor compared to the main impact of habitat loss.

The management approach is to minimise noise where relevant. This is further described in Section 6.

Fauna and Artificial Lighting

The Project is expected to use artifical lighting during night operations.

Artificial lighting for the Project has the potential to affect the behavioural patterns of some fauna species. For example, some bird and bat species are attracted to insects that swarm around artificial lights. As a consequence of this, these bird and bat species could then become vulnerable to predation by larger predators which may lead to changes in population structure and community composition.

The management approach is to minimise artificial lighting where relevant. This is further described in Section 6.

Cumulative Impacts

The below discussion of regional clearing is sourced from FloraSearch (2011):

> *The clearance of native flora for this Project would continue an historical, albeit fluctuating, trend towards reduction in the area of native vegetation in the region. The most fertile arable land in the lower lying flat to undulating parts of the Liverpool Plains is highly productive agricultural land that has been farmed intensively for a century and a half. The surrounding steeper slopes, hills and ranges have been subject to episodes of logging, clearing and sometimes natural regeneration throughout this period. The larger tracts of very steep and/or highly infertile areas have retained their natural vegetation cover and variously been dedicated as State Forests for timber extraction or conservation reserves.*
>
> *The Western Regional Assessments from the late 1990s to 2004 resulted in conversion of large areas of State Forests to conservation reserves in the region. This included the dedication of several new reserves close to the study area, for example, the Leard* [and Vickery] *State Forests and the enlargement of Pilliga Nature Reserve and Mt. Kaputar National Park.*
>
> *A consequence of the history of land clearing in the Namoi Valley is that native vegetation types characteristic of the fertile soils of the Liverpool Plains have been all but eliminated from the region with only small fragmented remnants remaining, usually on private land. These communities comprise the bulk of the EECs listed for the region. By contrast, most vegetation types on steeper slopes, and skeletal and infertile soils, are well represented in the conservation reserve system.*
>
> …

Most of the reserves are on infertile substrates such as Jurassic Pilliga Sandstone (Pilliga Nature Reserve) or skeletal soils on the Boggabri Volcanics (parts of Leard State Conservation Area), or lithosols of the Nandewar Volcanic Complex (Mt. Kaputar National Park) (see Gunnedah Coalfield Regional Geology North Map [Pratt 1998]). Vickery State Forest is on steep terrain between the Mooki and Playgan Thrusts on Late Carboniferous Currabubula Formation rocks of the New England Orogen.

Other operating Gunnedah Basin coal mining operations of potential relevance to Project interactions include:

- the Canyon Coal Mine site located immediately north of the Project (operations at this mine ceased in 2009) and impacted 46 ha of woodland and derived native grassland;
- the Rocglen Coal Mine located approximately 5 km east of the Project, which impacted 36 ha of woodland vegetation; and
- the Tarrawonga Coal Mine, Boggabri Coal Mine and Maules Creek Coal Project located between approximately 10 and 20 km north of the Project. As mentioned in the DP&I Maules Creek Coal Project Report (DP&I, 2013), these mines would clear approximately 3,392 ha of woodland and 3,861 ha of total native vegetation.

The Canyon and Rocglen Mines would have affected habitat utilised by populations in the current Project study area. The range of many of the fauna species within Leard State Forest would not extend to the Project area, although it is possible that highly mobile species such as birds and bats may utilise habitat within both areas. Based on vegetation mapping by Niche the current Project would impact 273 ha of disturbed woodland, 188 ha of Cypress regrowth and 1,284 ha of derived native grasslands. Therefore, the Canyon, Rocglen and Vickery mines would cumulatively impact up to 359 ha of woodland habitat in the locality, out of a total of approximately 5,643 ha of woodland habitat in the locality (see Section 4.2.3). The Project would impact approximately 4.8% of woodland in the locality.

To calculate cumulative impacts on vegetation in the sub-region, regional vegetation mapping of the Namoi CMA by Ecological (2009) was used. The sub-region is the Liverpool Basin sub-region in which the Project is located.

Cumulatively, the current Project and other mining projects in the sub-region (Vickery, Canyon, Rocglen, Tarrawonga, Boggabri and Maules Creek mines) would disturb approximately 3,751 ha of remnant native woodland vegetation of the Leard State Forest and surrounds (DP&I, 2013), which represents 1.5% of that in the sub-region (approximately 254,865 ha) (Table 17).

Although the removal of up to 4.8% of the woodland in the locality is not insubstantial, the woodland to be impacted is mostly heavily disturbed having been exposed to logging/thinning, firewood collection, tracks and grazing. Compared with adjacent habitat within Vickery State Forest, the habitat in the study area is of a poorer quality. Given that threatened species that would be affected by the Project are highly mobile (birds and bats) it is likely that local populations of these species also utilise Boonalla Conservation Area, and revegetation as part of the compensatory habitat package for the Rocglen Mine is strengthening the link between these areas of remnant vegetation in the locality.

Table 17. Total Area of Woodland/Forest Vegetation Disturbance Compared to the Estimated Amount Remaining within the Sub-region

	Regional Vegetation Community[1]	Area of disturbance at Vickery (ha)[2]	Area within the sub-region (ha)[2]	Percentage disturbance
44	White Box - pine - Silver-leaved Ironbark shrubby open forests, Brigalow Belt South	218.2	54,667.2	0.4
17	Box-gum grassy woodlands, Brigalow Belt South and Nandewar	4.7	14,602.2	0.03
18	White Box grassy woodland, Brigalow Belt South and Nandewar	64.1	83,920.5	0.08
19	White Cypress Pine - Silver-leaved Ironbark grassy woodland, Nandewar	16.5	871.6	1.9
21	Inland Grey Box tall grassy woodland on clay soils, Brigalow Belt South and Nandewar	23.05	1,406.8	1.64
74	Yellow Box woodland on alluvial plains, mainly Darling Riverine Plains	0	0	-
32	Pilliga Box – Poplar Box – White Cypress Pine grassy open woodland on alluvial loams, Darling RIverine Plains and Brigalow Belt South	0.16	3,124.3	0.005
59	Narrow-leaved Ironbark – pine – box woodlands and open forests, Brigalow Belt South and Nandewar	111.5	52,999.5	0.2
73	River Red Gum riverine woodlands and forests, Darling RIverine Plains, Brigalow Belt South and Nandewar	0.01	24,452.5	<0.001
80	Poplar Box grassy woodland on alluvial clay soils, Brigalow Belt South and Nandewar	0	17,226.6	-
75	Weeping Myall open woodland, Darling Riverine Plains, Brigalow Belt South and Nandewar	0	1,594	-
95	Tall rushlands, reedlands or sedgelands of inland river systems, Darling Riverine Plains, Brigalow Belt South and Nandewar	0	-	-
Total		438	254,865	0.2

Note: the total area of disturbance does not equal that calculated based on Project mapping (1,748 ha; Section 5.1) due to the differences in mapped infrastructure (i.e. not included in vegetation calculations).

[1] Namoi CMA (2013) *Community Profiles* http://www.namoi.cma.nsw.gov.au/416845.html?2

[2] EcoLogical Australia (2009) *Regional Vegetation Mapping – Namoi CMA.*

Given these factors and conditions, it is unlikely that any ecological thresholds would be crossed for affected threatened species populations within the locality such that the Project would lead to a significant loss of these species in the medium to long-term.

Although the loss of vegetation associated with these mines would be compensated for by their respective valuable biodiversity offsets, their clearance requirements nevertheless represents a net loss of biodiversity in the immediate region in the short term until rehabilitation. However, in the context of the broader sub-region, substantial areas of similar vegetation to that on these mines and the Project study area remain and**Error! Reference source not found.** provides the estimated amount remaining within the sub-region.

The offset proposed has been based on maintaining or improving biodiversity values of the region in the medium to long-term as required by the DGRs. The offset strategy for the Project is described in Section 6.

5.2 Assessment under Division 4.1 State significant development of the EP&A Act

The following impact assessment has been conducted considering the Guidelines for Threatened Species Assessment under Part 3A of the EP&A Act (DEC and NSW Department of Primary Industries [DPI] 2005) which have been assumed to still apply despite recent changes to State Significant Development planning legislation. These guidelines have been utilised here in relation to affected threatened biodiversity as listed on the TSC Act.

5.2.1 Endangered Ecological Communities

Native vegetation on cracking clay soils of the Liverpool Plains

Whilst the locality and, more broadly, the Liverpool Plains (Part B) IBRA sub-bioregion are likely to contain extensive areas of self-mulching cracking clays, a soil analysis of the study area has demonstrated that these soil types are not present (MacKenzie 2012). Therefore, the EEC Native vegetation on cracking clay soils of the Liverpool Plains is not present on the site and does not require further consideration.

Myall Woodland

The EEC, Myall Woodland, as listed on the TSC Act is present within the southern portion of the study area (80 ha) (Figure 6). Approximately 1 ha of this EEC would be removed by the Project for the Bluevale Road Realignment. This impact has been considered further in Appendix E.

Within the study area, this EEC is characterised by a dominant low overstorey of Weeping Myall (*Acacia pendula*) to 8 m high, an absent mid-storey and shrub layer and a degraded and sparse groundcover.

Management of the Myall Woodland is discussed in Section 6.1.

White Box - Yellow Box - Blakely's Red Gum Woodland

The EEC, White Box – Yellow Box – Blakely's Red Gum Woodland listed on the TSC Act, is present as one isolated remnant patch within the Project area (3 ha) (Figure 6). The Project layout has been designed to avoid a larger patch (5 ha) along South Creek (Figure 6). This EEC occurs along the majority of the Haul Road development site west of Gunnedah (Yellow Box - Blakely's Red Gum Grassy Woodland) and an additional 3 ha of this would be removed by the proposed Haul Road re-alignment in this location (Figure 7b). This impact has been considered further in Appendix E.

Within the study area this EEC exists in a relatively natural state and therefore as a single condition class. Weed cover typically remained low throughout this vegetation community.

White Box – Yellow Box – Blakely's Red Gum Woodland is included in the offset area as discussed in Section 6.2.

Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Darling River (FM Act)

The EEC Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Darling River, as listed on the FM Act, is considered to exist within the Namoi River and its tributaries and floodplains downstream of the junction with the Manilla River at Manilla (DPI 2012). Potential impacts of the Project mining area on this community are assessed in Appendix E. Potential impacts of the Project Private Haul Road and Highway Overpass on this community are assessed in Appendix I. This community is not mapped on the figures within this report although is reported to occur within the drainage lines and floodplains of the Namoi River adjacent to the Project in the vicinity of the Private Haul Road and Highway Overpass.

5.2.2 Flora

An occurrence of 46 *Lepidium monoplocoides* was recorded within the study area and would be removed by the Project (Figure 9). The species is listed as endangered on both the TSC and EPBC Acts. An additional occurrence of an estimated 420 individuals exists approximately 2 km north to north-west of the occurrence within the Project on the edge of the rehabilitated Canyon Coal Mine site (Figure 9).These 420 individuals would be reserved and managed in-perpetuity as part of the on-going rehabilitation of the Canyon Coal Mine site.

These two occurrences are possibly two sub-populations of the same genetic stock that were once linked by a continuous landscape of derived native grassland on light clays through what is now the Canyon Coal Mine void and emplacement. Whether considered as part of a single population or two separate populations, a series of amelioration measures, including offsetting, have been recommended (Section 6).

D. porrecta has not been recorded within the study area. However, flora surveys undertaken for this Project were undertaken in November outside of the optimal survey period for this species (mid-January to late February). As such, pre-clearance surveys would be undertaken for *D. porrecta* in suitable potential habitat between December and May 2014. The surveys would be undertaken by an appropriately qualified person (Section 6.1).

5.2.3 Fauna

Developments can impact upon fauna in a number of ways. The significance of an impact would be greatest if any of the following situations occur:

- death or injury of individuals;
- loss or disturbance of limiting foraging resources; and
- loss or disturbance of limiting breeding resources.

Limiting resources are those that are important for a particular species survival. For example, animals that only feed on certain types of plants or only breed in certain habitats such as tree hollows.

The assessment of affected threatened fauna in Section 4.2.4 concluded that 24 threatened species listed on the TSC Act have the potential to be affected by the Project, although none significantly.

The impacts from the Project on each of these species is assessed according to the guidelines in Appendix E.

A series of amelioration measures in relation to the management of the habitat for these 24 threatened fauna species would be implemented in order to minimise the impacts from the Project. Amelioration measures are discussed in detail in Section 6.

5.3 Assessment under the EPBC Act

The Project has been referred to the SEWPaC (Whitehaven 2011) and has been determined as not being a controlled action. Therefore no further assessment is provided within this document.

5.4 State Environmental Planning Policy No. 44 – Koala Habitat Protection

SEPP 44 aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for Koalas to ensure a permanent free-living population over their present range and reverse the current trend of Koala population decline:

a) by requiring the preparation of plans of management before development consent can be granted in relation to areas of core Koala habitat; and

b) by encouraging the identification of areas of core Koala habitat; and

c) by encouraging the inclusion of areas of core Koala habitat in environment protection zones.

A number of criteria in the SEPP 44 are to be considered during an assessment of potential Koala habitat. These criteria are set out and assessed below.

1. Does the policy apply? Does the subject land occur in a LGA identified in Schedule 1?

The study area occurs in the Gunnedah LGA, which is listed under Schedule 1 of SEPP 44.

2. Is the landholding to which the DA* (the proposed State significant development in this case) *applies greater than 1 hectare in area?

Yes.

3. Is the land potential Koala habitat? Does the site contain areas of native vegetation where the trees of types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component?

The study area contains River Red Gum (*Eucalyptus camaldulensis*), White Box (*E. albens*) and Poplar Box (*E. populnea*) which are listed as Koala feed tree species on Schedule 2 of SEPP 44. Within the study area, each of these species are dominant in their relevant vegetation communities and would represent at least 15% or more of the total number of trees in the upper or lower strata.

4. Is the land core Koala habitat?

Under SEPP 44 ***core Koala habitat*** means an area of land with a resident population of Koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population.

Whilst it is clear that the Gunnedah LGA and, more broadly the Liverpool Plains (Part B) IBRA sub-bioregion, supports a healthy and viable population of Koala, three recent fauna surveys have not detected this species within and immediately adjacent to the study area (current study; Cenwest Environmental Services 2011; RPS 2010). Therefore, despite the dominance of Koala feed tree species within the study area it is considered unlikely that the land represents core Koala habitat as defined in SEPP 44.

Conclusion

The study area does not contain core habitat for Koalas as defined by SEPP 44. A plan of management for this species is not considered necessary.

6 AMELIORATION MEASURES

6.1 Avoid and Mitigate

The Project mine layout has been designed, as far as is practicable, to avoid items of high ecological value. For example, initial designs for the Project and emplacement areas would have resulted in the complete removal of the White Box - Yellow Box - Blakely's Red Gum Woodland EEC from within the study area, but the design was modified to avoid this community in the eastern portion of the Project mining area. The Project has also been designed to avoid direct disturbance to the Vickery State Forest, the Namoi River and riparian vegetation associated with the Namoi River.

The residual impacts of the Project and the applicable mitigation measures are summarised in Table 18. With the exception of those measures relating to sediment and erosion control, it is recommended that each of these mitigation measures, are brought together within a Biodiversity Management Plan (BMP) for the Project and Haul Road developments. The BMP should be a graphical, working document and list specific actions to be carried out in a staged manner, such that on-ground managers and operators can easily implement the actions.

Table 18. Mitigation Measures

Impact	Mitigation Measure
Direct impacts	
Removal or Modification of Native Vegetation	1. Development and implementation of a BMP to describe in detail all site management actions contained herein. 2. Stripping and management of healthy soil for use in rehabilitation. 3. Re-alignment of Bluevale Road to avoid woodland vegetation where possible, particularly EEC vegetation. 4. Weed management. 5. Seed collection and propagation of local provenance tubestock for use in rehabilitation. 6. Monitoring and performance evaluation adopted vegetation management actions.
Removal of threatened species (*Lepidium monoplocoides*)	7. Collection and propagation of seed over as many seasons as possible prior to mining. 8. Installation of tubestock at recipient site (i.e. the occurrence located immediately west of the Canyon rehabilitation area). 9. Translocation of soil profile from impacted *Lepidium monoplocoides* habitat (in and around the population) to nominated recipient site. 10. Long-term conservation of the Canyon Coal Mine occurrence including fencing and signage of the area with a 20 m buffer. 11. Translocating the occurrence of 46 individuals from within the Western Emplacement to the fenced protected area, detailed in the above point. 12. Monitoring and performance evaluation adopted *L. monoplocoides* management actions including Whitehaven contribution to additional survey and monitoring of the species in Pilliga National Park. The northern Pilliga occurrence to be used as a 'Control'.

Impact	Mitigation Measure
Direct impacts	
Rapid Restoration/Enhancement of Weeping Myall	13. A programme would be implemented to retain and manage vegetation along a portion of Stratford Creek, including approximately 80 ha of the Weeping Myall EEC (Figure 5b). Weeping Myall EEC is located along the main flood channel of Stratford Creek and is characterised by a dominant low over-storey of Weeping Myall (*Acacia pendula*) to 8 m high with an absent mid-storey and shrub layer and a degraded and sparse groundcover. The perimeter of the area would be fenced with a stock proof fence to facilitate regeneration of the native vegetation. Whitehaven would undertake control of weeds within this area.
Finger Panic Grass (*Digitaria porrecta*)	14. Pre-clearance surveys would be undertaken for the Finger Panic Grass (*Digitaria porrecta*) in suitable potential habitat between December and May 2014. The surveys would be undertaken by an appropriately qualified person. If Finger Panic Grass is identified in the Project area during the pre-clearance surveys, the following management measures would be evaluated and applied, where practicable: • evaluation of whether the occurrence can be avoided (e.g. modifying a stockpile); • further survey work to evaluation the complete extent of the population; • collection and propagation of seed/vegetative material for use in revegetation and rehabilitation; and/or • conservation of Finger Panic Grass in an offset area or funds towards conservation of Finger Panic Grass in NSW.
Removal or Modification of threatened fauna micro-habitat (i.e., other than native vegetation)	15. Minimisation of removal of hollow trees, logs and stags. 16. Removal of the potential owl roost tree in spring or summer. 17. Removal of hollow-bearing trees (other than the owl roost tree) in autumn or winter, where practicable. 18. Clearing monitoring, two-staged clearing, fauna rescue and relocation of micro-habitat features. 19. Monitoring and performance evaluation of fauna micro-habitat management actions.
Staged and progressive rehabilitation of the Project mining area.	20. Once mining areas are no longer active, these areas would be rehabilitated to either native woodland/forest or land suitable for agricultural uses. The northern section of the Western Emplacement would be revegetated with native tree, shrub and grass species, creating a native woodland/forest corridor that would connect the existing native vegetation in the Vickery State Forest with the Namoi River (Figure 28).
Indirect impacts	
Deleterious hydrological changes in relation to management of biodiversity	21. Project design to incorporate measures that account for natural hydrology where alteration may have an impact on biodiversity. 22. Haul Road design and construction to be implemented with regard to possible impacts on EECs.
Sedimentation and erosion	23. Use of existing disturbed areas and tracks. 24. Development and implementation of a Construction Environmental Management Plan especially describing staged clearing and management of tracks and roads (cross-banks, drains, culverts, sedimentation basins, revegetation of batters, etc.), in order to minimise sediment-laden scouring, run-off and subsequent deposition.
Weed invasion	25. As per Point 4 above. 26. Implement management responsibilities as required under the NVM Act.
Increased human activity within or directly adjacent to native vegetation or otherwise sensitive habitat areas	27. Implementation of exclusion zones in retained native vegetation or vegetation staged for clearing. 28. Highlight exclusion zones during inductions to staff and contractors.
Fire	29. The Biodiversity Management Plan would include bushfire management measures such as clearing restrictions, controlled grazing, restricted vehicle movements, fire breaks, no smoking areas, fire fighting equipment and training.
Dust	30. Dust and air quality controls include details on soil stripping, water spraying, minimising vegetation clearance, enclosing crushing/screening facility, schedule of blasting and progressive rehabilitation.

Impact	Mitigation Measure
Direct impacts	
Lighting	31. Lighting strategies/control measures to minimise potential artificial lighting impacts would include the use of unidirectional lighting fixtures.
Noise	32. Noise mitigation measures to be used at the Project to achieve the relevant noise conditions in the Project Approval, if granted.
Farm Management	33. Management measures include proactive management of stock, selected areas of natural regeneration and riparian restoration along semi-permanent creek/drainage lines (South Creek and Stratford Creek).
Fish impacts	
Drawing of threatened fish and/or eggs into water supply pump system	34. Installing a suitable self-cleaning screen that would reduce intake of fish eggs and larvae at the pump inlet. 35. Starting pump slowly and the ramping up velocity of a level that reduces likelihood of fish in the vicinity being drawn into pump. 36. Regular cleaning of screen to dislodge trapped organisms.

6.2 Offsetting

In order to maintain or improve biodiversity values of the region in the medium to long-term, as required by the DGRs for the Project, offsets would need to be provided in relation to the unavoidable impacts of the Project. This section provides an assessment of the adequacy of the proposed biodiversity Offset Area by comparing against the principles for the use of biodiversity offsets in NSW (OEH 2011a). Full descriptions of the ecological values of the biodiversity Offset Area (Willeroi East Offset Areas) is provided in a separate report (Niche 2012), Appendix K of this report.

This section focuses on the Willeroi East component of the proposed biodiversity offset. The *Lepidium monoplocoides* offset (including conservation, translocation, monitoring and regional research) is a pre-existing commitment from the EPBC assessment and Particular Manner decision process, is described in Section 6.1, Table 18 and the relevant assessment in Appendix E. The *Lepidium monoplocoides* offset is in addition to the biodiversity offset described in this section and further increases the ecological gains of the Project.

Measures that are proposed to avoid and mitigate impacts from the Project on fauna are described in Section 5. This section describes an offset proposal aimed at addressing the residual impacts. Environmental offsets are defined by the Australian Government as (SEWPaC, 2011c): measures to compensate for the adverse impacts of an action on the environment.

The offset proposal for the Project involves conserving an area of land with existing fauna and flora conservation values and providing active management to maintain and enhance the values. The proposal has been prepared considering:

- Specific government advice on the Project:
  - NSW Planning and Infrastructure Director-General's Requirements; and
  - OEH's Recommended EAR's.
- A number of government guidelines:
  - OEH's principles for the use of biodiversity offsets in the NSW (OEH, 2012c);

- *Namoi CMA Biodiversity Offsets Policy* (Namoi CMA, 2011b); and
- *Namoi Catchment Action Plan 2010-2020* (Namoi CMA, 2011a).

This section provides an assessment of the adequacy of the proposed offset by comparing it against the principles for the use of biodiversity offsets in NSW (OEH 2011a).

6.2.1 Offset Area Proposal - Management, Security, Monitoring and Auditing

Conservation in Perpetuity

The land tenure underlying the proposed offset area would be secured in perpetuity for conservation of native flora and fauna. Whitehaven Coal intends to reach an agreement with the NPWS so that the proposed offset area can be added to the adjoining Mount Kaputar National Park (Figure 1). Mount Kaputar National Park was created in 1967 and presently covers an area of 50,225 ha (OEH, 2012d).

If the proposed offset area is not accepted by NPWS an alternate arrangement would be made to ensure long-term protection and management of the offset area within 12 months of Project approval (e.g. a voluntary conservation agreement with the NSW Minister for the Environment).

Proposed Management and Management Plan

The proposed offset area would be managed to enhance its values for native flora and fauna. The proposed offset area would be managed similar to the management of Mount Kaputar National Park. A number of policies from the Mount Kaputar National Park Plan of Management (NPWS, 2006) are outlined in Table 19 along with a description of how the policy relates to the proposed offset area.

