



ENVIRONMENTAL IMPACT ASSESSMENT AND ENVIRONMENTAL MANAGEMENT PLAN

**Proposed Coalfields Highway Upgrade (15.90–
26.34 SLK)**





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EXECUTIVE SUMMARY

The Coalfields Highway is a state road that links Collie to Perth, Bunbury and the south-west. A number of road fatalities have occurred in recent years along the highway and expanding industry continues to increase traffic volumes along it. Main Roads Western Australia (Main Roads) has determined the need to upgrade a 10.44 km section of the existing highway.

The subject of this report is the realignment of Coalfields Highway between 15.90–26.34 SLK (Figure 1). The proposed realignments will improve overtaking opportunities, increase road width and include culvert extensions and drainage improvements. The community benefits from the project include heightened road safety, reduced impact of road crashes on road users and greater transport efficiency, including reduced freight costs.

The project is expected to be constructed in four separate sections, with construction of the first two sections (Wellington Dam and Hamilton River) commencing in 2014. The two remaining sections will be constructed when funding becomes available.

RPS was commissioned to prepare this combined Environmental Impact Assessment and Environmental Management Plan (EIA and EMP). RPS and its specialist sub-consultants were required to investigate a 150 m wide corridor over the project length to cater for potential future expansion of the network. This EIA and EMP incorporates the results from desktop studies and field investigations (2010–2012) that included flora, fauna, heritage and *Phytophthora* dieback surveys. It will be used by Main Roads to obtain project environmental approvals and assist managing the environmental impacts of the project.

The findings of the assessment have been considered, and management recommendations to avoid environmental impacts have been prepared as an Environmental Management Plan (EMP), which is attached as Appendix 9 (in tabular format).

The key outcomes of this EIA are:

- Project clearing is expected to be approximately 25 ha.
- The project land requirement is approximately 46.5 ha including the excision of 19.1 ha from the Wellington National Park.
- Referral of the project to the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) is required to confirm the need for approvals under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) in respect to the loss of black cockatoo habitat.
- Referral of the project to the Western Australian Environmental Protection Authority (EPA) under Part IV of the *Environmental Protection Act 1986* is required to determine the need for formal environmental assessment.

- Obtaining a Bed and Banks Permit from the Department of Water under the *Rights in Water and Irrigation Act 1914* will be undertaken.
- Broad-scale Acid Sulfate Soil (ASS) risk mapping indicates that the Wellington Dam area has a “High Probability” of ASS. Main Roads will need to undertake further preliminary site assessment for ASS where project activities require soil disturbance in the dam area.
- No contaminated sites are expected to be impacted by the project.
- The project clearing has been assessed against the EPA’s Ten Clearing Principles. It is concluded that the project clearing is
 - likely to be at variance to Principle D
 - may be at variance to Principle A, F and H
 - not likely to be at variance to Principles B and I
 - not at variance to Principles C, E, G and J
 - if the project is not formally assessed by the EPA then project clearing can be conducted under Main Roads existing Clearing Permit 818.
- The vegetation to be impacted by the roadwork is well represented regionally with 70.3% of its pre-European extent remaining and within the Shire of Collie there is 83.9% remaining.
- No Declared Rare Flora or Threatened Ecological Communities have been identified within the study area.
- One Priority 1 flora species (*Lomandra whicherensis*) and one Priority 2 species (*Millotia tenuifolia* var. *laevis*) were recorded within the project area. It is expected that 140 of the more than 1500 *Lomandra whicherensis* plants identified will be taken for by project clearing. No *Millotia tenuifolia* var. *laevis* will be impacted by project clearing.
- One other taxon, *Sphenotoma capitata*, was recorded and considered to be regionally significant, although the plants identified are not expected to be impacted by project works.
- A total of 52 weed species were recorded in the survey area, two of which (bridal creeper and blackberry) are Declared Plants (weeds) within the Shire of Collie that require specific management. Minimising the spread of weeds in general is considered important to protect conservation values in the Wellington National Park. A separate topsoil management plan will be developed to address the management of weeds.
- *Phytophthora cinnamomi* dieback occurrence is extensive across the study area. However, two minor sections are “Uninfested” that warrant consideration as being “Protectable” from dieback.

- Main Roads will update the current mapping and arrange a meeting with the DEC Wellington District to finalise any dieback “Protectable” areas and detailed dieback hygiene measures for the project.
- A total of 44 native fauna species were recorded during the site fauna survey.
- Four vertebrate species of conservation significance (listed as state or federal threatened/migratory species or DEC priority species) were positively identified within the project site including three black cockatoo species and the rainbow bee-eater. No other conservation significant fauna species are expected to be impacted by the project.
- The project will require the clearing of 25 ha of potential black cockatoo foraging habitat including 424 potential cockatoo nest trees (DBH >50 cm) out of the 1195 identified within the survey area. The site survey identified 77 of these trees with hollows potentially suitable for black cockatoo species of which 28 will be cleared. None of these trees showed signs of use by black cockatoos during the site assessment. However, the impact due to this clearing is expected to be minimal as there is more than 30 000 ha of similar habitat available within 10 km of the site.
- An assessment of the project clearing against the EPBC Referral Guidelines for three threatened black cockatoo species (Commonwealth of Australia 2012) indicates that the Coalfields Highway Upgrade project requires referral to DSEWPaC under the EPBC Act 1999.
- An assessment of the project clearing against the Matters of National Environmental Significance, Significant Impact Guidelines 1.1 (Commonwealth of Australia 2009) shows that the significance of the impact on EPBC protected species is not considered significant due to the extent of similar suitable habitat (30 000 ha) within 10 km of the project.
- The proposed clearing of relatively narrow, discontinuous sections of vegetation located at various points within the linear study area will not fragment any potential fauna habitat to the extent that it would represent a barrier to fauna movement above that already present in the area (i.e. the existing Coalfields Highway and network of existing roads, tracks and power line easements).
- Overall, in respect to native fauna, no substantial impacts are anticipated as a consequence of developing the project due to large areas of similar habitat within the adjacent national park.
- There are no South-west Regional Ecological Linkage axis lines traversing or in close proximity to the project.
- Registered Aboriginal heritage sites will be impacted by the project. Main Roads has approval under Section 18 of the Western Australian *Aboriginal Heritage Act 1972* to disturb Aboriginal sites Appendix 10.

- No impact to European heritage is expected as a result of developing the project.
- Existing roadside memorials and the Munda Bididi Trail crossing require management during project implementation.
- Preparing a Topsoil Management Plan and Revegetation/Landscape Plan are considered an important aspect of road construction activities.
- Main Roads should continue liaison with the DEC in respect to environmental management measures within the Wellington National Park.
- Main Roads should adopt the environmental management measures detailed in this report to deliver the project in an environmentally and socially acceptable manner.

TABLE OF CONTENTS

Page

EXECUTIVE SUMMARY	i
1.0 INTRODUCTION.....	1
1.1 Background.....	1
1.2 Scope of this Report.....	2
1.2.1 Exclusions	3
1.3 Project Location and Study Area.....	4
1.3.1 Project Scope.....	4
2.0 EXISTING ENVIRONMENT, IMPACTS AND MANAGEMENT MEASURES	5
2.1 Climate	5
2.2 Landforms, Geology and Soils	5
2.2.1 Acid Sulfate Soils.....	6
2.3 Hydrology and Drainage.....	6
2.3.1 Surface Water and Drainage	6
2.3.2 Proclaimed Areas.....	8
2.3.3 Wetlands.....	8
2.4 Vegetation.....	9
2.4.1 Vegetation Complexes	10
2.4.2 Site Vegetation Units	11
2.4.3 Extent of Vegetation Remaining.....	11
2.4.4 Vegetation Condition	13
2.4.5 Declared Rare and Priority Flora	14
2.4.6 Site Flora Survey and Significant Species.....	16
2.4.7 Threatened Ecological Communities.....	18
2.4.8 Clearing of Native Vegetation.....	20
2.5 Weeds and Introduced Species	22
2.6 <i>Phytophthora Dieback</i>	24
2.7 Topsoil Management.....	27
2.8 Revegetation and Landscaping	27

2.9	Fauna	28
2.9.1	Listed Fauna Potentially Utilising the Study Area.....	28
2.9.2	Opportunistic Fauna Search Results.....	30
2.9.3	Black Cockatoos and Habitat Trees.....	31
2.9.4	Fauna Habitat Assessment.....	31
2.9.5	Conservation Significance of Habitat in the Study Area.....	32
2.9.6	Ecological Linkages and Wildlife Corridors.....	33
2.9.7	Potential Fauna Impact Assessment.....	33
2.10	Heritage.....	40
2.10.1	Aboriginal Heritage.....	40
2.10.2	European Heritage.....	42
2.10.3	Roadside Memorials.....	42
2.11	Land Use Considerations.....	42
2.11.1	Environmentally Sensitive Areas.....	42
2.11.2	Contaminated Sites.....	42
2.11.3	Existing / Surrounding Land Uses.....	43
2.11.4	Traffic Noise.....	43
2.11.5	DEC Managed Assets.....	44
2.11.6	Visual Amenity.....	45
2.12	Pre-construction Works.....	45
2.13	Construction Phase Impacts.....	45
3.0	ENVIRONMENTAL MANAGEMENT	47
3.1	Environmental Monitoring and Compliance	47
4.0	CONSULTATION	49
4.1	Department of Water (Carol Anderson, Senior NRM Officer – DoW Bunbury, 27 January 2011)	49
4.2	Department of Environment and Conservation (Kelly Faulkner, Manager – Native Vegetation Conservation Branch, February 2011).....	50
4.3	Department of Environment and Conservation and Main Roads Meeting (DEC Bunbury, 19 November 2010).....	50
4.4	Department of Environment and Conservation (Forest Management Branch and Wellington District Office)	50
4.5	Department of Environment and Conservation and Main Roads Meeting (DEC Bunbury, 20 January 2012).	51

4.6 Department of Environment and Conservation and Main Roads Meeting (DEC Bunbury, 20 November 2012). 51

4.7 Conservation Commission of Western Australia and Conservation and Main Roads Meeting (DEC Crawley, 11 February 2013). 52

5.0 LIMITATIONS53

6.0 REFERENCES.....55

TABLES

(contained within report text)

	Page
Table 1: Climate Data for Collie	5
Table 2: Vegetation Extents Remaining in the Region and Shire of Collie.....	12
Table 3: Regional Vegetation Protected in Reserves and National Parks	13
Table 4: DEC-listed Declared Rare and Priority Flora and their Likelihood of Occurrence in the Survey Area.....	15
Table 5: Standard Control Codes (these may vary for Individual Plants)	22
Table 6: Area Statement (Applies to Entire Mappable Area Assessed).....	26
Table 7: Likelihood of Occurrence of Fauna Species of Conservation Significance.....	29
Table 8: Possible Impacts on Fauna Species of Conservation Significance.....	33
Table 9: Assessment of Black Cockatoo Habitat Impacts against DSEWPC Criteria (2012).....	36
Table 10: Significant Impact Criteria for Significant Species (DSEWPC 2009).....	38
Table 11: Approximate Distance from Existing and Realigned Highway of Private Residence.....	43

FIGURES

(compiled at rear of report)

Figure 1: Site Location
Figure 2: Study Area
Figure 3: Geology and Landforms
Figure 4: Vegetation Complexes
Figure 5: Significant Flora and Weeds
Figure 6: Environmental Constraints

APPENDICES

- APPENDIX 1 Main Roads Project Realignment Sections
- APPENDIX 2 Lomandra whicherensis survey for the Proposed Coalfields Highway Realignment
- APPENDIX 3 Flora and Vegetation Survey Report (Ekologica 2012)
- APPENDIX 4 EPBC Act Protected Matters Search Report
- APPENDIX 5 Flora and Vegetation Study or the Wellington Dam Rd Grey Sands (255DpWGs) Area (Morgan 2012)
- APPENDIX 6 Clearing Assessment Report and Agency Consultation
- APPENDIX 7 *Phytophthora* Dieback Interpretation Survey Report
- APPENDIX 8 Fauna Assessment Report
- APPENDIX 9 Environmental Management Plan

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1.0 INTRODUCTION

1.1 Background

The Coalfields Highway links Collie to Perth, Bunbury and the south-west.

Several road fatalities have occurred in recent years along the highway, with various contributing factors being identified; these include increased traffic volumes, narrow lane width, poor geometry (winding tight curves), limited overtaking opportunities, and large trees in close proximity to the road.

Main Roads Western Australia (Main Roads) proposes to undertake roadwork on a 10.44 km section of the Coalfields Highway (15.90–26.34 SLK) to improve road safety and transport efficiency (Figure 1). The project occurs from Lullaby Road (1850 m west of the Wellington Dam Road) to 1 km east of the Wellington Dam.

The project is expected to be constructed as four separate sections as detailed below with the first two (Wellington Dam and Hamilton River) commencing in 2014. The remaining sections will be constructed when funding becomes available.

- Wellington Dam section – 15.90 to 18.80 SLK
- Gastaldo West section – 18.80 to 20.90 SLK
- Gastaldo East section – 20.90 to 23.70 SLK
- Hamilton River section – 23.70 to 26.30 SLK.

As detailed in Section 1.3.1 the proposed project scope includes:

- construction of a 10.4 km single carriageway with 3.5 m lanes, and 1.5 m sealed and 1.0 m unsealed shoulders
- construction of four overtaking lanes (two eastbound and two westbound)
- new intersections at Wellington Dam Road, Worsley Back Road, Gastaldo Road and Wellington Dam Campsite Road
- drainage structures including cross road culverts, table drains and retention basins and levees

The community benefits from the project include:

- increased road safety for all the community
- greater transport efficiency, including reduced freight costs.

RPS was commissioned by Main Roads to prepare this Environmental Impact Assessment and Environmental Management Plan (EIA and EMP) specifically for the proposed Coalfields Highway upgrade project (15.90–26.34 SLK). This EIA and EMP report includes the results from both desktop and field investigations (2010–2012) that included flora, fauna, heritage and *Phytophthora* dieback surveys. Relevant studies completed in the general area are also considered herein, including a Preliminary EIA that includes the project section, plus an EIA/EMP prepared specifically for the adjacent section of the highway (GHD 2009 and GHD 2010).

This Coalfields Highway Upgrade EIA and EMP report assesses potential environmental impacts and provides environmental management measures to assist Main Roads in obtaining the appropriate environmental approvals and to deliver the project in an environmentally acceptable manner.

1.2 Scope of this Report

This combined EIA and EMP report was prepared according to Main Roads requirements and includes the following:

- review of relevant environmental reports, including GHD (2009) and GHD (2010)
- a description of the existing environment
- identification of key environmental aspects and impacts
- assessing the project clearing against the Environmental Protection Act's 10 Clearing Principles (Schedule 5) – based on provided information
- field investigations
 - Level I Flora and Vegetation Survey (Brian Morgan) – with regard to EPA *Guideline No. 51* (EPA, 2004)
 - Fauna Assessment, targeted black cockatoo searches and recording potential Habitat Tree locations – with regard to EPA *Guideline No. 56* (EPA, 2004)
 - *Phytophthora* dieback interpretation survey – with regard to DEC Interpreter Guidelines (DEC, 2001)
 - *Lomandra whicherensis* Survey for the Proposed Coalfields Highway Realignment (Brian Morgan 2012)
 - Flora and Vegetation Survey of the Wellington Dam Road Grey Sands (255DpWGs) Area (Brian Morgan 2012)
 - Level I Flora and Vegetation Assessment for a Proposed Upgrade of Coalfields Highway (SLK 15.9-SLK 26.34) (Ekologica 2012)

- assessment of environmental aspects to advise whether the project would likely require referral to the Western Australian Environmental Protection Authority (EPA)
- assessment of Matters of National Environmental Significance to advise whether the project would likely require referral to federal Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC)
- consultation with relevant government agencies
- determining (but not applying for) clearances required under other legislative provisions, including (but not limited to) those under the following Acts
 - Environmental Protection (Clearing of Native Vegetation) Regulations 2004
 - *Rights in Water and Irrigation Act 1914*
 - *Country Areas Water Supply Act 1947*
 - *Conservation and Land Management Act 1984*
 - *Wildlife Conservation Act 1950*
 - *Heritage of Western Australia Act 1990*
- providing environmental management measures suitable for inclusion in the tender documentation for project implementation
- reporting on the results with sufficient information to prepare the EMP for construction

1.2.1 Exclusions

The following items did not form part of this commission and were managed separately by Main Roads:

- Aboriginal Heritage Surveys – RPS engaged Brad Goode and Associates on behalf of Main Roads complete Aboriginal Archaeological and Ethnographic studies over the project area. This includes consultations with relevant Aboriginal group representatives. Main Roads will ensure its compliance with the *Aboriginal Heritage Act 1972* with regard to the outcomes of the aforementioned heritage investigations.
- No specific investigations were undertaken for potential Basic Raw Materials (BRM) source areas, new access tracks and/or spoil sites as such information was not available at the time of preparing this report.
- Public consultation did not form part of this commission.

1.3 Project Location and Study Area

The project site is located approximately 15 km west from Collie town site and extends over 10.44 km, from 15.90 SLK to 26.34 SLK (Figure 1).

RPS and its specialist sub-consultants were engaged to investigate a 150 m wide corridor between Lullaby Road in the west (a forest track south 16 SLK) and Rose Road in the east (28 SLK) which covers the proposed realignment 15.90–26.34 SLK.

At the western end of the study corridor, two realignment options were originally investigated. Main Roads conducted an assessment of these options against a number of criteria including road safety (geometry), construction safety, environmental impact, community (traffic) and social impact, cost and time. These investigations lead to the final concept alignment (Figure 1) which is discussed in this document. The proposed scope for this alignment is discussed below.

1.3.1 Project Scope

Main Roads proposes to undertake the below activities as part of the realignment project:

- construction of approximately 10.4 km of two lane single carriageway road with two 3.5 m wide lanes, 1.5 m sealed shoulder and 1.0 m unsealed shoulders
- two eastbound and two westbound passing lanes
- side road intersection at Wellington Dam Road, Worsley Back Road, Gastaldo Road and Wellington Dam Campsite Road
- private property accesses
- fencing of private properties
- a new culverted crossing of Wellington Dam
- cross-road and roadside culverts and drainage structures
- off-road drainage including retention basins and levees
- safety barriers
- pre-construction activities such as geotechnical investigations and service relocations
- landscaping and rehabilitation
- Reinstatement of DEC infrastructure (fire access, Munda Bidli Trail, connection to information bay).

2.0 EXISTING ENVIRONMENT, IMPACTS AND MANAGEMENT MEASURES

This section describes the existing study areas physical, biological and social aspects based on previous studies and recent (2010–2012) field investigations. This includes an assessment of potential and expected impacts of the proposed roadwork on the receiving environment. Environmental management measures are also provided where applicable to avoid, minimise and/or manage impacts. The EMP prepared from this assessment is attached as Appendix 9.

The information included in this section was sourced from database records, literature review, previous studies and field surveys.

2.1 Climate

The climate of the study area falls within the Mediterranean zone that experiences dry, hot summers and cool, wet winters. The recorded climate data from the closest Bureau of Meteorology weather recording Site No. 009628 is summarised in Table 1 (Bureau of Meteorology 2011).

Table 1: Climate Data for Collie

Weather Observation	Minimum	Maximum
Mean Annual Maximum Temperature Range	15.5 °C (July)	30.5 °C (January)
Mean Annual Minimum Temperature Range	13.2 °C (February)	4.2 °C (July)
Mean Annual Rainfall	933.3 mm	
Mean Annual Days of Rain /= 1 mm	89.8	

2.2 Landforms, Geology and Soils

The survey area is located on the Darling Plateau physiographic unit that comprises an undulating surface with an average elevation of 250–300 mAHD. There are a range of soils present including sands, lateritic soils and clays which generally occur in distinct parts of the landscape (Beard 1980). Eight soil landscape subsystems have been mapped over the study area as shown at Figure 3 (DAFWA 2011). The two most extensive of these and their locations within the study area are:

- 255LvGR – moderately deep valleys in granite with loamy earths and loamy gravels. This soil subsystem extends over much of the eastern third of the study area.
- 255DpDWi – lateritic soils comprised of gravel with some sands and loams. This soil subsystem can be associated with mid-upper slope areas in the central and western parts of the study area.

The potential risk of water and wind erosion as a consequence of the proposed works is expected to be moderate and confined to areas of steep slopes. Timing of operations and dust control measures will manage these issues in the short term. Appropriate design of road drainage will be necessary to manage potential water erosion in the longer term.

It is anticipated that revegetation works proposed along the realignment will also reduce the potential for erosion of the road cut and fill batters.

2.2.1 Acid Sulfate Soils

The current Department of Environment and Conservation (DEC) Acid Sulfate Soil (ASS) risk mapping does not cover the study area. The Commonwealth Scientific and Industrial Research Organisation's (CSIRO) Australian Soil Resource Information System (ASRIS) indicates that the Coalfields Highway between 15.90 and 26.34 SLK has "no known occurrence" of ASS, except for the area over the Wellington Dam that has been mapped as having a "High Probability" of ASS.

Given the project site is well elevated above sea level and contains no observed characteristics commonly associated with the presence of ASS, the likelihood of encountering ASS is considered very low in most parts and marginal only where the section of proposed road realignment traverses the Wellington Dam.

2.2.1.1 Management Measures

If project activities require soil disturbance in the Wellington Dam area, Main Roads should undertake further preliminary site assessments for ASS. If all activities in the aforementioned area only involve fill rather than excavation or boring, no further investigation or management is considered necessary for ASS.

2.3 Hydrology and Drainage

2.3.1 Surface Water and Drainage

There are no major rivers within the project study area corridor, the main drainage system in the locality is the Collie River which is situated south and outside of the study area corridor. It feeds into the Wellington Dam reservoir before traversing westwards through forested land and the Swan Coastal Plain to discharge into Leschenault Estuary.

The Luxenburgh Watershed extends (in part) from the western end of the study area through to Gastaldo Road draining northwards and encompasses the upper Otho River, also outside of the study area. The remaining project area falls within the upper Wellington Reservoir watershed that drains south and east. The Hamilton River drains into Wellington Dam north and outside of the study area.

The project traverses an ephemeral drainage line at 19.950 SLK, which flows north and forms the upper reaches of the Otho River. A culverted crossing will maintain the existing surface water drainage at this crossing.

An ephemeral drainage line is situated south of the existing highway and north of the proposed highway re-alignment, over approximately 700m immediately west of Wellington Dam. This narrow and incised watercourse drains east into Wellington Dam.

In respect to environmental impacts, the proposed realignments are not expected to significantly alter the natural surface water regime, including groundwater recharge. No dewatering is likely to be required to develop the project. It is expected that water required for road construction and any dust suppression will be sourced from a scheme supply or dedicated bore under licence.

Given the study area has a high mean annual rainfall (900 mm), employing best management practices in design and erosion control will be necessary to manage potential scouring and soil erosion within adjacent forested areas.

Potential Risks to the Wellington Dam water quality from project activities include the following:

- potential contamination from off-road run-off during highway operation
- risk of spills from road crash during operation of the highway
- risk of spill during construction or contamination from refuelling operations and storage of fuel, oils and chemicals and machinery parking areas. This risk can be significantly reduced and managed during the projects implementation through not storing large quantities (over 20 L) of hydrocarbons within the dam catchment
- the greatest risk to the water quality is likely to be from sediment and turbidity from road construction earthworks. This risk will be managed during construction through erosion control methods such as construction timing and silt curtains.

The project design will include erosion control and sediment management measures to reduce water quality risks during the ongoing operation of the highway.

The EMP prepared for the project includes relevant management practises to minimise risks to water quality as detailed in the Western Australian Planning Commission (WAPC) Statement of Planning Policy No 2.7 – *Public Drinking Water Source Policy*, and the DoW's Water Quality Protection Note – *Land use Compatibility in Public Drinking Water Source Areas*. Employing such practices will be important to protect the reservoirs water quality that may be a future drinking water source.

2.3.2 Proclaimed Areas

The proposed works fall within a proclaimed Surface Water Area under the *Rights in Water and Irrigation Act 1914* (RIVI Act). Correspondence received from the Department of Water (DoW) confirmed that obtaining a Bed and Banks Permit from the DoW is required prior to any interference with the bed and/or banks of any rivers or any other waterways. Main Roads will obtain the necessary approvals as required under the RIVI Act prior to the commencement of construction works.

The Wellington Dam Catchment Area is also proclaimed under the *Country Areas Water Supply Act 1947* (CAWS Act). Its current proclamation status is a “Not Assigned” Public Drinking Water Source Area with a management objective to protect the resource for future needs. The Wellington Reservoir is used for irrigation but is potentially important for industry and a drinking water supply. Historically, the reservoir was used as a supply of potable water. Currently, it is not used as a drinking water supply because of high salinity levels, associated with dry-land salinity in the upper catchment.

Previously, a licence to clear native vegetation under the CAWS Act was required to clear vegetation within this area. However, if a clearing permit under the *Environmental Protection Act 1986* (EP Act) has been issued (by DEC), it is not necessary to also obtain a licence under the CAWS Act as well, except if compensation for the refusal of a licence has been paid to a previous applicant. If clearing is assessed by the DEC and found to be exempt then a clearing licence will be required under the *Country Area Water Supply Act 1947*.

2.3.3 Wetlands

There are no wetlands within the project study area of state or international importance. There are scattered wetlands of the Multiple Use category and one Resource Enhancement wetland, all of which are situated outside of the study area, towards its western end. The project will not impact existing wetlands, apart from a small dampland area located north of the existing highway at 19 100 SLK (approximately 100 m east of Wellington Dam Road) and associated with the vegetation units EmCcTI and EmCcBI.

2.3.3.1 Management Measures

Obtain a Bed and Banks Permit with the Department of Water under the *Rights in Water and Irrigation Act 1914*.

Design and implement road drainage to maintain existing surface water flows.

Ensure adequate culverts are installed to maintain existing surface water flows.

Ensure road drainage design incorporates erosion control and sediment management requirements.

Road drainage will be managed so that there is no direct discharge of road run-off to existing watercourses or the Wellington Dam.

All chemicals on site will be stored in suitable containers or tanks in accordance with their MSDS.

Construction in the vicinity of water bodies/courses should, if possible, be done within the drier months of the year to avoid/minimise turbidity from erosion.

No bulk on-site storage of fuel, oils and other contaminant materials should be permitted during road construction.

Any temporary on-site refuelling or storage of fuel, oils and other contaminant materials should be done on a pre-designated hardstand area located a minimum of 100 m from any surface water, drainage line or perimeter of the Wellington Dam Reservoir. Bunding to capture spills would be required consistent with relevant agency standards.

Spill clean-up materials will be kept on site for the clean-up of any accidental spillages.

Major vehicle and plant servicing will not be permitted on the project site.

Any minor servicing is to be undertaken in pre-designated refuelling areas as defined above.

Overnight parking of machinery and vehicles shall be on a dedicated hardstand area or road formation that is not in proximity to any watercourse, the Wellington Dam Reservoir or any wetland.

2.4 Vegetation

Level I Flora and Vegetation Surveys were completed during November 2010, December 2010 and February 2011 by Brian Morgan (Consultant Plant Biologist) for the entire project length and previously proposed re-alignment option in the vicinity of the Wellington Dam Road. All surveys were conducted in accordance with the *EPA Guidance for the Assessment of Environmental Factors No 51 – Terrestrial Flora and Vegetation Surveys for the Environmental Impact Assessment in Western Australia* (EPA 2004).

Since these 2010 and 2011 Level I surveys, a Level I flora and vegetation survey was carried out in early October 2012 by Ekologica to determine the presence of rare flora and to define and map vegetation units with the proposed project corridor (15.90–26.34 SLK). This more recent survey built on the work undertaken by Morgan (2011, 2012a, 2012b).

After reviewing the Level 1 surveys and reports, DEC officers raised concerns relating to an area of Soil Landscape Subsystems 255DpWGs that was traversed by the Coalfields Highway. These concerns were that this area of Soil Landscape Subsystems 255DpWGs, located around the intersection of Wellington Dam Road and the Coalfields Highway, was restricted in this region and may be associated with restricted plant communities.

The DEC suggested that further work was required to determine the regional context of the vegetation occurring on deep grey sands around and to the east of the Wellington Dam Road Information Board. Consequently, a survey was undertaken by Brian Morgan between 14 October and 29 December 2011 to determine the extent of deep grey sands vegetation in the Soil Landscape Subsystem 255DpWGs in the Wellington Dam Road area (south of the existing Coalfields Highway) and to determine whether any special flora values or regional significance was associated with this vegetation.

Further flora surveys also include a *Lomandra whicherensis* survey undertaken by Brian Morgan between November 2010 and November 2011. Details of this survey are provided in Section 2.4.6.1 and included as Appendix 2.

Key results from both desktop information and all site surveys are detailed below. For the full October 2012 *Flora and Vegetation Survey Report* with supporting maps, refer to Appendix 3.

2.4.1 Vegetation Complexes

The study area lies in the Dale Botanical Sub-district, in the Darling Botanical District of south-west Western Australia (Beard 1980). Figure 4 shows the three Vegetation Complexes mapped by Havel and Matiske (1998) in the Coalfields Highway survey area that includes:

- Dwellingup I (DI) (Darling Plateau – Uplands): mosaic of open forest of *E. marginata* subsp. *marginata-Corymbia calophylla*, with some admixtures..., including woodlands of *E. wandoo*, low woodlands of *Allocasuarina huegeliana* and closed heaths on or near granite outcrops.
- Yarragil I (YgI) (Darling Plateau – Valleys): open forest of *E. marginata* subsp. *marginata-Corymbia calophylla* on slopes with mixtures of *E. patens* and *E. megacarpa* on valley floors.
- Murray I (MyI) (Darling Plateau – Valleys): open forest of *E. marginata* subsp. *marginata-Corymbia calophylla-E. patens* on valley slopes.

The eastern part of the surveyed corridor traverses large areas mapped as vegetation complexes MyI and YgI. The central and western part of the survey corridor mostly crosses areas mapped as complex DI.

2.4.2 Site Vegetation Units

Eleven vegetation units were mapped in the Coalfields Highway survey area (see Appendix 3, Figures 7A–C). These were further classified into the following four broad vegetation groups:

- *Eucalyptus patens* (blackbutt) mixed eucalypt forests on lower valley slopes
- *Eucalyptus marginata* subsp. *marginata* (jarrah)–*Corymbia calophylla* (marri) woodlands to open forests on gravelly slopes of lateritic ridges
- *Eucalyptus marginata* subsp. *marginata* (jarrah)–*Corymbia calophylla* (marri) woodlands on sandy soils on lower slopes and valley floor
- dampland vegetation.

Eucalyptus patens (blackbutt) – *Eucalyptus marginata* subsp. *marginata* (jarrah) *Corymbia calophylla* (marri) mixed eucalypt forests dominated the vegetation in the eastern one third of the survey area). The western two thirds of the survey area mostly had a covering of *Eucalyptus marginata* subsp. *marginata* (jarrah) *Corymbia calophylla* (marri) woodlands to open forests. A small area of dampland vegetation units was mapped southeast of Lot 1020. The dampland vegetation was considered as more properly belonging to the “Muja complex – Depressions and Swamps” which has large areas present east of Allanson (Morgan 2011).

2.4.3 Extent of Vegetation Remaining

The EPA recognises vegetation associations that are not well represented in reserves as being “significant”. Vegetation associations that have 10% to 30% of their pre-European extent remaining may be considered regionally significant. Proposals that could impact on a vegetation complex with 10% or less remaining are likely to be formally assessed by the EPA (EPA 2006).

The study area lies in the Dale Botanical Sub-district, in the Darling Botanical District of the South West Botanical Province of Western Australia (Beard 1980), being characterised by *Eucalyptus marginata* (jarrah) forest on ironstone gravels, *Corymbia calophylla* (marri)-*Eucalyptus wandoo* (wandoo) woodlands on loamy soils with sclerophyll understorey (Beard 1980).

The site is on the border of two Interim Biogeographic Regionalisation for Australia (IBRA) regions, being the Jarrah Forest and Warren IBRA region. The vegetation association most applicable to the survey area is “Medium Forest; jarrah–marri”. Shepherd et al. (2002) reported that a high percentage of the pre-European extent of “Medium Forest; jarrah–marri” remains in the region (72.1%). Eighteen point five per cent of it is contained in secure (IUCN category of I–IV) conservation reserves

(Government of Western Australia 2012). This is above the target of 15% of pre-European extent for each ecological community to be protected in a comprehensive, adequate and representative reserve system (EPA 2006).

Mattiske and Havel (2002) reviewed the reservation status of vegetation complexes in the south-west. On the basis of the following criteria they found that over one third were poorly reserved:

- ten per cent of pre-European area in proposed and existing formal reserves
- fifteen per cent in proposed and existing formal and informal reserves.

The Dwellingup (D1) complex is the only one that occurs in the survey area found by Mattiske and Havel (2002) to be poorly reserved. Although it is one of the most widespread vegetation complexes, and has 88% of its pre-European extent remaining, only 14.7% is contained in formal and informal reserves. However, it was considered that:

Given the level of reservation, the percentage of the complex remaining, and proposed improvements to forest management practices, the conservation values in this vegetation complex are considered adequately protected.

Further analysis using the DEC's updated CAR Reserve Analysis identified its regional extent to be slightly less at 70.3% and within the Shire of Collie it is 83.9%, both being above the EPA's threshold. The DEC analysis results are shown in Table 2, and are those considered herein (DEC 2007 and DEC 2009).

Table 2: Vegetation Extents Remaining in the Region and Shire of Collie

Reference Area	Vegetation Association	Pre-European Extent (ha)	Current Extent (ha)	Remaining (%)	Current Extent in IUCN Class Reserves (%)
South-west Region	(No. 3) Medium Forest: jarrah-marri	2,661,405.03	1,863,719.41	70.03	25.57
Shire of Collie	(No. 3) Medium Forest: jarrah-marri	158,907.33	133,316.52	83.90	25.14

According to mapping by Heddle et al. (1980) the vegetation of the subject land is considered to be representative of the Yarragil Complex and Murray Complex. An assessment of the extent of vegetation within 10 km and 20 km of the project site has been undertaken, with direct reference to Heddle mapping and reserves and national parks adjacent to the proposed realignments. These are summarised below in Table 3

Table 3: Regional Vegetation Protected in Reserves and National Parks

Reserve	Reserve Area (ha)	Heddle Complex Areas with Reserves (ha)	
		Murray Complex	Yarragil Complex
Within 10 km of Coalfields Highway Upgrade Project			
State Forest	15769.8		9723.3
Nature Reserve	6.80		
National Park	12391.5	3846.1	4154.7
Conservation Park	854		
Other Reserve	5.2		
CALM Executive Body Freehold	1070	479.5	83.3
Total	30097.3	4325.6	13961.3
Within 20 km of Coalfields Highway Upgrade Project			
National Park	17421.6	3940.9	4600.3
State Forest	70890.2		33524.1
Nature Reserve	513.4		
Other Reserve	2144.3		811.6
Conservation Park	1042.3		
CALM Executive Body Freehold	2086.6	1063.4	205
Total	94098.4	5004.3	39141

2.4.4 Vegetation Condition

The vegetation condition was assessed during the 2010–2011 and 2012 Flora and Vegetation Surveys. It was rated according to the commonly applied Keighery vegetation condition rating scale given in *Bush Forever* (Department of Environmental Protection 2000) as follows:

Pristine (1): Pristine or nearly so, no obvious signs of disturbance.

Excellent (2): Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.

Very Good (3): Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.

Good (4): Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.

Degraded (5): Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.

Completely Degraded (6): The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as “parkland cleared” with the flora comprising weed or crop species with isolated native trees or shrubs.

The vegetation condition within the survey area is shown in Figures 11a to 11c of Appendix 3. Of the total survey area extent of approximately 130 ha, 73.4 ha (57.2%) was considered to be remnant vegetation. Isolated paddock trees were not included as remnant vegetation.

The main cause of vegetation degradation was physical disturbance (roads, gravel and sand pits, logging), Phytophthora dieback disease and invasion by weeds. The effects of dieback disease as well as heavy logging are particularly noticeable in the jarrah–marri woodland and open forest on the gravel ridges west of Wellington Dam Road. Dieback disease has removed a suite of susceptible species from some parts of the upland jarrah–marri forest and because of this and the sometimes heavy impact of the logging these areas were scored as Good–Very Good condition.

Most of the blackbutt mixed eucalypt open forest in the eastern part of the survey area was scored as Very Good–Excellent because logging impact is generally low, dieback disease, though present, has had little impact, and weeds, except for unobtrusive herbaceous species, are absent.

Vegetation condition along the edge of the highway is variable, due largely to physical disturbance and consequent weed invasion. Grazing has impacted the condition of remnant vegetation in private property Lot 103, north of the highway, and it was consequently rated only as Good. The “edge effect” of increased physical disturbance and altered micro-climate and consequent weed invasion has impacted the condition of the narrow strip of vegetation along the north side of the highway and it has mainly been classed as Degraded to Good.

2.4.5 Declared Rare and Priority Flora

Declared Rare Flora (DRF) are protected under the *Wildlife Conservation Act 1950* (WA). In WA, the DEC applies conservation codes to Priority Flora, whose conservation status warrants some protection (but is not specifically covered under current legislation). These codes include Priority 1, 2 and 3 for those flora species that are poorly known based on their known occurrence and degree of threat. A fourth category, Priority 4, is used for those species that have been adequately surveyed and are considered to be rare but not currently threatened.

A search of the DEC Rare and Priority Flora database was undertaken in February 2013 to identify any significant flora that may potentially occur within the project area. Twenty five DRF and Priority flora taxa are known to occur in the region. Morgan (2011) and RPS (2013) considered the habitats in which these taxa have been found and completed an assessment as to the likelihood of each taxa occurring in the survey area (Table 4).

An EPBC Act Protected Matters Search Report over the greater study area identified no known flora species of National Environmental Significance (NES) as previously recorded within the study area (Appendix 4).

Table 4: DEC-listed Declared Rare and Priority Flora and their Likelihood of Occurrence in the Survey Area

Taxon	Status	Preferred Habitat	Likelihood of Occurrence in Survey Area
<i>Grevillea rara</i>	R	Lateritic loam; creek lines	<u>Low</u> . (Very little creek line with remnant vegetation in survey area. Western part of the survey area comprises uplands with gravelly sandy soils rather than loams)
<i>Jacksonia velveta</i>	R	Brown gravelly loam, dry grey sand, ironstone. Slight hill slopes, ridges	<u>Low to moderate</u> . Some grey sand soils in the survey area. Range appears to be further east on the Darling Plateau
<i>Sphaerolobium benectum</i>	P1	White gravelly sandy clay, sandy loam, granite, laterite. Ridges, swamps and undulating rises.	<u>Low to moderate</u> . Very limited known occurrence in the area. Mostly known from the south coast
<i>Leucopogon</i> sp. Collie (E.M. Bennett BUC 063)	P2	Seasonal damplands or sumps	<u>Low</u> : only known from two locations east of Collie. Very little seasonal dampland in the Coalfields Highway survey area. Plant low and spreading with distinctive chordate leaves
<i>Thysanotus unicipensis</i>	P2	No information available	?
<i>Adenanthos cygnorum</i> subsp. <i>chamaephyton</i>	P3	Grey sand, lateritic gravel	<u>Moderate</u> . Perennial plant with very distinctive habit
<i>Calytrix pulchella</i>	P3	Grey or white sand over laterite. Ridges, flats	<u>Low</u> . Little area of suitable soils in survey area. Presently known from east of Collie
<i>Eryngium ferox</i> ms	P3	Grey to brown loamy to sandy clay, brown cracking clay. Winter-wet flats, swamps, dried claypans, ridges	<u>Low</u> . Only a small area of poorly developed damplands in the survey area (marginal habitat)
<i>Grevillea prominens</i>	P3	Gravelly loam. Along creek lines	<u>Low</u> . Very little creek line in survey area (small length of creek line on southern boundary of survey area in blackbutt valley)
<i>Meeboldina thysanantha</i> ms	P3	Sand, swamps, creek banks	<u>Low</u> . Dampland and creek bank habitat is very limited in the survey area. A distinctive tall perennial rush

Taxon	Status	Preferred Habitat	Likelihood of Occurrence in Survey Area
<i>Stylidium rhipidium</i>	P3	Sandy soils. Wet creek flats, swamps, granite outcrops	<u>Low to moderate</u> . Sandy dampland soils area present, albeit in small area
<i>Synaphea hians</i>	P3	Sandy soils. Rises	<u>Moderate</u> . At northern end of its range
<i>Tetralochea parvifolia</i>	P3	No information available	?
<i>Acacia cuneifolia</i>	P4	Sand, clay or loam over granite. Granite outcrops and hills, rocky watercourses	<u>Low</u> . No granite outcrops or evidence of shallow soils over granite in survey area
<i>Acacia semitrullata</i>	P4	White to grey sand, sometimes over laterite, clay. Sand plains, swampy areas	<u>Low</u> . Preferred habitat of sandy plains adjacent to damplands not present in survey area. A very distinctive perennial plant
<i>Grevillea ripicola</i>	P4	Sandy clay, clay or gravelly loam. Swampy flats, granite outcrops, along watercourses	<u>Low</u> . Little suitable habitat in survey area. Only a short section of creek line with sandy loam soils and a small area of marginal damplands
<i>Lasiopetalum cardiophyllum</i>	P4	Lateritic gravelly soils, sandy clay. Flats, hillslopes	<u>Moderate</u> . Gravelly lateritic soils present in the survey area
<i>Pultenaea skinneri</i>	P4	Sandy or clayey soils. Winter-wet depressions	<u>Low</u> . Only a small area of marginal damplands occurs within the survey area
<i>Lomandra whicherensis</i>	P1	Jarrah forests	<u>High</u> . Identified in the area during flora surveys
<i>Millotia tenuifolia</i> var. <i>laevis</i>	P2	Granite or laterite soils	<u>High</u> . Identified in the area during flora surveys
<i>Stylidium lepidum</i>	P3	Gravelly sand or loamy clay. Winter wet depressions	<u>Low</u> . Only a small area of marginal damplands occurs within the survey area
<i>Stylidium acuminatum</i> aubsp. <i>Acuminatum</i>	P1	Clayey sands over laterite. Hillslopes, ridges and valleys	<u>Moderate</u> . Gravelly lateritic soils present in the survey area
<i>Logania sylvicola</i>	P2	No information available	?
<i>Calothamnus rupestris</i>	P4	Gravelly skeletal soils, granite outcrops and rocks and hillsides.	<u>Low</u> . No granite outcrops or evidence of shallow soils over granite in survey area
<i>Calothamnus graniticus</i> subsp. <i>Leptophyllum</i>	P4	Clay over granite, lateritic soils. Hillsides	<u>Low</u> . No evidence of shallow soils over granite in survey area
<i>Caladenia lodgeana</i>	T	Black loam	<u>Low to moderate</u> . Very limited known occurrence in the area. Mostly known from the further south

2.4.6 Site Flora Survey and Significant Species

Two hundred and fourteen species of native flora and 54 weed species were identified in the survey area during the survey undertaken in 2012. This compares to two hundred and four species of native flora and 52 introduced species found during the survey by Morgan (2011), which covered a larger and slightly different area.

The most numerous genera were: Fabaceae (33 species), Poaceae (23), Asteraceae (22), Cyperaceae (18) and Orchidaceae (18 species).

In respect to Rare and Priority flora occurrence within the study area, Morgan (2011) and Ekologica (2012) recorded two Priority species, *Lomandra whicherensis* (Priority 1) and *Millotia tenuifolia* var. *laevis* (Priority 2).

One other taxon, *Sphenotoma capitata*, was also recorded and is considered to be regionally significant as the survey area is near the edge of its known range. Two plants were identified in the same locality during the survey, the location of which is provided in Figure 5. These two plants are not expected to be impacted by clearing for the project.

The mapped locations of all significant flora (including *Sphenotoma capitata*) and weeds recorded in 2011 are shown in Figure 5. The 2012 Flora and Vegetation Survey Report included complete inventories of site flora and weed species (Appendix 3).

2.4.6.1 *Lomandra whicherensis* Survey

The Level 1 flora and vegetation survey undertaken between November 2010 and February 2011 identified a number of *Lomandra whicherensis* plants within the previously proposed realignment corridors.

The DEC indicated that there were no department records of *Lomandra whicherensis* within the locality of the proposed alignments, or outside the Whicher Ranges and in particular there were no other records in the Wellington National Park.

Consequently, a further *Lomandra whicherensis* survey was undertaken between 23 and 25 November 2011 to document the locations of *Lomandra whicherensis* along the previously proposed alignments and determine whether there are any occurrences in the Wellington National Park.

Seven transects were sampled within the national park to determine regional occurrence, with *Lomandra whicherensis* observed along all transects. More than 600 *Lomandra whicherensis* plants were recorded along these transects. Additional surveys conducted in the area identified four additional *Lomandra whicherensis* populations supporting more than 280 plants within 6-10 km of Coalfields Highway. Plants were observed in gravelly lateritic soils and it is considered likely that the distribution of *Lomandra whicherensis* in the Wellington National Park is more widespread than currently recognised, especially in similar soils. Based on the 2013 project concept design it is expected that approximately 140 individual plants will be taken for roadworks required for the Wellington section.

2.4.6.2 Grey Sands (255DpWGs) Survey

As previously noted (Section 2.4), an additional survey was conducted to further investigate the extent and significance of deep grey sands vegetation in the Soil Landscape Subsystem 255DpWGs in the Wellington Dam Road area south of the Coalfields Hwy (WDRGS survey area), between 14 and 16 October 2011, 11 and 14 November 2011 and 26 and 29 November 2011. The results of this survey and outcomes of the investigation are further detailed in Section 2.4.7.1.

A total of 259 native plant species were identified within the WDRGS survey area and regional quadrats. One Priority species, *Stylidium rigidifolium* (now listed on FloraBase as *Stylidium striatum*) (Priority 4) was recorded in one of the regional quadrats.

One hundred and eighty-nine native plants were recorded in just the WDRGS survey area (south of the Coalfields Highway), none of which were considered to be significant. Consequently, no significant flora was found to be associated with the vegetation on the deep grey sands.

2.4.6.3 *Sphenotoma capitata* Survey

Two *Sphenotoma capitata* plants (Figure 5) were found in the same location as previously reported by Morgan (2011). *S. capitata* is a common shrub with a distribution ranging from just east of Albany and the Stirling Range to the Whicher Range. The northernmost and nearest collection of the species was in 1967 at a point 12 km east of Harvey (about 25 km north of the survey area). Its occurrence in the survey area is considered to be regionally significant because it is near the edge of its known range, and is consequently a geographic outlier. A search was made for other *S. capitata* plants within 100 m of the population on Coalfields Highway but none were found.

The two plants identified are not expected to be impacted by roadworks.

2.4.7 **Threatened Ecological Communities**

Threatened Ecological Communities (TECs) are defined as “naturally occurring biological assemblages that occur in a particular type of habitat” (English and Blythe 1997). TECs have been assessed and assigned to one of four categories related to the status of the threat to the community, i.e. presumed totally destroyed, critically endangered, endangered, and vulnerable. Although TECs are not specifically protected under WA’s *Wildlife Conservation Act 1950*, this Act protects all native vegetation in Western Australia. The EPA’s position on TECs states that proposals resulting in the direct loss of TECs are likely to require formal assessment.

The DEC has also developed a Priority Ecological Communities (PECs) list to assign one of five categories according to them being possibly threatened, adequately known, near threatened or conservation dependent.

TECs may also be protected under the Commonwealth EPBC Act and the potential loss of, or disturbance to them can trigger this legislation.

This assessment included a 2010 search and GIS mapping query of DEC's TEC and PEC databases over the greater study area that showed none are known to occur within the area. Furthermore, consultants GHD (2010) found there were no TECs or PECs in proximate areas. An EPBC Act Protected Matters Search also identified no known TECs as occurring within the study area.

None of the vegetation units recorded in the survey area are on the Commonwealth's TEC list or the DEC's TEC database. Reference to DEC's December 2010 PEC list also led to the conclusion that none of the vegetation units recorded is a PEC.

Based on the above assessments, no TECs or PECs protected under state or Commonwealth legislation will be impacted by the project.

2.4.7.1 Grey Sands (255DpWGs) Survey

The Grey Sands Flora and Vegetation survey was undertaken within the deep grey sands vegetation in the Soil Landscape Subsystem 255DpWGs in the Wellington Dam Road area south of the Coalfields Highway (WDRGS survey area), between 14 and 16 October 2011, 11 and 14 November 2011 and 26 and 29 November 2011 (Appendix 5).

The survey and subsequent analysis involved seven quadrats and one relevè from the WDRGS survey area (including five sites in the deep grey sands area) and 11 regional quadrats distant from the project area. These were analysed using PATN to determine their floristic similarity.

The vegetation mapping showed that the WDRGS survey area (the Soils Landscape Subsystem 255DpWGs south of the Coalfields Hwy), rather than being an area of homogeneous soils and vegetation, had a variety of soils, habitats and associated vegetation units, reflected in the 11 vegetation units identified in the area. Furthermore, the area of deep grey sands and associated vegetation was restricted to a small area at the western end of the WDRGS survey area (about 7.5 ha).

The scope of the survey limited the results, as the limited regional data set meant a comprehensive test for regional significance could not be conducted. The PATN analysis suggested that, despite some moderate similarity with some of the regional sites included in the study, the deep grey sands vegetation is likely to be restricted and regionally significant.

There are also some regional sites that were sampled that had moderate similarity to the WDRGS survey area. As the regional data set was limited and therefore did not allow a comprehensive analysis of the regional dataset, it cannot be concluded that this vegetation type does not occur in areas of the adjacent national park.

The area of deep grey sands and associated vegetation occurring within the WDRGS survey area covers approximately 7.5 hectares. Main Roads expects their impacts on this vegetation to cover approximately 1.2 hectares. This is only approximately 16.0% of the area within the WDRGS survey area and is not considered significant.

2.4.8 Clearing of Native Vegetation

Any clearing of native vegetation will require a permit under Part V of the *Environmental Protection Act 1986*, except where an exemption applies under Schedule 6 of the Act or is prescribed by regulation in the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*, and not in an Environmentally Sensitive Area (ESA). Consultation of the DEC's online web-based Native Vegetation Map Viewer in January 2012 and field investigations confirmed that the project does not occur within an ESA.

Clearing applications are assessed against the EPA's Ten Clearing Principles outlined in Schedule 5 of the *Environmental Protection Amendment Act 2003*. These principles aim to ensure that all potential impacts resulting from removal of native vegetation can be assessed in an integrated way.

Main Roads advised RPS that a clearing corridor of approximately 40 m wide over the centre line is required to develop the proposed realignment and to create a safety clear zone for traffic. The approximate clearing area based on this is 25 ha. The area proposed to be cleared is based on 2012 concept designs and consequently may change marginally as the design is finalised.

A Clearing Assessment Report has been completed for the proposed clearing in consideration of the EPA's "Ten Clearing Principles" based on the finding of this EIA (Appendix 6).

Main Roads also invited early comment on vegetation clearing from various agency stakeholders based on the results of an earlier Preliminary EIA (GHD 2009). The PEIA indicated that five "Clearing Principles" may be at variance (based on desktop information available at that time).

The Clearing Assessment Report and agency feedback received is included in Appendix 6. Based on additional site surveys and advice from stakeholders it is concluded that the project is:

- likely to be at variance to Principle D
- may be at variance to Principle A, F and H
- not likely to be at variance to Principles B and I

- not at variance to Principles C, E, G and J
- if the project is not formally assessed by the EPA then project clearing can be conducted under Main Roads existing Clearing Permit 818

The clearing assessment concluded that project clearing for the realignments can be done under Main Roads *Clearing Permit 818* and that an environmental offset would be required. Should the EPA decide not to formally assess the project then clearing can be conducted under CPS 818. Project clearing under Main Roads existing permit would remove the requirement to obtain a clearing license under the CAWS Act.

2.4.8.1 Management Measures

Design the project to minimise clearing, utilise previously disturbed areas and avoid sensitive vegetation where possible.

Main Roads should continue liaison with the DEC in respect to environmental management of project activities within the Wellington National Park.

Main Roads should liaise with DEC's Wellington District Office to provide regular field notice on staff movements, ensure vehicle and machinery hygiene is adequate, and to satisfy *Bushfires Act 1954* requirements.

Main Roads should discuss clearing operations and opportunities to harvest timber / salvage firewood with the DEC and Forest Products Commission.

Clearing should be kept to the minimum within the clearing envelope, with consideration for use of "internal clearing permits" to manage clearing operations.

The limits of clearing should be clearly marked on site and relevant plans to inform site personnel to contain all activities within the clearing envelope.

Minimise clearing in the dampland vegetation units (EmCcBI and EmCcTI).

Significant trees to be retained shall be clearly marked prior to the start of clearing operations to minimise impact to potential fauna habitat and a fauna specialist should be present to manage any impact to native fauna.

Trees to be removed should be felled in a manner that ensures they fall within the approved clearing envelope.

The remainder of cleared vegetation should be salvaged, chipped on site for in situ site rehabilitation and/or soil stabilisation (note: consider the dieback and weed status of the material and its location of dispersal).

Existing cleared areas should be utilised for locating site access, site offices and any temporary lay-down areas (but not adjacent to waterways or drainage lines).

No fires or burning of cleared vegetation should be permitted on site.

Vehicles should be equipped with fire-extinguishers and machinery such as water carts made available in the event of any bushfire during project activities.

2.5 Weeds and Introduced Species

A total of 54 weed species were recorded in the survey area by Ekologica (2012). Many of these were ephemeral or annual taxa that only establish in highly disturbed areas such as road verges. There were several species that are either included in the list of Declared Plants in Western Australia (Smith 2010), or are known environmental weeds. Environmental weeds are introduced or non-native taxa, able to establish in relatively undisturbed bushland and compete with native species.

There was one Declared plant, *Rubus anglocandicans* (Blackberry), which is a P4 (Table 5) weed in the Shire of Collie under the *Agriculture and Related Resources Protection Act 1976* (APB 2011). Blackberry is mainly found in the blackbutt mixed eucalypt open forest in the eastern part of the survey area. Environmental weeds of concern that occur in the survey area include *Watsonia meriana*, *Leptospermum laevigatum* (Victorian ti-tree) and *Lavandula stoechas* (lavender).

Morgan (2011) also identified another Declared Plant (*Asparagus asparagoides* (bridle creeper)) (P1) during his surveys which as mentioned previously were for a slightly different area.

Relevant control codes apply to the identified Declared Plants under the Act as shown in Table 5 for the following weeds identified in the study area:

Table 5: Standard Control Codes (these may vary for Individual Plants)

<p>P1 Requirements Prohibits Movement</p>	<p>The movement of plants or their seeds is prohibited within the state. This prohibits the movement of contaminated machinery and produce including livestock and fodder.</p>
<p>P4 Requirements Aims to Prevent Infestation spreading beyond Existing Boundaries of Infestation</p>	<p>The infested area must be managed in such a way that prevents the spread of seed or plant parts within and from the property on or in livestock, fodder, grain, vehicles and/or machinery. Treat to destroy and prevent seed set all plants:</p> <ul style="list-style-type: none"> ▪ within 100 metres inside of the boundaries of the infested property ▪ within 50 metres of roads and high water mark on waterways ▪ within 50 metres of sheds, stock yards and houses. <p>Treatment must be done prior to seed set each year. Properties with less than 2 hectares of infestation must treat the entire infestation. Additional areas may be ordered to be treated.</p>

Special Considerations	In the case of P4 infestations where they continue across property boundaries there is no requirement to treat the relevant part of the property boundaries as long as the boundaries of the infestation as a whole are treated. There must be agreement between neighbours in relation to the treatment of these areas.
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Bridle creeper locations were recorded on site within 2 km of the eastern end of the surveyed corridor. Some of these locations included sizeable stands.

Blackberry was most abundant towards the eastern end of the study area and plants were observed beyond it, typically in areas containing moist soils such as where blackbutt and bracken fern occur. In a number of cases only a small number of plants were recorded, but in about half the locations, areas of cover had to be estimated rather than counting individual plants.

Watsonia sp. (*Watsonia meriana* var. *bulbillifera*) is a “Priority” weed in the Shire of Collie and was recorded in a few locations. Lavender (*Lavandula stoechas*) was also recorded during the survey, in ten locations within the jarrah–marri woodlands and is a Shire of Collie “Alert” weed species.

The locations of significant weeds have been mapped over the study corridor. Also on this map are the locations of threatened flora, as any weed control needs to avoid unnecessary damage to adjacent vegetation and flora (see Figure 5).

As well as the locations indicated in Figure 5, blackberry, bridal creeper and watsonia are known to occur within the Wellington National Park (DEC 2005). Consequently, actions undertaken during the project will not cause the spread of these weeds into the national park since they are already present. However, management actions discussed in Section 2.5.1.1 are recommended to prevent any further spread of these weeds and any other introduced species in the area.

Discussions with officers from the DEC's Wellington District, highlighted that preventing the spread of weeds within the Wellington National Park is clearly an important issue to manage. The movement of topsoil, construction machinery, Basic Raw Materials (BRM), vehicles and equipment through the project site presents a high risk of introducing and/or spreading weeds.

Weeds can establish themselves in natural ecosystems and cause the decline of the communities they invade by displacing native plants, particularly on disturbed sites. They can also cause significant impacts to fauna habitat, support pests and diseases and alter fire regimes. The longer term negative impact of introduced weeds can also be significant on biodiversity and amenity values, such as within the Wellington National Park.

Employing a range of weed hygiene measures during the projects development including provision of information to all site personnel on weed hygiene management will be necessary. Main Roads Integrated Service Agreement Partner (ISA Partner) should be informed of the known weed occurrences and ongoing need to manage this aspect appropriately.

2.5.1.1 Management Measures

Declared Plants should be treated according to their Control Codes and advice from the DEC/Agriculture and Food WA.

The workforce should be inducted on weed hygiene measures prior to commencing site activities.

Prior to entering the Wellington National Park, vehicles/machinery and equipment should be cleaned and inspected so they are free of weeds, seeds or soil material in a designated clean-down area.

Main Roads should manage any newly identified Declared Plants within the road reserve in line with its responsibilities under the *Agriculture and Related Resources Protection Act 1976*.

Inform Main Roads ISA Partner of the need to control any known Declared Plant locations within the road reserve and of the locations of proximate threatened flora to avoid impacting them in the process.

Apply standard weed control measures during all clearing and earthwork activities as required in CPS 818.

Weed management will be necessary through the development of a Topsoil Management Plan.

2.6 ***Phytophthora Dieback***

Dieback disease caused by the pathogen *Phytophthora cinnamomi* (referred to as “dieback” herein) is a major threat to ecosystem health and biodiversity in south-western Australia. Approximately 40% of all known flora in the south-west region are susceptible to dieback. Soil moving activities such as during roadwork can spread dieback-infected soil/vegetation.

RPS assessed dieback over the study area during March and April 2011. Interpretation followed the standard methodology and procedures for a linear survey as described in *Volume 2 – Phytophthora cinnamomi and disease caused by it: Interpreter guidelines for detection, diagnosis and mapping* (CALM 2001). The assessment included dieback occurrence mapping to identify areas as Infested, Un-infested, Uninterpretable and Excluded. The complete *Phytophthora Dieback Interpretation Report* is given in Appendix 7 with a summary below.

Interpretation was completed over the entire project study corridor by Bruno Rikli of RPS (previously a Dieback Interpreter within CALM and currently a technical advisor to the Busselton Dieback Working Group. Peter Blankendaal (A/Disease Standards Officer, DEC) inspected the field work on 1 March 2011, provided technical inputs and produced the final Dieback Occurrence Maps in the DEC's Bunbury office in liaison with RPS.

The survey locality is situated within the 900–1200 mm rainfall zone and does not occur within a forest Disease Risk Area (DRA).

Based on this assessment and previous DEC dieback mapping, “Infested” areas are extensive both within and beyond the study area. A total of eleven samples were collected over the length of the study corridor of which nine returned positive results for *Phytophthora cinnamomi*. Disease expression varied from subtle to obvious across the survey corridor and was typically characterised by widely scattered dead and dying *Xanthorrhoea preissii*, *X. gracilis*, *Banksia littoralis*, *B. grandis* and *P. longifolia*. Historic disease introductions and spread (autonomous and anthropogenic) appear to have reduced the biomass in many areas leaving only widely scattered indicator plant species deaths amongst non-susceptible vegetation.

Two minor sections situated south and west from Gastaldo Road were classed as “Uninfested”. Both also occur within the Wellington National Park that contains down-slope vegetation in good to better condition. Both warrant consideration as being “Protectable” from dieback.

Phytophthora cinnamomi was positively identified across the majority of remaining areas within the study corridor, except in the eastern end that was classed as “Uninterpretable” due to its vegetation type, and “Excluded” areas such as cleared service corridors, paddocks and recently burnt patches. These areas are considered as unlikely to warrant protection from dieback during the development of Main Roads project.

The total area that was mappable for dieback within the study corridor was 77.5 ha. Table 6 provides a breakdown of the areas mapped per dieback category.

Table 6: Area Statement (Applies to Entire Mappable Area Assessed)

Category	Area (ha)
Un-infested	5.1
Uninterpretable	24.9
Infested	47.5
Total Area:	77.5

The “Infested” area boundaries were demarcated in the field using 50 mm day-glow orange flagging tape with the knots facing the infestation, except where physical boundaries exist such as cleared tracks or the interface of vegetation and cleared pasture. The DEC agreed that no other field demarcation was necessary given the obvious physical boundaries within the survey area.

Overall, disease distribution is extensive within and beyond the study area that can be attributed to historic land uses, current activities and supporting environmental conditions for *Phytophthora* dieback. The high number of existing forest tracks open to public access within the Wellington National Park act as vectors for disease introductions and spread. Further evidence of activities that can introduce and spread dieback was observed within most areas such as firewood collection, materials extraction, horse/trail-bike tracks and four-wheel driving. Collectively these activities are known to extend disease distribution.

Phytophthora cinnamomi occurrence maps have been prepared that identify existing disease boundaries within the study area (Appendix 7). These occurrence maps will form the basis of determining “Protectable” areas and a site-specific Hygiene Management Plan (HMP). The DEC Wellington District Office requested that Main Roads discuss these results with them to formulate specific management measures (pers. com. Tom Kenneally, DEC March 2011).

It should be noted that the occurrence maps were valid for one year (April 2012) after which all boundaries should be rechecked in the field. The maps should not be used if older than three years (April 2014) due to possible further disease spread and a full site interpretation is then required by the DEC (CALM 2001). Consequently, Main Roads proposes to update the dieback occurrence maps during the detailed project design phase and prior to any construction activities are undertaken.

Applying and maintaining dieback hygiene to any areas deemed “Protectable” will greatly reduce the risk of spreading or introducing *Phytophthora* dieback during project activities.

2.6.1.1 Management Measures

Main Roads will update the dieback occurrence maps during the detailed design phase prior to any ground disturbing works.

Main Roads arrange a meeting with the DEC Wellington District to finalise any “Protectable” areas and to determine practical and realistic hygiene planning for the project.

Incorporate the dieback hygiene requirements (Topsoil Management Plan) into the project’s contractual documents, site induction materials and overall site environmental management.

Monitor the implementation and compliance of site personnel with dieback hygiene measures.

2.7 Topsoil Management

The management of topsoil during roadwork is important to optimise resource use and to minimise the risk of transporting weeds and / or dieback infected materials. A Topsoil Management Plan will be prepared by Main Roads for the project to detail the use and movement of in situ topsoil during roadworks.

2.7.1.1 Management Measures

Main Roads should prepare a Topsoil Management Plan that includes consideration of relevant weed and dieback site information.

Soil movement should be conducted in line with the Topsoil Management Plan prepared specifically for the project.

2.8 Revegetation and Landscaping

Opportunities to stabilise disturbed soil surfaces, enhance roadside visual amenity, floral diversity and provide opportunities for fauna habitat exist along the entire project length. This could be achieved by revegetation of cleared areas within the corridor using local “provenance” native seed and / or seedlings. Opportunities to provide some ground dwelling fauna habitat should also be considered such as replacement of cleared logs surrounding areas.

Main Roads will undertake rehabilitation and revegetation where possible. A Revegetation Plan will be developed for the project to guide any revegetation or rehabilitation undertaken.

2.8.1.1 Management Measures

Main Roads should prepare and implement a Revegetation and Landscaping Plan for the project using local provenance seed (where possible).

Main Roads should consider visual landscape management in consultation with the DEC, as to how this can be best incorporated into the project.

2.9 Fauna

A fauna assessment was carried out by Greg Harewood (Consulting Zoologist) during February and March 2011 with regard to relevant EPA position statements and guidelines (EPA 2000, 2004 and 2010). The entire length of the proposed realignment was examined twice.

The purpose of the fauna assessment was to record and categorise fauna assemblages and identify fauna habitats and undertake targeted species searches. The extent and quality of black cockatoo habitat present was also quantified. Locations of potential habitat/hollow bearing trees were recorded and mapped. The full survey report, species inventories and habitat mapping is included in Appendix 8 and a summary of the key results follows. Management recommendations proposed by Harewood (2011) have been incorporated into this report.

2.9.1 Listed Fauna Potentially Utilising the Study Area

Desktop information suggests that 185 native species are listed as potentially occurring in the area, nine are considered to be endangered / vulnerable or in need of special protection under state and/or federal law (Table 7). In addition, four migratory species and six DEC priority species may occasionally frequent the area.

Four vertebrate species of conservation significance (listed as state or federal threatened/migratory species or DEC priority species) were positively identified during surveys, these being Baudin's black cockatoo, Carnaby's Black-Cockatoo, forest red-tailed black cockatoo and rainbow bee-eater (Table 7).

Fifteen fauna species of conservation significance were identified as potentially utilising the study area, but none of these species were observed or evidence of their presence found during surveys (Table 7). It should be noted that habitat for some of these species on site may be marginal in extent/quality and the species listed below may only visit the area for short periods, or as rare/uncommon vagrants.

A number of other vertebrate species of conservation significance, while possibly present in the general area were not listed as potential species due to known localised extinction (and no subsequent recruitment from adjoining areas) and/or lack of suitable habitat.

Five threatened or priority invertebrate species appeared in the DEC and/or EPBC Act database searches and only two have some potential to be present within the study area as discussed in Table 7.