Table 19. Mount Kaputar National Park Plan of Management

Policy from the *Mount Kaputar National Park Plan of Management* (NPWS, 2006)	How the policy relates to the proposed offset area
Native Vegetation	
Native vegetation will be managed to: • *maintain floristic and structural diversity;*	The diversity of the area would be protected through conservation in perpetuity and appropriate management.
• *conserve threatened or uncommon communities and species;*	The proposed offset area contains Box-Gum Woodland and Vine Thicket EEC and a variety of threatened fauna species.
• *encourage regeneration of areas previously cleared or grazed; and*	A substantial area of derived native grasslands (previously cleared land) in the proposed offset area would be revegetated (248 ha).
• *maximise habitat values for native animal species.*	The native vegetation in the proposed offset area would be managed to maximise the habitat values, through revegetation, habitat manipulation, habitat enhancement, weed control, animal pest management.

Policy from the *Mount Kaputar National Park Plan of Management* (NPWS, 2006)	How the policy relates to the proposed offset area
Areas of degraded vegetation, old tracks or previously cleared areas not needed for recreation or management purposes will be rehabilitated.	A substantial area of derived native grasslands (previously cleared land) in the proposed offset area would be revegetated (248 ha) either through natural regeneration and/or appropriate plantings.
Only plant species endemic to Mount Kaputar National Park will be used in revegetation work. As far as possible plant material will be propagated from communities within the area to be treated.	Only plant species endemic to the local area surrounding the offset would be used in revegetation work.
Research into the abundance, distribution and management needs of rare and threatened plant species and communities shall be encouraged and supported. Information gained shall be utilised in any works undertaken, particularly fire and pest [weed] management.	Flora surveys undertaken in the proposed offset area (Appendix K) gives an indication of the abundance, distribution of plants and plant communities. A programme would be undertaken to monitor and report on the effectiveness of the measures and the performance of the offset.
Fauna	
The diversity and high quality of habitats for native animals occurring in the national park will be conserved.	The diversity of the area would be protected through conservation in perpetuity and appropriate management.
Priority will be given to management strategies or programs that favour conservation of threatened species. However, as far as possible programs will be designed to conserve the full range of native animal species in the park.	The fauna habitats in the proposed offset area would be managed to maximise their habitat values, through revegetation, habitat manipulation, habitat enhancement, weed control, animal pest management and enhancement of existing habitat resources (farm dams).
Research and monitoring shall be encouraged into the status, distribution and management needs of animal species within the park, with greatest priority given to threatened species and declining woodland birds.	Fauna surveys have been undertaken in the proposed offset area (Appendix K). A programme would be undertaken to monitor and report on the effectiveness of the measures and the performance of the offset.

An Offset Area Management Plan would be prepared by a suitably qualified person(s) within 12 months of Project approval to facilitate the management of the offset area prior to transfer to the NSW NPWS and managed by OEH. The management plan would provide further detail on the concepts described here. A number of management measures are listed and described below based on detailed flora and fauna surveys of the proposed offset area (Appendix K) and an assessment of the measures required to enhance the flora and fauna values of the area:

- natural regeneration and revegetation;
- habitat enhancement;
- habitat manipulation;
- control of weeds;

- pest management; and
- fire management.

Natural Regeneration and Revegetation

The primary method for revegetating the 248 ha of previously cleared farmland (comprising native grasslands) in the offset area would be through management of threatening processes that inhibit natural regeneration. Although the offset land was previously a cattle station predominantly used for grazing livestock, the livestock have been removed since the property was purchased in 2010 and natural regeneration processes have commenced. The land is considered to have moderate to high resilience despite the past disturbance, evidenced by regrowth of trees and native understorey (Appendix K).

It is also noted that White Cypress Pine has regrown in some areas of the proposed offset area form a dense locked growth monoculture. White Cypress Pine regrowth may become a management issue for the regeneration of White Box Woodland in the derived grasslands requiring monitoring and adaptive management actions. These may include ecological thinning supplemented with appropriate plantings or seeding of White Box using local seed sources.

Eucalypt regeneration in the derived grasslands could also be suppressed in the short-term due to the dense grassy layer in the derived grasslands. Management options that cause some disturbance to the grassland could be trialled. For example, slashing or low-intensity controlled burning around paddock trees before seed fall and seasonal rains. In areas with no paddock trees, disturbance could be caused before seasonal rains to encourage regrowth from soil seed stores.

The areas of active erosion would be actively revegetated through minor erosion and sediment control works and appropriate plantings or seeding of species represented in the surrounding native vegetation communities. Again, local seed sources would be used.

The aim of natural regeneration and revegetation would be to establish a range of habitat niches through revegetation (including canopy, understorey and ground cover). The revegetation of cleared land would help restore internal connectivity of woodland and forest habitats within the proposed offset area.

It should be noted that the current vertebrate faunal diversity across the proposed offset area is likely partly dependent on the disturbed and patchy nature of the landscape, significant forest and woodland edges adjacent to derived or exotic grasslands, a range of successional regrowth stages across the landscape and the extent and range of broad habitat types present. This very variable habitat creates a significant range of habitat niches that partly explain the species diversity present. Hence it would be important in the management plan to provide for the management of this landscape to optimise the available range of habitat types, stages and niches present in the landscape, if the current level of species diversity is to be maintained.

Habitat Manipulation

Habitat manipulation would likely be required to optimise vertebrate species diversity in the offset area. The aim of the revegetation is to restore woodland/open woodland habitat. Growth-locked expansive stands of White Cypress Pine regrowth can also exclude some species but nevertheless can be an important component in creating a diverse range of habitat types within the offset area, if they help to diversify patchiness in the landscape. Regenerating woodland can also grow back in forest formation.

Such areas, if likely to be extensive, might need to be managed, for example, by selected thinning to create an optimal outcome for species diversity. This is because if the whole offset area reverted to a forest – closed woodland habitat, forest-woodland edges and open grasslands could be eliminated leading to the loss of some existing species from the area such as the Grey-crowned Babbler (eastern subspecies) and Diamond Firetail. The principles and opportunities for implementing appropriate habitat manipulation strategies would be further developed in the proposed Offset Management Plan.

Habitat Enhancement

A range of habitat enhancement initiatives would be adopted in managing this landscape for optimal species diversity. These might include the use of: the provision of supplementary ground log cover that could be sourced from limited habitat thinning outcomes, disused fence posts; and ensuring that some dams retain water for longer periods of time. The principles and opportunities for implementing appropriate habitat enhancement strategies would be further developed in the proposed Offset Management Plan.

Control of Weeds

Three noxious weeds listed under the NSW Noxious Weeds Act, 1993 for the Narrabri Shire Council area were recorded within the offset area, namely *Xanthium* sp., Prickly Pear (*Opuntia* sp.) and St. John's wort (*Hypericum perforatum*). None of these noxious weeds are particularly abundant. In addition to these species, environmental weeds (e.g. Sweet Briar and Coolatai Grass) were more common in the low lying areas, gentle slopes and adjacent to drainage lines.

Weeds would be controlled and monitored by an appropriately qualified contractor. Woody weeds within the derived grassland areas were observed to be used by a range of small birds. These woody weeds would be removed gradually and replaced with appropriate plantings of native shrubs to minimise disruption to native birds that use the woody weeds as habitat.

Animal Pest Management

Introduced species were located during the survey of the proposed offset area. These included the Goat, Rabbit, Black Rat, Pig, Deer and Red Fox (Attachment K). Animal pests would be controlled and monitored by an appropriately qualified contractor.

Monitoring

A programme would be undertaken to monitor and report on the effectiveness of the measures and the performance of the offset, with summary reporting to be carried out annually and comprehensive reporting following the independent environmental audit. The monitoring would be undertaken by a suitably qualified person(s).

Independent Audits

The proposed offset area would be independently audited at intervals agreed with relevant authorities. The audits would be conducted by a suitably qualified person(s) to:

- assess compliance with the management plan;
- assess the performance of the proposed offset area;
- review the adequacy of the management measures and monitoring programme; and
- recommend actions or measures to improve the performance of the offset, management plan, or monitoring programme.

Completion Criteria

Completion Criteria are presented in Table 20.

Table 20. Proposed Offset Completion Criteria

Component	Completion Criteria
Enhancement Areas (i.e. existing woodland/forest)	Areas of existing remnant vegetation within the proposed offset area (1,396 ha) have been conserved and enhanced.
Revegetation Areas (i.e. derived grasslands and cleared land)	248 ha of revegetated woodland/open woodland habitat areas as a self-sustaining ecosystem[1].

[1] The methodology for determining a self-sustaining ecosystem shall be to the satisfaction of the Director-General.

6.2.2 Flora and Fauna Characteristics of the Proposed Offset Area

Regional Location

The proposed offset area is located within the same CMA region as the Project area (i.e. the Namoi CMA Region) and therefore has the capacity to benefit biodiversity values in the same region as the Project.

Existing Reserve System

The proposed offset area compliments the existing reserve system in NSW. It is located on the south-eastern boundaries of Mount Kaputar National Park (via an existing Whitehaven proposed offset for another project) (Figure 1). It is also located directly south of an area proposed as a conservation area for the Maules Creek Project by Aston Resources (Cumberland Ecology, 2011) (Figure 1).

Regional Conservation Priorities

There are a number of regional priorities for biodiversity conservation in the Namoi CMA Region (Namoi CMA, 2011). One conservation priority is the buffering of habitat from the potential impacts of climate change (Namoi CMA, 2011). The proposed offset area is located within an OEH recognised 'high priority area', 'regional key fauna habitat' and climate change linkage, as described and mapped in the Wildlife Corridors for Climate Change – New England Tablelands and Nandewar bioregions - Landscape Selection Process, Connectivity for response to Climate Change (DECC, 2007b) (Figure 27).

Tenure of the Proposed Offset Area

The proposed offset area is located on the Willeroi property. It is owned and managed by Whitehaven Coal and therefore there is certainty of the offset proposal and it is not subject to purchasing additional land. As previously stated, the land tenure underlying the proposed offset area would be secured in perpetuity for wildlife conservation (Section 5).

A 132 kilovolt power line runs east-west through the proposed offset area. The overhead lines vary in distance from the ground and are higher where they span valleys, such that the clearance allows for woodland to grow beneath the overhead lines in those areas. In other sections of the line, a clearance corridor is maintained by Country Energy.

These powerlines continue through the lower portion of Mount Kaputar National Park. The existence of the power line would not significantly undermine the value of the proposed offset area.

Shape

The shape of the proposed offset area conforms to the land tenure boundary to the north, west and east. The western extent of the proposed offset area is the western side of Maules Creek and abuts an existing Whitehaven proposed offset. The proposed offset area is one 1,671 ha continuous block rather than multiple smaller areas.

Area

The proposed offset area for the Project covers approximately 1,671 ha of land, and comprises of approximately 1,396 ha of existing forest/woodland and 275 ha of cleared farmland (with 248 ha of derived native grasslands and 27 ha of erosion/scald) that would be restored with species characteristic of the naturally occuring woodland.

Table 21 provides a summary of the non-grassland vegetation types to be impacted against those to be conserved by the offset. The offset ratios provided in Table 22 would be greater if the cleared areas within the offset area (i.e. 275 ha) were included as these areas are proposed to be regenerated/revegetated with species characteristic of a woodland.

Table 21. Quantification of the Proposed Offset Area

Vegetation Type	Project Disturbance (ha)	Willeroi East Offset Area (ha)	Offset Ratio
Mature and Derived Woodland/Forest/Shrubland/Sedgeland	55	256	5:1
a. Cypress Regeneration	188	549	3:1
b. Semi-cleared	187	591	3:1
e. Mature Cypress Woodland	25	0	-
f. Mature Cypress Forest	9	0	-
Total	464	1,396	3:1

The derived grassland to be impacted by the Project is a result of previous vegetation clearance and continued agricultural land use. The biodiversity offset provides an overall better conservation outcome by conserving and enhancing 1,396 ha of Woodland/Forest/Shrubland/Sedgeland and 248 ha of derived grassland, compared to the 464 ha of Woodland/Forest/Shrubland/Sedgeland and 1,284 ha of derived grassland that would be cleared for the Project. The total area to be conserved is 1,671 ha.

Table 22. Broad Fauna Habitat Types – Quantities

Broad Fauna Habitat Types	Disturbance Area (ha)	Offset Area (ha)
Woodland/Forest	273	1,132
Native Grassland	1,284	248
Cypress Regeneration	188	121
Shrubland	1	32
Sedgeland	2	0
Vine Thicket	0	19
Riparian	0	92
Total	1,748	1,644

Vegetation

Flora surveys were undertaken within the proposed offset area during March and April 2012 by Niche (Appendix K). A total of 10 native vegetation communities are present in the proposed offset area including shrubby forests and woodlands dominated by combinations of White Box (*Eucalyptus albens*), Narrow-leaved Ironbark (*E. crebra*) and White Cypress Pine (*Callitris glaucophylla*) on rugged terrain; grassy woodlands dominated by combinations of White Box, Yellow Box (*E. melliodora*) and/or Rough-barked Apple (*Angophora floribunda*) on more fertile soils and gentler terrain; and riparian forests dominated by Bracteate Honeymyrtle (*Melaleuca bracteata*).

The Box-Gum Woodland EEC and the Vine Thicket EEC are present in the proposed offset area. The proposed clearance of Box-Gum Woodland EEC (approximately 6 ha) is offset with a substantial area of existing Box-Gum Woodland EEC (approximately 156 ha) (Table 23). The 6 ha of the White Box – Yellow Box – Blakely's Red Gum Woodland EEC that would be cleared is existing woodland and this would be offset with 156 ha of derived grasslands. Although the values are not currently equal, with active restoration of the woodland in the offset area, it is anticipated that there would be a substantial net gain in biodiversity values in the medium to long-term. Although features, such as tree hollows, would take a long time to form, these features are present in other vegetation communities in the offset area.

The Box-Gum Woodland EEC that occurs in the proposed offset area is more diverse than that which would be cleared. This is due to the presence of the Yellow Box – Blakely's Red Gum Grassy Woodland, forming Riparian/Floodplain Habitat for a variety of fauna species.

The offset area contains approximately 19 ha of Vine Thicket EEC while the Project would not disturb any of this community (Table 23).

Table 23. Comparison of Endangered Ecological Communities between the Project and the Proposed Offset Area

EEC	Total Impact (ha)	Total Offset (ha)	Ratio
White Box Yellow Box Blakely's Red Gum Woodland	6	156	31:1
Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions	0	19	-
Weeping Myall Woodlands	1	0	-
Total	**7**	**175**	**25:1**

The threatened flora species, *Swainsona sericea*, was recorded within the offset area although was not recorded at the Project. Furthermore, White-flowered Wax Plan (*Cynanchum elegans*) was recorded by Niche in a previous survey of the adjacent Willeroi west property which has now become an offset for the Tarrawonga Coal Mine. Given that the Willeroi East Offset Area is adjacent and contains similar habitat it is likely that the species would be present.

White Box - White Cypress Pine - Mature Cypress Forest would be impacted by the Project and offset by other forms of White Box - White Cypress Pine. Two forms of Silver-leaved Ironbark - White Box - White Cypress Pine would be impacted by the Project (i.e. Silver-leaved Ironbark - White Box - White Cypress Pine – Semi-cleared and Silver-leaved Ironbark - White Box - White Cypress Pine - Mature Cypress Woodland) these would be offset by other vegetation types with similar habitat values.

Ecosystem Resilience

Resilience is the ability of an ecosystem to return to its former state after it has been disturbed (McIntyre *et al*. 2002). As previously stated, although the offset land was previously part of a cattle station, the livestock have been removed since the property was purchased in 2010 and natural regeneration processes have commenced. This is evidenced by regrowth of trees and thick (grassy) understorey. The existing ecosystem is considered to have a moderate to high resilience despite the past and current disturbances.

This description of ecosystem resilience is consistent with the 'Resilience Thinking' approach outlined in the Namoi Catchment Action Plan 2010-2020 (Namoi CMA, 2011).

Broad Fauna Habitat Types

All of the main broad fauna habitat types disturbed by the Project are represented in the proposed offset area, with the exception of Shrubland (1 ha) and Sedgeland (2 ha) (Table 22; Figure 14). Examples of broad fauna habitat types in the proposed offset area are shown on Plates 16-21.

Watercourses

A number of ephemeral creek lines occur in the proposed offset area. The most prominent is Maules Creek (approximately 13 km).

Native Fauna Present

Fauna surveys were undertaken within the proposed offset area during March and April 2012. During the survey, a total of 93 species were recorded, including five amphibians, five reptiles, 61 birds and 22 mammals (Attachment K).

Threatened Species

In relation to threatened fauna, all but two species recorded in or adjacent to the Project (or considered potential occurrences) have also either been recorded or area considered potential occurrences within the proposed offset area.

The two threatened fauna that are not considered to have habitat at the Willeroi Offset Area are the Blue-billed Duck and Gilbert's Whistler. In the case of the Blue-billed Duck, the animal recorded within the Project was considered to be occupying a small area of sub-optimal habitat which was unlikely to support a viable local population of the species. It was probable that the animal was resting while in transit. The Gilbert's Whistler record from the nearby Rocglen Coal Mine site (RPS 2010) is considered unusual as the nearest previous know record is from the Warrumbungles National Park, over 100 km to the south-west. It is highly unlikely that the individual recorded forms part of a viable local population within the locality.

Plate 16: Cypress Regeneration Habitat

Plate 17: Forest Habitat

Plate 18: Heathland Habitat

Plate 19: Riparian Habitat

Plate 20: Vine Thicket Habitat

Plate 21: Woodland Habitat

6.2.3 Address of NSW offsetting principles

The following principles provide a framework for considering environmental impacts and developing offset Projects (OEH 2011a). The principles do not apply where legislation defines requirements for biodiversity offsets. Each of these principles has been addressed in relation to the impacts associated with the Project. Italicised text in quotes is direct from the OEH web-site with the address of each principle beneath.

1. Impacts must be avoided first by using prevention and mitigation measures.

"Offsets are then used to address remaining impacts. This may include modifying the proposal to avoid an area of biodiversity value or putting in place measures to prevent offsite impacts."

Address of principle

A description of on-site avoidance and mitigation of areas of biodiversity value has been provided in Section 6.1 and listed in Table 18.

The Project mine layout has been designed, as far as is practicable, to avoid items of high ecological value. It is recommended that each of the mitigation measures are brought together within a BMP for the Project and Haul Road developments. The BMP will be a graphical, working document and list specific actions to be carried out in a staged manner, such that on-ground managers and operators can easily implement the actions.

2. All regulatory requirements must be met.

"Offsets cannot be used to satisfy approvals or assessments under other legislation, e.g. assessment requirements for Aboriginal heritage sites, pollution or other environmental impacts (unless specifically provided for by legislation or additional approvals)."

Address of principle

The proposed Willeroi East Offset Area has been provided to satisfy the biodiversity assessment requirements of the EP&A Act and the EPBC Act. The Offset Area, as required by the NSW planning framework, are also recognised by the SEWPaC. Approval for the Project has been granted under the EPBC Act, subject to conditions.

3. Offsets must never reward ongoing poor performance.

"Offset schemes should not encourage landholders to deliberately degrade or mismanage offset areas in order to increase the value from the offset."

Address of principle

Whitehaven has previously secured biodiversity offsets for other mining activities within the Namoi CMA, including the Tarrawonga and Narrabri operations. Offsets for the Project would also be secured and managed for conservation in-perpetuity. All current and proposed offset sites are managed for conservation and no other purpose.

In this way Whitehaven has demonstrated its capacity to comply with biodiversity guidelines and planning law. Furthermore, Whitehaven conduct on-site monitoring and auditing of their offset sites to ensure that conservation goals are being met.

4. Offsets will complement other government programs.

"A range of tools is required to achieve the NSW Government's conservation objectives, including the establishment and management of new national parks, nature reserves, state conservation areas and regional parks and incentives for private landholders."

Address of principle

It is anticipated that a Biodiversity Offset Strategy would be a Condition of Consent and will require security of the offsets in perpetuity and funding of management actions, including land management, erosion control, revegetation/rehabilitation and monitoring. Whitehaven proposes that the Willeroi East Offset Area is transferred to the NSW National Parks and Wildlife Service and managed by OEH.

5. Offsets must be underpinned by sound ecological principles.

"They must:

- *include the consideration of structure, function and compositional elements of biodiversity, including threatened species*
- *enhance biodiversity at a range of scales*

- *consider the conservation status of ecological communities*
- *ensure the long-term viability and functionality of biodiversity.*

Biodiversity management actions, such as enhancement of existing habitat and securing and managing land of conservation value for biodiversity, can be suitable offsets. Reconstruction of ecological communities involves high risks and uncertainties for biodiversity outcomes and is generally less preferable than other management strategies, such as enhancing existing habitat."

Address of principle

The provision and management of the proposed Willeroi East Offset Area constitutes the 'enhancement of existing habitat and securing and managing land of conservation value for biodiversity'. The offset proposed has been based on maintaining or improving biodiversity values of the region in the medium to long-term as required by the DGRs. The address of Principle 9 examines this in more detail.

The offset property proposed has been chosen with regard to compensating appropriately the ecological communities and species affected by the proposed development. The proposed package:

- includes consideration of structure, function and compositional elements of biodiversity, including threatened species;
- aims to enhance biodiversity at a local and regional scale;
- provides a net benefit to biodiversity conservation at both local and regional scales;
- considers the local conservation status of the White Box – Yellow Box – Blakely's Red Gum Woodland EEC by providing a local offset for this community; and
- aims to ensure the long-term viability and functionality of biodiversity at the proposed Willeroi East Offset Area.

6. Offsets should aim to result in a net improvement in biodiversity over time.

"Enhancement of biodiversity in offset areas should be equal to or greater than the loss in biodiversity from the impact site.

Setting aside areas for biodiversity conservation without additional management or increased security is generally not sufficient to offset against the loss of biodiversity. Factors to consider include protection of existing biodiversity (removal of threats), time-lag effects, and the uncertainties and risks associated with actions such as revegetation.

Offsets may include enhancing habitat, reconstructing habitat in strategic areas to link areas of conservation value, or increasing buffer zones around areas of conservation value and removal of threats by conservation agreements or reservation."

Address of principle

As demonstrated in the address of Principle 9, the offset provided will clearly lead to a net improvement in biodiversity over time. It is anticipated that a Biodiversity Offset Strategy will be a Condition of Consent and will require a detailed description of management actions required at the Willeroi East Offset Area. Such management actions may include fencing to exclude stock, weed management, feral animal management, revegetation of heavily degraded areas, import of logs and/or nesting hollows and performance evaluation and monitoring.

The Biodiversity Offset Strategy will also describe the mechanism for securing the offset in perpetuity and funding for its management.

7. Offsets must be enduring - they must offset the impact of the development for the period that the impact occurs.

"As impacts on biodiversity are likely to be permanent, the offset should also be permanent and secured by a conservation agreement or reservation and management for biodiversity. Where land is donated to a public authority or a private conservation organisation and managed as a biodiversity offset, it should be accompanied by resources for its management. Offsetting should only proceed if an appropriate legal mechanism or instrument is used to secure the required actions."

Address of principle

It is anticipated that a Biodiversity Offset Strategy will be a Condition of Consent and will require security of the offset in perpetuity and funding of management actions. Whitehaven would envisage that the Willeroi East Offset Area will be secured in-perpetuity through a transfer to the National Parks estate.

8. Offsets should be agreed prior to the impact occurring.

"Offsets should minimise ecological risks from time-lags. The feasibility and in-principle agreements to the necessary offset actions should be demonstrated prior to the approval of the impact. Legal commitments to the offset actions should be entered into prior to the commencement of works under approval."

Address of principle

The Statement of Commitments by Whitehaven will include a commitment to secure the Willeroi East Offset Area. The timing of finalising the security mechanism will be determined in consultation with OEH and to the satisfaction of DP&I.

9. Offsets must be quantifiable - the impacts and benefits must be reliably estimated.

"Offsets should be based on quantitative assessment of the loss in biodiversity from the clearing or other development and the gain in biodiversity from the offset. The methodology must be based on the best available science, be reliable and used for calculating both the loss from the development and the gain from the offset. The methodology should include:

- *the area of impact*

- *the types of ecological communities and habitat/species affected*
- *connectivity with other areas of habitat/corridors*
- *the condition of habitat*
- *the conservation status and/or scarcity/rarity of ecological communities*
- *management actions*
- *level of security afforded to the offset site.*

The best available information/data should be used when assessing impacts of biodiversity loss and gains from offsets. Offsets will be of greater value where:

- *they protect land with high conservation significance*
- *management actions have greater benefits for biodiversity*
- *the offset areas are not isolated or fragmented*
- *the management for biodiversity is in perpetuity (e.g. secured through a conservation agreement).*

Management actions must be deliverable and enforceable."

Address of principle

The assessment of impacts at the Project meet the guidelines as required for such assessments in NSW, both in terms of the background information used, the field survey effort and the targeting of the Willeroi East Offset Area. The ecological assessment of the proposed Willeroi East Offset Area was also done to these standards (Niche 2012).

The Project would impact 54 hectares of mature and derived Woodland/Forest/ Shrubland/Sedgeland, and 375 hectares of Cypress Regeneration and Semi-cleared Woodland/Forest. Approximately 1,671 ha of land will be provided as offset for the Project. Up to 1,396 ha (85%) of this site is intact or regrowth woodland and forest and a further 248 ha (15%) is derived native grassland that would, over time, regenerate to good condition woodland. On this basis, the loss of mature forest and woodland would be offset at a ratio of 8:1 (Table 22).

In relation to the conservation of EECs, approximately 175 ha of EEC will be conserved on the Willeroi East Offset Area to compensate for the loss of 7 ha on the development site (Table 23). The offset property would compensate the loss of the White Box – Yellow Box – Blakely's Red Gum Woodland EEC at a ratio of 31:1 (6 ha cleared and 156 ha conserved). The 6 ha of the White Box – Yellow Box – Blakely's Red Gum Woodland EEC that would be cleared is existing woodland and this would be offset with 156 ha of derived grasslands. Although the values are not currently equal, with active restoration of the woodland in the offset area, it is anticipated that there would be a substantial net gain in biodiversity values in the medium to long-term. Although features, such as tree hollows, would take a long time to form, these features are present in other vegetation communities in the offset area.

The offset property also provides 19 ha of the Semi-evergreen Vine Thicket EEC, although this is not impacted by the Project (see Figure 3 in Appendix K).

A total of 1 ha of the Myall Woodland EEC would be impacted by the Project but not present in the offset property. The impact on the local occurrence of Myall Woodland EEC would instead be mitigated by enhancing the greater area of Myall Woodland EEC mapped in the locality (Section 6.1).

The Willeroi East Offset Area (1,671 ha) adjoins Mount Kaputar National Park and will provide a significant extension to its range.

In relation to the offsetting of habitat for threatened fauna, all but two species recorded in or adjacent to the Project (or considered to have potential habitat within the study area) have been either:

- recorded at the Willeroi East Offset Area; or
- are predicted in the ecosystems of the Willeroi East Offset Area by the Threatened Species Profiles Database; or
- are considered to have at least a moderate likelihood of occurrence at the Willeroi East Offset Area.

The examination of threatened fauna offsetting habitat has been provided in Appendix K.

The two threatened fauna that are not considered to have habitat at the Willeroi Offset Area are the Blue-billed Duck and Gilbert's Whistler. In the case of the Blue-billed Duck, the animal recorded within the Project was considered to be occupying a small area of sub-optimal habitat which was unlikely to support a viable local population of the species. It was probable that the animal was resting while in transit. The Gilbert's Whistler record from the nearby Rocglen Coal Mine site (RPS 2010) is considered unusual as the nearest previous know record is from the Warrumbungles National Park, over 100 km to the south-west. It is highly unlikely that the individual recorded forms part of a viable local population within the locality.

Appendix K demonstrates that the proposed Willeroi East Offset Area would maintain or improve biodiversity values of the region in the medium to long-term for the habitat for each of the threatened fauna recorded at the Project, and for those considered to have a moderate to high likelihood of occurrence.

In relation to the occurrence of 46 *Lepidium monoplocoides* individuals that would be removed by the Project, a number of on-site mitigation measures would be carried out, including the conservation of the occurrence of 420 individuals approximately 2 km to the north in the Canyon Coal Mine rehabilitation area. The mitigation measures have been outlined in Section 6 and also include seed collection and propagation of the impacted population, soil translocation of the area of habitat occupied by the impacted plants and a financial contribution to the study and on-going conservation of the regional population that occurs 85 km to the north-west in Pilliga National Park. The on-going conservation of 420 individuals adjacent to the Canyon Coal Mine rehabilitation area provides a 9.1:1 offset ratio which would greatly improve this species conservation in the region in the medium to long-term.

The random meander survey effort during the field surveys met the NSW guidelines and the season of survey was considered appropriate for the detection of threatened flora throughout the study area. It is considered therefore that *Lepidium monoplocoides* was the only threatened flora species present in the study area despite potential habitat being present for a number of other threatened flora (Section 3.2). Similarly, the threatened flora survey effort at the offset property was also considered adequate. Silky Swainson-pea (*Swainsona sericea*), which is listed as Vulnerable on the TSC Act was recorded at Willeroi East.

Furthermore, White-flowered Wax Plant (*Cynanchum elegans*) was recorded by Niche in a previous survey of the adjacent Willeroi west property which has now become an offset for the Tarrawonga Coal Mine. It is highly likely that the species would also occur on the Willeroi East Offset Area.

10. Offsets must be targeted.

"They must offset impacts on the basis of like-for-like or better conservation outcome. Offsets should be targeted according to biodiversity priorities in the area, based on the conservation status of the ecological community, the presence of threatened species or their habitat, connectivity and the potential to enhance condition by management actions and the removal of threats. Only ecological communities that are equal or greater in conservation status to the type of ecological community lost can be used for offsets. One type of environmental benefit cannot be traded for another: for example, biodiversity offsets may also result in improvements in water quality or salinity but these benefits do not reduce the biodiversity offset requirements."

Address of principle

The address of Principle 9 has demonstrated that the Willeroi East Offset Area is a like-for-like or better conservation outcome for biodiversity. In relation to EECs, Table 23 provides a comparison of the quantities of the probable impact at the Project and the offset provided at the Willeroi East Offset Area.

Whilst Weeping Myall Woodland will not be offset at the Willeroi East Offset Area, the Seven Part Test in Appendix E has clearly demonstrated that this vegetation community within the Project area would not be significantly impacted by the Project due to its severely degraded condition and the negligible amount to be impacted. The impact on the local occurrence of Myall Woodland EEC would instead be mitigated by enhancing the greater area of Myall Woodland EEC mapped in the locality (Section 6.1).

It is considered that this loss is more than made up for by the gains in conservation of Yellow Box – White Box –Blakely's Red Gum Woodland and Semi –evergreen Vine Thicket, thus demonstrating a clear like-for-like or better outcome for EECs and biodiversity.

11. Offsets must be located appropriately.

"Wherever possible, offsets should be located in areas that have the same or similar ecological characteristics as the area affected by the development."

Address of principle

The Project is located wholly within the Brigalow Belt South IBRA bioregion, the Namoi CMA and the Gunnedah LGA. The offset site is more-or-less on the boundary of the Brigalow Belt South and Nandewar IBRA bioregions, within the Namoi CMA and within the Narrabri LGA. The offset site is strategically located in order to complement existing reserves.

The proposed Willeroi East Offset Area would maintain or improve biodiversity values of the region in the medium to long-term as required by the requirements for the Project of the Director-General of the DP&I. The Willeroi East Offset Area has a number of features that ensures that biodiversity values of the region would be maintained or improved in the medium to long-term. These include:

- The offset frees substantial areas of native vegetation from the deleterious effects of livestock grazing, thereby allowing it to recover and improve over time.
- The offsets support examples of all natural vegetation communities from the highest positions in the sub-catchments to the lowest in the floodplains, consequently sampling all the local vegetation communities.
- The offsets comprise Yellow Box – White Box –Blakely's Red Gum Woodland and Semi-evergreen Vine Thicket within their full natural landscape context.
- By encompassing the top of catchments, the likelihood of deleterious influences on the offset from outside is substantially reduced.

12. Offsets must be supplementary.

"They must be beyond existing requirements and not already funded under another scheme. Areas that have received incentive funds cannot be used for offsets. Existing protected areas on private land cannot be used for offsets unless additional security or management actions are implemented. Areas already managed by the government, such as national parks, flora reserves and public open space cannot be used as offsets."

Address of principle

The Willeroi East Offset Area is currently grazing land and is not currently subject to management or funding for conservation. This property is considered a supplementary offset.

13. Offsets and their actions must be enforceable through development consent conditions, licence conditions, conservation agreements or a contract.

"Offsets must be audited to ensure that the actions have been carried out, and monitored to determine that the actions are leading to positive biodiversity outcomes."

Address of principle

It is anticipated that a Biodiversity Offset Strategy will be a Condition of Consent and will require security of the Willeroi East Offset Area into perpetuity and funding of management actions, including on-going monitoring. Whitehaven proposes that the offset areas are secured through transfer to the National Parks estate. The baseline flora and fauna assessment for Willeroi East is available in Appendix K.

6.3 Summary of Ecological Gains of the Proposed Offset

In summary, the proposed offset area has the following values relating to fauna:

- The proposed offset area is located within the same CMA region as the Project area (i.e. the Namoi CMA Region) and therefore has the capacity to benefit biodiversity values in the same region as the Project;
- It is located adjacent to Mount Kaputar National Park and compliments the existing reserve system;
- The proposed offset area is also located in a defined Climate Change Corridor and OEH recognised need to protect the area;
- All the main broad fauna habitat types (with the exception of Shrubland and Sedgeland, total of 3 ha) present in the Project area are represented in the proposed offset area (1,671 ha);
- The proposed offset area has the capacity to improve (with moderate to high resilience) through removal of threatening process and active management;
- Ephemeral creeks such as Maules Creek (approximately 13 km) occur within the proposed offset area providing a diversity of habitats;
- Most of the threatened species recorded in the Project area have also been recorded within the proposed offset area and/or have potential habitat in the proposed offset area;
- Substantial areas of Box-Gum Woodland EEC occur in the proposed offset area (156 ha) and is more diverse than that which would be cleared due to the presence of Yellow Box – Blakely's Red Gum Grassy Woodland, forming Riparian/Floodplain Habitat; and
- An additional EEC (Vine Thicket – 19 ha) is present within the proposed offset area that would not be disturbed by the Project.

7 CONCLUSION

This assessment describes the threatened biodiversity, as listed on the TSC Act and FM Act, that would potentially be affected by the Project, including the associated Haul Road re-alignment located approximately 7 km west of Gunnedah. Threatened biodiversity with potential to be affected by the Project include:

- Two EECs listed under the TSC Act - Myall Woodland and White Box – Yellow Box – Blakely's Red Gum Woodland.
- One EEC listed under the FM Act –Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Darling River.
- One plant species - Winged Peppercress (*Lepidium monoplocoides*).
- Three owl species - Barking Owl, Powerful Owl and Masked Owl.
- Four hollow-dependent micro-bat species - Beccari's Freetail-bat, Corben's Long-eared Bat, Eastern Freetail-bat and Yellow-bellied Sheathtail-bat.
- One hollow dependent arboreal mammal - Squirrel Glider.
- Four raptor species - Grey Falcon, Little Eagle, Square-tailed Kite and Spotted Harrier.
- Eight woodland birds - Brown Treecreeper (eastern subspecies), Diamond Firetail, Gilbert's Whistler, Grey-crowned Babbler (eastern subspecies), Hooded Robin (south-eastern form), Painted Honeyeater, Speckled Warbler and Varied Sittella.
- Four cockatoo or parrots - Glossy Black-cockatoo, Little Lorikeet, Turquoise Parrot and Superb Parrot.

The Project includes a series of 36 mitigation measures relating to the on-going management of biodiversity within the locality, along with the in-perpetuity conservation and management of a large area of native vegetation contiguous with the Mount Kaputar National Park and a large occurrence of *L. monoplocoides* as offsets for unavoidable impacts. It is considered that the Project would maintain or improve biodiversity values of the region in the medium to long-term.

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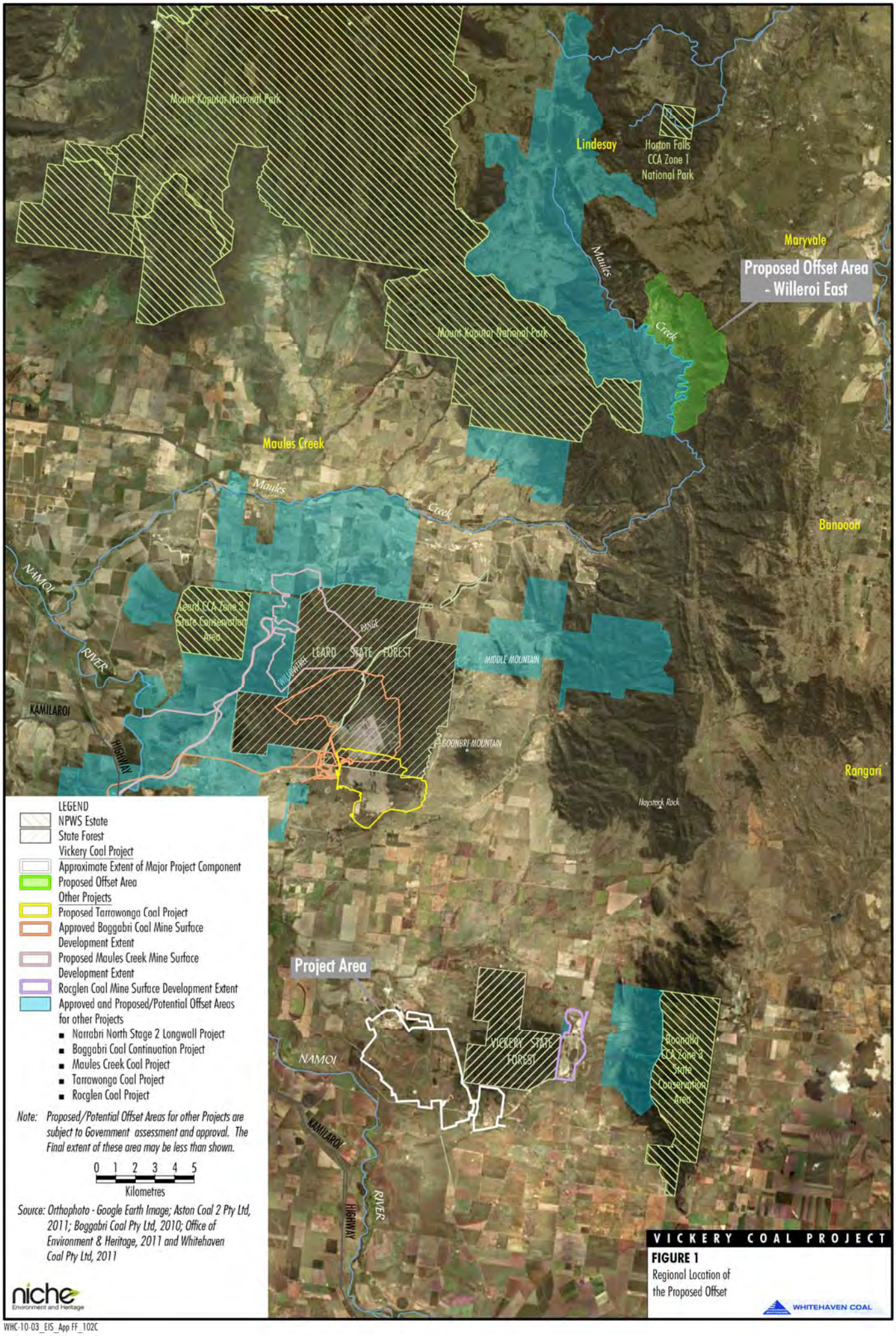
FIGURES



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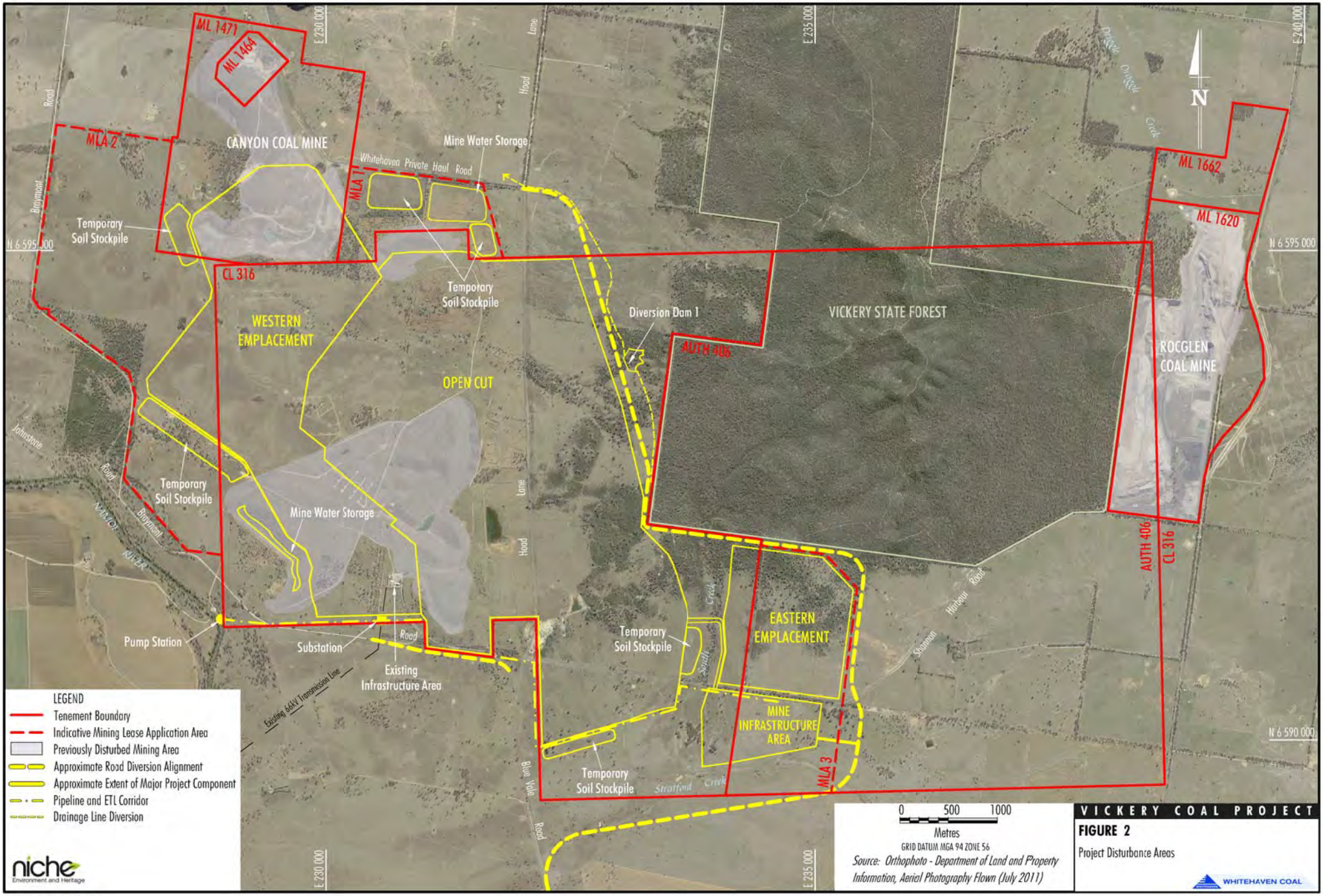

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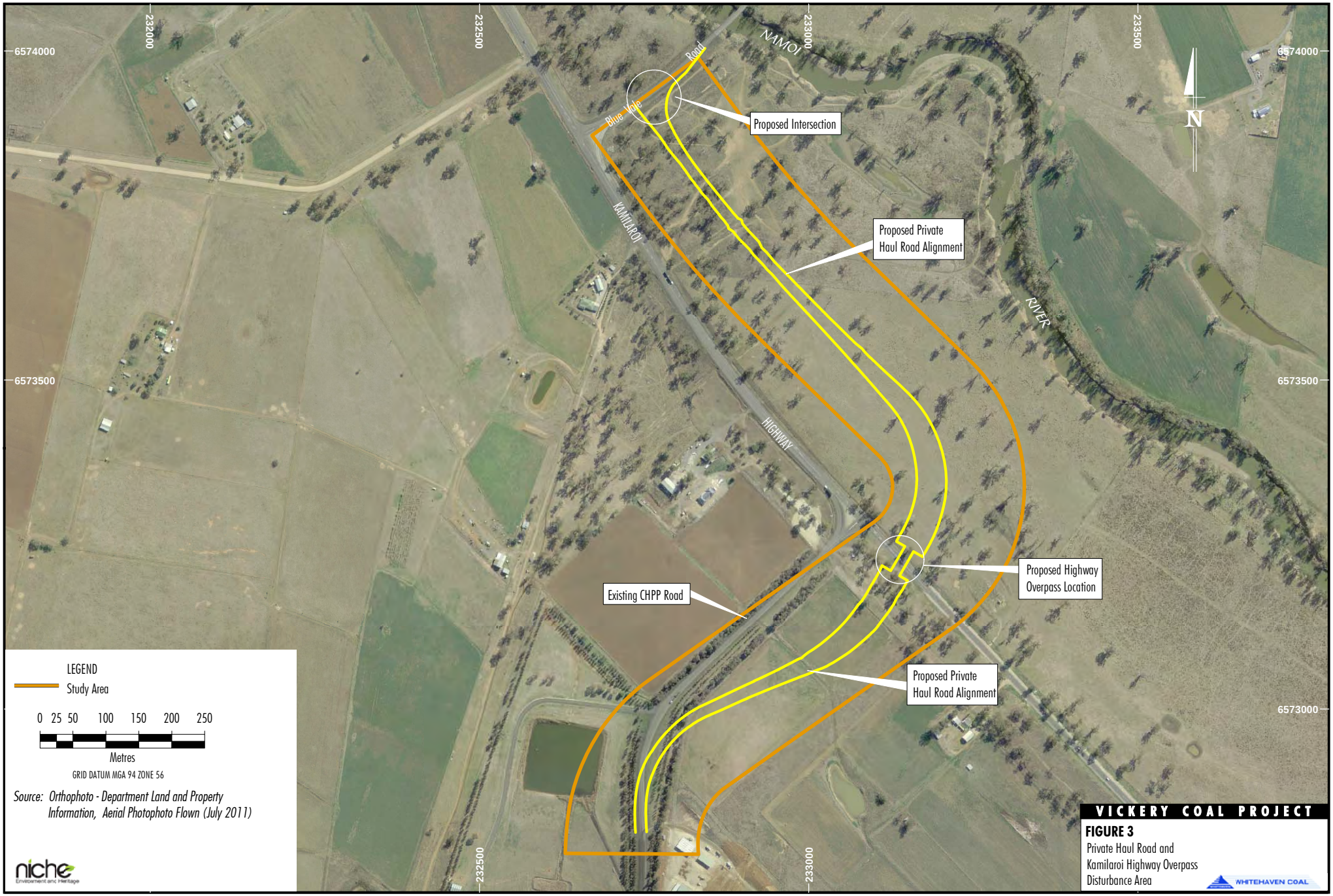