Table 7: Likelihood of Occurrence of Fauna Species of Conservation Significance

Common Name	Scientific Name	Conservation Status	Likelihood of Occurrence and Habitat Present
Unnamed scorpionfly	<i>Austromerope poultoni</i>	P2	Marginal habitat Possible but unlikely occurrence
Unnamed cricket	<i>Pachysaga munggai</i>	P3	Marginal habitat Possible but unlikely occurrence
Tingle trapdoor spider	<i>Moggridgea tingle</i>	S1	No habitat present Unlikely to occur
Margaret River (hairy) marron	<i>Cherax tenuimanus</i>	S1 Critically Endangered	No habitat present Unlikely to occur
Carter's freshwater mussel	<i>Westralunio carteri</i>	P4	No habitat present Unlikely to occur
Balston's pygmy perch	<i>Nannatherina balstoni</i>	S1 Vulnerable	No habitat present Unlikely to occur
Pouched lamprey	<i>Geotria australis</i>	P1	No habitat present Unlikely to occur
Darling Range heath ctenotus	<i>Ctenotus dell</i>	P4	Marginal habitat present, however possibly out of species range. Possible occurrence
Southern carpet python	<i>Morelia spilota imbricate</i>	S4, P4	Habitat is present. Possible occurrence
Great egret	<i>Ardea alba</i>	S3 Migratory	Marginal habitat present. Possible occurrence
Cattle egret	<i>Ardea ibis</i>	S3 Migratory	Marginal habitat present. Possible occurrence
Australasian bittern	<i>Botaurus poiciloptilus</i>	S1 Endangered	No habitat present Unlikely to occur
Little bittern	<i>Ixobrychus minutus</i>	P4	No habitat present Unlikely to occur
Black bittern	<i>Ixobrychus flavicollis</i>	P3	No habitat present Unlikely to occur
White-bellied sea-eagle	<i>Haliaeetus leucogaster</i>	S3 Migratory	No habitat present Unlikely to occur
Peregrine falcon	<i>Falco peregrinus</i>	S4	Habitat is present. Possible occurrence
Bush stone curlew	<i>Burhinus grallarius</i>	P4	Habitat is present Unlikely to occur as locally extinct
Carnaby's Black-Cockatoo	<i>Calyptorhynchus latirostris</i>	S1 Endangered	Habitat is present. Known to occur
Baudin's black cockatoo	<i>Calyptorhynchus baudinii</i>	S1 Vulnerable	Habitat is present. Known to occur
Forest red-tailed black cockatoo	<i>Calyptorhynchus banksii naso</i>	S1 Vulnerable	Habitat is present. Known to occur

Common Name	Scientific Name	Conservation Status	Likelihood of Occurrence and Habitat Present
Masked owl (SW population)	<i>Tyto n. novaehollandiae</i>	P3	Habitat is present. Possible occurrence
Fork-tailed swift	<i>Apus pacificus</i>	S3 Migratory	Habitat is present Unlikely to occur
Rainbow bee-eater	<i>Merops ornatus</i>	S3 Migratory	Habitat is present. Possible occurrence
Western shrike tit	<i>Falcunculus frontatus leucogaster</i>	P4	No habitat, or possibly marginal habitat present Unlikely to occur
Chuditch	<i>Dasyurus geoffroii</i>	S1 Vulnerable	Habitat is present. Possible occurrence
Numbat	<i>Myrmecobius fasciatus</i>	S1 Vulnerable	Habitat is present Unlikely to occur as locally extinct
Southern brush-tailed phascogale	<i>Phascogale tapoatafa ssp</i>	S1	Habitat is present. Possible occurrence
Southern brown bandicoot	<i>Isoodon obesulus fusciventer</i>	P5	Habitat is present. Possible occurrence
Bilby	<i>Macrotis lagotis</i>	S1 Vulnerable	No habitat Unlikely to occur
Western ringtail possum	<i>Pseudocheirus occidentalis</i>	S1 Vulnerable	Habitat is present. Possible occurrence
Western brush wallaby	<i>Macropus irma</i>	P4	Habitat is present. Possible occurrence
Woylie	<i>Bettongia penicillata ogiby</i>	S1 Endangered	Marginal habitat present Possible occurrence
Tammar	<i>Macropus eugenii</i>	P4	No habitat present Unlikely to occur
Quokka	<i>Setonix brachyurus</i>	S1 Vulnerable	No habitat present Unlikely to occur
Western false pipistrelle	<i>Falsistrellus mackenziei</i>	P4	Habitat is present. Possible occurrence
Water rat	<i>Hydromys chrysogaster</i>	P4	Marginal habitat present Possible, but unlikely to occur

2.9.2 Opportunistic Fauna Search Results

A total of 44 native fauna species were recorded during the site fauna survey. With respect to native vertebrate fauna, 21 mammals (including nine bat species), 104 bird, 41 reptile, nine frogs and three fish species have previously been recorded in the general area, some of which have the potential to occur in or utilise sections of the study area at times.

Introduced species observed on site included the laughing kookaburra, rabbits and feral bees. The proposed works are not expected to contribute to an increase in their numbers or range.

2.9.3 Black Cockatoos and Habitat Trees

Almost all areas of remnant native vegetation within and beyond the proposed road realignments were considered to represent potential black cockatoo foraging habitat, as it contains a range of plant species documented as foraging habitat for the three species of black cockatoo.

It is estimated that a maximum of 25 ha of potential black cockatoo foraging habitat will be cleared, given the dominance of marri and jarrah with vegetation complexes in the area.

An assessment of potential nest trees expected to be impacted identified that 424 trees with a dbh >50 cm will be cleared, including 28 of the trees with potential nest hollows. Although assessment of potential nest trees within the wider area has not been conducted vegetation mapping indicates more than 30 000 ha and 94 000 ha of potential foraging habitat occurs within 10 and 20 km of the project site respectively.

2.9.4 Fauna Habitat Assessment

Faunal assemblages potentially present are unlikely to be of high diversity or different to those found in similar habitats located elsewhere in the immediate vicinity. It was concluded that the area to be cleared does not contain habitats of high ecological significance from a faunal perspective, or contain faunal assemblages that are ecologically significant (Harewood 2013).

The habitat within the study area likely to be used by migratory species listed under the EPBC Act does not represent “significant habitat” and the number of individuals utilising these areas would not, under any circumstances, represent an ecologically significant proportion of the population of any of the species in question.

Observations made during site fauna assessment suggest that substantial populations of these EPBC Act listed species below do not, or are unlikely, to be relying exclusively on habitat within the study area. Harewood (2013) noted that the linear project clearing would not constitute a “significant impact” or “likely significant impact” upon the following species as defined by DSEWPac (DEH 2006):

- *Pseudocheirus occidentalis* western ringtail possum – Vulnerable
- *Dasyurus geoffroii* chuditch – Vulnerable
- *Bettongia penicillata* ogibyi woylie – Endangered.

With respect to fauna in general no substantial impacts to fauna or fauna habitat are anticipated as a consequence of the realignment being constructed. In cases where some impact is anticipated, the degree of the impact is only expected to be very low and relates to the loss of a relatively small area of vegetation (25 ha) the loss of which will be dampened by the presence of a large areas of similar or better quality habitat in adjoining areas (e.g. Wellington National Park and associated reserves in the area comprise approximately 20,000 ha (DEC 2008)) (further details on reserves in the area are provided as Table 3).

Using current DSEWPaC impact criteria (DSEWPaC 2012), the clearing for the proposed realignment has been categorised to have a “high risk of significant impact” with respect to the loss of black cockatoo potential breeding and foraging habitat. Consequently, a referral of the project to DSEWPaC for assessment will be undertaken to ensure compliance with the EPBC Act. Impacts on other EPBC Act species are considered by Harewood (2011) unlikely to be “significant” as DSEWPaC criteria are not anticipated to be compromised.

2.9.5 Conservation Significance of Habitat in the Study Area

The results of the fauna assessment indicate that the study site hosts or potentially hosts a range of fauna species some of which are of special conservation significance. The extent of habitat suitable for those species identified as utilising the study area extends well outside the proposed corridor route itself and these fauna habitats are therefore well represented in adjoining national park and state forest areas. No evidence was gathered that suggest habitats within the proposed realignment corridors are in a significantly better condition than those found in adjoining areas. These facts suggest that the study area itself does not have any specific local conservation significance above that of adjoining areas.

Within the Wellington National Park, Westralia Conservation Park and Wellington Discovery Forest Management Plan (DEC 2008) four significant fauna habitats were identified, these being:

- Granite Outcrops: Small, isolated and disjunct granite outcrop communities are interspersed throughout the planning area, particularly along the lower Collie River valley.
- Wetlands and Riparian Habitats: Important wetland habitats exist as seasonally or permanently inundated features along creek systems.
- Ecologically Mature Forest: Small areas of ecologically mature forest exist along riparian zones of the lower Collie River, where the effects of disturbances such as timber harvesting, road/track construction and clearing are considered negligible.
- Ecotones: These are transition zones between adjacent but different environments.

No substantial areas of any of these identified significant habitats occur within the area that may be directly affected by the proposed Coalfields Highway upgrade project.

The DEC have also indicated that the area of grey sandy soils and associated vegetation around the National Park information bay east of Wellington Dam road is notable and potentially of conservation significance. The naturally restricted extent of this soil-landscape mapping unit may be an indication of a naturally restricted plant community (DEC 2011). It is not however suggested in this correspondence that this particular area has any specific conservation value with respect to fauna, with its possible significance being related to its potentially restricted floristic components only.

The Heddle Complexes which occur over the realignment area are Murray and Yarragil Complexes. The area of these complexes within adjacent reserves was calculated to determine the size of Wellington National Park and other reserves which provides similar habitat to that over the alignment areas. Within a 10 km radius of 15.90–26.34 SLK, there is 12 391 ha of Wellington National Park, of which 3 846 ha comprises Murray Complex and 4 154 ha comprises Yarragil Complex. Consequently, approximately 40% of the habitat within the Wellington National Park (within a 10 km radius) is likely to contain similar habitat to that present within the project area.

2.9.6 Ecological Linkages and Wildlife Corridors

The proposed clearing of relatively thin, discontinuous sections of vegetation located at various points within the linear study area will not fragment any potential fauna habitat to the extent that it would represent a barrier to fauna movement above that already present in the area (i.e. the existing Coalfields Highway and network of existing roads, tracks and power line easements). There are no south-west regional ecological linkage axis lines traversing or in close proximity to the project study area.

2.9.7 Potential Fauna Impact Assessment

Harewood (2013) concluded that in respect to fauna, overall no substantial impacts are anticipated to significant fauna as a consequence of developing the project (Table 8). Also that in cases where some impact is anticipated, the degree of impact is only expected to be very low and relates to the loss of small areas of habitat in the local and regional context.

Table 8: Possible Impacts on Fauna Species of Conservation Significance

Common Name	Scientific Name	Conservation Status	Possible Impacts and Significance of Impact
Unnamed scorpionfly	<i>Austromerope poultoni</i>	P2	Loss/modification of small areas of habitat/Very Low
Unnamed cricket	<i>Pachysaga munggai</i>	P3	Loss/modification of small areas of habitat/Very Low

Common Name	Scientific Name	Conservation Status	Possible Impacts and Significance of Impact
Tingle trapdoor spider	<i>Moggridgea tingle</i>	S1	No impacts
Margaret River (hairy) marron	<i>Cherax tenuimanus</i>	S1 Critically Endangered	No impacts
Carter's freshwater mussel	<i>Westralunio carteri</i>	P4	No impacts
Balston's pygmy perch	<i>Nannatherina balstoni</i>	S1 Vulnerable	No impacts
Pouched lamprey	<i>Geotria australis</i>	P1	No impacts
Darling Range heath ctenotus	<i>Ctenotus dell</i>	P4	Loss/modification of small areas of habitat/Very Low
Southern carpet python	<i>Morelia spilota imbricate</i>	S4, P4	Loss/modification of small areas of habitat/Very Low
Great egret	<i>Ardea alba</i>	S3 Migratory	Loss/modification of very small areas of habitat/Very Low
Cattle egret	<i>Ardea ibis</i>	S3 Migratory	Loss/modification of very small areas of habitat/Very Low
Australasian bittern	<i>Botaurus poiciloptilus</i>	S1 Endangered	No impacts
Little bittern	<i>Ixobrychus minutus</i>	P4	No impacts
Black bittern	<i>Ixobrychus flavicollis</i>	P3	No impacts
White-bellied sea-eagle	<i>Haliaeetus leucogaster</i>	S3 Migratory	No impacts
Peregrine falcon	<i>Falco peregrinus</i>	S4	Loss/modification of small areas of habitat/Very Low
Bush stone curlew	<i>Burhinus grallarius</i>	P4	No impacts
Carnaby's Black-Cockatoo	<i>Calyptorhynchus Latirostris</i>	S1 Endangered	Loss/modification of small areas of habitat/Low
Baudin's black cockatoo	<i>Calyptorhynchus baudini</i>	S1 Vulnerable	Loss/modification of small areas of habitat/Low
Forest red-tailed black cockatoo	<i>Calyptorhynchus banksii naso</i>	S1 Vulnerable	Loss/modification of small areas of habitat/Low
Masked owl (SW population)	<i>Tyto n. novaehollandiae</i>	P3	Loss/modification of small areas of habitat/Very Low
Fork-tailed swift	<i>Apus pacificus</i>	S3 Migratory	No impacts
Rainbow bee-eater	<i>Merops ornatus</i>	S3 Migratory	Loss/modification of small areas of habitat/Very Low
Western shrike tit	<i>Falcunculus frontatus leucogaster</i>	P4	No impacts
Chuditch	<i>Dasyurus geoffroii</i>	S1 Vulnerable	Loss/modification of small areas of habitat/Very Low
Numbat	<i>Myrmecobius fasciatus</i>	S1 Vulnerable	No impacts
Southern brush-tailed phascogale	<i>Phascogale tapoatafa ssp</i>	S1	Loss/modification of small areas of habitat/Very Low
Southern brown bandicoot	<i>Isoodon obesulus fusciventer</i>	P5	Loss/modification of small areas of habitat/Very Low
Bilby	<i>Macrotis lagotis</i>	S1 Vulnerable	No impacts

Common Name	Scientific Name	Conservation Status	Possible Impacts and Significance of Impact
Western ringtail possum	<i>Pseudocheirus occidentalis</i>	S1 Vulnerable	Loss/modification of small areas of habitat/Very Low
Western brush wallaby	<i>Macropus irma</i>	P4	Loss/modification of small areas of habitat/Very Low
Woylie	<i>Bettongia penicillata ogiby</i>	S1 Endangered	Loss/modification of small areas of habitat/Very Low/Nil
Tammar	<i>Macropus eugenii</i>	P4	No impacts
Quokka	<i>Setonix brachyurus</i>	S1 Vulnerable	No impacts
Western false pipistrelle	<i>Falsistrellus mackenziei</i>	P4	Loss/modification of small areas of habitat/Very Low
Water rat	<i>Hydromys chrysogaster</i>	P4	Loss/modification of small areas of habitat/Very Low/Nil

The Coalfields Highway project and potential impacts on the Commonwealth EPBC Act protected fauna species was assessed against the DSEWPaC criteria (2012). Harewood (2013) considered the realignment vegetation clearing as likely to constitute a “significant impact” with respect to the loss of black cockatoo potential breeding and foraging habitat. It is understood that referral of the project to DSEWPaC for assessment will be undertaken by Main Roads to ensure compliance with the EPBC Act in this regard.

Overall, it is considered that the proposed linear clearing is the minimum necessary for the safe upgrade and long-term operation of the highway and it is expected that fauna will have adequate adjacent areas to find habitat/refuge if disturbed.

The most likely potential impacts to fauna as a consequence of developing the project are:

- loss of vegetation/fauna habitat that may be used for foraging, breeding, roosting, or dispersal (includes loss of hollow bearing trees)
- death or injury of fauna during clearing, construction and operation (including road kills).

Fauna management recommendations proposed by Harewood (2011) have been incorporated into this report.

2.9.7.1 Potential Impact on Black Cockatoos

As noted at Section 2.9.3, almost all areas of remnant native vegetation within and beyond the proposed road realignment were considered to represent potential black cockatoo foraging habitat.

It is expected that project clearing will impact:

- 25 ha of potential black cockatoo foraging habitat
- 424 of the 1195 potential black cockatoo nest trees (DBH >50 cm) identified in the area
- 28 of the 77 trees with nest hollows potentially suitable for black cockatoo species identified adjacent to the project site
- There will be no impact on confirmed nest trees or roosting trees as none were identified during surveys.

The criteria used to judge significant impact for vulnerable (e.g. Baudin’s black cockatoo and the FRTBC) and endangered (e.g. Carnaby’s Black-Cockatoo) species are listed in the Significant impact guidelines 1.1 (DEWHA 2009b). An assessment of the project clearing impact against these criteria is detailed in Table 10.

The criteria in the significant impact guidelines refer to “populations” and “important populations”. These terms have not been defined for black cockatoos, due to the mobile and widely-distributed nature of these species, and the variation in flock compositions (for example, between breeding and non-breeding seasons).

For black cockatoos DSEWPac have recently released referral guidelines for the three threatened black cockatoo species (DSEWPac 2012) which provides guidance for when one or more “habitat impacts” may trigger the need to refer an “action”. An assessment of the project clearing impact against the 2012 criteria is included in Table 9.

Table 9: Assessment of Black Cockatoo Habitat Impacts against DSEWPC Criteria (2012)

Risk Type	Referral Trigger
High Risk of Significant Impacts: Referral to DSEWPac Recommended	
Clearing of Any Known Nesting Tree	Referral is not triggered No actual nesting trees were identified within the study area during the field reconnaissance surveys. 77 trees were identified within or very near the study area that contained hollows which may possibly be suitable for black cockatoos to utilise for breeding, though no sign of actual use by black cockatoos was seen. Based on observations made to date this criterion will not be compromised by roadworks proceeding.
Clearing or Degradation of Any Part of a Vegetation Community Known to Contain Breeding Habitat	Referral is triggered The habitat tree survey undertaken by Harewood (2011) identified 1195 trees within or very near the study area that had a DBH of greater than 50 cm all of which represents “potential breeding habitat”

Risk Type	Referral Trigger
Clearing of More Than One Ha of Quality Foraging Habitat	Referral is triggered Most of the native vegetation remaining within the study area represents potential black cockatoo foraging habitat. The estimated extent of clearing is estimated to be about 25 ha and will therefore exceed the defined threshold. This criterion will be triggered by roadworks proceeding and will be deemed by DSEWPaC as having a high risk of significant impact.
Clearing or Degradation (Including Pruning the Top Canopy) of a Known Night Roosting Site	Referral is not triggered No roosting trees were identified within the study area during the field reconnaissance survey.
Creating a Gap of Greater than 4 Km Between Patches of Black Cockatoo Habitat (Breeding, Foraging or Roosting)	Referral is not triggered Roadworks and the occurrence of adjacent similar vegetation at any scale would not compromise this criterion
Actions That Have an Uncertain Risk of Significant Impacts	
Degradation (Such as Through Altered Hydrology or Fire Regimes) of More than 1 Ha of Foraging Habitat. Significance will Depend on the Level and Extent of Degradation and the Quality of the Habitat	Referral is not triggered Degradation of foraging habitat through altered hydrology or fire is considered unlikely to occur as a consequence of the proposed roadworks.
Clearing or Disturbance in Areas Surrounding Black Cockatoo Habitat that has the Potential to Degrade Habitat through Introduction of Invasive Species, Edge Effects, Hydrological Changes, Increased Human Visitation or Fire	Referral is not triggered The proposed roadworks are within identified black cockatoo habitat and so impacts will be direct. Additional indirect impacts, not addressed elsewhere, are considered unlikely.
Actions that Do Not Directly Affect the Listed Species but that have the Potential for Indirect Impacts such as Increasing Competitors for Nest Hollows	Referral unlikely to be triggered It is unlikely that the proposed roadworks will have indirect impacts such as increasing competition for nest hollows.
Actions with the Potential to Introduce Known Plant Diseases such as Phytophthora Spp. to an Area where the Pathogen was Not Previously Known	Referral is not triggered The study area has been assessed for dieback and has been determined to be dieback infected and uninfected/unprotectable from Phytophthora along its entire length. It is therefore considered unlikely that roadworks will significantly contribute to any existing, ongoing impacts that are already at play in the area with respect to plant diseases. While in theory it is possible that this criterion could be compromised by roadworks proceeding, the area is open to public access and therefore there is no control on the introduction or spread of plant diseases.
Actions that have a Low Risk of Significant Impacts	
Actions that Do Not Affect Black Cockatoo Habitat or Individuals	Not applicable in this case.
Actions Whose Impacts Occur Outside the Modelled Distribution of the Three Black Cockatoos	Not applicable in this case

The above assessment using DSEWPaC Black Cockatoo Referral Guidelines (2012) suggests that the proposed roadworks represent an action that has a high risk of significant impact on black cockatoos. Consequently, a referral of the project to DSEWPaC for assessment will be undertaken to ensure compliance with the EPBC Act in this regard.

In respect to the EPBC Act Impact Significance Guidelines (2009), the expected project impact is summarised in Table 10.

Table 10: Significant Impact Criteria for Significant Species (DSEWPC 2009)

Significant Impact Criterion	Discussion – Black Cockatoo Species	Meets Criterion
Lead to a long-term decrease in the size of an important population of a species	<p>The majority of vegetation within the proposed realignment contains potential black cockatoo foraging habitat. 424 trees (28 of which had hollows) are expected to be cleared as part of the proposal.</p> <p>Although assessment of potential nest trees within the wider area has not been conducted, 1195 potential habitat trees were identified in the area and vegetation mapping indicates more than 30 000ha and 94 000 ha of potential foraging habitat occurs within 10 and 20 km of the project site respectively.</p> <p>Consequently, although the proposed action involves clearing both potential breeding and foraging habitat, due to the large areas of similar habitat protected within reserves in the region, the impact is not considered significant.</p>	No
Reduce the area of occupancy of an important population	The proposed action involves clearing a linear area of vegetation and due to the mobility of these species will not impact on the area of occupancy of the current population	No
Fragment an existing important population into two or more populations	The proposed action involves clearing a linear area of vegetation and due to the mobility of these species will not fragment current population	No
Adversely affect habitat critical to the survival of a species	<p>The majority of vegetation within the proposed realignment contains potential black cockatoo foraging habitat. 424 potential breeding trees were also identified as likely to be cleared. No actual breeding trees were identified during the survey.</p> <p>Although assessment of potential nest trees within the wider area has not been conducted, vegetation mapping indicates more than 30 000ha and 94 000 ha of potential foraging habitat occurs within 10 and 20km of the project site respectively.</p> <p>Consequently, although the proposed action involves clearing both potential breeding and foraging habitat, due to the large areas of similar habitat protected within reserves in the region, the impact is not considered significant.</p>	No
Disrupt the breeding cycle of an important population	Four hundred and twenty-four of the 1195 potential breeding trees will be cleared through the proposed realignment. However, it is considered likely that there is existing similar habitat in the reserves and national parks in the local area.	No

Significant Impact Criterion	Discussion – Black Cockatoo Species	Meets Criterion
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	While small areas of feeding habitat is to be removed, the abundance of other suitable resources will not lead to a decline in the species	No
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat	The proposed highway realignment is not likely to result in the introduction of any new species into the surrounding habitat.	No
Introduce disease that may cause species decline	The study area has been assessed for dieback and has been determined to be dieback infected and uninfected/unprotectable from Phytophthora along its entire length. It is therefore considered unlikely that roadworks will significantly contribute to any existing, ongoing impacts that are already existing in the area with respect to plant diseases. The area is open to public access and therefore there is no control on the introduction or spread of plant diseases. Main Roads will also employ appropriate hygiene methods during construction works.	No
Interfere substantially with the recovery of the species	The proposed realignment will not impact on the recovery of the species.	No

In respect to the EPBC Act Impact Significance Guidelines (2009) and EPBC Act referral guidelines for three threatened black cockatoo species (DSEWPC 2012) as discussed above, the proposed Coalfields upgrade may potentially represent an action that has a high risk of significant impact on black cockatoos through the loss of 25 ha of potential cockatoo foraging habitat, 424 of the 1195 large trees (dbh >50 cm) identified in the area, and 28 of 77 trees with actual nest hollows. The significance of this impact is considered to be reduced however due to the amount of potential habitat present in reserves and national parks locally and regionally.

As discussed in Section 2.4.3, vegetation mapping indicates that more than 30 000 ha and 94 000 ha of similar potential foraging habitat occurs within 10 and 20 km of the project site respectively (Table 3).

Due to the potential impact on black cockatoo species, a referral of the project to DSEWPaC for assessment will be undertaken to ensure compliance with the EPBC Act in this regard.

2.9.7.2 Management Measures

As the project will be formally referred to DSEWPaC, Main Roads will liaise with DSEWPaC to define the requirements for referral under the EPBC Act in respect to the loss of black cockatoo habitat.

Provide site inductions and “tool-box meetings” to all site personnel/contractors to inform them that all native fauna is protected and of their environmental management obligations.

Do not permit site personnel to bring firearms, other weapons or pets on site.

Schedule major clearing operations to avoid peak breeding times of threatened species that utilise tree hollows, fallen hollow logs and burrows where possible. Based on documented breeding and fledging times, this would be during March–April.

Trees observed to contain hollows (or possum dreys) should be felled in a manner that reduces the likelihood that fauna present will be injured.

If any native fauna is disturbed during clearing it should be allowed to make its own way to adjacent vegetated areas and if injured it should be taken to a designated veterinary clinic or a DEC nominated wildlife carer.

Any holes, pits or trenches required for services should be kept open for the minimum period necessary with escape ramps (45° batter) and bridging provided if left unattended for extended periods. Significant sized holes, pits or trenches should be inspected regularly and any fauna present should be safely removed immediately prior to filling.

Four weeks prior to clearing operations, a suitably experienced “fauna spotter” should be employed to inspect logs, trees and hollows (where possible) within the clearing envelope to reduce likelihood of injury to fauna.

2.10 Heritage

2.10.1 Aboriginal Heritage

An Aboriginal heritage survey of Coalfields Highway Upgrade project, and adjoining sections of Coalfields Highway, was conducted in 2011 by Brad Goode and Associates (2011) on behalf of RPS. This survey included both archaeological and ethnographic components.

An additional survey was conducted in 2013 to ensure that the entire project site was assessed adequately and to conduct follow up consultation with members of the Aboriginal community in respect to minor changes to the project realignments. The outcomes of these surveys relevant to the Coalfields Highway project are discussed below.

2.10.1.1 Archaeological Survey

An archaeological field survey was conducted in April 2011 by Tom O'Reilly (Archaeologist), accompanied by Natasha Sanders. The entire length of the project area was surveyed and examined for the presence of Aboriginal archaeological sites and/or material using regularly spaced transects that followed the general alignment of each survey area.

Additional survey of the Wellington section was conducted on February 6, 2013 by Tom and Stephen O'Reilly to assess minor changes to the Wellington and Hamilton sections. As a result of research at the Heritage and Culture Division, Department of Indigenous Affairs (DIA) and a search of their Aboriginal Heritage Inquiry System, it was established that no Aboriginal archaeological sites had been previously reported within the survey area. As a result of the archaeological surveys (2011 and 2013) no Aboriginal archaeological sites or archaeological material were identified within the Coalfields Highway Upgrade project area.

2.10.1.2 Ethnographic Survey

A search of the DIA Aboriginal Sites Register identified one previously recorded ethnographic Registered 'Aboriginal heritage site that overlays the proposed road upgrade corridor. This site is the Collie River Waugal (Site ID 16 713).

A site visit and consultation with seven representatives of the Gnaala Karla Booja GKB WC98/058 Native Title Claim group was conducted by Brad Goode (Anthropologist) and Main Roads representatives on 24 May 2011. The consultation confirmed that Site ID 16 713 "Collie River Waugal", will be directly affected where the Coalfields Highway project traverses an arm of the Wellington Dam south of the Hamilton River. No new ethnographic sites of significance as defined by section 5 of the *Aboriginal Heritage Act, 1972* (AHA) were identified to be located within the project area.

As a consequence of the survey and recommendations from the Aboriginal heritage survey Main Roads submitted an application under Section 18 of the AHA to use the land overlain by Site ID 16 713 for the construction of the Coalfields Highway upgrade. A section 18 approval was subsequently issued by the Minister for Indigenous Affairs in November 2011.

As a consequence to changes to both the Wellington and Hamilton section alignments after the 2011 consultation additional consultation was conducted with nine representative of the GKB on 7 February 2013. During the consultation GKB representatives were advised of the minor changes to the Wellington and Hamilton sections and were provided with an opportunity to provide comment. Community representatives indicated their support for the amended alignment.

Advice from DIA is that as the changes to the alignment are minor the previously issued S18 approval remains valid for the current project.

2.10.2 European Heritage

There is no listed European heritage in a proximity that would likely be impacted by the project. This assessment is based on online searches in May 2011 of the Australian Heritage Places Inventory and the Heritage Council of WA Places Database. The EPBC Act Protected Matters Report generated over the study area identified it as falling within the South-west Irrigation Area (SWIA). The SWIA is listed only as an “Indicative Place” on the Register of National Estate. As such the SWIA is afforded no legal protection at this time.

2.10.3 Roadside Memorials

A number of fatalities have occurred over the years along 15.90–26.34 SLK of the Coalfields Highway, as is evident in the presence of roadside memorials dedicated to people who lost their lives in a road crashes. These memorials should be managed in accordance with Main Roads Policy and Guidelines (Main Roads 2008).

2.10.3.1 Management Measures

Main Roads should ensure management of roadside memorials complies with its Roadside Memorials Policy and Guidelines.

2.11 Land Use Considerations

2.11.1 Environmentally Sensitive Areas

There are no Environmentally Sensitive Areas (ESAs) within or proximate to the project study area that would be affected by the project, as declared in Regulation 6 in Government Gazette No. 115 Environmental Protection (Clearing of Native Vegetation) Regulations 2004.

2.11.2 Contaminated Sites

Interrogation of the DEC’s Contaminated Sites Database on 10 January 2013 revealed that there are no known classified sites in proximity to the project. No obvious visual evidence of contamination or potentially contaminating land uses was observed during the field reconnaissance survey as part of the 2011 study. Disturbance of contaminated sites is not expected during the project.

2.11.2.1 Management Measures

If any suspected contaminated material is encountered during project implementation, works should cease in the area and the site Superintendent/Environment Officer be contacted for advice.

2.11.3 Existing / Surrounding Land Uses

The 10.44 km project traverses the Wellington National Park and private property. There are five single detached dwellings situated within approximately 600 m of the proposed realignments, which have been marked on Figure 6. As a part of the project Main Roads will maintain and improve the safety of access to all adjacent private properties.

The project area has a high level of accessibility, with public access available to two and four-wheel drive vehicles via sealed and unsealed public roads and forest tracks. Land acquisition is expected to be required from one private landowner and the Wellington National Park. Land acquisition is an important issue for this project, and due consideration and negotiations will be necessary with affected landholders and agencies.

There are no other surrounding land uses that appear to be negatively impacted by the project. Construction/traffic noise impacts are not expected to be significant at nearby private properties given the project's location.

2.11.3.1 Management Measures

Main Roads should continue to liaise with any affected landholders and agencies in respect to the land acquisition / excision necessary to develop the project.

Minimise any temporary disturbances during construction to proximate residences by employing standard noise, dust and safe access practices.

Access to existing private properties and DEC Wellington Dam Camping Area will be incorporated into the project design.

2.11.4 Traffic Noise

Five private residences occur within approximately 600 m of the current Coalfields Highway. The separation between the existing and realigned highway to private residences is detailed in Table II.

Table II: Approximate Distance from Existing and Realigned Highway of Private Residence

Location	Existing Separation (m)	Separation of Realigned Highway (m)
Lot 171 Coalfields Hwy	50	260
Lot 1020 Coalfields Hwy	145	125
Lot 3041 Wellington Dam Road	620	420
Lot 2983 Coalfields Hwy	220	225
Lot 103 Worsley Back Rd	240	225

For those residences within 150 m of the existing highway the project will marginally reduce the distance to the highway at Lot 1020 while significantly increasing the separation at Lot 171.

Traffic volumes on the existing Coalfields Highway in 2011 were estimated at 5900 vehicles per day (vpd) with 14.9% heavy vehicles west of Gastaldo Road, and 3500 vpd with (14.5%) heavy vehicles east of Gastaldo Road.

Based on the changes, separation distances between the highway and adjacent noise sensitive receptors, traffic volumes and location of the existing Coalfields Highway; Main Roads considers that any changes to existing traffic noise exposure are congruent with the State Planning Policy 5.4 (WAPC 2009).

2.11.5 DEC Managed Assets

DEC manages the Wellington Nation Park on behalf of the Conservation Commission of Western Australia. Main Roads has been liaising with DEC as to how existing management of the national park can be improved through the implementation of the project. Issues discussed include maintaining fire access, rationalising access to the national park and improving the safety of access to the park from Coalfields highway.

The Munda Biddi Trail (which means path through the forest in the Nyoongar Aboriginal language) is considered a world-class nature-based off-road cycling experience (Munda Biddi Trail Foundation 2011). Part of the existing trail traverses the proposed Wellington realignment in a north–south direction (see Figure 6) west of Wellington Dam Road.

The Munda Biddi Track will be marginally re-routed and the highway crossing maintained in consultation with DEC. Main Roads will continue discussions with DEC Wellington District regarding this matter.

The upgraded Coalfields Highway / Wellington Dam Road intersection will not impact the existing DEC visitor information bay located on Wellington Dam Road.

2.11.5.1 Management Measures

Main Roads will consult with the DEC Wellington Office regarding the Munda Bindi Track realignment and any disturbances due to construction works including trail/roadside signage, public notification of access limitations during road construction and any repositioning of the trail at the point where it crosses the highway (to maximise public safety).

2.11.6 Visual Amenity

A visual assessment did not form part of this commission. However, during the site reconnaissance survey, the entire study corridor was traversed and observations of likely views were made. It is considered that clearing vegetation and developing the road will not cause a significant change in comparison to the existing route.

Where the proposed realignment sections traverse forested land on both sides, this may be considered appealing in the opinion of some road users and tourists. Main Roads should consider the visual landscape management in consultation with the DEC/ Conservation Commission, as to how this can be best incorporated into the project.

2.11.6.1 Management Measures

Main Roads should develop a Revegetation and Landscape Plan and invite comments from the DEC before implementation.

2.12 Pre-construction Works

A number of above and underground service utilities exist within the project area. Identifying these and relocating them such as power and telecommunications cables will be required. This pre-construction work will be undertaken by other agencies prior to commencing roadwork. Management measures in this EMP should be communicated and followed by service providers. A copy of the EMP should be given to all relevant service providers and contractors responsible for service relocations with a requirement to fulfil the EMP measures.

2.12.1.1 Management Measures

Main Roads should ensure all agencies and contractors involved with service relocations are provided a copy of the EMP and comply with its requirements.

2.13 Construction Phase Impacts

Additional impacts that require consideration and management during the projects construction phase include the following:

- construction noise and vibration
- damage to public/private property
- elevated dust levels
- traffic access and safety
- fire management
- fuel and chemical storage/handling
- waste disposal.

These issues are specific to each section of the projects development and detailed measures to manage them are given in the EMP at Appendix 9. Construction work will be managed by implementing the projects EMP and ensuring its management measures are included in relevant contractual documents.

2.13.1.1 Management Measures

Main Roads should incorporate relevant environmental information and EMP measures in project tender documentation and site induction materials for all personnel, contractors and service providers involved in the project.

3.0 ENVIRONMENTAL MANAGEMENT

The project is expected to be delivered through a construction contract. Roadworks will be conducted in line with Main Roads Specifications and environmental management as detailed in a Construction Environmental Management Plan (EMP). The EMP will present management measures that Main Roads will be responsible for implementing to ensure that the project is environmentally acceptable. The EMP is presented in Appendix 9.

The EMP details who is responsible for each commitment (management measure) at the applicable design, construction or operational phases of the project. The management measures outlined in the EMP aim to provide a basis for which performance and compliance can be measured throughout the projects planning and development. They can also be used as the basis for guiding the development of Construction Environmental Management Plans where relevant.

3.1 Environmental Monitoring and Compliance

The environmental management measures in the EMP can be translated as “commitments” and should be included in relevant contract documents and technical specifications prepared for the project. All Main Roads WA employees, service authorities, contractors and other personnel employed on the project should be made aware of the EMP.

During the construction phase, regular compliance monitoring of the EMP’s implementation should be undertaken. Any non-conformances should be addressed at the first opportunity. Records of non-conformances and the status of improvement actions should be detailed in appropriate construction documentation.

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4.0 CONSULTATION

To date, agency consultation undertaken for the project has been managed by Main Roads and is ongoing. RPS has been provided with information arising from such consultations and has also participated in discussions with the DEC. A number of government agency managed databases were consulted / interrogated to acquire background site information that has been included within this report including:

- DEC – Declared Rare and Priority Flora database searches
- DEC – WA Herbarium Specimens database search
- DEC / DSEWPaC – Threatened and Priority Fauna database searches
- DEC / DSEWPaC – TECs database searches
- DEC – Contaminated sites database
- DIA and Heritage Commission of WA database queries.

Main Roads invited early comment on vegetation clearing from various agency stakeholders based on the results of a Preliminary EIA (GHD, 2009). The PEIA indicated that five “Clearing Principles” may be at variance (based on desktop information available at that time). At that time it was also estimated that clearing totalled approximately 15 ha of native vegetation. This EIA and EMP report has refined those details. However, the agency feedback received has some relevance and was incorporated within this EIA and EMP accordingly. The agency feedback received is summarised below with the original Main Roads letter inviting comments and correspondence included in Appendix 6.

4.1 Department of Water (Carol Anderson, Senior NRM Officer – DoW Bunbury, 27 January 2011)

The DoW noted in respect to clearing being possibly at variance to Clearing Principle (f) that the proposed roadwork is within a proclaimed Surface Water Area and a “Not Assigned” Public Drinking Water Source Area. Information on relevant permits/licences was also provided to assist Main Roads compliance under the *Rights in Water and Irrigation Act 1914* and the Department’s *Country Area Water Supply Act 1947*. Comment of the occurrence of threatened flora was also given along with recognition of potential impacts from works being associated with the management of refuelling operations and storage of fuel, oils and chemicals, machinery parking areas and effluent management.

4.2 Department of Environment and Conservation (Kelly Faulkner, Manager – Native Vegetation Conservation Branch, February 2011)

The DEC provided comment on assessment of “Clearing Principles” completed in the Preliminary EIA completed by consultants GHD (2009) and was generally in agreement based on the information provided. DEC also recognised the need for a detailed flora survey and site assessment to further clarify clearing impacts. Importantly, the DEC noted the need to resolve all land tenure issues prior to developing an offset package and any clearing to access the land.

During the preparation of this report, Main Roads and RPS were also involved in a number of agency consultations as outlined below.

At the commencement of this study a meeting was held with Main Roads, RPS and the DEC’s Bunbury and Wellington District staff.

4.3 Department of Environment and Conservation and Main Roads Meeting (DEC Bunbury, 19 November 2010)

A meeting was held where Main Roads provided a general project overview to DEC staff in Bunbury. Discussions pertained to land excision from within the Wellington National Park, project timing, previously proposed alternative realignment options and a number of environmental and planning considerations. This meeting was an information sharing exercise and acknowledged Main Roads intent of developing the project with due consideration of environmental issues.

The attendees at this meeting included DEC officers, Tom Kenneally, Kim Williams and Aminya Ennis. Main Roads Project Managers John Szeliga and Chris Coates also attended along with Jeanette Della-Bona (Environment Officer – south-west). Bruno Rikli of RPS also attended as the primary project environmental consultant.

4.4 Department of Environment and Conservation (Forest Management Branch and Wellington District Office)

Prior to commencing field work, RPS liaised with the DEC’s Forest Management Branch and Wellington District office. Bruno Rikli of RPS met with Peter Blankendaal (DEC – A/Disease Standards Officer) in the Bunbury office to obtain any previous *Phytophthora* dieback mapping records.

Prior to undertaking the *Phytophthora* dieback survey, Peter Gibson (DEC Wellington District) was consulted to provide RPS with details of prescribed burning over the study area, that ranged from one year to 24 years.

RPS was also required to liaise daily with DEC's Wellington District office daily during all field surveys in respect to vehicle hygiene, staff movements and fire safety when working on DEC managed land.

4.5 Department of Environment and Conservation and Main Roads Meeting (DEC Bunbury, 20 January 2012).

The purpose of this meeting was to present the findings of any additional investigations that had been undertaken along the proposed realignment, obtain DEC feedback on these investigations and discuss any future steps.

Investigations that were discussed included the *Lomandra whicherensis* survey and Grey Sands Survey.

It was discussed that *Lomandra whicherensis* was distributed over a wide area adjacent to the proposed alignment and consequently realignment of the Coalfields Highway would not significantly impact this population.

Kim Williams commented that the Grey Sands survey showed that the Grey Sands area is regionally significant and unique.

Kim Williams stated that based on the environmental factors, DEC's preferred alignment option was Option 1, however may accept option two if the environmental impacts could be sufficiently reduced.

The attendees at this meeting included DEC officers; Kim Williams and Andrew Webb, Main Roads Project Manager; Brett Lowcock, RPS; Glenn Yeatman and consultant botanist Brian Morgan.

4.6 Department of Environment and Conservation and Main Roads Meeting (DEC Bunbury, 20 November 2012).

Matthew Coppen (MRWA) gave a summary on the more recent alignment options assessment and noted that the preferred (southern alignment) had benefits including better alignment, safety for construction, property access, constructability and staging. This was offset by greater impact on the Wellington National Park. Main Roads has been working to optimise the southern alignment to reduce the clearing footprint by changing vertical geometry, alignment and rationalising the Wellington Dam Road intersection.

Matthew Coppen also provided details on the potential environmental issues, environmental assessments and offsets for the proposed realignment.

Drew Griffiths (DEC) raised concerns regarding the potential impacts on the Wellington National Park from the proposed realignment and management opportunities were discussed.

The attendees at this meeting included DEC officers, Peter Hanly, Kim Williams, Drew Griffiths, Tony Mennen and Leon Price and Main Roads Project Managers Matthew Coppen and Neil McCarthy.

4.7 Conservation Commission of Western Australia and Conservation and Main Roads Meeting (DEC Crawley, 11 February 2013).

Matthew Coppen (MRWA) provided a presentation to the Commission members on the background, warrant and status of the project. He also noted the alignment options considered for the Wellington section, the benefits of the selected alignment, opportunities to improve existing National Park management and on-going consultation with DEC Wellington District.

Neil McCarthy (MRWA) provided a presentation on the environmental background to the project including consultation, field surveys completed, modifications to the project to reduce environmental impacts, residual environmental impacts and proposed environmental management measures.

The attendees at this meeting included members of the Conservation Commission and Main Roads Project Managers Matthew Coppen and Neil McCarthy.

5.0 LIMITATIONS

This report presents the results of desktop data searches and professional site surveys. Desktop information within this report was largely gained from government agency managed databases and RPS accepts no responsibility for its correctness, accuracy or subsequent changes to it.

The status and currency of desktop information may change and should be re-checked as part of any further investigations. Site observations can be subject to natural, seasonal or anthropocentric changes over time and this should be considered when assessing the data.

The data and advice provided within this report relates only to the project study area and must be reviewed by a competent scientist before being used for any other purpose. Any third party information or similar work performed and recorded by others, is included and used in the form provided by others. The accuracy of such data remains with the issuing authority, not with RPS. RPS accepts no responsibility for other use of the data or any edits or alterations to the submitted final report copy issued.

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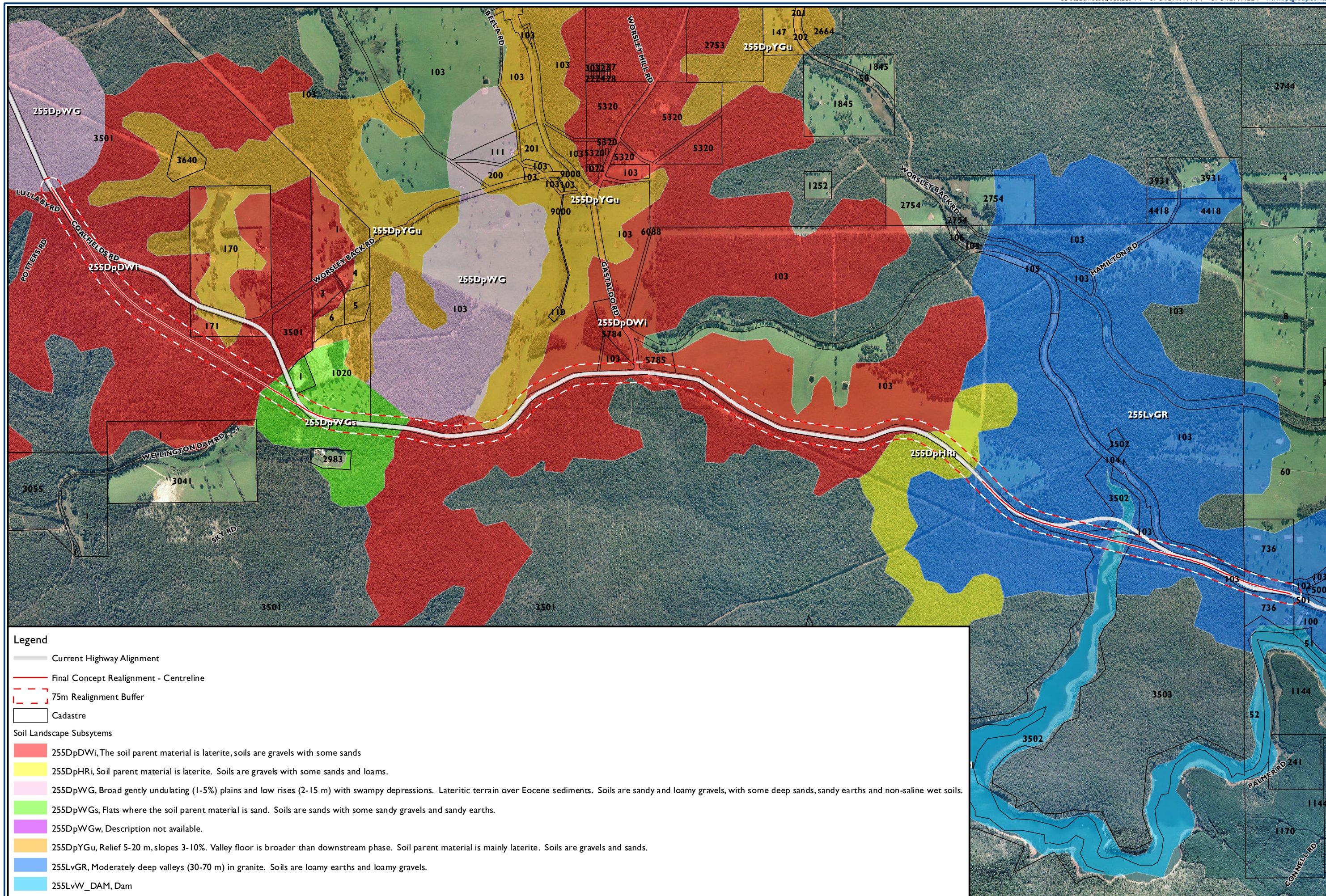
FIGURES





LEGEND

- Current Highway Alignment
- Final Concept Realignment - Centreline
- 75m Realignment Buffer
- Cadastre
- Hydrography

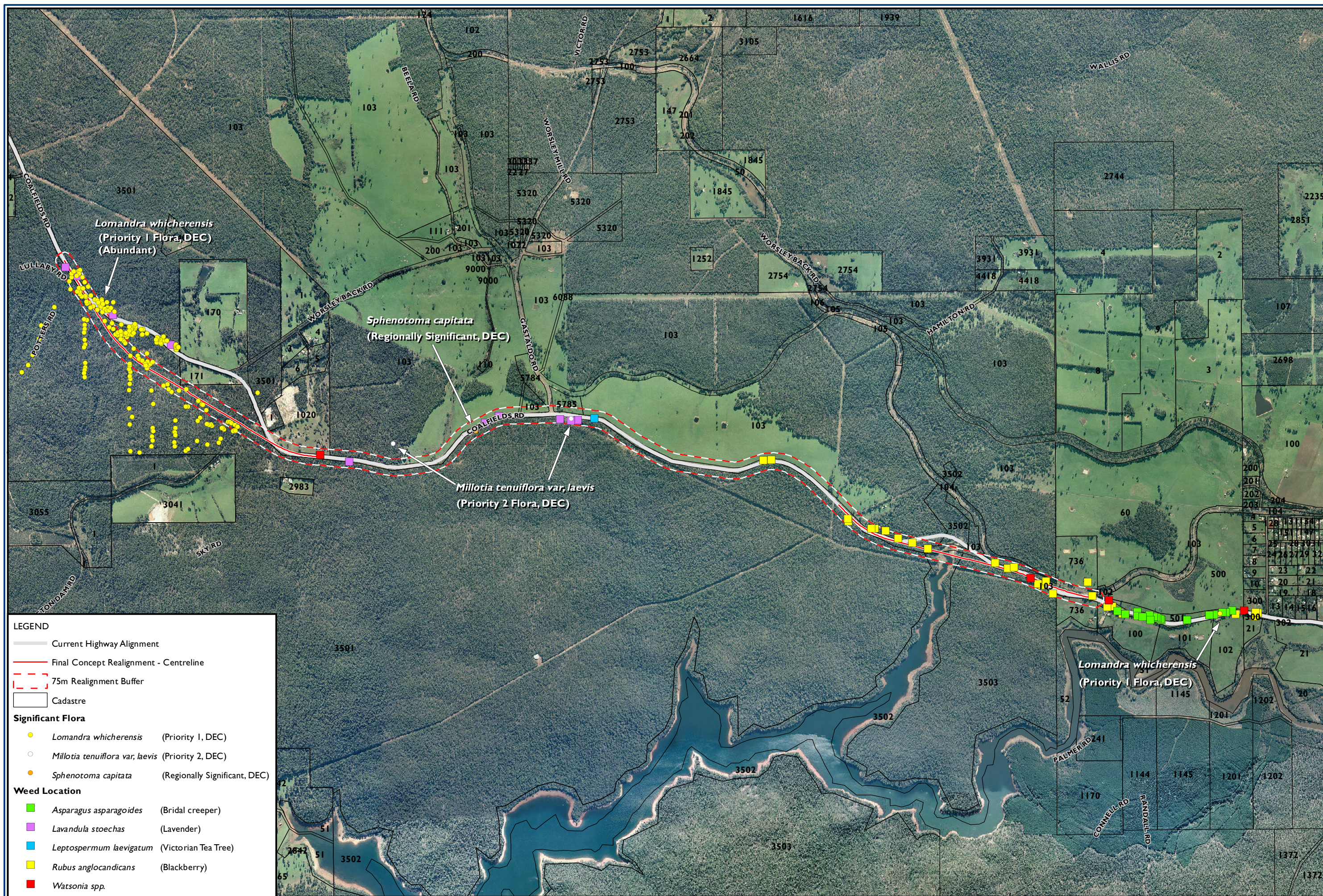


Legend

- Current Highway Alignment
- Final Concept Realignment - Centreline
- 75m Realignment Buffer
- Cadastre

Soil Landscape Subsystems

- 255DpDWi, The soil parent material is laterite, soils are gravels with some sands
- 255DpHRi, Soil parent material is laterite. Soils are gravels with some sands and loams.
- 255DpWG, Broad gently undulating (1-5%) plains and low rises (2-15 m) with swampy depressions. Lateritic terrain over Eocene sediments. Soils are sandy and loamy gravels, with some deep sands, sandy earths and non-saline wet soils.
- 255DpWGs, Flats where the soil parent material is sand. Soils are sands with some sandy gravels and sandy earths.
- 255DpWGw, Description not available.
- 255DpYGu, Relief 5-20 m, slopes 3-10%. Valley floor is broader than downstream phase. Soil parent material is mainly laterite. Soils are gravels and sands.
- 255LvGR, Moderately deep valleys (30-70 m) in granite. Soils are loamy earths and loamy gravels.
- 255LvW_DAM, Dam



LEGEND

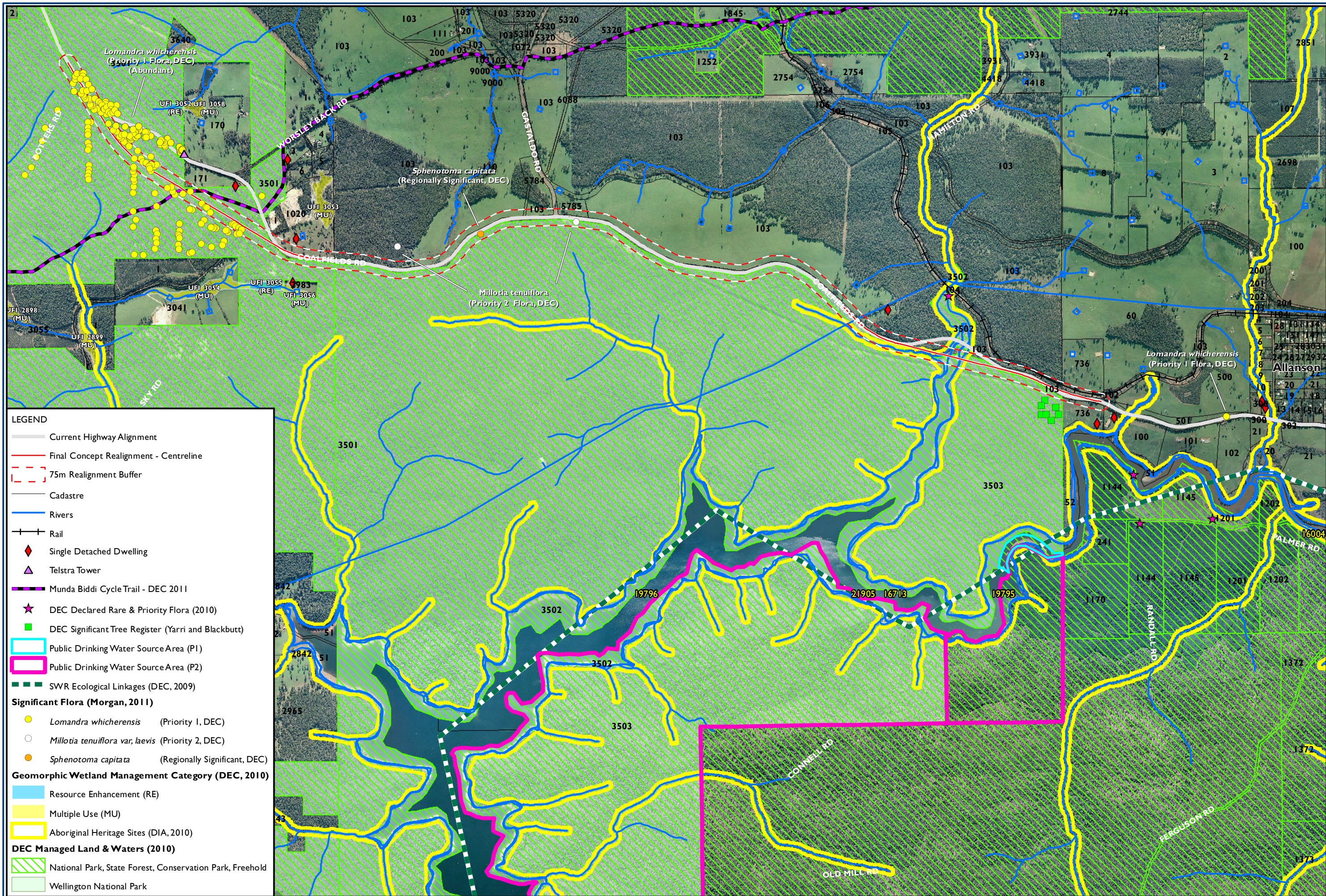
- Current Highway Alignment
- Final Concept Realignment - Centreline
- - - 75m Realignment Buffer
- Cadastrate

Significant Flora

- *Lomandra whicherensis* (Priority 1, DEC)
- *Millotia tenuiflora var. laevis* (Priority 2, DEC)
- *Sphenotoma capitata* (Regionally Significant, DEC)

Weed Location

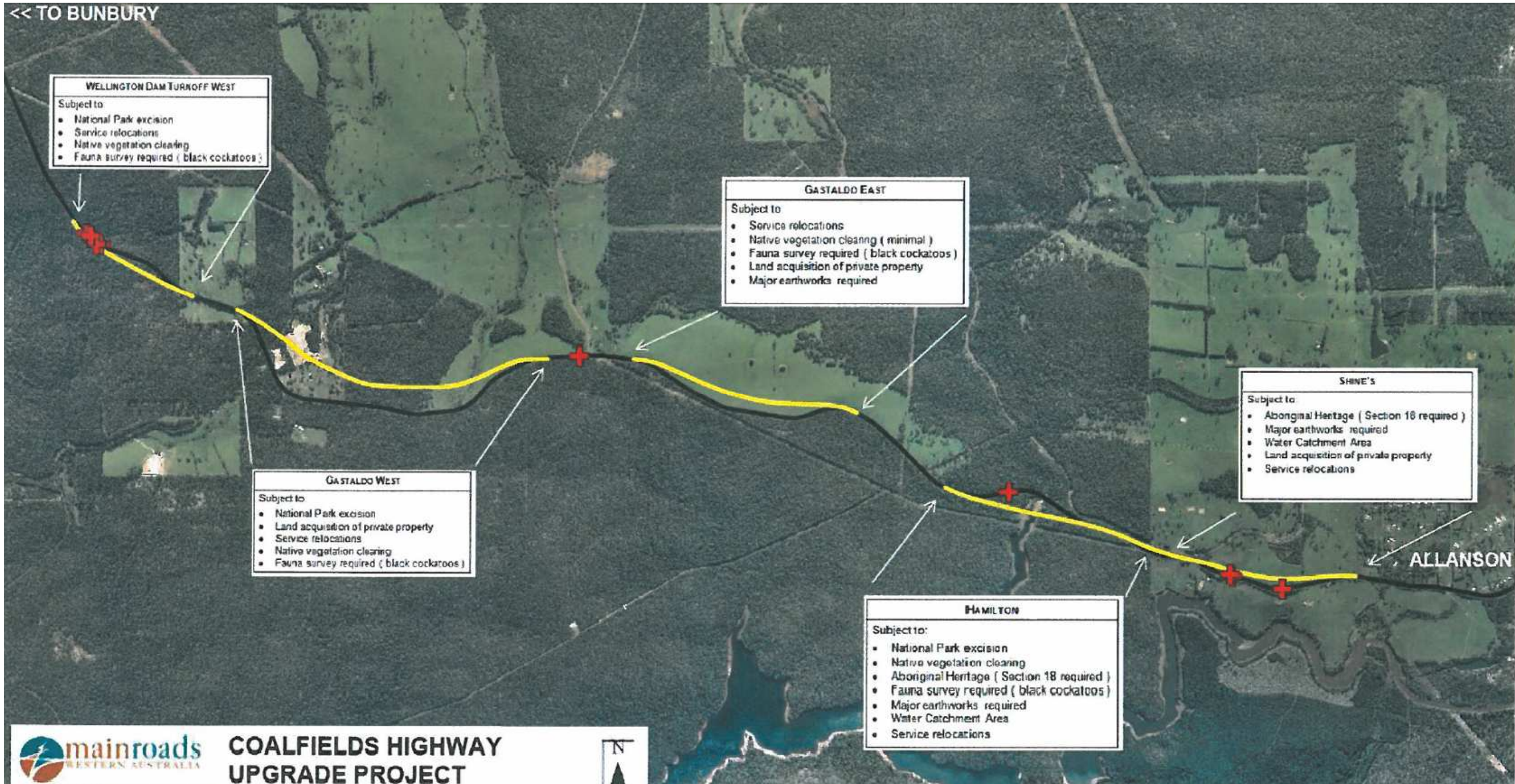
- *Asparagus asparagoides* (Bridal creeper)
- *Lavandula stoechas* (Lavender)
- *Leptospermum laevigatum* (Victorian Tea Tree)
- *Rubus anglocandicans* (Blackberry)
- *Watsonia* spp.



APPENDIX I

Main Roads Project Realignment Sections

<< TO BUNBURY



COALFIELDS HIGHWAY UPGRADE PROJECT



APPENDIX 2

***Lomandra whicherensis* Survey for the Proposed Coalfields Highway Realignment**

LOMANDRA WHICHERENSIS
SURVEY
FOR THE
PROPOSED
COALFIELDS HIGHWAY
REALIGNMENT

Prepared for RPS Group PL
on behalf of Main Roads Western Australia

by

Brian Morgan
Consultant Plant Biologist

January 2012

CONTENTS

1.0 INTRODUCTION.....	1
1.1 Proposed works	1
1.2 Purpose of the survey	1
2.0 METHODS AND LIMITATIONS OF THE SURVEY	3
2.1 Methods of the <i>Lomandra whicherensis</i> survey	3
2.1.1. Introduction	3
2.1.2 Search for <i>Lomandra whicherensis</i> in the proposed Coalfields Highway alignment corridors	3
2.1.3 Search for <i>Lomandra whicherensis</i> in conservation estate	3
2.1.4 Search for other stands of <i>Lomandra whicherensis</i> in the region	4
2.2 Limitations of the <i>Lomandra whicherensis</i> survey	4
3.0 RESULTS OF THE <i>LOMANDRA WHICHERENSIS</i> SURVEY	6
3.1 <i>Lomandra whicherensis</i> locations in Alignments 1 and 2	6
3.2 <i>Lomandra whicherensis</i> stands in conservation estate.....	6
3.3 Other stands of <i>Lomandra whicherensis</i> in the region.....	6
3.4 Collections of <i>Lomandra whicherensis</i>	7
4.0 CONCLUSIONS.....	9
5.0 ACKNOWLEDGEMENTS	10
6.0 REFERENCES.....	11
FIGURES	
Figure 1. <i>Lomandra whicherensis</i> records from November 2010 to February 2011 and November 2011 surveys.....	2
Figure 2. Locations of <i>Lomandra whicherensis</i> and the Soil Landscape Subsystems.....	8
PLATES	
Plate 1. <i>Lomandra whicherensis</i> (Priority 1), showing the old leaves around the outside of the clump that have become brown to grey and are tightly spiralled.....	5
Plate 2. A grazed <i>Lomandra whicherensis</i> plant.....	5
APPENDICES.....	12
APPENDIX ONE. All locations of <i>Lomandra whicherensis</i> recorded during the various Coalfields Highway realignment surveys.	13

1.0 INTRODUCTION

1.1 Proposed works

Main Roads Western Australia is undertaking the Coalfields Highway Upgrade 16-28 SLK project, which aims to realign, widen and otherwise upgrade parts of that section of the Coalfields Highway to improve road safety. A realignment route has been proposed for the 16-28 SLK Coalfields Highway (Alignment 1), including a second alternative alignment for the western part (Alignment 2).

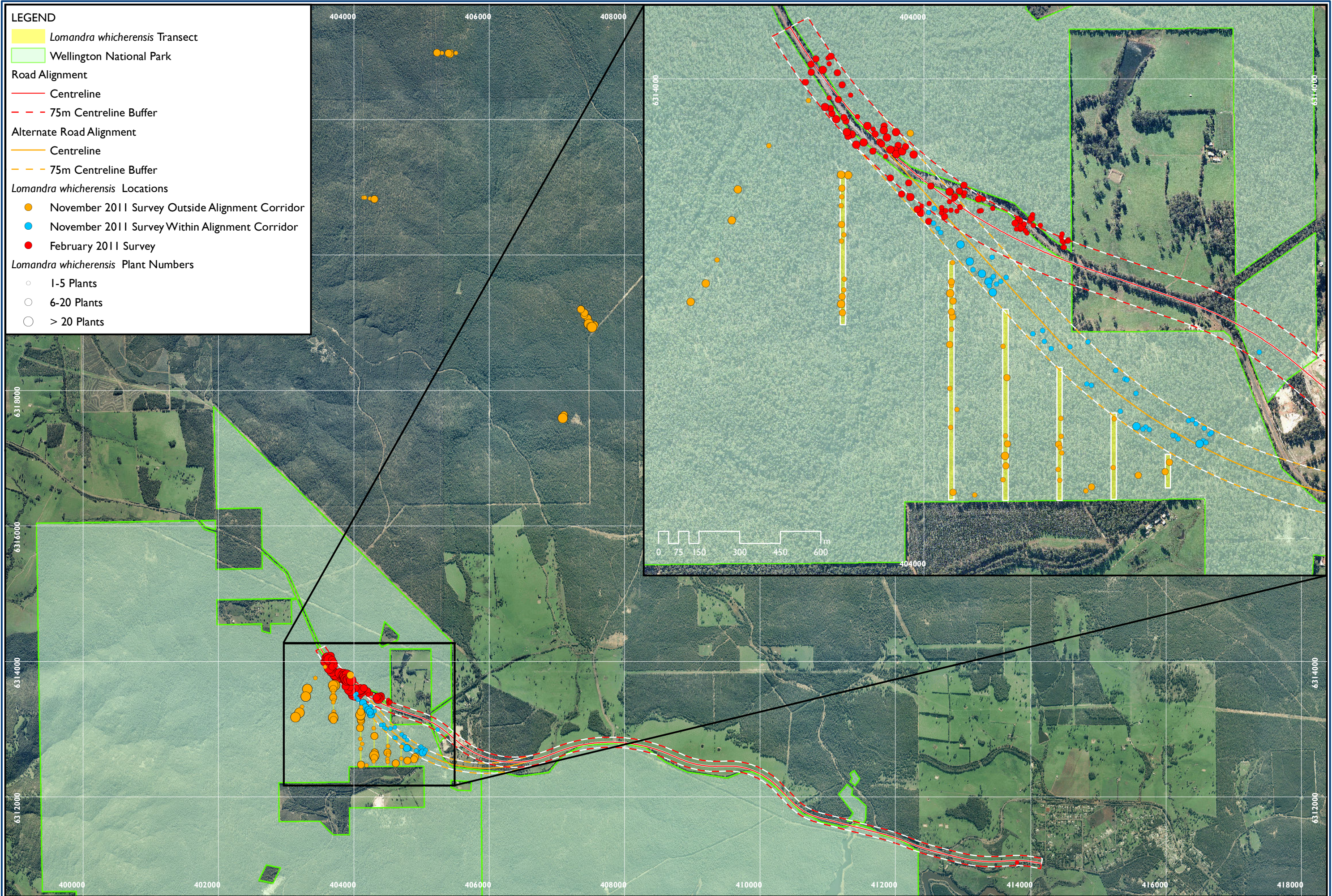
A Level 1 flora and vegetation survey of the proposed 16-28 SLK Coalfields Highway Alignments was undertaken between November 2010 and February 2011. The survey found one *Lomandra whicherensis* (Priority 1 (P1)) plant on the Coalfields Hwy verge near the eastern end of the alignment corridor and more than one thousand plants in the western end of the corridor (Morgan 2011; Figure 1; Appendix 1).

The Bunbury Department of Environment and Conservation (DEC) office subsequently noted that they had more recently observed *Lomandra whicherensis* (P1) plants further east along the Alignment 2 corridor, near Wellington Dam Rd. The Bunbury DEC office also expressed concern that there were no other Departmental records of *Lomandra whicherensis* (P1) in the locality of the proposed 16-28 SLK Coalfields Highway Alignments or indeed outside the Whicher Ranges and more particularly, that there were no other records of *Lomandra whicherensis* in the Wellington National Park ('conservation estate') outside the Alignment corridors.