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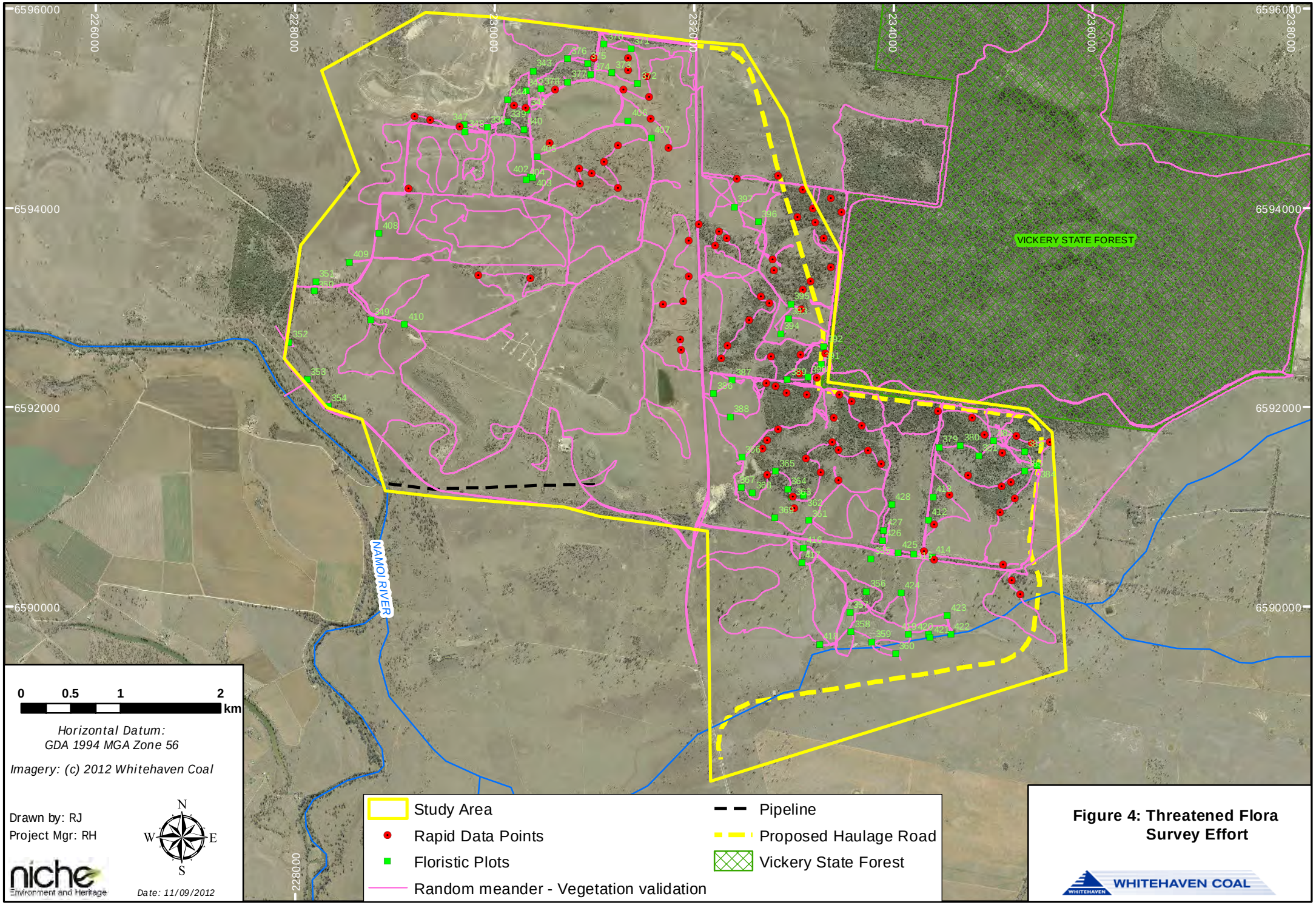

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Figure 5a: Vegetation

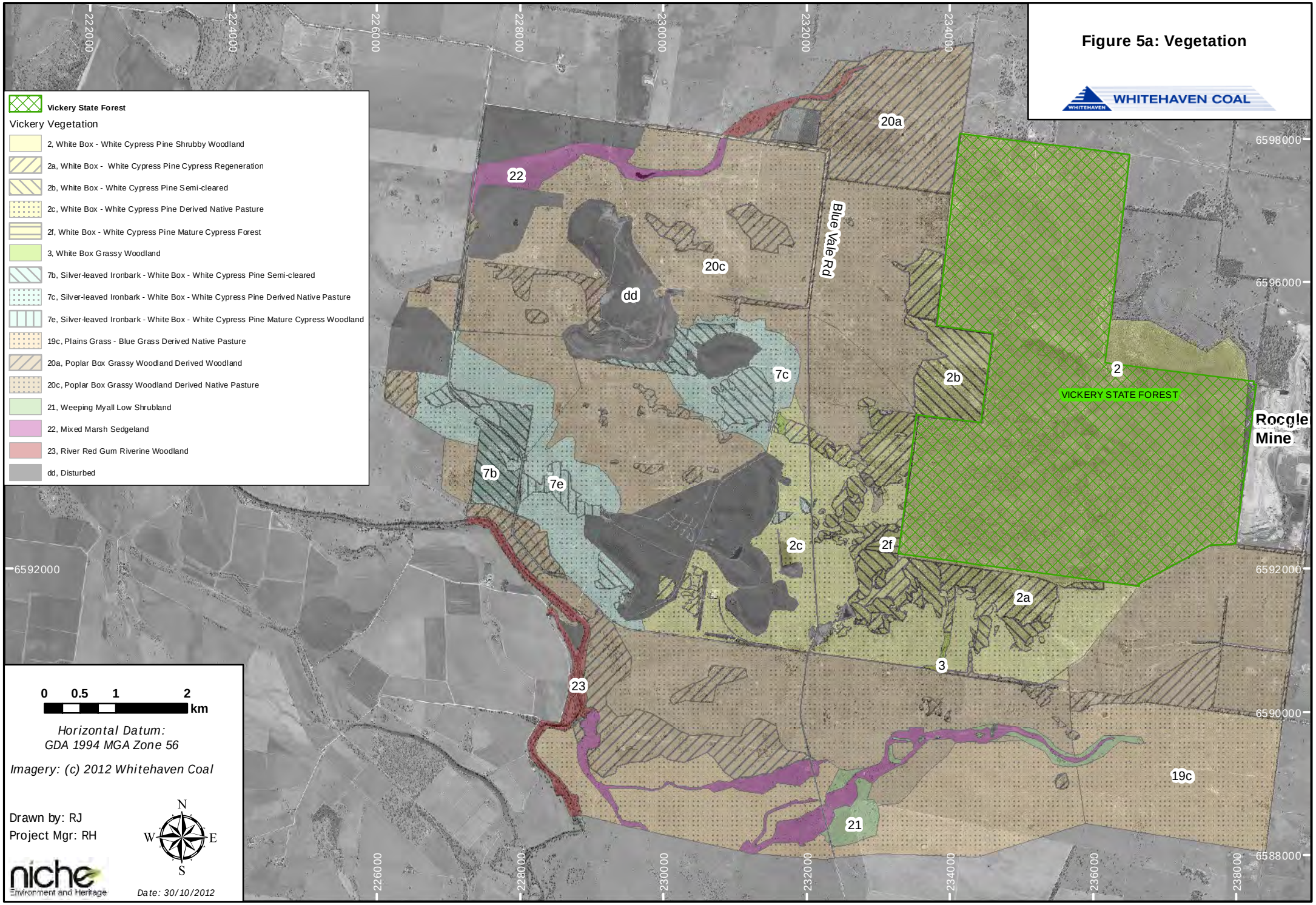

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Figure 5b: Vegetation showing Vickery Mine Disturbance Area

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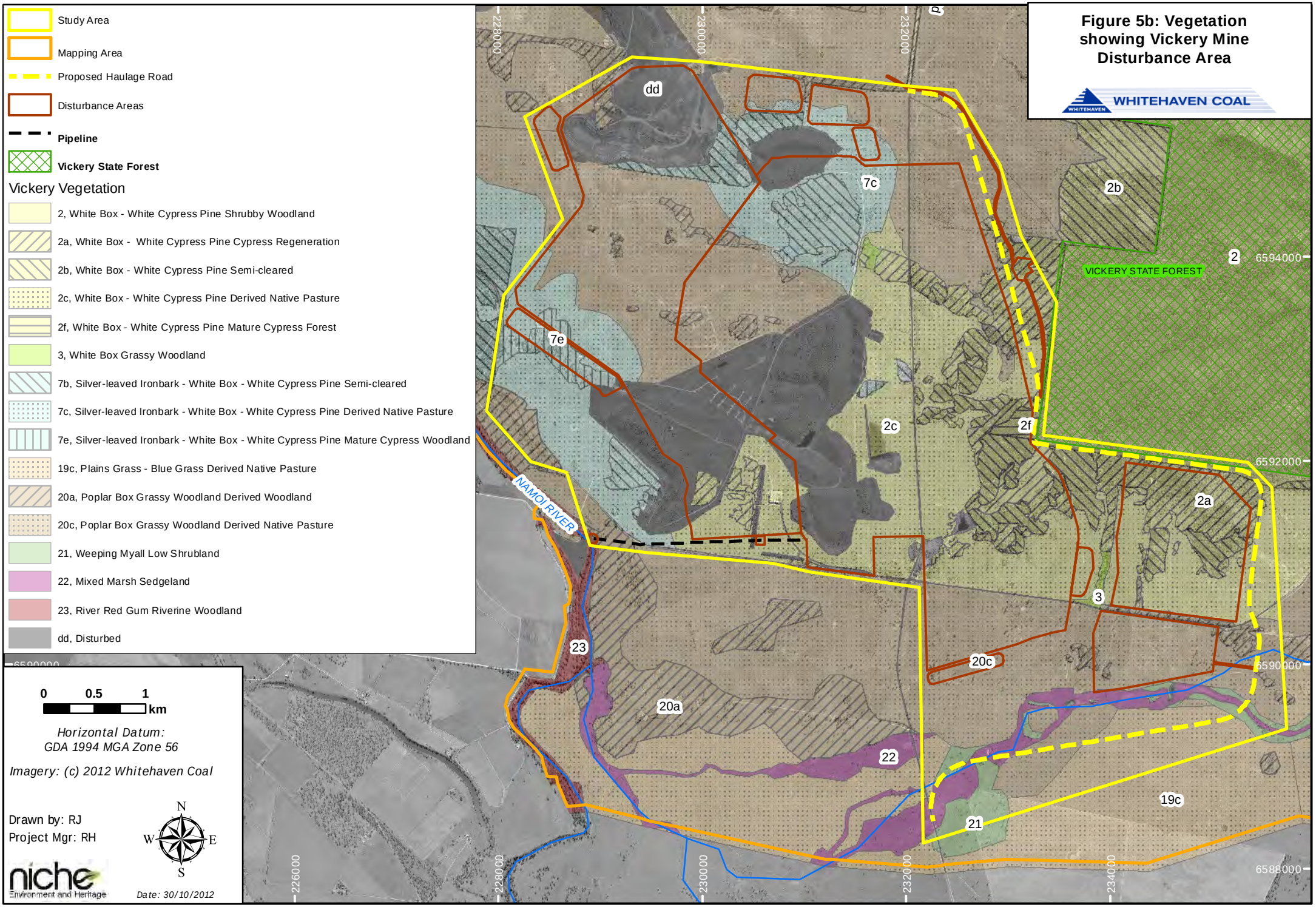

0 0.5 1 km

Horizontal Datum: GDA 1994 MGA Zone 56

Imagery: (c) 2012 Whitehaven Coal

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Project Mgr: RH

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Date: 30/10/2012

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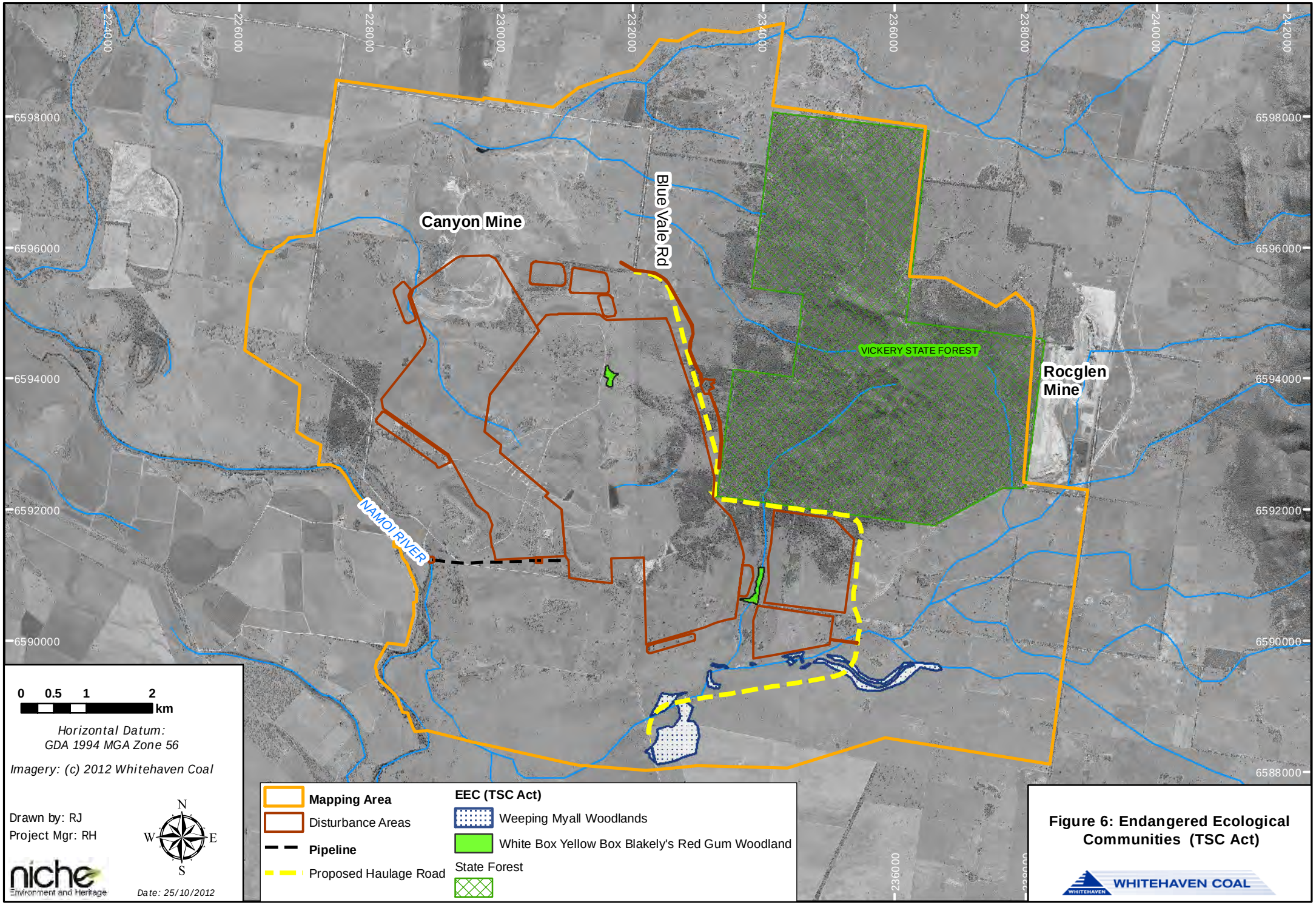

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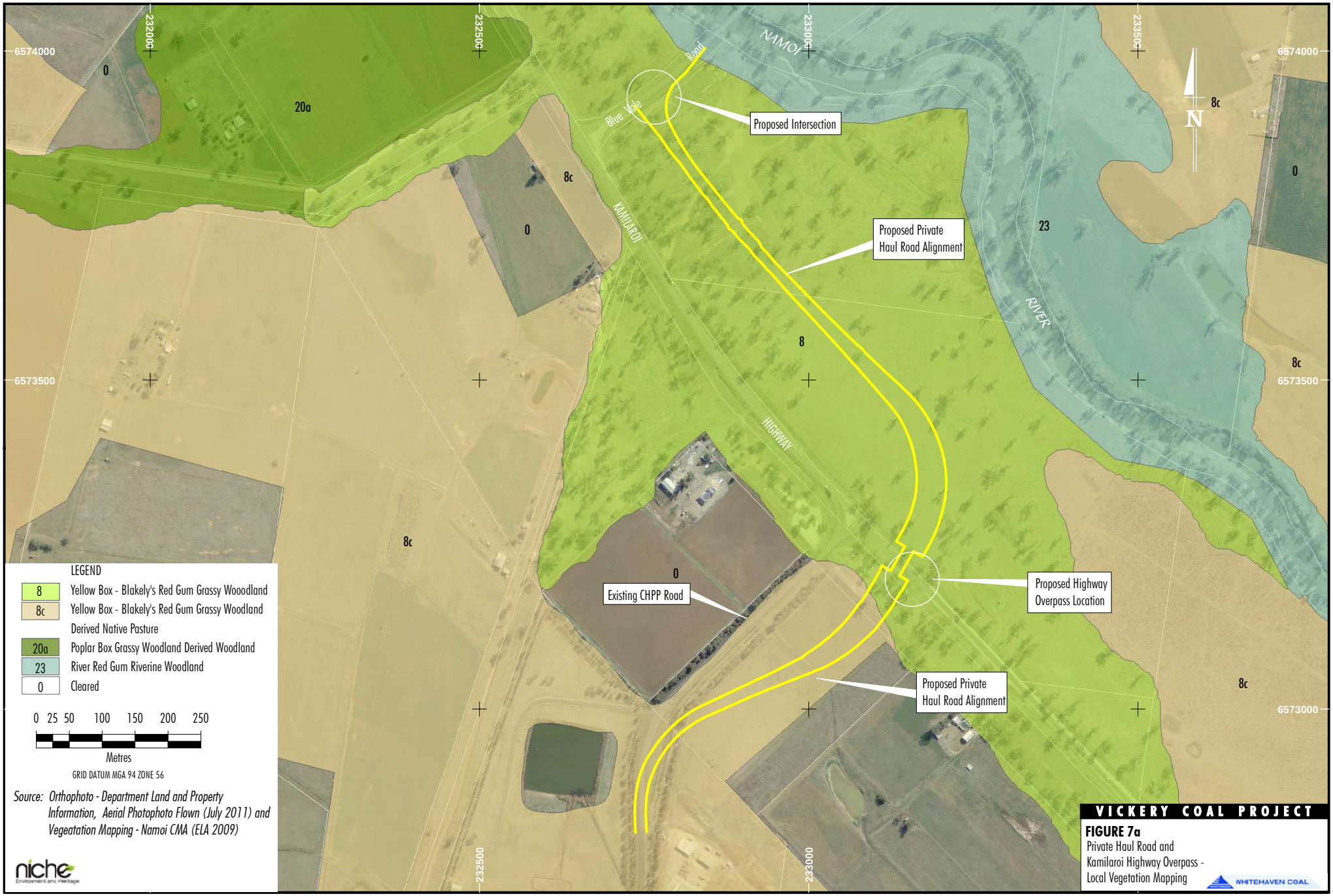

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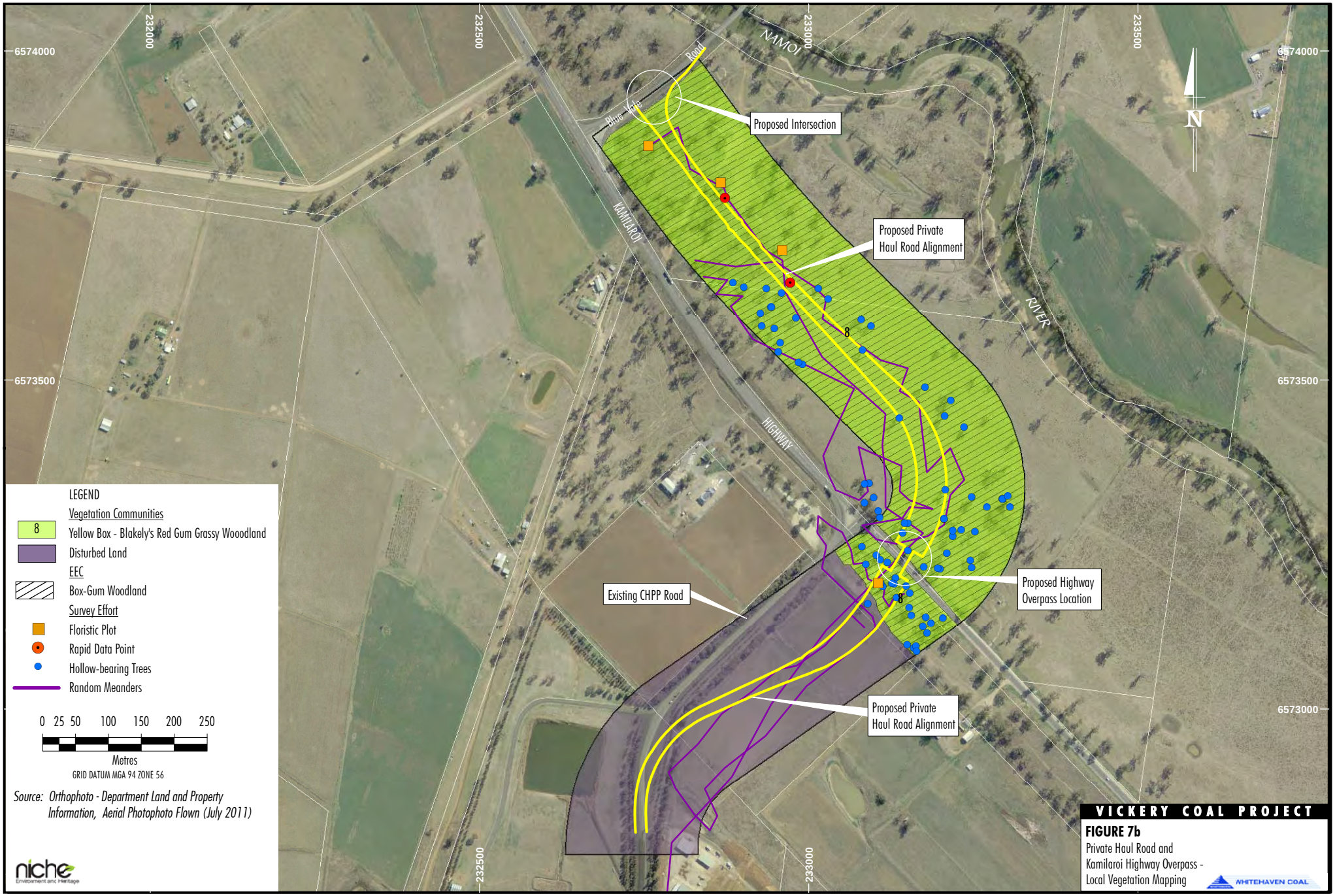