1.2 Purpose of the survey

The purpose of this survey was to :

- Document the distribution of *Lomandra whicherensis* in the proposed 16-28 SLK Coalfields Highway Alignment options 1 and 2 (here after 'Coalfields Highway Alignments' or 'Alignments') east of the previous survey records;
- Determine if there were *Lomandra whicherensis* stands in the Wellington NP conservation estate outside the proposed Coalfields Highway Alignments;
- Confirm reports of other locations of *Lomandra whicherensis* in the general locality to further indicate the likely range of *Lomandra whicherensis* in the area.



LEGEND

- Lomandra whicherensis* Transect
- Wellington National Park

Road Alignment

- Centreline
- 75m Centreline Buffer

Alternate Road Alignment

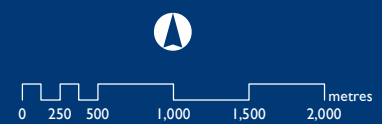
- Centreline
- 75m Centreline Buffer

***Lomandra whicherensis* Locations**

- November 2011 Survey Outside Alignment Corridor
- November 2011 Survey Within Alignment Corridor
- February 2011 Survey

***Lomandra whicherensis* Plant Numbers**

- 1-5 Plants
- 6-20 Plants
- > 20 Plants



Job Number: I10572
 Date: 23.01.12
 Scale: Main Map 1:50000, Close up 1:12500 @ A3
 Revision: A
 Drafted by: HT
 Source: Orthophoto - Landgate, 2008, DEC Managed Areas - DEC 2010.



Figure 1

Lomandra whicherensis Locations - 2011 Surveys

2.0 METHODS AND LIMITATIONS OF THE SURVEY

2.1 Methods of the *Lomandra whicherensis* survey

2.1.1. Introduction

The *Lomandra whicherensis* survey was undertaken between the 23rd and 25th of November, 2011.

2.1.2 Search for *Lomandra whicherensis* in the proposed Coalfields Highway alignment corridors

The proposed Coalfields Highway Alignment 2 corridor was searched for *Lomandra whicherensis* between Wellington Dam Rd and the previously recorded stands to the west. The corridor was searched by walking a zig-zag transect along the southern and then northern halves of the corridor in turn. Location and plant numbers were recorded for each stand of *Lomandra whicherensis* observed. While time did not permit a complete walk of the Alignment 1 corridor between the Alcoa Back Rd and the previously reported stands to the west, a transect was started from Alcoa Back Rd and progressed west until being terminated at the first observed stand of *Lomandra whicherensis*.

Targeted searches for *Lomandra whicherensis* were not conducted along the Alignments East of Wellington Dam Rd. However, in a separate study, a comprehensive flora survey was conducted over the Wellington Dam Rd Grey Sands survey area, which lies immediately East of Wellington Dam Rd, including traverses while conducting general flora searches and vegetation mapping and the recording of 7 quadrats.

2.1.3 Search for *Lomandra whicherensis* in conservation estate

To determine if *Lomandra whicherensis* occurred elsewhere in Wellington NP other than in the proposed Coalfields Hwy Alignment corridor's, seven transects were sampled in the Wellington NP on the south side of the Alignment 2 corridor. Six of these transects were walked, along Northings 403700E, 404100E, 404300E, 404500E, 404700E and 404900E, with their northern ends at the southern boundary of Alignment 2 (with one exception, see Figure 1). The walked transects ended, to the south, at physical barriers such as roads and farm fences or at arbitrary points determined by time constraints. The full walked transect lengths are represented by the extent of the rectangular boxes centred around the transect lines in Figure 1. The search for *Lomandra whicherensis* was effective over a width of about 5 to 10 metres on either side of the walked line (represented by the relative width of the rectangular boxes centred around the transect Northings in Figure 1). Where *Lomandra whicherensis* was found, a count was conducted over about a 20 metre radius around the find.

One further transect was effected by driving south along Ridge Rd, starting from the southern boundary of the Alignment 2 corridor, and stopping about every 50metres and later every 100 metres, to search for *Lomandra whicherensis* within about a 20 metre radius of the stopping

point. This transect was terminated after a distance of about 900m. Again, where *Lomandra whicherensis* was found, a count was conducted over about a 20 metre radius around the find.

2.1.4 Search for other stands of *Lomandra whicherensis* in the region

Eleanor Bennett (*pers. comm.*) has reported finding large numbers of *Lomandra whicherensis* on the east and west side of Beala Rd, north of the Coalfields Hwy. As her data remained confidential, it was decided to visit 4 locations on the extremities of the distribution she reported to make location records for this survey and to collect specimens for vouchering. The four locations were within a large area bounded by Gastaldo Rd and Mornington Rd. Tracks were accessed to get the car as close to the four locations as possible. *Lomandra whicherensis* stands were recorded along the walk from the parked car to the designated *Lomandra* location. Voucher specimens were collected in the vicinity of the four target locations.

2.2 Limitations of the *Lomandra whicherensis* survey

Season was not a limitation for the *Lomandra whicherensis* survey, as it is a perennial species.

The greatest limitation to the *Lomandra whicherensis* survey was that a *L. whicherensis* plant can be fairly inconspicuous, having an appearance not dissimilar to a tussocky grass (Plates 1 and 2). Furthermore, this taxa appears to be a preferred grazing target of (most likely) kangaroos, often leaving a plant almost grazed to ground level (Plate 2).



Plate 1. *Lomandra whicherensis* (Priority 1), showing the old leaves around the outside of the clump that have become brown to grey and are tightly spiralled.



Plate 2. A grazed *Lomandra whicherensis* plant.

3.0 RESULTS OF THE *LOMANDRA WHICHERENSIS* SURVEY

3.1 *Lomandra whicherensis* locations in Alignments 1 and 2

Lomandra whicherensis was found scattered along Alignment 2, between the stands recorded at the western end of the Alignment in February 2011 and Wellington Dam Rd/Alcoa Back Rd to the east (Figure 1; Appendix 1). *Lomandra whicherensis* was not recorded on the east side of Wellington Dam Rd.

Lomandra whicherensis was also recorded in Alignment 1 on the north side of the Coalfields Hwy, just east of Alcoa Back Rd (Figure 1; Appendix 1). While the section of corridor between this eastern record and the large stands further west was not searched, the occurrence in this part of Alignment 1 suggests that *Lomandra whicherensis* would most likely be scattered along this section of corridor.

3.2 *Lomandra whicherensis* stands in conservation estate

More than 600 *Lomandra whicherensis* plants were recorded along the 7 transect lines in conservation estate (Wellington NP) (Figure 1; Appendix 1). *Lomandra whicherensis* plants were recorded along all 7 transect lines (covering an east-west distance of almost 2 kilometres), and from points up to 900 metres from the Alignment 2 corridor. All of the conservation estate transects were in gravelly lateritic soils (soil landscape subsystem 255DpDWi, Figure 2). The distribution of the *Lomandra whicherensis* recordings and the associated Soil Landscape unit suggest that the taxon may have a more extensive distribution in the Wellington NP.

While most of the recordings in this survey were from higher in the landscape, *Lomandra whicherensis* was also recorded on lower slopes.

3.3 Other stands of *Lomandra whicherensis* in the region

Lomandra whicherensis records were confirmed at all four locations visited that were based on sites near the extremities of recordings made by Eleanor Bennett in 2009 (E. Bennett, *pers. comm.*) (Figure 1 and Appendix 1). Many *Lomandra whicherensis* locations were recorded while walking from the parked car over varying distances to the given site locations (Appendix 1) and *Lomandra whicherensis* was scattered, and in parts abundant, in these areas. The four localities visited were about 4 to 5 kilometres apart in both a North-South and East-West direction. Eleanor Bennett reported many records of *Lomandra whicherensis* from the area adjacent and between these four sites. The four sites and observed surrounds, had gravelly lateritic soils and were high in the landscape.

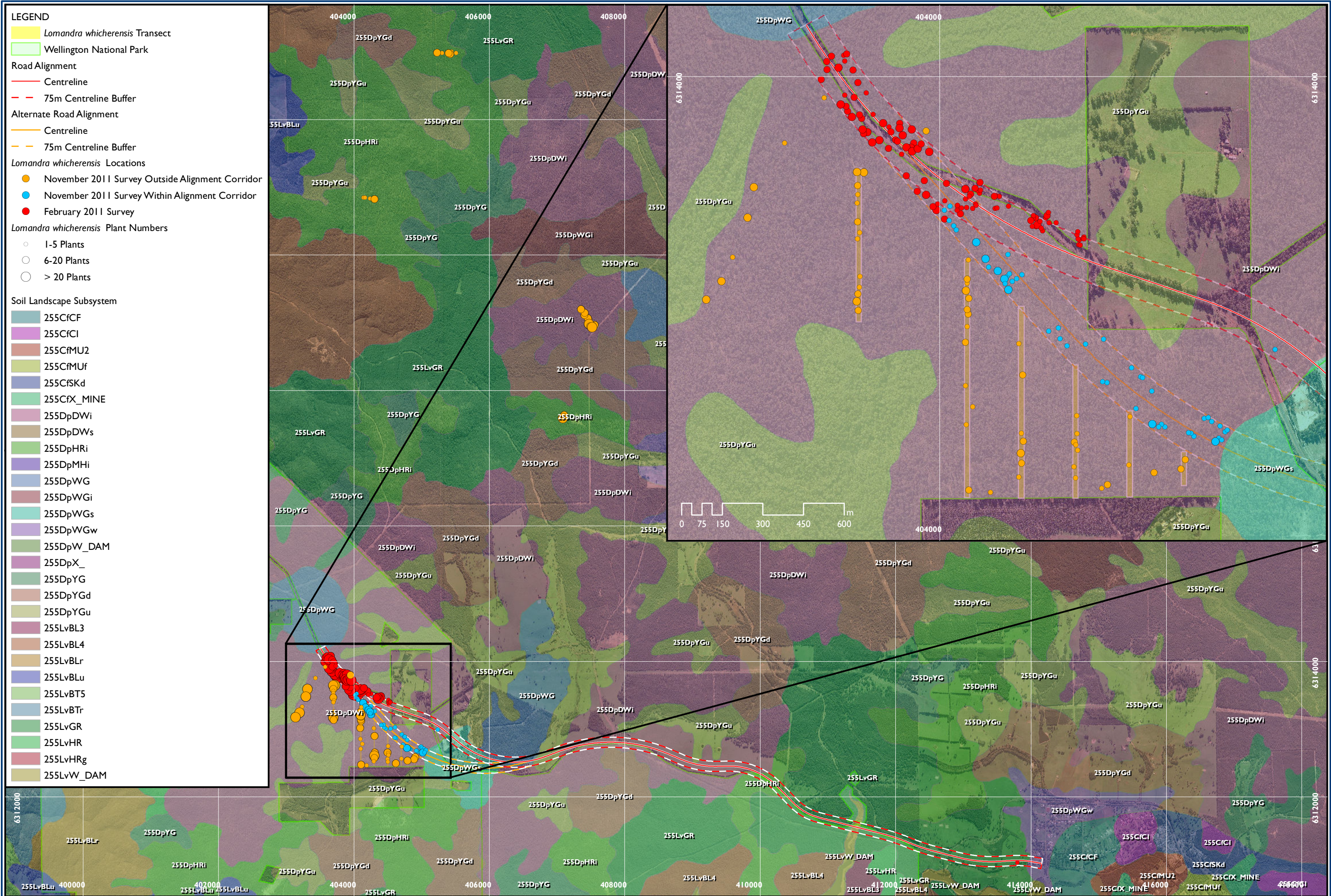
Mike Hislop and Rob Davis (*pers. comm.*, Western Australian Herbarium) confirmed that they had collected what they now believe to be *Lomandra whicherensis* at the parking area at the base of Wellington Dam about 15 years ago. The specimen was sent to a DEC botanist, but it appears

that the specimen has not been vouchered since. Time did not allow for a search for *Lomandra whicherensis* at the reported Wellington Dam location during this survey.

3.4 Collections of *Lomandra whicherensis*

Eleven collections were made of *Lomandra whicherensis* during the survey, including collections of three female plants (Appendix 1). One collection was made at each of the four Eleanor Bennett sites, five collections were made from four of the seven transect lines and one collection was made from the surveyed section of each of the two Alignment corridors surveyed.

Voucher specimens will be lodged with the Western Australian Herbarium.



4.0 CONCLUSIONS

The following conclusions can be made from the *Lomandra whicherensis* survey:

- i. The *Lomandra whicherensis* stands in the Alignments are now known to extend from the western end of the proposed Alignments 1 and 2 to Wellington Dam Rd (and its extension north of the current Coalfields Highway, Alcoa Back Rd).
- ii. *Lomandra whicherensis* is now known to occur over an extensive area and in significant numbers, in the Wellington NP outside the proposed alignments. As such the *Lomandra whicherensis* population in the Wellington NP could be considered secure from impacts from the proposed works.
- iii. *Lomandra whicherensis* probably has a considerable range in the locality of the proposed Coalfields Highway Alignments, having been found to be scattered to abundant at and around four locations between 4 and 9 kilometres north of the Alignment corridors and associated with lateritic soils that occur widely in the Alignment area.

5.0 ACKNOWLEDGEMENTS

Field work and reporting were undertaken by Brian Morgan. Glenn Yeatman from the RPS Busselton office coordinated the project and provided Health and Safety support. GIS maps presented in the report were prepared by Hisayo Thornton and Simon Crofts from RPS Perth.

6.0 REFERENCES

Morgan, B. (2011). Level 1 flora and vegetation survey of the proposed Coalfields Highway realignment. Unpublished report prepared for RPS Group PL, Busselton.

APPENDICES

APPENDIX ONE. All locations of *Lomandra whicherensis* recorded during the various Coalfields Highway realignment surveys.

Location	Location coordinates (WGS84)		Site/ Collctn Nos	Nos of plants	Notes
	Eastng	Northng			
CH Algnmt Feb 2011	413797	6311032	CHG24	1	Nth side of Hwy, eastern end of corridor on Hwy verge.
CH Algnmt Feb 2011	404391	6313479	(CHG162)	1	Nth side of Hwy
CH Algnmt Feb 2011	404404	6313460		1	Nth side of Hwy
CH Algnmt Feb 2011	404396	6313486		14	Nth side of Hwy; within 5m radius
CH Algnmt Feb 2011	404400	6313499		4	Nth side of Hwy
CH Algnmt Feb 2011	404429	6313461		1	Nth side of Hwy
CH Algnmt Feb 2011	404513	6313379		1	Nth side of Hwy
CH Algnmt Feb 2011	404518	6313378		3	Nth side of Hwy
CH Algnmt Feb 2011	404515	6313397		1	Nth side of Hwy
CH Algnmt Feb 2011	404510	6313401		1	Nth side of Hwy
CH Algnmt Feb 2011	404506	6313417		1	Nth side of Hwy
CH Algnmt Feb 2011	404509	6313428		3	Nth side of Hwy
CH Algnmt Feb 2011	404532	6313407		2	Nth side of Hwy
CH Algnmt Feb 2011	404529	6313403		1	Nth side of Hwy
CH Algnmt Feb 2011	404532	6313402		1	Nth side of Hwy
CH Algnmt Feb 2011	404379	6313431		1	Sth side of Hwy
CH Algnmt Feb 2011	404355	6313445		1	Sth side of Hwy
CH Algnmt Feb 2011	404360	6313453		36	(within 10m radius); Sth side of Hwy
CH Algnmt Feb 2011	404341	6313447		4	Sth side of Hwy
CH Algnmt Feb 2011	404374	6313441		3	Sth side of Hwy
CH Algnmt Feb 2011	404370	6313465		1	Sth side of Hwy
CH Algnmt Feb 2011	404353	6313479		7	(within 5m radius); Sth side of Hwy
CH Algnmt Feb 2011	404344	6313477		1	Sth side of Hwy
CH Algnmt Feb 2011	404345	6313487		1	Sth side of Hwy
CH Algnmt Feb 2011	404336	6313468		7	(within 5m radius); Sth side of Hwy
CH Algnmt Feb 2011	404253	6313522		1	Sth side of Hwy
CH Algnmt Feb 2011	404219	6313558		4	on edge of bush adjacent to road verge; Sth side of Hwy
CH Algnmt Feb 2011	404201	6313557		17	to 404166E, 6313574N (bush adjacent to road verge); Sth side of Hwy
CH Algnmt Feb 2011	404204	6313514		2	Sth side of Hwy
CH Algnmt Feb 2011	404211	6313515		5	5m radius; Sth side of Hwy
CH Algnmt Feb 2011	404017	6313474		11	5m radius; Sth side of Hwy
CH Algnmt Feb 2011	404076	6313493		8	5m radius; Sth side of Hwy
CH Algnmt Feb 2011	404064	6313506		5	5m radius; Sth side of Hwy

CH Algnmt Feb 2011	404066	6313520		2	Sth side of Hwy
CH Algnmt Feb 2011	404080	6313515		2	Sth side of Hwy
CH Algnmt Feb 2011	404099	6313517		3	5m radius; Sth side of Hwy
CH Algnmt Feb 2011	404121	6313514		4	5m radius; Sth side of Hwy
CH Algnmt Feb 2011	404132	6313530		1	Sth side of Hwy
CH Algnmt Feb 2011	404134	6313526		2	Sth side of Hwy
CH Algnmt Feb 2011	404146	6313570		3	Sth side of Hwy
CH Algnmt Feb 2011	404140	6313580		1	Sth side of Hwy
CH Algnmt Feb 2011	404150	6313581		4	adj. to Hwy verge; Sth side of Hwy
CH Algnmt Feb 2011	404131	6313588		10	5m radius; Sth side of Hwy
CH Algnmt Feb 2011	404114	6313566		12	10m radius; Sth side of Hwy
CH Algnmt Feb 2011	404109	6313557		5	10m radius; Sth side of Hwy
CH Algnmt Feb 2011	404094	6313548		5	10m radius; Sth side of Hwy
CH Algnmt Feb 2011	404065	6313525		4	10m radius; Sth side of Hwy
CH Algnmt Feb 2011	403988	6313506		22	10m radius; Sth side of Hwy
CH Algnmt Feb 2011	403975	6313519		14	10m radius; Sth side of Hwy
CH Algnmt Feb 2011	403992	6313531		3	10m radius; Sth side of Hwy
CH Algnmt Feb 2011	404018	6313541		4	10m radius; Sth side of Hwy
CH Algnmt Feb 2011	404095	6313585		>43	10m radius; Sth side of Hwy
CH Algnmt Feb 2011	404025	6313606		12	10m radius; Sth side of Hwy
CH Algnmt Feb 2011	403950	6313564		26	10m radius; Sth side of Hwy
CH Algnmt Feb 2011	403917	6313576		8	10m radius; Sth side of Hwy
CH Algnmt Feb 2011	403943	6313616		6	10m radius; Sth side of Hwy
CH Algnmt Feb 2011	403876	6313634		7	10m radius; Sth side of Hwy
CH Algnmt Feb 2011	403858	6313714		3	10m radius; Sth side of Hwy
CH Algnmt Feb 2011	403811	6313734		9	10m radius; Sth side of Hwy
CH Algnmt Feb 2011	403777	6313765		>34	10m radius; Sth side of Hwy
CH Algnmt Feb 2011	403750	6313757		32	10m radius; Sth side of Hwy
CH Algnmt Feb 2011	403733	6313795		≥21	10m radius; Sth side of Hwy
CH Algnmt Feb 2011	403719	6313789		10	10m radius; Sth side of Hwy
CH Algnmt Feb 2011	403715	6313805		≥24	10m radius; Sth side of Hwy
CH Algnmt Feb 2011	403711	6313845		7	10m radius; Sth side of Hwy
CH Algnmt Feb 2011	403704	6313859		≥12	10m radius; Sth side of Hwy
CH Algnmt Feb 2011	403675	6313852		≥25	10m radius; Sth side of Hwy
CH Algnmt Feb 2011	403660	6313872		7	10m radius; Sth side of Hwy
CH Algnmt Feb 2011	403654	6313891	(CHG170)	12	10m radius; Sth side of Hwy
CH Algnmt Feb 2011	403634	6313897		≥38	10m radius; Sth side of Hwy
CH Algnmt Feb 2011	403649	6313931		5	10m radius; Sth side of Hwy
CH Algnmt Feb 2011	403562	6313989		9	10m radius; Sth side of Hwy
CH Algnmt Feb 2011	403583	6314025		12	10m radius; Sth side of Hwy
CH Algnmt Feb 2011	403582	6314055		6	10m radius; Sth side of Hwy
CH Algnmt Feb 2011	403600	6314075		≥17	10m radius; Nth side of Hwy
CH Algnmt Feb 2011	403645	6314079		5	10m radius; Nth side of Hwy
CH Algnmt Feb 2011	403656	6314084		8	10m radius; Nth side of Hwy
CH Algnmt Feb 2011	403649	6314057		2	10m radius; Nth side of Hwy
CH Algnmt Feb 2011	403626	6314033		≥25	10m radius; Nth side of Hwy
CH Algnmt Feb 2011	403680	6314024		9	10m radius; Nth side of Hwy
CH Algnmt Feb 2011	403698	6313979		6	10m radius; Nth side of Hwy
CH Algnmt Feb 2011	403684	6313924		7	10m radius; Nth side of Hwy

CH Algnmt Feb 2011	403728	6313940		5	10m radius; Nth side of Hwy
CH Algnmt Feb 2011	403754	6313861		1	10m radius; Nth side of Hwy
CH Algnmt Feb 2011	403791	6313827		≥52	20m radius; Nth side of Hwy
CH Algnmt Feb 2011	403812	6313815		1	10m radius; Nth side of Hwy
CH Algnmt Feb 2011	403852	6313827		7	10m radius; Nth side of Hwy
CH Algnmt Feb 2011	403851	6313810		≥45	10m radius; Nth side of Hwy
CH Algnmt Feb 2011	403819	6313796		20	10m radius; Nth side of Hwy
CH Algnmt Feb 2011	403836	6313767		20	10m radius; Nth side of Hwy
CH Algnmt Feb 2011	403844	6313760		9	10m radius; Nth side of Hwy
CH Algnmt Feb 2011	403863	6313784		≥29	10m radius; Nth side of Hwy
CH Algnmt Feb 2011	403897	6313804		≥25	10m radius; Nth side of Hwy
CH Algnmt Feb 2011	403904	6313755		18	10m radius; Nth side of Hwy
CH Algnmt Feb 2011	403893	6313736		24	10m radius; Nth side of Hwy
CH Algnmt Feb 2011	403876	6313739		≥50	10m radius; Nth side of Hwy
CH Algnmt Feb 2011	403898	6313723		≥42	10m radius; Nth side of Hwy
CH Algnmt Feb 2011	403919	6313733		≥63	10m radius; Nth side of Hwy
CH Algnmt Feb 2011	403932	6313751		13	10m radius; Nth side of Hwy
CH Algnmt Feb 2011	403961	6313721		23	10m radius; Nth side of Hwy
CH Algnmt Feb 2011	404148	6313609		8	10m radius; Nth side of Hwy
CH Algnmt2 Nov 2011	404938	6312671	CHSG80	1	
CH Algnmt2 Nov 2011	404928	6312683		1	
CH Algnmt2 Nov 2011	404918	6312685		4	
CH Algnmt2 Nov 2011	404831	6312706		1	
CH Algnmt2 Nov 2011	404819	6312717		1	
CH Algnmt2 Nov 2011	404808	6312707		2	
CH Algnmt2 Nov 2011	404785	6312718		8	
CH Algnmt2 Nov 2011	404724	6312774		1	
CH Algnmt2 Nov 2011	404617	6312870		2	
CH Algnmt2 Nov 2011	404600	6312874		1	
CH Algnmt2 Nov 2011	404469	6313006		5	
CH Algnmt2 Nov 2011	404444	6313032		3	
CH Algnmt2 Nov 2011	404437	6313072		1	
CH Algnmt2 Nov 2011	404402	6313060		2	
CH Algnmt2 Nov 2011	404253	6313213		8	
CH Algnmt2 Nov 2011	404267	6313244		5	
CH Algnmt2 Nov 2011	404283	6313253		3	
CH Algnmt2 Nov 2011	404303	6313268		3	
CH Algnmt2 Nov 2011	404538	6313012		2	
CH Algnmt2 Nov 2011	404605	6313031		1	
CH Algnmt2 Nov 2011	404707	6312925		1	
CH Algnmt2 Nov 2011	404741	6312892		1	
CH Algnmt2 Nov 2011	404749	6312889		5	
CH Algnmt2 Nov 2011	404783	6312840		1	
CH Algnmt2 Nov 2011	404976	6312739		3	
CH Algnmt2 Nov 2011	404991	6312742		5	
CH Algnmt2 Nov 2011	405004	6312727		5	
CH Algnmt2 Nov 2011	405034	6312711		4	
CH Algnmt2 Nov 2011	405030	6312665		1	
CH Algnmt2 Nov 2011	405017	6312653		12	
CH Algnmt2 Nov 2011	405054	6312689		1	

CH Algnmt2 Nov 2011	405061	6312695		2	
CH Algnmt2 Nov 2011	405041	6312659		1	
CH Algnmt2 Nov 2011	404251	6313342		1	
CH Algnmt2 Nov 2011	404037	6313522		5	
CH Algnmt2 Nov 2011	404016	6313507		2	
CH Algnmt2 Nov 2011	404034	6313468		2	
CH Algnmt2 Nov 2011	404051	6313449		1	
CH Algnmt2 Nov 2011	404061	6313434		1	
CH Algnmt2 Nov 2011	404135	6313389		10	
CH Algnmt2 Nov 2011	404169	6313326		7	
CH Algnmt2 Nov 2011	404180	6313297		4	
CH Algnmt2 Nov 2011	404214	6313287		8	
CH Algnmt2 Nov 2011	404248	6313262		2	
CH Algnmt2 Nov 2011	404256	6313271		2	
CH Algnmt2 Nov 2011	404238	6313252		17	
CH Algnmt2 Nov 2011	404241	6313236		5	
CH Algnmt1 Nov 2011	405238	6312992	CHSG95 (female)	3	
Transect 404300E	404291	6313014		4	
Transect 404300E	404306	6312898		14	
Transect 404300E	404301	6312683	CHSG86	4	
Transect 404300E	404308	6312653		9	
Transect 404300E	404299	6312610		23	
Transect 404300E	404302	6312573		9	
Transect 404300E	404291	6312522		5	
Opportunistic (tran)	404187	6312465		1	
Transect 404100E	404107	6312474	CHSG87	9	
Transect 404100E	404098	6312715		1	
Transect 404100E	404121	6312781		5	
Transect 404100E	404095	6312859		2	
Transect 404100E	404095	6313019		6	
Transect 404100E	404101	6313077		2	
Transect 404100E	404105	6313123		6	
Transect 404100E	404101	6313140		6	
Transect 404100E	404107	6313181		9	
Transect 404100E	404097	6313209		28	
Transect 404100E	404101	6313238		2	
Transect 404100E	404101	6313251		7	
Transect 404100E	404105	6313323		3	
Transect 404900E	404906	6312586		11	
Transect 404900E	404890	6312552		11	
Transect 404700E	404698	6312566		3	
Transect 404700E	404702	6312745		5	
Transect 404500E	404505	6312748		5	
Transect 404500E	404506	6312682		4	
Transect 404500E	404497	6312651		7	
Transect 404500E	404502	6312641		4	
Transect 404500E	404508	6312620	CHSG88	3	

Transect 404500E	404495	6312559		2	
Transect 404500E	404501	6312519		5	
Opportunistic (tran)	404597	6312481		5	
Opportunistic (tran)	404619	6312494		8	
Opportunistic (tran)	404791	6312538		13	
Transect Ridge Road	403950	6313800		11	
Transect Ridge Road	403427	6313754		1	
Transect Ridge Road	403313	6313592	CHSG92	23	
Transect Ridge Road	403290	6313479		36E, 27W	
Transect Ridge Road	403235	6313333		4	
Transect Ridge Road	403194	6313245	CHSG93 (female)	48E, 37W	
Transect Ridge Road	403138	6313177		27E, 2W	
Opportunistic	403573	6313921		4	
Transect 403700E	403720	6313646		40	
Transect 403700E	403694	6313647		35	
Transect 403700E	403697	6313597		17	
Transect 403700E	403696	6313565		3	
Transect 403700E	403694	6313533		3	
Transect 403700E	403696	6313464		11	
Transect 403700E	403704	6313425		1	
Transect 403700E	403695	6313401		3	
Transect 403700E	403705	6313262		1	
Transect 403700E	403703	6313222		5	
Transect 403700E	403698	6313197		15	
Transect 403700E	403693	6313170		22	
Transect 403700E	403699	6313137		10	
EL4	407555	6318969		16	
EL4	407535	6318978		5	
EL4	407529	6318993		3	
EL4	407465	6319048	CHSG89	20	
EL4	407454	6319070		17	
EL4	407404	6319112		8	
EL4	407410	6319148		8	
EL4	407353	6319198		>10	
EL4 Opportunistic	407430	6319007		1	
EL4 Opportunistic	407471	6318984		33	
EL4 Opportunistic	407489	6318948		>10	
EL4 Opportunistic	407520	6318933		>30	
EL2	407105	6317640		>15	
EL2	407089	6317591	CHSG90	>40	
EL1	405509	6322988		4	
EL1	405424	6322967	CHSG91	8	
EL1	405397	6322984		>10	
EL1	405298	6322988		2	
EL1	405229	6322986		13	

EL3	404140	6320849		1	
EL3	404159	6320850		4	
EL3	404237	6320837		5	
EL3	404304	6320822	CHSG92 (?f)	17	

APPENDIX 3

Flora and Vegetation Survey Report (Ekologica 2012)

Level 1 Flora and Vegetation Assessment for a proposed Upgrade of the Coalfields Highway (SLK 16-SLK 26.5)

Prepared for RPS Group on behalf of Main Roads WA

December 2012

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Contents

Summary	2
1. Introduction	5
2. Scope and Objectives	5
3. Regulatory Context	6
3.1. Wildlife Conservation Act (1950)	6
3.2. Environmental Protection and Biodiversity Conservation Act (1999)	6
3.3. DEC Priority Species List.....	6
4. Climate	7
5. Landscape and Soils	7
6. Vegetation	8
6.1. Regional Vegetation Mapping.....	8
6.2. Regional Vegetation Types.....	8
6.3. Previous Vegetation Mapping in the Survey Area.....	9
6.4. Vegetation Reservation and Conservation	9
6.5. Threatened and Priority Ecological Communities	9
7. Threatened and Priority Flora.....	9
8. Methods	0
9. Results and Discussion	1
9.1. Flora, including Rare Flora and Disjunct Flora.....	1
9.1.1. <i>Lomandra whicherensis</i> (Priority 1)	1
9.1.2. <i>Millotia tenuifolia</i> var. <i>laevis</i> (Priority 2).....	2
9.1.3. <i>Sphenotoma capitata</i> (a disjunct species)	2
9.2. Plant Communities	2
9.2.1. Vegetation of the 255DpWGs Soil-landscape Subsystem	3
9.2.2. The Vegetation of a Creekline Draining into Wellington Dam	3
9.3. Vegetation Condition.....	2
9.4. Introduced Species and Weeds	0
9.5. Threatened and Priority Ecological Communities	0
9.6. Poorly Represented Vegetation Complexes and Communities	0
9.7. The Requirement for Further Dieback Survey	0
10. Recommendations	0
11. References	2
Appendix A: Vegetation releves and Assessment Points.....	5
Appendix B: List of vascular species identified in survey area.	0
Appendix C: Vegetation Association Descriptions.....	0
Appendix D. Photographs of vegetation associations in the survey area.....	0

Summary

Main Roads Western Australia proposes to undertake roadwork to improve safety of a section of the Coalfields Highway between SLK 16 and SLK 26.5. The roadworks will include four realignments to existing winding sections and increasing the width of the highway. A flora and vegetation survey was carried out in early October 2012 to determine the presence of rare flora and to define and map vegetation units with the proposed project corridor. The survey built on the work done by Morgan (2011, 2012a, 2012b) and others in a previous proposed project corridor.

Two hundred and fourteen (214) species of native flora were identified during the survey, in addition fifty four (54) species of introduced flora were recorded. Three of the species were of conservation significance; two Priority taxa, *Lomandra whicherensis* (P1) and *Millotia tenuifolia* var. *laevis* (P2) and one geographically disjunct taxon, *Sphenotoma capitatum*. Each of these had been found during the previous survey.

Individuals of *Lomandra whicherensis* found during the present survey were all within the area of its previously identified occurrence. The surveys by Morgan (2011, 2012a) determined that the species was present within an area covering about 160 ha within and surrounding the project corridor, some of which is within Wellington National Park.

Plants presumed to be the Priority 2 taxon *Millotia tenuifolia* var. *laevis* were found at two sites near where it had been identified by Morgan (2011). It was too early in the plants' development at the time of survey to be sure that the individuals belonged to the Priority form of the taxon. *M. tenuifolia* var. *laevis* can only be separated from its close relative *M. tenuifolia* var. *tenuifolia* using the shape of the seed, and is consequently likely to be under-collected and more common than herbarium records indicate.

Two *Sphenotoma capitata* plants were found in the same location as previously reported by Morgan (2011). These individuals are near the northern limit of the known distribution of this species. Disjunct populations may be important in the maintenance or ongoing development of genetic diversity in species. The true significance of the Coalfields Highway population of *S. capitata* could only be determined by genetic testing and comparisons, and perhaps further searching in the adjacent area immediately south of Coalfields Highway.

Four broad vegetation groups containing eleven vegetation associations in total were mapped in the Coalfields Highway survey area. The four broad vegetation formations were;

- ❖ *Eucalyptus patens* (Blackbutt) mixed eucalypt forests on lower valley slopes;
- ❖ *Eucalyptus marginata* subsp. *marginata* (Jarrah)-*Corymbia calophylla* (Marri) woodlands to open forests on gravelly slopes of lateritic ridges;
- ❖ *Eucalyptus marginata* subsp. *marginata* (Jarrah)-*Corymbia calophylla* (Marri) woodlands on sandy soils on lower slopes and valley floor; and
- ❖ Dampland vegetation.

The eastern one third of the survey area was dominated by *Eucalyptus patens* (Blackbutt) - *Eucalyptus marginata* subsp. *marginata* (Jarrah)-*Corymbia calophylla* (Marri) open forest on loams and gravelly loams of the Lowden Valleys soil-landscape system . The western two thirds of the survey area mostly had a covering of *Eucalyptus marginata* subsp. *marginata* (Jarrah)-*Corymbia calophylla* (Marri) woodlands to open forests on gravelly slopes of lateritic ridges of the Dwellingup (255DpDWi) soil-landscape subsystem. A third landform element, the relatively poorly drained soils of the Wilga soil-landscape subsystem, particularly the sandy soil phase of the subsystem (255DpWGs) carried the greatest diversity of vegetation associations within the survey area.

Five vegetation associations are associated with the 255DpWGs (“grey sands”) subsystem. Because of concerns by the local office of the Department of Environment and Conservation about the regional distribution and potential rarity of the 255DpWGs vegetation, a survey was commissioned into its floristic and plant community values and regional significance. This survey (Morgan, 2012b) demonstrated that, while the grey sands area did not contain flora of conservation significance, it contained a range of soils and vegetation types, some of which may be regionally restricted.

Vegetation along a creekline that flows into an arm of Wellington Dam and which is “straddled” by a proposed new alignment for the Coalfields Highway was considered by Harewood (2012) to contain the only substantial area of “significant fauna habitat” in the survey area. The creekline zone contains large old Marri and Blackbutt trees, a number of them with hollows. Vegetation along the creekline appears to have not been burnt for a relatively long period. No flora of especial conservation significance grows along the creek, except perhaps for *Lepidosperma persecans*. According to herbarium records this is a disjunct population of the species. However an expert in the genus considers that other regional populations of *Lepidosperma*, currently identified as the common and widespread *L. effusum*, are actually *L. persecans* – and consequently that though the creekline population is near the edge of the species’ range, it is not necessarily disjunct.

Of the approximately 73 ha of remnant vegetation in the survey area almost 80% was in Good or better condition. About 30%, mainly “Blackbutt mixed eucalypt forests on lower valley slopes” was in Very Good-Excellent condition, with low *Phytophthora* impact and little weed invasion. However, much of the “Jarrah-Marri woodlands to open forests on gravelly slopes of lateritic ridges” west of the Wellington Dam turnoff has been impacted by *Phytophthora* dieback and heavy logging, and consequently was rated only as Good – Very Good.

One P4 Declared Plant, Blackberry (*Rubus anglocandicans*), was found in the survey area. The classification of P4 means that the spread of the plant species beyond where it currently occurs is to be prevented. Blackberry is mainly found in the Blackbutt mixed eucalypt open forest in the eastern part of the survey area. Most of the other introduced species were not considered to be of environmental significance, although *Watsonia meriana*, *Leptospermum laevigatum* (Victorian Ti-tree) and *Lavandula stoechas* (Lavender) are recognized environmental weeds.

None of the vegetation associations identified within the survey area corresponds to a threatened or priority ecological community. Some of the vegetation associations occurring on the 255DpWGs soil-landscape subsystem may be regionally restricted based on work by Morgan (2012b). However mapping of

the Jarrah forest vegetation at an adequate level of detail is lacking, and the degree of rarity of plant communities or associations occurring on particular soil-landscape *subsystems* (in contrast to the more broadscale soil-landscape *systems*) cannot be assessed quantitatively.

A *Phytophthora* disease survey in April 2011 found that at least 60% of the survey area was infested. Unfortunately a large proportion of the survey area at that time could not be assessed for the presence of dieback because of a recent prescribed burn west of Wellington Dam Road, and was excluded from the survey. The evidence of biomass reduction, particularly in the understorey, supports a conclusion that most if not all of the Jarrah-Marri forest west of Wellington Dam is infested and exhibiting a high impact of the disease. Most of the Blackbutt mixed eucalypt open forest in the eastern part of the survey area was considered to be “uninterpretable” at the time of the 2011 survey and this situation will not change. However, given the disturbance history of the area and the fact that it is downslope from known infested areas, it is highly likely to be infested also.

Observations made during the present survey confirm the conclusions of the 2011 dieback assessment that the only substantial part of the survey area not infested with disease is just west of Gastaldi Road. Except to the extent that the area classified as “uninfested” (5.1 ha) may have reduced since April 2011 due to further spread of the disease it is not considered that the dieback situation has changed significantly in the interim and a further dieback assessment is considered unnecessary.

The following recommendations are made regarding the proposed roadworks;

- ❖ Minimise the area of impact on *Lomandra whicherensis* (P1) populations,
- ❖ Generally minimize the width of works in the Wellington National Park and large areas of remnant bushland in Good or better condition.
- ❖ Minimise the area of works in the dampland vegetation units (EmCcBI and EmCcTI) as this vegetation is considered to be poorly reserved,
- ❖ If possible the small population of *Sphenotoma capitata* should be conserved during the proposed roadworks.

1. Introduction

Main Road Western Australia proposes to undertake roadwork to improve safety of a section of the Coalfields Highway between SLK 16 and SLK 26.5. The roadworks will include four realignments to existing winding sections, improving overtaking opportunities, increasing road width and culvert works and drainage improvements (RPS, 2011a). A preferred alignment has now been chosen after previous consideration of an alternate route for much of the western section of the proposed realignment. This preferred alignment forms the basis for the “survey area” as shown in Figure 1.

A number of environmental and other assessments have been carried out with regard to the proposed realignment and are listed in RPS (2012). Included in these are three assessments relating to the flora and vegetation of the proposed realignment (Morgan, 2011, 2012a, 2012b).

A Level 1 assessment of the flora and vegetation of the proposed realignment (which included the alternative route for the western end) was carried out in late November and early December 2010 (Morgan, 2011). Following on from this initial investigation were further surveys to address the distribution of the Priority 1 species *Lomandra whicherensis* in the western part of the proposed realignment (Morgan, 2012a) and the vegetation and flora of an occurrence of grey sand at the Wellington Dam turnoff (Morgan, 2012b).

Because the previous Level 1 flora and vegetation assessment had been conducted in late spring 2010 (28th November to 1st December) and summer 2011 (26th - 28th February) a further Level 1 assessment was required that would take place in early/mid-spring. Ekologica Pty Ltd was engaged by RPS Group to carry out a second Level 1 assessment.

2. Scope and Objectives

The objective of this assessment was to survey the proposed alignment for the Coalfields Highway upgrade in early/mid spring, in accordance with the EPA *Guidance for the Assessment of Environmental Factors No 51 – Terrestrial Flora and Vegetation Surveys for the Environmental Impact Assessment* in Western Australia (EPA, 2004), to assess the flora and vegetation values. In particular to determine the presence of the following within the survey area;

- Declared Rare Flora, Priority Flora or other flora of conservation significance,
- Threatened or Priority Ecological Communities, or other communities of conservation significance,
- Any Matter of National Environmental Significance occurs, with regard to flora or vegetation communities.

Particular tasks to be carried out in achieving and reporting on these objectives were to include;

- ❖ compiling background information on the flora and vegetation already known to occur in the survey area and its locality;
- ❖ undertaking a survey of the project corridor that included:
 - compiling a list of flora in the survey area;

- targeting particular habitats where significant flora might be found;
- recording any significant flora occurring in the survey area;
- describing and mapping the vegetation in the survey area and mapping the vegetation condition;
- assessing flora and vegetation values in the survey area; and
- reporting the survey results

Specific tasks arising out of previous biological surveys of the study area included;

- ❖ making specific reference to the occurrence of *Sphenotoma capitata* and its significance (see Morgan, 2011, RPS, 2011),
- ❖ providing feedback on the requirement for further dieback studies (last was done in April 2011- see RPS, 2011),
- ❖ making specific reference to the “section of creekline that falls within the ‘ultimate’ alignment near Wellington Dam” (see Harewood, G., 2011, page 21).

3. Regulatory Context

Species of flora and fauna are defined as Declared Rare (DRF) or Priority (PF) conservation status where their populations are restricted geographically or threatened by local processes. The Department of Environment and Conservation (DEC) and Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) recognize these threats of extinction and consequently apply regulations towards population and species protection.

3.1. *Wildlife Conservation Act (1950)*

DRF species are gazetted under subsection 2 of section 23F of the *Wildlife Conservation Act (1950)* (Wildlife Cons Act) and therefore it is an offence to “take” or damage rare flora without Ministerial approval. Section 23F of the Wildlife Cons Act defines “to take” as “... to gather, pick, cut, pull up, destroy, dig up, remove or injure the flora or to cause or permit the same to be done by any means (Government of Western Australia, 2010).

3.2. *Environmental Protection and Biodiversity Conservation Act (1999)*

Flora of national or international significance may also be listed as Matters of National Environmental Significance (MNES) under the *Environmental Protection and Biodiversity Conservation Act (1999)* (EPBC Act). An EPBC Act Protected Matters Report on threatened flora and communities can be generated to confirm the Commonwealth listings for these values (DSEWPC, 2012a).

3.3. *DEC Priority Species List*

Priority List Flora are under consideration for declaration as “rare flora”, but are in urgent need of further survey (Priority One to Three) or require monitoring every 5-10 years (Priority Four). The definitions of Declared Rare and the four Priority ratings under the Wildlife Cons Act (DEC, 2012a) are shown below.

- R Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection and have been gazetted as such.
- P1 Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey
- P2 Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.
- P3 Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora', but are in need of further survey.
- P4 Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years.

Ecological communities may also be listed as threatened under the Wildlife Cons Act (DEC, 2010), given Priority status (DEC, 2012b) as listed as MNES (DSEWPAC, 2012b).

4. Climate

The survey area lies in the "temperate" climatic zone (using the Koeppen climatic system), with hot, dry summers and cool, wet winters. Rainfall till the end of November for Collie was 693 mm, compared to an average of 917 mm for this period. However, September was substantially wetter than average, which ensured a good flowering period for undertaking the survey.

5. Landscape and Soils

The western two thirds of the survey area is situated on the Darling Plateau soil-landscape system and the eastern third on the Lowden Valleys system of the Western Darling Range Zone (Tille, 1996). The Western Darling Range Zone is comprised of:

Moderately dissected lateritic plateau on granite with deeply incised valleys; includes the Darling Scarp on the western margin. Soils are formed in laterite, lateritic colluvium, granite weathered in-situ and gneiss.

The Darling Plateau system comprises a lateritic plateau with duplex sandy soils, loamy gravels and wet soils and the Lowden Valleys system is comprised of deep gneissic valleys with loamy earths, loamy duplex soils, gravels and stony soils. Within each soil-landscape systems are a number of sub-systems which are areas of characteristic landforms features containing definite suites of soils (Tille, 1996). Soil-landscape subsystems present in the survey area are;

- ❖ 255DpDWi: Dwellingup subsystem of the Darling Plateau system (ironstone gravel phase);
 - Broad undulating divides with gravels

- ❖ 255DpWG: Wilga subsystem of the Darling Plateau system (also 255DpWGs: sandy soil phase);
 - Gently undulating, poorly drained terrain formed on sedimentary deposits with gravels and sands
- ❖ 255DpYGu: Yarragil subsystem of the Darling Plateau system (upstream valleys/flats phase);
 - Minor swampy valleys with gravels and loams
- ❖ 255DpHRi: Hester subsystem of the Darling Plateau system (ironstone gravel phase);
 - Lateritic and granitic ridges and hill crests with gravels and loams
- ❖ 255LvGR: Grimwade subsystem of the Lowden Valleys system;
 - Moderately incised valleys with low slopes and loams and gravels

6. Vegetation

6.1. Regional Vegetation Mapping

The study area lies in the Dale Botanical Sub District, in the Darling Botanical District of the South West Botanical Province of Western Australia (Beard, 1980). The Dale Botanical Sub District is characterized by *Eucalyptus marginata* (Jarrah) forest on ironstone gravels and *Corymbia calophylla* (Marri)-*Eucalyptus wandoo* (Wandoo) woodlands on loamy soils, with both having a sclerophyll understorey (Beard, 1981).

The vegetation of the Collie-Bunbury area was mapped at a broad structural level by Smith (1974). The whole of the survey area was mapped as “Medium forest; Jarrah-Marri”.

The vegetation of the forest areas of the south west of Western Australia were mapped as part of the Regional Forest Agreement process by Mattiske and Havel (1998). Their mapping was at a vegetation complex level, which are patterns of vegetation mapped at a regional scale based on factors such as landform, soil and climate. The survey area crosses three of these vegetation complexes (Figure 2), viz.:

- ❖ Dwellingup 1 (D1): Open forest of *Eucalyptus marginata* subsp. *marginata*-*Corymbia calophylla* on lateritic uplands in mainly humid and subhumid zones.
- ❖ Murray 1 (My1): Open forest of *Eucalyptus marginata* subsp. *marginata*-*Corymbia calophylla*-*Eucalyptus patens* on valley slopes to woodland of *Eucalyptus rudis*-*Melaleuca raphiophylla* on the valley floors in humid and subhumid zones.
- ❖ Yarragil 1 (Yg1): Open forest of *Eucalyptus marginata* subsp. *marginata*-*Corymbia calophylla* on slopes with mixtures of *Eucalyptus patens* and *Eucalyptus megacarpa* on the valley floors in humid and subhumid zones.

6.2. Regional Vegetation Types

Havel (1975) and Strehlein (1988) developed site-vegetation types for the northern and southern Jarrah forests, respectively. These “site-vegetation types” are characterized by “indicator species” and reflect the influence of soil structure, fertility, water-holding capacity and drainage on the vegetation at a particular site. However, the Coalfields Highway is situated in a “gap” which was not covered by these surveys so

there is not necessarily a good match between their site-vegetation types and the vegetation of the survey area.

6.3. Previous Vegetation Mapping in the Survey Area

As previously mentioned most of the survey area has been previously surveyed and the vegetation mapped at broad formation and association level (Morgan, 2011). Additionally a more intensive survey and mapping was done of the “grey sands” (255DpWGs) area near the junction of the Coalfields Highway with Wellington Dam Road (Morgan, 2012b).

6.4. Vegetation Reservation and Conservation

Mattiske and Havel (2002) reviewed the reservation status of vegetation complexes in the south west. On the basis of the following criteria they found that over one third were poorly reserved;

- 1) < 10% of Pre-European area in proposed and existing formal reserves; and
- 2) <15% in proposed and existing formal and informal reserves.

The Dwellingup (D1) complex is the only one that occurs in the survey area found by Mattiske and Havel (2002) to be poorly reserved. Although it is one of the most wide-spread vegetation complexes, and has 88% of its pre-European extent remaining, only 14.7% is contained in formal and informal reserves. However, it was considered that

“Given the level of reservation, the percentage of the complex remaining, and proposed improvements to forest management practices, the conservation values in this vegetation complex are considered adequately protected.”

6.5. Threatened and Priority Ecological Communities

There are no Threatened Ecological Community occurrences within 10 km of the survey area (GHD, 2010), and although geographic location information for Priority Ecological Communities is not readily available, based on the descriptions in DEC (2012b) there does not appear to be any occurrences within 10 km of the survey area.

7. Threatened and Priority Flora

Two species of Priority listed flora were found during the previous survey (Morgan, 2011). One of these, *Lomandra whicherensis* (P1) was the subject of a further survey to increase knowledge of its distribution and population size within and adjacent to the survey area (Morgan, 2012a). Several hundred plants were found in and adjacent to the survey area.



Figure 1. Location of the survey area.

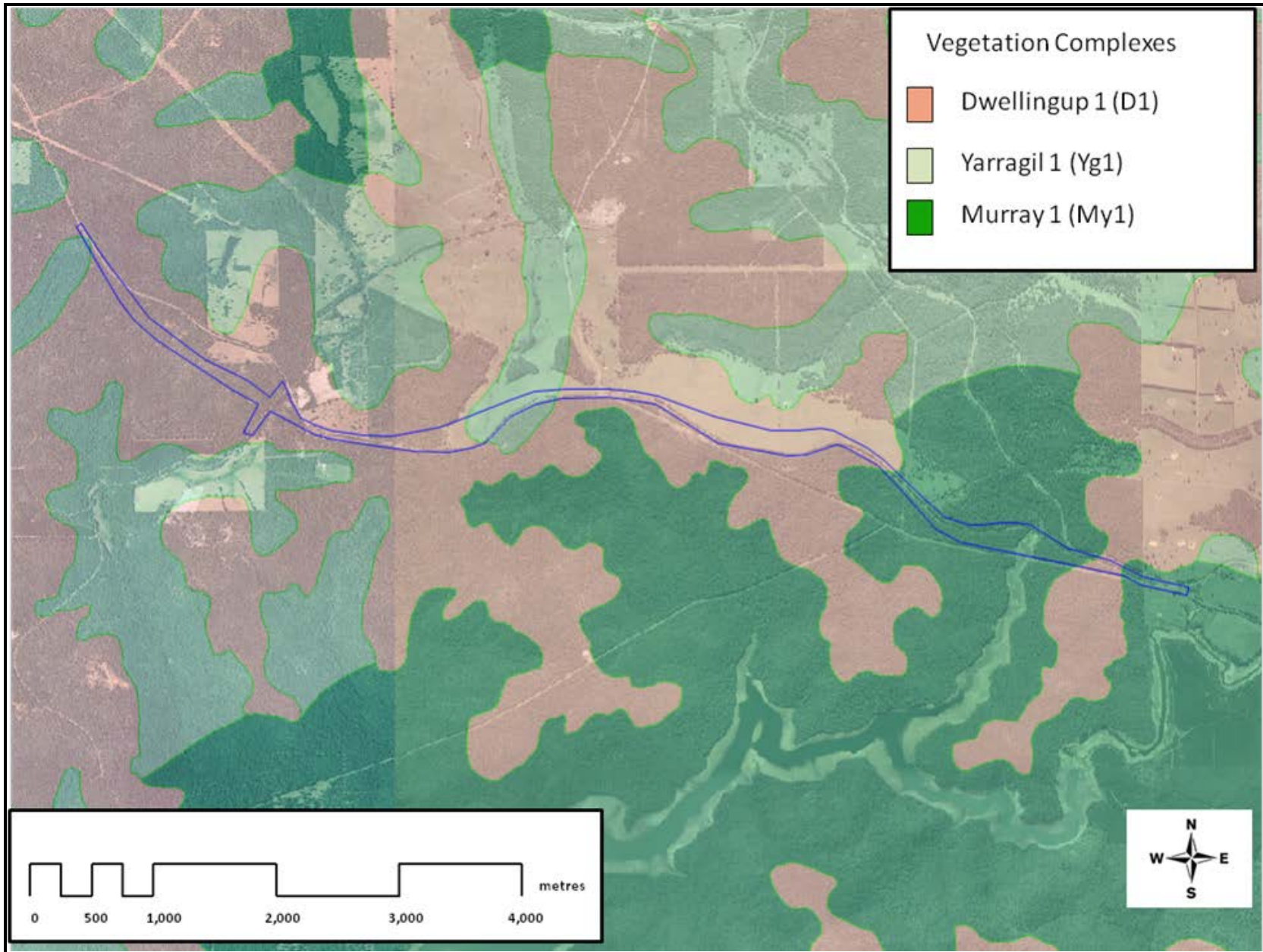


Figure 2. Vegetation complexes.

Taxon	Status	Description, flowering, habitat	Likelihood of occurrence
<i>Acacia cuneifolia</i>	P4	Erect or straggly shrub, 1-3 m high. Fl. yellow, Jul to Oct. Sand, clay or loam over granite. Granite outcrops & hills, rocky watercourses.	LOW. No outcrops or shallow soil over rock in survey area
<i>Acacia oncinophylla</i> subsp. <i>oncinophylla</i>	P3	Shrub, 0.9-2.5 m high, 'minni-ritchi' bark, phyllodes mostly 8-13 cm long, 1-2 mm wide. Fl. yellow, Aug to Oct. Granitic soils.	LOW. No outcrops in survey area
<i>Acacia semitrullata</i>	P4	Slender, erect, pungent shrub, (0.1-)0.2-0.7(-1.5) m high. Fl. cream, white, May-Oct. White/grey sand, sometimes over laterite, clay. Sandplains, swampy areas.	LOW-MODERATE. Preferred habitat of sandplain not present
<i>Grevillea rara</i>	DRF	Dense, prickly shrub, to 2 m high. Fl. white, pink, Oct. Lateritic loam. Creeklines.	MODERATE. Potentially along creek flowing into Wellington Dam.
<i>Grevillea ripicola</i>	P4	Spreading, much-branched, non-lignotuberous shrub, 0.6-2(-3) m high, to 4 m wide. Fl. red, orange, Jan-Apr/Nov-Dec. Sandy clay, clay or gravelly loam. Swampy flats, granite outcrops, along watercourses.	MODERATE. Potential habitat in dampland west of Wellington Dam turnoff
<i>Juncus meianthus</i>	P2	Tufted perennial, herb, 0.05-0.2 m high, to 0.4 m wide. Fl. brown, Nov-Jan. Black sand, sandy clay. Creeks, seepage areas.	MODERATE. Dampland west of Wellington Dam turnoff
<i>Lasiopetalum cardiophyllum</i>	P4	Erect, multi-stemmed shrub, 0.2–0.5 m high. Fl. pink, Aug–Jan. Lateritic gravelly soils, sandy clay. Flats, hillslopes.	MODERATE. Upland lateritic gravels in survey area
<i>Lomandra whicherensis</i>	P1	Tufted rhizomatous herb 20 cm high x 30 cm wide. Flowers yellow with purple stripe, Nov-Dec. Jarrah-Marri forest, lateritic soils, sandy clay.	HIGH. Known populations.
<i>Meeboldina thysanantha</i>	P3	Rhizomatous, perennial, herb (rush-like), 0.4-1 m high. Fl. brown, Dec. Sand. Swamps.	LOW. Only small amount of dampland in survey area.
<i>Millotia tenuifolia</i> var. <i>laevis</i>	P2	Ascending to erect annual, herb, 0.02-0.1 m high. Fl. yellow, Sep to Oct. Granite or laterite soils.	HIGH. Known populations.
<i>Pultenaea skinneri</i>	P4	Slender shrub, 1-2 m high. Fl. yellow, orange, red, Jul-Sep. Sandy or clayey soils. Winter-wet depressions.	LOW/MODERATE. Small amount of dampland in survey area.
<i>Stylidium acuminatum</i> subsp. <i>acuminatum</i>	P1	Rosetted perennial, herb, Leaves oblanceolate. Inflorescence racemose. Fl. yellow, Oct to Dec or Jan. Clayey sand over laterite. Hillslopes, ridges and valleys. Eucalypt forest, open woodland, Agonis shrubland.	MODERATE. Preferred habitat may be present in survey area.
<i>Stylidium rhipidium</i>	P3	Slender annual, herb, ca 0.05 m high. Fl. white, Oct–Nov. Sandy soils. Wet creek flats, swamps, granite outcrops.	LOW/MODERATE. Only small amount of dampland in survey area.
<i>Synaphea hians</i>	P3	Prostrate or decumbent shrub, 0.15-0.6 m high, to 1 m wide. Fl. yellow, Jul-Nov. Sandy soils. Rises.	MODERATE. Near northern limit of range.
<i>Tetratheca parvifolia</i>	P3	Small shrub, 0.2-0.3 m high. Fl. pink, Oct. Jarrah, woodland, wandoo woodland, gravelly soils.	LOW/MODERATE. Gravelly soils present in survey area.
<i>Xanthoparmelia louisii</i>	P2	Lichen, green with black edges. River valleys, rock outcrops.	LOW. No rock outcrops in survey area

Table 1. Declared Rare Flora and Priority Flora known to occur within 15 km of the survey area, together with an assessment of the likelihood of their occurrence in the survey area based on preferred habitat derived from Florabase (DEC, 2012d).

8. Methods

The survey was carried out on 1st, 3rd and 13th October 2012, with a follow-up visit to selected areas on 1st December to pick up late-flowering taxa. The entire survey area was walked, generally in a zigzag pattern, with particular attention being paid to likely habitat for DRF and PLF. A comprehensive list of vascular flora was compiled. Species not able to be determined definitely in the field were photographed or collected for later identification. Taxonomy and conservation status were checked against DEC (2012d, 2012e).

Details of the location and numbers of rare flora found during the survey were recorded. However, because of the previous intensive survey for the Priority species *Lomandra whicherensis* by Morgan (2012a) within and adjacent to the survey area no attempt was made to record and count all individuals within the survey area.

Details of dominant species and vegetation structure, as well as vegetation condition (using the method of Keighery, 1994) were collected at 40 assessment points (Appendix A). The basis of the description and mapping of vegetation in the survey area was the report by Morgan (2011), with some modifications to descriptions and extensions of the mapping based on the current survey. The vegetation for the Coalfields Highway survey area are described and mapped in terms of “Broad Floristic Formations”, and within these broad units several “Associations” are described. Broad Floristic Formations and Associations are two vegetation description and mapping types from the hierarchy of the National Vegetation Information System (ESCAVI, 2003). The definitions of these vegetation description and mapping units are;

- Broad Floristic Formation: Dominant growth form, cover, height and dominant land cover genus for the upper most or the ecologically or structurally dominant stratum.
- Association: Dominant growth form, height, cover and species (3 species) for the three traditional strata. (i.e. Upper, Mid and Ground).

However, instead of using the complex NVIS method for describing and coding vegetation types a similar system based on Specht (1970) as modified by Aplin (1979) is used in this report. The vegetation association codes that differentiate the different units are derived from the generic and species names of the dominant or more abundant species in the different strata (Table 2).

Code	Species name	Code	Species name
Af	<i>Allocasuarina fraseriana</i>	Ha	<i>Hypocalymma angustifolium</i>
Ba	<i>Banksia attenuata</i>	Ka	<i>Kingia australis</i>
Bl	<i>Banksia littoralis</i>	Lt	<i>Lepidosperma tetraquetrum</i>
Cc	<i>Corymbia calophylla</i>	Pc	<i>Phlebocarya ciliata</i>
Em	<i>Eucalyptus marginata</i> subsp. <i>marginata</i>	Tl	<i>Taxandria linearifolia</i>
Ep	<i>Eucalyptus patens</i>		

Table 2. Abbreviations of species names used in vegetation unit codes (from Morgan, 2011).

Mapping of vegetation condition was carried out using information collected during the current survey and interpretation of aerial photography. The method used to score vegetation condition was that of Keighery (1994) – see Table 3.

SCORE	DESCRIPTION
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very Good	Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as ‘parkland cleared’ with the flora comprising weed or crop species with isolated native trees or shrubs.

Table 3. Vegetation condition scale (from Keighery, 1994).

9. Results and Discussion

9.1. Flora, including Rare Flora and Disjunct Flora

Two hundred and fourteen (214) species of native flora were identified in the survey area during the survey, in addition fifty four (54) species of introduced flora were recorded (Appendix B). This compares to 204 species of native flora and 52 introduced species found during the survey by Morgan (2011) – which covered a larger, and somewhat different area. The most numerous genera were: Fabaceae (33 species), Poaceae (23), Asteraceae (22), Cyperaceae (18) and Orchidaceae (18 species). Two Priority species, *Lomandra whicherensis* (P1) and *Millotia tenuiflora* var. *laevis* (P2) and one geographically disjunct taxon, *Sphenotoma capitatum* were found within the survey area (Figure 3). These were all previously found by Morgan (2011). There were no Declared Rare Flora or other flora of conservation significance found within the survey area.

9.1.1. *Lomandra whicherensis* (Priority 1)

Prior to the surveys by Morgan (2011, 2012a) *Lomandra whicherensis*, a dioecious perennial herb about 40 cm high (Figure 4), was thought to be restricted to a small area between Dardanup and Donnybrook (in Dardanup, Crooked Brook and Argyle forest blocks). As well as the more than 700 plants both inside and outside the survey area found by Morgan (2012a) other populations are known from an area north of the survey area (Morgan *op cit.*). *L. whicherensis* is a relatively anonymous-looking plant that could be mistaken

for other more common species, particularly superficially similar *Patersonia* species abundant in the survey area – so it is likely that other populations will be found in the region.

As stated above, no attempt was made in the current survey to replicate the extent of the previous survey by Morgan (2012a). However representative locations were recorded for *L. whicherensis* and these are shown (Figure 3) in comparison to the general area where they had been found in the previous surveys. The plants were all healthy, though some showed signs of grazing by kangaroos.

9.1.2. *Millotia tenuifolia* var. *laevis* (Priority 2)

Millotia tenuifolia var. *laevis* is an ascending or erect annual herb, 2 cm - 10 cm high (Figure 5). It can only be distinguished from its close relative *M. tenuifolia* var. *tenuifolia* by the fact that it has a wrinkled seed rather than a smooth one. At the time of the survey (early October) it was not possible to be confident that the plants found were in fact the priority-listed variety of the species and they are ascribed to var. *laevis* here on the basis that they were found in the same general areas that the taxon was found by Morgan (2011). The location of the *M. tenuifolia* plants found during the current survey area shown in Figure 3.

Because of its inconspicuous appearance *Millotia tenuifolia* is easily overlooked. The range of *M. tenuifolia* var. *laevis* (mainly the Swan Coastal Plain) overlaps with that of the more common and widespread variety *M. tenuifolia* var. *tenuifolia*. Because of their very similar appearance, except when the seeds are examined, it is very likely that var. *laevis* is under-collected and is in fact more common than the small number of herbarium specimens indicates.

9.1.3. *Sphenotoma capitata* (a disjunct species)

Two *Sphenotoma capitata* plants (Figure 6) were found in the same location as previously reported by Morgan (2011). *S. capitata* is a common shrub with a distribution ranging from just east of Albany and the Stirling Range to the Whicher Range. The northernmost and nearest collection of the species was in 1967 at a point 12 km east of Harvey (about 25 km north of the survey area). Its occurrence in the survey area is considered to be regionally significant because it is near the edge of its known range, that is it is a geographic outlier. A search was made for other *S. capitata* plants within 100 m of the population on Coalfields Highway but none were found.

Species with disjunct distributions have been very significant in the evolution of the southwest flora, particularly through the Quaternary (Conservation Commission, 2011). One of the causes of disjunction in species distribution is climatic change, whereby habitat previously suitable for a taxon becomes less so because of long-term changes in climate. Geographical isolation may promote the development of new species through reduced gene flow (White and Turner, 1986). Thus geographic outliers may be important as the potential source of speciation, or they may harbour genes that have allowed them to spread into an otherwise unsuitable habitat (i.e. a genetic variant) (Platnick and Nelson, 1978). Therefore geographic outliers are significant because they may be genetically important with regard to the future of the species.

With regard to the two-plant population of *S. capitata* in the survey area only a genetic study would be able to determine its true importance. Because it is on the edge of a disturbed area, there is a slight chance that it is in fact a relatively recent introduction to the site.

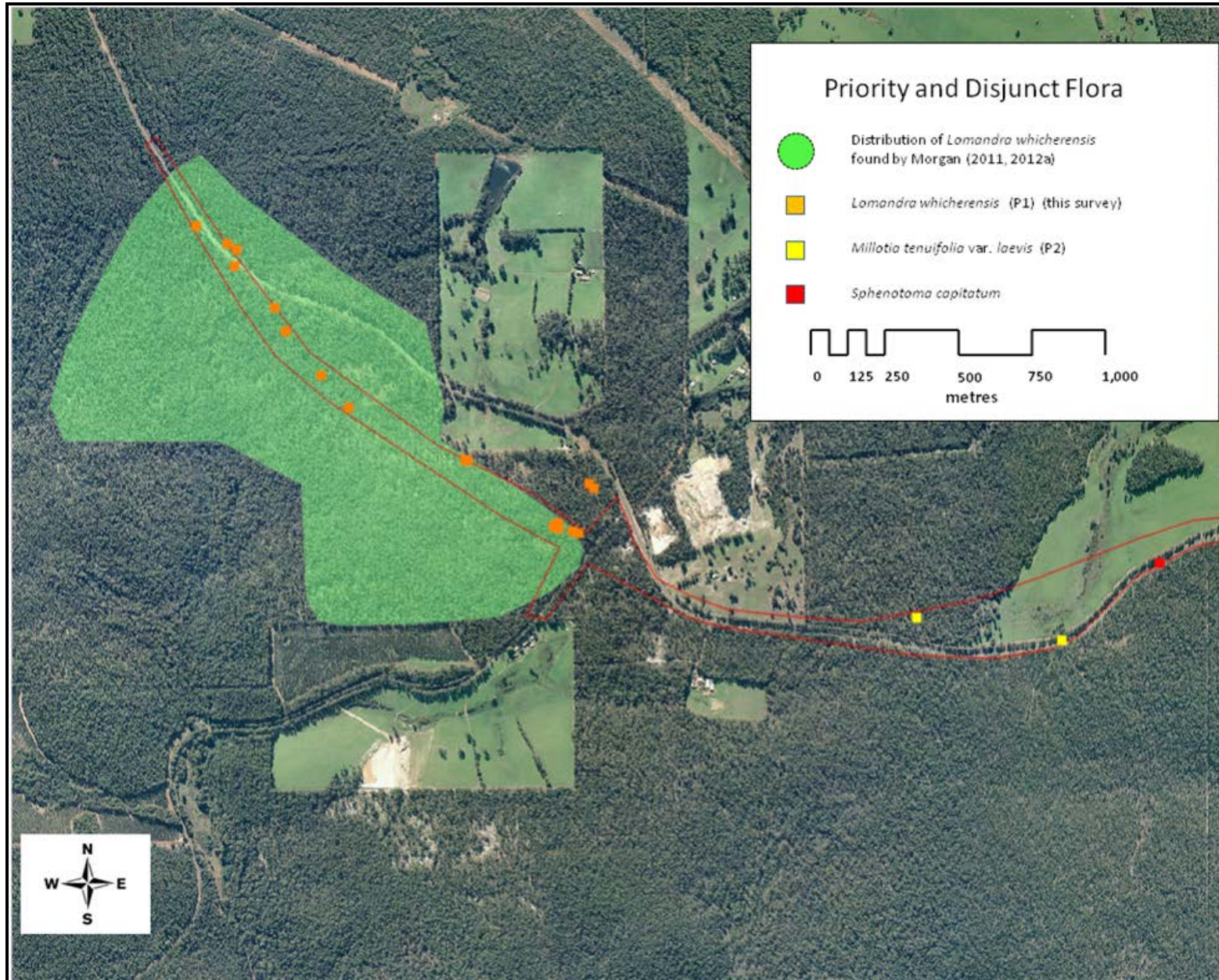


Figure 3. Priority and Disjunct flora distribution.



Figure 4. *Lomandra whicherensis*.



Figure 5. *Millotia tenuifolia*



Figure 6. *Sphenotoma capitatum*

9.2. Plant Communities

Eleven vegetation associations were mapped in the Coalfields Highway survey area (see Figure 7). These were classified into four broad vegetation groups, and within these were several vegetation associations:

- 1) *Eucalyptus patens* (Blackbutt) mixed eucalypt forests on lower valley slopes;
 - a) *Eucalyptus patens*, *Corymbia calophylla* open forest (EpCc)
 - b) *Corymbia calophylla*, *Eucalyptus marginata* subsp. *marginata*, (*Eucalyptus patens*) open forest (CcEmEp)
 - c) *Eucalyptus patens*, (*Corymbia calophylla*) open forest with *Lepidosperma tetraquetrum* tall sedges along creeklines (EpCcLt)
- 2) *Eucalyptus marginata* subsp. *marginata* (Jarrah) *Corymbia calophylla* (Marri) woodlands to open forests on gravelly slopes of lateritic ridges;
 - a) *Eucalyptus marginata* subsp. *marginata*, *Corymbia calophylla* woodland or open forest (EmCc)
 - b) *Eucalyptus marginata* subsp. *marginata*, *Corymbia calophylla* open forest over *Allocasuarina fraseriana* low open woodland (EmCcAf)
- 3) *Eucalyptus marginata* subsp. *marginata* (Jarrah) *Corymbia calophylla* (Marri) woodlands on sandy soils on lower slopes and valley floor;
 - a) *Eucalyptus marginata* subsp. *marginata* scattered trees to open woodland over *Allocasuarina fraseriana*, *Banksia attenuata* low woodland (EmAfBa)
 - b) *Eucalyptus marginata* subsp. *marginata*, (*Corymbia calophylla*) woodland over *Allocasuarina fraseriana* with *Phlebocarya ciliata* herbland in the understorey (EmAfPc)
 - c) *Corymbia calophylla*, *Eucalyptus marginata* subsp. *marginata* open woodland over *Nuytsia floribunda* with *Hypocalymma angustifolium* low shrubland (EmCcHa)
- 4) Dampland vegetation;
 - a) *Eucalyptus marginata* subsp. *marginata*, *Corymbia calophylla* open woodland over *Banksia littoralis* low open woodland (EmCcBl)
 - b) *Eucalyptus marginata* subsp. *marginata*, *Corymbia calophylla* open woodland (over *Melaleuca preissiana* scattered low trees) over *Taxandria linearifolia* high shrubland (EmCcTl)
 - c) Scattered *Corymbia calophylla* trees over *Taxandria linearifolia* tall open shrubland in pasture (CcTl)

Descriptions of these associations are given in Appendix C and representative photos of them are provided in Appendix D.

The eastern one third of the survey area was dominated by *Eucalyptus patens* (Blackbutt) - *Eucalyptus marginata* subsp. *marginata* (Jarrah)-*Corymbia calophylla* (Marri) open forest on loams and gravelly loams

of the Lowden Valleys soil-landscape system (Figure 7). The western two thirds of the survey area mostly had a covering of *Eucalyptus marginata* subsp. *marginata* (Jarrah)-*Corymbia calophylla* (Marri) woodlands to open forests on gravelly slopes of lateritic ridges of the Dwellingup (255DpDWi) soil-landscape subsystem. A third landform element is provided by the relatively poorly drained soils of the Wilga soil-landscape subsystem, particularly the sandy soil phase of the subsystem (255DpWGs) immediately east of the Wellington Dam Road, of which more in the following subsection.

9.2.1. Vegetation of the 255DpWGs Soil-landscape Subsystem

Five vegetation associations are associated with the 255DpWGs subsystem, viz. EmAfPc, EmAfBa, EmCcHa, EmCcBl and EmCcTl. Because of concerns of the local office of the Department of Environment and Conservation about the regional distribution and potential rarity of the 255DpWGs vegetation, particularly that occurring on the deep grey sands, a survey was commissioned into its floristic and plant community values and regional significance (Morgan, 2012b).

No flora of conservation significance was found to be associated with the 255DpWGs subsystem. Eleven vegetation units were mapped in the 255DpWGs subsystem south of the Coalfields Highway. The survey showed that, rather than being an area of relatively homogenous soil and vegetation, had a variety of soils and associated vegetation – with the deep grey sands being restricted to a relatively small proportion of the total area surveyed.

A multivariate analysis of floristic data from seven quadrats and one releve placed within the 255DpWGs area and eleven other quadrats from the same or a similar soil-landscape subsystem (255DpDWs) within 45 km of the survey area was carried out using the software program PATN. The results of the analysis demonstrated that the deep grey sands vegetation is likely to be regionally significant. However, it was concluded that the limited regional data set meant that a comprehensive test of regional significance could not be conducted (Morgan, 2012b).

Mattiske Consulting (1999) carried out a survey of the Worsley Refinery lease area, which lies 11 km north east of the Coalfields Highway survey area. Of the seventeen site-vegetation types (a similar level to the associations defined in this report) they identified one, Type E (Open forest of *Eucalyptus marginata* on lower slopes with mixed understorey including *Kingia australis*) which they found to be restricted in distribution. This site-vegetation type is similar to the EmCcTl association in the survey area.

9.2.2. The Vegetation of a Creekline Draining into Wellington Dam

The fauna assessment of the proposed Coalfields Highway upgrade area (Harewood, 2012) found that no substantial amounts of significant fauna habitats occurred in the survey area with the possible exception of a “creekline that falls within the ultimate alignment near Wellington Dam”. Construction of a new section of the Coalfields Highway here would require the “realignment of the creekline and removal of some large old trees which may be considered of significance.”

About 700 m of the un-named creek is situated within the survey area, with about 100 metres being “straddled” by the proposed alignment of the new road (Figure 8). The creekline and its banks carry the EpCCLt association while surrounding this is the EpCc association (Figure 7). Harewood (2012) found a relatively high number of trees with greater than 50 cm DBH (diameter at breast height) adjacent to the creek, many of them with hollows. In fact many of the larger Marri and Blackbutt (*Eucalyptus patens*) would be in excess of 30 m tall and 100 cm DBH. There is a tall shrubland dominated by *Taxandria linearifolia*, and *Melaleuca viminea* where the creek empties into Wellington Dam (Figure 9).

The creekline is narrow, and its flow is ephemeral – there are few species apart from *Lepidosperma tetraquetrum* associated with the creek-bed, though Morgan (2011) reported finding *L. persecans* there. Based on Florabase records this population could be considered to be a disjunct population, the nearest collection of this species in the Western Australian herbarium is near Margaret River. However, because of past confusion between *L. persecans* and *L. effusum* it is likely that *L. persecans* is in fact more common and widespread in the region (Dr R. Barrett¹, pers. comm.)

The most common understorey species on banks of the creek are Maidenhair fern (*Adiantum aethiopicum*) and the tiny orchids *Corybas recurvus* (Figure 10) and *Pterostylis nana*. Logs and the forest floor itself are carpeted with moss and lichen indicating a long period since the last fire.

There are likely to be a number of creeks with similar vegetation composition and structure in the Wellington National Park south of the survey area and which, consequently, have similar conservation value.

¹ Research scientist, Kings park and Botanic Garden, Perth.

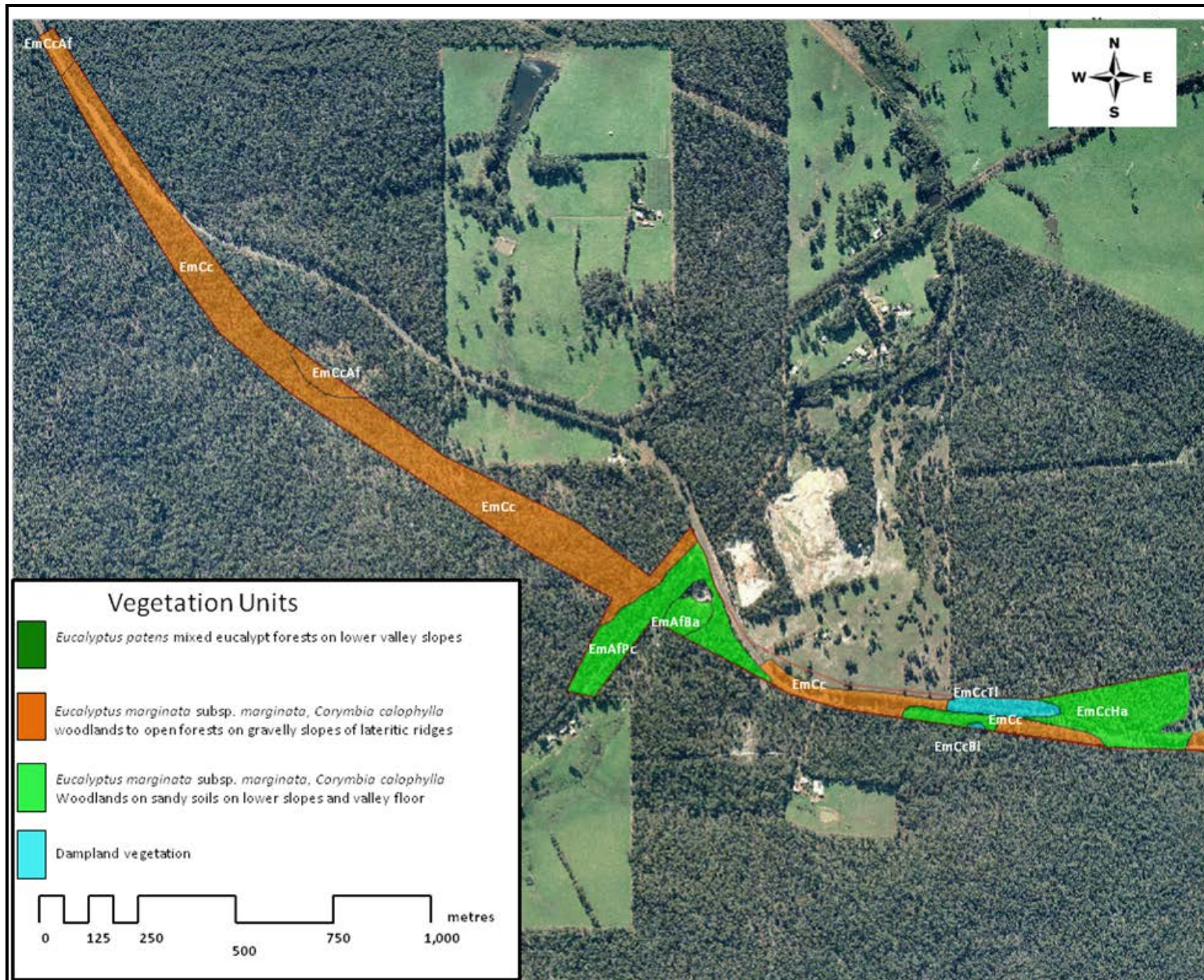


Figure 7a. Vegetation units in the survey area (western)

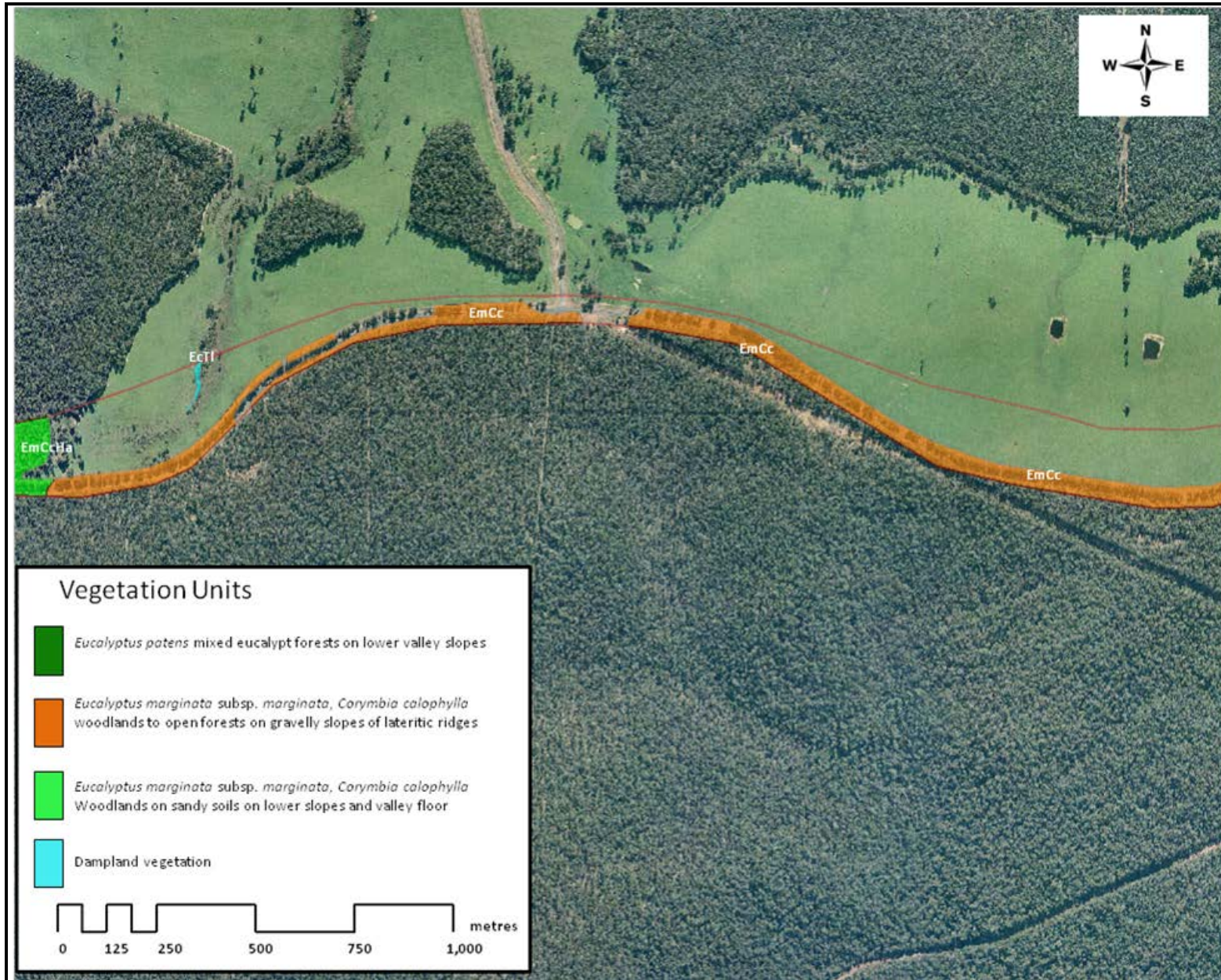


Figure 7b. Vegetation units in the survey area (central).

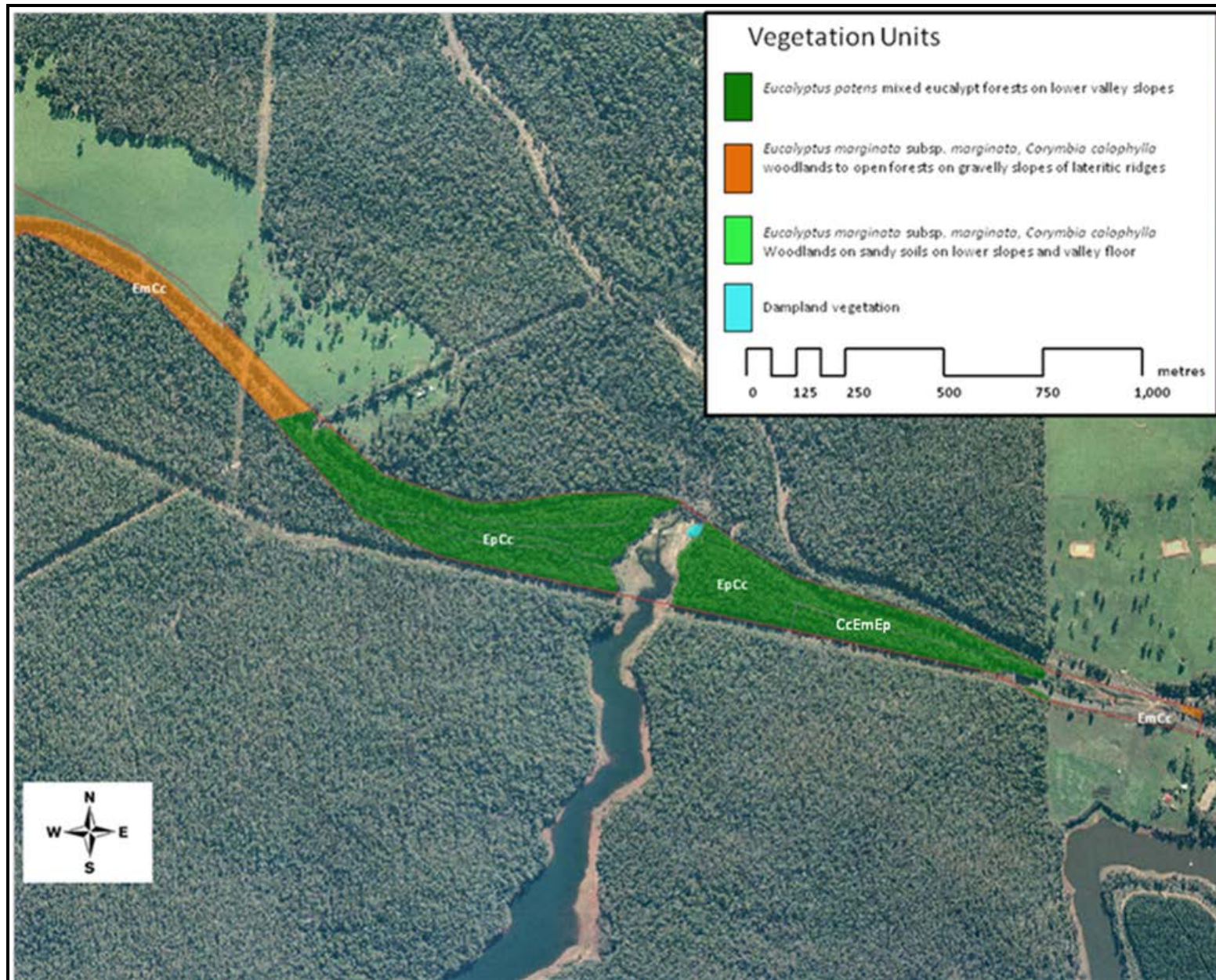


Figure 7c. Vegetation units in the survey area (eastern).



Figure 8. *Eucalyptus patens* – *Corymbia calophylla* open forest along the Wellington Dam creek.



Figure 9. Tall shrubland where the creek enters Wellington Dam.



Figure 10. Maidenhair fern and *Corybas recurvus* in creekline vegetation.

9.3. Vegetation Condition

The distribution of vegetation condition scores within the survey area is shown in Figure 11. Of the total survey area extent of about 130 ha, 73.4 ha, or 57.2% was considered to be remnant vegetation. Isolated paddock trees were not included as remnant vegetation. Of the total area of remnant vegetation the proportion in the various condition score classes is shown in Table 3.

Condition Score	Ha	%
Degraded	7.2	9.8
Degraded-Good	2.7	3.7
Good	5.3	7.2
Good-Very Good	20.6	28.1
Very Good	16.4	22.4
Very Good-Excellent	21.2	28.8
Total	73.4	100.0

Table 3. Amount and proportion of remnant vegetation in each condition class.

The main cause of vegetation degradation was physical disturbance (roads, gravel and sand pits, logging), *Phytophthora* dieback disease and invasion by weeds. A *Phytophthora* disease survey in 2011 found that at least 60% of the survey area was infested (RPS, 2011b). The effects of dieback disease as well as heavy logging are particularly noticeable in the Jarrah-Marri woodland and open forest on the gravel ridges west of Wellington Dam Road. Dieback disease has removed a suite of susceptible species from some parts of the upland Jarrah-Marri forest and because of this and the sometimes heavy impact of the logging these areas were scored as Good – Very Good condition. Most of the Blackbutt mixed eucalypt open forest in the eastern part of the survey area was scored as Very Good-Excellent because logging impact is generally low, dieback disease, though present, has had little impact, and weeds, except for unobtrusive herbaceous species, are absent.

Vegetation condition along the edge of the highway is variable, due largely to physical disturbance and consequent weed invasion. Grazing has impacted the condition of remnant vegetation in private property Lot 103, north of the highway, and it was consequently rated only as Good. The “edge effect” of increased physical disturbance and altered micro-climate and consequent weed invasion has impacted the condition of the narrow strip of vegetation along the north side of the highway and it has mainly be classed as Degraded to Good.

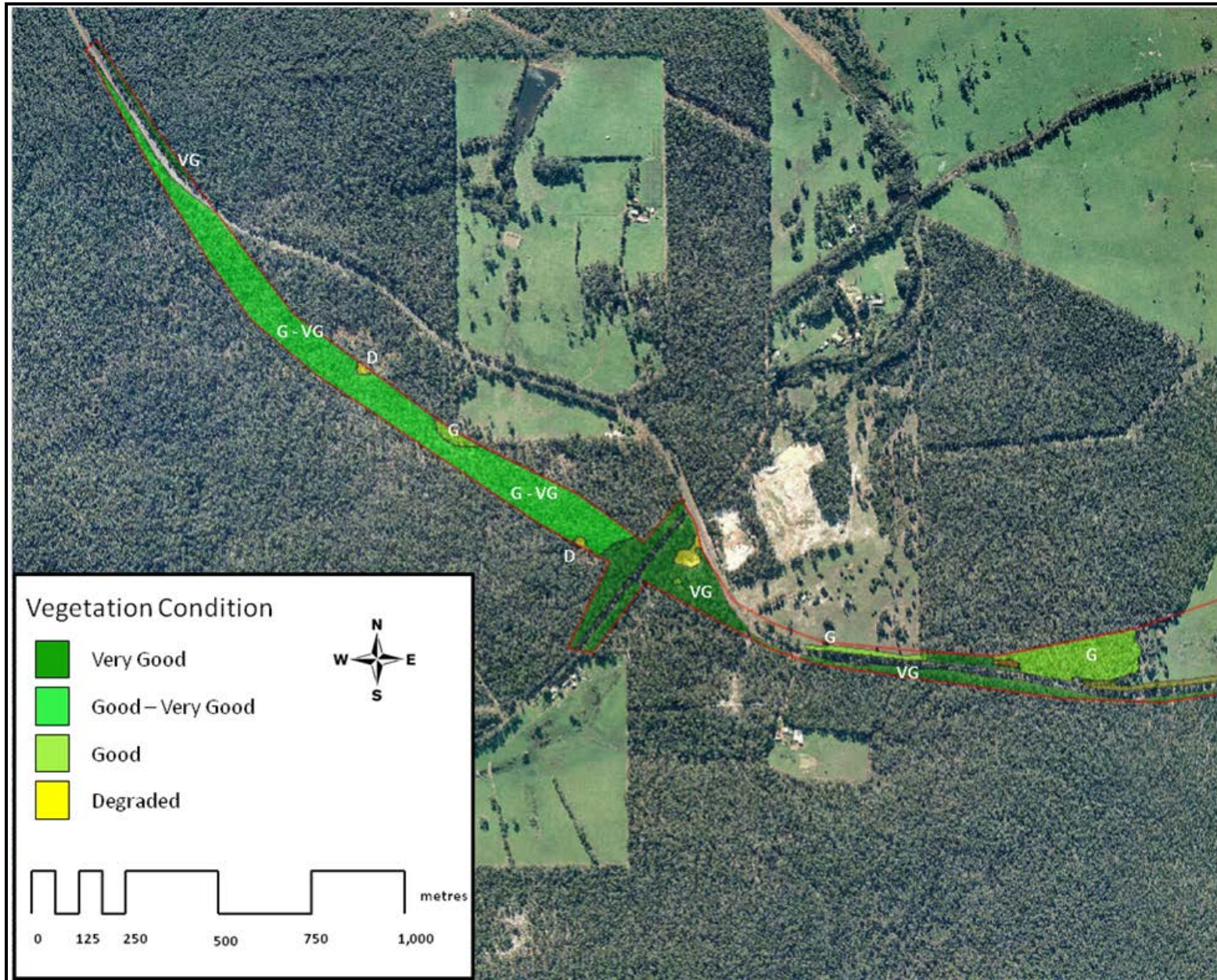


Figure 11a. Vegetation condition in the survey area (western).

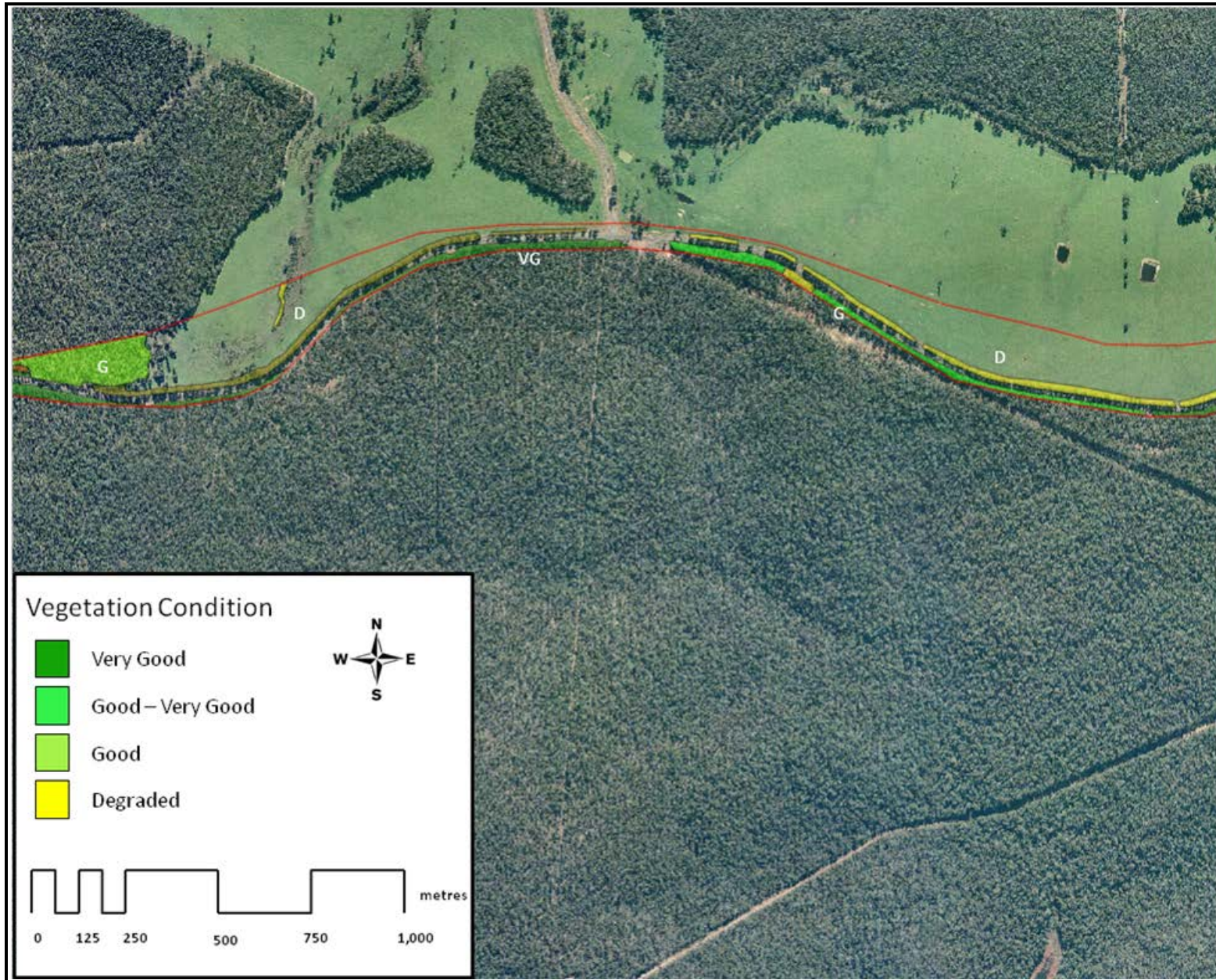


Figure 11b. Vegetation condition in the survey area (central).

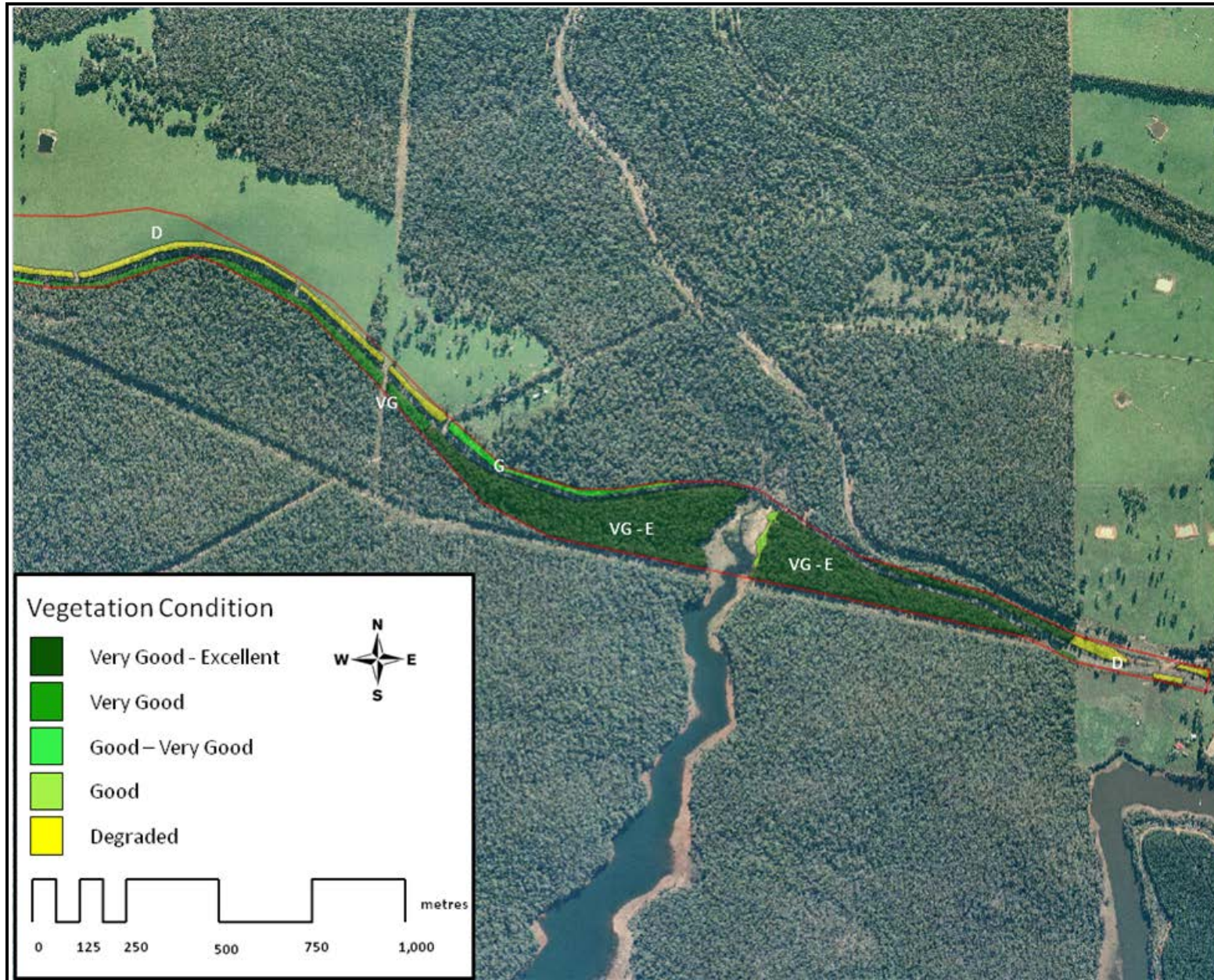


Figure 11c. Vegetation condition in the survey area (eastern).

9.4. *Introduced Species and Weeds*

Fifty four species of introduced flora were recorded in the survey area (Figure 12). Many of these were ephemeral or annual taxa that only establish in highly disturbed areas, like road verges. There were several species that are either included in the list of Declared Plants in Western Australia (Smith, 2010), or are known environmental weeds (Figure E). Environmental weeds are introduced or non-native taxa able to establish in relatively undisturbed bushland and compete with native species.

There was one Declared plant, *Rubus anglocandicans* (Blackberry), which is a P4 weed in the Collie Shire. The classification of P4 means that the spread of the plant species beyond where it currently occurs is to be prevented. Blackberry is mainly found in the Blackbutt mixed eucalypt open forest in the eastern part of the survey area. Environmental weeds of concern that occur in the survey area include *Watsonia meriana*, *Leptospermum laevigatum* (Victorian Ti-tree) and *Lavandula stoechas* (Lavender).

9.5. *Threatened and Priority Ecological Communities*

None of the vegetation associations identified within the survey area corresponds to a threatened or priority ecological community.

9.6. *Poorly Represented Vegetation Complexes and Communities*

Only D1 vegetation complex (Dwellingup, high rainfall – lateritised uplands on the western edge of the Darling Plateau, carrying an open forest of Jarrah and Marri) of the three complexes present in the survey area was listed by Mattiske and Havel (2002) as being poorly reserved. However, the authors concluded with regard to this complex, that ‘given the level of reservation, the percentage of the complex remaining, and proposed improvements to forest management practices, the conservation values in this vegetation complex are considered adequately protected’.

Morgan (2011) considered that the dampland vegetation mapped in the survey area as EmCcTI (which included *Melaleuca preissiana* scattered low trees) and EmCcBI would probably better be described as belonging to vegetation complex MJ (‘Muja complex – Depressions and Swamps : Open woodland of *Melaleuca preissiana* – *Banksia littoralis* – *Banksia ilicifolia* with some *Eucalyptus patens* on moister sites, *Banksia* spp, on drier sites on valley floors in the subhumid zone’). Mattiske and Havel (2002) listed vegetation complex MJ as a ‘poorly represented vegetation complex’ (51% of pre-European area remaining; 14.0% reserved). However, the Muja vegetation complex is restricted to the Collie basin, which commences several kilometres east of the survey area. Nevertheless, the survey of the 255DpWGs soil-landscape subsystem (Morgan, 2012b) demonstrated that the suite of dampland vegetation associations east of Wellington Dam Road is likely to be regionally restricted.

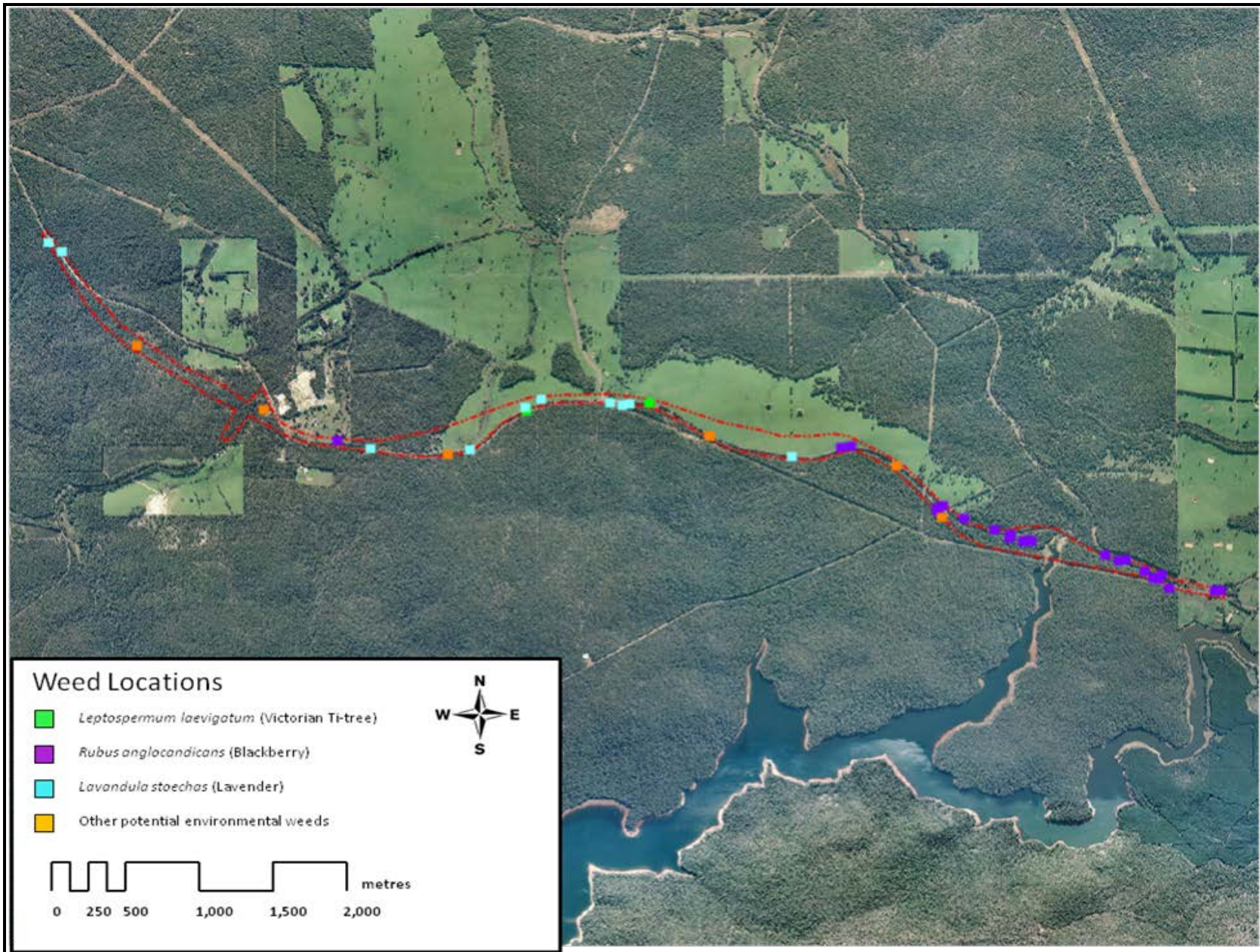


Figure 12. Locations of Declared Plants and potential environmental weeds in the survey area.

9.7. *The Requirement for Further Dieback Survey*

A *Phytophthora* disease survey in April 2011 found that at least 60% of the survey area was infested. Unfortunately a large proportion of the survey area at that time could not be assessed for the presence of dieback because of a recent prescribed burn west of Wellington Dam Road, and was excluded from the survey. The evidence of biomass reduction, particularly in the understorey, supports a conclusion that most if not all of the Jarrah-Marri forest west of Wellington Dam is infested and exhibiting a high impact of the disease. Recent deaths of *Xanthorrhoea preissii* plants are evidence of continuing disease activity near an old gravel pit within the survey area 930 m north east of Wellington Dam Road. However most of the susceptible species have apparently been removed from the understorey by *Phytophthora* disease along the alignment between Coalfields Highway and Wellington Dam Road (most of which was excluded from the 2011 dieback assessment).

Most of the Blackbutt mixed eucalypt open forest in the eastern part of the survey area was considered to be “uninterpretable” at the time of the 2011 survey and this situation will not change. Eucalypt forest on more fertile soils, such as the Blackbutt mixed eucalypt open forest normally has a relatively low representation of susceptible species, and also the disease usually has a lower impact in this vegetation type. In any case, given the disturbance history of the area and the fact that it is downslope from known infested areas, it is highly likely to be infested also.

Observations made during the present survey confirm the conclusions of the 2011 dieback assessment that the only substantial part of the survey area not infested with disease is just west of Gastaldi Road. Except to the extent that the area classified as “uninfested” (5.1 ha) may have reduced since April 2011 due to further spread of the disease it is not considered that the dieback situation has changed significantly in the interim and a further dieback assessment is considered unnecessary.

10. Recommendations

The following recommendations (generally concurring with those made by Morgan, 2011) are made with respects to the proposed roadworks;

- ❖ Minimise the area of impact on *Lomandra whicherensis* (P1) populations,
- ❖ Generally minimize the width of works in the Wellington National Park and large areas of remnant bushland in Good or better condition.
- ❖ Minimise the area of works in the dampland vegetation units (EmCcBI and EmCcTI) as this vegetation is considered to be poorly reserved,

In addition;

- ❖ If possible the small population of *Sphenotoma capitata* should be conserved during the proposed roadworks.

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Appendix A: Vegetation releves and Assessment Points

WAYPOINT	DOMINANTS	RELEVE	SPECIES	CONDITION
196	EmCc	EKR01	Trees: Jarrah, Marri, Shrubs: <i>Hakea ruscifolia</i> , <i>Macrozamia riedlei</i> , <i>Acacia pulchella</i> , <i>Banksia dallanneyi</i> , Sedges/herbs: <i>Patersonia occidentalis</i> , Soil: Gravel	Very Good
198	EmAf	EKR02	Trees: Jarrah, <i>Allocasuarina fraseriana</i> , Shrubs: <i>Leucopogon capitellatus</i> , Herbs: <i>Dianella revoluta</i> , <i>Pteridium esculentum</i> , <i>Patersonia occidentalis</i> , Soil: Grey sand	Very Good
189	CCEm	EKR03	Trees: Marri, Jarrah, Small trees: <i>Banksia grandis</i> , Shrubs: <i>Bossiaea aquifolium</i> , <i>Hibbertia amplexicaulis</i> , <i>Hibbertia hypericoides</i> , <i>Macrozamia riedlei</i> ; Soil: gravel	Very Good
191	EmCc	EKR04	Trees: Jarrah, Marri, Shrubs: <i>Bossiaea aquifolium</i> , <i>Macrozamia riedlei</i> , <i>Hakea amplexicaulis</i> , <i>Bossiaea aquifolium</i> , <i>Hibbertia hypericoides</i> , <i>Hypocalymma angustifolium</i> , Herbs: <i>Lomandra whicherensis</i> , Soil: Gravel	Very Good
192	EmCc	EKR05	Trees: Jarrah, Marri, Shrubs: <i>Macrozamia riedlei</i> , <i>Hibbertia hypericoides</i> , <i>Hakea amplexicaulis</i> , <i>Acacia extensa</i> , <i>Leucopogon capitellatus</i> , <i>Opercularia hispidula</i> , Soil: Gravel	Very Good
193	EmCc	EKR06	Trees: Jarrah, Marri, Shrubs: <i>Macrozamia riedlei</i> , <i>Hibbertia hypericoides</i> , <i>Acacia extensa</i> , <i>Leucopogon capitellatus</i> , <i>Acacia pulchella</i> , <i>Xanthorrhoea preissii</i> , Herbs: <i>Pteridium esculentum</i>	Very Good
194	EmCcAf	EKR07	Trees: Jarrah, Marri, <i>Allocasuarina fraseriana</i> , Shrubs: <i>Acacia pulchella</i> , <i>Hibbertia hypericoides</i> , <i>Hakea amplexicaulis</i> , <i>Philothea spicata</i> , <i>Bossiaea ornata</i> , <i>Macrozamia riedlei</i> , <i>Pimelea suaveolens</i> , <i>Bossiaea aquifolium</i> , Soil: Yellow-brown sandy loam	Very Good
41	CcBl	EKR08	Trees: <i>Eucalyptus patens</i> , Marri, Jarrah, Small tree: <i>Banksia littoralis</i> , Shrubs: <i>Xanthorrhoea preissii</i> , <i>Hibbertia hypericoides</i> , <i>Xanthorrhoea gracilis</i> , <i>Banksia dallanneyi</i> , Herbs/Sedges: <i>Pteridium esculentum</i> , <i>Lepidosperma scabrum</i> , <i>Tetralia</i> sp. Jarrah Forest	Very Good
42	EmCcNf	EKR09	Trees: Jarrah, Marri, Small tree: <i>Nuytsia floribunda</i> , Shrubs: <i>Acacia extensa</i> , <i>Xanthorrhoea preissii</i> , Herbs/Sedges: <i>Mesomelaena tetragona</i> , <i>Johnsonia lupulina</i> , <i>Phlebocarya ciliata</i> , <i>Patersonia occidentalis</i> , <i>Desmodium fasciculare</i>	Very Good
281	EmCc	EKR10	Trees: Jarrah, Marri, Shrubs: <i>Bossiaea aquifolium</i> , <i>Bossiaea linophylla</i> , Others: <i>Clematis pubescens</i> , <i>Pteridium esculentum</i> , Soil: Yellow-brown gravelly sandy clay loam	Very Good
282	EpCc	EKR11	Trees: <i>Eucalyptus patens</i> , Marri, Shrubs: <i>Bossiaea aquifolium</i> , <i>Acacia pulchella</i> , <i>Acacia urophylla</i> , Others: <i>Clematis pubescens</i> , <i>Pteridium esculentum</i> .	Very Good
267	EmCc	EKR12	Trees: Jarrah, Marri, Shrubs: <i>Macrozamia riedlei</i> , <i>Hibbertia hypericoides</i> , <i>Hypocalymma angustifolium</i> , <i>Opercularia hispidula</i> , Others: <i>Millotia tenuifolia</i> ,	Very Good
268	TI	EKR13	Shrubs: <i>Taxandria linearifolia</i> , Herbs: <i>Holcus lanatus</i> , <i>Mentha pulegium</i>	Poor
269	CcEm	EKR14	Trees: Marri, Jarrah, Shrubs: <i>Hakea amplexicaulis</i> , <i>Hakea lissocarpa</i> , <i>Bossiaea ornata</i> , <i>Acacia lateritica</i> , <i>Hypocalymma angustifolium</i> , Herbs etc: <i>Patersonia occidentalis</i> , <i>Dianella revoluta</i> , <i>Johnsonia lupulina</i> , Soil: Grey-brown sandy loam	Very Good
271	EmCc	EKR16	Trees: Jarrah, Marri, Shrubs: <i>Kingia australis</i> , <i>Hakea ruscifolia</i> , <i>Adenanthos obovatus</i> , <i>Grevillea quercifolia</i> , <i>Hibbertia hypericoides</i> , <i>Acacia lateritica</i> , <i>Xanthorrhoea preissii</i>	Very Good
273	EmCc	EKR17	Trees: Jarrah, Marri, Shrubs: <i>Hibbertia hypericoides</i> , <i>Bossiaea ornata</i> , <i>Banksia dallanneyi</i> , <i>Macrozamia riedlei</i> , <i>Acacia pulchella</i> , Herbs etc: <i>Patersonia occidentalis</i> , <i>Johnsonia lupulina</i> , Soil: Gravel	Very Good
275	EmCc	EKR18	Trees: Jarrah, Marri, Small tree: <i>Persoonia longifolia</i> , Shrubs: <i>Kingia australis</i> , <i>Hibbertia hypericoides</i> , <i>Macrozamia riedlei</i> , <i>Acacia pulchella</i> , <i>Xanthorrhoea gracilis</i> , <i>Leucopogon capitellatus</i> , Soil: Gravel	Very Good

WAYPOINT	DOMINANTS	RELEVE	SPECIES	CONDITION
276	EmCc	EKR19	Trees: Jarrah, Marri, Shrubs: <i>Bossiaea aquifolium</i> , <i>Xanthorrhoea preissii</i> , <i>Macrozamia riedlei</i> , <i>Hakea lissocarpa</i> , <i>Bossiaea ornata</i> , <i>Leucopogon capitellatus</i> , <i>Hakea amplexicaulis</i> , Soil: Gravel	Very Good
279	EmCc	EKR20	Trees: Jarrah, Marri, Shrubs: <i>Hakea lissocarpa</i> , <i>Dodonaea viscosa</i> , <i>Bossiaea aquifolium</i> , <i>Xanthorrhoea preissii</i> , <i>Hibbertia hypericoides</i> , <i>Acacia pulchella</i> , <i>Opercularia hispidula</i> , Soil: Gravel	Very Good
283	CcEm	EKR21	Trees: Marri, Jarrah, Shrubs: <i>Bossiaea aquifolium</i> , <i>Hibbertia hypericoides</i> , Others: <i>Clematis pubescens</i> , <i>Pteridium esculentum</i>	Very Good
284	EpCc	EKR22	Trees: Marri, <i>Eucalyptus patens</i> , Shrubs: <i>Tremandra stelligera</i> , <i>Bossiaea aquifolium</i> , <i>Bossiaea linophylla</i> , <i>Macrozamia riedlei</i> , <i>Phyllanthus calycinus</i> , Others: <i>Stylidium adnatum</i> , <i>Clematis pubescens</i> , <i>Pteridium esculentum</i>	Very Good
285	CcEm	EKR23	Trees: Marri, Jarrah, Shrubs: <i>Trymalium odoratissimum</i> , <i>Tremandra stelligera</i> , <i>Bossiaea aquifolium</i> , <i>Macrozamia riedlei</i> , others: <i>Adiantum aethiopicum</i> , <i>Pteridium esculentum</i> , <i>Stylidium adnatum</i>	Very Good
286	EpCc	EKR24	Trees: <i>Eucalyptus patens</i> , Marri, Shrubs: <i>Bossiaea aquifolium</i> , <i>Tremandra stelligera</i> , <i>Hibbertia sylvestris</i> , <i>Trymalium odoratissimum</i> , Others: <i>Pteridium esculentum</i>	Very Good
259	EmCcAf	EKR26	Trees: Jarrah, Marri, <i>Allocasuarina fraseriana</i> , Small trees: <i>Nuytsia floribunda</i> , Shrubs: <i>Xanthorrhoea preissii</i> , <i>Macrozamia riedlei</i> , Others: <i>Pteridium esculentum</i> , <i>Phlebocarya ciliata</i> , <i>Conostylis aculeata</i>	Very Good
260	EmCc	EKR27	Trees: Jarrah, Marri, Shrubs: <i>Acacia lateritica</i> , <i>Xanthorrhoea preissii</i> , <i>Hakea lissocarpa</i> , <i>Hypocalymma angustifolium</i> , <i>Pericalymma ellipticum</i> , Others: <i>Tetraria</i> sp. Jarrah Forest, Soils: Grey sand with gravel	Very Good
261	EmCcBl	EKR28	Trees: Jarrah, Marri, <i>Eucalyptus patens</i> , Small tree: <i>Banksia littoralis</i> , Shrubs: <i>Taxandria linearifolia</i> , <i>Hakea amplexicaulis</i> , <i>Acacia divergens</i> , <i>Leucopogon verticillatus</i> , Others: <i>Lepidosperma scabrum</i> complex	Very Good
262	CcEmTI	EKR29	Trees: Marri, Jarrah, Shrubs: <i>Taxandria linearifolia</i> , <i>Dampiera linearis</i> , <i>Taxandria parviceps</i> , Others: <i>Dianella revoluta</i> , <i>Agrostocrinum hirsutum</i> , <i>Tetraria</i> sp. Jarrah Forest, Soil: Yellow-brown clay loam	Very Good
263	CcEmTI	EKR30	Trees: Jarrah, Marri, Shrubs: <i>Taxandria linearifolia</i> , <i>Bossiaea ornata</i> , <i>Acacia lateritica</i> , <i>Sphaerolobium medium</i> , <i>Astartea scoparia</i> , Others: <i>Tetraria</i> sp. Jarrah Forest, <i>Hypolaena exsulca</i> , <i>Tetrarrhena laevis</i> , Soil: Gravelly clay loam	Very Good
264	EmCc	EKR31	Trees: Jarrah, Marri, Shrubs: <i>Bossiaea ornata</i> , <i>Xanthorrhoea preissii</i> , <i>Hibbertia hypericoides</i> , <i>Macrozamia riedlei</i> , <i>Leucopogon capitellatus</i> , <i>Acacia lateritica</i> , <i>Hakea amplexicaulis</i> , <i>Hypocalymma angustifolium</i> , Others: <i>Patersonia occidentalis</i> , Soil: Gravel	Very Good
265	CcEm	EKR32	Trees: Marri, Jarrah, Shrubs: <i>Hakea lissocarpa</i> , <i>Hibbertia hypericoides</i> , <i>Hypocalymma angustifolium</i> , <i>Acacia lateritica</i> , <i>Xanthorrhoea preissii</i> , <i>Hakea amplexicaulis</i> , Others: <i>Tetraria</i> sp. Jarrah Forest, <i>Pteridium esculentum</i> , Soil: Grey clayey sand with gravel	Very Good
266	EmCc	EKR33	Trees: Jarrah, Marri, Shrubs: <i>Hibbertia hypericoides</i> , <i>Hypocalymma angustifolium</i> , <i>Xanthorrhoea preissii</i>	Good
353	EmCc	EKR34	Trees: Jarrah, Marri, Shrubs: <i>Macrozamia riedlei</i> , <i>Hibbertia hypericoides</i> , <i>Bossiaea aquifolium</i> , <i>Banksia dallanneyi</i> , <i>Xanthorrhoea preissii</i> , Soil: Gravel	Very Good
354	EmCc	EKR35	Trees: Jarrah, Marri, Shrubs: <i>Bossiaea aquifolium</i> , <i>Macrozamia riedlei</i> , <i>Acacia pulchella</i> , <i>Hakea amplexicaulis</i> , <i>Xanthorrhoea preissii</i> , Soils: Gravel	Very Good
345	EpCc	EKR36	Trees: <i>Eucalyptus patens</i> , Marri, Shrubs: <i>Hibbertia amplexicaulis</i> , <i>Acacia pulchella</i> , <i>Bossiaea aquifolium</i> , <i>Hibbertia perfoliata</i> , <i>Trymalium odoratissimum</i> , Others: <i>Clematis pubescens</i>	Very Good

WAYPOINT	DOMINANTS	RELEVE	SPECIES	CONDITION
346	EpCc	EKR37	Trees: Marri, <i>Eucalyptus patens</i> , Shrubs: <i>Hibbertia perfoliata</i> , <i>Macrozamia riedlei</i> , <i>Tremandra stelligera</i> , <i>Bossiaea aquifolium</i> , <i>Opercularia hispidula</i> , Others: <i>Pteridium esculentum</i> , <i>Clematis pubescens</i>	Very Good
347	CcEm	EKR38	Trees: Marri, Jarrah, Shrubs: <i>Tremandra stelligera</i> , <i>Trymalium odoratissimum</i> , <i>Hibbertia perfoliata</i> , <i>Bossiaea aquifolium</i> , <i>Hakea amplexicaulis</i> ; Others: <i>Kennedia prostrata</i> , <i>Clematis pubescens</i> , <i>Pteridium esculentum</i>	Very Good
348	EmCc	EKR39	Trees: Jarrah, Marri, Small trees: <i>Persoonia longifolia</i> , Shrubs: <i>Hibbertia hypericoides</i> , <i>Acacia pulchella</i> , <i>Dodonaea viscosa</i> , <i>Acacia pulchella</i> , Others: <i>Chorizema cordatum</i> , <i>Stackhousia monogyna</i>	Very Good
349	EpCc	EKR40	Trees: Marri, <i>Eucalyptus patens</i> , Shrubs: <i>Bossiaea linophylla</i> , Others: <i>Clematis pubescens</i> , <i>Pteridium esculentum</i> , <i>Plantago lanceolata</i> , <i>Oxalis pes-caprae</i>	Good
350	CcEm	EKR41	Trees: Marri, Jarrah, Shrubs: <i>Bossiaea linophylla</i> , <i>Hibbertia amplexicaulis</i> , <i>Macrozamia riedlei</i> , <i>Scaevola calliptera</i> , Others: <i>Chorizema cordatum</i> , <i>Agrostocrinum hirsutum</i> , <i>*Watsonia meriana</i>	Good
288	EpCcEm	EKR42	Trees: <i>Eucalyptus patens</i> , Marri, Jarrah, Shrubs: <i>Bossiaea linophylla</i> , <i>Bossiaea aquifolium</i> , <i>Rubus anglocandicans</i> , <i>Tremandra stelligera</i> , Others: <i>Clematis pubescens</i> , <i>Pteridium esculentum</i>	Very Good

Appendix B: List of vascular species identified in survey area.