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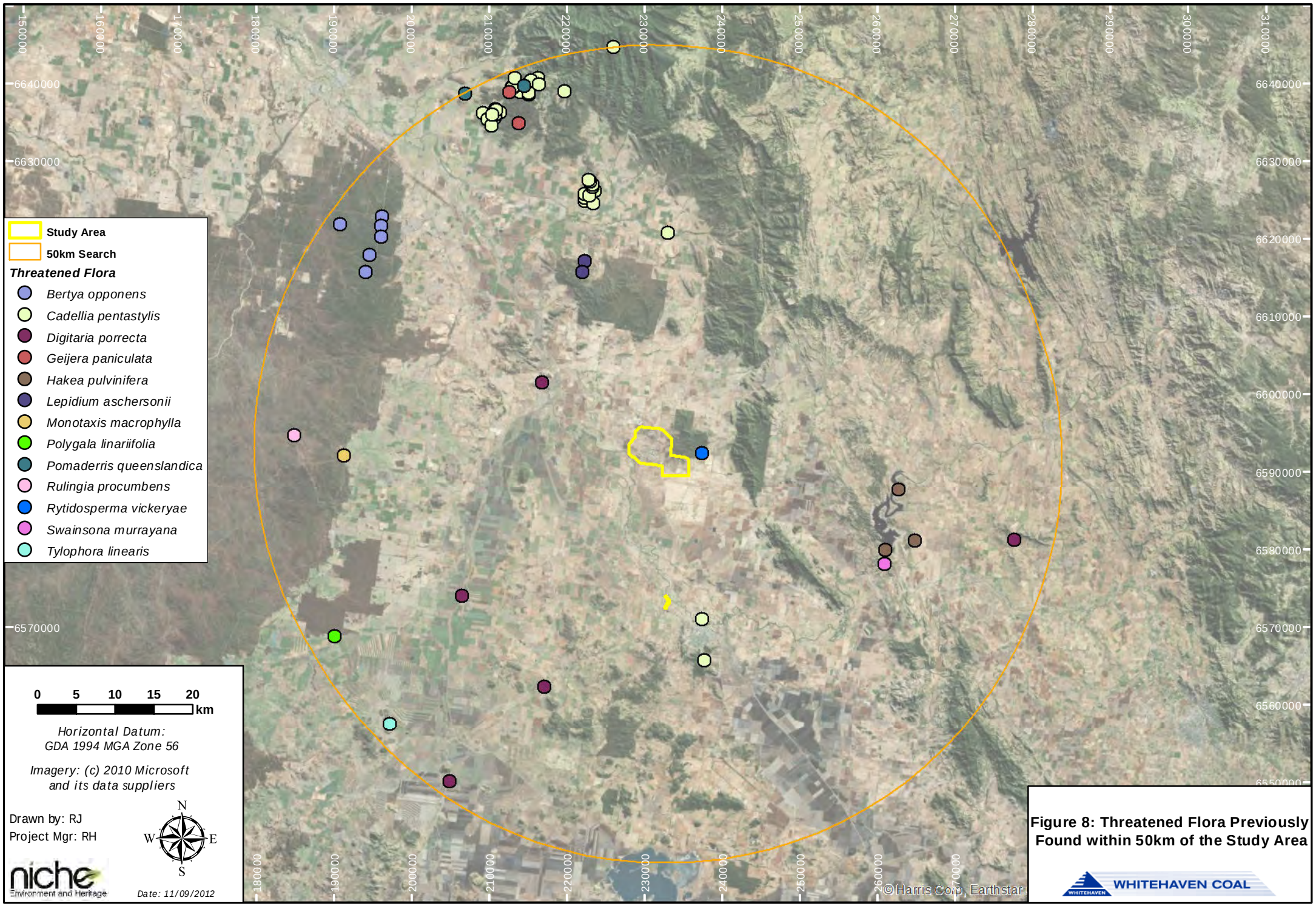

Figure 8: Threatened Flora Previously Found within 50km of the Study Area

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Source: Atlas of NSW Wildlife 24 May 2012

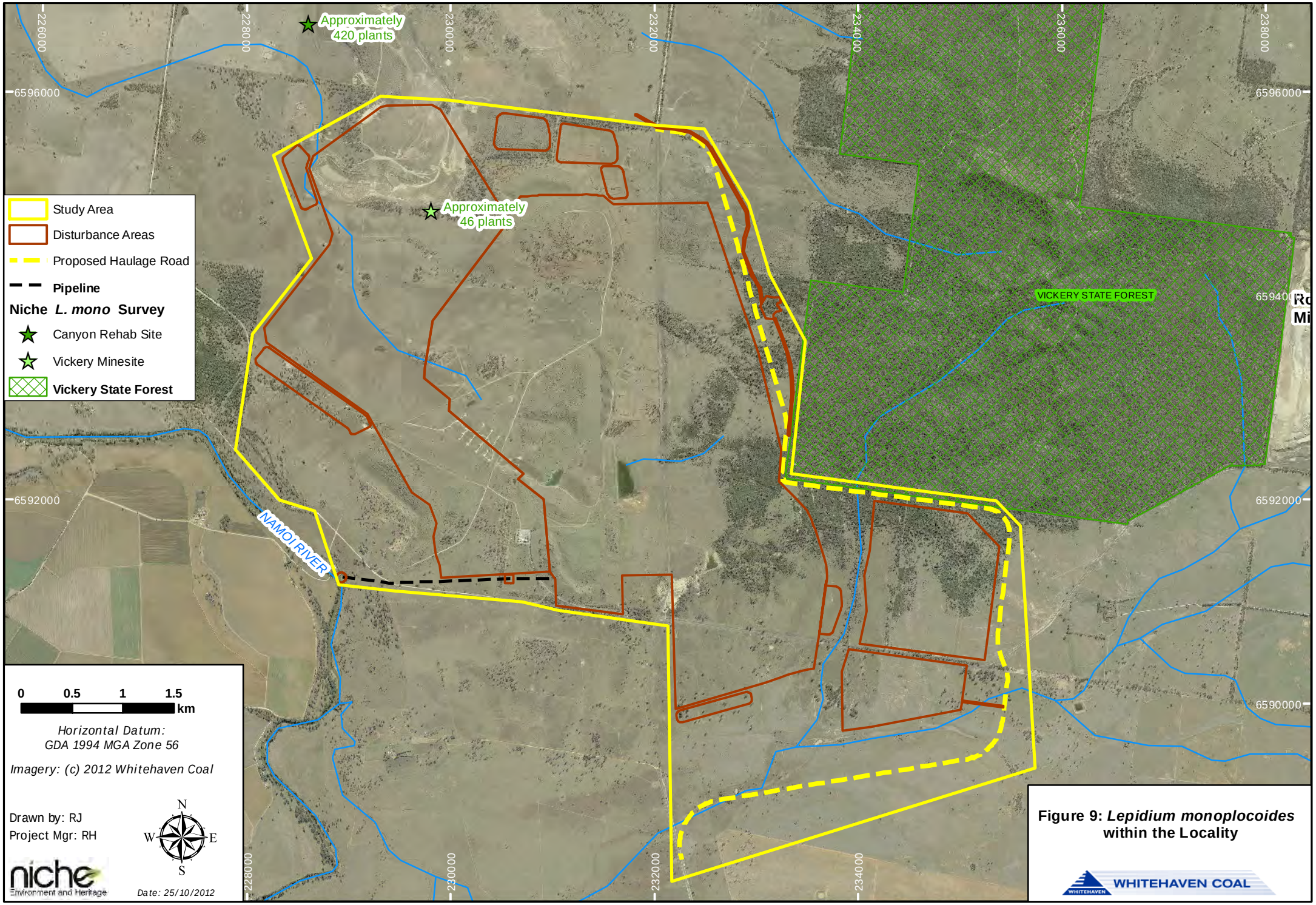

Figure 9: *Lepidium monoplocoides* within the Locality

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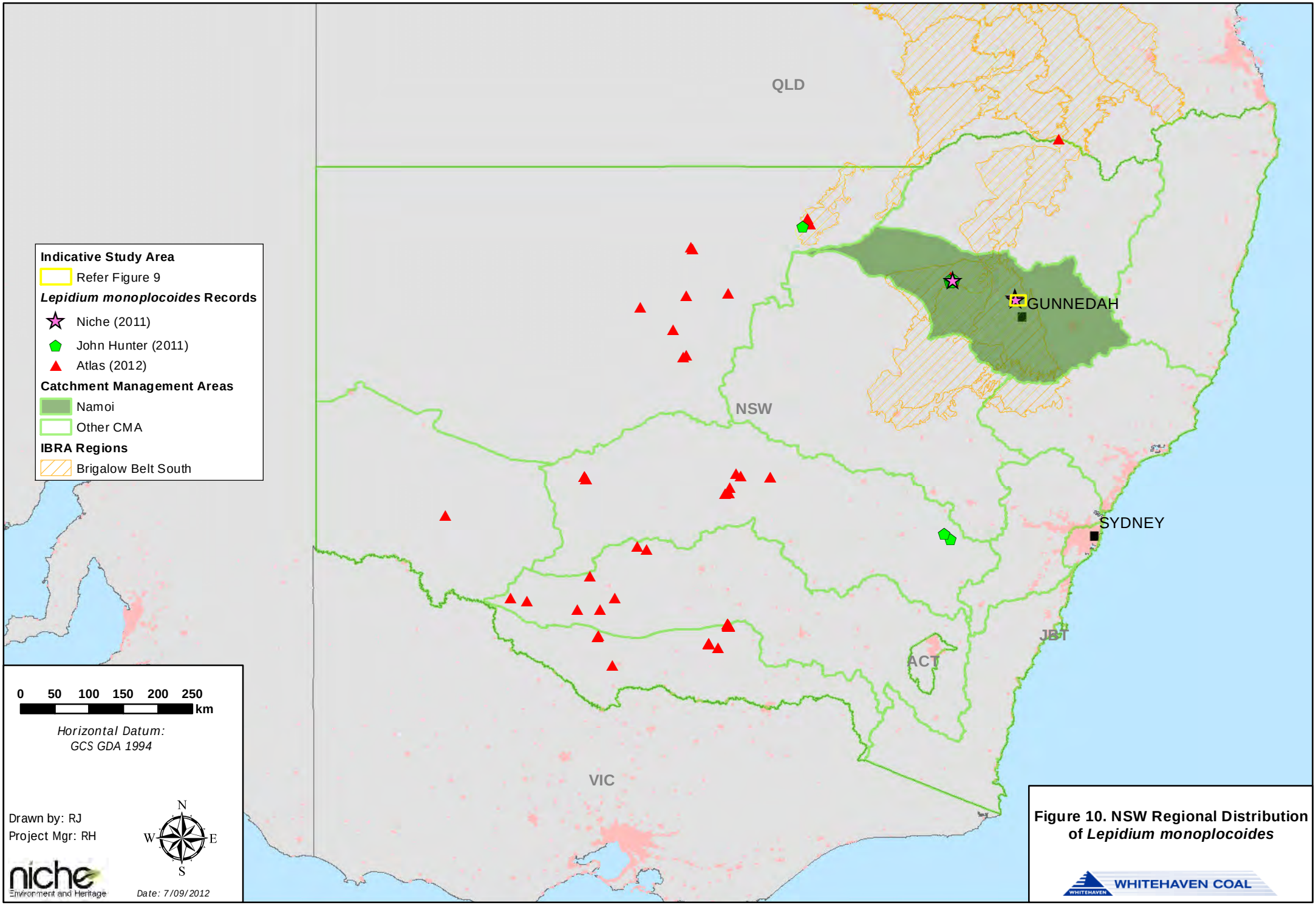

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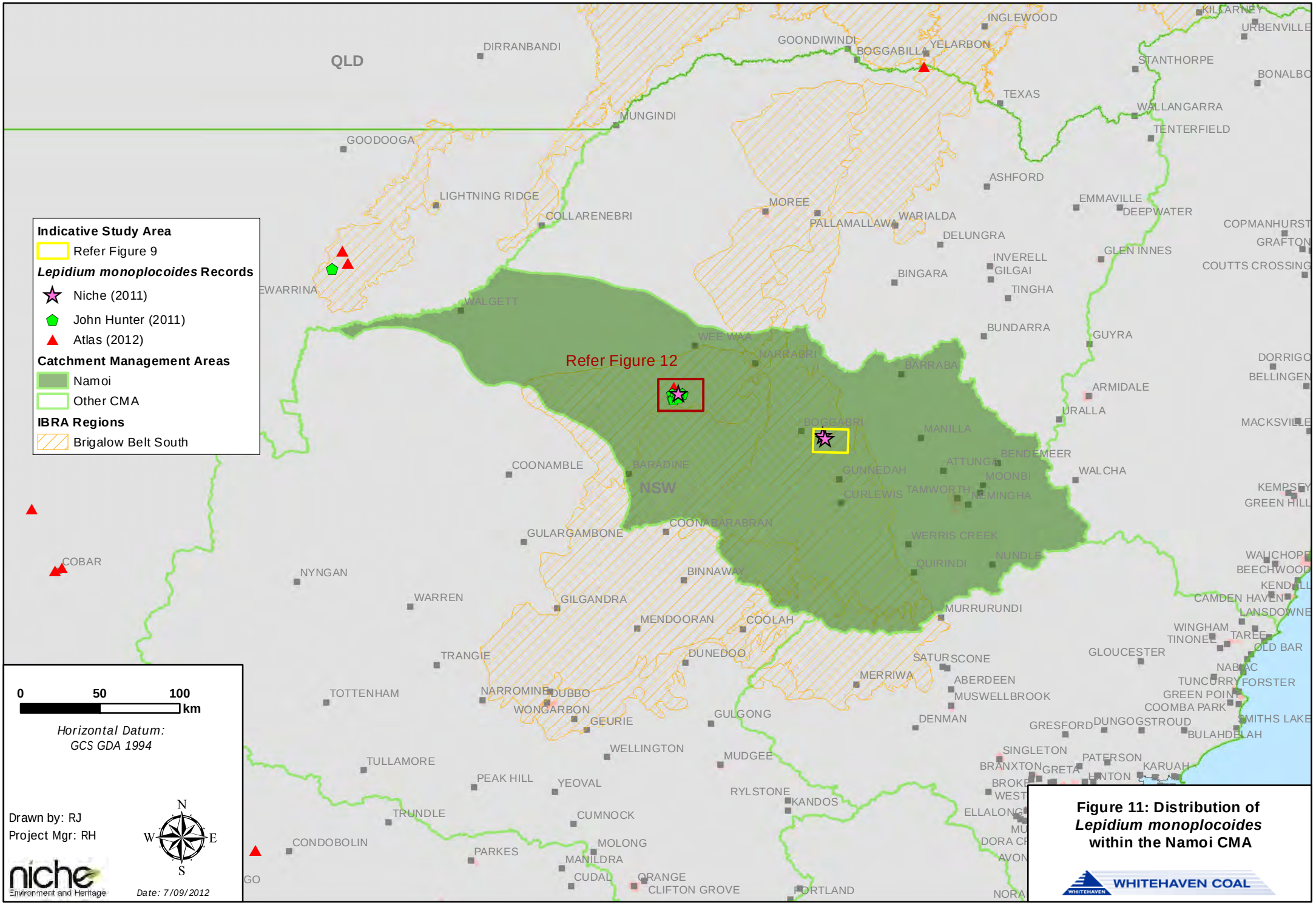

Figure 11: Distribution of *Lepidium monoplocoides* within the Namoi CMA

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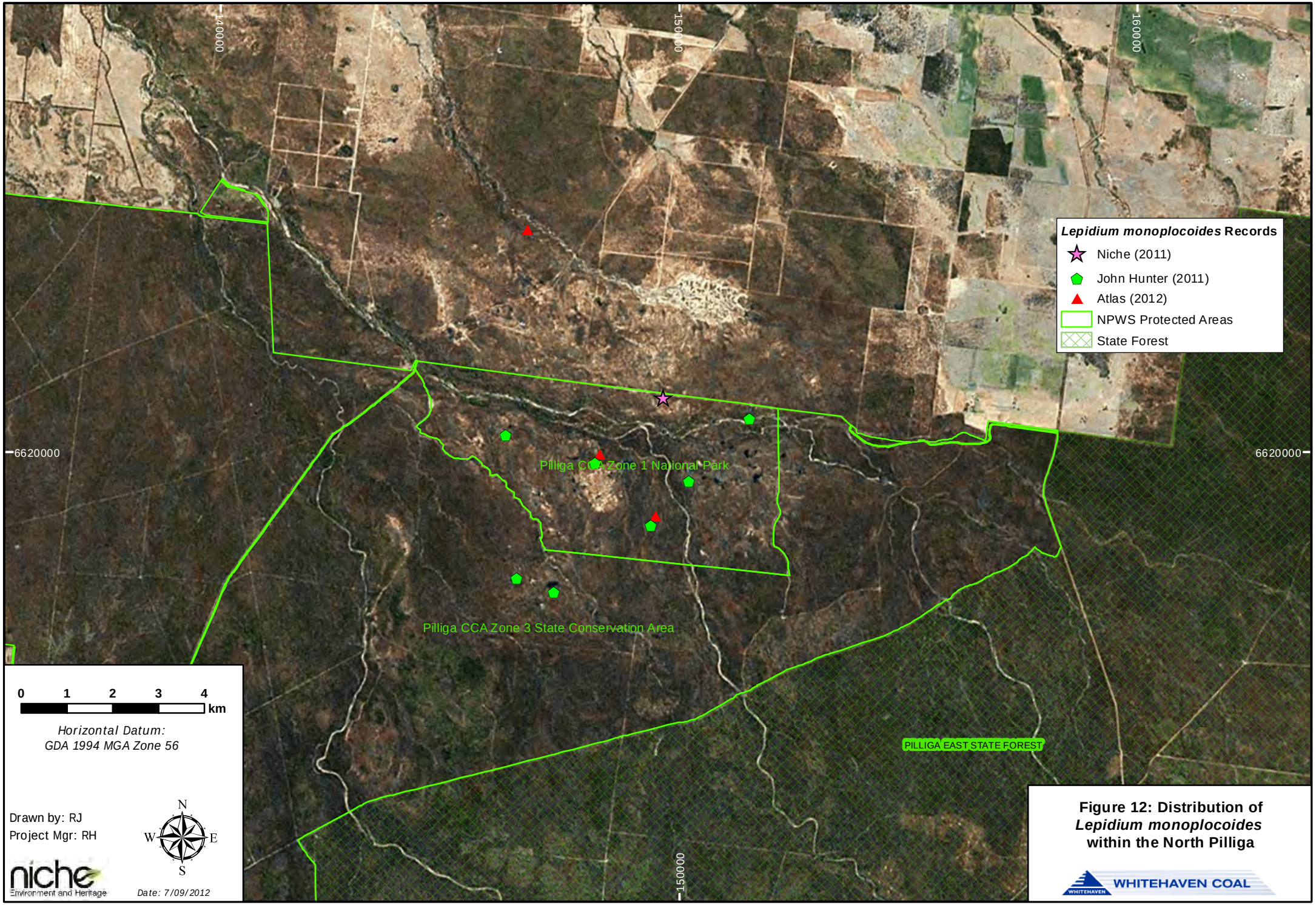

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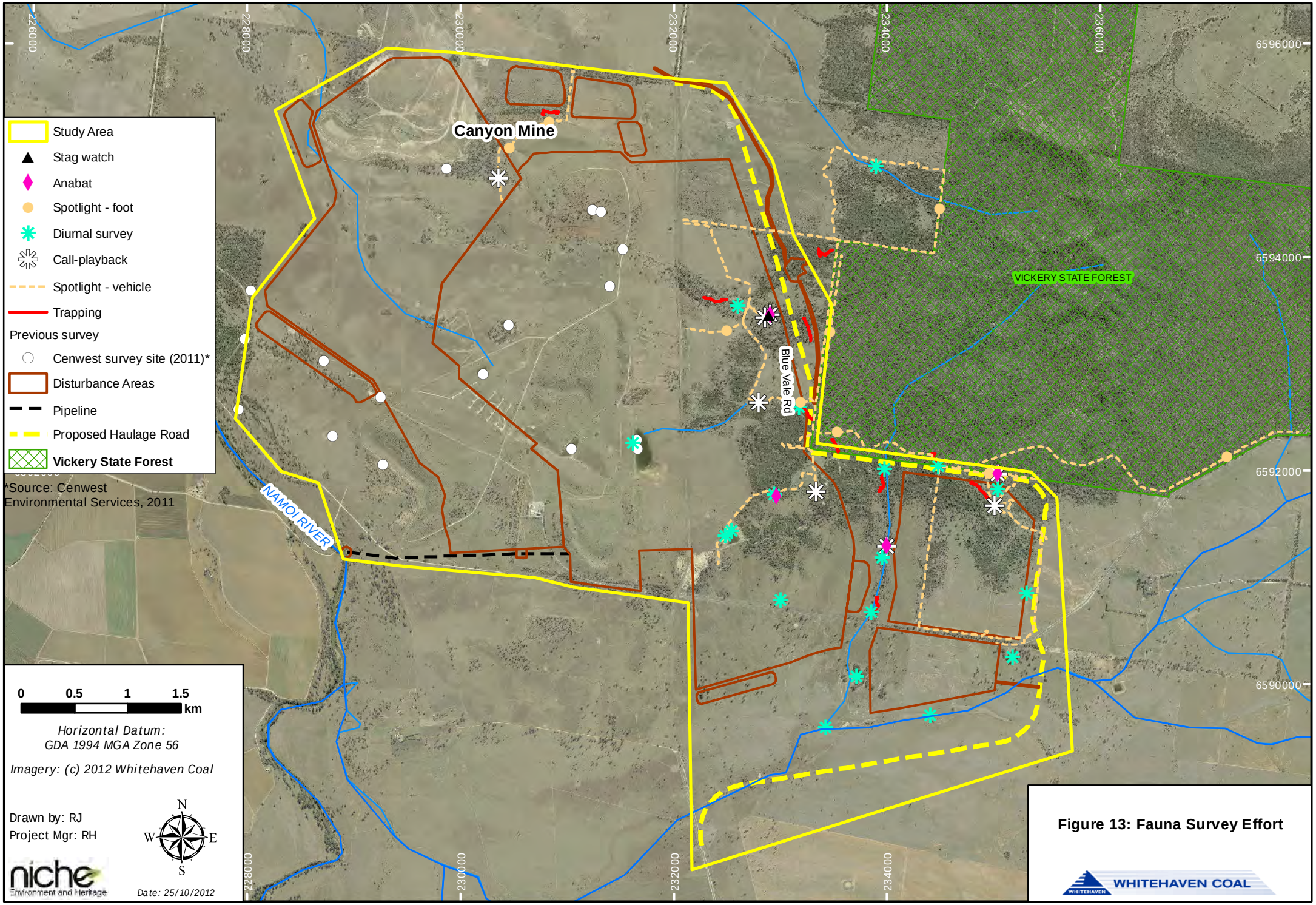

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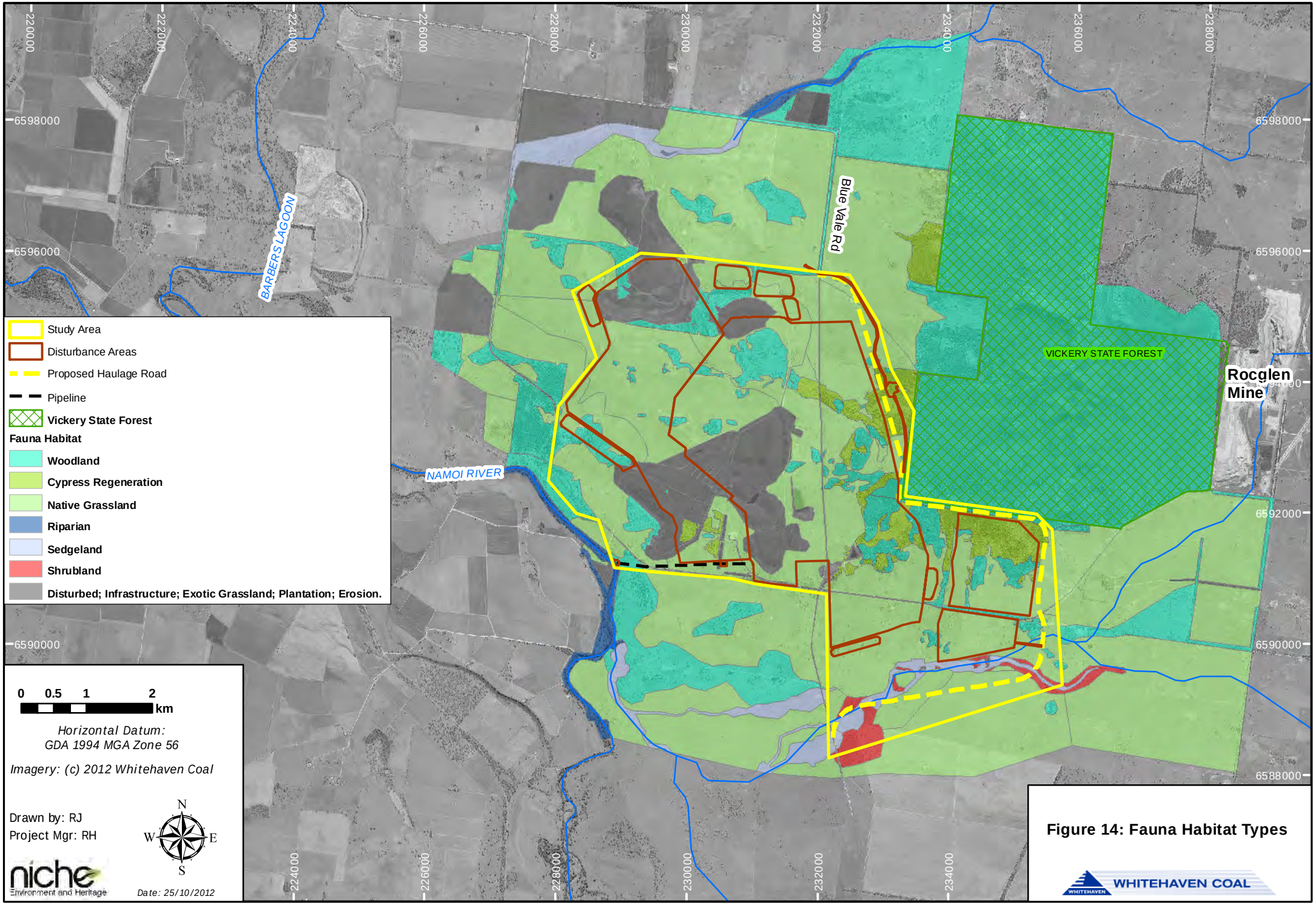

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Figure 15a: Threatened Fauna Likely to Occur within 50km of the Study Area - Bats

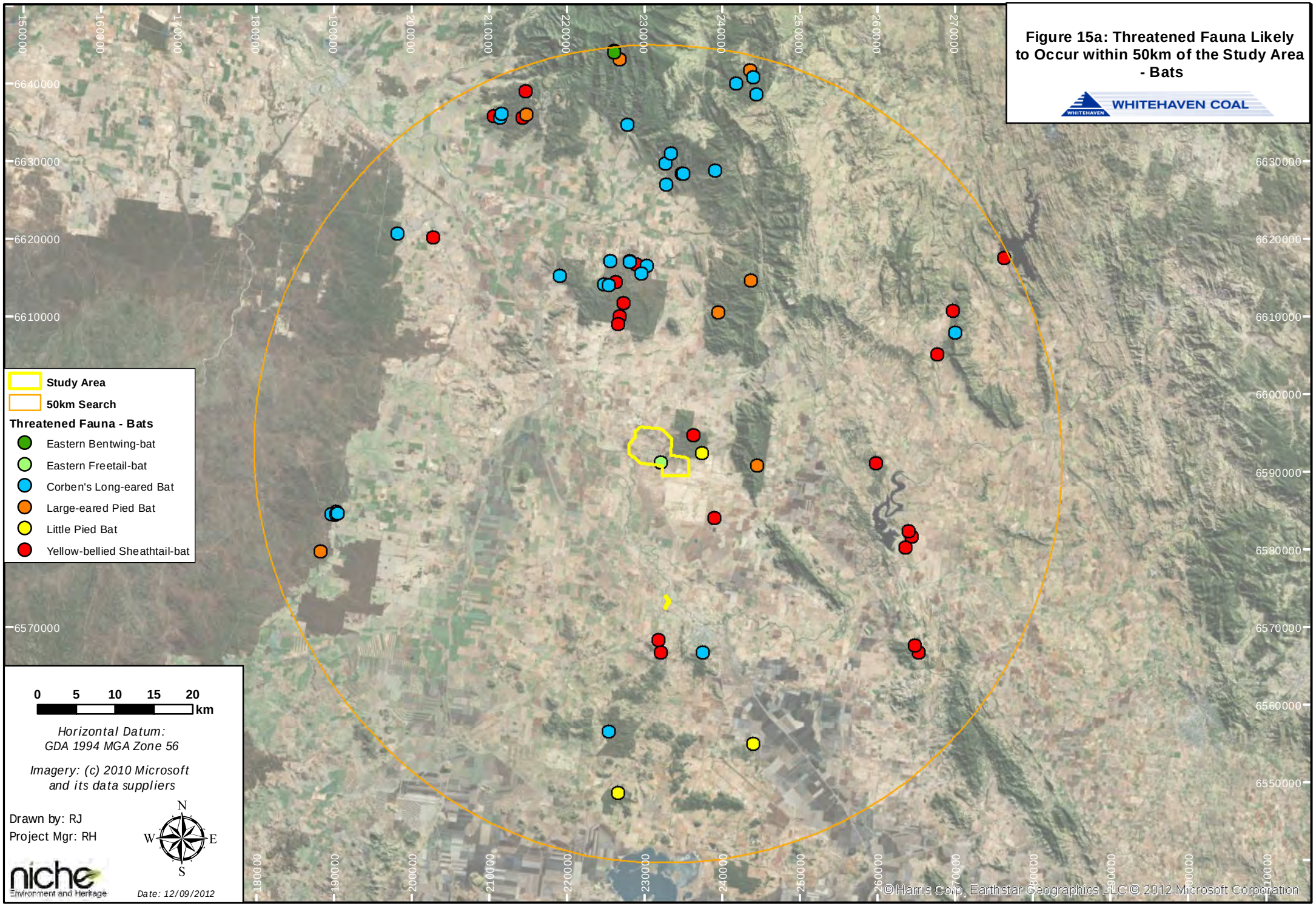

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Figure 15b: Threatened Fauna Likely to Occur within 50km of the Study Area - Mammals and Reptiles

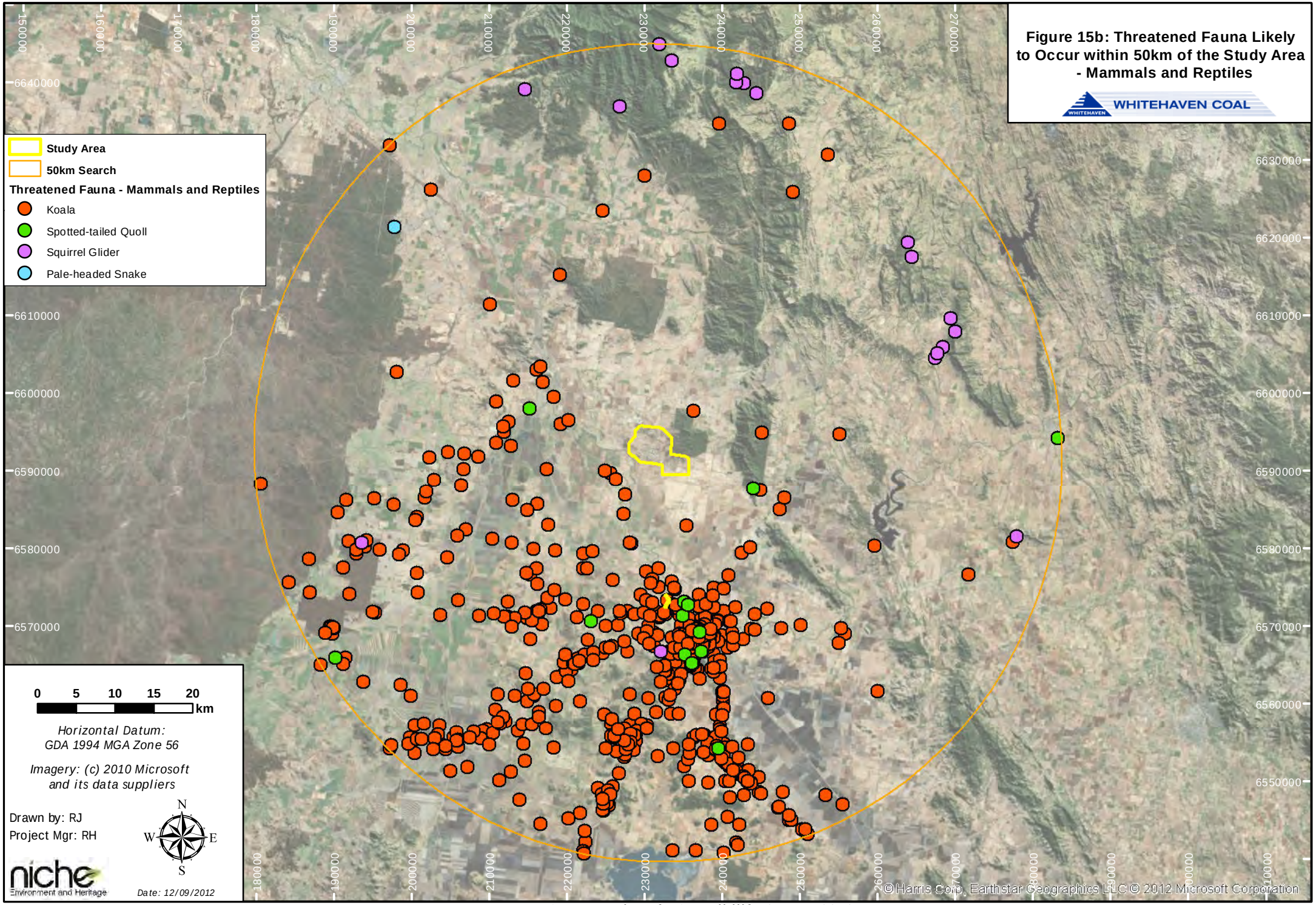

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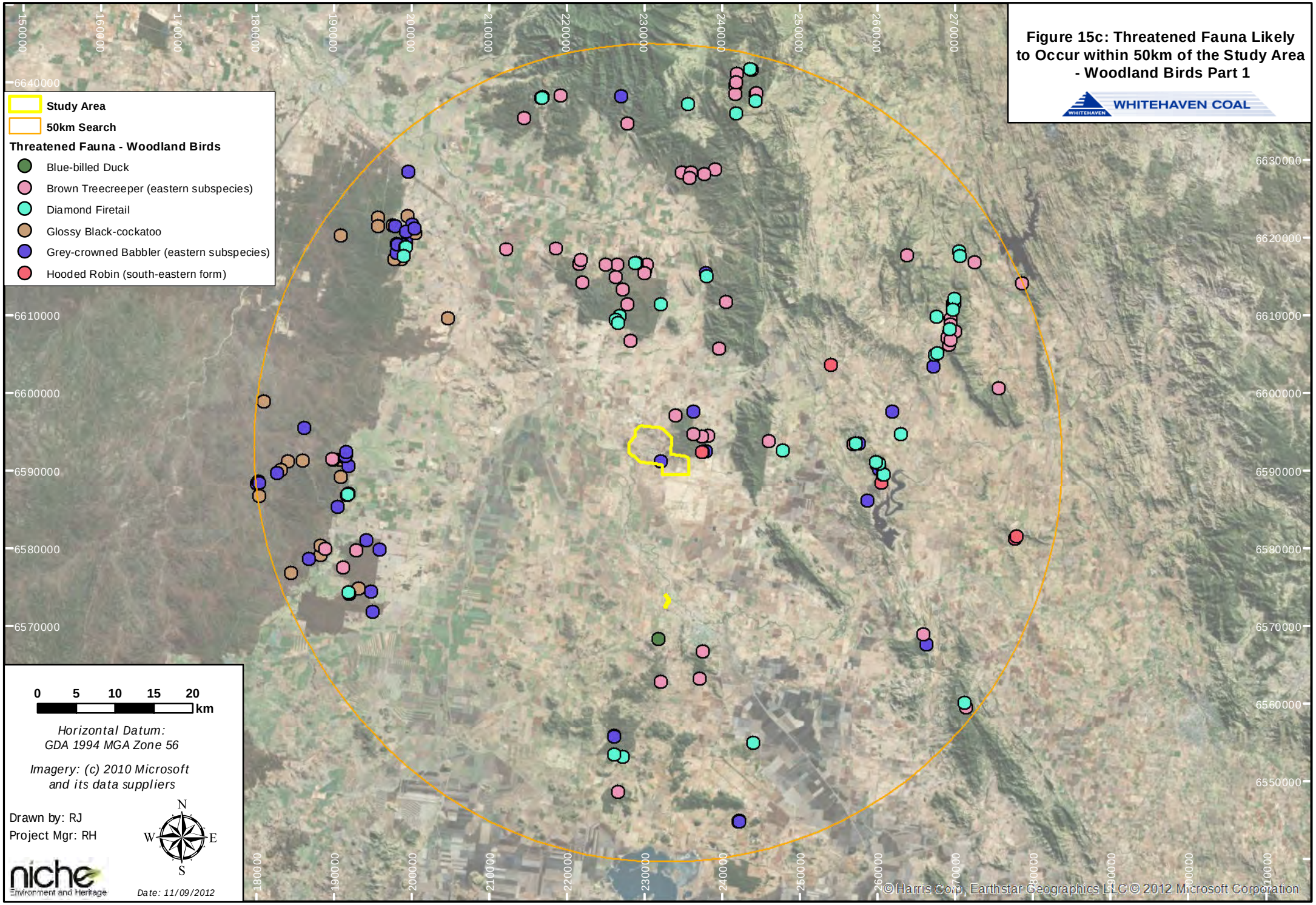
Figure 15c: Threatened Fauna Likely to Occur within 50km of the Study Area - Woodland Birds Part 1



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Source: Atlas of NSW Wildlife 24 May 2012

Figure 15d: Threatened Fauna Likely to Occur within 50km of the Study Area - Woodland Birds Part 2

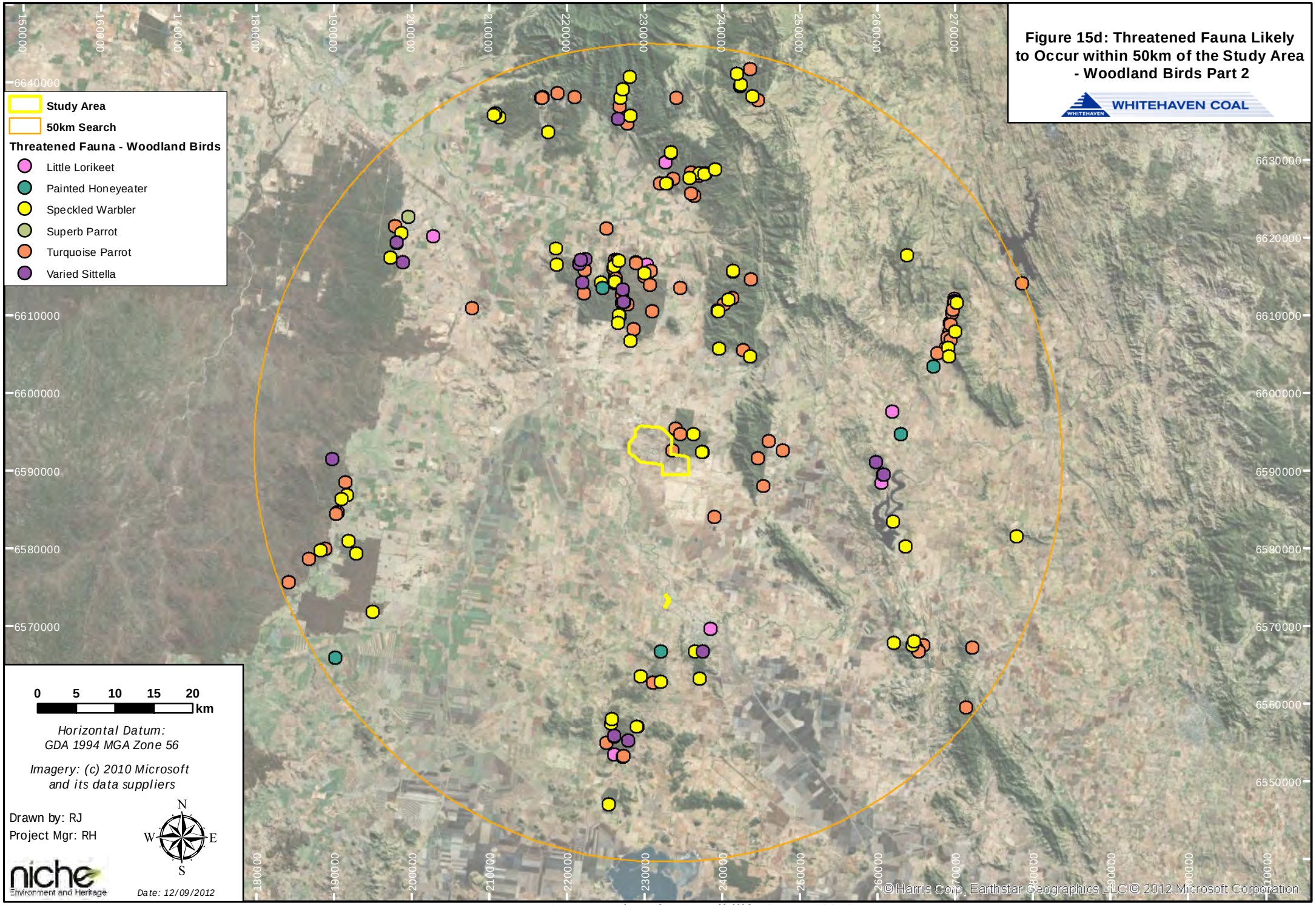

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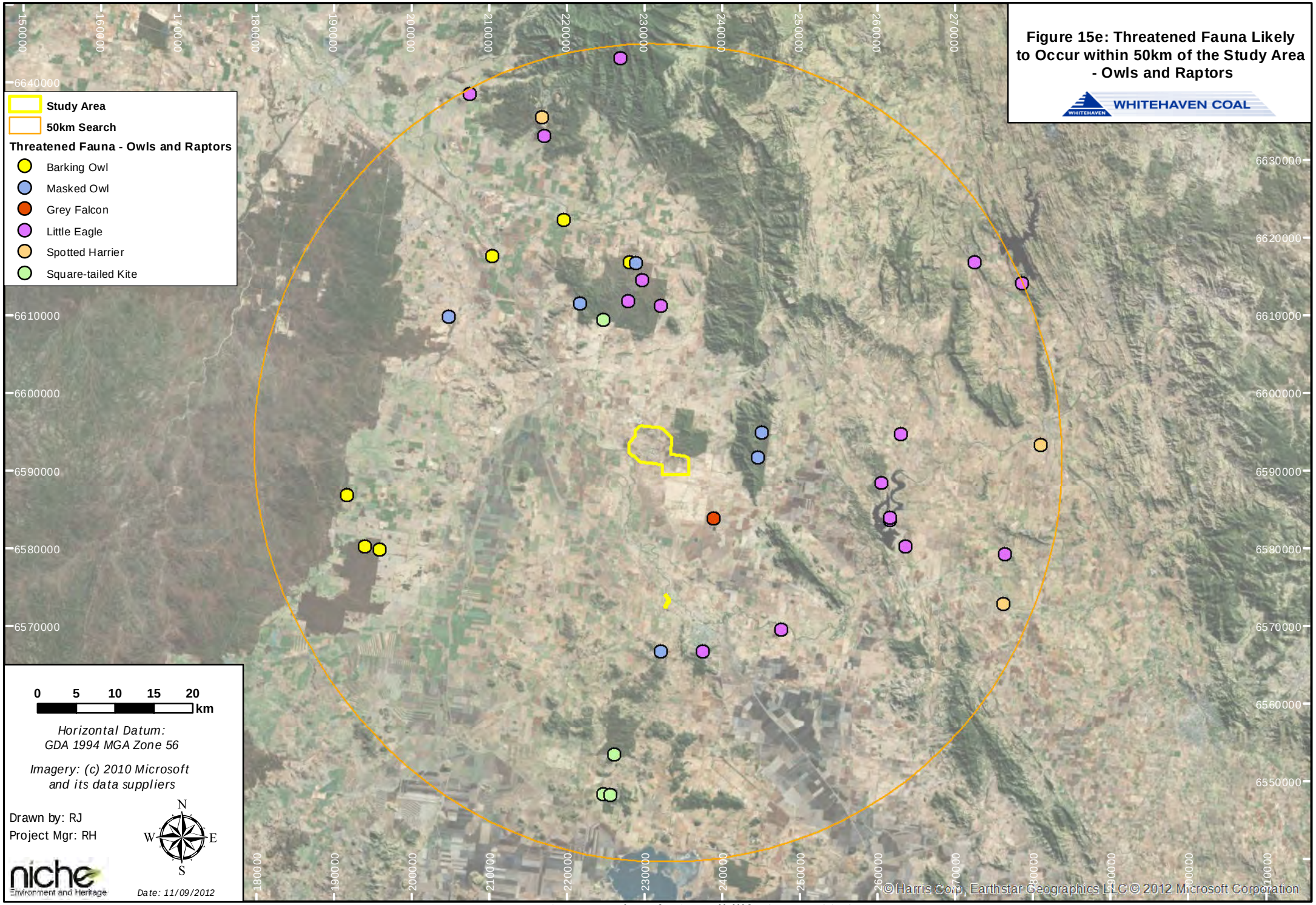
Figure 15e: Threatened Fauna Likely to Occur within 50km of the Study Area - Owls and Raptors



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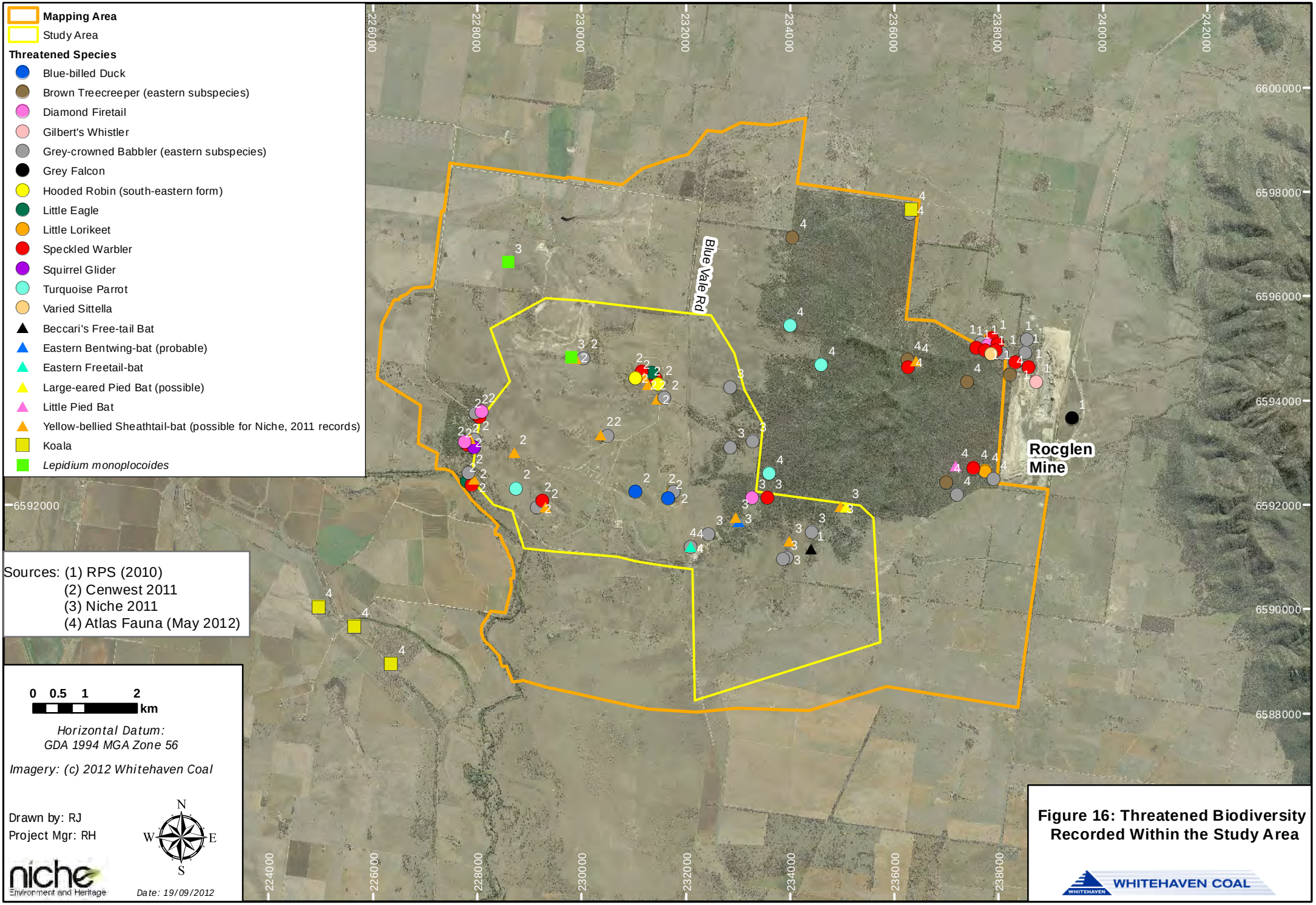