FAMILY	SPECIES	NATURALISED	CONSV_CODE	VERNACULAR
Loranthaceae	<i>Nuytsia floribunda</i>			WA Christmas Tree
Anarthriaceae	<i>Lyginia imberbis</i>			
Apiaceae	<i>Actinotus glomeratus</i>			
	<i>Daucus glochidiatus</i>			Australian Carrot
	<i>Xanthosia candida</i>			
	<i>Xanthosia huegelii</i>			
	<i>Xanthosia tasmanica</i>			
Araliaceae	<i>Hydrocotyle callicarpa</i>			Small Pennywort
	<i>Trachymene pilosa</i>			Native Parsnip
Asparagaceae	<i>Lomandra integra</i>			
	<i>Lomandra nigricans</i>			
	<i>Lomandra odora</i>			Tiered Matrush
	<i>Lomandra preissii</i>			
	<i>Lomandra purpurea</i>			Purple Mat Rush
	<i>Lomandra sonderi</i>			
	<i>Lomandra whicherensis</i>		P1	
	<i>Thysanotus multiflorus</i>			Many-flowered Fringe Lily
	<i>Thysanotus thyrsoideus</i>			
Asteraceae	<i>Arctotheca calendula</i>	*		Cape Weed
	<i>Asteridea pulverulenta</i>			Common Bristle Daisy
	<i>Cotula turbinata</i>	*		Funnel Weed
	<i>Craspedia variabilis</i>			
	<i>Dimorphotheca ecklonis</i>	*		
	<i>Dittrichia graveolens</i>	*		Stinkwort
	<i>Helichrysum luteoalbum</i>			Jersey Cudweed
	<i>Hypochaeris glabra</i>	*		Smooth Catsear
	<i>Lagenophora huegelii</i>			
	<i>Millotia tenuifolia</i> var. <i>laevis</i>		P2	Soft Millotia
	<i>Podolepis gracilis</i>			Slender Podolepis
	<i>Quinetia urvillei</i>			

FAMILY	SPECIES	NATURALISED	CONSV_CODE	VERNACULAR
Asteraceae	<i>Rhodanthe citrina</i>			
	<i>Senecio diaschides</i>	*		
	<i>Senecio hispidulus</i>			Hispid Fireweed
	<i>Senecio quadridentatus</i>			
	<i>Siloxerus humifusus</i>			Procumbent Siloxerus
	<i>Silybum marianum</i>	*		Variegated Thistle
	<i>Sonchus asper</i>	*		Rough Sowthistle
	<i>Sonchus oleraceus</i>	*		Common Sowthistle
	<i>Tolpis barbata</i>	*		Yellow Hawkweed
	<i>Ursinia anthemoides</i>	*		Ursinia
Brassicaceae	<i>Raphanus raphanistrum</i>	*		Wild Radish
Campanulaceae	<i>Isotoma hypocrateriformis</i> var. <i>cristata</i>			
	<i>Lobelia anceps</i>			Angled Lobelia
	<i>Lobelia rhytidosperma</i>			Wrinkle-seeded Lobelia
Caryophyllaceae	<i>Petrorhagia dubia</i>	*		
Casuarinaceae	<i>Allocasuarina fraseriana</i>			Sheoak
Celastraceae	<i>Stackhousia monogyna</i>			
	<i>Tripterococcus brunonis</i>			Winged Stackhousia
Colchicaceae	<i>Burchardia congesta</i>			
Cyperaceae	<i>Cyathochaeta avenacea</i>			
	<i>Isolepis cernua</i>			Nodding Club-rush
	<i>Isolepis marginata</i>	*		Coarse Club-rush
	<i>Lepidosperma costale</i>			
	<i>Lepidosperma effusum</i>			Spreading Sword-sedge
	<i>Lepidosperma longitudinale</i>			Pithy Sword-sedge
	<i>Lepidosperma pubisquameum</i>			
	<i>Lepidosperma scabrum</i> (complex)			
	<i>Lepidosperma squamatum</i>			
	<i>Lepidosperma tenue</i>			
	<i>Lepidosperma tetraquetrum</i>			

FAMILY	SPECIES	NATURALISED	CONSV_CODE	VERNACULAR
Cyperaceae	<i>Mesomelaena tetragona</i>			Semaphore Sedge
	<i>Schoenus curvifolius</i>			
	<i>Schoenus efoliatus</i>			
	<i>Schoenus subflavus</i>			Yellow Bog-rush
	<i>Schoenus unispiculatus</i>			
	<i>Tetraria octandra</i>			
	<i>Tetraria</i> sp. Jarrah Forest (R. Davis 7391)			
Dasypogonaceae	<i>Kingia australis</i>			Kingia
Dennstaedtiaceae	<i>Pteridium esculentum</i>			Bracken
Dilleniaceae	<i>Hibbertia amplexicaulis</i>			
	<i>Hibbertia commutata</i>			
	<i>Hibbertia hypericoides</i>			Yellow Buttercups
	<i>Hibbertia perfoliata</i>			
	<i>Hibbertia pulchra</i>			
	<i>Hibbertia quadricolor</i>			
	<i>Hibbertia silvestris</i>			
	<i>Hibbertia vaginata</i>			
Droseraceae	<i>Drosera pulchella</i>			Pretty Sundew
Elaeocarpaceae	<i>Platytheca galioides</i>			
	<i>Tetratheca hirsuta</i>			Black Eyed Susan
	<i>Tremandra stelligera</i>			
Ericaceae	<i>Andersonia caerulea</i>			Foxtails
	<i>Andersonia involucrata</i>			
	<i>Astroloma pallidum</i>			Kick Bush
	<i>Leucopogon capitellatus</i>			
	<i>Leucopogon conostephioides</i>			
	<i>Leucopogon propinquus</i>			
	<i>Leucopogon sprengelioides</i>			
	<i>Leucopogon verticillatus</i>			Tassel Flower
	<i>Sphenotoma capitata</i>			

FAMILY	SPECIES	NATURALISED	CONSV_CODE	VERNACULAR
Euphorbiaceae	<i>Monotaxis occidentalis</i>			
Fabaceae	<i>Acacia dealbata</i>	*		
	<i>Acacia divergens</i>			
	<i>Acacia extensa</i>			Wiry Wattle
	<i>Acacia huegelii</i>			
	<i>Acacia lateriticola</i>			
	<i>Acacia longifolia</i>	*		
	<i>Acacia podalyriifolia</i>	*		
	<i>Acacia pulchella</i> var. <i>goadbyi</i>			
	<i>Acacia stenoptera</i>			Narrow Winged Wattle
	<i>Acacia urophylla</i>			
	<i>Bossiaea aquifolium</i> subsp. <i>aquifolium</i>			
	<i>Bossiaea linophylla</i>			
	<i>Bossiaea ornata</i>			Broad Leaved Brown Pea
	<i>Chorizema cordatum</i>			
	<i>Chorizema reticulatum</i>			Showy Flame Pea
	<i>Daviesia decurrens</i>			Prickly Bitter-pea
	<i>Daviesia horrida</i>			Prickly Bitter-pea
	<i>Daviesia physodes</i>			
	<i>Gastrolobium bilobum</i>			Heart Leaf Poison
	<i>Gompholobium knightianum</i>			
	<i>Gompholobium ovatum</i>			
	<i>Gompholobium polymorphum</i>			
	<i>Gompholobium tomentosum</i>			Hairy Yellow Pea
	<i>Hovea chorizemifolia</i>			Holly-leaved Hovea
	<i>Hovea trisperma</i>			Common Hovea
	<i>Isotropis cuneifolia</i>			
	<i>Kennedia carinata</i>			
	<i>Kennedia coccinea</i>			Coral Vine
	<i>Kennedia prostrata</i>			Scarlet Runner

FAMILY	SPECIES	NATURALISED	CONSV_CODE	VERNACULAR
Fabaceae	<i>Labichea punctata</i>			Lance-leaved Cassia
	<i>Lotus subbiflorus</i>	*		
	<i>Sphaerolobium medium</i>			
	<i>Trifolium arvense</i> var. <i>arvense</i>	*		
Gentianaceae	<i>Centaurium erythraea</i>	*		Common Centaury
Geraniaceae	<i>Geranium solanderi</i>			Native Geranium
Goodeniaceae	<i>Dampiera alata</i>			Winged-stem Dampiera
	<i>Dampiera linearis</i>			Common Dampiera
	<i>Goodenia eatoniana</i>			
	<i>Scaevola calliptera</i>			
Haemodoraceae	<i>Conostylis aculeata</i> subsp. <i>aculeata</i>			
	<i>Conostylis pusilla</i>			
	<i>Conostylis serrulata</i>			
	<i>Haemodorum spicatum</i>			Mardja
	<i>Phlebocarya ciliata</i>			
Hemerocallidaceae	<i>Agrostocrinum hirsutum</i>			
	<i>Caesia micrantha</i>			Pale Grass-lily
	<i>Dianella revoluta</i> var. <i>divaricata</i>			
	<i>Johnsonia lupulina</i>			Hooded Lily
Iridaceae	<i>Ixia maculata</i>	*		Yellow Ixia
	<i>Moraea flaccida</i>	*		One-leaf Cape Tulip
	<i>Patersonia occidentalis</i> var. <i>angustifolia</i>			
	<i>Patersonia umbrosa</i> var. <i>xanthina</i>			Yellow Flags
	<i>Sparaxis bulbifera</i>	*		
	<i>Watsonia meriana</i> var. <i>bulbillifera</i>	*		
Juncaceae	<i>Juncus gregiflorus</i>			
	<i>Juncus microcephalus</i>	*		
	<i>Juncus pallidus</i>			Pale Rush
Lamiaceae	<i>Hemiandra pungens</i>			Snakebush
	<i>Hemigenia pritzelii</i>			

FAMILY	SPECIES	NATURALISED	CONSV_CODE	VERNACULAR
Lamiaceae	<i>Lavandula stoechas</i>	*		Italian Lavender
Linaceae	<i>Linum marginale</i>			Wild Flax
Malvaceae	<i>Thomasia grandiflora</i>			Large Flowered Thomasia
Myrtaceae	<i>Astartea scoparia</i>			
	<i>Calytrix flavescens</i>			Summer Starflower
	<i>Corymbia calophylla</i>			Marri
	<i>Eucalyptus citriodora</i>	*		Lemon-scented Gum
	<i>Eucalyptus marginata</i> subsp. <i>marginata</i>			Jarrah
	<i>Eucalyptus patens</i>			Swan River Blackbutt
	<i>Eucalyptus rudis</i>			Flooded Gum
	<i>Hypocalymma angustifolium</i>			White Myrtle
	<i>Leptospermum laevigatum</i>	*		Coast Teatree
	<i>Melaleuca pauciflora</i>			
	<i>Melaleuca viminea</i> subsp. <i>viminea</i>			
	<i>Pericalymma ellipticum</i>			Swamp Teatree
	<i>Taxandria linearifolia</i>			
	<i>Taxandria parviceps</i>			
Orchidaceae	<i>Pterostylis pyramidalis</i>			Snail Orchid
	<i>Caladenia flava</i>			Cowslip Orchid
	<i>Caladenia macrostylis</i>			Leaping Spider Orchid
	<i>Corybas recurvus</i>			
	<i>Cryptostylis ovata</i>			Slipper Orchid
	<i>Cyanicula sericea</i>			
	<i>Disa bracteata</i>	*		
	<i>Elythranthera brunonis</i>			Purple Enamel Orchid
	<i>Lyperanthus serratus</i>			Rattle Beak Orchid
	<i>Pheladenia deformis</i>			
	<i>Pterostylis barbata</i>			Bird Orchid
	<i>Pterostylis recurva</i>			Jug Orchid
	<i>Pterostylis</i> sp. Slender Snail Orchid (G.J. Keighery 14516)			

FAMILY	SPECIES	NATURALISED	CONSV_CODE	VERNACULAR
Orchidaceae	<i>Pterostylis vittata</i>			Banded Greenhood
	<i>Thelymitra crinita</i>			Blue Lady Orchid
Orobanchaceae	<i>Orobanche minor</i>	*		Lesser Broomrape
	<i>Parentucellia viscosa</i>	*		Sticky Bartsia
Oxalidaceae	<i>Oxalis corniculata</i>	*		Yellow Wood Sorrel
	<i>Oxalis pes-caprae</i>	*		Soursob
Phyllanthaceae	<i>Phyllanthus calycinus</i>			False Boronia
	<i>Poranthera microphylla</i>			Small Poranthera
Phytolaccaceae	<i>Phytolacca octandra</i>	*		Red Ink Plant
Pinaceae	<i>Pinus pinaster</i>	*		Pinaster Pine
	<i>Pinus radiata</i>	*		Radiata Pine
Pittosporaceae	<i>Billardiera variifolia</i>			
	<i>Marianthus tenuis</i>			
Plantaginaceae	<i>Plantago lanceolata</i>	*		Ribwort Plantain
Poaceae	<i>Amphipogon amphipogonoides</i>			
	<i>Amphipogon turbinatus</i>			
	<i>Anthoxanthum odoratum</i>	*		Sweet Vernal Grass
	<i>Austrostipa campylachne</i>			
	<i>Austrostipa compressa</i>			
	<i>Austrostipa mollis</i>			
	<i>Avena barbata</i>	*		Bearded Oat
	<i>Briza maxima</i>	*		Blowfly Grass
	<i>Briza minor</i>	*		Shivery Grass
	<i>Cynodon dactylon</i>	*		Couch
	<i>Deyeuxia quadriseta</i>			Reed Bentgrass
	<i>Ehrharta calycina</i>	*		Perennial Veldt Grass
	<i>Eragrostis cilianensis</i>	*		Stinkgrass
	<i>Eragrostis curvula</i>	*		African Lovegrass
	<i>Holcus lanatus</i>	*		Yorkshire Fog
	<i>Lolium rigidum</i>	*		Wimmera Ryegrass

FAMILY	SPECIES	NATURALISED	CONSV_CODE	VERNACULAR
Poaceae	<i>Microlaena stipoides</i> var. <i>stipoides</i>			
	<i>Neurachne alopecuroidea</i>			Foxtail Mulga Grass
	<i>Pennisetum clandestinum</i>	*		Kikuyu Grass
	<i>Poa annua</i>	*		Winter Grass
	<i>Rytidosperma acerosum</i>			
	<i>Rytidosperma setaceum</i>			
	<i>Tetrarrhena laevis</i>			Forrest Ricegrass
Podocarpaceae	<i>Podocarpus drouynianus</i>			Wild Plum
Polygalaceae	<i>Comesperma confertum</i>			
	<i>Comesperma virgatum</i>			Milkwort
Polygonaceae	<i>Acetosella vulgaris</i>	*		
	<i>Persicaria decipiens</i>			
Primulaceae	<i>Lysimachia arvensis</i>	*		Pimpernel
Proteaceae	<i>Adenanthos obovatus</i>			Basket Flower
	<i>Banksia attenuata</i>			Slender Banksia
	<i>Banksia dallaneyi</i>			Couch Honeypot
	<i>Banksia grandis</i>			Bull Banksia
	<i>Banksia littoralis</i>			Swamp Banksia
	<i>Conospermum capitatum</i> subsp. <i>glabratum</i>			
	<i>Grevillea quercifolia</i>			Oak-leaf Grevillea
	<i>Hakea amplexicaulis</i>			Prickly Hakea
	<i>Hakea lissocarpha</i>			Honey Bush
	<i>Hakea ruscifolia</i>			Candle Hakea
	<i>Persoonia longifolia</i>			Snottygobble
	<i>Petrophile linearis</i>			Pixie Mops
	<i>Synaphea gracillima</i>			
Pteridaceae	<i>Adiantum aethiopicum</i>			Common Maidenhair
Ranunculaceae	<i>Clematis pubescens</i>			Common Clematis
	<i>Ranunculus colonorum</i>			Common Buttercup
Restionaceae	<i>Desmocladus fasciculatus</i>			

FAMILY	SPECIES	NATURALISED	CONSV_CODE	VERNACULAR
Restionaceae	<i>Hypolaena exsulca</i>			
	<i>Loxocarya cinerea</i>			
	<i>Meeboldina roycei</i>			
Rhamnaceae	<i>Trymalium odoratissimum</i> subsp. <i>trifidum</i>			
Rosaceae	<i>Acaena echinata</i>			Sheep's Burr
	<i>Rubus anglocandicans</i>	*		
Rubiaceae	<i>Opercularia hispidula</i>			Hispid Stinkweed
Rutaceae	<i>Boronia dichotoma</i>			
	<i>Boronia ramosa</i> subsp. <i>anethifolia</i>			
	<i>Boronia spathulata</i>			Boronia
	<i>Diplolaena dampieri</i>			Southern Diplolaena
	<i>Philothea spicata</i>			Pepper and Salt
Sapindaceae	<i>Dodonaea viscosa</i> subsp. <i>angustissima</i>			
Scrophulariaceae	<i>Verbascum virgatum</i>	*		Twiggy Mullein
Solanaceae	<i>Solanum nigrum</i>	*		Black Berry Nightshade
Stylidiaceae	<i>Levenhookia pusilla</i>			Midget Stylewort
	<i>Levenhookia stipitata</i>			Common Stylewort
	<i>Stylidium adnatum</i>			Common Beaked Triggerplant
	<i>Stylidium brunonianum</i>			Pink Fountain Triggerplant
	<i>Stylidium calcaratum</i>			Book Triggerplant
	<i>Stylidium ciliatum</i>			Golden Triggerplant
	<i>Stylidium rhynchocarpum</i>			Black-beaked Triggerplant
	<i>Stylidium schoenoides</i>			Cow Kicks
Thymelaeaceae	<i>Pimelea ciliata</i> subsp. <i>ciliata</i>			
	<i>Pimelea suaveolens</i>			Scented Banjine
Xanthorrhoeaceae	<i>Xanthorrhoea gracilis</i>			Graceful Grass Tree
	<i>Xanthorrhoea preissii</i>			Grass tree
Zamiaceae	<i>Macrozamia riedlei</i>			Zamia

Appendix C: Vegetation Association Descriptions

Group	Unit Code	Description	Habitat and Soils	Notes
1	EpCc	<i>Eucalyptus patens</i> , <i>Corymbia calophylla</i> open forest over <i>Bossiaea aquifolium</i> subsp. <i>aquifolium</i> high shrubland to open scrub over <i>Tremandra stelligera</i> , <i>Hibbertia silvestris</i> low open shrubland over <i>Microlaena stipoides</i> var. <i>stipoides</i> scattered grasses and <i>Pteridium esculentum</i> fernland.	Habitat and soils: Lower slope of hill. Orange brown loam. Soil-landscape subsystem: 255LvGR	Relevés: EKR22, EKR24, EKR25, EKR36, EKR37 Photo: EKR24
1	CcEmEp	<i>Corymbia calophylla</i> , <i>Eucalyptus marginata</i> subsp. <i>marginata</i> , (<i>Eucalyptus patens</i>) open forest over <i>Persoonia longifolia</i> scattered tall shrubs over <i>Bossiaea linophylla</i> high open shrubland over <i>Macrozamia riedlei</i> scattered shrubs over <i>Hibbertia silvestris</i> low open shrubland with <i>Pteridium esculentum</i> fernland and <i>Clematis pubescens</i> very open lianes.	Habitat and soils: East-facing mid-slope of ridge. Soil-landscape subsystem: 255LvGR	Notes: <i>Eucalyptus patens</i> is only present sporadically in this association. Relevés: EKR38, EKR39, EKR40 Photo: EKR38
1	EpCcLt	<i>Eucalyptus patens</i> , (<i>Corymbia calophylla</i>) open forest over <i>Trymalium odoratissimum</i> subsp. <i>trifidum</i> open scrub over <i>Tremandra stelligera</i> scattered low shrubs over <i>Lepidosperma tetraquetrum</i> open sedgeland (patchy) with <i>Adiantum aethiopicum</i> open fernland.	Habitat and soils: Narrow creekline and steep banks. Gravelly brown loam. Soil-landscape subsystem: 255LvGR	Notes: This creekline vegetation also included <i>Lepidosperma persecans</i> on the creek bed. Relevés: EKR23, EKR42 Photo: EKR42
2	EmCc	<i>Eucalyptus marginata</i> subsp. <i>marginata</i> , <i>Corymbia calophylla</i> woodland over <i>Xanthorrhoea preissii</i> scattered tall shrubs over <i>Macrozamia riedlei</i> , <i>Hakea lissocarpha</i> scattered shrubs over <i>Hibbertia hypericoides</i> , <i>Bossiaea ornata</i> low open heath over <i>Tetraria octandra</i> , <i>Tetraria</i> sp. Jarrah Forest scattered sedges.	Habitat and soils: Crest of low hill. Gravelly, brown sand. Lateritic rocks seen elsewhere in this unit. Soil-landscape subsystems: 255DpDWi, 255DpYGu	Notes: This vegetation was the most widespread in the western two thirds of the survey corridor. Similar vegetation occurred on the upper ridge slopes at the western end of the survey area, but typically with a <i>Bossiaea aquifolium</i> subsp. <i>aquifolium</i> high shrubland to open scrub . Relevés: EKR01, EKR03, EKR04, EKR05, EKR06, EKR10, EKR11, EKR16, EKR17, EKR18, EKR19, EKR20, EKR21, EKR31, EKR34, EKR35, EKR41 Photos: EKR03, EKR05

Group	Unit Code	Description	Habitat and Soils	Notes
2	EmCcAf	<i>Eucalyptus marginata</i> subsp. <i>marginata</i> , <i>Corymbia calophylla</i> open forest over <i>Allocasuarina fraseriana</i> , (<i>Banksia grandis</i>) low open woodland over <i>Bossiaea aquifolium</i> subsp. <i>aquifolium</i> high shrubland over <i>Macrozamia riedlei</i> scattered shrubs over <i>Hibbertia hypericoides</i> scattered low shrubs over <i>Tetraria</i> sp. Jarrah Forest scattered sedges.	Habitat and soils: Gently sloping, east-facing, midslope of broad ridge. Gravelly grey sand. Laterite rocks present. Soil-landscape subsystems: 255DpDWi	Notes: This vegetation occurred in several areas of gravelly grey sand on the lateritic ridges in the western part of the survey area. Note: No releves, based on Morgan (2011)
3	EmAfBa	<i>Eucalyptus marginata</i> subsp. <i>marginata</i> scattered trees to open woodland over <i>Allocasuarina fraseriana</i> , <i>Banksia attenuata</i> low woodland over <i>Macrozamia riedlei</i> scattered shrubs over <i>Hibbertia hypericoides</i> , (<i>Calytrix flavescens</i> , <i>Petrophile linearis</i>) low shrubland over <i>Lyginia imberbis</i> scattered sedges with <i>Phlebocarya ciliata</i> , <i>Patersonia occidentalis</i> var. <i>angustifolia</i> open herbland and <i>Pteridium esculentum</i> scattered ferns.	Habitat and soils: Gentle, east-facing midslope of broad low ridge on Plateau. Pale grey sand. Soil-landscape subsystems: 255DpWGs	Notes: This vegetation occurred in small areas of sandy soils.
3	EmAfPc	<i>Eucalyptus marginata</i> subsp. <i>marginata</i> , (<i>Corymbia calophylla</i>) woodland over <i>Allocasuarina fraseriana</i> low woodland over <i>Xanthorrhoea preissii</i> , <i>Macrozamia riedlei</i> scattered shrubs over <i>Hibbertia hypericoides</i> low open shrubland over <i>Desmocladius fasciculatus</i> very open sedgeland with <i>Patersonia occidentalis</i> var. <i>angustifolia</i> , <i>Phlebocarya ciliata</i> open herbland and <i>Pteridium esculentum</i> open fernland.	Habitat and soils: Lower slopes. Grey sand, Red-brown sandy loam. Soil-landscape subsystems: 255DpDWi, 255DpWGs	Notes: This vegetation occurred on sandy soils in the central west part of the survey corridor. A variant of this association occurs on yellow-brown and red-brown loamy sand west of Wellington Dam Road Releves: EKR02, EKR07, EKR26 Photo: EKR26

Group	Unit Code	Description	Habitat and Soils	Notes
3	EmCcHa	<i>Corymbia calophylla</i> , <i>Eucalyptus marginata</i> subsp. <i>marginata</i> open woodland over <i>Nuytsia floribunda</i> scattered low trees over <i>Acacia extensa</i> , <i>Xanthorrhoea preissii</i> scattered shrubs over <i>Hypocalymma angustifolium</i> scattered low shrubs to low shrubland over <i>Hypolaena exsulca</i> , <i>Desmocladus fasciculatus</i> open sedgeland with <i>Patersonia occidentalis</i> var. <i>angustifolia</i> , <i>Johnsonia lupulina</i> , <i>Phlebocarya ciliata</i> herbland.	Habitat and soils: Very gently sloping flats. Sand. Soil-landscape subsystems: 255DpWGs, 255DpDWi, 255DpWG	Notes: The adjacent bushland on the north side of the Coalfields Highway (releve EKR12) had vegetation that was closer to unit EmCc, but was included in EmCcHa because of the presence of some dampland species that set it aside. (Releves: EKR09, EKR12, EKR27, EKR33 Photo: EKR27
4	EmCcBI	<i>Eucalyptus marginata</i> subsp. <i>marginata</i> , <i>Corymbia calophylla</i> open woodland over <i>Banksia littoralis</i> low open woodland over <i>Xanthorrhoea preissii</i> , <i>Acacia divergens</i> open shrubland over <i>Banksia dallanneyi</i> , <i>Hibbertia hypericoides</i> scattered low shrubs over <i>Lepidosperma scabrum</i> complex sedgeland.	Habitat and soils: Very gently sloping, broad flow line/basin. Soil-landscape subsystems: 255DpWGs	Notes: This vegetation is situated in a broad, shallow flowline/basin. Releves: EKR08, EKR28 Photo: EKR28
4	EmCcTI	<i>Eucalyptus marginata</i> subsp. <i>marginata</i> , <i>Corymbia calophylla</i> open woodland (over <i>Melaleuca preissiana</i> scattered low trees) over <i>Taxandria linearifolia</i> high shrubland over <i>Hypocalymma angustifolium</i> , (<i>Hibbertia hypericoides</i>) low open shrubland over <i>Cyathochaeta avenacea</i> , <i>Desmocladus fasciculatus</i> sedgeland with <i>Patersonia occidentalis</i> , <i>Liparophyllum latifolium</i> very open herbland.	Habitat and soils: Seasonal dampland. Dark brown sandy loam. (Appears to be light grey when dry; also silty). Soil-landscape subsystem: 255DpWGs	Notes: Includes transitional dampland vegetation with <i>Taxandria linearifolia</i> high open shrubland to open scrub. Releves: EKR29, EKR30 Photo: EKR30
4	CcTI	Scattered <i>Corymbia calophylla</i> (<i>Eucalyptus rudis</i>) trees over <i>Taxandria linearifolia</i> (<i>Melaleuca viminea</i>) tall open shrubland over annual introduced species	Creekline in otherwise cleared pasture [Probably a degraded version of the previous association] and edge of Wellington Dam. Soil-landscape subsystems: 255DpYGu, 255LvGR	

Appendix D. Photographs of vegetation associations in the survey area.



Group 1: *Eucalyptus patens*, *Corymbia calophylla* open forest (EpCc)



Group 1: *Corymbia calophylla*, *Eucalyptus marginata* subsp. *marginata*, (*Eucalyptus patens*) open forest (CcEmEp)



Group 1: *Eucalyptus patens*, (*Corymbia calophylla*) open forest with *Lepidosperma tetraquetrum* tall sedges along creeklines (EpCclt)



Group 2: *Eucalyptus marginata* subsp. *marginata*, *Corymbia calophylla* woodland or open forest (EmCc)



Group 2: *Eucalyptus marginata* subsp. *marginata*, *Corymbia calophylla* woodland or open forest (EmCc)



Group 2: *Eucalyptus marginata* subsp. *marginata*, *Corymbia calophylla* open forest over *Allocasuarina fraseriana* low open woodland (EmCcAf)



Group 3: *Eucalyptus marginata* subsp. *marginata* scattered trees to open woodland over *Allocasuarina fraseriana*, *Banksia attenuata* low woodland (EmAfBa)



Group 3: *Eucalyptus marginata* subsp. *marginata*, (*Corymbia calophylla*) woodland over *Allocasuarina fraseriana* with *Phlebocarya ciliata* herbland in the understorey (EmAfPc)



Group 3: *Corymbia calophylla*, *Eucalyptus marginata* subsp. *marginata* open woodland over *Nuytsia floribunda* with *Hypocalymma angustifolium* low shrubland (EmCcHa)



Group 4: *Eucalyptus marginata* subsp. *marginata*, *Corymbia calophylla* open woodland over *Banksia littoralis* low open woodland (EmCcBI)



Group 4: *Eucalyptus marginata* subsp. *marginata*, *Corymbia calophylla* open woodland (over *Melaleuca preissiana* scattered low trees) over *Taxandria linearifolia* high shrubland (EmCcTI)



Group 4: Scattered *Corymbia calophylla* trees over *Taxandria linearifolia* tall open shrubland in pasture (CcTI)

APPENDIX 4

EPBC Act Protected Matters Search Report



EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 24/01/13 17:28:19

[Summary](#)

[Details](#)

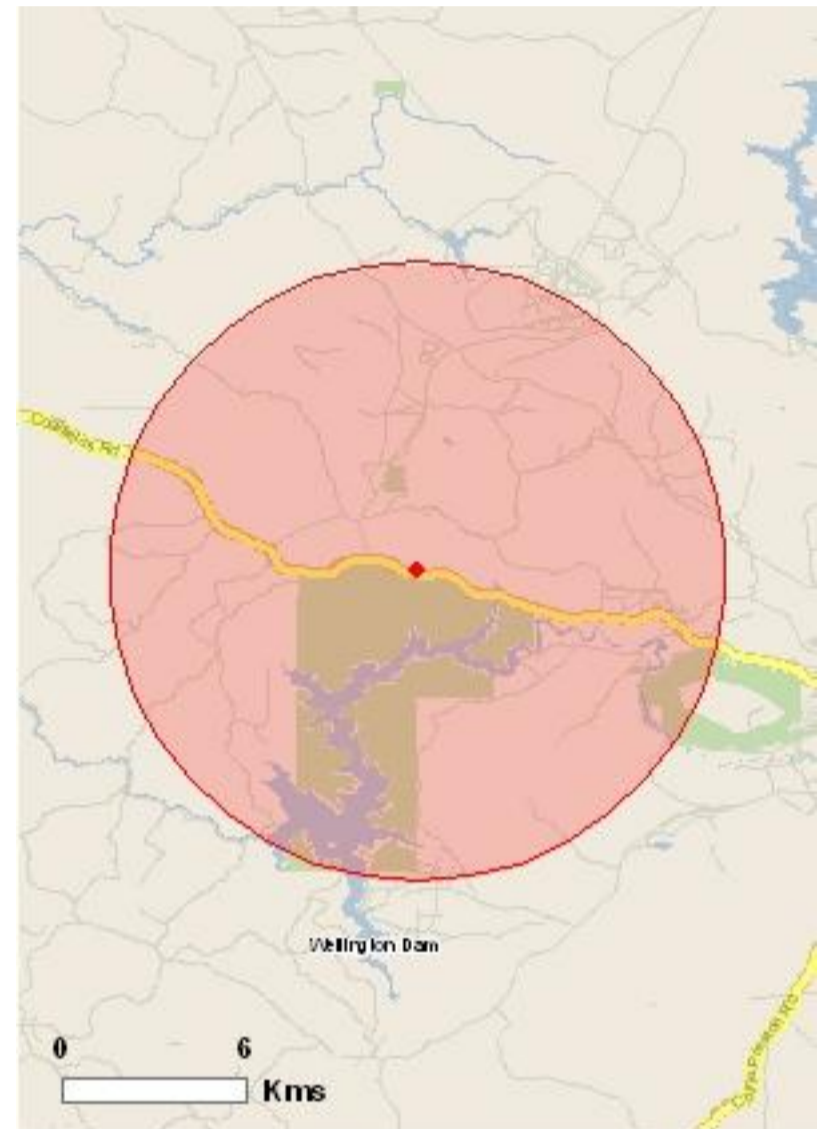
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

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Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	13
Listed Migratory Species:	8

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As [heritage values](#) of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate.

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	5
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

Place on the RNE:	3
State and Territory Reserves:	2
Regional Forest Agreements:	1
Invasive Species:	11
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo [67034]	Vulnerable	Species or species habitat may occur within area
Calyptorhynchus baudinii Baudin's Black-Cockatoo, Long-billed Black-Cockatoo [769]	Vulnerable	Breeding known to occur within area
Calyptorhynchus latirostris Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Breeding likely to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
Fish		
Nannatherina balstoni Balston's Pygmy Perch [66698]	Vulnerable	Species or species habitat may occur within area
Mammals		
Bettongia penicillata ogilbyi Woylie [66844]	Endangered	Species or species habitat known to occur within area
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area
Pseudocheirus occidentalis Western Ringtail Possum [25911]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Setonix brachyurus Quokka [229]	Vulnerable	Species or species habitat may occur within area
Plants		
Centrolepis caespitosa [6393]	Endangered	Species or species habitat may occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat known to occur within area
Drakaea elastica Glossy-leaved Hammer-orchid, Praying Virgin [16753]	Endangered	Species or species habitat likely to occur within area

Listed Migratory Species [\[Resource Information \]](#)

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area

Migratory Terrestrial Species

Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area

Migratory Wetlands Species

Ardea alba Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [\[Resource Information \]](#)

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Ardea alba Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area

Extra Information

Places on the RNE [\[Resource Information \]](#)

Note that not all Indigenous sites may be listed.

Name	State	Status
Natural		
Lennard Management Priority Area	WA	Indicative Place
South West Irrigation Area	WA	Indicative Place
Westralia Management Priority Area	WA	Indicative Place

State and Territory Reserves [\[Resource Information \]](#)

Name	State
Wellington	WA
Westralia	WA

Regional Forest Agreements [\[Resource Information \]](#)

Note that all areas with completed RFAs have been included.

Name	State
South West WA RFA	Western Australia

Invasive Species [\[Resource Information \]](#)

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resources Audit, 2001.

Name	Status	Type of Presence
Mammals		
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area

Plants

Name	Status	Type of Presence
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area

Coordinates

-33.32305 116.0237

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [-Department of Environment, Climate Change and Water, New South Wales](#)
- [-Department of Sustainability and Environment, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment and Natural Resources, South Australia](#)
- [-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts](#)
- [-Environmental and Resource Management, Queensland](#)
- [-Department of Environment and Conservation, Western Australia](#)
- [-Department of the Environment, Climate Change, Energy and Water](#)
- [-Birds Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-SA Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
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- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Atherton and Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence](#)
- [-State Forests of NSW](#)
- [-Geoscience Australia](#)
- [-CSIRO](#)
- Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.

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APPENDIX 5

**Flora and Vegetation Study or
the Wellington Dam Road Grey
Sands (255DpWGs) Area
(Morgan 2012)**

**FLORA AND VEGETATION
STUDY
OF THE
WELLINGTON DAM RD
GREY SANDS (255DpWGs) AREA**

Prepared for RPS Group PL

by

Brian Morgan

Consultant Plant Biologist

January 2012

Contents

1.	INTRODUCTION	1
1.1	Proposed works.....	1
1.2	Purpose of the survey.....	1
1.3	The survey area.....	2
2.	METHODS AND LIMITATIONS OF THE SURVEY	3
2.1	Survey timing.....	3
2.2	Flora survey of the WDRGS survey area	3
	2.2.1 Compilation of a flora species list – general flora survey methods	3
	2.2.2 Limitations of the flora survey	4
2.3	Vegetation survey of the WDRGS survey area	4
	2.3.1 Methods of the vegetation survey of the WDRGS survey area.....	4
	2.3.2 Limitations of the vegetation survey	5
2.4	Vegetation mapping of the WDRGS survey area.....	5
	2.4.1 Methods for vegetation mapping.....	5
2.5	Assessing a regional context for vegetation on the deep grey sands in the WDRGS survey area	6
	2.5.1 Selecting an approach to study the regional context of the WDRGS vegetation6	
	2.5.2 Site selection and data collection for regional sites.....	7
	2.5.3 PATN analysis of regional data set	7
3.	FLORA OF THE WDRGS SURVEY AREA	9
3.1	Flora list for the WDRGS survey area.....	9
3.2	Significant flora recorded in the survey area	9
	3.2.1 Declared Rare Flora (DRF)	9
	3.2.2 Priority flora species recorded in the survey area	9
4.	VEGETATION OF THE WDRGS SURVEY AREA.....	10
4.1	Vegetation description	10
	4.1.1 Introduction to vegetation descriptions	10
	4.1.2 Description of the Coalfields Highway survey area vegetation	10
4.2	Vegetation Condition.....	22
5.	PATN ANALYSIS AND ASSESSMENT OF REGIONAL SIGNIFICANCE	24
5.1	Vegetation and soils of the study sites.....	24

5.2	PATN classification dendrogram.....	24
5.3	Association matrix	25
5.4	Conclusions.....	25
6.	ACKNOWLEDGEMENTS	31
7.	REFERENCES	32

PLATES

Plate 1:	Vegetation unit EmAfPc at quadrat CHSQ1, on deep grey sands.....	15
Plate 2:	Vegetation unit EmAfPc at quadrat CHSQ5.	16
Plate 3:	Vegetation unit EmAfPc at quadrat CHSQ6.	17
Plate 4:	Vegetation unit EmAfPc at quadrat CHSQ18, just north of the Information Board.....	17
Plate 5:	Vegetation unit EmCc on lateritic gravelly soils at quadrat CHSQ3 in the central part of the WDRGS survey area.	18
Plate 6:	Vegetation unit EmCc on lateritic gravelly soils at quadrat CHSQ4 in the south-western corner of the WDRGS survey area.....	18
Plate 7:	Vegetation unit EmCcHa at releve site CHSR13.	21
Plate 8:	Vegetation unit EmHePc at releve site CHSR11.....	21
Plate 9:	The ‘Completely Degraded’ sand pit with exotic Pinus sp. and Eucalyptus sp. plantings.	22

TABLES

Table 1:	Abbreviations of species names used in vegetation unit codes.	10
Table 2:	Vegetation and soils of the study quadrats	27
Table 3:	Tabulation of the Association Matrix, showing the dissimilarity coefficients for each pairing of sites.....	30

FIGURES

Figure 1: Vegetation units of of the WDRGS survey area.	11
Figure 2: Location of regional quadrat sites and the Soil-landscape Subsystems in which they occurred.	12
Figure 3: Vegetation condition of the WDRGS survey area.	23
Figure 4: Classification dendrogram of WDRGS survey area and regional vegetation sample sites.	29

APPENDICES

APPENDIX 1: Definition of Department of Environment and Conservation's Declared Rare and Priority Flora categories (Smith 2010).....	33
APPENDIX 2 : Vegetation structural table of Specht as modified by Aplin (1979). .	34
APPENDIX 3 : Vegetation condition scale and descriptions (from Department of Environmental Protection, 2000)	35
APPENDIX 4 : Flora list for the WDRGS survey area and regional study quadrats ..	36
APPENDIX 5 : Quadrat descriptions and species lists for the WDRGS survey area south of the Coalfields Highway and regional sites.....	47
APPENDIX 6: Releve and Mapping Note descriptions for the WDRGS survey area south of the Coalfields Highway.....	72

EXECUTIVE SUMMARY

Main Roads Western Australia is undertaking the Coalfields Highway Upgrade 16-28 SLK project, which aims to realign, widen and otherwise upgrade parts of that section of the Coalfields Highway to improve road safety. A Level 1 flora and vegetation survey of the Coalfields Highway Alignments was undertaken between November 2010 and February 2011. After reviewing the report document, the Bunbury Department of Environment and Conservation (DEC) office raised concerns relating to an area of Soil Landscape Subsystems 255DpWGs that was traversed by the Coalfields Highway Alignments. These concerns were that this area of Soil Landscape Subsystems 255DpWGs, located around the intersection of Wellington Dam Rd and the Coalfields Hwy, was restricted in this region and may be associated with restricted plant communities (Figure 1) and that the part of this area traversed by Alignment 2 lies in the Wellington National Park ('secure conservation vesting'). In particular, the DEC suggested that further work was required to determine the regional context of the vegetation occurring on deep grey sands around and to the east of the Wellington Dam Rd Information Board (included the traversing section of Alignment 2).

The purpose of this survey was to determine the extent of the deep grey sands vegetation in the Soil Landscape Subsystem 255DpWGs in the Wellington Dam Rd area south of the Coalfields Hwy (WDRGS survey area), if special flora values were associated with the deep grey sand vegetation and test the regional significance status of the deep grey sand vegetation.

The field survey was conducted between the 14th and 16th October; between the 11th and 14th November and between the 26th and 29th of November 2011.

A flora list was compiled for the WDRGS survey area and the vegetation was described and mapped in the WDRGS survey area. Seven quadrats and one releve from the WDRGS survey area (five sites in the deep grey sands area) and eleven (11) regional quadrats were analysed using PATN to determine their floristic similarity.

One hundred and eighty nine native plants were recorded in the WDRGS survey area (south of the Coalfields Highway), while a total of two hundred and fifty nine (259) native species were recorded in total in either the WDRGS survey area or the regional quadrats. No significant flora was found to be associated with the vegetation on the

deep grey sands. In particular, no Declared Rare Flora (DRF) species or Priority flora species were recorded in the WDRGS survey area. One Priority species, *Stylidium rigidifolium* (now listed on FloraBase as *Stylidium striatum*) (Priority 4) was recorded in one of the regional quadrats.

Eleven vegetation units were mapped in the WDRGS area (south of the Coalfields Highway) and included some minor revisions to the 2010 mapped units in the Alignments. The vegetation mapping showed that the WDRGS survey area (the Soils Landscape Subsystem 255DpWGs south of the Coalfields Hwy), rather than being an area of homogeneous soils and vegetation, had a variety of soils, habitats and associated vegetation units, reflected in the eleven (11) vegetation units described for the area. Furthermore, the area of deep grey sands and associated vegetation was restricted to a small area at the western end of the WDRGS survey area (about 7.5 ha).

The vegetation condition in the WDRGS survey area (south of the Coalfields Highway) was mostly in the range Very Good to Excellent. However, the sand pit area in the south-western corner of the Wellington Dam Rd-Coalfields Hwy intersection was mapped as Completely Degraded, with patchy disturbance in the surrounding area resulting in its vegetation condition being rated as 'Good to Very Good'.

The PATN analysis generated a four and nine group classification for the nineteen sites. Interpretation of the classification dendrogram and the Association Matrix concluded that the results DID NOT demonstrate that the deep grey sands vegetation in the WDRGS survey area WAS NOT regionally significant. Furthermore, it suggests that, despite some moderate similarity with some of the regional sites included in the study, the deep grey sands vegetation is likely to be restricted and regionally significant. The scope of the study did limit the results, as the limited regional data set meant a comprehensive test for regional significance could not be conducted.

The PATN analysis results also demonstrated that:

- the vegetation in the WDRGS survey area is not floristically homogeneous.
- The sites on the deeper grey sands in the western part of the survey area were floristically most similar to each other and could be considered as one floristic entity.

1. INTRODUCTION

1.1 Proposed works

Main Roads Western Australia is undertaking the Coalfields Highway Upgrade 16-28 SLK project, which aims to realign, widen and otherwise upgrade parts of that section of the Coalfields Highway to improve road safety. A realignment route has been proposed for the 16-28 SLK Coalfields Highway (Alignment 1), including a second alternative alignment for the western part (Alignment 2) (here after ‘Coalfields Highway Alignments’ or ‘Alignments’).

A Level 1 flora and vegetation survey of the Coalfields Highway Alignments was undertaken between November 2010 and February 2011. After reviewing the report document, the Bunbury Department of Environment and Conservation (DEC) office raised concerns relating to an area of Soil Landscape Subsystems 255DpWGs that was traversed by the Coalfields Highway Alignments. These concerns were that this area of Soil Landscape Subsystems 255DpWGs, located around the intersection of Wellington Dam Rd and the Coalfields Hwy, was restricted in this region and may be associated with restricted plant communities (Figure 1) and that the part of this area traversed by Alignment 2 lies in the Wellington NP (‘secure conservation vesting’). The DEC suggested that, for the area of vegetation on deep grey sands around and to the east of the Wellington Dam Rd Information Board (included the traversing section of Alignment 2), further work was required to place its plant community(ies) in regional context and that the DEC needed to be assured ‘that there is not any floristic uniqueness associated with this soil type’ (Andrew Webb (DEC), *pers. comm.*).

1.2 Purpose of the survey

The purpose of this survey was to:

- compile a comprehensive flora list for the area of Soil Landscape Subsystem 255DpWGs in the locality of the Wellington Dam Rd-Coalfields Hwy intersection (Figure 1);
- map and describe the vegetation units and vegetation condition for this area of Soil Landscape Subsystem 255DpWGs;

- test the regional significance of the vegetation units on the area of deep grey sands where Alignment 2 traverses the Soil Landscape Subsystems 255DpWGs if sufficient data sets were available or test if similar vegetation occurred elsewhere in the region.

1.3 The survey area

This study limited itself to that part of the Soil Landscape Subsystems 255DpWGs area of interest (Figure 1) that was south of the current Coalfields Highway (here after ‘WDRGS survey area’), as that included the part of the 255DpWGs area that is in the Wellington NP and which is traversed by Alignment 2. The part of Soil Landscape Subsystems 255DpWGs that occurs on the north side of the Coalfields Hwy is on privately owned property.

2. METHODS AND LIMITATIONS OF THE SURVEY

2.1 Survey timing

The WDRGS survey area was traversed for flora records and quadrat recording between the 14th and 16th October. Further quadrat recording was undertaken and the vegetation mapping of the WDRGS area finalised between the 11th and 14th November and the regional quadrats were located and recorded between the 26th and 29th of November 2011.

2.2 Flora survey of the WDRGS survey area

2.2.1 Compilation of a flora species list – general flora survey methods

The flora list for the WDRGS survey area was compiled from records while walking broad flora traverses through the area in mid-Spring, from species records from quadrats recorded in the area, when describing the vegetation at other sites in the study area using releves and mapping notes and while walking between the vegetation recording sites and mapping the vegetation. General flora searches were more concentrated in the western end of the WDRGS survey area that included the old sand mine pit and its surrounds, as the Alignment 2 corridor was proposed to traverse this area.

At quadrat sites, all plant species present were recorded. At releve sites ('unbounded' sample sites) and mapping note sites (abbreviated releves), dominant and subdominant species and some associated species were recorded. In the case of both quadrats, releves and mapping note sites, where a plant species was not well known, a specimen was collected and allocated a specimen number.

Plant species were recorded elsewhere in the WDRGS survey area if they had not been recorded at a quadrat or releve sampling site or if they were of particular interest. Again, where a plant species was not well known, a specimen was collected and allocated a specimen number. GPS coordinates were recorded (using a Garmin 60CX hand held GPS unit) whenever it was considered there was a possibility that the plant species may be of special interest.

The specimens collected were pressed, dried and identified. The identifications were made by comparison to specimens in the reference and research collections of the

Western Australian Herbarium, by the use of keys in various papers and books and by relevant experts on various groups of flora.

The DEC Declared Rare and Priority Flora List (Smith, 2010; definitions in Appendix 1) was consulted as required to confirm the status of plant species in the survey area.

2.2.2 Limitations of the flora survey

The major limitation of the flora survey is that any such survey is a sampling procedure of a variable environment with plant populations of variable growth habit, life span and flowering season. Some species, including annuals, are only available for collection for part of the year. This means that to locate all species that grow in an area is a substantial task, the success of which is related to the time available and the size and diversity of habitat in the survey. Consequently, it is possible that there are species present in the survey area that were not recorded during this survey as they have only low abundance on the land, or were not flowering at the time of the survey. However, this limitation was minimised by conducting this survey during Spring when most annual species were present and in some stage of flowering.

Given the limitations of the flora survey, it is likely that this survey recorded more than 85% of the vascular flora in the survey area. That is, while the flora survey was relatively thorough, it was possible that some species occurring in the survey area were not recorded.

2.3 Vegetation survey of the WDRGS survey area

2.3.1 Methods of the vegetation survey of the WDRGS survey area

Locations were selected for survey quadrats and releves that were representative of observed variations in the vegetation and habitat. Suitable sites for the quadrats were limited to sites in Good or better condition, where a good suite of species representative of that vegetation type, were present.

Seven (7) 10 metre by 10 metre quadrats (CHSQ1 to CHSQ6; CHSQ18; Figure 1) were marked out with a field measuring tape between fence dropper stakes driven into the ground at each corner, each fitted with a yellow plastic safety cap. The 10 metre by 10 metre quadrat dimensions were used because a 100m² sample area was considered to capture most species in a given plant community. Five of the seven

quadrats were located in the western part of the WDRGS survey area because the vegetation in that area was the focus of the regional significance study.

Each quadrat was photographed. A description of the quadrat location, the habitat, surface soil texture and colour were all recorded and the time since the site was last burnt was estimated. The vegetation structure was described using a modification of Specht's vegetation description table by Aplin (1979; Appendix 2). To obtain more representative data for the overstorey cover, the tree layer(s) cover was estimated over a larger area around the quadrats. The condition of vegetation in the quadrat was described using the Keighery classification outlined in Bush Forever (Department of Environmental Protection, 2000; see Appendix 3). All plant species occurring in a quadrat were recorded, along with their height, percentage cover and specimen number if collected.

Fifteen releves were recorded in the WDRGS survey area to also describe vegetation units. The composition of the releve descriptions was similar to that of the quadrats, but not all plant species in the releve area were recorded, but rather the dominant, subdominant and some associated species were recorded. Nine mapping note descriptions were also recorded. Releve and mapping note sites used in the vegetation unit descriptions are shown in Figure 1.

2.3.2 Limitations of the vegetation survey

There is a limit to the accuracy of the assignment of the different strata in the vegetation descriptions to structural units (for example, low open woodland, low woodland, low open forest, open shrubland, shrubland etc.). Referral of a stratum to a structural category depends on assessment of its cover. Such estimation is imprecise and it is not unusual for different observers to give quite different estimates of the cover of a species, or stratum in a stand. However, descriptive exercises such as that carried out for this report require only a moderate level of accuracy.

2.4 Vegetation mapping of the WDRGS survey area

2.4.1 Methods for vegetation mapping

Vegetation units were described generally between plant community and vegetation association level. The vegetation unit boundaries were drawn on a computer generated aerial photograph while traversing the study area and interpreting the

vegetation structure and floristics, using GPS coordinate readings to locate actual boundary positions. Orthorectified aerial photography at 1:5000 was used.

The vegetation mapping unit descriptions were based on the quadrat, releve and mapping note descriptions. The vegetation descriptions recorded in the field were later synthesized into vegetation units.

2.5 Assessing a regional context for vegetation on the deep grey sands in the WDRGS survey area

2.5.1 Selecting an approach to study the regional context of the WDRGS vegetation

An effort was made to source large vegetation quadrat data sets for the Jarrah forest, particularly from the Collie region. The DEC does not have suitable data sets representing vegetation types from the Jarrah forest (Andrew Webb, *pers. comm.*). Eleanor Bennett has recorded a considerable number of quadrats from many surveys in the Collie region, but was not able to get permission from clients for the release of the data within the timeframe of this study.

It was therefore decided to explore the forests in the Collie region to look for vegetation that may be similar to that on the deep grey sands in the WDRGS survey area and statistically test the similarity between the vegetation samples. If numerous sites of regional vegetation were found that were similar to that on the deep grey sands, then it may be possible to argue that the study area vegetation was not unique and depending on the regional extent, not uncommon. On the other hand, if regional vegetation samples, selected from vegetation of sites considered to be most similar to that on the deep grey sands in the study area, were found to be dissimilar to vegetation units in the study area, then while the data set of this survey would be too small to conclude that the study area vegetation was regionally significant, it could be reasonably concluded that the study area vegetation was different to the regional vegetation sampled and was most likely uncommon and probably regionally significant.

As was noted in section 2.3.1 above, five of the seven study area quadrats were recorded in the western part of the WDRGS survey area, as this was where the Alignment 2 corridor was proposed to traverse the area. Therefore, it was the vegetation units in this part of the study area that were the focus of the regional study.

One releve from the study area, CHR23, was also included in the analysis as it was the only sample point in the vegetation unit that included a *Banksia attenuata* strata (EmAfBa) and occurred on the deep grey sands area of interest. While the considerable disturbance in the area meant that it was too difficult to locate a 10 metre by 10 metre quadrat in the unit, numerous small areas in good condition were searched to compile a species list comparable with that for a quadrat. Any new species were added to the CHR23 releve list from November 2010.

2.5.2 Site selection and data collection for regional sites

The Soils Landscape Subsystems map was used to target sandy soil areas to view for soils and/or vegetation that may be similar to that on the deep grey sands in the study area. Most of the Soil Landform Subsystem 255DpWGs areas and related sandy soils areas (mostly 255DpDWs) occurred between 18 and 45 kilometres from the study area.

Eleven (11) 10 metre by 10 metre regional quadrats (CHSQ7 to CHSQ17; Figure 2) were recorded. The methods used for recording the regional quadrats and the data collected, were the same as those described for the study area quadrats (see section 2.3.1 above).

2.5.3 PATN analysis of regional data set

A PATN analysis was used to statistically determine the floristic (species presence/absence) similarity of the regional and study area vegetation. Mr Ted Griffin conducted the analysis and provided the results in the form of a classification dendrogram and a tabulation of the ‘association matrix’.

Eighteen (18) quadrats and one releve were included in the analysis.

Prior to the analysis, the site data was edited to remove duplicate names and to remove indeterminate names that could not be adequately compared between sites (such as ‘*Drosera* sp.’). To improve the analysis, weed species were removed to eliminate any possibly influence they may have on the analysis.

As there was some difference in timing between the recording of some of the study area quadrats (mid October) and the regional data set (late November), consideration was given to removing annual species. However, it was decided that species numbers were reasonably comparable between sites and that the late Spring season had meant

that most annuals could still be identified/observed in late November and therefore that the data set was not compromised.

3. FLORA OF THE WDRGS SURVEY AREA

3.1 Flora list for the WDRGS survey area

One native fern (*Pteridium esculentum*), one native cycad (*Macrozamia riedlei*) and one hundred and eighty seven (187) native flowering plants were recorded in the WDRGS survey area (south of the Coalfields Highway) (Appendix 4). In addition, eleven (11) weed species were recorded in the WDRGS survey area. The list of weeds in the WDRGS survey area is not exhaustive.

One hundred and eighty nine native plants represents a high number for the relatively small area of the WDRGS survey area (about 70 ha) and reflects the diversity of habitat and vegetation types in the area.

A total of two hundred and ninety (290) species, including two hundred and fifty nine (259) native species, were recorded in the WDRGS survey area and regional quadrats (Appendix 4).

3.2 Significant flora recorded in the survey area

3.2.1 Declared Rare Flora (DRF)

No DRF species were recorded in the survey area.

3.2.2 Priority flora species recorded in the survey area

One Priority species, *Stylidium rigidifolium* (now listed on FloraBase as *Stylidium striatum*) (Priority 4) was recorded during the WDRGS survey. It was collected in one of the regional quadrats (CHSQ16).

4. VEGETATION OF THE WDRGS SURVEY AREA

4.1 Vegetation description

4.1.1 Introduction to vegetation descriptions

The vegetation units described for the WDRGS survey area are considered to be mostly described between the plant community and vegetation association level.

The vegetation unit codes, used to represent the different vegetation units, are derived from the generic and species names of the more abundant species in the different strata (Table 1).

Table 1: Abbreviations of species names used in vegetation unit codes.

Code	Species name	Code	Species name
Af	<i>Allocasuarina fraseriana</i>	Ge	<i>Gastrolobium ebracteolatum</i>
Ap	<i>Acacia pulchella</i> var. <i>glaberrima</i>	Ha	<i>Hypocalymma angustifolium</i>
Ba	<i>Banksia attenuata</i>	He	<i>Hypolaena exsulca</i>
Cc	<i>Corymbia calophylla</i>	Pc	<i>Phlebocarya ciliata</i>
Em	<i>Eucalyptus marginata</i>	Tl	<i>Taxandria linearifolia</i>
Ep	<i>Eucalyptus patens</i>		

4.1.2 Description of the Coalfields Highway survey area vegetation

Eleven vegetation units were mapped in the WDRGS area (Figure 1). The vegetation units mapped in November 2010 in the proposed Alignments in the 255DpWGs area north of the Coalfields Highway, were not reviewed during this survey and are the same as previously reported (Morgan 2011). However, the vegetation mapping in the WDRGS area (255DpWGs area south of the Coalfields Highway) did result in some revision to the 2010 mapped units in the Alignments.

Some interesting results from the WDRGS survey area vegetation mapping included:

- The area of deep grey sands and associated vegetation was quite restricted within the WDRGS survey area. Vegetation unit EmAfPc (and small areas of EmAfBa) occurred on these deep grey sands surrounding and east of the Wellington Dam Rd Information Centre. The *Allocasuarina fraseriana* cover in this area varied significantly from low open woodland (CHSQ1) to an open forest in the area immediately around the old sand mine (CHSQ5).
- As the depth of grey sand decreased to the point that gravelly sands and loamy sands were within 15cm of the surface, the EmAfPc vegetation gave way to

the EmCc vegetation unit. EmCc vegetation dominated the lateritic gravelly sands and loamy sands that are more typical jarrah forest soils and which were extensive in the eastern and south-eastern third of the survey area.

- Lower lying seepage areas occurred in the central part of the WDRGS survey area. Vegetation units occurring in these lower, damper areas included EmHePc, EmCcHa, and a small low shrubland/herbland unit CcApHa just east of the farmland. An area of Blackbutt forest, EpCc, extended down a seepage area in the eastern parts of the WDRGS survey area, with Jarrah-Marri woodland to open forest over *Taxandria linearifolia* high shrublands in some adjacent parts.
- Rather than being an area of homogeneous soils and vegetation, the WDRGS survey area (Soils Landscape Subsystem 255DpWGs) had a variety of soils, habitats and associated vegetation units, reflected in the eleven (11) vegetation units described for the area.

Vegetation unit descriptions for the WDRGS area are presented in unit alphabetical order below. Three new units were described for this exercise, although one of these, EmCcGe, covered only a small area and probably would normally be included a creekline vegetation unit that extended to the south (beyond the survey area). Eight of the vegetation units were described as part of the vegetation mapping in November 2010 (Morgan 2011), but are set out below with some additional comments about any variation of those units in this survey area.

CcAf (vegetation unit description as per Morgan, 2011)

Corymbia calophylla (Marri) woodland over *Allocasuarina fraseriana* low woodland over *Persoonia longifolia* (Snotty gobble) scattered tall shrubs over *Hibbertia hypericoides*, *Bossiaea ornata* low shrubland over *Lepidosperma squamatum* complex very open sedgeland with *Pteridium esculentum* (Bracken) open fernland.

Habitat and soils: Gentle lower slopes of valley floor between ridges. Grey sand.

Notes: This small area of vegetation occurred on sandy soils on the north side of the Coalfields Hwy, near the Wellington Dam Rd turnoff. It was described and mapped during the November 2010 survey.

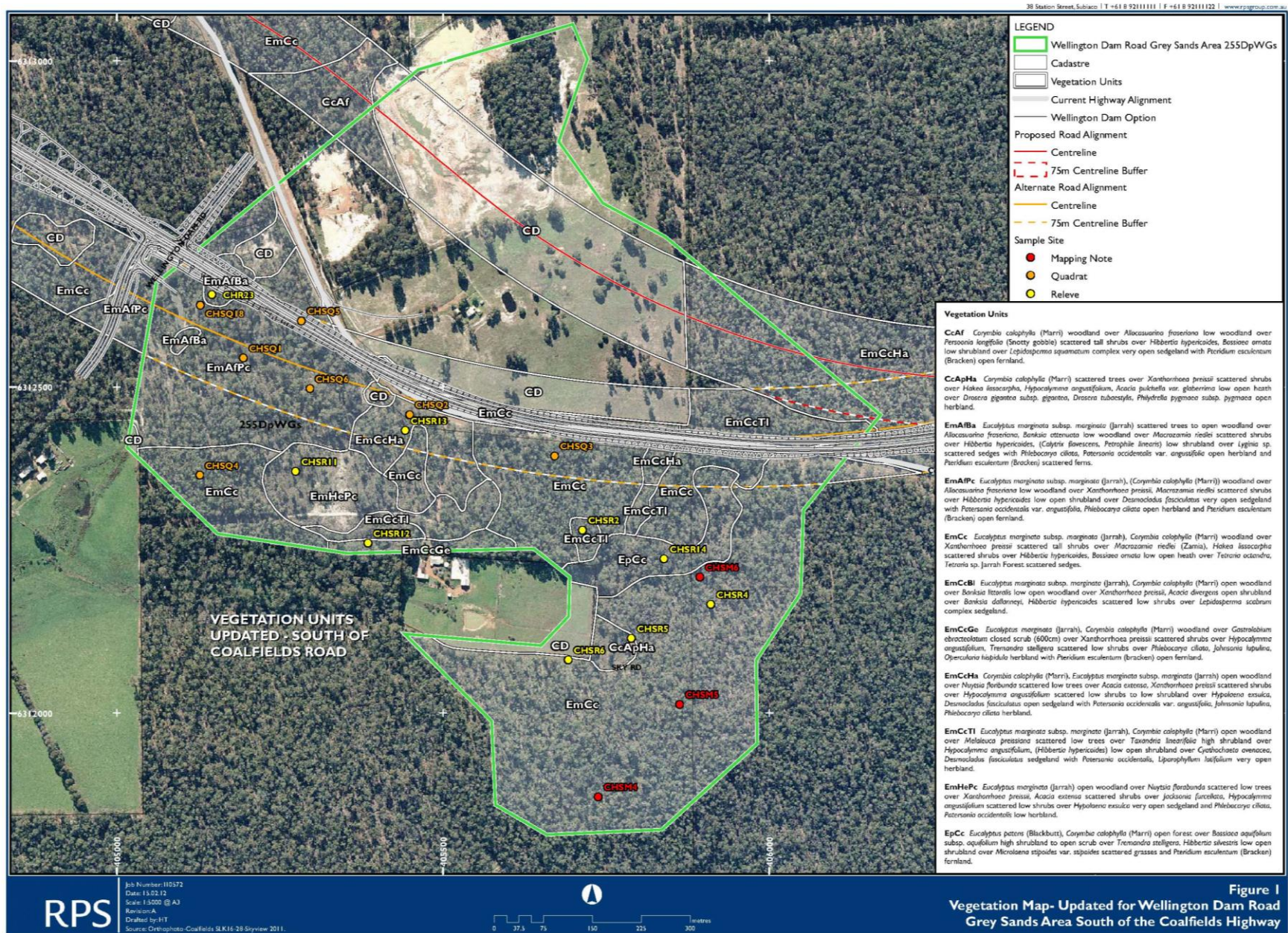


Figure 1: Vegetation units of of the WDRGS survey area.

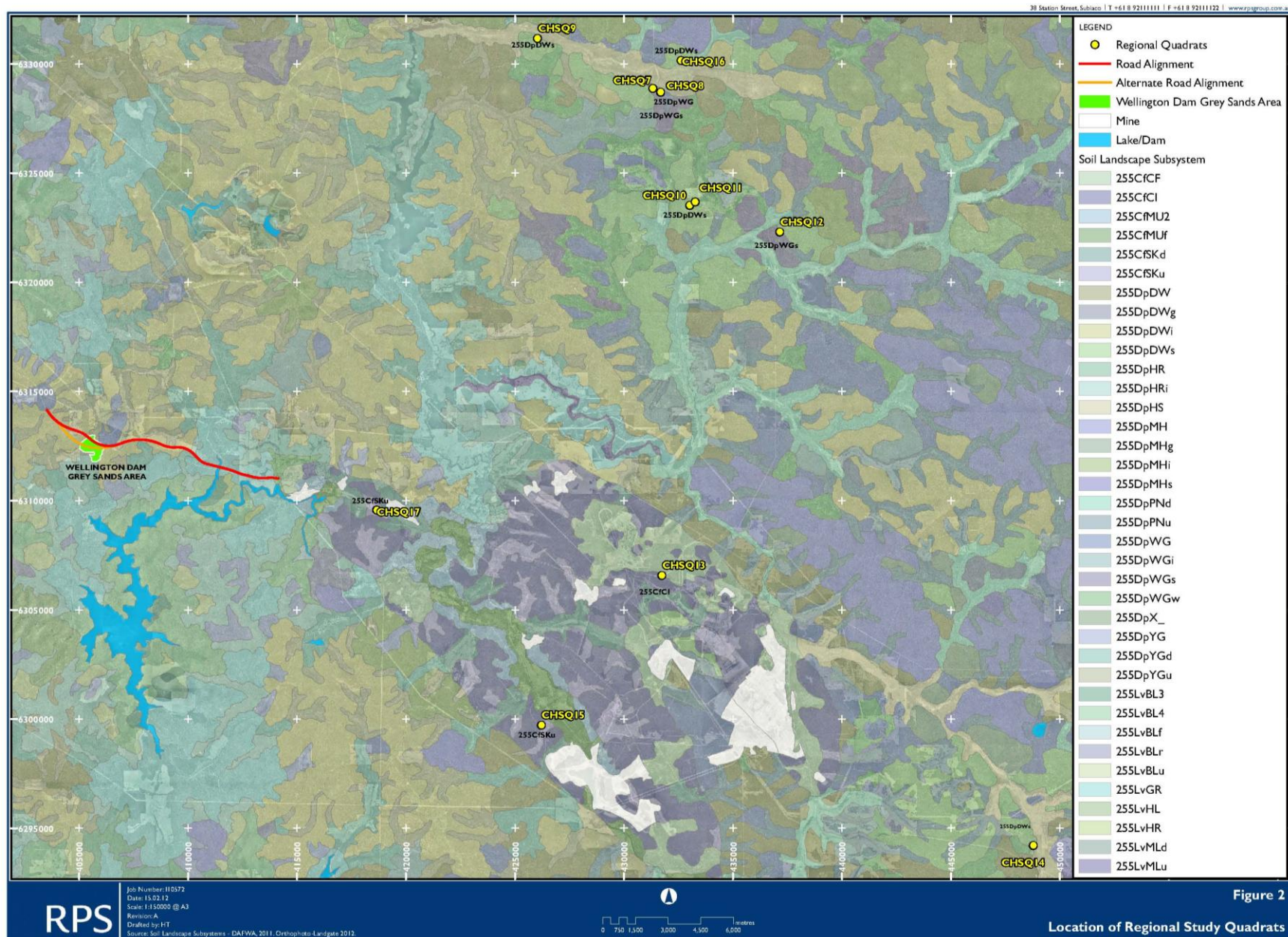


Figure 2: Location of regional quadrat sites and the Soil-landscape Subsystems in which they occurred.

CcApHa

Corymbia calophylla (Marri) scattered trees over *Xanthorrhoea preissii* scattered shrubs over *Hakea lissocarpha*, *Hypocalymma angustifolium*, *Acacia pulchella* var. *glaberrima* low open heath over *Drosera gigantea* subsp. *gigantea*, *Drosera tubaestylis*, *Philydrella pygmaea* subsp. *pygmaea* open herbland.

Habitat and soils: Very gentle, west-facing lower slope of low broad ridge on plateau. Gravelly, dark brown loam.

Notes: This vegetation occurred in a small area at the base of a ridge on the eastern boundary of the farmland. It was described at releve site CHSR5.

EmAfBa (vegetation unit description as per Morgan, 2011)

Eucalyptus marginata subsp. *marginata* (Jarrah) scattered trees to open woodland over *Allocasuarina fraseriana*, *Banksia attenuata* low woodland over *Macrozamia riedlei* scattered shrubs over *Hibbertia hypericoides*, (*Calytrix flavescens*, *Petrophile linearis*) low shrubland over *Lyginia* sp. scattered sedges with *Phlebocarya ciliata*, *Patersonia occidentalis* var. *angustifolia* open herbland and *Pteridium esculentum* (Bracken) scattered ferns.

Habitat and soils: Gentle, east-facing midslope of broad low ridge on Plateau. Pale grey sand (disused sandpit near by).

Notes: This vegetation occurred in small areas of sandy soils in Alignment 2 in the western part of the corridor. It was described at releve site CHR23 during the November 2010 survey. The main area of this unit (just south of the sand pit) had a lot of disturbance patches, such as old tracks and a quadrat could not be suitably located within it. It was rated as having a 'Good to Very Good' vegetation condition. The intact areas of the unit were thoroughly searched for additional species to add to the November 2010 releve list so that it would be equivalent to and comparable to quadrats and could be used in the analysis. The updated CHR23 releve data is included in Appendix 6.

EmAfPc (vegetation unit description as per Morgan, 2011)

Eucalyptus marginata subsp. *marginata* (Jarrah), (*Corymbia calophylla* (Marri)) woodland over *Allocasuarina fraseriana* low woodland over *Xanthorrhoea preissii*, *Macrozamia riedlei* scattered shrubs over *Hibbertia hypericoides* low open shrubland

with *Patersonia occidentalis* var. *angustifolia*, *Phlebocarya ciliata* low open herbland and *Pteridium esculentum* (Bracken) open fernland.

Habitat and soils: Lower slopes. Deep grey sand.

Notes: This vegetation covered most of the area of deep grey sands in the western part of the WDRGS survey area. It was recorded at quadrats CHSQ1, CHSQ5, CHSQ6 (near the eastern boundary of the vegetation unit) and CHSQ18 (Plates 1 to 4). These quadrats were all within a few hundred metres of each other. The *Allocasuarina fraseriana* strata varied from an open to closed forest around the sand pit/mine area (CHSQ5, CHSQ18) to a low open woodland or scattered low trees towards its southern and eastern boundaries. Species richness was generally high (48 to 52/100m² quadrat), but was lower under the *Allocasuarina fraseriana* closed forest (37 species in quadrat CHSQ5). The terete leaved Hibbertia, *H. hemignosta*, was recorded in this area.

EmCc (vegetation unit description as per Morgan, 2011)

Eucalyptus marginata subsp. *marginata* (Jarrah), *Corymbia calophylla* (Marri) woodland over *Xanthorrhoea preissii* scattered tall shrubs over *Macrozamia riedlei* (Zamia), *Hakea lissocarpha* scattered shrubs over *Hibbertia hypericoides*, *Bossiaea ornata* low open heath over *Tetraria octandra*, *Tetraria* sp. Jarrah Forest scattered sedges.

Habitat and soils: Crest of low hill, hill slopes. Gravelly, grey to brown sands and loamy sands. Lateritic gravels in this unit.

Notes: This vegetation was described, in this survey, on the broad ridge slopes in the eastern part of the WDRGS survey area (CHSR4, CHSM3, CHSM4, CHSM5, CHSM6) as well as transitional areas of this vegetation in the central area (CHSQ3, Plate 5) and south-western area (CHSQ4, Plate 6). The soils this vegetation occurred on were lateritic loamy sand soils with perhaps a shallow, grey sand surface layer in transitional areas.

EmCcBl (vegetation unit description as per Morgan, 2011)

Eucalyptus marginata subsp. *marginata* (Jarrah), *Corymbia calophylla* (Marri) open woodland over *Banksia littoralis* low open woodland over *Xanthorrhoea preissii*, *Acacia divergens* open shrubland over *Banksia dallanneyi*, *Hibbertia hypericoides* scattered low shrubs over ‘*Lepidosperma scabrum* complex’ sedgeland.



Plate 1: Vegetation unit EmAfPc at quadrat CHSQ1, on deep grey sands.



Plate 2: Vegetation unit EmAfPc at quadrat CHSQ5.



Plate 3: Vegetation unit EmAfPc at quadrat CHSQ6.



Plate 4: Vegetation unit EmAfPc at quadrat CHSQ18, just north of the Information Board.



Plate 5: Vegetation unit EmCc on lateritic gravelly soils at quadrat CHSQ3 in the central part of the WDRGS survey area.



Plate 6: Vegetation unit EmCc on lateritic gravelly soils at quadrat CHSQ4 in the south-western corner of the WDRGS survey area.

Habitat and soils: Very gently sloping, broad seepage line/basin.

Notes: This vegetation was mapped in November 2010 over a small area on the edge of Alignment 2 near the eastern end of the WDRGS survey area. It appeared to be part of a broad, shallow flowline/basin. This small area has been erroneously left out of Figure 1, but was included in the November 2010 survey report vegetation maps (Morgan, 2011).

EmCcGe

Eucalyptus marginata (Jarrah), *Corymbia calophylla* (Marri) woodland over *Gastrolobium ebracteolatum* closed scrub (600cm) over *Xanthorrhoea preissii* scattered shrubs over *Hypocalymma angustifolium*, *Tremandra stelligera* scattered low shrubs over *Phlebocarya ciliata*, *Johnsonia lupulina*, *Opercularia hispidula* herbland with *Pteridium esculentum* (bracken) open fernland.

Habitat and soils: Lower slope adjacent to creek line. Grey sand.

Notes: This vegetation was recorded at releve CHSR12 along the southern-central boundary of the WDRGS survey area. It was probably transitional vegetation to the creek bank vegetation immediately to the south and out of the survey area.

EmCcHa (Revision of description in Morgan, 2011)

Corymbia calophylla (Marri), *Eucalyptus marginata subsp. marginata* (Jarrah) open woodland to woodland over *Acacia extensa*, *Xanthorrhoea preissii* scattered shrubs over *Hypocalymma angustifolium* low open shrubland to closed heath over *Hypolaena exsulca*, *Desmocladius fasciculatus* open sedgeland.

Habitat and soils: Very gently sloping lower slopes of broad ridge. Grey sand.

Notes: This vegetation was described at releve site CHSR13 (Plate 7) and occurred on seepage areas in the central part of the WDRGS survey area.

EmCcTI (vegetation unit description as per Morgan, 2011)

Eucalyptus marginata subsp. marginata (Jarrah), *Corymbia calophylla* (Marri) open woodland over *Melaleuca preissiana* scattered low trees over *Taxandria linearifolia* high shrubland over *Hypocalymma angustifolium*, (*Hibbertia hypericoides*) low open shrubland over *Cyathochaeta avenacea*, *Desmocladius fasciculatus* sedgeland with *Patersonia occidentalis*, *Liparophyllum latifolium* very open herbland.

Habitat and soils: Seasonal dampland. Dark brown sandy loam. (Appears to be light grey when dry; also silty).

Notes: This vegetation description was originally recorded in a dampland area on the north side of the Coalfields Highway (releve site CHR12, Morgan 2011). The area of scattered *Melaleuca preissiana* was very restricted within the unit extent. The surrounding transitional vegetation included a *Taxandria linearifolia* high open shrubland to open scrub and was described at releve site CHR17 (Morgan, 2011). The area of this unit described and mapped at releve site CHSR2 in the WDRGS survey area on the south side of the Coalfields Highway, was similar to this transitional vegetation.

EmHePc

Eucalyptus marginata (Jarrah) open woodland over *Nuytsia floribunda* scattered low trees over *Xanthorrhoea preissii*, *Acacia extensa* scattered shrubs over *Jacksonia furcellata*, *Hypocalymma angustifolium* scattered low shrubs over *Hypolaena exsulca* very open sedgeland and *Phlebocarya ciliata*, *Patersonia occidentalis* low herbland.

Habitat and soils: Very gentle, south-facing, lower slope of broad ridge. Grey sand.

Notes: This vegetation was described at releve site CHSR11 in a lower slopes seepage area in the south-western part of the WDRGS survey area (Plate 8). A scarred, degraded area with high weed cover and dead Jarrah trees occurred in the centre of this unit, coinciding with a drainage line from the highway.

EpCc (vegetation unit description as per Morgan, 2011)

Eucalyptus patens (Blackbutt), *Corymbia calophylla* (Marri) open forest over *Bossiaea aquifolium* subsp. *aquifolium* high shrubland to open scrub over *Tremandra stelligera*, *Hibbertia silvestris* low open shrubland over *Microlaena stipoides* var. *stipoides* scattered grasses and *Pteridium esculentum* (Bracken) fernland.

Habitat and soils: Wetter slope of hill associated with drainage. Orange-brown sandy loam.



Plate 7: Vegetation unit EmCcHa at releve site CHSR13.



Plate 8: Vegetation unit EmHePc at releve site CHSR11.

Notes: A transitional form of this vegetation unit was recorded at releve CHSR14 in the eastern part of the WDRGS survey area. The understorey vegetation was more similar to that of Jarrah-Marri forest vegetation.