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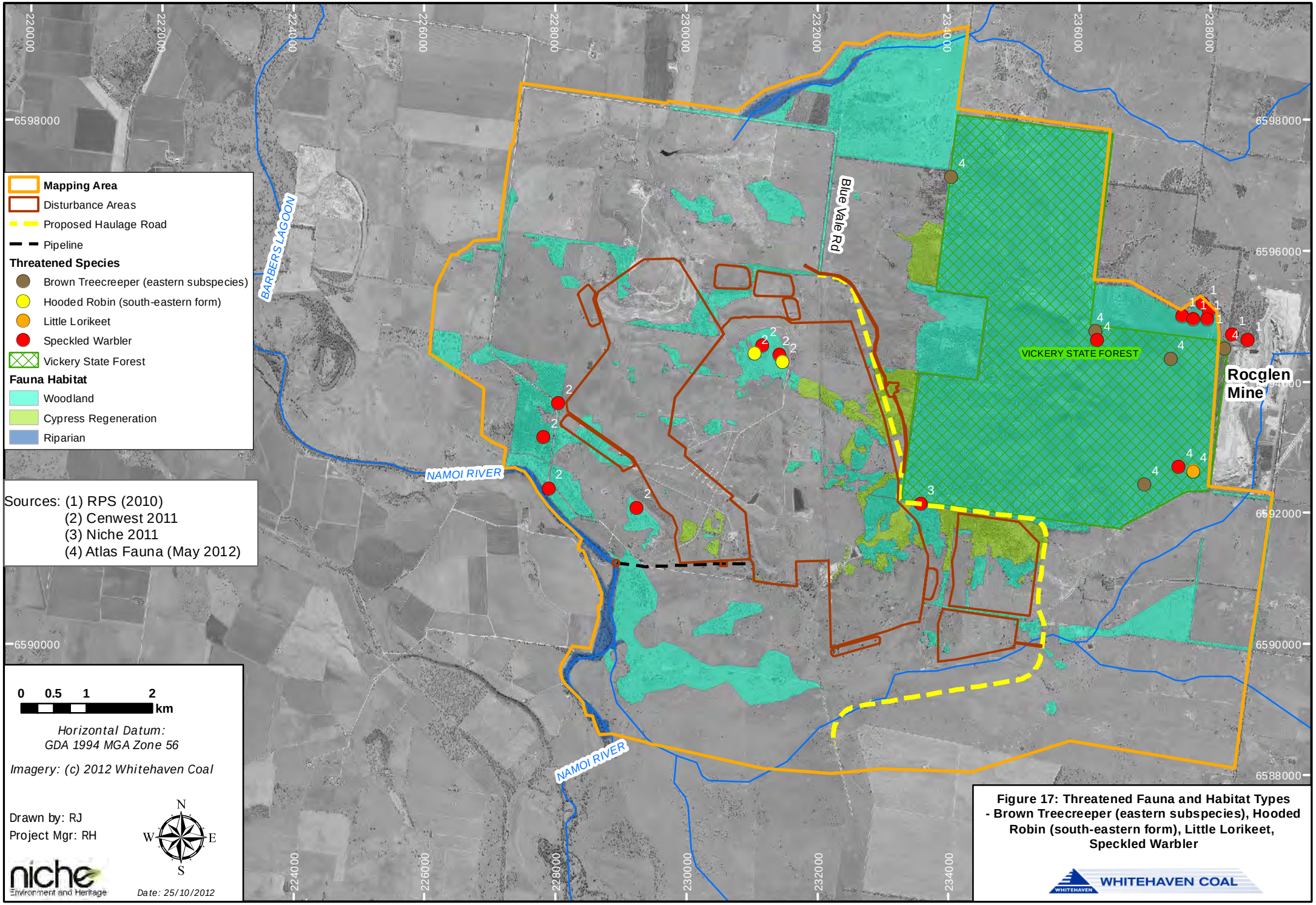

Figure 17: Threatened Fauna and Habitat Types - Brown Treecreeper (eastern subspecies), Hooded Robin (south-eastern form), Little Lorikeet, Speckled Warbler

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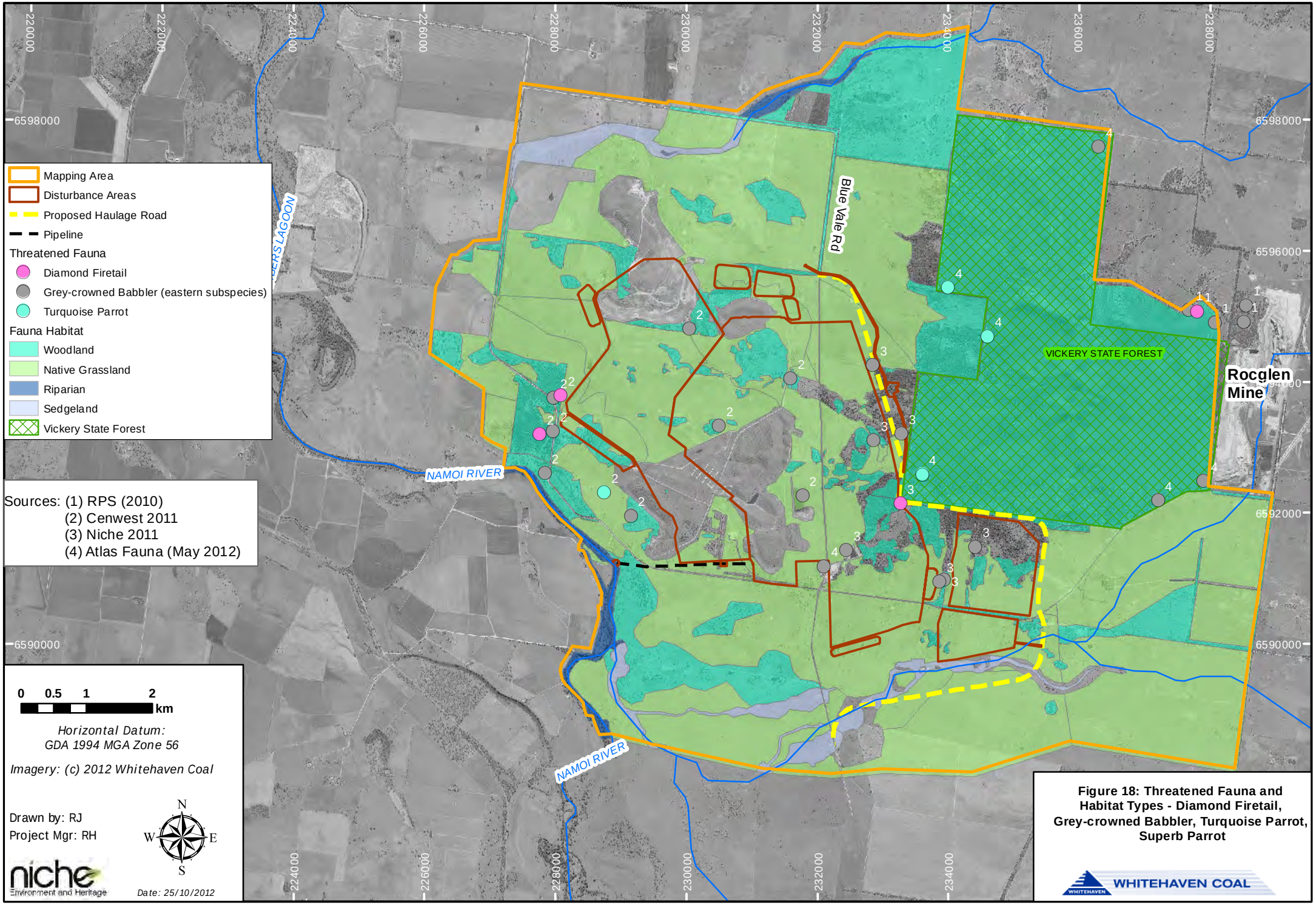

Figure 18: Threatened Fauna and Habitat Types - Diamond Firetail, Grey-crowned Babbler, Turquoise Parrot, Superb Parrot

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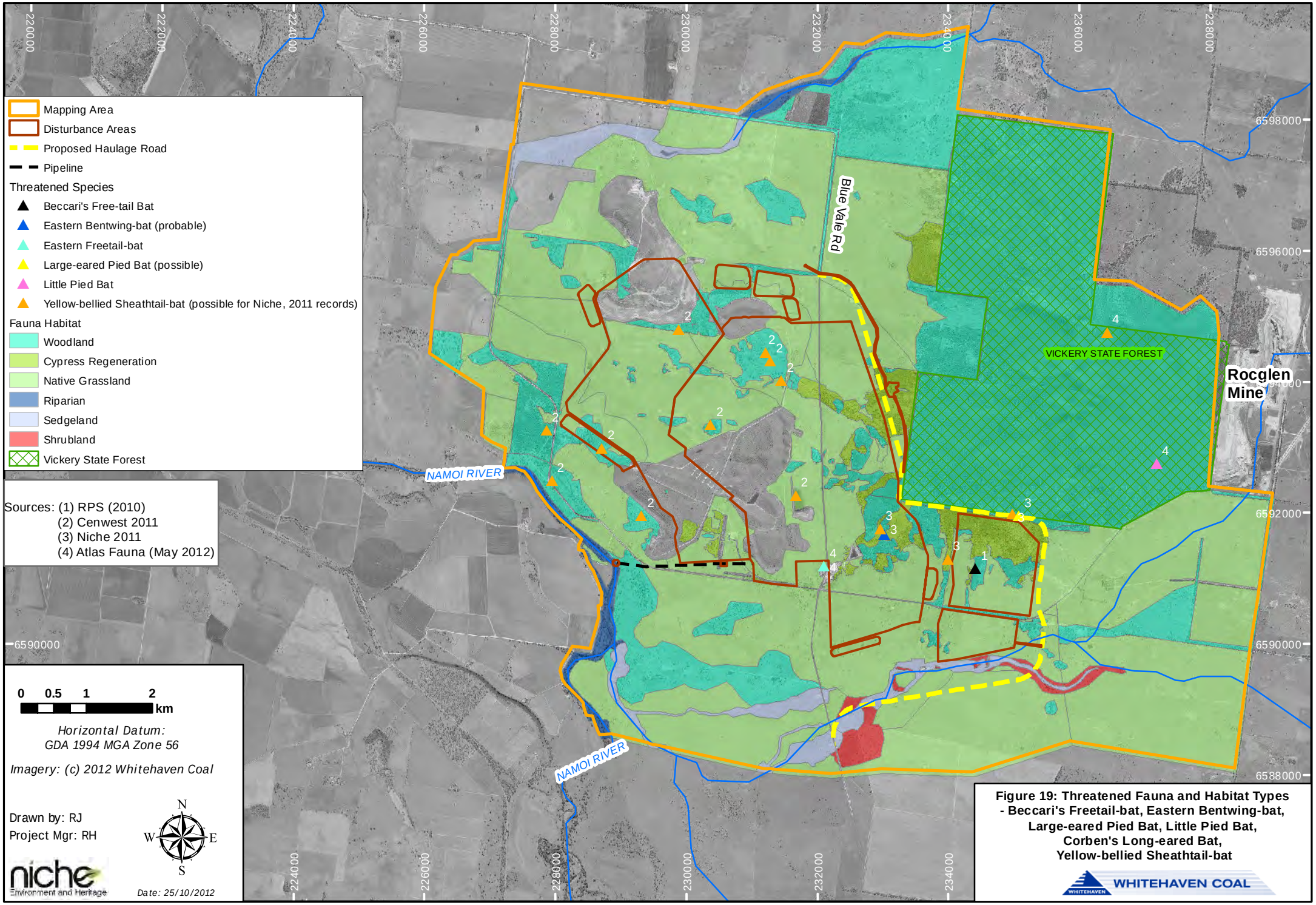

Figure 19: Threatened Fauna and Habitat Types - Beccari's Freetail-bat, Eastern Bentwing-bat, Large-eared Pied Bat, Little Pied Bat, Corben's Long-eared Bat, Yellow-bellied Sheathtail-bat

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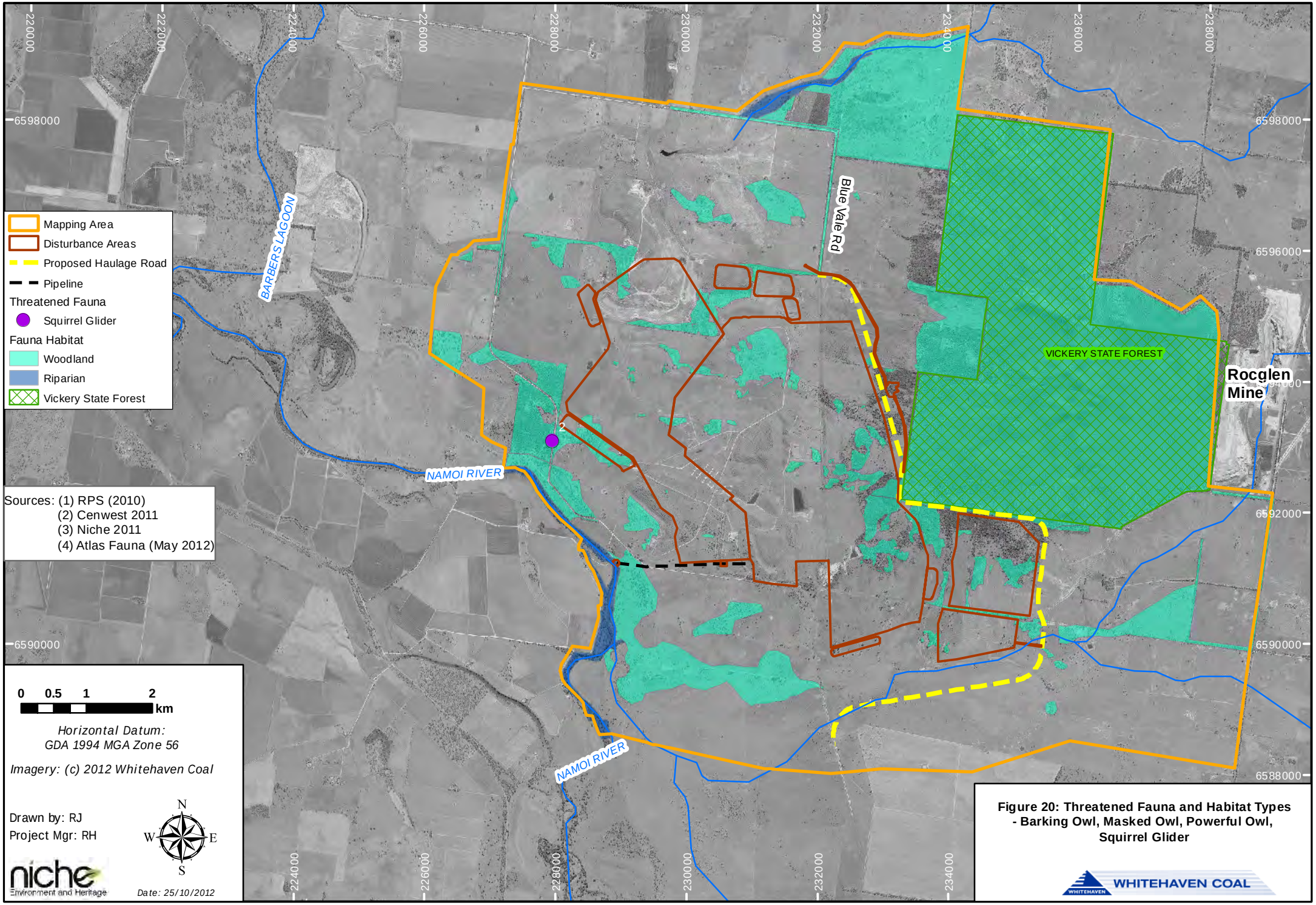

Figure 20: Threatened Fauna and Habitat Types - Barking Owl, Masked Owl, Powerful Owl, Squirrel Glider

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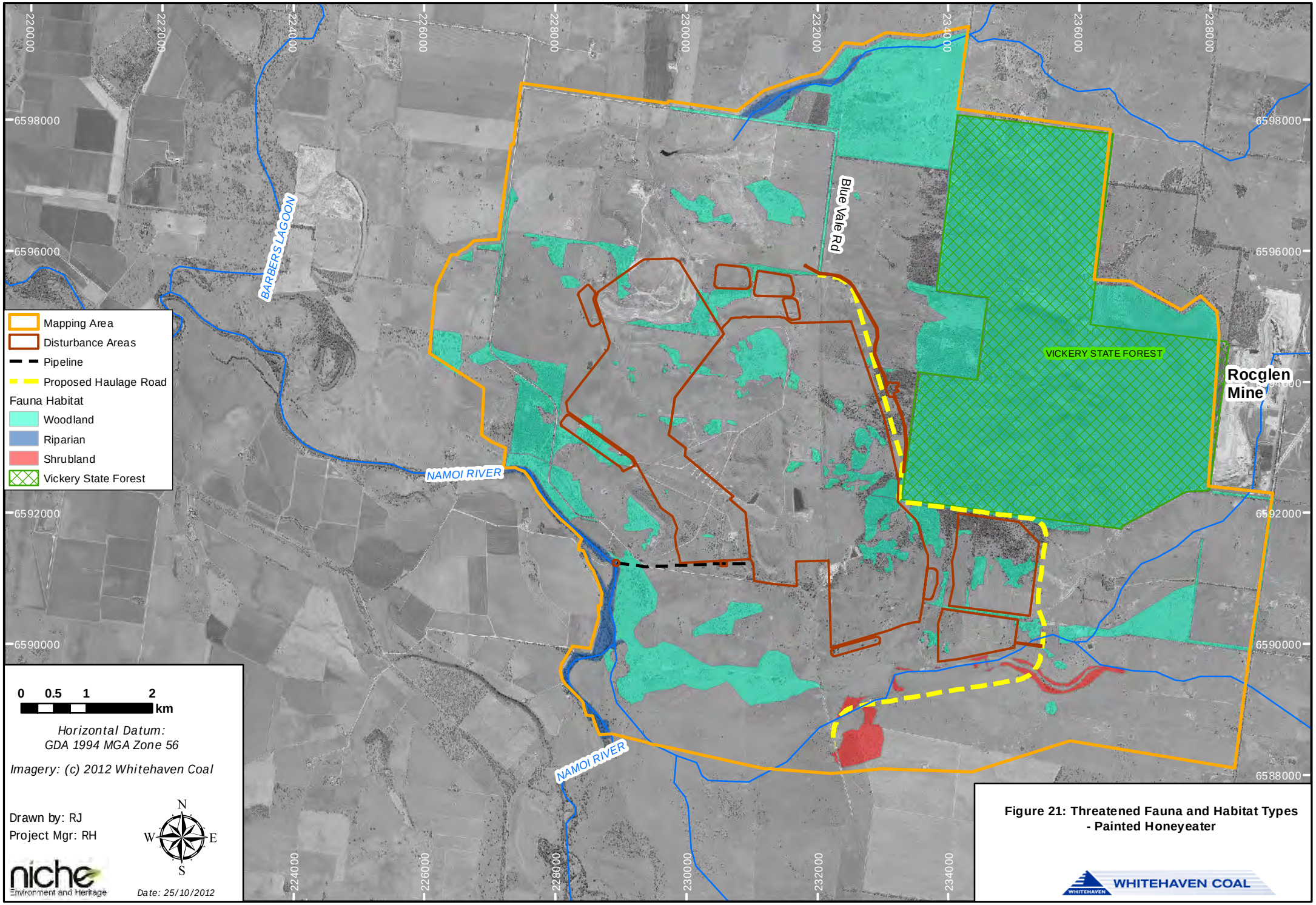

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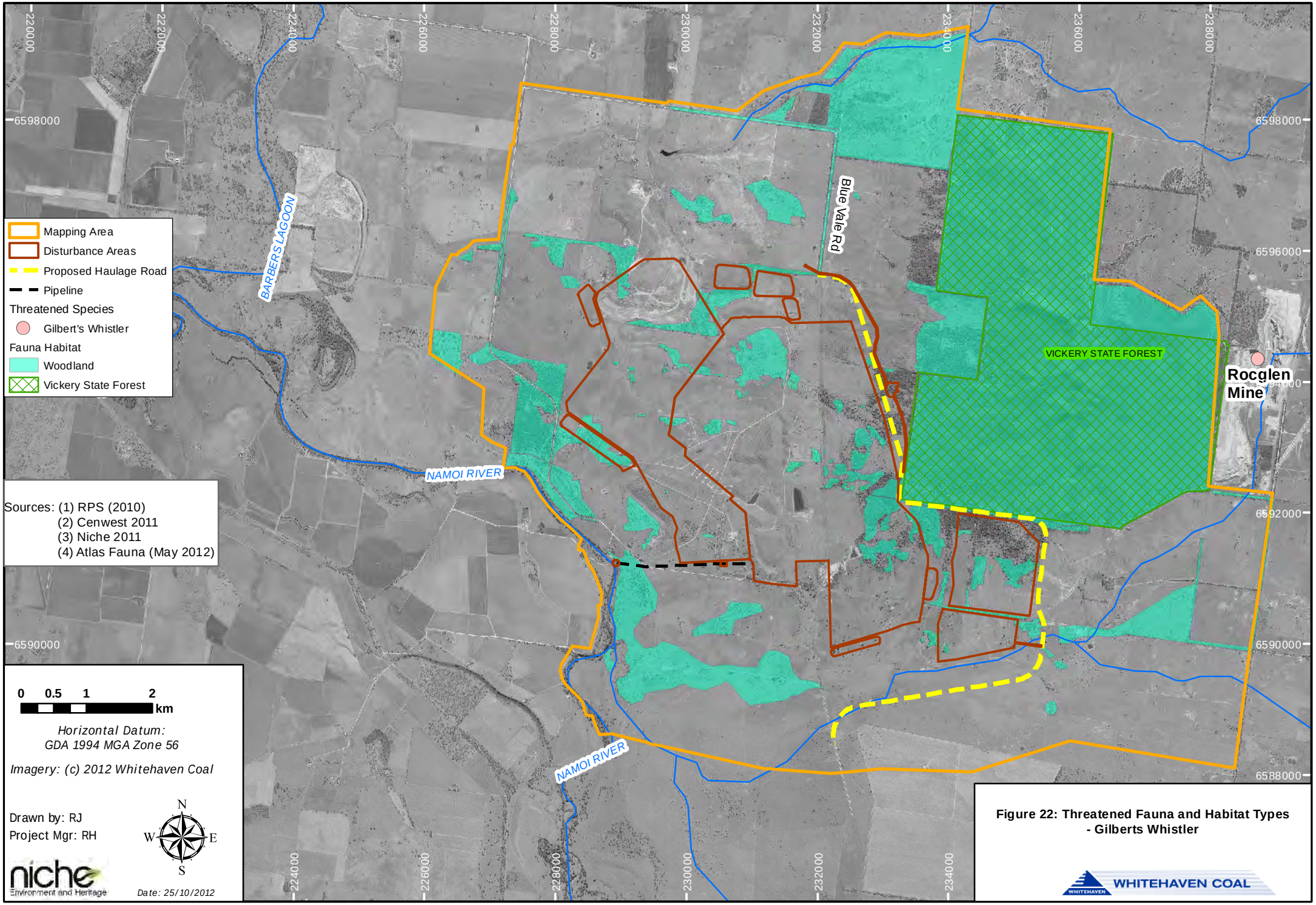

Figure 22: Threatened Fauna and Habitat Types - Gilberts Whistler

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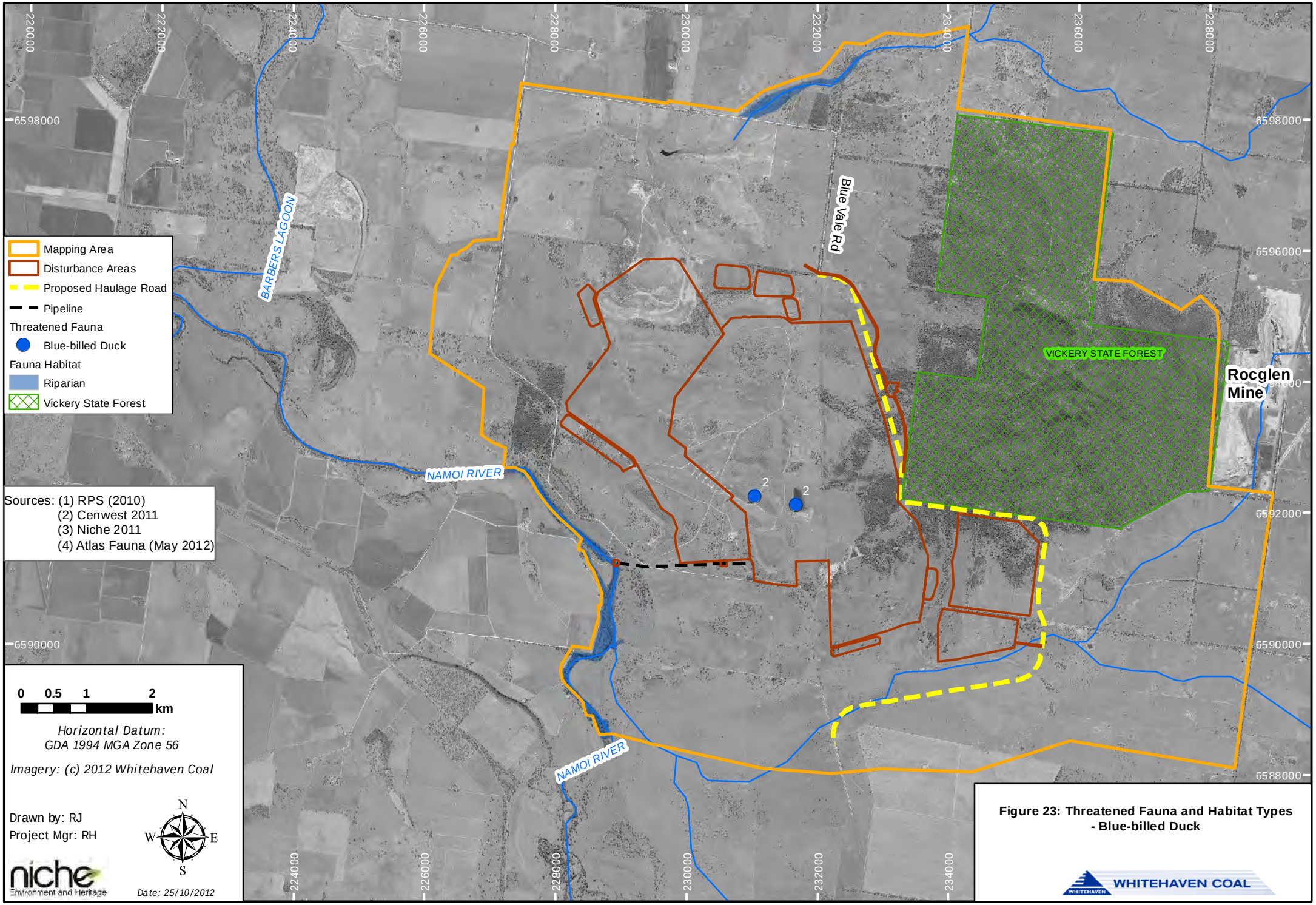

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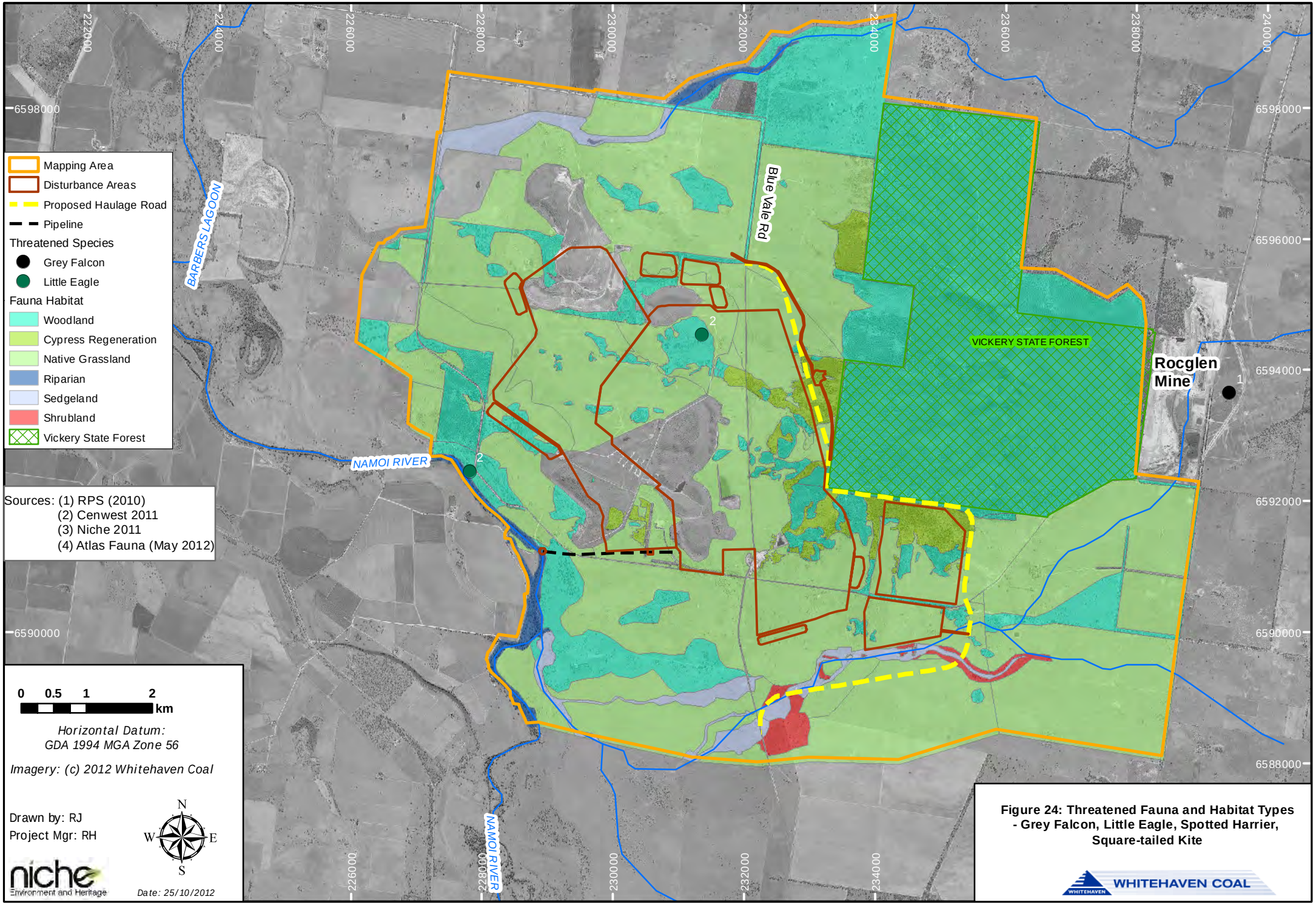

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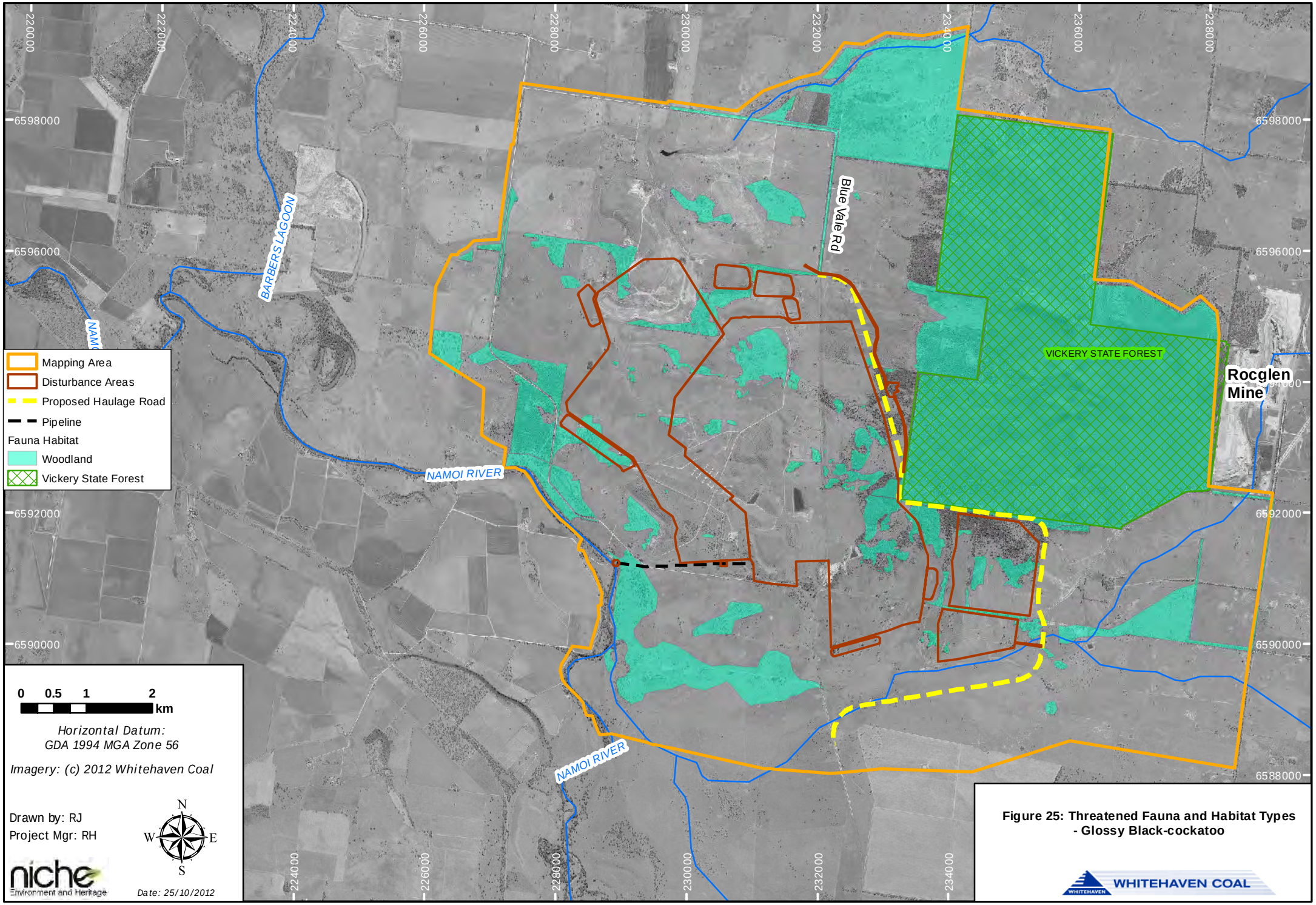

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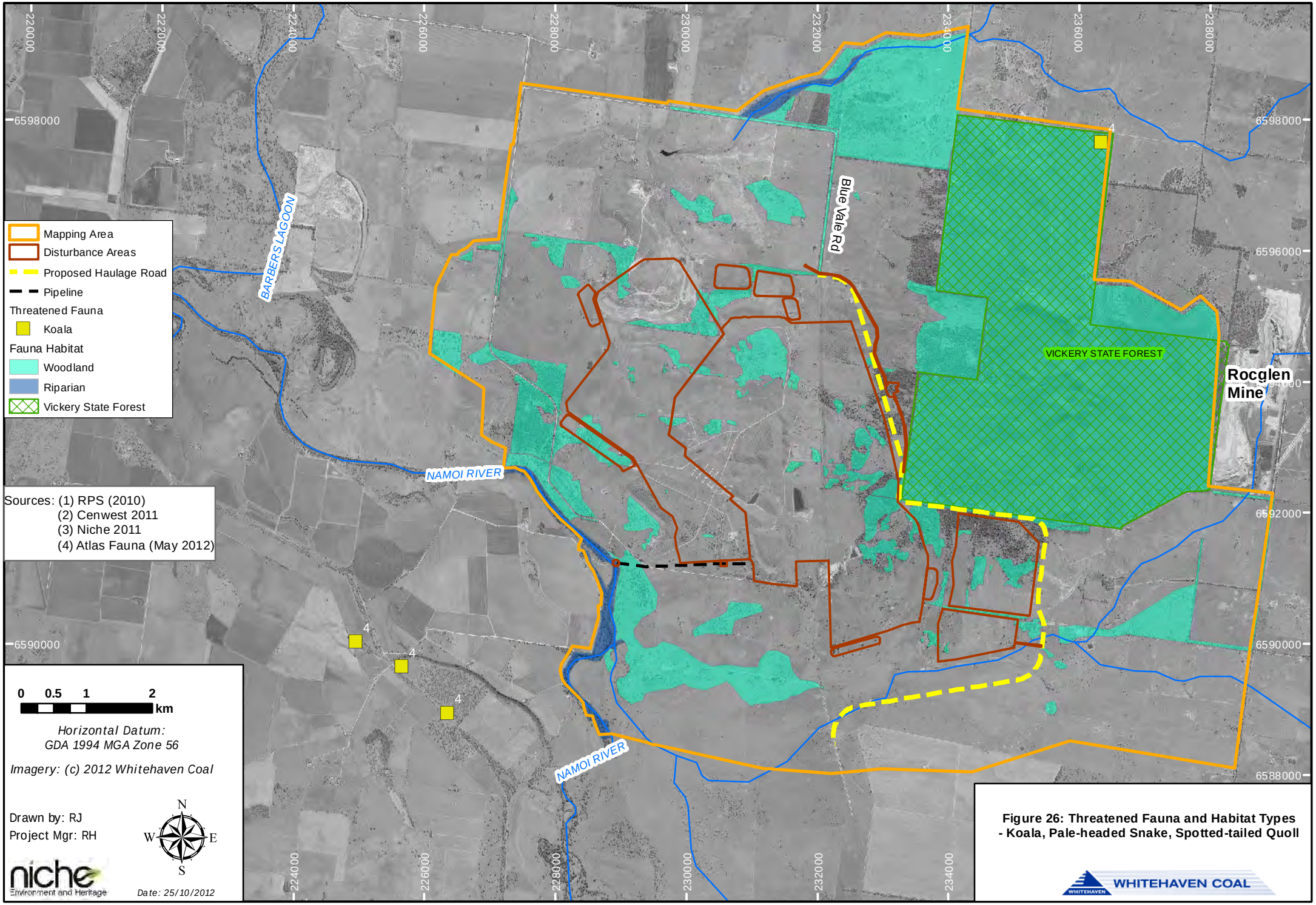

Figure 26: Threatened Fauna and Habitat Types - Koala, Pale-headed Snake, Spotted-tailed Quoll

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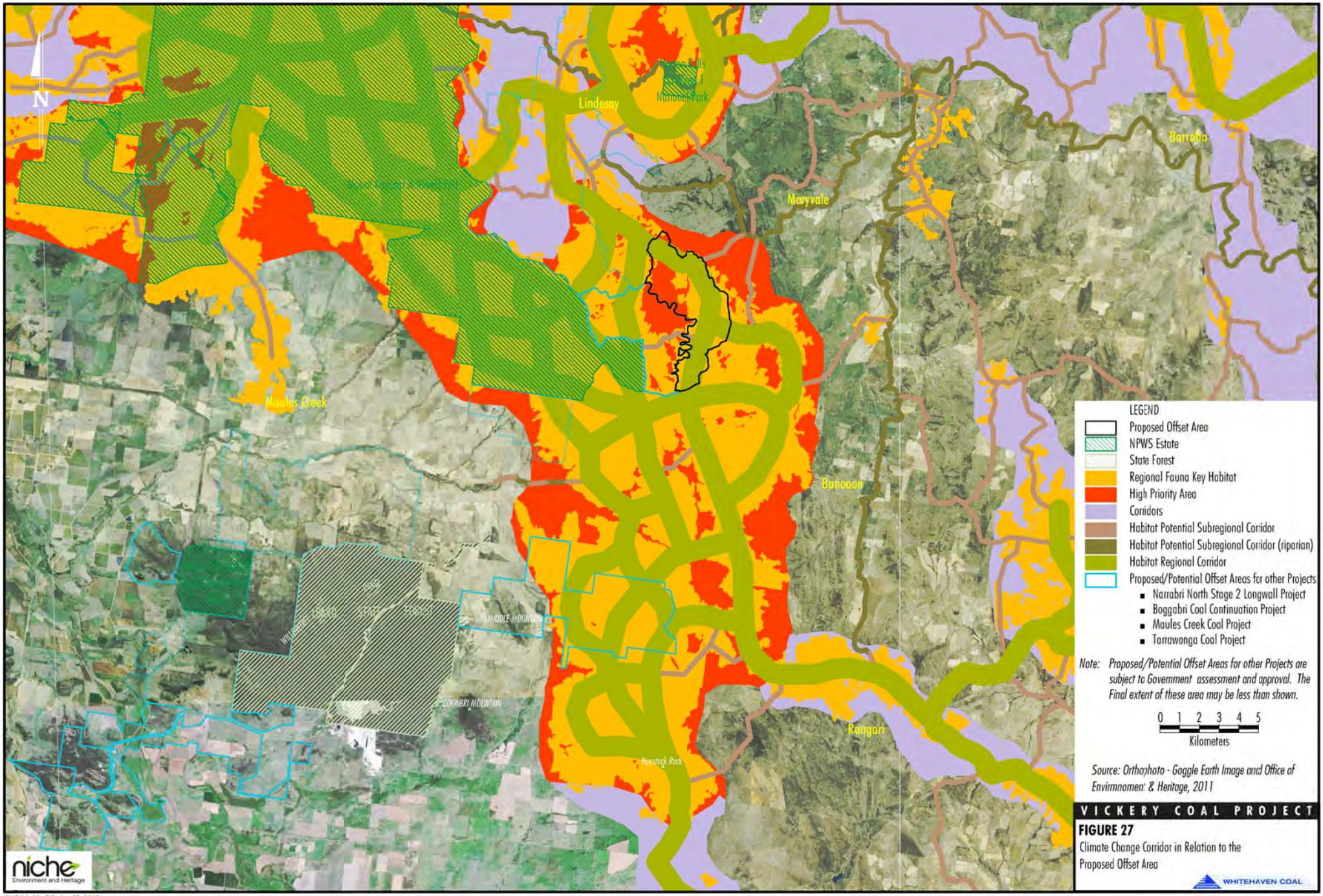

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FIGURE 27

Climate Change Corridor in Relation to the Proposed Offset Area

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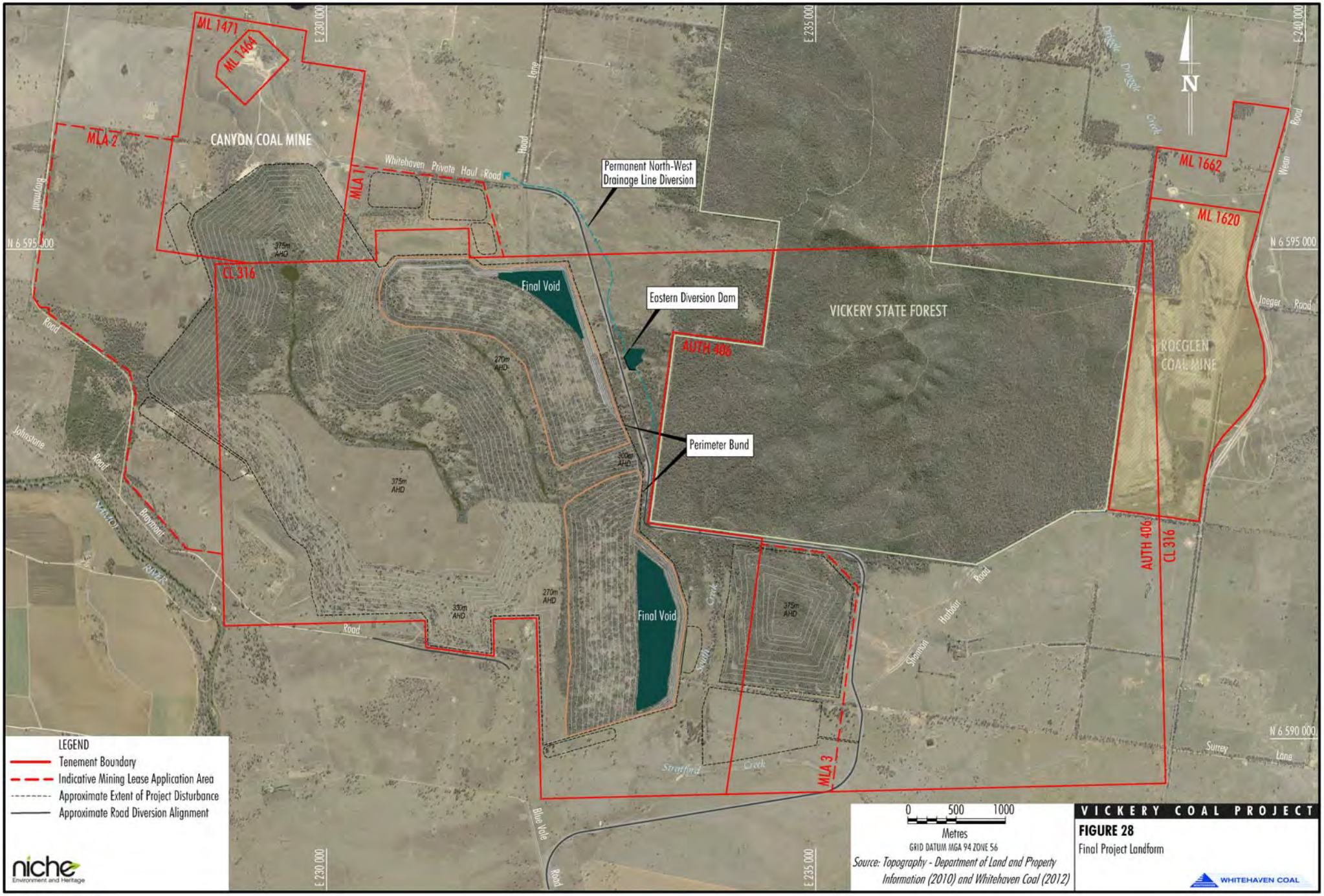

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