4.2 Vegetation Condition

The vegetation condition in the Soils Landscape Subsystem 255DpWGs area on the north side of the Coalfields Highway was not reviewed during this survey.

The vegetation condition in the WDRGS survey area (south of the Coalfields Highway) was mostly in the range Very Good to Excellent (Figure 3). However, the disused sand pit looked to have some replanting with exotic pine and eucalypt species and was considered to be Completely Degraded (Plate 9). The area surrounding the sand pit had considerable old disturbance in it, mostly old disused tracks and lay-down areas, and was mapped as ‘Good to Very Good’ with indicative boundaries.

A Degraded area further to the east was associated with drainage from the current Coalfields Highway. It was an area of high weed cover and Jarrah tree deaths.



Plate 9: The ‘Completely Degraded’ sand pit with exotic *Pinus* sp. and *Eucalyptus* sp. plantings.

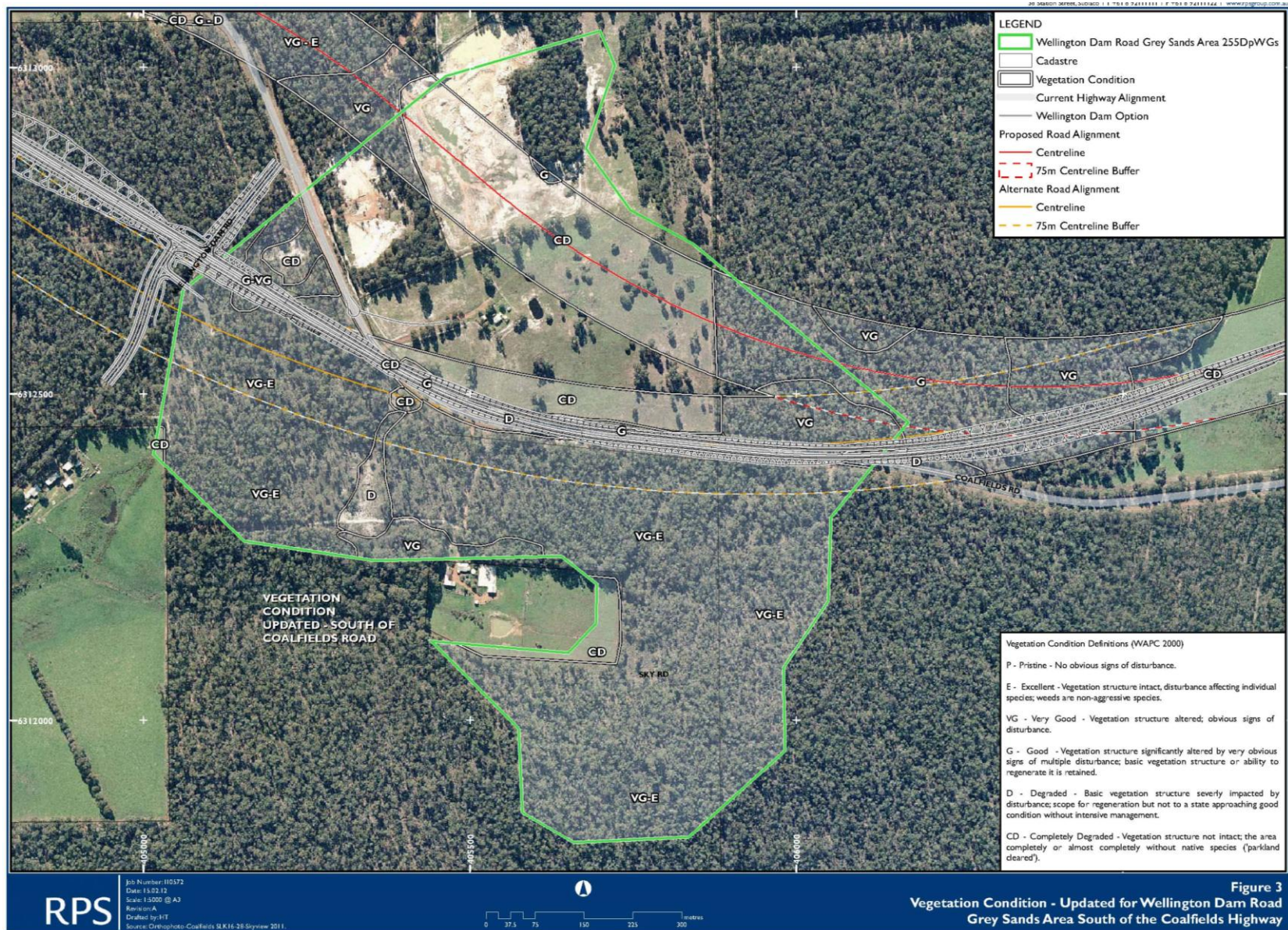


Figure 3: Vegetation condition of the WDRGS survey area.

5. PATN ANALYSIS AND ASSESSMENT OF REGIONAL SIGNIFICANCE

5.1 Vegetation and soils of the study sites

Table 2 summarises the vegetation and soils at the nineteen (19) sites included in the analysis; eleven regional quadrats and the 7 quadrats and one releve located in the WDRGS survey area).

The most common types of grey sand vegetation that were observed in the regional area and sampled for this study were:

- *Eucalyptus marginata* subsp. *marginata* (Jarrah) scattered trees to open woodland over *Banksia attenuata* low woodland vegetation on lower valley slopes, typically just upslope of valley floor dampland vegetation that often included *Melaleuca preissiana* (CHSQ7, 8, 9, 11, 14);
- *Eucalyptus marginata* subsp. *marginata* (Jarrah) scattered trees over *Allocasuarina fraseriana* woodland (sometimes with *Banksia attenuata*, *Xylomelum occidentale*) on lower slopes with deep grey sands (CHSQ13, 15, 17).

5.2 PATN classification dendrogram

The PATN analysis classification dendrogram was generated at the 4-group and 9-group level (Figure 4). At the 4-group level, 3 of the 5 sites on deep grey sands in the WDRGS survey area grouped together in group₄1. Site CHSQ2 on grey sands on a seepage slope in the WDRGS survey area separated off into its own group₄4. All but 2 of the regional quadrats grouped together in group₄2. Two regional sites, one with yellow sand (CHSQ10) and another with shallow grey sands over lateritic gravelly soils (CHSQ16), grouped with two WDRGS sites on deep grey sands (CHSQ5 and CHSQ6) and two WDRGS sites on lateritic gravelly loamy sands (CHSQ3 and CHSQ4) in group₄3.

At the 9-group level, the group₄3 from the 4-group analysis separated into 3 groups; one group with the two regional sites, one group with the two WDRGS deep grey sand soil sites and one group with the WDRGS lateritic soil sites.

5.3 Association matrix

One point of interest from the PATN analysis was that the five sites located on deep grey sands in the WDRGS area split into 2 different groups (group₉1 and group₉8, Figure 4). Even though these two groups were shown at opposite ends of the dendrogram (Figure 4), that is only the result of the two-dimensional depiction of the classification and does not itself indicate the degree of dissimilarity. The association matrix (Table 3) shows that in fact, quadrat CHSQ5 is quite similar to other deep grey sand quadrats in group₉1: CHSQ1 (0.3976 dissimilarity coefficient (dc)), and CHSQ18 (0.475dc) and is more similar to these quadrats than to any other quadrats in the study (other than the other group₉8 quadrat CHSQ6 (0.4318dc). It is less similar to the deep grey sand releve site CHSQ23, although this may be related to disturbance in that area and the different recording method. Similarly, quadrat CHSQ6, which was near the eastern boundary of the deep sands area where the soil profile and hence vegetation would be expected to be transitioning, was moderately similar to the group₉1 site CHSQ1 (0.4949dc). Its similarity to the lateritic gravelly soil sites CHSQ3 and CHSQ4 (0.4505dc and 0.5059dc respectively; Table 3) probably reflects its transitional status.

WDRGS sites CHSQ1, CHSQ18 and CHR23, also showed some moderate similarity with the regional sites CHSQ9, CHSQ11 and CHSQ12 (see Table 2 for a description of the vegetation at those sites). Of the regional sites, WDRGS sites CHSQ5 and CHSQ6 were most similar to, and had varying degrees of some similarity with, regional sites CHSQ7, CHSQ12 and CHSQ17.

5.4 Conclusions

The following conclusions can be derived from the PATN analysis results.

- The vegetation in the WDRGS survey area is not floristically homogeneous. This reflects the variation in soils and habitats within this area. Only 4 of the mapped structural vegetation units were sampled by quadrats (albeit the units covering the greatest area) and these came out in three different floristic groups at the 9-group level.
- The sites on the deeper grey sands in the western part of the survey area, despite being classified to 2 different floristic groups at the 9-group level, were floristically most similar to each other. This justifies the mapping of most of this area as the EmAfPc unit, with smaller areas of the structurally different but floristically similar EmAfBa unit. Furthermore, the 9-group level classification separated out the deep grey sands soil vegetation sites

(EmAfPc and EmAfBa) from the gravelly loamy sand soil vegetation sites (EmCc). In summary, the deep grey sands vegetation in the western part of the WDRGS survey area is restricted to a small area of about 7.5ha.

- The scope of the study was such that it fell well short of being a comprehensive test for regional significance (because of its limited regional data set). However, it DID NOT demonstrate that the deep grey sands vegetation in the WDRGS survey area WAS NOT regionally significant. Furthermore, it suggests that, despite some moderate similarity with some of the regional sites included in the study, this deep grey sands vegetation is likely to be restricted and regionally significant.
- The study selected regional sites that might be most similar to the deep grey sand vegetation within the WDRGS survey area and hence this study was not designed to make conclusions about the regional significance of vegetation in other parts of the WDRGS survey area.

Table 2: Vegetation and soils of the study quadrats

Quadrat	Study Area_a	Soils and Habitat	Vegetation
CHSQ1	WDR Grey Sds	Grey sand (deep)	<i>Eucalyptus marginata</i> subsp. <i>marginata</i> (Jarrah), <i>Corymbia calophylla</i> (Marri) (not in quadrat) open woodland over <i>Allocasuarina fraseriana</i> low open woodland over <i>Leucopogon capitellatus</i> , <i>Hibbertia hypericoides</i> low shrubland over <i>Phlebocarya ciliata</i> , <i>Patersonia occidentalis</i> low open herbland with <i>Pteridium esculentum</i> (Bracken) fernland.
CHSQ2	WDR Grey Sds	Grey sand (depth?); lower to mid seepage slope	<i>Corymbia calophylla</i> (Marri), <i>Eucalyptus marginata</i> subsp. <i>marginata</i> (Jarrah) woodland <i>Hypocalymma angustifolium</i> scattered low shrubs <i>Hypolaena exsulca</i> open sedgeland with <i>Patersonia occidentalis</i> , low open herbland.
CHSQ3	WDR Grey Sds	Grey-brown sand, shallow; mid-slope.	<i>Eucalyptus marginata</i> subsp. <i>marginata</i> (Jarrah), <i>Corymbia calophylla</i> (Marri) woodland to open forest over <i>Persoonia longifolia</i> scattered tall shrubs over <i>Hibbertia hypericoides</i> low open heath over <i>Tetraria</i> sp. Jarrah Forest very open sedgeland.
CHSQ4	WDR Grey Sds	Gravelly brown loamy sand; mid-slope.	<i>Eucalyptus marginata</i> subsp. <i>marginata</i> (Jarrah), <i>Corymbia calophylla</i> (Marri) open forest over <i>Persoonia longifolia</i> scattered tall shrubs over <i>Hibbertia hypericoides</i> low open heath over <i>Tetraria</i> sp. Jarrah Forest scattered sedges/grasses.
CHSQ5	WDR Grey Sds	Grey sand (deep)	<i>Eucalyptus marginata</i> subsp. <i>marginata</i> (Jarrah), <i>Corymbia calophylla</i> (Marri) open woodland over <i>Allocasuarina fraseriana</i> open forest over <i>Macrozamia riedlei</i> open shrubland over <i>Hibbertia hypericoides</i> low shrubland over <i>Desmocladius fasciculatus</i> scattered sedges with <i>Phlebocarya ciliata</i> , <i>Patersonia occidentalis</i> very open herbland.
CHSQ6	WDR Grey Sds	Grey sand (deep) (near boundary)	<i>Eucalyptus marginata</i> subsp. <i>marginata</i> (Jarrah), <i>Corymbia calophylla</i> (Marri) woodland over <i>Banksia grandis</i> scattered low trees over <i>Persoonia longifolia</i> , <i>Xanthorrhoea preissii</i> high open shrubland over <i>Hibbertia hypericoides</i> low shrubland with <i>Pteridium esculentum</i> (Bracken) very open fernland.
CHSQ7	Regional	Grey sand; lower slope.	<i>Eucalyptus marginata</i> subsp. <i>marginata</i> (Jarrah) open woodland to woodland over <i>Allocasuarina fraseriana</i> open woodland to woodland over <i>Persoonia longifolia</i> scattered tall shrubs over <i>Hibbertia hypericoides</i> , <i>Bossiaea eriocarpa</i> low shrubland over <i>Lyginea barbata</i> , <i>Lepidosperma squamatum</i> complex scattered sedges.
CHSQ8	Regional	Grey-brown sand; lower slope.	<i>Eucalyptus marginata</i> subsp. <i>marginata</i> (Jarrah) scattered trees over <i>Banksia attenuata</i> low woodland over <i>Calytrix flavescens</i> , <i>Bossiaea eriocarpa</i> , <i>Hibbertia racemosa</i> low shrubland over <i>Lyginea barbata</i> , <i>Lepidosperma squamatum</i> complex scattered sedges with <i>Phlebocarya ciliata</i> very open herbland.
CHSQ9	Regional	Grey sand; lower slope.	<i>Eucalyptus marginata</i> subsp. <i>marginata</i> (Jarrah) scattered trees to open woodland over <i>Banksia attenuata</i> low woodland over <i>Kunzea glabrescens</i> high open shrubland over <i>Xanthorrhoea preissii</i> , <i>Macrozamia riedlei</i> open shrubland over <i>Calytrix flavescens</i> , <i>Hibbertia racemosa</i> low shrubland.
CHSQ10	Regional	Yellow sand; lower slope.	<i>Eucalyptus marginata</i> subsp. <i>marginata</i> (Jarrah), <i>Corymbia calophylla</i> (Marri)) woodland over <i>Banksia grandis</i> scattered low trees to low woodland (patches) over <i>Persoonia longifolia</i> scattered tall shrubs over <i>Hibbertia hypericoides</i> low shrubland over <i>Tetraria</i> sp. Jarrah Forest

Quadrat	Study Area ^a	Soils and Habitat	Vegetation
			scattered sedges.
CHSQ11	Regional	Grey-brown sand; lower slope.	<i>Eucalyptus marginata</i> subsp. <i>marginata</i> (Jarrah), <i>Corymbia calophylla</i> (Marri) scattered trees to open woodland over <i>Banksia attenuata</i> low woodland over <i>Kunzea glabrescens</i> high open shrubland over <i>Calytrix flavescens</i> low open shrubland over <i>Lyginia barbata</i> scattered sedges with <i>Phlebocarya ciliata</i> very open herbland.
CHSQ12	Regional	Grey sand with some coarse quartz granules on surface; lower slope.	<i>Eucalyptus marginata</i> subsp. <i>marginata</i> (Jarrah) open woodland over <i>Persoonia longifolia</i> , <i>Kunzea glabrescens</i> scattered tall shrubs over <i>Bossiaea eriocarpa</i> , <i>Calytrix flavescens</i> low shrubland over <i>Tetraria</i> sp. Jarrah Forest very open sedgeland with <i>Phlebocarya ciliata</i> very open herbland.
CHSQ13	Regional	Grey sand; lower slope.	<i>Eucalyptus marginata</i> subsp. <i>marginata</i> (Jarrah) scattered trees over <i>Allocasuarina fraseriana</i> , <i>Banksia attenuata</i> , <i>Xylomelum occidentale</i> low open forest over <i>Kunzea glabrescens</i> scattered tall shrubs over <i>Leucopogon conostephioides</i> scattered low shrubs over <i>Lyginia barbata</i> , <i>Hypolaena exsulca</i> scattered sedges with <i>Dasypogon bromeliifolius</i> , <i>Phlebocarya ciliata</i> open herbland.
CHSQ14	Regional	Grey sand; lower slope.	<i>Eucalyptus marginata</i> subsp. <i>marginata</i> (Jarrah) scattered trees to open woodland over <i>Banksia attenuata</i> low woodland over <i>Calytrix flavescens</i> , <i>Bossiaea eriocarpa</i> low shrubland with <i>Phlebocarya ciliata</i> very open herbland.
CHSQ15	Regional	Grey sand (60cm deep over deep white to pale yellow-white sand); lower slope.	<i>Eucalyptus marginata</i> subsp. <i>marginata</i> (Jarrah) scattered trees over <i>Allocasuarina fraseriana</i> woodland over <i>Banksia attenuata</i> , <i>Xylomelum occidentale</i> low open woodland over <i>Calytrix flavescens</i> scattered low shrubs over <i>Hypolaena exsulca</i> , <i>Lyginia barbata</i> scattered sedges with <i>Dasypogon bromeliifolius</i> open herbland.
CHSQ16	Regional	Grey sand (only about 50cm deep?); lower slope.	<i>Eucalyptus marginata</i> subsp. <i>marginata</i> (Jarrah), <i>Corymbia calophylla</i> (Marri) open forest over <i>Banksia grandis</i> scattered low trees over <i>Persoonia longifolia</i> scattered tall shrubs over <i>Hibbertia hypericoides</i> , <i>Bossiaea ornata</i> low shrubland over <i>Tetraria</i> sp. Jarrah Forest scattered sedges.
CHSQ17	Regional	Grey sand (deep); lower slope.	<i>Eucalyptus marginata</i> subsp. <i>marginata</i> (Jarrah) woodland over <i>Allocasuarina fraseriana</i> low open woodland over <i>Hibbertia hypericoides</i> , <i>Bossiaea eriocarpa</i> low open heath over <i>Lepidosperma squamatum</i> complex, <i>Tetraria octandra</i> scattered sedges.
CHSQ18	WDR Grey Sds	Grey sand (deep)	<i>Eucalyptus marginata</i> subsp. <i>marginata</i> (Jarrah), <i>Allocasuarina fraseriana</i> open forest over <i>Hibbertia hypericoides</i> , <i>Leucopogon capitellatus</i> low shrubland over <i>Lepidosperma squamatum</i> complex scattered sedges with <i>Phlebocarya ciliata</i> , <i>Patersonia occidentalis</i> open herbland and <i>Pteridium esculentum</i> (Bracken) scattered ferns.
CHR23	WDR Grey Sds	Grey sand (deep)	<i>Eucalyptus marginata</i> subsp. <i>marginata</i> (Jarrah) open woodland over <i>Allocasuarina fraseriana</i> , <i>Banksia attenuata</i> low woodland over <i>Macrozamia riedlei</i> scattered shrubs over <i>Hibbertia hypericoides</i> low shrubland over <i>Lyginia barbata</i> scattered sedges with <i>Phlebocarya ciliata</i> , <i>Patersonia occidentalis</i> low open herbland and <i>Pteridium esculentum</i> (Bracken) scattered ferns.

a WDR Grey Sds: WDRGS survey area; Regional: 1 of 11 quadrats located in regions for comparison with WDR Grey Sds area quadrats (see Figure 2)

Figure 4: Classification dendrogram of WDRGS survey area and regional vegetation sample sites.

(The coefficients along the 'long' axis are dissimilarity coefficients. The higher the dissimilarity coefficient, the less similar the floristics of quadrats/groups of quadrats).

ID	site	no	gp4	gp9	data									
1					01/15/12 19:24:21.38 dend BRM Collie Highway Jan 2012									
2					0.2310	0.3003	0.3697	0.4390	0.5083	0.5777	0.6470	0.7163	0.7857	0.8550
3														
4	CHR23	64	1	1	_____									
5	CHSQ1	48	1	1	_____									
6	CHSQ18	48	1	1	_____									
7	CHSQ11	36	2	2	_____									
8	CHSQ9	33	2	2	_____									
9	CHSQ14	49	2	2	_____									
10	CHSQ12	53	2	3	_____									
11	CHSQ17	60	2	3	_____									
12	CHSQ7	37	2	4	_____									
13	CHSQ8	36	2	4	_____									
14	CHSQ13	27	2	5	_____									
15	CHSQ15	33	2	5	_____									
16	CHSQ10	59	3	6	_____									
17	CHSQ16	52	3	6	_____									
18	CHSQ3	39	3	7	_____									
19	CHSQ4	34	3	7	_____									
20	CHSQ5	37	3	8	_____									
21	CHSQ6	54	3	8	_____									
22	CHSQ2	31	4	9	_____									
23														
24					0.2310	0.3003	0.3697	0.4390	0.5083	0.5777	0.6470	0.7163	0.7857	0.8550

Table 3: Tabulation of the Association Matrix, showing the dissimilarity coefficients for each pairing of sites.

(A high coefficient means a high dissimilarity between the two quadrats. The cells have been shaded such that the darker the cell shading, the more similar (that is, less dissimilar) the floristics of the two sites).

		gp4	1	1	1	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	4
		gp9	1	1	1	2	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9
gp4	gp9	site	CHR23	CHSQ1	CHSQ18	CHSQ11	CHSQ9	CHSQ14	CHSQ12	CHSQ17	CHSQ7	CHSQ8	CHSQ13	CHSQ15	CHSQ10	CHSQ16	CHSQ3	CHSQ4	CHSQ5	CHSQ6	CHSQ2
1	1	CHR23	0	0.3542	0.3118	0.5696	0.525	0.6404	0.596	0.6699	0.6429	0.6706	0.6842	0.7037	0.7308	0.84	0.8182	0.7805	0.5529	0.6634	0.7632
1	1	CHSQ1	0.3542	0	0.2308	0.6104	0.5641	0.6782	0.567	0.6634	0.6098	0.7349	0.7297	0.6709	0.6863	0.7959	0.6279	0.775	0.3976	0.4949	0.6757
1	1	CHSQ18	0.3118	0.2308	0	0.5405	0.52	0.5952	0.5957	0.6531	0.6203	0.675	0.6338	0.6842	0.7172	0.7684	0.6867	0.7403	0.475	0.5625	0.6901
2	2	CHSQ11	0.5696	0.6104	0.5405	0	0.4098	0.4286	0.5	0.7143	0.5692	0.4848	0.614	0.6452	0.7176	0.8519	0.8261	0.7778	0.6364	0.8049	0.8246
2	2	CHSQ9	0.525	0.5641	0.52	0.4098	0	0.6338	0.5556	0.7882	0.6364	0.5224	0.7241	0.746	0.6744	0.9024	0.8857	0.875	0.7015	0.7831	0.8276
2	2	CHSQ14	0.6404	0.6782	0.5952	0.4286	0.6338	0	0.5778	0.5957	0.5467	0.5789	0.6716	0.5556	0.7053	0.7143	0.7722	0.7808	0.7105	0.7174	0.7313
2	3	CHSQ12	0.596	0.567	0.5957	0.5	0.5556	0.5778	0	0.5385	0.4588	0.6047	0.6623	0.6341	0.5048	0.6238	0.6854	0.6627	0.5581	0.6078	0.7922
2	3	CHSQ17	0.6699	0.6634	0.6531	0.7143	0.7882	0.5957	0.5385	0	0.5056	0.6889	0.6543	0.6047	0.5596	0.619	0.5914	0.7011	0.6	0.566	0.7037
2	4	CHSQ7	0.6429	0.6098	0.6203	0.5692	0.6364	0.5467	0.4588	0.5056	0	0.4085	0.6129	0.4627	0.6444	0.6512	0.7297	0.7647	0.5493	0.6322	0.7419
2	4	CHSQ8	0.6706	0.7349	0.675	0.4848	0.5224	0.5789	0.6047	0.6889	0.4085	0	0.5873	0.6176	0.8242	0.8851	0.9467	0.913	0.75	0.8182	0.7778
2	5	CHSQ13	0.6842	0.7297	0.6338	0.614	0.7241	0.6716	0.6623	0.6543	0.6129	0.5873	0	0.4915	0.8537	0.7949	0.8788	0.9	0.619	0.7722	0.7037
2	5	CHSQ15	0.7037	0.6709	0.6842	0.6452	0.746	0.5556	0.6341	0.6047	0.4627	0.6176	0.4915	0	0.7471	0.7108	0.7183	0.8462	0.5588	0.6667	0.661
3	6	CHSQ10	0.7308	0.6863	0.7172	0.7176	0.6744	0.7053	0.5048	0.5596	0.6444	0.8242	0.8537	0.7471	0	0.4528	0.6383	0.6364	0.6264	0.6262	0.8049
3	6	CHSQ16	0.84	0.7959	0.7684	0.8519	0.9024	0.7143	0.6238	0.619	0.6512	0.8851	0.7949	0.7108	0.4528	0	0.6	0.619	0.7011	0.6117	0.7692
3	7	CHSQ3	0.8182	0.6279	0.6867	0.8261	0.8857	0.7722	0.6854	0.5914	0.7297	0.9467	0.8788	0.7183	0.6383	0.6	0	0.4722	0.4933	0.4505	0.6667
3	7	CHSQ4	0.7805	0.775	0.7403	0.7778	0.875	0.7808	0.6627	0.7011	0.7647	0.913	0.9	0.8462	0.6364	0.619	0.4722	0	0.7391	0.5059	0.8667
3	8	CHSQ5	0.5529	0.3976	0.475	0.6364	0.7015	0.7105	0.5581	0.6	0.5493	0.75	0.619	0.5588	0.6264	0.7011	0.4933	0.7391	0	0.4318	0.5556
3	8	CHSQ6	0.6634	0.4949	0.5625	0.8049	0.7831	0.7174	0.6078	0.566	0.6322	0.8182	0.7722	0.6667	0.6262	0.6117	0.4505	0.5059	0.4318	0	0.6709
4	9	CHSQ2	0.7632	0.6757	0.6901	0.8246	0.8276	0.7313	0.7922	0.7037	0.7419	0.7778	0.7037	0.661	0.8049	0.7692	0.6667	0.8667	0.5556	0.6709	0

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Mr Ted Griffin conducted the PATN analysis and provided the analysis results.

Data was entered by Jacinta King and Laura Skates.

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APPENDIX 1: Definition of Department of Environment and Conservation's Declared Rare and Priority Flora categories (Smith 2010).

Declared Rare Flora - Extant Taxa

Taxa which have been adequately searched for and are deemed to be, in the wild, either rare, in danger of extinction, or otherwise in need of special protection.

Declared Rare Flora - Presumed Extinct Flora

Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such.

Priority One

Poorly Known Taxa. Taxa which are known from one or a few (generally <5) populations which are under threat.

Priority Two

Poorly Known Taxa. Taxa which are known from one or a few (generally < 5) populations, at least some of which are not believed to be under immediate threat.

Priority Three

Poorly Known Taxa. Taxa which are known from several populations, at least some of which are not believed to be under immediate threat.

Priority Four

Rare Taxa. Taxa which are considered to have been adequately surveyed and which whilst being rare, are not currently threatened by any identifiable factors.

APPENDIX 2 : Vegetation structural table of Specht as modified by Aplin (1979).

Life form and height of tallest stratum	Projective foliage cover of tallest stratum as %	Description
Trees over 30 metres	70 -100	High closed forest
	30 -70	High open forest
	10 - 30	high woodland
	2 -10	high open woodland
	under 2	Scattered tall trees
Trees 10 - 30 metres	70 -100	Closed forest
	30 -70	Open forest
	10 - 30	Woodland
	2 -10	Open woodland
	under 2	Scattered trees
Trees under 10 metres	70 -100	Low closed forest
	30 - 70	Low open forest
	10 - 30	Low woodland
	2 -10	Low open woodland
	under 2	Scattered low trees
Shrubs over 2 metres	70 - 100	Closed scrub
	30 - 70	Open scrub
	10 - 30	High shrubland
	2 -10	High open shrubland
	under 2	Scattered tall shrubs
Shrubs 1 - 2 metres	70 - 100	Closed heath
	30 - 70	Open heath
	10 - 30	Shrubland
	2 -10	Open shrubland
	under 2	Scattered shrubs
Shrubs under 1 metre	70 - 100	low closed heath
	30 - 70	low open heath
	10 - 30	low shrubland
	2 -10	Low open shrubland
	under 2	Low scattered shrubs
Herbs/Sedges/Grasses	70 - 100	Closed herb, sedge, grassland
	30 - 70	Herb, sedge, grassland
	10 - 30	Open herb, sedge, grassland
	2 -10	Very open herb, sedge, g'land under 2 Scattered

herbs sedges, grasses

Grasslands then divided into:

Tussock grasslands (perennial tussock species, e.g. *Eragrostis* species);

Hummock grasslands (*Triodia* and *Plectrachne* species that form hummocks)

Curly spinifex grassland (*Plectrachne pungens*, which does not form hummocks)

Annual tussock grassland (e.g. annual *Sorghum* species).

The "curly spinifex grassland " division follows J.S. Beard.

APPENDIX 3 : Vegetation condition scale and descriptions (from Department of Environmental Protection, 2000)

Pristine (1) : Pristine or nearly so, no obvious signs of disturbance

Excellent (2) : Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.

Very Good (3) : Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.

Good (4) : Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.

Degraded (5) : Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.

Completely Degraded (6) : The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

APPENDIX 4 : Flora list for the WDRGS survey area and regional study quadrats

Notes:

1. Species are listed alphabetically within Families that are, in turn, listed alphabetically within the listed vascular plant Divisions of the Plant Kingdom.
2. An asterisk (*) beside a taxon name indicates it is an introduced species or weed (introduced horticultural/forestry/other species, including plantings of Australian native species that do not naturally occur in the survey area).
3. 'GS Area' list is the species list for the WDRGS survey area south of the Coalfields Hwy. The entire species list also includes all species recorded in the regional study quadrats (quadrats CHSQ7-17). The 'GS Area' list consists only of species recorded in the November 2011 survey and did not draw on November 2010 survey data.
4. The 'status' column shows the conservation status of significant flora species on the list.

DRF = Declared Rare Flora; P1 to P5 = Priority 1 to Priority 5 (see definitions in Appendix 1); RS = other regionally significant flora

FAMILY/TAXA	GS AREA	COMMON NAME	CONS
PTERIDOPHYTA			
<i>Class PTERIDOPSODA</i>			
DENNSTAEDTIACEAE			
Pteridium esculentum	X		
GYMNOSPERMAE			
<i>Class CYCADOPSISIA</i>			
ZAMIACEAE			
Macrozamia riedlei	X		
<i>Class PINOPSISIDA</i>			
PINACEAE			
*Pinus pinaster			
ANGIOSPERMAE			
AMARANTHACEAE			
Ptilotus manglesii	X		
APIACEAE			
Actinotus glomeratus	X		
Daucus glochidiatus	X		
Eryngium pinnatifidum	X		
Xanthosia candida	X		
Xanthosia ciliata			
Xanthosia huegelii	X		
Xanthosia tasmanica	X		
ARALIACEAE			
Hydrocotyle alata	X		
Hydrocotyle callicarpa	X		
Trachymene pilosa	X		

FAMILY/TAXA	GS AREA	COMMON NAME	CONS
ASPARAGACEAE			
Chamaescilla corymbosa var. corymbosa	X		
Lomandra brittanii	X		
Lomandra caespitosa	X		
Lomandra hermaphrodita			
Lomandra nigricans	X		
Lomandra preissii	X		
Lomandra purpurea	X		
Lomandra sericea	X		
Lomandra suaveolens			
Sowerbaea laxiflora	X		
Thysanotus arbuscula	X		
Thysanotus manglesianus	X		
Thysanotus manglesianus/patersonii	X		
Thysanotus multiflorus	X		
Thysanotus sp.			
Thysanotus thyrsoideus	X		
ASTERACEAE			
Brachyscome iberidifolia	X		
Craspedia variabilis	X		
Hyalosperma pusillum			
Lagenophora huegelii	X		
Millotia tenuifolia var. tenuifolia	X		
Pododthea angustifolia	X		
Pododthea gnaphalioides			
Quinetia urvillei	X		
Rhodanthe citrina			
Senecio hispidulus	X		
Siloxerus humifusus	X		
Trichocline spathulata			
Waitzia suaveolens var. suaveolens			
*Arctotheca calendula			
*Cotula turbinata			
*Hypochoeris glabra	X		
*Sonchus oleraceus			
*Ursinia anthemoides	X		

FAMILY/TAXA	GS AREA	COMMON NAME	CONS
CAMPANULACEAE			
Isotoma hypocrateriformis	X		
Lobelia rhombifolia			
Lobelia tenuior			
Wahlenbergia sp.	X		
*Wahlenbergia capensis			
CARYOPHYLLACEAE			
*Petrorhagia dubia	X		
*Spergula arvensis	X		
CASUARINACEAE			
Allocasuarina fraseriana	X		
CELASTRACEAE			
Tripterococcus brunonis	X		
CENTROLEPIDACEAE			
Aphelia cyperoides	X		
Centrolepis aristata	X		
COLCHICACEAE			
Burchardia congesta	X		
Burchardia multiflora	X		
CRASSULACEAE			
Crassula colorata var. colorata			
Crassula decumbens var. decumbens			
CYPERACEAE			
Lepidosperma narrow leaf	X		
Lepidosperma sp. Darling Range heath (K. L. Wilson 8926)			
Lepidosperma squamatum complex	X		
Mesomelaena tetragona	X		
Schoenus curvifolius	X		
Schoenus efoliatus	X		
Schoenus sp.			
Schoenus sublateralis	X		
Tetraria octandra	X		
Tetraria sp. Jarrah Forest	X	Formerly T. capillaris	
*Isolepis marginata			

FAMILY/TAXA	GS AREA	COMMON NAME	CONS
DASYPOGONACEAE			
Dasypogon bromeliifolius			
DILLENACEAE			
Hibbertia acerosa			
Hibbertia amplexicaulis	X		
Hibbertia commutata	X		
Hibbertia diamesogenos			
Hibbertia hemignosta	X		
Hibbertia huegelii			
Hibbertia hypericoides	X		
Hibbertia pilosa			
Hibbertia racemosa			
Hibbertia silvestris			
Hibbertia subvaginata			
Hibbertia vaginata	X		
DROSERACEAE			
Drosera erythrorhiza subsp. squamosa	X		
Drosera gigantea subsp. gigantea	X		
Drosera neesii subsp. neesii	X		
Drosera paleacea subsp. paleacea	X		
Drosera pallida	X		
Drosera pulchella	X		
Drosera rosulata	X		
Drosera stolonifera			
Drosera tubaestylis	X		
ELAEOCARPACEAE			
Tetratheca hirsuta	X		
Tremandra stelligera	X		
ERICACEAE			
Andersonia caerulea			
Andersonia involucrata	X		
Andersonia sprengelioides	X		
Astroloma ciliatum	X		
Astroloma drummondii			
Astroloma pallidum	X		

FAMILY/TAXA	GS AREA	COMMON NAME	CONS
ERICACEAE (cont)			
Leucopogon australis	X		
Leucopogon capitellatus	X		
Leucopogon conostephioides			
Leucopogon nutans			
Leucopogon propinquus	X		
Leucopogon sprengelioides	X		
Leucopogon verticillatus	X		
Styphelia tenuiflora			
EUPHORBIACEAE			
Monotaxis grandiflora var. grandiflora	X		
Monotaxis occidentalis	X		
FABACEAE			
Acacia applanata			
Acacia browniana var. endlicheri			
Acacia divergens	X		
Acacia extensa	X		
Acacia huegelii	X		
Acacia lateriticola	X		
Acacia pulchella var. glaberrima	X		
Acacia stenoptera	X		
Bossiaea aquifolium	X		
Bossiaea eriocarpa			
Bossiaea ornata	X		
Bossiaea rufa			
Chorizema cordatum	X		
Chorizema rhombeum	X		
Daviesia physodes			
Gastrolobium ebracteolatum	X		
Gompholobium capitatum	X		
Gompholobium confertum	X		
Gompholobium marginatum			
Gompholobium ovatum	X		
Gompholobium polymorphum	X		
Gompholobium preissii			
Gompholobium shuttleworthii			
Gompholobium tomentosum	X		
Hovea chorizemifolia	X		
Hovea trisperma	X		

FAMILY/TAXA	GS AREA	COMMON NAME	CONS
FABACEAE (cont)			
Isotropis cuneifolia subsp. cuneifolia	X		
Jacksonia furcellata	X		
Kennedia coccinea	X		
Kennedia prostrata			
Kennedia sp.			
Sphaerolobium macranthum	X		
Sphaerolobium medium	X		
*Trifolium dubium	X		
GENTIANACEAE			
*Cicendia filiformis	X		
GERANIACEAE			
*Geranium molle			
GOODENIACEAE			
Dampiera linearis	X		
Lechenaultia biloba			
Scaevola calliptera	X		
HAEMODORACEAE			
Anigozanthos sp.			
Conostylis aculeata subsp. aculeata	X		
Conostylis serrulata	X		
Conostylis setigera subsp. setigera	X		
Conostylis sp.			
Haemodorum spicatum	X		
Phlebocarya ciliata	X		
HALORAGACEAE			
Glischrocaryon angustifolium			
HEMEROCALLIDACEAE			
Agrostocrinum hirsutum	X		
Caesia micrantha	X		
Johnsonia lupulina	X		
Dianella revoluta var. divaricata	X		
Tricoryne elatior			

FAMILY/TAXA	GS AREA	COMMON NAME	CONS
HYPOXIDACEAE			
Hypoxis glabella var. leptantha	X		
IRIDACEAE			
Patersonia babianoides	X		
Patersonia juncea			
Patersonia occidentalis	X		
*Romulea rosea			
*Watsonia sp.	X		
JUNCACEAE			
Luzula meridionalis	X		
LAMIACEAE			
Hemiandra pungens			
Hemigenia pritzelii	X		
LOGANIACEAE			
Logania serpyllifolia subsp. angustifolia	X		
Phyllangium paradoxum	X		
LORANTHACEAE			
Nuytsia floribunda	X		
MALVACEAE			
Thomasia paniculata	X		
MENYANTHACEAE			
Ornduffia albiflora	X		
MYRTACEAE			
Astartea scoparia	X		
Calothamnus sanguineus			
Calytrix flavescens			
Calytrix fraseri			
Corymbia calophylla	X		
Eucalyptus marginata subsp. marginata	X		
Eucalyptus patens	X	Swan River Blackbutt	
Hypocalymma angustifolium	X		
Kunzea glabrescens	X		
Kunzea micrantha			
Leptospermum erubescens			

FAMILY/TAXA	GS AREA	COMMON NAME	CONS
MYRTACEAE (cont)			
Melaleuca raphiophylla	X		
Taxandria linearifolia	X		
Verticordia plumosa var. brachyphylla			
*Leptospermum laevigatum			
ORCHIDACEAE			
Caladenia ferruginea	X		
Caladenia flava subsp. flava	X		
Caladenia longiclavata	X		
Caladenia sp.	X		
Caladenia splendens			
Cryptostylis ovata	X		
*Disa bracteata	X		
Elythranthera brunonis	X		
Eriochilus dilatatus subsp. multiflorus	X		
Leporella fimbriata	X		
Pterostylis barbata	X		
Pterostylis nana complex			
Pterostylis sp.	X		
Pterostylis vittata	X		
Pyrorchis nigricans	X		
Thelymitra benthamiana/crinita	X		
Thelymitra crinita	X		
Thelymitra graminea	X		
OXALIDACEAE			
*Oxalis glabra			
*Oxalis purpurea			
PHILYDRACEAE			
Philydrella pygmaea subsp. pygmaea	X		
PHYLLANTHACEAE			
Phyllanthus calycinus	X		
Poranthera microphylla			
PITTOSPORACEAE			
Marianthus sp.	X		

FAMILY/TAXA	GS AREA	COMMON NAME	CONS
POACEAE (cont)			
<i>Amphipogon amphipogonoides</i>	X		
<i>Amphipogon turbinatus</i>			
<i>Austrodanthonia occidentalis</i>			
<i>Austrodanthonia setacea</i>			
<i>Austrodanthonia</i> sp.	X		
<i>Austrostipa compressa</i>			
<i>Dichelachne crinita</i>	X		
<i>Microlaena stipoides</i>			
<i>Neurachne alopecuroidea</i>	X		
<i>Tetrarrhena laevis</i>	X		
* <i>Aira cupaniana</i>	X		
* <i>Aira praecox</i>			
* <i>Anthoxanthum odoratum</i>			
* <i>Briza maxima</i>	X		
* <i>Briza minor</i>			
* <i>Bromus diandrus</i>			
* <i>Ehrharta brevifolia</i>	X		
* <i>Ehrharta calycina</i>			
* <i>Ehrharta longiflora</i>			
* <i>Polypogon monspeliensis</i>			
* <i>Vulpia myuros</i>			
POLYGALACEAE			
<i>Comesperma calymega</i>	X		
<i>Comesperma</i> sp.	X		
<i>Comesperma virgatum</i>	X		
PRIMULACEAE			
* <i>Lysimachia arvensis</i>			
PROTEACEAE			
<i>Adenanthos cygnorum</i>			
<i>Adenanthos obovatus</i>	X		
<i>Banksia attenuata</i>	X		
<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>	X	Formerly <i>Dryandra lindleyana</i> var. <i>lindleyana</i>	
<i>Banksia grandis</i>	X		
<i>Banksia littoralis</i>	X		
<i>Banksia sessilis</i> var. <i>sessilis</i>	X	Formerly <i>Dryandra sessilis</i> var. <i>sessilis</i>	
<i>Conospermum capitatum</i> subsp. <i>glabratum</i>	X		

FAMILY/TAXA	GS AREA	COMMON NAME	CONS
PROTEACEAE (cont)			
Hakea amplexicaulis	X		
Hakea lissocarpha	X		
Hakea ruscifolia			
Persoonia longifolia	X		
Petrophile linearis	X		
Synaphea gracillima	X		
Xylomelum occidentale			
RANUNCULACEAE			
Clematis pubescens	X		
RESTIONACEAE			
Desmocladius fasciculatus	X		
Hypolaena exsulca	X		
Lyginia barbata	X		
Lyginia sp.			
RUBIACEAE			
Opercularia apiciflora	X		
Opercularia hispidula	X		
RUTACEAE			
Boronia ramosa subsp. anethifolia	X		
Boronia spathulata	X		
Philothea spicata	X		
STYLIDIACEAE			
Levenhookia pusilla	X		
Levenhookia stipitata	X		
Stylidium androsaceum	X		
Stylidium bicolor	X		
Stylidium brunonianum	X		
Stylidium calcaratum	X		
Stylidium carnosum			
Stylidium ciliatum	X		
Stylidium crassifolium	X		
Stylidium piliferum	X		
Stylidium repens			
Stylidium rynchocarpum	X		

FAMILY/TAXA	GS AREA	COMMON NAME	CONS
STYLIDIACEAE (cont)			
Stylidium rigidifolium		(now Stylidium striatum on Flora base)	P4
Stylidium schoenoides	X		
Stylidium violaceum			
THYMELAEACEAE			
Pimelea angustifolia	X		
Pimelea lehmanniana subsp. nervosa			
VIOLACEAE			
Hybanthus debilissimus	X		
XANTHORACEAE			
Xanthorrhoea gracilis	X		
Xanthorrhoea preissii	X		

APPENDIX 5 : Quadrat descriptions and species lists for the WDRGS survey area south of the Coalfields Highway and regional sites.

Coalfields	Sit	CHSQ1				
Described by	BRM	Date	15/10/2011	Type	Q	10m x10m
Season	E					
Location	WDRGS survey area south of the Coalfields Highway					
MGA Zone	50		405194	mE		6312545 mN
Habitat	Gentle, west facing, upper slope of broad ridge on plateau.					
Soil	Grey sand.					
Rock Type	NA.					
Vegetation	Eucalyptus marginata subsp. marginata (Jarrah), Corymbia calophylla (Marri) (not in quadrat) open woodland over Allocasuarina fraseriana low open woodland over Persoonia longifolia scattered tall shrubs over Xanthorrhoea preissii scattered tall shrubs over Macrozamia riedlei scattered shrubs over Leucopogon capitellatus, Hibbertia hypericoides low shrubland over Phlebocarya ciliata, Patersonia occidentalis low open herbland with Pteridium esculentum (Bracken) fernland.					
Veg Condition	(BF) Very Good- Excellent					
Fire Age	More than 10 years since fire.					
Notes	Search Intensity: Intense.					
	This quadrat is in a more open area on mid-upper slope.					

SPECIES LIST:

Quad	Name	Cover	C Class	Height	Specimen	Notes
	Allocasuarina fraseriana	15		700 cm		
	Bossiaea ornata	+		20 cm		Bossiaea orn
	Burchardia congesta	+		40 cm	CHSQ1-9	Burchardia congesta
	Caladenia flava subsp. flava	+		15 cm	=SR23a-3	Caladenia flava
	Chamaescilla corymbosa var. corymbosa	+		5 cm	=SR23a-1	Chamaescilla
	Comesperma calymega	+		15 cm	CHSQ1-15	herb (?Marianthus)
	Conostylis aculeata subsp. aculeata	+		15 cm	=SR23a-2	Conostylis aculeata
	Conostylis serrulata	+		25 cm	=SR23a-42	Conostylis shrt stipe
	Craspedia variabilis	+		10 cm	CHSQ1-4	?Stylid/ Craspedia
	Desmodcladus fasciculatus	+		10 cm		
	Dianella revoluta var. divaricata	+		30 cm		
	Drosera erythrorhiza subsp. squamosa	+		1 cm	CHSQ1-11	Drosera erythrorhiza
	Drosera pallida	+		25 cm	CHSQ1-7)	Drosera short fine
	Elythranthera brunonis	+		30 cm	=SR23a-6	Enamel orchid
	Eucalyptus marginata subsp. marginata	25		1300 cm		
	Gompholobium confertum	+		50 cm	CHSQ1-16	Conospermum? Tall
	Gompholobium tomentosum	+		35 cm		
	Hibbertia hemignosta	+		30 cm	CHSQ1-5	Hibbertia terete
	Hibbertia hypericoides	2		30 cm	CHSQ1- 26	Hibbertia hypericoides
	Hibbertia vaginata	+		20 cm	=SR23a-17	Hibbertia ?vag
	Hypochaeris glabra	+		1 cm		
	Isotropis cuneifolia subsp. cuneifolia	+		20 cm	CHSQ1-13	Isotropis cuneifolia
	Jacksonia furcellata	3-4		(40) 30 cm	CHSQ1-1	Jacksonia
	Johnsonia lupulina	+		50 cm	CHSQ1-17	Johnsonia tall glaucous
	Lagenophora huegelii	+		3 cm		lagenophora hueg
	Leucopogon capitellatus	11		35 cm	CHSQ1-18	Leucopogon
	Lomandra nigricans	+		30 cm	CHSQ1-6	Lomandra tall fine
	Lyginia barbata	+		70 cm	=SR23a-11	Lyginia
	Macrozamia riedlei	2-3		80-120 cm		Zamia reid
	Millotia tenuifolia var. tenuifolia	+		3 cm	CHSQ1-22	Millotia tenuifolia
	Monotaxis occidentalis	+		5 cm	CHSQ1-14	
	Opercularia hispidula	+		30 cm	CHSQ1-10	Opercularia hispidula
	Patersonia occidentalis	3		35 cm	CHSQ1-8	Patersonia occidentalis
	Persoonia longifolia	2-3		400 cm		
	Petrophile linearis	+		40 cm		
	Philothea spicata	+		30 cm	CHSQ1-29	Philothea spicata
	Philothea spicata	+		15 cm	CHSQ1-3	low shrub
	Phlebocarya ciliata	7		30 cm	CHSQ1-27	Phlebocarya cil
	Phyllangium paradoxum	+		3 cm	CHSQ1-23	Phyllangium
	Podotheca angustifolia	+		4 cm	=SR23a-33	Podotheca angust
	Pteridium esculentum	30-40		80-160 cm		Bracken

<i>Pterostylis vittata</i>	+	35 cm	CHSQ1-12	pterostylis
<i>Pyrorchis nigricans</i>	+	1 cm		not flowering
<i>Quinetia urvillei</i>	+	5 cm	CHSQ1-20	??? Daisy
<i>Stylidium androsaceum</i>	+	6 cm	CHSQ1-21	Stylid, small basal lvs
<i>Stylidium schoenoides</i>	+	20 cm	CHSQ1-19	Stylid schoen
<i>Thysanotus manglesianus</i>	+		CHSQ1-2	Thysanotus pat/mang
<i>Trachymene pilosa</i>	+	3 cm		
<i>Xanthorrhoea preissii</i>	1-2	220 cm		

Coalfields **Sit** **CHSQ2**
Described by BRM **Date** 15/10/2011 **Type** Q 10m x 10m
Season E **Uniformity**
Location WDRGS survey area south of the Coalfields Highway
MGA Zone 50 405449 **mE** 6312458 **mN**
Habitat Gentle, south-west facing, upper slope of broad ridge on plateau.
Soil Grey sand.
Rock Type NA.
Vegetation Corymbia calophylla (Marri), Eucalyptus marginata subsp. marginata (Jarrah) woodland over Nuytsia floribunda scattered low trees over Xanthorrhoea preissii scattered shrubs over Hypocalymma angustifolium, Philotheca spicata, Andersonia sprengelioides scattered low shrubs over Hypolaena exsulca, Desmocladius fasciculatus open sedgeland with Patersonia occidentalis, Phlebocarya ciliata low open hermland.
Veg Condition (BF) Excellent (logged in past).
Fire Age Estimated to be more that 5 to 7 years since fire.
Notes Elevation: 259m
 Search Intensity: Intense.

SPECIES LIST:

Quad	Name	Cover	C Class	Height	Specimen	Notes
	Acacia extensa	+		70 cm	=CHSQ1-X7	Acacia winged
	Actinotus glomeratus	+		15-20 cm	CHSQ2-7	?Platysace/Trachymen
	Andersonia sprengelioides	1		15 cm	CHSQ2-2	Andersonia
	Briza maxima	+		20 cm		
	Chamaescilla corymbosa var. corymbosa	+		10 cm		
	Corymbia calophylla	30-35		1300 cm		
	Craspedia variabilis	+		10 cm	=CHSQ1-X1	Craspedia
	Desmocladius fasciculatus	9-10		12-15 cm		
	Drosera rosulata	+		1 cm	CHSQ2-10	Drosera erythrorhiza
	Eriochilus dilatatus subsp. multiflorus	+		12 cm	CHSQ2-4	spade leaf orchid
	Eucalyptus marginata subsp. marginata	1-2		500 cm		
	Hypocalymma angustifolium	1-2		30 cm		
	Hypochaeris glabra	+		1 cm		
	Hypolaena exsulca	15-16		30 cm		
	Johnsonia lupulina	1-2		60 cm	=CHSQ1-17	Johnsonia tall
	Levenhookia pusilla	+		2 cm	CHSQ2-9	Levenhookia pusilla
	Lomandra nigricans	+		40 cm	CHSQ2-12	Lomandra preissii
	Lomandra preissii	+		40 cm	CHSQ2-6	Lomandra purpurea
	Mesomelaena tetragona	+		35 cm	CHSQ2-13	Mesomelaena tetragon
	Nuytsia floribunda	1- 2		500 cm		
	Patersonia occidentalis	4		30 cm	=CHSQ1-8	Patersonia occidentalis
	Philotheca spicata	+		30 cm	-CHSQ1-29	Philotheca spicata
	Phlebocarya ciliata	9		30 cm	=CHSQ1-27	Phlebocarya cil
	Thelymitra benthamiana/crinita	+		6 cm	CHSQ2-11	spade leaf #2
	Thelymitra crinita	+		20 cm	CHSQ2-5	Thelymitra brd lf
	Thelymitra graminea	+		35 cm	CHSQ2-1	Thelymitra
	Thysanotus manglesianus/patersonii	+		30 cm		sterile
	Trachymene pilosa	+		3 cm		
	Ursinia anthemoides	+		25 cm		
	Xanthorrhoea preissii	1		90 cm		
	Xanthosia huegelii	+		15 cm	CHSQ2-8	Xanthosia

Coalfields **Sit** CHSQ3
Described by BRM **Date** 16/10/2011 **Type** Q 10m x 10m
Season E **Uniformity**
Location
MGA Zone 50 405671 **mE** 6312395 **mN**
Habitat Gentle, south-facing, upper slope of broad ridge on plateau.
Soil Grey-brown sand (transitioning from grey sand immediately to west).
Rock Type NA.
Vegetation Eucalyptus marginata subsp. marginata (Jarrah), Corymbia calophylla (Marri) woodland to open forest over Persoonia longifolia scattered tall shrubs over Xanthorrhoea preissii scattered shrubs over Hibbertia hypericoides low open heath over Tetraria sp. Jarrah Forest very open sedgeland.
Veg Condition (BF) Excellent.
Fire Age More than 7 years since fire.
Notes Search Intensity: Intense.

SPECIES LIST: WDRGS survey area south of the Coalfields Highway

Quad	Name	Cover	C Class	Height	Specimen	Notes
	Acacia extensa	+		40 cm	=CHSQ1-X7	Acacia flattened stem
	Acacia lateritica	1-2		110 cm	CHSQ3-4	Acacia ?lateritica (globula flrs)
	Amhipogon amhipogonoides	+		30 cm	CHSQ3-8	Amhipogon
	Banksia dallanneyi var. dallanneyi	+		20 cm	CHSQ3-14	Dryandra lindleyanus
	Boronia spathulata	+		25 cm	=CHSQ10	Boronia, pink (?spath)
	Bossiaea ornata	+		5 cm		
	Burchardia congesta	+		60 cm	=CHSQ1-9	Burchardia congesta
	Caladenia flava subsp. flava	+		10 cm	CHSQ3-5	Caladenia ?flava (leaf only)
	Conostylis aculeata subsp. aculeata	+		15 cm	=SR23a-2	Conostylis aculeata
	Conostylis serrulata	+		15 cm	=SR23a-42	Conostylis shrt glaucous
	Corymbia calophylla	12		1600 cm		
	Craspedia variabilis	+		6 cm	CHSQ3-16	?Craspedia
	Dampiera linearis	+		5 cm		
	Desmocladus fasciculatus	+		10 cm		
	Drosera erythrorhiza subsp. squamosa	+		1 cm		
	Eucalyptus marginata subsp. marginata	25		1400-1800		
	Hemigenia pritzelii	+		(15) 35 cm	CHSQ3-11	?Hemiantra
	Hibbertia amplexicaulis	+		15 cm	CHSQ3-2	?Hibbertia amplex
	Hibbertia hypericoides	50-60		35 cm		
	Hypocalymma angustifolium	+		30 cm		
	Johnsonia lupulina			50 cm	=CHSQ1-17	Johnsonia tall
	Lagenophora huegelii	+		5 cm		
	Lomandra nigricans	+		30 cm	CHSQ3-6	Lomandra narrow flat
	Lomandra sericea	+		30 cm	CHSQ3-12,13	Lomandra sericea
	Marianthus sp.	+		20 cm	CHSQ3-20	Strange dentate leaf
	Marianthus sp.	+		130 cm	CHSQ3-21	Marianthus
	Mesomelaena tetragona	2-3		60 cm	=CHSQ2-13	Mesomelaena tetragona
	Opercularia apiciflora	+		30 cm	CHSQ3-7	?Opercularia
	Persoonia longifolia	<1		110 cm		
	Pterostylis barbata	+		20 cm	CHSQ3-19	Pterostylis nana
	Scaevola calliptera	+		15 cm	=SR23a-30	Scaevola
	Sphaerolobium medium	+		25 cm	CHSQ3-3,17	Sphaerolobium ylw
	Stylidium ciliatum	+		10 cm	CHSQ3-10	Stylid alute
	Stylidium schoenoides	+		15 cm	=CHSQ1-19	Stylidium ?schoenoides
	Tetraria sp. Jarrah Forest	2		35 cm	CHSQ3-1	Tetraria
	Tetraria octandra	+		50 cm	CHSQ3-18	Tetraria octandra
	Tetrarrhena laevis	+		15 cm	CHSQ3-9	?Tetrarrhena laevis
	Thelymitra graminea	+		40 cm	CHSQ3-22	Thelymitra narrow lf
	Xanthorrhoea preissii	2		180 cm		
	Xanthosia tasmanica	+		3 cm	CHSQ3-15	Xanthosia

Coalfields **Sit** CHSQ4
Described by BRM **Date** 11/11/2011 **Type** Q **Uniformity** 10m x 10m
Season
Location WDRGS survey area south of the Coalfields Highway
MGA Zone 50 405127 mE 6312365 mN
Habitat Gentle, south-facing mid slope of broad ridge.
Soil Gravelly, brown loamy sand.
Rock Type Gravel is lateritic, no rocks present.
Vegetation Eucalyptus marginata subsp. marginata (Jarrah), Corymbia calophylla (Marri) open forest over Persoonia longifolia scattered tall shrubs over Bossiaea aquifolium scattered shrubs over Hibbertia hypericoides low open heath over Tetraria sp. Jarrah Forest, Amphipogon amphipogonoides scattered sedges/grasses.
Veg Condition Excellent. (very low weed cover; some fine animal tracks present; past logging)
Fire Age More than 7 years since fire.
Notes NB: Nice stand of Jarrah/Marri open forest. Large old stumps from historical logging. Jarrah is dominant.
 Search Intensity: Thorough

SPECIES LIST:

Quad	Name	Cover	C Class	Height	Specimen	Notes
	<i>Acacia lateritica</i>	5-6		120 cm	CHSQ4-5	<i>Acacia</i> ?lateritica
	<i>Amphipogon amphipogonoides</i>	+		10 cm	CHSQ4-2	<i>Amphipogon</i>
	<i>Astroloma ciliatum</i>	+		5 cm	CHSQ4-8	<i>Astroloma ciliatum</i>
	<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>	1		20 cm	=	<i>Dryandra lind</i>
	<i>Boronia spathulata</i>	+		25 cm	CHSQ4-25	<i>Boronia ple</i> fr
	<i>Bossiaea aquifolium</i>	1		180 cm		
	<i>Caladenia flava</i> subsp. <i>flava</i>	+		10 cm	CHSQ4-10	<i>Caladenia flava</i>
	<i>Caladenia</i> sp.	+		30 cm	CHSQ4-23	<i>Caladenia</i> tall
	<i>Comesperma virgatum</i>	+		45 cm	=CHSG60	<i>Conospermum</i> pink
	<i>Corymbia calophylla</i>	13		600 cm		juvenile
	<i>Daucus glochidiatus</i>	+		6 cm	CHSQ4-22	<i>Daucus</i>
	<i>Dichelachne crinita</i>	+		50 cm	CHSQ4-16	tall grass
	<i>Eucalyptus marginata</i> subsp. <i>marginata</i>	35-40		1700 cm		
	<i>Hibbertia amplexicaulis</i>	+		15 cm	CHSQ4-26	<i>Hibbertia amplex</i>
	<i>Hibbertia hypericoides</i>	40		40 cm		
	<i>Hybanthus debilissimus</i>	+		15 cm	=CHSG59	<i>Hybanthus</i> blue
	<i>Lagenophora huegelii</i>	+		3 cm		
	<i>Leucopogon capitellatus</i>	+		35 cm	CHSQ4-24	<i>Epacrid</i> upright
	<i>Lomandra caespitosa</i>	+		30 cm	CHSQ4-9	<i>Lomandra caesp/ micrantha</i>
	<i>Lomandra nigricans</i>	+		35 cm	CHSQ4-12	<i>Lomandra ?nigricans</i>
	<i>Lomandra sericea</i>	+		20 cm	CHSQ4-3,7	herb linear hairy leaves, purple base
	<i>Macrozamia riedlei</i>	+		30 cm		<i>Zamia</i>
	<i>Marianthus</i> sp.	+		4 cm	CHSQ4-13	herb dentate lf
	<i>Marianthus</i> sp.	+		15 cm	CHSQ4-14	<i>Marianthus</i> (blue flower, straggling)
	<i>Opercularia hispidula</i>	+		20-45 cm	=	<i>Opercularia crisp ovate</i> lf
	<i>Patersonia babianoides</i>	+		15 cm	CHSQ4-4	<i>Patersonia groove</i> lf
	<i>Persoonia longifolia</i>	+		45 cm		<i>Persoonia long</i> (juv)
	<i>Pterostylis barbata</i>	+		30 cm	CHSQ4-11	<i>Pterostylis</i>
	<i>Scaevola calliptera</i>	+		15 cm	CHSQ4-1	<i>Scaevola</i>
	<i>Stylidium rhynchocarpum</i>	+		10 cm	=CHSG58	<i>Stylid stolon</i> dk grn erect leaves
	<i>Tetraria</i> sp. Jarrah Forest	1		30-60 cm	CHSQ4-6	<i>Tetraria</i>
	<i>Tetraria octandra</i>	+		20 cm		
	<i>Tetarrhena laevis</i>	+		20 cm	CHSQ4-15	?Tet laevis
	<i>Thelymitra crinita</i>	+		12-20 cm	CHSQ4-20	broad leaf orchid
	<i>Thysanotus thyrsoideus</i>	+		35 cm	CHSQ4-17	<i>Thysanotus</i> single basal teret lf, unequal anthers

Stylidium androsaceum	+	4 cm	CHSQ6-22	Stylidium
Stylidium schoenoides	+	20 cm	CHSQ6-9	Thysanotus ?triandra
Tetralia octandra	+	60 cm		
Tetralia laevis	+	20-45 cm	CHSQ6-12	Tetralia laevis
Tetralia hirsuta	+	20 cm	CHSQ6-13	Tetralia
Thelymitra graminea	+	40 cm	CHSQ6-8	Thelymitra
Thysanotus manglesianus	+	40 cm	CHSQ6-6	Thys mang/pat (flg)
Xanthorrhoea preissii	8	210-300		

Coalfields Sit CHSQ7
Described by BRM **Date** 26/11/2011 **Type** Q **Uniformity** 10m x 10m
Season
Location regional survey site
MGA Zone 50 431331 mE 6328895 mN
Habitat Gentle, NE-facing lower slope of ridge.
Soil Grey sand.
Rock Type NA.
Vegetation Eucalyptus marginata subsp. marginata (Jarrah) open woodland to woodland over Allocasuarina fraseriana open woodland to woodland over Persoonia longifolia scattered tall shrubs over Hibbertia hypericoides, Bossiaea eriocarpa low shrubland over Lyginia barbata, Lepidosperma squamatum complex scattered sedges.
Veg Condition (BF) Excellent (past logging; low weed cover).
Fire Age More than 7 to 10 years since fire.
Notes Search Intensity: Thorough.

SPECIES LIST:

Quad	Name	Cover	C Class	Height	Specimen	Notes
	Acacia extensa	+		110-170	CHSQ7-19	Acacia ?extense
	Agrostocrinum hirsutum	+		35 cm	CHSQ7-18	Agrostocrinum
	Allocasuarina fraseriana	40		1100-1200		
	Austrostipa compressa	+		35 cm	CHSQ7-24	Austrostipa ?flav
	Banksia attenuata	+		250 cm		
	Banksia grandis	2-3		500 cm		
	Bossiaea eriocarpa	1-2		20 cm		
	Bossiaea ornata	+		30 cm	CHSQ7-14,23	Bossiaea ornata
	Caladenia sp.	+		45 cm	CHSQ7-22	Caladenia
	Calytrix flavescens	2-3	cm	25 cm	CHSQ7-26	Calytrix flavescens
	Desmocladius fasciculatus	+		6 cm		
	Eucalyptus marginata subsp. marginata	17		(350)1600		
	Gompholobium tomentosum	+		12 cm		G.tomentosum
	Hibbertia amplexicaulis	+		30 cm		
	Hibbertia huegelii	+		8 cm	CHSQ7-1	Hibbertia ?hueg/laxmannia
	Hibbertia hypericoides	18		35 cm		
	Hibbertia racemosa	+		15 cm	CHSQ7-2	Hibbertia racemosa
	Hypolaena exsulca	+		25 cm	CHSQ7-3	? Desmocladius/ Hypolaena
	Lepidosperma squamatum complex	+		40 cm	CHSQ7-9	Lepidosperma squamatum
	Lomandra caespitosa	+		35 cm	CHSQ7-4	Lomandra caespitosa
	Lomandra hermaphrodita	+		25 cm	CHSQ7-5	Lomandra hermaphrodita (>6)
	Lomandra sericea	+		25 cm	CHSQ7-8	Lomandra sericea
	Lyginia barbata	+		50 cm	CHSQ7-6	Lyginea ?not rhizome
	Macrozamia riedlei	5-6		70 cm		
	Monotaxis occidentalis	+		6 cm	CHSQ7-7	
	Patersonia occidentalis	+		20 cm		
	Persoonia longifolia	6		400 cm		
	Philothea spicata	+		20 cm		
	Phlebocarya ciliata	3-4		20 cm		
	Pteridium esculentum	4-5		70 cm		Bracken
	Schoenus sp.	+		20 cm	CHSQ7-15	Schoenus
	Stylidium schoenoides	+		15 cm	CHSQ7-21	Stylidium ?affine
	Styphelia tenuiflora	+		25 cm	CHSQ7-10	Styphelia
	Tetralix sp. Jarrah Forest	+		30 cm	CHSQ7-17	Tetralix
	Thysanotus arbuscula	+		30 cm	CHSQ7-11	Thysanotus erect, (glabrous)
	Thysanotus arbuscula				CHSQ7-11B	
	Thysanotus multiflorus	+		15 cm	CHSQ7-13	? Thysanotus triandra
	Trachymene pilosa	+		12 cm		

Coalfields Sit CHSQ8**Described by** BRM**Date** 26/11/2011**Type** Q

10m x 10m

Season**Uniformity****Location** regional survey site**MGA Zone** 50431680 **mE**6328713 **mN****Habitat** Very gentle, north-facing, lower slope of broad ridge.**Soil** Grey, brown sand.**Rock Type** NA.**Vegetation** Eucalyptus marginata subsp. marginata (Jarrah) scattered trees over Banksia attenuata low woodland over Calytrix flavescens, Bossiaea eriocarpa, Hibbertia racemosa low shrubland over Lyginia barbata, Lepidosperma squamatum complex scattered sedges with Phlebocarya ciliata very open herbland.**Veg Condition** (BF) Excellent (very low weed cover).**Fire Age** More than 10 years since fire.**Notes** Search Intensity: Thorough.**SPECIES LIST:**

Quad Name	Cover	C Class	Height	Specimen	Notes
Actinotus glomeratus	+		5 cm	CHSQ8-16	
Agrostocrinum hirsutum	+		70 cm	=CHSQ7-18	Agrostocrinum
Allocasuarina fraseriana	3		450 cm		
Amphipogon turbinatus	+		40 cm	CHSQ8-18	Amphipogon
Andersonia caerulea	+		12 cm	CHSQ8-12	Green whorl
Austrostipa compressa	+		12 cm	=CHSQ7-24	Austrostipa
Banksia attenuata	25-30		650 cm		
Bossiaea eriocarpa	5		30 cm		
Calytrix flavescens	5		20 cm	=CHSQ7-26	Calytrix flavescens
Calytrix fraseri	+		12 cm	CHSQ8-10	Calytrix fraseri
Drosera paleacea subsp. paleacea	+		1 cm	CHSQ8-1	Drosera pygmaea
Drosera stolonifera	+		6 cm	CHSQ8-15	Drosera stolon
Eucalyptus marginata subsp. marginata	23		1400 cm		
Gompholobium tomentosum	+		5 cm		
Hibbertia huegelii	+		20 cm	CHSQ8-17	?Hibbertia hueg
Hibbertia racemosa	1-2		20 cm		
Hovea trisperma	+		5 cm	CHSQ8-20	? Hovea trisperma
Hypolaena exsulca	+		30 cm		
Jacksonia furcellata	+		180 cm		
Kunzea glabrescens	+		30 cm		
Lepidosperma squamatum complex	+		35 cm	CHSQ8-5	Lepidosperma ?squam
Leucopogon conostephioides	+		12 cm	CHSQ8-9	Leucopogon
Lomandra caespitosa	+		35 cm	=CHSQ7-4	Lomandra caespitosa
Lomandra hermaphrodita	+		20 cm	=CHSQ7-5	Lomandra hermaphrodita
Lyginia barbata	1		40 cm	CHSQ8-8	Lyginia clumped
Macrozamia riedlei	2		70 cm		Zamia
Neurachne alopecuroidea	+		15 cm	CHSQ8-14	?Desmocaldus
Philothea spicata	1		45 cm	CHSQ8-6	?Lyginia/Philothea
Phlebocarya ciliata	9		30 cm		
Phyllangium paradoxum	+		4 cm	CHSQ8-3	Phyllangium
Sowerbaea laxiflora	+		35 cm	CHSQ8-4	Thysanotus?
Stylidium schoenoides	+		12 cm	CHSQ8-13	Stylid affine
Stylidium violaceum	+		20 cm	CHSQ8-7	Stylid pink
Styphelia tenuiflora	1		30 cm	=CHSQ7-10	Styphelia
Trachymene pilosa	+		5 cm		
Xanthosia huegelii	+		5 cm	CHSQ8-2	Xanthosia

Coalfields Sit CHSQ10

Described by BRM

Date 27/11/2011 **Type** Q

10m x 10m

Season

Uniformity

Location regional survey site

MGA Zone 50

433015 **mE**

6323531 **mN**

Habitat Gentle, south-east facing, lower slope of broad ridge.

Soil Yellow sand.

Rock Type NA.

Vegetation *Eucalyptus marginata* subsp. *marginata* (Jarrah), *Corymbia calophylla* (Marri) (not in quadrat) woodland to open forest over *Banksia grandis* scattered low trees to low woodland (patches) over *Persoonia longifolia* scattered tall shrubs over *Macrozamia riedlei* scattered shrubs over *Hibbertia hypericoides* low shrubland over *Tetraria* sp. Jarrah Forest scattered sedges.

Veg Condition (BF) Very Good- Excellent. (past logging; prescribed burns; low weed cover).

Fire Age About 3 to 5 years since last fire.

Notes Search intensity: Thorough.

SPECIES LIST:

Quad	Name	Cover	C Class	Height	Specimen	Notes
	<i>Acacia applanata</i>	+		20 cm	CHSQ10-15	winged Acacia
	<i>Acacia pulchella</i> var. <i>glaberrima</i>	+		20 cm		
	<i>Aira cupaniana</i>	+		10 cm	CHSQ10-6	Aira
	<i>Astroloma drummondii</i>	+		5 cm	CHSQ10-16	<i>Astroloma ciliat</i> (prostrate)
	<i>Astroloma pallidum</i>	+		5 cm	CHSQ10-35	<i>Astroloma</i>
	<i>Austrodanthonia occidentalis</i>	+		35 cm	CHSQ10-13	<i>Austrodanthonia</i>
	<i>Austrodanthonia setacea</i>				CHSQ10-13B	
	<i>Banksia grandis</i>	4		400 cm		
	<i>Bossiaea ornata</i>	+		6 cm		
	<i>Caladenia flava</i> subsp. <i>flava</i>	+		12 cm	CHSQ10-28	<i>Caladenia flava</i>
	<i>Chamaescilla corymbosa</i> var. <i>corymbosa</i>	+		10 cm		
	<i>Comesperma virgatum</i>	+		40 cm	CHSQ10-33	<i>Comesperma</i> pink
	<i>Conostylis aculeata</i> subsp. <i>aculeata</i>	+		12 cm	CHSQ10-7	<i>Conostylis</i> bristles
	<i>Conostylis serrulata</i>	+		20 cm	CHSQ10-14	<i>Patersonia occidentalis</i>
	<i>Dampiera linearis</i>	+		3 cm	CHSQ10-23	<i>Dampiera linearis</i>
	<i>Daucus glochidiatus</i>	+		6 cm	CHSQ10-20	<i>Daucus</i>
	<i>Desmocladus fasciculatus</i>	+		6 cm		
	<i>Dichelachne crinita</i>	+		35 cm	CHSQ10-24	M? Grass
	<i>Drosera stolonifera</i>	+		6 cm	=CHSQ9-	<i>Drosera</i> ?stolon (desiccated)
	<i>Eucalyptus marginata</i> subsp. <i>marginata</i>	30-35		1400-1600		
	<i>Gompholobium preissii</i>	+		45 cm	CHSQ10-5	<i>Gompholobium</i>
	<i>Hakea lissocarpha</i>	+		20 cm		
	<i>Hibbertia amplexicaulis</i>	+		15 cm		
	<i>Hibbertia commutata</i>	+		15 cm	CHSQ10-11	<i>Hibbertia commutata</i>
	<i>Hibbertia hypericoides</i>	15-20		35 cm		
	<i>Hibbertia racemosa</i>	+		20 cm	=CHSQ7-	<i>Hibbertia racemosa</i>
	<i>Hovea chorizemifolia</i>	+		10 cm	CHSQ10-36	<i>Hovea chorizemifolia</i>
	<i>Hypochaeris glabra</i>	+		10 cm		
	<i>Isotropis cuneifolia</i> subsp. <i>cuneifolia</i>	+		10 cm	CHSQ10-38	<i>Isotropis cuneifolia</i>
	<i>Kennedia prostrata</i>	+		5 cm	CHSQ10-31	<i>Kennedia prostrata</i>
	<i>Kennedia</i> sp.	+		10 cm	CHSQ10-32	<i>Kennedia coccinea</i>
	<i>Lagenophora huegelii</i>	+		4 cm		
	<i>Lechenaultia biloba</i>	+		30 cm	CHSQ10-27	<i>Lechenaultia</i> / <i>Cordonocarpa</i>
	<i>Lepidosperma</i> sp. Darling Range heath (K. L. Wilson 8926)	+		35 cm	CHSQ10-12	<i>Tetraria</i>
	<i>Levenhookia pusilla</i>	+		2 cm		
	<i>Lobelia tenuior</i>	+		30 cm	CHSQ10-1	<i>Wahlenbergia</i>
	<i>Lomandra brittanii</i>	+		12 cm	CHSQ10-40	<i>Lomandra fine</i> lf sht
	<i>Lomandra hermaphrodita</i>	+		15-20 cm	CHSQ10-9	<i>Lomandra</i> <i>hermaphrodita</i> (>20)
	<i>Lomandra nigricans</i>	+		15 cm	CHSQ10-17	<i>Lomandra nigricans</i>
	<i>Lomandra preissii</i>	+		30 cm	CHSQ10-29	<i>Lomandra preissii</i>
	<i>Lomandra sericea</i>	+		12 cm	CHSQ10-19	<i>Lomandra sericea</i> (grazed; hairy pple base)
	<i>Macrozamia riedlei</i>	5-6		110 cm		<i>Zamia</i>

<i>Microlaena stipoides</i>	+	40 cm	CHSQ10-39	grass
<i>Millotia tenuifolia</i> var. <i>tenuifolia</i>	+	4 cm	CHSQ10-3	<i>Millotia tenuifolia</i>
<i>Monotaxis occidentalis</i>	+	4 cm	CHSQ10-10	<i>Stenanthemum</i> ?
<i>Persoonia longifolia</i>	6-7	320 cm		
<i>Phyllanthus calycinus</i>	+	20 cm	CHSQ10-4	<i>Phyllanthus calycinus</i>
<i>Polypogon monspeliensis</i>	+	15 cm	CHSQ10-26	? <i>Hordeum</i> grass
<i>Poranthera microphylla</i>	+	3 cm	CHSQ10-30	<i>Poranthera</i>
<i>Scaevola calliptera</i>	+	70 cm	CHSQ10-2	<i>Scaevola</i>
<i>Styphelia tenuiflora</i>	+	30 cm	=CHSQ8-	<i>Styphelia</i>
<i>Tetraria</i> sp. Jarrah Forest	+	30 cm	CHSQ10-8	<i>Lepidosperma terete</i>
<i>Tetraria octandra</i>	+	20 cm		
<i>Tetrarrhena laevis</i>	+	12 cm	CHSQ10-34	<i>Tetraria laevis</i>
<i>Thysanotus multiflorus</i>	+	12 cm	CHSQ10-25	<i>Thysanotus multi</i> ??
<i>Trachymene pilosa</i>	+	12 cm		
<i>Trichocline spathulata</i>	+	10 cm	CHSQ10-37	
<i>Trichocline spathulata</i>	+	10 cm	CHSQ10-22	herb ?? Grn lves
<i>Tricoryne elatior</i>	+	30 cm		
<i>Xanthosia huegelii</i>	+	5 cm	=	<i>Xanthosia</i>

Coalfields Sit CHSQ12
Described by BRM **Date** 27/11/2011 **Type** Q 10m x 10m
Season **Uniformity**
Location regional survey site
MGA Zone 50 437151 mE 6322310 mN
Habitat Very gentle, north-facing lower slope of broad low ridge.
Soil Grey sand with some coarse quartz grains on surface.
Rock Type NA.
Vegetation Eucalyptus marginata subsp. marginata (Jarrah) open woodland over Persoonia longifolia, Kunzea glabrescens scattered tall shrubs to high open shrubland over Macrozamia riedlei scattered shrubs over Bossiaea eriocarpa, Calytrix flavescens low shrubland over Tetraria sp. Jarrah Forest, Lyginia barbata
 very open sedgeland with Phlebocarya ciliata very open herbland.
Veg Condition (BF) Very Good- Excellent: quite a lot of shallow diggings (?pigs); low weed cover.
Fire Age About 3 to 5 years since fire? (cool burn)
Notes Search Intensity: thorough

SPECIES LIST:

Quad	Name	Cover	C Class	Height	Specimen	Notes
	Acacia applanata	+		30 cm	=CHSQ10-	Acacia winged
	Astroloma pallidum	+		10 cm	CHSQ12-5	Astroloma
	Austrostipa compressa	+		35 cm	CHSQ12-11	Austrostipa
	Bossiaea eriocarpa	8-10		30 cm		
	Caladenia flava subsp. flava	+		10 cm		leaf only
	Calytrix flavescens	3-4		12 cm	CHSQ12-2	Calytrix
	Chamaescilla corymbosa var. corymbosa	+		10 cm	CHSQ12-13	
	Conostylis serrulata	+		20 cm	CHSQ12-6	Conostylis sht flr
spicata	Dampiera linearis	+		4 cm	=CHSQ10-	Dampiera linearis
	Desmocladus fasciculatus	+		10 cm		
	Dianella revoluta var. divaricata	+		45 cm		
	Drosera stolonifera	+		5 cm	=CHSQ9-	Drosera ?stolon
	Eucalyptus marginata subsp. marginata	25		1500 cm		
	Gompholobium confertum	+		35 cm	CHSQ12-20	Gompholobium
	Hibbertia acerosa	+		5 cm	CHSQ12-8	?Hibbertia red stem
	Hibbertia amplexicaulis	+		10 cm		
	Hibbertia racemosa	1-2		12 cm	=CHSQ7-	Hibbertia racemosa
	Hypochaeris glabra	+		2 cm		
	Isolepis marginata	+		2 cm	CHSQ12-25	Isolepis marg
	Kunzea glabrescens	+		400 cm	CHSQ12-29	Kunzea glab
	Lagenophora huegelii	+		5 cm		
	Lepidosperma squamatum complex	+		45 cm	CHSQ12-4	Lepidosperma squa
	Leucopogon capitellatus	1-2		30 cm	CHSQ12-9	Epacrid bright grn
	Leucopogon propinquus	+		12 cm	CHSQ12-34	Leucopogon propinquus
	Lobelia tenuior	+		30 cm	CHSQ12-30	Wahlenbergia
	Lomandra caespitosa	+		35 cm	CHSQ12-15	Lomandra caespitosa
	Lomandra hermaphrodita	+		20 cm	CHSQ12-10	Lomandra hermaphrodita
	Lomandra nigricans	+		25 cm	CHSQ12-7	Lomandra nigricans
	Lomandra sericea	+		30 cm		
	Lomandra suaveolens	+		30 cm	CHSQ12-33	Lomandra ?suaveolens
	Lyginia barbata			45 cm		rhizomes
	Lysimachia arvensis	+		4 cm		Anagallis arvensis
	Macrozamia riedlei	1-2		120 cm		Zamia
	Marianthus sp.	+		20 cm	CHSQ12-3	Marianthus
	Monotaxis occidentalis	+		10 cm	CHSQ12-21	Stenanthemum?
	Opercularia hispidula	+		25 cm	CHSQ12-28	Opercularia spade lf
	Patersonia occidentalis	+		75 cm	CHSQ12-12	Patersonia occid
	Persoonia longifolia	3		260 cm		
	Phlebocarya ciliata	1-2		30 cm		
	Pteridium esculentum	2-3		35 cm		Bracken
	Pyrorchis nigricans	+		3 cm		
	Rhodanthe citrina	+		12 cm	CHSQ12-24	Waitzia?
	Scaevola calliptera	+		15 cm	=CHSQ10-	Scaevola
	Stylidium piliferum	+		2 cm	CHSQ12-19	Stylid ciliate rosette
	Stylidium schoenoides	+		12 cm	CHSQ12-18	Stylid schoen

Styphelia tenuiflora	+	20 cm	CHSQ12-27	?Styphelia
Tetraria sp. Jarrah Forest	1-2	30 cm	CHSQ12-1	Tetraria (in a big clump?)
Thysanotus arbuscula	+	45 cm	CHSQ12-31	Thysanotus tall erect (glabrous)
Trachymene pilosa	+	10 cm		
Trichocline spathulata	+	30 cm	CHSQ12-17	Trichocline
Tricoryne elatior	+	30 cm		
Xanthosia ciliata	+	12 cm	CHSQ12-26	Hibbertia commutata?
Xanthosia huegelii	+	5 cm	CHSQ12-22	Xanthosia

Coalfields Sit CHSQ13
Described by BRM **Date** 28/11/2011 **Type** Q **Uniformity** 10m x 10m
Season
Location regional survey site
MGA Zone 50 431739 **mE** 6306587 **mN**
Habitat Very gentle, North-facing, lower slope.
Soil Grey sand.
Rock Type na. Laterite nearby.
Vegetation Eucalyptus marginata subsp. marginata (Jarrah) scattered trees over Allocasuarina fraseriana, Banksia attenuata, Xylomelum occidentale low open forest over Kunzea glabrescens scattered tall shrubs over Leucopogon conostephioides scattered low shrubs over Lyginia barbata, Hypolaena exsulca scattered sedges with Dasypogon bromeliifolius, Phlebocarya ciliata open herbland.
Veg Condition (BF) Very Good- Excellent (low weed cover; past logging).
Fire Age More than 10 years since fire.
Notes Search Intensity: Thorough.

SPECIES LIST:

Quad	Name	Cover	C Class	Height	Specimen	Notes
	Allocasuarina fraseriana	17		1000-1400		
	Amphipogon turbinatus	+		10 cm	CHSQ13-5	Amphipogon
	Banksia attenuata	25-30		700 cm		
	Boronia ramosa subsp. anethifolia	+		15 cm	CHSQ13-11	? Corinotheca, weirdo plant
	Bossiaea eriocarpa	+		30 cm		
	Burchardia congesta	+		10 cm	CHSQ13-9	Orchid narrow lf
	Caesia micrantha	+		35 cm	CHSQ13-7	? Caesia micrantha
	Comesperma calymega	+		30 cm	CHSQ13-4	Wahlenbergia/ Conosperma
	Dasypogon bromeliifolius	20-25		40 cm		
	Eriochilus dilatatus subsp. multiflorus	+		15 cm	CHSQ13-13	spade lf orchid
	Eucalyptus marginata subsp. marginata	+		30 (1400)		juvenile
	Hypolaena exsulca	+		35 cm		
	Kunzea glabrescens	2		250 cm		
	Lepidosperma squamatum complex	+		35 cm	CHSQ13-3	Lepidosperma
	Leucopogon conostephioides	2		40 cm	CHSQ13-1	Epacrid
	Lomandra hermaphrodita	+		15 cm	CHSQ13-6	Lomandra hermaphrodita
	Lomandra nigricans	+		25 cm	CHSQ13-15	Lomandra nigricans
	Lomandra sericea	+		30 cm		
	Lyginia barbata	+		45 cm		clumped
	Monotaxis occidentalis	+		10 cm	CHSQ13-2	
	Nuytsia floribunda	+		90 cm		juvenile
	Phlebocarya ciliata	+				
	Pyrorchis nigricans	+		3 cm		
	Thysanotus arbuscula	+		35 cm	CHSQ13-10	?Thysanotus erect
	Thysanotus manglesianus/patersonii	+		15 cm	CHSQ13-14	?Thysanotus mang/pat
	Xanthosia huegelii	+		10 cm	=CHSQ7-	Xanthosia
	Xylomelum occidentale	4		600 cm		

Coalfields **Sit** CHSQ14
Described by BRM **Date** 28/11/2011 **Type** Q 10mx 10m
Location regional survey site
MGA Zone 50 448775 **mE** 6294219 **mN**
Habitat Very gently sloping, SE facing, lower slope of low broad ridge.
Soil Grey sand.
Rock Type NA.
Vegetation Eucalyptus marginata subsp. marginata (Jarrah) scattered trees to open woodland over Banksia attenuata low woodland over Calytrix flavescens, Bossiaea eriocarpa low shrubland with Phlebocarya ciliata very open herbland.
Veg Condition (BF) Very Good- Excellent. (past logging; track nearby; low weed cover, but more weeds than most other sites).
Fire Age About 3 to 4 years since fire.
Notes Search Intensity: Thorough.

SPECIES LIST:

Quad	Name	Cover	C Class	Height	Specimen	Notes
	Acacia extensa	+		160 cm	CHSQ14-9	? Acacia extensa
	Acacia huegelii	+		5 cm	CHSQ14-17	Acacia hueg
	Adenanthos cygnorum	1		90 cm		Adenanthos cyg
	Aira cupaniana	+		5 cm	=	Aira
	Anthoxanthum odoratum	+		20 cm	CHSQ14-16	Grass
	Austrostipa compressa	+		20 cm	CHSQ8-	Austrostipa ?flav
	Banksia attenuata	35		500-800		
	Banksia grandis	+		40 cm		regrowth of juvenile
	Bossiaea eriocarpa			35 cm		
	Briza maxima	+		20 cm		
	Briza minor	+		15 cm		
	Caladenia flava subsp. flava	+		10 cm	CHSQ14-1	Orchid narrow lf
	Calothamnus sanguineus	+		30 cm	CHSQ14-15	
	Calytrix flavescens	5-6		15-20 cm	=CHSQ12-	Calytrix flav (regrowth)
	Desmodcladus fasciculatus	+		5 cm		
	Eucalyptus marginata subsp. marginata	6		1000-1200		
	Hakea ruscifolia	1		50-110 cm		
	Hibbertia racemosa	+		15 cm		
	Hyalosperma pusillum	+		12 cm	CHSQ14-8	egg daisy
	Hypochaeris glabra	+		10 cm		
	Hypolaena exsulca	+		20 cm		
	Isolepis marginata	+		3 cm	=CHSQ12-	Schoenus marg
	Jacksonia furcellata	+		160 cm		
	Lepidosperma squamatum complex	+		60 cm		
	Levenhookia pusilla	+		3 cm		
	Lomandra caespitosa	+		30 cm	CHSQ14-11	Lomandra caespitosa
	Lomandra hermaphrodita	+		4 cm		
	Lomandra nigricans	+		20 cm	CHSQ14-3	Lomandra nigricans
	Lyginia barbata	+		40 cm	CHSQ14-10	Lyginia clumpy
	Marianthus sp.	+		20 cm	CHSQ14-5	Marianthus
	Millotia tenuifolia var. tenuifolia	+		1 cm		
	Petrophile linearis	+		20 cm		
	Phlebocarya ciliata	3-4		30 cm		regrowth (
	Phyllangium paradoxum	+		3 cm	=	Phyllangium
	Podotheca angustifolia	+		3 cm		
	Pyrorchis nigricans	+		3 cm		
	Quinetia urvillei	+		5 cm	CHSQ14-19	Urvillea daisy
	Romulea rosea	+		5 cm		guildford grass
	Scaevola calliptera	+		20 cm	=CHSQ7-	Scaevola blue
	Stylidium brunonianum	+		20 cm	CHSQ14-6	Stylid pink
	Stylidium carnosum	+		2 cm	CHSQ14-14	tall Stylid ovate
	Stylidium repens	+		10 cm	CHSQ14-13	Stylidium repens
	Tetraria sp. Jarrah Forest	+		40 cm	CHSQ14-2	? Tetraria
	Tetraria octandra	+		10 cm		grazed
	Trachymene pilosa	+		6 cm		
	Ursinia anthemoides	+		20 cm		
	Vulpia myuros	+		20 cm	CHSQ14-7	Vulpia
	Waitzia suaveolens var. suaveolens	+		20 cm	CHSQ14-18	Lawrencella daisy
	Xanthosia huegelii	+		5 cm	=	Xanthosia

Coalfields Sit CHSQ15
Described by BRM **Date** 28/11/2011 **Type** Q 10m x 10m
Season **Uniformity**
Location regional survey site
MGA Zone 50 426204 **mE** 6299729 **mN**
Habitat Very gentle, East-facing lower slope of broad ridge.
Soil Grey sand (~60cm deep over deep white and yellow-white sand).
Rock Type NA.
Vegetation Eucalyptus marginata subsp. marginata (Jarrah) scattered trees over Allocasuarina fraseriana woodland
over Banksia attenuata, Xylomelum occidentale low open woodland to low woodland over Calytrix flavescens scattered low shrubs over Hypolaena exsulca, Lyginia barbata scattered sedges with Dasypogon bromeliifolius open herbland.
Veg Condition (BF) Very Good (low weed cover, but lot of old disturbance in surrounding area).
Fire Age More than 10 years since fire.
Notes Search Intensity: Thorough. Deep leaf litter.

SPECIES LIST:

Quad	Name	Cover	C Class	Height	Specimen	Notes
	Acacia extensa	+		40-140 cm	CHSQ15-1	Acacia winged
	Allocasuarina fraseriana	20-25		1000-1200		Sheoak
	Banksia attenuata	12		400 cm		
	Banksia grandis	+		10 cm		juvenile
	Bossiaea eriocarpa	+		30 cm		
	Burchardia congesta	+		50 cm		
	Caladenia flava subsp. flava	+		4 cm	CHSQ15-7	Caladenia flava
	Calytrix flavescens	1		20-35 cm		
	Conospermum capitatum subsp. glabratum	+		15 cm	CHSQ15-11	Curly lf Proteaceae
	Conostylis serrulata	+		20 cm	=CHSQ12-	Conostylis sht flr
	Dasypogon bromeliifolius	9-10		50 cm		
	Desmocladius fasciculatus	4		10 cm		
	Drosera neesii subsp. neesii	+		35 cm	CHSQ15-4	Drosera macrantha
	Eucalyptus marginata subsp. marginata	6		1100- 1600		
	Gompholobium tomentosum	+		12 cm	CHSQ15-14	Gom tom
	Hypocalymma angustifolium	+		30 cm		
	Hypochaeris glabra	+		4 cm		
	Hypolaena exsulca	+		30 cm		
	Kunzea micrantha	+		130 cm	CHSQ15-12	Kunzea (possibly pink flower)
	Lepidosperma squamatum complex	+		30 cm	CHSQ15-3	Lepidosperma flat
	Lomandra hermaphrodita	+		20 cm	CHSQ15-10	Lomandra ?hermaph
	Lomandra nigricans	+		30 cm	CHSQ15-2	Lomandra preissii
	Lomandra preissii	+		30 cm	CHSQ15-6	Haemodorum (fibrous base)
	Lomandra sericea	+		20 cm		Lomandra sericea (hry pple- red base)
	Lyginia barbata	+		50 cm	=	Lyginea clump
	Monotaxis occidentalis	+		6 cm	=CHSQ13-	?Stenanthemum
	Phlebocarya ciliata	+		30 cm		
	Stylidium repens	+		5 cm	=CHSQ14-	Stylidium repens
	Stylidium schoenoides	+		15 cm	=CHSQ12-	Stylid schoen
	Thelymitra benthamiana/crinata	+		10 cm	CHSQ15-8	Orchid grn lf
	Trachymene pilosa	+		4 cm		
	Verticordia plumosa var. brachyphylla	+		40-70 cm	CHSQ15-9	low shrub
	Xylomelum occidentale	4		500 cm		

Coalfields Sit CHSQ16
Described by BRM **Date** 29/11/2011 **Type** Q **Uniformity** 10m x 10m
Season
Location regional survey site
MGA Zone 50 432627 **mE** 6330176 **mN**
Habitat Gentle, south-facing lower slope of broad ridge.
Soil Grey sand (probably 50-60 cm deep over gravelly lateritic sand).
Rock Type NA.
Vegetation Eucalyptus marginata subsp. marginata (Jarrah), Corymbia calophylla (Marri) open forest over Banksia grandis scattered low trees over Persoonia longifolia scattered tall shrubs over Hibbertia hypericoides, Bossiaea ornata low shrubland over Tetraria sp. Jarrah Forest scattered sedges.
Veg Condition (BF) Very Good- Excellent. (low weed cover).
Fire Age More than 5 years since fire.
Notes Search Intensity: Thorough.

SPECIES LIST:

Quad	Name	Cover	C Class	Height	Specimen	Notes
	Acacia browniana var. endlicheri	+		20 cm	CHSQ16-2	Acacia preissiana
	Acacia extensa	+		140 cm	=CHSQ14-	Acacia extensa
	Acacia stenoptera	+		20 cm	CHSQ16-6	? Acacia
	Astroloma ciliatum	+		5 cm	CHSQ16-32	Astroloma ciliate
	Banksia dallanneyi var. dallanneyi	+		15 cm		
	Banksia grandis	2-3		300 cm		
	Bossiaea eriocarpa	+		30 cm		
	Bossiaea ornata	4-5		30-35		
	Comesperma virgatum	+		35 cm	CHSQ16-27	Comesperma pk
	Conostylis serrulata	+		25 cm	CHSQ16-3	Conostylis sht flr
	Conostylis setigera subsp. setigera	+		10 cm	CHSQ16-5	Conostylis hry
	Corymbia calophylla	+		40 cm		marri
	Dampiera linearis	+		5 cm	CHSQ16-16	Dampiera linearis
	Desmocladius fasciculatus	+		5 cm		
	Eucalyptus marginata subsp. marginata	40		1400-1600		
	Glischrocaryon angustifolium	+		35-60	CHSQ16-17	Glischrocaryon
	Gompholobium polymorphum	+		12 cm	CHSQ16-19	? Gompholobium 3 leaflet
	Gompholobium preissii	+		5 cm	CHSQ16-20	Gompholobium shrt ?preissii
	Gompholobium shuttleworthii	+		10 cm	CHSQ16-38	Gompholobium
	Hakea lissocarpha	+		45 cm		
	Hibbertia amplexicaulis	+		12 cm		
	Hibbertia commutata	+		15 cm	CHSQ16-14	Hibbertia commutata
	Hibbertia diamesogenos	+		20 cm	CHSQ16-26	Hibbertia prostrata hry linear lf
	Hibbertia hypericoides	12-14		20-30 cm		
	Hibbertia pilosa	+		20 cm	CHSQ16-33	?? Ovate lf
	Hovea chorizemifolia	+		12 cm	CHSQ16-12	Hovea chorizemifolia
	Lagenophora huegelii	+		2 cm		
	Lechenaultia biloba	+		12 cm	CHSQ16-11	Lechenaultia
	Lepidosperma narrow leaf	+		35 cm	CHSQ16-13	?tall Johnsonia
	Lepidosperma squamatum complex	+		30 cm	CHSQ16-36	Lepidosperma flat
	Leptospermum erubescens	+		40 cm	CHSQ16-28	Leptospermum
	Levenhookia pusilla	+		3 cm		
	Lomandra brittanii	+		10 cm	CHSQ16-23	Lomandra black frt
	Lomandra hermaphrodita	+		5 cm	CHSQ16-29	Lomandra ?hermaph ?Lost
	Lomandra nigricans	+		30 cm	CHSQ16-1	Lomandra caespitosa
	Lomandra sericea	+		25 cm		
	Monotaxis occidentalis	+		4 cm	CHSQ16-21	herb
	Patersonia juncea	+		15 cm	CHSQ16-10	Patersonia pygmae
	Patersonia occidentalis	+		40 cm		
	Persoonia longifolia	1		350 cm		
	Ptilotus manglesii	+		5 cm	CHSQ16-18	Ptilotus manglesii
	Scaevola calliptera	+		20 cm	=	blue scaevola
	Stylidium rigidifolium	+		2 cm	CHSQ16-30	Stylid lanceolate rosette
	Tetraria sp. Jarrah Forest	+		60 cm	CHSQ16-8	Lepidosperma tall
	Tetraria octandra	+		25 cm		

Tetrarrhena laevis	+	10 cm		
Thelymitra benthamiana/crinata	+	5 cm	CHSQ16-7	orchid dry lf
Thysanotus sp.	+	15 cm	CHSQ16-9	Herb
Trichocline spathulata	+	12 cm	CHSQ16-35	Trichocline
Tricoryne elatior	+	20 cm	CHSQ16-25	Tricoryne
Xanthorrhoea gracilis	1-2	60 cm		
Xanthosia huegelii	+	5 cm	=CHSQ12-	Xanthosia

Coalfields Sit CHSQ17
Described by BRM **Date** 29/11/2011 **Type** Q **Uniformity** 10m x 10m
Season
Location regional survey site
MGA Zone 50 418647 mE 6309589 mN
Habitat Gentle, north-facing, lower slope.
Soil Grey sand.
Rock Type NA. (but laterite upslope)
Vegetation Eucalyptus marginata subsp. marginata (Jarrah) woodland to open forest over Allocasuarina fraseriana low open woodland to low woodland over Hibbertia hypericoides, Bossiaea eriocarpa low open heath over Lepidosperma squamatum complex, Tetraria octandra scattered sedges.
Veg Condition (BF) Very Good (between track and Hwy; low weed cover).
Fire Age Last fire about 3 years (regrowth after fire)
Notes Search Intensity: thorough.
 Photos= 136-138 of 3m deep pit 35m west of CHSQ17.

SPECIES LIST:

Quad	Name	Cover	C Class	Height	Specimen	Notes
	Acacia extensa	+		130 cm	CHSQ17-1	Acacia winged
	Agrostocrinum hirsutum	+		35 cm	CHSQ17-22	Agrostocrinum
	Aira cupaniana	+		12 cm	CHSQ17-37	Aira
	Allocasuarina fraseriana	3		450 (1200)		Sheoak
	Amphipogon amphipogonoides	+		35 cm	CHSQ17-27	Amphipogon
	Anigozanthos sp.	+		20 cm	CHSQ17-30	Anigozanthos ?manglesi (basal lvs only)
	Austrostipa compressa	+		30 cm	CHSQ17-15	Austrostipa
	Bossiaea eriocarpa	3		35 cm		
	Burchardia congesta	+		40 cm		
	Caladenia flava subsp. flava	+		10 cm		basal lf
	Chamaescilla corymbosa var. corymbosa	+		10 cm		
	Comesperma virgatum	+		70 cm	CHSQ17-29	Comesperma pink
	Conostylis sp.	+		30 cm		sht flr
	Dampiera linearis	+		20 cm		
	Daviesia physodes	+		30 cm	CHSQ17-21	Daviesia physodes
	Desmocladius fasciculatus	5-7		10 cm		
	Drosera pallida	+		50 cm	CHSQ17-6	Drosera ?? White
	Eucalyptus marginata subsp. marginata	25-30		1200- 1400		
	Gompholobium marginatum	+		4 cm	CHSQ17-9	Gomph marg
	Haemodorum spicatum	+		190 cm	CHSQ17-25	Haemodorum spicatum (basal lvs terete)
	Hibbertia amplexicaulis	+		20 cm		
	Hibbertia hypericoides	25-30		30-50 cm		
	Hibbertia subvaginata			30 cm	CHSQ17-11	Hibbertia ?racemosa
	Hovea chorizemifolia	+		20 cm	=CHSQ16-	Hovea chorizemifolia
	Hydrocotyle callicarpa	+		3 cm	CHSQ17-23	? Hydrocotyl sp.
	Hypochaeris glabra	+		1 cm		
	Isolepis marginata	+		3 cm	CHSQ17-3	Isolepis
	Isotropis cuneifolia	+		10 cm		
	Lagenophora huegelii	+		2 cm		
	Lepidosperma narrow leaf	+		40 cm	CHSQ17-24	? Tetraria
	Lepidosperma squamatum complex	+		40 cm	CHSQ17-2	Lepidosperma
	Levenhookia pusilla	+		3 cm		
	Lobelia rhombifolia	+		15 cm	CHSQ17-26	Lobelia
	Lobelia tenuior	+		30 cm	CHSQ17-18a	Wahlenbergia
	Lomandra caespitosa	+		20 cm	CHSQ17-13	Lomandra caespitosa
	Lomandra hermaphrodita	+		20 cm	CHSQ17-17	Lomandra hermaphrodita (>10)
	Lomandra preissii	+		30 cm	CHSQ17-4	Lomandra preissii
	Lomandra sericea	+		20 cm		
	Lyginia barbata	+		40 cm		clumped
	Marianthus sp.	+		50 cm	CHSQ17-35	Marianthus
	Mesomelaena tetragona	+		40 cm	CHSQ17-5	Mesomelaena stygia
	Monotaxis occidentalis	+		5 cm	=CHSQ16-	
	Nuytsia floribunda	1		300 cm		
	Opercularia apiciflora	+		35 cm	CHSQ17-28	?Opercularia
	Petrophile linearis	+		30 cm		

Philotheca spicata	+	30 cm	CHSQ17-10	?Philotheca
Phlebocarya ciliata		35 cm		
Poranthera microphylla	+	2 cm	CHSQ17-32	Poranthera
Scaevola calliptera	+	20 cm	CHSQ17-18	Scaevola ppl/blue
Stylidium ciliatum	+	2 cm	CHSQ17-31	Stylid ciliate rosette
Stylidium schoenoides	+	15 cm	CHSQ17-19	Stylid schoen
Tetraria sp. Jarrah Forest	+	40 cm	CHSQ17-7	Tetraria/ Mesomelaena graciliceps
Tetraria octandra	+	40 cm		
Thysanotus arbuscula	+	45 cm	CHSQ17-12	Thysanotus tall erect
Thysanotus multiflorus	+	20 cm	CHSQ17-34	Thysanotus triandra/
Thysanotus sp.	+	15 cm	CHSQ17-16	herb
Trachymene pilosa	+	5-12 cm		
Wahlenbergia capensis	+	20 cm	CHSQ17-14	Wahlenbergia
Xanthosia huegelii	+	4 cm	=CHSQ7-	Xanthosia
Xylomelum occidentale	1	40-80 cm		holly lf

Xanthorrhoea preissii
Xanthosia huegelii

1
+

100 cm
4 cm

CHSQ18-3 Xanthosia

APPENDIX 6: Releve and Mapping Note descriptions for the WDRGS survey area south of the Coalfields Highway.

Note: these sites descriptions were recorded for mapping notes and do not have a complete species list, but list representative species under 'Associated species'.

RELEVES

WDRGS survey area - Site: CHSR1

Described by: BM Date: 15/10/2011

Photo: BM100: 9 (1kg NW)

AMG: Zone50 405367mE, 6312352mN (GDA94)

Habitat: Gentle South West facing mud slope of broad ridge

Soil: Dark grey sand

Vegetation: *Eucalyptus marginata* subsp. *marginata* (Jarrah), *Corymbia calophylla* (Marri) open woodland over *Acacia extensa* (230cm), *Xanthorrhoea preissii* scattered shrubs over *Philotheca spicata* scattered low shrubs over *Hypolaena exsulca* very open sedgeland with *Phlebocarya ciliata* (50-60%) herbland.

Assoc. species: *Desmocladius fasciculatus*, *Conostylis aculeata* subsp. *aculeata*, *Gompholobium tomentosum*, *Craspedia variabilis*, *Trachymene pilosa*, *Ursinia anthemoides*, *Thelymitra crinita*, *Elythranthera brunonis*, *Schoenus sublateralis*, *Patersonia occidentalis*, *Phyllangium paradoxum*, *Allocasuarina fraseriana*.

Veg Condition (BF): Excellent, but open area to west is very disturbed (high weed cover) and probably Degraded to Good.

Notes: NB CHSR1 ~ CHSQ2

WDRGS survey area - Site: CHSR2

Described by: BM Date: 16/10/2011

Location: North East corner of farm.

Photo: BM100:11

AMG: Zone50 405714mE, 6312281mN (GDA94)

Habitat: Very gently sloping, South-facing, lower slope of broad low ridge on plateau

Soil: Dark yellow-brown sandy loam (saturated)

Rock Type: na

Vegetation: *Eucalyptus marginata* subsp. *marginata* (Jarrah), *Corymbia calophylla* (Marri) woodland to open forest over *Taxandria linearifolia* high shrubland (patchy) over *Hypocalymma angustifolium* low open shrubland to low shrubland (patchy) over *Mesomelaena tetragona*, *Tetraria octandra*, *Tetraria* sp. Jarrah Forest very open sedgeland.

Assoc. species: *Hibbertia amplexicaulis*, *Xanthorrhoea preissii*, *Pteridium esculentum* (Bracken), *Desmocladius fasciculatus*, *Tetrarrhena laevis*, *Tetraria octandra*, *Boronia spathulata*, *Adenanthos obovatus*, *Acacia divergens* (200cm), *Lomandra purpurea*, *Thelymitra graminea*.

Veg Condition (BF): Very Good to Excellent (low weed cover, old logging)

Fire Age: More than 7years since fire.

WDRGS survey area - Site: CHSR4

Described by: BM Date: 16/10/2011

Location: Eastern end.

Photo: BM100:14

AMG: Zone50 405911mE, 6312167mN (GDA94)

Habitat: Gentle, West-facing, mid to lower slope of broad low ridge on plateau.

Soil: Gravelly yellow-brown loamy sand.

Rock Type: Lateritic gravel (no outcropping)

Vegetation: *Eucalyptus marginata* subsp. *marginata* (Jarrah), *Corymbia calophylla* (Marri) woodland over *Xanthorrhoea preissii* scattered shrubs over *Hibbertia hypericoides*, *Hypocalymma angustifolium* low open heath over *Tetraria* sp. Jarrah Forest scattered sedges.

Assoc. species: *Hakea lissocarpha*, *Macrozamia riedlei*, *Acacia lateritica*, *Conostylis aculeata* subsp. *aculeata*, *Tetraria capillaris*, *Desmocladius fasciculatus*, *Lagenophora huegelii*, *Hakea amplexicaulis*.

Veg Condition (BF): Very Good to Excellent (part logging, low weed cover)

Fire Age: More than 5 to 7 years since fire.

WDRGS survey area - Site: CHSR5

Described by: BM **Date:** 16/10/2011

Location: Adjacent to Eastern end of farm.

Photo: BM100:15

AMG: Zone50 405789mE, 6312115mN (GDA94)

Habitat: Very gentle, West-facing, lower slope of low broad ridge on plateau.

Soil: Gravelly, dark brown loam.

Rock Type: na

Vegetation: *Corymbia calophylla* (Marri) scattered trees over *Xanthorrhoea preissii* scattered shrubs over *Hakea lissocarpha*, *Hypocalymma angustifolium*, *Acacia pulchella* var. *glaberrima* low open heath over *Drosera gigantea* subsp. *gigantea*, *Drosera tubaestylis*, *Philydrella pygmaea* subsp. *pygmaea* open herbland.

Assoc. species: *Centrolepis aristata*, *Hydrocotyle alata*, *Lagenophora huegelii*, *Hibbertia hypericoides*, *Aphelia cyperoides*, **Cicendia filiformis*, *Levenhookia pusilla*, *Desmocladius fasciculatus*, *Neurachne alopecuroidea*, *Ptilotus manglesii*, *Hibbertia commutata*, *Comesperma* sp., *Stylidium calcaratum*, *Thysanotus manglesianus*, *Millotia tenuifolia* var. *tenuifolia*, *Siloxerus humifusus*, *Schoenus clandestinus*, *Acacia stenoptera*, *Kunzea glabrescens*, *Xanthosia candida*, *Dampiera linearis*, *Patersonia occidentalis*, *Dryandra lindleyana* var. *lindleyana*, *Stylidium crassifolium*, *Thelymitra graminea*.

Veg Condition (BF): Excellent (low weed cover)

Fire Age: More than 7 years since fire.

WDRGS survey area - Site: CHSR6

Described by: BM **Date:** 16/10/2011

Location: adjacent to south-eastern boundary of farm

Photo: BM100:16, 17

AMG: Zone50 405692mE, 6312082mN (GDA94)

Habitat: Very gentle, North-facing, lower slopes of broad low ridge.

Soil: Gravelly, dark brown sandy loam.

Vegetation: *Corymbia calophylla* (Marri), *Eucalyptus marginata* subsp. *marginata* (Jarrah) open woodland over *Xanthorrhoea preissii*, *Acacia pulchella* var. *glaberrima* scattered shrubs over *Hypocalymma angustifolium*, *Hibbertia hypericoides*, *Hakea lasiocarpa* low open heath.

Assoc. species: *Gompholobium marginatum*, *Drosera erythrorhiza* subsp. *squamosa*, *Chamaescilla corymbosa*, **Lysimachia arvensis*, *Philydrella pygmaea* subsp. *pygmaea*, *Thelymitra graminea*.

Veg Condition (BF): Very Good to Excellent (past logging, low weed cover)

Fire Age: More than 7 years since fire.

WDRGS survey area - Site: CHSR7

Described by: BM Date: 16/10/2011

Location: Western end

Photo: BM100:21

AMG: Zone50 405107mE, 6312617mN (GDA94)

Habitat: Gentle, South-facing mid slope of low broad ridge.

Soil: Dark grey sand.

Rock Type: na

Vegetation: *Eucalyptus marginata* subsp. *marginata* (Jarrah) open woodland over *Allocasuarina fraseriana* lw over *Macrozamia riedlei*, *Jacksonia furcellata* scattered shrubs over *Hibbertia hypericoides*, (*Petrophile linearis*, *Philothea spicata*) low open heath over *Lepidosperma squamatum* complex scattered sedges.

Assoc. species: *Lomandra nigricans*, *Lagenophora huegelii*, *Burchardia congesta*, *Patersonia occidentalis*, *Lomandra preisii*, *Craspedia variabilis*, *Conostylis aculeata* subsp. *aculeata*, *Dianella revolute* var. *divaricata*.

Veg Condition (BF): Very Good to Excellent (part logging, low weed cover).

Fire Age: More than 7 years since fire

Notes: NB Same as CHSQ1

WDRGS survey area - Site: CHSR8

Described by: BM Date: 16/10/2011

Location: Near SW cnr of large sand pit, cnr of WD Rd and Coalfields Hwy.

Photo: BM100:

AMG: Zone50 405144mE, 6312727mN (GDA94)

Habitat: Gentle, South-facing, mid to upper ridge of low broad ridge on Plateau.

Soil: Pale grey sand.

Rock Type: na

Vegetation: *Eucalyptus marginata* subsp. *marginata* (Jarrah), *Corymbia calophylla* (Marri) open woodland over *Allocasuarina fraseriana* low woodland over *Persoonia longifolia* scattered tall shrubs over *Macrozamia riedlei* scattered shrubs over *Hibbertia hypericoides* low open shrubland with *Phlebocarya ciliata* open herbland and *Pteridium esculentum* (Bracken) fernland.

Assoc. species: *Bossiaea ornata*, *Burchardia congesta*, *Petrophile linearis*, *Hibbertia hemignosta*, *Scaevola calliptera*, *Trachymene pilosa*, *Jacksonia furcellata*, *Boronia ramosa* subsp. *anethifolia*, *Drosera erythrorhiza* subsp. *squamosa*, *Pyrorchis nigricans*, *Conostylis serrulata*.

Veg Condition (BF): Very Good (lot of nearby disturbance).

Fire Age: More than 5 to 7 years since fire.

WDRGS survey area - Site: CHSR9

Described by: BM Date: 12/11/2011

Location: Western end, near (160m east of) info ctre

Photo: BM100:134-139

AMG: Zone50 405160mE, 6312598mN (GDA94)

Habitat: Gentle, East-facing mid slope of broad ridge on Plateau.

Soil: Grey sand.

Rock Type: na

Vegetation: *Eucalyptus marginata* subsp. *marginata* (Jarrah) (16-20m) scattered trees to open woodland over *Allocasuarina fraseriana* low open forest (40%) over *Persoonia longifolia* scattered tall shrubs over *Xanthorrhoea preissii* scattered shrubs over *Hibbertia*

hypericoides (10-75%) low shrubland over *Phlebocarya ciliata* very open to open herbland and *Pteridium esculentum* (Bracken) (30-35%) fernland.

Assoc. species: *Gompholobium capitatum*, *Leucopogon capitellatus*, *Lomandra preissii*, *Lomandra nigricans*, *Philothea spicata*, *Jacksonia furcellata*, *Gompholobium tomentosum*, *Petrophile linearis*, *Pterostylis vittata*, *Conostylis aculeata subsp. aculeata*, *Hibbertia vaginata*, *Johnsonia lupulina*, *Monotaxis occidentalis*.

Veg Condition (BF): Excellent (very low weed cover)

Fire Age: More than 7 to 10years since fire.

Notes: NB ~CHSQ5

WDRGS survey area - Site: CHSR11

Described by: BM **Date:** 12/11/2011

Photo: BM100:143, 144 (looking East)

AMG: Zone50 405274mE, 6312371mN (GDA94)

Habitat: Very gentle, South-facing, lower slope on broad ridge on Plateau.

Soil: Grey sand.

Vegetation: *Eucalyptus marginata* (Jarrah) open woodland over *Nuytsia floribunda* scattered low trees over *Xanthorrhoea preissii*, *Acacia extensa* scattered shrubs over *Jacksonia furcellata*, *Hypocalymma angustifolium* scattered low shrubs over *Hypolaena exsulca* very open sedgeland and *Phlebocarya ciliata*, *Patersonia occidentalis* low herbland.

Assoc. species: *Drosera neesii subsp. neesii* (30cm), *Philothea spicata*, *Brachyscome iberidifolia*, *Trachymene pilosa*, *Thelymitra benthamiana/crinata*, *Hypochaeris glabra*, *Stylidium brunonianum*, *Gompholobium tomentosum*, *Schoenus efoliatus*, *Levenhookia pusilla*, *Lomandra nigricans*, **Disa bracteata*, *Agrostocrinum hirsutum*, *Watsonia* sp., *Andersonia involucrata* (150cm), *Adenanthos obovatus*, *Stylidium calcaratatum*, *Briza maxima*.

Veg Condition (BF): Very Good to Excellent (low weed cover) (some signs of logging – stumps).

Fire Age: More than 7-10years since fire.

WDRGS survey area - Site: CHSR12

Described by: BM **Date:** 14/11/2011

AMG: Zone50 405385mE, 6312261mN (GDA94)

Habitat: Lower slope adjacent to creek line.

Soil: Grey sand.

Rock Type: na

Vegetation: *Eucalyptus marginata subsp. marginata* (Jarrah), *Corymbia calophylla* (Marri) woodland over *Gastrolobium ebracteolatum* closed scrub (600cm) over *Xanthorrhoea preissii* scattered shrubs over *Hypocalymma angustifolium*, *Tremandra stelligera* scattered low shrubs over *Phlebocarya ciliata*, *Johnsonia lupulina*, *Opercularia hispidula* herbland with *Pteridium esculentum* (Bracken) open fernland.

Assoc. species: *Patersonia occidentalis*, *Agrostocrinum hirsutum*, *Thysanotus manglesianus/patersonii*, *Taxandria linearis*, *Gompholobium capitatum*, *Conostylis aculeata subsp. aculeata*, *Leucopogon australis*.

Veg Condition (BF): Very Good (lot of disturbance around this spot – track and transmiss line and farm boundary about 60 metres to East)

Fire Age: More than 7 to 10years since fire.

WDRGS survey area - Site: CHSR13
Described by: BM Date: 14/11/2011
Photo: BM100:173
AMG: Zone50 405442mE, 6312434mN (GDA94)
Habitat: Gentle, South-facing, lower slope of low broad ridge.
Soil: Grey sand.
Rock Type: na

Vegetation: *Corymbia calophylla* (Marri), *Eucalyptus marginata* subsp. *marginata* (Jarrah) woodland (lot of young Marri to 600cm (?)) over *Acacia extensa* scattered shrubs over *Hypocalymma angustifolium* low open heath to low closed heath over *Hypolaena exsulca*, *Desmocladius fasciculatus* very open sedgeland.

Assoc. species: *Agrostocrinum hirsutum*, *Johnsonia lupulina*, *Xanthorrhoea preissii*, *Nuytsia floribunda*, *Allocasuarina fraseriana*, *Andersonia sprengelioides*, *Philotheca spicata*, *Patersonia occidentalis*, *Phlebocarya ciliata*, **Briza maxima*, *Stylidium ciliatum*, *Thysanotus manglesianus/patersonii*, *Tetraria octandra*.

Veg Condition (BF): Excellent.

Fire Age: More than 7 to 10 years since fire.

WDRGS survey area - Site: CHSR14

Described by: BM Date: 14/11/2011

Photo: BM100:174, 175

AMG: Zone50 405839mE, 6312237mN (GDA94)

Habitat: Gentle, South West-facing, very shallow depression on lower slope of broad low ridge.

Soil: Orange-brown sandy loam.

Vegetation: *Eucalyptus patens* (Swan River Blackbutt), *Corymbia calophylla* (Marri) open forest over *Xanthorrhoea preissii*, *Hakea lissocarpha* scattered shrubs over *Hibbertia hypericoides*, *Hypocalymma angustifolium*, *Acacia lateritica* low heath over *Tetraria capillaris* scattered sedges.

Assoc. species: *Pteridium esculentum* (Bracken), *Acacia divergens* (170cm), *Tetraria octandra*, *Gompholobium polymorphum*.

Veg Condition (BF): Excellent

Fire Age: More than 7 years since fire.

Coalfields Sit CHR23
Described by BRM **Date** 26/02/2011 **Type** R
Season P **Uniformity**
Location Alignment #2
MGA Zone 50 405146 mE 6312642 mN
Habitat Gentle, East-facing midslope of a broad low ridge on Plateau
Soil Pale grey sand (disused sandpit nearby)

Rock Type

Vegetation *Eucalyptus marginata* subsp. *marginata* (Jarrah) scattered trees to open woodland over *Allocasuarina fraseriana*, *Banksia attenuata* low woodland over *Macrozamia riedlei* scattered shrubs over *Hibbertia hypericoides*, (*Calytrix flavescens*, *Petrophile linearis*) low shrubland over *Lyginia barbata* scattered sedges with *Phlebocarya ciliata*, *Patersonia occidentalis* low open herbland with *Pteridium esculentum* (Bracken) scattered ferns.

Veg Condition (BF) Good to Very Good

Fire Age

Notes Searched again in good season Oct 2011 (CHSR23a). Search around 405146E, 6312642N in *Banksia atten.* Stand.
 CHSR23a extended search area from previous year to all of B atten site up to sothern wall of sand pit. Area was too small plus too much old disturbance to warrant quadrat.

SPECIES LIST:

Quad	Name	Cover	C Class	Height	Specimen	Notes
	<i>Allocasuarina fraseriana</i>			Alloc fras		
	<i>Arctotheca calendula</i>			Capeweed (?)		
	<i>Banksia attenuata</i>			B atten		
	<i>Boronia ramosa</i> subsp. <i>anethifolia</i>		CHSR23a-9	<i>Boronia ramosa</i> (?)		
	<i>Briza maxima</i>			Briza max		
	<i>Bromus diandrus</i>		CHSR23a-25	<i>Bromus</i>		
	<i>Caladenia flava</i> subsp. <i>flava</i>		CHSR23a-3	<i>Caladenia flava</i>		
	<i>Caladenia splendens</i>		CHSR23a-36	<i>Caladenia spider</i>		
	<i>Calytrix flavescens</i>			<i>Calytrix</i>		
	<i>Chamaescilla corymbosa</i> var. <i>corymbosa</i>		CHSR23a-10	<i>Chamaescilla corym</i>		
	<i>Comesperma calymega</i>			<i>Comesperma</i>		
	<i>Conostylis aculeata</i> subsp. <i>aculeata</i>		CHSR23a-2	<i>Conostylis aculeata</i> (***?)		
	<i>Conostylis serrulata</i>		CHSR23a-42	<i>Conostylis sht</i>		
	<i>Cotula turbinata</i>		CHSR23a-24	<i>Cotula turbinata</i>		
	<i>Crassula colorata</i> var. <i>colorata</i>		CHSR23a-35	<i>Crassula colorata</i>		
	<i>Crassula decumbens</i> var. <i>decumbens</i>		CHSR23a-26	<i>Crassula prostrate</i> , on a small pit wall		
	<i>Dianella revoluta</i> var. <i>divaricata</i>			<i>Dianella rev</i> (sterile) (?)		
	<i>Drosera paleacea</i> subsp. <i>paleacea</i>		CHSR23a-34	Pygmy drosera		
	<i>Ehrharta calycina</i>			<i>Ehr calycin</i> (?) few scattered, adj to old rock		
	<i>Ehrharta longiflora</i>			<i>Ehr longifolia</i>		
	<i>Elythranthera brunonis</i>		CHSR23a-6	Enamel (?) orchid purple		
	<i>Eucalyptus marginata</i> subsp. <i>marginata</i>			Jarrah		
	<i>Geranium molle</i>		CHSR23a-23	<i>Pelargonium lit</i> , adj to disturbance		
	<i>Gompholobium tomentosum</i>			<i>Gompholobium tomentosum</i> (?)		
	<i>Hemiandra pungens</i>		CHSR23a-18	<i>Hemigenia</i>		
	<i>Hibbertia hypericoides</i>			<i>Hib hyp</i>		
	<i>Hibbertia vaginata</i>		CHSR23a-17	<i>Hib vag</i>		

Hypochaeris glabra		Hypochaeris glabra
Isotropis cuneifolia subsp. cuneifolia		CHSR23a-41 Isotropis
Jacksonia furcellata		Jack furcellata
Lagenophora huegelii		Lagenophora hueg
Lepidosperma squamatum complex		CHSR23a-5 Lepidosperma
Leucopogon capitellatus	40-50cm	CHSR23a-14 Leucopogon
Leucopogon sprengelioides	30cm	CHSR23a-31 Myrtaceae
Lomandra caespitosa		CHSR23a-15 Lomandra narrow flat (?)
Lomandra nigricans		CHSR23a-4 Lomandra preissii
Lyginia barbata		CHSR23a-11 Lyginia barb
Lysimachia arvensis		Anagallis arv (blue)
Macrozamia riedlei		Zamia
Millotia tenuifolia var. tenuifolia		CHSR23a-39 Millotia
Nuytsia floribunda		Xmas tree
Oxalis glabra		CHSR23a-22 Trifolium?
Oxalis purpurea		CHSR23a-32 Clover pale pk (?), old shallow pit walls
Patersonia occidentalis		Patersonia occid
Petrophile linearis		Petrop lin
Philothea spicata		CHSR23a-16 Philothea spicata
Phlebocarya ciliata		Phlebocarya cil
Pinus pinaster		CHSR23a-38 pine tree (paired, robust needle leaves)
Podotheca angustifolia		CHSR23a-33 Podotheca angustifolia
Podotheca gnaphalioides		CHSR23a-40 Podotheca gracillis (?)
Poranthera microphylla		CHSR23a-12 Poranthera ?
Pteridium esculentum		Bracken
Pterostylis nana complex		CHSR23a-7 Pterostylis nana (?)
Pterostylis vittata		CHSR23a-13 Pterostylis sang
Pyrorchis nigricans		Pyrorchis nig
Scaevola calliptera		CHSR23a-30 Scaevola
Schoenus curvifolius		CHSR23a-29 Schoenus curvifolius
Sonchus oleraceus		CHSR23a-37 Sonchus oleraceus
Stylidium androsaceum		CHSR23a-28 Short Stylid
Stylidium piliferum		CHSR23a-8 Stylidium cil
Thysanotus manglesianus		CHSR23a-21 Thysanotus pat/mang
Trachymene pilosa		Trachymene pilosa
Ursinia anthemoides		Ursinia

MAPPING NOTES

WDRGS survey area - Site: CHSMN3

Described by: BM **Date:** 16/10/2011

AMG: Zone50 405614mE, 6312011mN (GDA94)

Habitat: Gentle, North-facing, mid lower slope of low broad ridge.

Soil: Gravelly brown loamy sand.

Rock Type: Lateritic pebbles.

Vegetation: *Eucalyptus marginata subsp. marginata* (Jarrah), *Corymbia calophylla* (Marri) woodland over *Xanthorrhoea preissii* scattered shrubs over *Hibbertia hypericoides*, *Acacia lateritica* low open heath over *Tetraria sp.* Jarrah Forest scattered sedges.

Assoc. species: *Comesperma virgatum*, *Hakea lissocarpha*, *Burchardia congesta*, *Macrozamia riedlei*, *Hakea amplexicaulis*, *Acacia extensa*, *Stylidium ciliatum*, *Conostylis setigera subsp. setigera*, *Trachymene pilosa*, *Tetratheca hirsute*.

WDRGS survey area - Site: CHSMN4

Described by: BM **Date:** 16/10/2011

Photo: BM100:

AMG: Zone50 405738mE, 6311872mN (GDA94)

Habitat: Moderate, South-facing, mid to upper slope of low broad ridge.

Soil: Gravelly yellow-brown loamy sand.

Rock Type: lateritic gravel present.

Vegetation: *Eucalyptus marginata subsp. marginata* (Jarrah), *Corymbia calophylla* (Marri) woodland to low open forest over *Xanthorrhoea preissii* scattered shrubs over *Hibbertia hypericoides*, *Hypocalymma angustifolium*, *Acacia lateritica* low open heath.

Assoc. species: *Macrozamia riedlei*, *Boronia spathulata*, *Hakea amplexicaulis*, *Acacia extensa*, *Patersonia babilanoides*, *Leucopogon verticillatus*, *Lagenophora huegelii*, *Leucopogon propinquus*, *Stylidium rhynchocarpum*.

Veg Condition (BF): Very Good to Excellent (past logging, low weed cover)

WDRGS survey area - Site: CHSMN5

Described by: BM **Date:** 16/10/2011

Photo: BM100:

AMG: Zone50 405863mE, 6312014mN (GDA94)

Habitat: Gentle, West-facing, mid-upper slope of broad low ridge.

Soil: 5cm of grey sand over gravelly orange-brown loamy sand.

Rock Type:

Vegetation: *Eucalyptus marginata subsp. marginata* (Jarrah), *Corymbia calophylla* (Marri) woodland to low open forest over *Xanthorrhoea preissii* scattered shrubs over *Hibbertia hypericoides* low open heath over *Tetraria sp.* Jarrah Forest scattered sedges.

Assoc. species: *Acacia lateritica*, *Scaevola calliptera*, *Hypocalymma angustifolium*, *Hakea amplexicaulis*, *Macrozamia riedlei*, *Bossiaea ornata*, *Xanthorrhoea gracilis*, *Burchardia congesta*, *Persoonia longifolia*.

Veg Condition (BF): Very Good to Excellent.

Notes: NB ~ CHSMN4

WDRGS survey area - Site: CHSMN6

Described by: BM **Date:** 16/10/2011

AMG: Zone50 405894mE, 6312209mN (GDA94)

Habitat: Gentle West-facing low-mid slope of low broad ridge.

Soil: Gravelly yellow-brown loamy(?) sand.

Vegetation: *Eucalyptus marginata subsp. marginata* (Jarrah), *Corymbia calophylla* (Marri) woodland over *Xanthorrhoea preissii*, *Hakea lasiocarpa*, *Hakea amplexicaulis* scattered shrubs over *Hibbertia hypericoides*, *Hypocalymma angustifolium* cloh over *Tetraria* sp. Jarrah Forest scattered sedges.

Assoc. species: *Acacia lateriticola*, *Gompholobium marginatum*, *Banksia dallanneyi*, *Burchardia congesta*.

Veg Condition (BF): VG-E (low weed cover, logging)

APPENDIX 6

Clearing Assessment Report and Agency Consultation

MRWA Vegetation Clearing Assessment Report

This guideline has been prepared to assist MRWA in addressing condition 7 "Assessment of Clearing Impacts" under Clearing Permit CPS 818.

1. Area Under Assessment Details

1.1. Proponent details

Proponent's name: Main Roads Western Australia – South West Region
Contacts
Name: Matt Coppen (Project Manager)
Phone: 08 9724 5632
Email: matthew.coppen@mainroads.wa.gov.au

1.2. Property details

Property: Main Roads WA Road Reserve – Coalfields Highway (15.90 – 26.34 SLK), including realignments through areas zoned as State Forest (Wellington National Park), Rural and Public Purposes under the Shire of Collie Local Planning Scheme No. 5.
Colloquial name: Coalfields Highway Realignment 15.90 – 26.34 SLK

1.3. Area under assessment

Main Roads Western Australia (Main Roads) proposes to undertake roadwork on a 10.44 km section of the Coalfields Highway (15.90–26.34 SLK), which is approximately 18km west of Collie. The project occurs from Lullaby Road (1850m west of the Wellington Dam Road) to 1km east of the Wellington Dam. The specific clearing area assessed in this report comprises the project footprint based on the 85% design plus 2m.

RPS and specialist sub-consultants were engaged to investigate a corridor wide enough to cater for potential future expansion of the network to a dual carriage way. Thus, the environmental studies undertaken and referred to below investigated a 150m wide corridor over the proposed realignments. The project addressed in this Vegetation Clearing Assessment Report is for the construction of a single lane road only.

This project is at the final design stage and land acquisition details are yet to be finalised.

Clearing Area (ha) (Estimated)	No. Trees	Method of Clearing	For the purpose of:	Site Plan Attached
(15.9 – 26.34 SLK) 25 ha	Subject to detailed design.	Mechanical / chainsaw / dozer / stump grinding.	Improving road user safety on a key Regional link. Proposed works include realigning four sections of existing Coalfields Highway to construct a single carriageway with overtaking opportunities and road drainage.	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No

1.4. Avoidance/Minimise clearing

How have the clearing impacts been minimised?

The road design has been modified to reduce the clearing impact as far as practicable by:

- reducing batter slopes
- re-alignment to minimise the impact on the grey sands vegetation located south west of the Wellington Dam Road intersection
- optimising clear zone requirements

Finalisation of the road design will consider retention of significant (large trees, hollows etc) remnant trees wherever possible.

A number of recent site environmental investigations were completed in 2010/11/12 over the greater study area corridor (150m wide) to identify and map any significant aspects. The studies included:

- Flora and Vegetation Surveys (2010 – 2011 and 2012) - by experienced botanists to identify any significant flora, vegetation and/or TEC's to consider.

- A Fauna Assessment – by an experienced zoologist to identify any areas of significance to native fauna, including marking of hollow bearing “Potential Habitat” trees.
- A *Phytophthora* Dieback Survey – by an industry recognised RPS dieback-interpreter in liaison with the DEC’s Bunbury office who prepared the Dieback Occurrence Maps.
- An EIA and EMP reconnaissance survey - by a RPS Scientist to evaluate the existing environment and provide management measures to mitigate potential/actual impacts.

An EMP has been prepared to provide overall project environmental management guidance that will be used in contractual documentation. This includes the need to provide the workforce environmental awareness information as to their obligations and any sensitive areas to avoid/manage as part of their pre-work site inductions, as well as compliance monitoring requirements.

Prior to commencing clearing operations, the limits of clearing shall be marked on site and checked by the Construction Manager to ensure they are correctly defined. All construction activities will be contained within the pre-marked clearing limits and designated hard-stand areas.

Machinery, vehicles and equipment will not be parked or driven over tree roots or beyond the clearing envelope. This aspect shall also be addressed in workforce inductions.

Operational hygiene management (weeds, dieback, and pests) will be applied prior to entering particularly sensitive area or dieback-Protectable areas, and upon existing dieback/weed infested areas.

Trees to be removed will be felled in a manner that ensures they fall within the approved clearing envelope. Consideration will be given to harvesting any quality timber and recycling cleared vegetation for site rehabilitation and erosion control - depending on its weed/dieback status and that of the receiving location.

Pruning of tree limbs shall be done with consideration to public safety and improving their stability and form in the longer term.

If any native fauna is disturbed during clearing operations it shall be allowed to make its own way to adjacent vegetated areas and if necessary, the DEC or a recognised wildlife carer shall be contacted for advice/assistance.

2. Background

2.1. Existing environment and information

2.1.1. Description of the native vegetation under application

Site vegetation is comprised of *Eucalyptus patens* (Blackbutt) - *Eucalyptus marginata* subsp. *marginata* (Jarrah)-*Corymbia calophylla* (Marri) mixed eucalypt forests – that dominate the vegetation in the eastern section of the survey area near Wellington Dam. The western portion of survey area mostly has *Eucalyptus marginata* subsp. *marginata* (Jarrah)-*Corymbia calophylla* (Marri) woodlands to open forests on gravelly slopes of lateritic ridges. A small area of dampland vegetation units occurred on the east side of the lowland sand vegetation.

Three vegetation complexes were mapped in the survey area by Mattiske and Havel (1998). Eleven vegetation associations were mapped over the 15.90 – 26.34 SLK section during the 2012 survey, many of them covering small areas. This in part reflects numerous soil types that occur in the area.

Data for the IBRA bioregion ‘Jarrah Forest’, in which the survey area lies, shows that a large percentage of the pre-European vegetation remains (Morgan, 2011). The vegetation association most applicable to the survey area is ‘Medium Forest; jarrah-marri’. Application of the DEC’s 2009 CAR Reserve Analysis’ showed that the regional extent remaining of *Medium Forest; jarrah-marri* is 70.0 % and within the Shire of Collie 83.9 %.

The dampland vegetation mapped in the survey area was assessed as vegetation complex MJ (‘*Muja complex – Depressions and Swamps: Open woodland of Melaleuca preissiana – Banksia littoralis – Banksia ilicifolia with some Eucalyptus patens on moister sites, Banksia spp, on drier sites on valley floors in the subhumid zone*’). Havel (2002) noted 51% of this vegetation complex remaining and large areas of MJ complex are mapped to the east of Allanson (outside of the survey area) (Morgan, 2011).

Across the study area, vegetation condition ratings ranged from Completely Degraded to Excellent condition (based on Keighery scale 1994). There are more areas of disturbance in the *Eucalyptus marginata* subsp. *marginata* (Jarrah) - *Corymbia calophylla* (Marri) woodlands at the western end of the survey area and parts of these were assessed as in Good condition. Fragmented remnants along the existing road verges varied

considerably, being rated between Good and Degraded condition. The project corridors also traverse cleared pasture, basic raw materials pits and some cleared road verges which are Completely Degraded.

Site Visit Undertaken	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Fauna / Flora Survey Undertaken	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Site Report Attached	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Fauna / Flora Survey Report Attached	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Site Photos Attached	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Other Relevant References Attached	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Vegetation Complexes	Clearing Description	Vegetation Condition	Comment
Dwellingup 1 (D1)	Refer item 1.3 above.	Ranged from Excellent to Completely Degraded.	The eastern part of the Coalfields Highway survey corridor crosses large areas mapped as complexes My1 and D1 while the central and western part of the survey corridor mostly crosses through areas mapped as complex D1 and Yg1.
Yarragil 1 (Yg1)			
Murray 1 (My1)			The vegetation condition ratings mapped over the study area range from Excellent to Completely Degraded. Disturbance factors were observed throughout.

3. Assessment of application against Clearing Principles

(a) Native vegetation should not be cleared if it comprises a high level of biological diversity.

Comments **Proposal may be at variance to this Principle**

Based on the site biological surveys (Flora, Fauna and Dieback) over the study area, native vegetation in the proposed clearing areas is considered to support a low to moderate level of biological diversity.

Three vegetation complexes were mapped in the survey area by Mattiske and Havel (1998). The vegetation association most applicable to the survey area is 'Medium Forest; jarrah-marri' that is both Regionally and locally well represented and typical in the greater Collie area.

The flora survey undertaken by Ekologica in 2012 recorded 214 native species and 54 weed species. The most numerous genera were: Fabaceae (33 species), Poaceae (23), Asteraceae (22), Cyperaceae (18) and Orchidaceae (18 species).

Morgan (2011) undertook a survey over an area slightly different to 15.90 – 26.34 SLK and identified two native ferns, one native cycad and 201 common native flowering plants were also recorded with 52 weed species (within the 150 m survey corridors). This could be considered a moderate number for the area surveyed and given the timing of this survey, it is likely that it recorded 80% to 85% of the native vascular flora present (Morgan, 2011).

Site surveys and discussions with DEC identified an area of dissimilar vegetation south east of the existing Coalfields Highway / Wellington Dam Road that will be impacted by the project, and referred to as the Wellington Dam Road Grey Sands (WDRGS). Additional detailed vegetation mapping shows that the WDRGS survey area (the Soils Landscape Subsystem 255DpWGs south of the Coalfields Hwy), rather than being an area of homogeneous soils and vegetation, had a variety of soils, habitats and associated vegetation units, reflected in the 11 vegetation units identified in the area. Furthermore, the area of deep grey sands and associated vegetation was restricted to a small area at the western end of the WDRGS survey area comprising approximately 7.5 ha.

Flora assessment of eleven additional regional sites, as identified from soil and landform mapping within 20km of the project site, was conducted in an attempt to determine the regional significance of the WDRGS vegetation. A PATN analysis of the floristics at the WDRGS and regional sites was inconclusive in determining the regional significance of the WDRGS vegetation.

Project clearing will impact on approximately 1.27 ha of the 7.5 ha deep grey sands vegetation association.

The flora surveys recorded two Priority flora (*Lomandra whicherensis* and *Millotia tenuifolia* var. *laevis*), one other taxon, *Sphenotoma capitata*, was also recorded and is considered to be regionally significant as the survey area is near the edge of its known range. Only two plants were recorded which were in the same location and are not expected to be impacted by project clearing.

Lomandra whicherensis (Priority 1) was relatively abundant and mostly at the western end of the project (Morgan 2011). Over 1 600 plants were counted in about 100 'discrete' areas. One plant was also recorded at the eastern end within the road reserve. This strongly indicates that this species occurs more widely in the immediate and greater area that has extensive equivalent habitat. Based on this assessment, clearing of 140 *L. whicherensis* within the earthworks footprint will not significantly affect its local populations.

Millotia tenuifolia var. *laevis* (Priority 2) was recorded from two locations during the 2011 survey, being within Lot 103 and on the southern side of the existing highway immediately west of Gastaldo Road. However, the proposed road realignment (15.9 – 26.34 SLK) is not expected to impact this species.

Phytophthora dieback infestations are extensive within and beyond the clearing area and the pathogen has obviously caused an impact to susceptible species and vegetation structure/composition (in parts) over a long period of time (RPS, 2011). The occurrence of *Phytophthora cinnamomi* was also verified at points across the clearing area through field sampling and laboratory testing. Visual interpretation and knowledge of this pathogen's effects, supports the conclusion that it has had, and continues to have, a negative impact upon the general areas biological diversity. Overall, there are very few sections within the clearing areas that are uninfested or protectable from dieback.

Faunal assemblages potentially present are unlikely to be of high diversity or different to those found in similar habitats located elsewhere in the immediate vicinity. It was therefore concluded that the area to be cleared does not contain habitats of high ecological significance from a faunal perspective, or contain faunal assemblages that are ecologically significant (Harewood, 2011).

There are no Environmentally Sensitive Areas (ESAs) within or proximate to the proposed clearing corridors.

- Methodology**
- EPBC Act Protected Matters Search Tool (2011)
 - DEC database enquiry (2010)
 - WA Museum database records (2010)
 - Level 1 Flora & Vegetation Survey (Morgan, 2011)
 - Site Fauna Assessment (Harewood, 2011)
 - Phytophthora Dieback Interpretation Survey (RPS, 2011)
 - DEC Dieback Interpretation Records for Collie area cited at DEC Bunbury (March, 2011)

(b) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.

Comments **Proposal is not likely to be at variance to this Principle**

The fauna assessment was undertaken over a 5 day period in 2011 with an updated survey in 2012 by Mr Greg Harewood (B.Sc. Zoology) who is very familiar with the area and region having completed numerous surveys within the south-west and Collie area. Harewood (2011 and 2012) noted that most of the fauna habitats present within the proposed realignment corridor have been subject to substantial historical disturbance and are generally common and widespread in the greater area.

A total of 44 native fauna species were recorded during the site fauna survey. With respect to native vertebrate fauna, 21 mammals (including nine bat species), 104 bird, 41 reptile, nine frogs and three fish species have previously been recorded in the general area, some of which have the potential to occur in or utilise sections of the study area at time.

Four vertebrate species of conservation significance (listed as state or federal threatened/migratory species or DEC priority species) were positively identified within the project site including three black cockatoo species and the Rainbow Bee-eater. No other species of conservation significant fauna area expected to be impacted by the project.

As the area to be cleared is linear, the impact of clearing on fauna or fauna habitat in general will be relatively small at any one location. With respect to fauna in general, no substantial impacts are anticipated as a consequence of the realignment being constructed. In cases where some impact is anticipated, the degree of the impact is only expected to be very low and relates to the loss of small areas of habitat.

The proposed realignment is unlikely to impact upon the distribution and habitat resources currently available to indigenous fauna in the locality as the vegetation association is extensive in adjacent and greater areas. The vegetation association 'Medium Forest; jarrah-marri', is common across and beyond the site and was considered to represent "potential" black cockatoo foraging habitat for one or more of the three black cockatoo species in WA - all of which are known to frequent the area.

The degree to which any one section of the route is utilised for foraging purposes would vary considerably based on species composition and density. Generally, the most dominant and widespread foraging species are Marri and Jarrah though in some areas other species are also present (e.g. Sheoak and Banksia). As this vegetation association is extensive in the region, the proposed realignment does not involve clearing vegetation that is necessary for the maintenance of significant fauna species.

Almost all areas of remnant native vegetation within and beyond the proposed project were considered to represent potential black cockatoo foraging habitat, as it contains a range of plant species documented as suitable habitat for the three species of black cockatoo. The project will require the clearing 25ha of potential foraging habitat.

Within the survey area, a total of 1195 trees with a diameter at breast height (DBH) of over 50 cm were identified, 77 of which were identified with hollows potentially suitable for black cockatoos. No evidence of past or present nesting or overnight roosting by black cockatoos was observed during the surveys. Of the 1195 trees within the survey area with a DBH >50cm, 424 are expected to be cleared for roadworks, including 28 of the 77 trees with potential nest hollows.

Although the proposed action will impact on some significant black cockatoo habitat, removal of this habitat is not considered to be significant for the maintenance of local black cockatoo populations. Vegetation mapping indicates more than 30 000ha and 94 000 ha of potential foraging habitat and breeding habitat occurs within 10 and 20km of the project site respectively.

- Methodology**
- EPBC Act Protected Matters Search Tool (2011)
 - DEC database enquiry (2010)
 - GIS mapping of flora records and alignment options over aerial imagery
 - Targetted threatened fauna and habitat (opportunistic) searches by Harewood (2011)
 - Site Fauna Assessment (Harewood, 2013)

(c) Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.

Comments Proposal is not at variance to this Principle

GIS plotting of DEC's Declared Rare and Priority Flora database records (2010) over the study area identified no significant flora as being recorded within or adjacent to the proposed clearing corridor.

Morgan (2011) and Ekologica (2012) recorded no DRF species within the 150m wide surveyed corridors and two Priority flora (*Lomandra whicherensis* and *Millotia tenuifolia* var. *laevis*).

One other taxon, *Sphenotoma capitata*, was also recorded and is considered to be regionally significant as the survey area is near the edge of its known range. Only two plants were recorded which were in the same location. None of these plants are expected to be impacted by the proposal.

As discussed in Section (a), *Lomandra whicherensis* is widespread throughout the area and the proposed action will impact less than half of the plants identified in the area.

As no DRF were identified during any of the surveys undertaken and any impact on priority flora is low, the potential impact for clearing to impact on DRF is considered low and the proposed action is not considered to be at variance to this principle.

- Methodology**
- EPBC Act Protected Matters Search Tool (2011)
 - DEC database enquiry (2010)
 - Level 1 Flora & Vegetation Survey (Morgan, 2011)
 - GIS plotting of recorded flora locations

(d) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a threatened ecological community.

Comments **Proposal is likely to be at variance to this Principle**

A 2010 search of DEC's TEC and PEC databases over the greater study area that showed no TECs or PECs are known to occur within the area. Furthermore, consultants GHD (2010) found there were no TECs or PECs in proximate areas. An EPBC Act Protected Matters Search also identified no known TECs as occurring within the study area.

None of the vegetation units recorded in the survey area are on the Commonwealth's TEC list or the DEC's TEC database. Reference to DEC's December 2010 PEC list also led to the conclusion that none of the vegetation units recorded is a PEC.

Based on the above assessments, no TECs or PECs protected under state or Commonwealth legislation will be impacted by the project.

After reviewing the Level 1 surveys and reports, DEC officers raised concerns relating to an area of Soil Landscape Subsystems 255DpWGs that was traversed by the Coalfields Highway. These concerns were that this area of Soil Landscape Subsystems 255DpWGs, located around the intersection of Wellington Dam Road and the Coalfields Highway, was restricted in this region and may be associated with restricted plant communities.

Consequently, further surveys were undertaken to determine the regional context of the vegetation occurring on deep grey sands around and to the east of the Wellington Dam Road Information Board. The Grey Sands Flora and Vegetation survey was undertaken within the deep grey sands vegetation in the Soil Landscape Subsystem 255DpWGs in the Wellington Dam Road area south of the Coalfields Highway (WDRGS survey area), between the 14 and 16 October 2011, 11 and 14 November 2011 and 26 and 29 November 2011

The vegetation mapping showed that the WDRGS survey area (the Soils Landscape Subsystem 255DpWGs south of the Coalfields Hwy), rather than being an area of homogeneous soils and vegetation, had a variety of soils, habitats and associated vegetation units, reflected in the 11 vegetation units identified in the area. Furthermore, the area of deep grey sands and associated vegetation was restricted to a small area at the western end of the WDRGS survey area (about 7.5 ha).

The scope of the survey limited the results, as the limited regional dataset meant a comprehensive test for regional significance could not be conducted. The PATN analysis suggested that, despite some moderate similarity with some of the regional sites included in the study, the deep grey sands vegetation is likely to be restricted and regionally significant.

The area of deep grey sands and associated vegetation occurring within the WDRGS survey area covers approximately 7.5 hectares. Main Roads expects their impacts on this vegetation to be approximately 1.2 hectares. This is only approximately 16.0% of the area within the WDRGS survey area and is not considered significant.

Consequently, the proposed highway upgrade is not expected to impact on any listed PECs or TECs. However, as it may impact on the potentially regionally significant grey sands vegetation, the proposed action is likely to be at variance to this principle.

- Methodology**
- EPBC Act Protected Matters Search Tool (2011)
 - DEC TEC database (2010)
 - Level 1 Flora & Vegetation Survey (Morgan, 2011)
 - Coalfields Highway Preliminary EIA (GHD, 2009)

(e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.

Comments **Proposal is not at variance to this Principle**

The project does not occur in an area that would be considered extensively cleared, with large areas of remnant vegetation which are protected in reserves and national parks, as indicated in the below table.

Reserve	Reserve Area (ha)	Hedde Complex Areas with Reserves (ha)	
		Murray Complex	Yarragil Complex
Within 10km of Coalfields Highway Upgrade project			
State Forest	15769.8		9723.3
Nature Reserve	6.80		
National Park	12391.5	3846.1	4154.7
Conservation Park	854		
Other Reserve	5.2		
CALM Executive Body Freehold	1070	479.5	83.3
Total	30097.3	4325.6	13961.3
Within 20km of Coalfields Highway Upgrade project			
National Park	17421.6	3940.9	4600.3
State Forest	70890.2		33524.1
Nature Reserve	513.4		
Other Reserve	2144.3		811.6
Conservation Park	1042.3		
CALM Executive Body Freehold	2086.6	1063.4	205
Total	94098.4	5004.3	39141

The vegetation association most applicable to the survey area is extensive (*'Medium Forest; jarrah-marri'*), and its regional extent remaining is 70.0 % with 83.9 % remaining in the Shire of Collie. The small area of dampland vegetation mapped within the survey corridor has 51% remaining and large areas have been mapped east of Allanson outside of the survey area (Morgan, 2011).

Methodology

- Level 1 Flora & Vegetation Survey (Morgan, 2011)
- Coalfields Highway Preliminary EIA (GHD, 2009)
- Vegetation association data (DEC, 2009)

(f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.

Comments **Proposal is may be at variance to this Principle**

The Luxenburgh Watershed extends (in part) from the western end of the study area through to Gastaldo Road draining northwards and encompasses the upper Otho River, also outside of the study area. The remaining project area falls within the upper Wellington Reservoir watershed that drains south and east.

The Hamilton River drains into Wellington Dam north and outside of the project area. At the eastern location of the proposed highway upgrade, a new culverted crossing of the Wellington Dam is proposed which will involve some clearing of vegetation associated with a watercourse or wetland.

There are no major rivers within the project study area corridor. The main drainage system in the locality is the Collie River and this is situated south and outside of the study area corridor.

The project traverses an ephemeral drainage line at 19.950 SLK, which flows north and forms the upper reaches of the Otho River. A culverted crossing will maintain the existing surface water drainage at this crossing and no impacts on surface water flows are considered likely.

An ephemeral drainage line is situated south of the existing highway and north of the proposed highway re-alignment, over approximately 700m immediately west of Wellington Dam. This narrow and incised watercourse drains east into Wellington Dam and is immediately south of the proposed Hamilton re-alignment.

There are no wetlands within the project study area of state or international importance. There are scattered wetlands of the Multiple Use category and one Resource Enhancement wetland, all of which are situated outside of the study area towards its western end. The project will not impact existing wetlands, apart from a small dampland area located north of the existing highway at 19 100 SLK (approximately 100m east of Wellington Dam Road). Clearing of vegetation associated with this wetland (EmCcTI and EmCcBI) will be minimised to reduce any potential impacts.

In respect to environmental impacts, the proposed project is not expected to significantly alter the natural surface water regime, including groundwater recharge. However some clearing of vegetation associated with wetlands and watercourses is expected as part of the culvert crossings of the Wellington Dam and ephemeral drainage line and potential clearing of the vegetation units associated with the small dampland. Consequently the proposed action may be at variance to this principle.

- Methodology**
- Examination of aerial photography
 - GIS Geomorphic and significant wetland mapping
 - Level 1 Flora & Vegetation Survey (Morgan, 2011)
 - Site Fauna Assessment (Harewood, 2011)
 - Site environmental reconnaissance survey (RPS, 2011)

(g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.

Comments Proposal is not at variance to this Principle

The proposed linear clearing within a locality that is well vegetated is considered as not likely to cause appreciable land degradation, provided sound environmental management measures are employed during road development activities. Implementation of the EMP will provide for managing any land degradation impacts. In particular this employing best practice stormwater design/management principles and operational hygiene measures when clearing to prevent the introduction/spread of weeds and dieback to any vulnerable native vegetation will be necessary.

- Methodology**
- Examination of aerial photography
 - Discussions with Main Roads Project Manager
 - Site environmental reconnaissance survey (RPS, 2011)

(h) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.

Comments Proposal may be at variance to this Principle

The project traverses (in parts) the Wellington National Park (WNP) that has inherent values with its vesting purpose. It is noted in general that large, contiguous vegetated areas, support biodiversity, fauna movements and environmental education and scientific endeavours - as they are not affected by edge effects or separated by cleared pasture or roads.

The upgraded highway will in essence replicate the edge effects of the existing highway on the WNP.

The project land requirement of 46.5 ha will include an excision of 19.1 ha of WNP. WNP is approximately 17 000 ha in area, and the proposed excision is unlikely to have any impact on its conservation values. Main Roads is working with DEC to maintain existing WNP management measures such as:

- strategic fire access tracks
- close unmanaged vehicle access to the park
- improve the safety of existing park and visitor information bay access
- improve the safety of the Munda Bindi crossing of Coalfields Highway.

None of the studies over the proposed clearing corridor recorded environmental values of outstanding importance or significant vegetation communities, habitat or ecological linkages that would be separated by the linear clearing being proposed.

- Methodology**
- Desktop land tenure checks using Landgate (2011)
 - Desktop assessment using the online DEC Native Vegetation Map Viewer (2011)
 - Level 1 Flora & Vegetation Survey (Morgan, 2011)
 - Site Fauna Assessment (Harewood, 2011)

(i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.

Comments **Proposal is not likely to be at variance to this Principle**

Field investigations noted a number of minor ephemeral drainage lines of which some enter the Wellington Dam. The Wellington Dam Catchment Area is a 'Not Assigned' Public Drinking Water Source Area under the *Country Areas Water Supply Act 1947* (CAWS Act).

Potential Risks to the Wellington Dam water quality from project activities include the following:

- potential contamination from off-road runoff during highway operation
- risk of spills from road crash during operation of the highway
- risk of spill during construction or contamination from refuelling operations and storage of fuel, oils and chemicals and machinery parking areas. This risk can be significantly reduced and managed during the projects implementation through not storing large quantities (over 20 L) of hydrocarbons within the dam catchment

The greatest risk to the water quality is likely to be from sediment and turbidity from road construction earthworks. This risk will be managed during construction through erosion control methods such as construction timing and silt curtains.

The project design will include erosion control and sediment management measures to reduce water quality risks during the on-going operation of the highway.

The Coalfields Highway Upgrade is not expected to significantly alter the natural surface water regime, including groundwater recharge. Vegetation clearing around surface water will be kept to a minimum and appropriate drainage design and construction management is considered likely to mitigate any potential impacts. Therefore the proposed action is not considered likely to be at variance to this principle.

- Methodology**
- Desktop EIA and site assessment (2011)
 - Examination of aerial photography
 - Main Roads consultation with Department of Water (2010)

(j) Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.

Comments **Proposal is not at variance to this Principle**

It is understood that the proposed design will include provision culverts and roadside drainage without obstructing existing natural flow paths. The project is generally high in the landscape and parts occur on upper watersheds. The proposed realignment is proximate to the existing highway and as such, existing drainage paths will be utilised wherever possible so there will be no significant change to existing drainage. The project clearing would be linear and is not within a confined or built up area, or a location subject to inundation where drainage may otherwise be impeded and development could increase/exacerbate flood risk.

- Methodology**
- Examination of aerial photography
 - Discussions with Main Roads Project Manager
 - Desktop EIA and site assessments (2011)

Planning instrument, Native Title, RIWI Act Licence, EP Act Licence, Works Approval, Previous EPA decision or other matter.

Comments Main Roads will refer the project to the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) to confirm the need for approvals under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) in respect to the loss of black cockatoo habitat.

Main Roads will also refer the project to the Western Australian Environmental Protection Authority (EPA) under Part IV of the *Environmental Protection Act 1986* is required to determine the need for formal environmental assessment.

Should the EPA decide not to assess this project then clearing is expected to be conducted under the provisions of Main Roads Clearing Permit 818.

Main Roads will also obtain a Bed and Banks Permit from the Department of Water under the *Rights in Water and Irrigation Act 1914*.

The Minister for Indigenous Affairs has issued an approval, under Section 18 of the WA Aboriginal Heritage Act (1972), to use the land overlain by the registered Collie River Waugal site (Site ID 16 713) for the construction of the Coalfields Highway Upgrade.

Methodology

- Discussions with Main Roads Project Manager
- Discussions with officers from the Office of the Environmental Protection Authority
- Desktop information
- Site studies referred to above
- DoW correspondence

4. Assessor's recommendations

List of Principles seriously at variance, at variance or maybe at variance

Recommendations

Proposal is not likely to be at variance to: The following recommendations are made:

- | | |
|--|---|
| b) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia | 1. Clearing is possible under CPS 818
2. Main Roads should refer the project to the EPA
3. Main Roads should refer the project to the DSEWPaC
4. Prepare an offset proposal for the proposed clearing. |
| i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water. | 5. Prepare a rehabilitation and revegetation plan as clearing is >0.5 ha.
6. Adhere to the EMP for all clearing and project activities.
7. Continue liaison with the Department of Environment and |

Proposal may be at variance to Principle: Conservation in respect to environmental management of project activities within the Wellington National Park.

a) Native vegetation should not be cleared if it comprises a high level of biological diversity

f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.

h) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.

Proposal *likely be* at variance to
Principle:

d) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a threatened ecological community.

5. References

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- EPA (2004b). Guidance for the Assessment of Environmental Factors: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia. No. 56.
- Ekologica (2012). Level 1 Flora and Vegetation Assessment for a Proposed Upgrade of the Coalfields Highway (SLK 16 – SLK 26.5)
- GHD (2009). Coalfields Highway Upgrade (27.92- 35.45 SLK). Environmental Impact Assessment and Environmental Management Plan. Unpublished report prepared for Main Roads Western Australia.
- Harewood, G. (2011). Coalfields Highway Realignment (16 – 28 SLK). Site Fauna Assessment.
- Keighery, B.J. (1994). Bushland Plant Survey: A Guide to Plant Community Survey for the Community. Wildflower Society of WA (Inc.), Nedlands, Western Australia.
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OFFICE PREPARING REPORT

Prepared by RPS on behalf of
Main Roads Western Australia

13 March 2013

Enquiries: Jeanette Della-Bona on 97255661
Our Ref: 08/6080
Your Ref:

24 November 2010

Mr M Warnock
A/ Manager Native Vegetation Conservation Branch
Department of Environment & Conservation
Locked Bag 104
BENTLEY DELIVERY CENTRE WA 6983

Dear Mr Warnock

INVITATION FOR SUBMISSIONS – COALFIELDS HIGHWAY UPGRADE WELLINGTON DAM ROAD WEST TO ALLANSON 16 – 28 SLK

Coalfields Highway provides the primary road link between Bunbury and Collie. A section of this road located between the Allanson town site and west of the Wellington Dam Turnoff has been identified as requiring safety improvements.

Concept planning and constraint mapping over the project area has led to the identification of a preferred alignment for upgrade of the existing highway, see attached. The project proposes construction of a single carriageway with multiple overtaking opportunities.

Main Roads WA has funding identified for commencement of construction of upgrade works during the 2011-12 Financial Year, with funding to complete the works currently being sought over the following 3 year period.

Main Roads has completed a Preliminary Environmental Impact Assessment (PEIA) for the project including a preliminary assessment of the clearing impacts. The overall proposed clearing for these works currently totals approximately 15 Ha of native vegetation. The PEIA indicated that there are five Principles that may be at variance.

As per Main Roads' Clearing Permit CPS 818/5, given the above project may be at variance with the WA Environmental Protection Act's – 10 Clearing Principles, Main Roads invites submissions from your group on the environmental aspects of this proposal.

The Principles that were considered maybe at variance are as follows:

(b) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.

It is likely that the Wellington National Park as well as the surrounding vegetation could provide habitat for indigenous Western Australian fauna species. It is possible that the project is at variance with this principle, however this will be determined once a fauna / habitat survey is completed.

(c) Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.

The project may be at variance with this principle. Main Roads will undertake a flora survey as DEC database records list a number of threatened flora as occurring in the general vicinity of the project.

(f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.

The project could be at variance with this principle if vegetation associated with the Hamilton and Ortho Rivers is cleared. Besides these small sections the remainder of the project area will not be at variance with this Principle. Main Roads will reassess this principle once the flora survey is completed.

(g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.

The project may be at variance with this principle. Further environmental impact assessment and site investigations will be necessary to assesses if the project will be at variance to this principle.

(h) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.

The project will directly impact the Wellington National Park as it is proposed that 10.6 Ha of native vegetation excised from the park will be cleared for the new realignment.

Offsets

As mentioned above, approximately 15 Ha of native vegetation is proposed to be cleared in order to construct the Coalfields Highway realignments project, of which approximately 8 Ha is currently in DEC ownership and 7 Ha is owned by others (Worsley and Road Reserve). The project will however result in approximately 31 Ha of land to be relinquished to DEC and included into the Wellington National Park. Of this land, approximately 9 Ha is currently native vegetation and 22 Ha is cleared farmland or existing road that is proposed to be rehabilitated back to native vegetation. All of the above areas are subject to future detailed road design.

Main Roads welcomes any comments you may have on this proposal. Please provide your submissions by 17th December 2010. For further details, or if you cannot respond by 17th December please contact Jeanette Della-Bona on (08) 9725 5661 or by email on jeanette.dellabona@mainroads.wa.gov.au.

Yours sincerely

Brett Belstead
DIRECTOSOUTH WEST OPERATIONS

From: ANDERSON Carol [mailto:Carol.ANDERSON@water.wa.gov.au]
Sent: Thursday, 27 January 2011 4:19 PM
To: DELLA BONA Jeanette (EO)
Subject: 08/6080 Coalfields Highway

Hi Jeanette

I refer to the possible variance (f).

The proposed roadworks are within a proclaimed Surface Water Area where any interference with the bed and/or banks of the rivers or any other waterways, will require a Permit to be obtained from the Department of Water under the *Rights in Water and Irrigation Act 1914*.

Should the clearing be assessed by the DEC and found to be exempt then a license will be required under the Department's *Country Area Water Supply Act 1947*.

There is also *Rare and Priority Flora* identified just north of where the Collie River meets the Highway.

The works fall under a 'Not Assigned' Public Drinking Water Source Area where the management objective is to protect the resource for future needs. The greater potential impact from works will be associated with the management of refuelling operations and storage of fuel, oils and chemicals, machinery parking areas and effluent management.

Regards

Carol Anderson
S W Region
Dept of Water

Disclaimer:

This e-mail is confidential to the addressee and is the view of the writer, not necessarily that of the Department of Water, which accepts no responsibility for the contents. If you are not the addressee, please notify the Department by return e-mail and delete the message from your system; you must not disclose or use the information contained in this email in any way. No warranty is made that this material is free from computer viruses.



Government of **Western Australia**
Department of **Environment and Conservation**

Your ref: 08/6080
Our ref: CPS 818/5
Enquiries: Chloe Sykes
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Mr Brett Belstead
Director
South West Operations
Main Roads Western Australia
PO Box 5010
BUNBURY WA 6231

08/6080
Document No. B11#3433
Resp. Officer POE Della Bona
Related: B10#22535

Dear Mr Belstead

CPS 818/5 – SUBMISSION – COALFIELDS HIGHWAY - UPGRADE – WELLINGTON DAM ROAD WEST TO ALLANSON (SLK 16 - 28)

Thank you for your letter dated 24 November 2010, inviting the Department of Environment and Conservation's (DEC) Native Vegetation Conservation Branch to provide comment on Main Roads Western Australia's (MRWA) proposed upgrade to Coalfield Highway, Wellington Dam Road West to Allanson (16 – 28 SLK), within the Shire of Collie. I understand that the area of impact involves the clearing of approximately 15 hectares of native vegetation.

Submissions are invited in accordance with condition 8 of clearing permit CPS 818/5 for any clearing that 'may be at variance', 'is at variance' or 'is seriously at variance' with the clearing principles contained within Schedule 5 of the EP Act.

The 15 hectares of native vegetation proposed to be cleared has been assessed against the clearing principles contained in Schedule 5 of the *Environmental Protection Act 1986* (EP Act), taking into account information you have provided and information the Department of Environment and Conservation (DEC) has obtained through consultation.

In relation to clearing principle (b), your letter indicates that the proposal 'is at variance.' With the information currently available, I consider this principle 'may be at variance.' The proposed clearing area contains suitable habitat for a number of conservation significant fauna species, including Western ringtail possum (*Pseudocheirus occidentalis*), Chuditch (*Dasyurus geoffroyi*), Quokka (*Setonix brachyurus*) and Numbat (*Myrmecobius fasciatus*). A fauna survey will be required to determine the presence of suitable habitat for fauna species of conservation significance.

In relation to clearing principle (c), your letter indicates that the proposal 'may be at variance.' I agree with this level of variance. There are several records of *Grevillea rara* within the local area (10km radius). This species occurs within the same soil and vegetation type as parts of the area to be impacted. I also consider principle (a) 'may be at variance.' There are ten priority flora species recorded within the local area, of these, six are mapped within the same soil and vegetation type as areas proposed to be cleared. A flora and vegetation survey will be required to appropriately determine the impacts to rare and priority flora species.

In relation to clearing principle (f), your letter indicates that the proposal 'may be at variance.' I agree with this level of variance. The Collie, Hamilton and Ortho Rivers intersect sections of the area to be cleared and riparian vegetation is likely to occur in these areas. A flora and vegetation survey will determine the full extent of impacts to riparian vegetation.

Native Vegetation Conservation Branch

Phone: (08) 9219 8700 or (08) 9219 8744 Fax: (08) 9219 8701 Email: nvp@dec.wa.gov.au
Postal Address: Locked Bag 104, Bentley Delivery Centre, BENTLEY WA 6983
www.dec.wa.gov.au/nvc
wa.gov.au

In relation to clearing principle (g), your letter indicates that the proposal 'may be at variance.' With the information currently available, I agree with this level of variance. I understand that further site investigations and impact assessment is required to determine if land degradation will result from the proposed clearing.

In relation to clearing principle (h), your letter indicates that the proposal 'is at variance.' I agree with this level of variance. Approximately 10.6 hectares of vegetation is to be cleared from within the Wellington National Park and it is proposed that this vegetation be excised. Please resolve all land tenure issues prior to the construction of an offset proposal.

I note that you have not identified any variance levels for the remaining clearing principles. After desktop analysis and additional advice, I consider that principle (i) 'may be at variance.' Given that watercourses may be impacted by the proposed activities, surface water quality may be adversely affected. Best practise management measures (such as culverts) will aid in reducing impacts to surface water quality.

I agree that the remaining principles are 'not likely to be at variance'.

In accordance with conditions 5(a)(ii) and 9(c) and Part V of clearing permit CPS 818/5, MRWA is required to submit for approval an offset proposal as the clearing 'is' and 'may be' at variance to a number of clearing principles.

Furthermore, a management plan is also required to be submitted as the clearing 'may be at variance' to Principles (g) and (i).

I note that land is required to be excised from the Wellington National Park and acquired from private landowners. Please be aware that access to the land must be obtained prior to the commencement of clearing.

If you have any queries regarding the matters raised above, please contact Chloe Sykes at DEC's Native Vegetation Conservation Branch on (08) 9219 8743.

Yours sincerely



Kelly Faulkner
MANAGER
NATIVE VEGETATION CONSERVATION BRANCH

*Officer delegated under Section 20
of the Environmental Protection Act 1986*

16 February 2011

Cc: Mr Murray Limb, Manager, Main Roads WA, PO Box 6202, East Perth 6892

APPENDIX 7

***Phytophthora* Dieback Interpretation Survey Report**



PHYTOPHTHORA DIEBACK INTERPRETATION REPORT

Proposed Coalfields Highway Realignment (16–28 SLK)

Prepared by:

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Report No: **110572:2**

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TABLE OF CONTENTS

Page

1.0 INTRODUCTION 1

1.1 Background 1

1.2 Study Area..... 2

 1.2.1 Landforms and Soils 2

 1.2.2 Vegetation Complexes 2

1.3 Historical Land Use and Past Disturbances 3

2.0 METHODS 5

2.1 Interpretation 5

2.2 Mapping 5

 2.2.1 Mapping Categories..... 5

 2.2.2 Terminology..... 6

2.3 Demarcation 7

2.4 Soil and Tissue Sampling 7

3.0 RESULTS AND DISCUSSION 9

3.1 Disease Distribution 9

3.2 Sample Results 10

3.3 Disease Expression and Impact 11

4.0 CONCLUSIONS..... 13

5.0 RECOMMENDATIONS..... 15

6.0 REFERENCES 17

TABLES

(contained within report text)

	Page
Table 1: Mapping Categories.....	6
Table 2: Area Statement	10
Table 3: Summary of Sample Results – Coalfields Highway (16–28 SLK)	11

PLATES

(compiled at rear of report)

Plate 1:	Area west of Wellington Dam Road burnt in 2010
Plate 2:	This <i>Xanthorrhoea gracilis</i> death is evidence of infestation
Plate 3:	Uninterpretable area of <i>Eucalyptus Patens</i> (Blackbutt) mixed eucalypt forest in eastern part of the study
Plate 4:	This <i>Xanthorrhoea preissii</i> death is evidence of an old infestation

APPENDICES

APPENDIX 1:	<i>Phytophthora cinnamomi</i> Occurrence Maps (DEC's Original Map was printed on a Single A2 Sheet at 1:10,000, these are Printed on A3 making the Scale Approximately 1:15,000)
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1.0 INTRODUCTION

1.1 Background

Dieback disease caused by the pathogen *Phytophthora cinnamomi* (referred to as “dieback” herein) is a major threat to ecosystem health and biodiversity in south-western Australia. Approximately 40% of all known flora in the south-west region are susceptible to dieback.

Dieback is a microscopic soil-borne water mould that can spread through water, soil, and root-to-root contact. Soil moving activities such as during roadwork have the potential to spread infected soil/vegetation. The risk of introducing and spreading dieback can occur on site during soil-moving activities and off site such as when machinery leaves an infected area without being cleaned free of soil and mud. This can increase in wet soil conditions. To minimise this risk, it is important to consider dieback in road project planning and employ sound hygiene practices when constructing, rehabilitating and maintaining roads. Typically, this involves identifying “Protectable” areas of native vegetation followed by educating the workforce, establishing vehicle clean-on-entry points and controlling access/soil-disturbance activities.

Main Roads Western Australia (Main Roads) proposes to realign parts of the Coalfields Highway to improve its safety and accommodate increasing traffic volumes. The realignment project extends between 16 Straight Line Kilometre (SLK) and 28 SLK, west of Allanson in the Shire of Collie. Main Roads commissioned RPS to assess the occurrence of dieback over the project length and to provide management measures as required.

Dieback interpretation was undertaken during March and April 2011. Interpretation was completed over the entire project corridor and included two alternative realignment options situated in the western end of the project. Interpretation was undertaken by Bruno Rikli of RPS (previously a Dieback Interpreter within CALM and currently a technical advisor for the Busselton Dieback Working Group). Peter Blankendaal of the Department of Environment and Conservation (DEC) (A/Disease Standards Officer) inspected the field work on 1 March 2011, provided technical advice and produced the dieback maps per DEC standards in liaison with RPS.

This report gives the results of *Phytophthora* dieback occurrence mapping that identifies areas as Infested, Un-infested, Uninterpretable and Excluded. After *Phytophthora* occurrence information has been established, “Protectable” areas can be overlaid on the occurrence information to further simplify site management.

1.2 Study Area

The linear survey is situated west of Allanson and extends approximately 12 km through the Wellington National Park, private property, cleared pasture and over parts of the existing Coalfields Highway corridor. A 150 m wide corridor was mapped. Its eastern end lies at approximately the junction of Rose Road/Coalfields Highway in Allanson. The western end is at the Lullaby Road (a forest track)/Coalfields Highway junction. As part of the study, an alternate road alignment was also interpreted in the western part that forms an arch of approximately 3 km. This is referred to as “Option 2” herein.

The locality is situated within the 900–1200 mm rainfall zone and does not occur within a forest Disease Risk Area (DRA). Within the study area corridor, the entire area that could be interpreted and mapped was 77.5 ha.

Large areas of the survey corridors were excluded from interpretation due to their high degrees of disturbance that did not allow *Phytophthora* dieback to be mapped. This included recently burnt areas, cleared pasture and cleared service corridors.

1.2.1 Landforms and Soils

The study area is located on the Darling Plateau physiographic unit that comprises an undulating surface with an average elevation of 250–300 mAHD. There are a range of soils present including sands, lateritic soils and clays which generally occur in distinct parts of the landscape (Beard, 1980). Eight soil landscape subsystems have previously been mapped over the study area (DAFWA, 2011). Of these, the two most extensive within the study area are:

- 255LvGR – moderately deep valleys in granite with loamy earths and loamy gravels. This soil subsystem extends over much of the eastern third of the study area
- 255DpDWi – lateritic soils comprised of gravel with some sands and loams. This soil subsystem can be associated with mid-upper slope areas in the central and western parts of the study area.

1.2.2 Vegetation Complexes

The study area lies in the Dale Botanical Sub-district, in the Darling Botanical District of the south-west Botanical Province of Western Australia (Beard, 1980). The three vegetation complexes mapped by Havel and Mattiske (1998) in the Coalfields Highway study area are:

- Dwellingup I (DI) (Darling Plateau – Uplands): mosaic of open forest of *E. marginata* subsp. *marginata*-*Corymbia calophylla*, with some admixtures..., including woodlands of *E. wandoo*, low woodlands of *Allocasuarina huegeliana* and closed heaths on or near granite outcrops

- Yarragil I (YgI) (Darling Plateau – Valleys): open forest of *E. marginata* subsp. *marginata-Corymbia calophylla* on slopes with mixtures of *E. patens* and *E. megacarpa* on valley floors
- Murray I (MyI) (Darling Plateau – Valleys): open forest of *E. marginata* subsp. *marginata-Corymbia calophylla-E. patens* on valley slopes.

The eastern part of the surveyed corridor traverses large areas mapped as vegetation complexes MyI and YgI. The central and western part of the survey corridor mostly crosses areas mapped as complex DI.

1.3 Historical Land Use and Past Disturbances

The DEC office in Bunbury was consulted prior to commencing field interpretation to obtain any previous interpretation records for the general study area. The records showed previous interpretation had occurred, namely along service corridors and some forest tracks. Dieback “Infested” areas had been identified along some firebreaks, parts of the Munda Biddi Trail in the Wellington National Park, a transmission line easement and the Collie power station saline water easement. Where relevant, the previous DEC’s interpretation records were considered.

The DEC Wellington District Office in Collie was consulted for records on prescribed burn history for the study area. Peter Gibson (DEC) provided specific dates for prescribed burning undertaken in relevant areas that ranged from 1 year to 24 years. The more recently burnt areas limited interpretation as the understorey had not sufficiently regenerated and possible indicator plants were found to be severely fire damaged.

Historical land uses in the area include logging, grazing, firewood collection, rubbish dumping and cattle grazing. In addition, obvious signs of disturbance to the original native vegetation are present, most notably proximate to the existing Coalfields Highway and the western end of the interpreted area. This includes gravel and sand extraction, disturbance from developing road drains that enter forested land, clearing for tracks and easement corridors.

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2.0 METHODS

2.1 Interpretation

Field interpretation followed the standard methodology and procedures described in the document titled *Volume 2 – Phytophthora cinnamomi and disease caused by it: Interpreter guidelines for detection, diagnosis and mapping* (CALM 2001). Field interpretation was based on the linear survey technique that the DEC noted as requiring interpretation up to 150 m outside of the study area corridor.

The occurrence of dieback was determined by consulting previous interpretation records, field observation and soil/tissue sampling. Non-differential hand-held global positioning system (GPS) was used for field navigation and to record waypoints and demarcated boundaries.

2.2 Mapping

The *Phytophthora cinnamomi* Occurrence Maps were produced by DEC in their Bunbury office using the field data obtained during this interpretation to complete this task.

Notes for map users:

- The original single map prepared by the DEC was printed on a single A2 sheet at 1:10,000.
- The three maps in Appendix I are printed on A3 sheets for ease of printing, thus their scale is approximately 1:15,000.

2.2.1 Mapping Categories

The following table describes the *Phytophthora cinnamomi* occurrence categories applied during this interpretation as directed by Peter Blankendaal (A/Disease Standards Officer, DEC).

Table 1: Mapping Categories

Excluded Areas that are sufficiently disturbed so that <i>Pc</i> occurrence mapping is not possible at the time of inspection	Further categorisation may be possible after variable regeneration periods for different types of disturbance	
Mappable Natural undisturbed vegetation. <i>Pc</i> occurrence mapping is possible. Three categories may result.	Infested	Areas that a qualified person has determined to have plant disease symptoms consistent with the presence of the pathogen
	Un-infested	Areas that a qualified person has determined to be free of plant disease symptoms that indicate the presence of the pathogen
	Uninterpretable	Areas where indicator plants are absent or too few to determine the presence or absence of disease caused by

2.2.2 Terminology

Basic Raw Materials (BRM)

Sand (including silica sand), clay, rock, limestone, gravel and other construction or road building materials.

Dieback Occurrence Map

This is the main map produced to show Infested areas, Un-infested areas and Uninterpretable areas. If this map is older than one year, the field boundaries should be re-checked before operations proceed. This map should not be used if it is older than three years, upon which the area should be entirely re-interpreted by an experienced dieback interpreter.

Dieback Hygiene Plan

A document that describes how human access to “Protectable” areas will be managed to avoid and minimise establishing new centres of infestation to the lowest possible level.

Protectable Areas

Protectable areas can include Un-infested or Uninterpretable sites that have been determined as warranting protection from dieback. They may include areas of high conservation and/or socio-economic value within the vulnerable zone and can be shown on maps. Infested areas are not protectable.

2.3 Demarcation

The “Infested” area boundaries were demarcated using 50 mm day-glow orange flagging tape with the knots facing the infestation. The exception to this was where physical boundaries exist such as cleared tracks or the interface of vegetation and cleared pasture where no demarcation was required. This was confirmed with DEC’s Acting Disease Standards Officer (pers. com. P. Blankendaal, 1 March 2011).

2.4 Soil and Tissue Sampling

Eleven soil and tissue samples were collected during interpretation to provide further evidence of the presence and absence of dieback. All samples were sent to the DEC’s Vegetation Health Service laboratory in Kensington, where diagnostic baiting was conducted.

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3.0 RESULTS AND DISCUSSION

3.1 Disease Distribution

Phytophthora cinnamomi was positively identified across the majority of the study area corridor, except towards its easternmost end and parts that were excluded.

Two minor sections situated south and west from Gastaldo Road were classed as uninfested. They also occur within the Wellington National Park that contains down-slope vegetation in good to better condition. Both uninfested areas warrant consideration as being “Protectable” from dieback.

Areas west of the Wellington Dam Road and Worsley Back Road were burnt in a DEC prescribed burn in 2010, most of which was “excluded” from this interpretation (see Plate 1). From the western end of the project eastwards for approximately 1km on the north side of the highway is infested. Historic disease in this area has reduced its biomass and evidence of dieback was found in its adjacent down-slope areas. Within this western part there were some small patches where interpretation was possible and these were mapped as infested. Previous DEC interpretation (2005) identified dieback along parts of the Munda Bididi trail that traverses the proposed realignments at one point in the west in a north–south direction. At the point where the trail traverses the realignments it was not possible to demarcate the current dieback boundaries due to the recent burn. The DEC is aware of this and advised that it is not necessary to show the previous DEC interpretation on the dieback occurrence maps herein. None of the project corridor situated west of Wellington Dam Road and Worsley Back Road is considered to warrant the “Protectable” status. This is based on the general extent of known dieback in the area (including previous DEC interpretation results), site topography and its proximity to the existing Coalfields Highway and related drainage.

The vegetation situated immediately east from Lot 1020 is infested. This area has been heavily grazed with an understorey that is now very sparse. That contains widely scattered *Xanthorrhoea gracilis* deaths (see Plate 2). A positive *Phytophthora cinnamomi* sample was recovered in this area. Within Lot 1020 was not permitted at the time of interpretation, however this area has largely been cleared and contains an existing sand pit that was “Excluded” from interpretation. This area is considered unprotectable.

DEC interpretation (2011) identified dieback along the majority of the Collie Power Station Saline Water Easement of which a section enters the study corridors eastern part. The section of easement within the study corridor falls within an area now demarcated as infested. All remaining areas within the corridor are infested and unprotectable.

Uninterpretable areas occur at the eastern end of the project study corridor where too few indicator species exist due to the vegetation type, namely *Eucalyptus patens* (Blackbutt) mixed eucalypt forest (see Plate 3). This area is not likely to warrant the

“Protectable” status. The disease may be already be present (but not visually evident) in this section, particularly as it mostly falls down-slope from existing roadside drainage. and is situated low in the catchment. Furthermore, it contains no known threatened flora/ecological communities or susceptible species that could otherwise be impacted by the dieback pathogen.

Overall, disease distribution is extensive within and beyond the study area attributed to historic land uses and current activities. The high number of existing forest tracks open to public access within Wellington National Park could act as vectors for disease introductions and spread. This conclusion is supported by previous DEC mapping and this recent survey where nine samples across the study area tested positive for *Phytophthora cinnamomi*. Further evidence of activities that can introduce and spread dieback was observed within most areas such as firewood collection, materials extraction, horse/trail-bike tracks and four-wheel driving. Collectively these activities are known to extend disease distribution.

Table 2: Area Statement

Category	Area (ha)
Un-infested	5.1
Uninterpretable	24.9
Infested	47.5
Total Area:	77.5 – applies to entire mappable assessment area

3.2 Sample Results

A total of eleven (11) samples were collected, of which nine (9) returned positive results for *Phytophthora cinnamomi* and two returned negative results (see Table 3). The positive samples were collected across the study area as evidence to demonstrate the pathogen is extensively distributed. Samples were collected in both up-slope and down-slope areas, plus adjacent to drainage lines.

One negative sample (Sample No. 1) supported the conclusion that fire damage was the causal agent of scattered *Banksia littoralis* deaths observed east and south of where the Wellington Dam intersects the proposed realignment corridor. Other supporting evidence that the pathogen is absent from that area was observed on the stems of *Banksia*'s that had been severely fire-scarred along with no distinct chronology of deaths or other affected plants. The DEC's prescribed burning records for this area showed that it was burnt within 12 months of this interpretation.

The second negative sample (Sample No. 3) was not expected as the area it was collected within falls proximate to a previous DEC sample that tested positive for *Phytophthora cinnamomi*. It was also in an area containing a series of indicator-plant species deaths. Note, based on current scientific knowledge, a negative sample result does not prove absolute evidence that *Phytophthora* is absent and a range of factors need to be evaluated as was the case during this interpretation (DEC, 2009).

Table 3: Summary of Sample Results – Coalfields Highway (16–28 SLK)

Sample No.	Plant Sampled	Coordinates (MGA Zone 50H)	Result (Positive / Negative)
1	<i>Banksia grandis</i>	E 411475 N 6311472	Negative
2	<i>Xanthorrhoea preissii</i>	E 410369 N 6311782	Positive
3	<i>Xanthorrhoea preissii</i>	E 410369 N 6311782	Negative
4	<i>Astroloma xerophyllum</i>	E 407243 N 6312663	Positive
5	<i>Xanthorrhoea gracilis</i>	E 406369 N 6312442	Positive
6	<i>Banksia littoralis</i>	E 405948 N 6312379	Positive
7	<i>Xanthorrhoea preissii</i>	E 405047 N 6312571	Positive
8	<i>Patersonia occidentalis</i>	E 403809 N 6313865	Positive
9	<i>Xanthorrhoea gracilis</i>	E 406423 N 6312606	Positive
10	<i>Xanthorrhoea preissii</i>	E 405062 N 6313178	Positive
11	<i>Xanthorrhoea preissii</i>	E 405203 N 6313176	Positive

3.3 Disease Expression and Impact

Disease expression varied from subtle to obvious across the survey corridor and was typically characterised by widely scattered dead and dying *Xanthorrhoea preissii*, *X. gracilis*, *Banksia littoralis*, *B. grandis* and *P. longifolia*. Historic disease introductions and spread (autonomous and anthropogenic) appear to have reduced the biomass in many areas leaving widely scattered indicator plant deaths amongst non-susceptible vegetation. In addition, the effect of prescribed burns on vegetation has also modified the plant communities' structure, notably in the west end of the study corridor where resistant colonising species such as *Bossiaea aquifolium* subsp. *aquifolium* are now highly abundant.

Disease impact in the easternmost and central parts of the survey area was subtle as the disease has likely been present in the area for a long period of time and removed susceptible species. Outside of the 150 m study corridor within lower slopes and gullies, disease expression became increasingly obvious where a higher number and frequency of indicator species deaths was found. Disease impact in these areas ranged from low-moderate in the understorey with much of the upper and over-storey vegetation remaining in good to better condition.

Some moderate disease impacts were identified in mappable western parts of the study area. Disease impact was more obvious near the Wellington Dam Road amongst in the low woodland of *Allocasuarina huegeliana* where scattered mid and lower storey deaths were found. Where the realignment “Option 2” traverses an information bay near the Wellington Dam Road, disease impact was relatively high. In this area affected Jarrah (*Eucalyptus marginata*) and a positive sample of a *Xanthorrhoea preissii* death were recorded. This area is low in the profile and the soils are likely to remain moist throughout the year. Within the study corridor a section of approximately 600 m long extending east from Gastaldo Road and south of the existing highway has been significantly disturbed by clearing and a narrow strip of vegetation remains. This section contains scattered very old *X. preissii* stumps considered evidence of an old infestation (see Plate 4).

Armillaria luteobubalina, an endemic plant disease was observed and identified on the eastern side of the Wellington Dam on a number of *Banksia grandis*. This fungus can be found randomly in the central and southern forest region and in this area has had a very low impact on the vegetation. The location where it was found is too small and insignificant to be of concern and was not mapped.

4.0 CONCLUSIONS

This interpretation showed that *Phytophthora* dieback occurrence is extensive within the study area and known to be more widely spread in the locality. Both historic and current activities that can transport soil have been considered as exacerbating the spread of dieback. Two minor sections within the corridor were found to be “Uninfested” and both warrant consideration as being “Protectable” from dieback. These are situated south and west from where Gastaldo Road adjoins the Coalfields Highway and both form part of, and extend into, Wellington National Park. Based on the results of this and previous DEC dieback mapping, it is considered unlikely that any other parts within the study corridor warrant protection during the development of Main Roads realignment project. Further interpretation beyond the study area would be necessary to map the full extents of dieback occurrence.

Phytophthora cinnamomi Occurrence Maps have been prepared to show existing disease boundaries within the study area corridors (Appendix 1). The Occurrence Maps form the basis of determining “Protectable” areas and a site-specific Hygiene Management Plan (HMP). The DEC requested that Main Roads discuss this and the development of a HMP with them based on the results herein (personal communication, Tom Kenneally-DEC, March 2011).

The Occurrence Maps herein are valid for one year (April 2012) after which all boundaries should be re-checked in the field. This mapping should not be used if it is older three years (April 2014) and a full site interpretation is then required by the DEC (CALM, 2001).

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5.0 RECOMMENDATIONS

Applying and maintaining hygiene management to activities within the project area will greatly reduce the risk of spreading or introducing dieback within any areas deemed “Protectable” and beyond the project site.

It is recommended that:

- Main Roads arrange a meeting with the DEC Wellington District to finalise any “Protectable” areas and to develop a practical and realistic Hygiene Management Plan.
- Incorporate dieback hygiene management requirements into the project’s contractual documents, site induction materials and overall site environmental management.
- Monitor the implementation and compliance of dieback hygiene management by site personnel.

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6.0 REFERENCES

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PLATES

PLATES

These photographs were taken during the site interpretation in April 2011.



Plate 1: Area West of Wellington Dam Road Burnt in 2010



Plate 2: This *Xanthorrhoea gracilis* Death is Evidence of Infestation



Plate 3: Uninterpretable Area of *Eucalyptus Patens* (Blackbutt) Mixed Eucalypt Forest in Eastern part of the Study



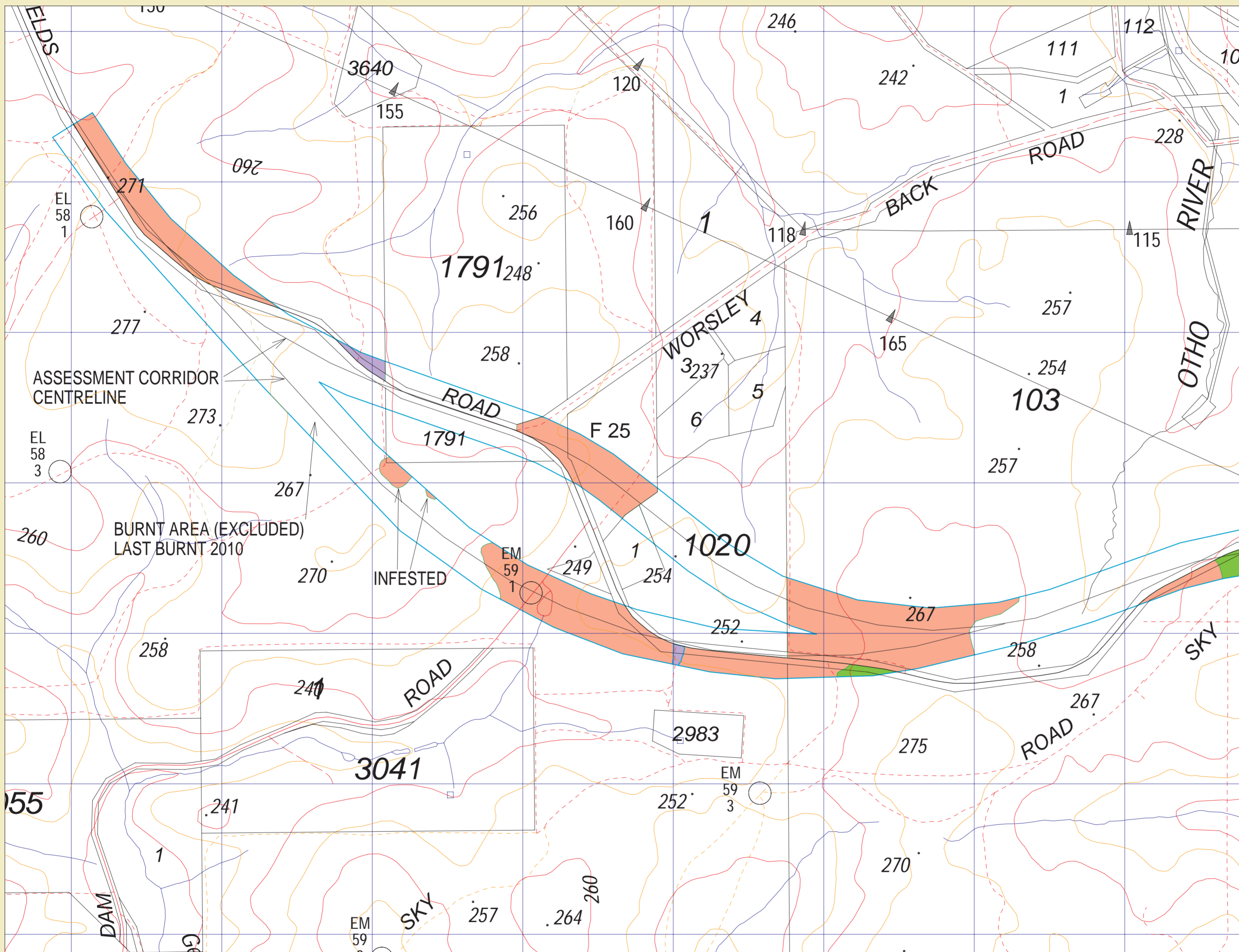
Plate 4: This *Xanthorrhoea preissii* Death is Evidence of an old Infestation

APPENDIX I

Phytophthora cinnamomi
Occurrence Maps
(DEC's Original Map was printed
on a Single A2 Sheet at 1:10,000,
these are Printed on A3 making
the Scale Approximately 1:15,000)

403500ME 404000ME 404500ME 405000ME 405500ME 406000ME 406500ME 407000ME

6314500MN
6314000MN
6313500MN
6313000MN
6312500MN
6312000MN
6311500MN



WELLINGTON DISTRICT GERVASSE BLOCK

Coalfieds Highway 16 - 28 SLK map 1
PHYTOPHTHORA CINNAMOMI
OCCURRENCE MAP

MAP LEGEND

UNINFESTED (PROTECTABLE)
 Determined by a qualified Interpreter to be free of plant disease symptoms which indicates the presence of *P. cinnamomi*.

UNINTERPRETABLE (PROTECTABLE)
 Where susceptible plants are absent or too few to enable the interpretation of *P. cinnamomi* presence or absence.

INFESTED
 Determined by a qualified Interpreter to have plant disease symptoms consistent with the presence of *P. cinnamomi*.

EXCLUDED
 Areas not able to be mapped at the time of interpretation.

BOUNDARY OF INTERPRETATION

AGE LIMITS FOR THIS MAP

Map Boundaries should be checked before Operations proceed if this map is older than 1 year (April 2012).

This map should not be used if it is older than 3 years (April 2014).

Areas that have had an Operation in them become unreliable and should be checked prior to Further / New activities.

MAP LIMITATIONS

The smallest areas of interpretation that can be portrayed on this map are 1 millimetre in diameter, representing 10.0 metres diameter on the ground. Areas less than this are symbolised to this size.

MAP METHOD

Interpreted using strip line survey.
Boundaries captured using GPS. Boundaries positioned relative to map features.

PRODUCT VERSION STATEMENT

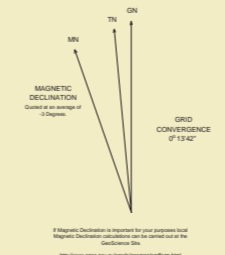
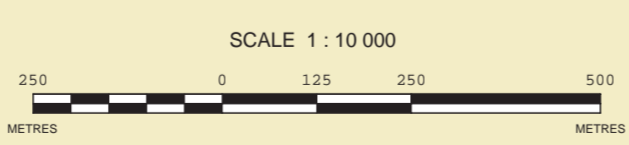
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Occurrence	coalfield11 occ10map1	06/04/11	RPS BER	PAB	20/04/11	06/04/12	06/04/14
This Map ID	coalfield11 occ10map1						

AREA STATEMENT

Categories	Area ha	Notes
UNINFESTED	5.1	Area statement applies to entire assessment area
UNINTERPRETABLE	24.9	
INFESTED	47.5	
UNPROTECTABLE		
TOTAL AREA	77.5	

LEGEND

2 LANE SEALED ROAD	SWAMP
2 LANE UNSEALED ROAD	DAM
1 LANE SEALED ROAD	LOADING RAMP
1 LANE UNSEALED ROAD	WATER POINT
VEHICULAR TRACK	SPOT HEIGHT
POWERLINE, PYLON No.	
REFERENCE TREE	
HYDROLOGY	
CONTOUR (5 metre intervals)	



PROJECTION: TRANSVERSE MERCATOR G.M. 117 E ZONE 50
HORIZONTAL DATUM: GEOCENTRIC DATUM AUSTRALIA 1994
VERTICAL DATUM: AUSTRALIAN HEIGHT DATUM 1971.



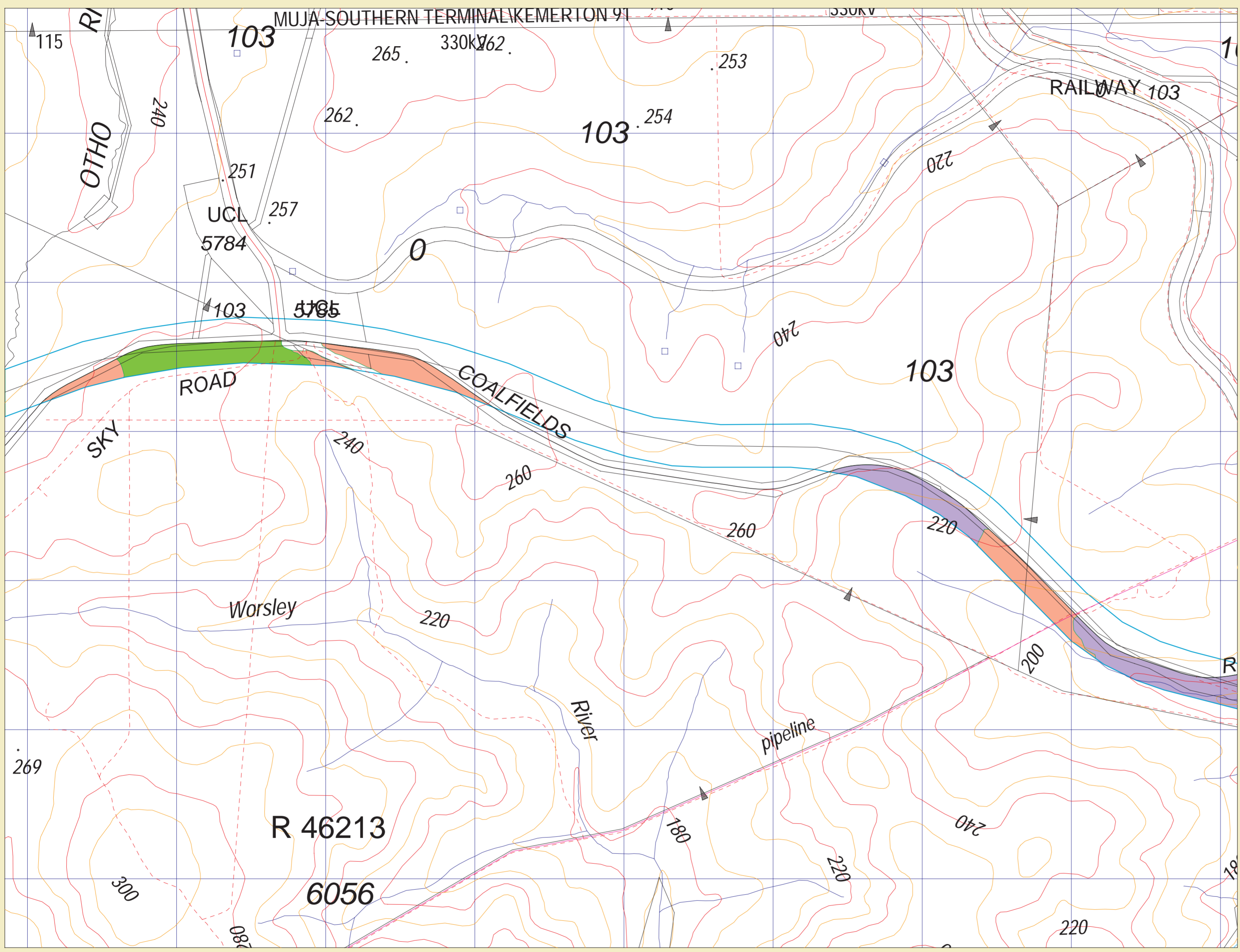
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JOINS MAP 2

407000ME 407500ME 408000ME 408500ME 409000ME 409500ME 410000ME 410500ME 411000ME

WELLINGTON DISTRICT
 GERVASSE BLOCK
 Coalfields Highway 16 - 28 SLK Map2.
 PHYTOPHTHORA CINNAMOMI OCCURRENCE MAP

6313500MN
 6313000MN
 6312000MN
 6311500MN
 6311000MN



MAP LEGEND

UNINFESTED (PROTECTABLE)
 Determined by a qualified Interpreter to be free of plant disease symptoms which indicates the presence of *P. cinnamomi*.

UNINTERPRETABLE (PROTECTABLE)
 Where susceptible plants are absent or too few to enable the interpretation of *P. cinnamomi* presence or absence.

INFESTED
 Determined by a qualified Interpreter to have plant disease symptoms consistent with the presence of *P. cinnamomi*.

EXCLUDED
 Areas not able to be mapped at the time of interpretation.

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AGE LIMITS FOR THIS MAP
 Map Boundaries should be checked before Operations proceed if this map is older than 1 year (April 2012).
 This map should not be used if it is older than 3 years (April 2014).
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 Areas less than this are symbolised to this size.

MAP METHOD
 Interpreted using strip line survey.
 Boundaries captured using GPS.
 Boundaries positioned relative to map features.

PRODUCT VERSION STATEMENT

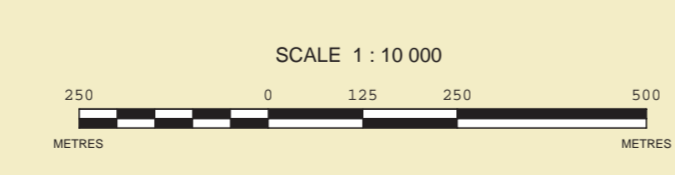
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This Map ID	coalfield11 occ10map2						

AREA STATEMENT

Categories	Area ha	Notes
		See Map 1 for area statement

LEGEND

2 LANE SEALED ROAD	SWAMP
2 LANE UNSEALED ROAD	DAM
1 LANE SEALED ROAD	LOADING RAMP
1 LANE UNSEALED ROAD	WATER POINT
VEHICULAR TRACK	SPOT HEIGHT
POWERLINE, PYLON No.	
REFERENCE TREE	
HYDROLOGY	
CONTOUR (5 metre intervals)	



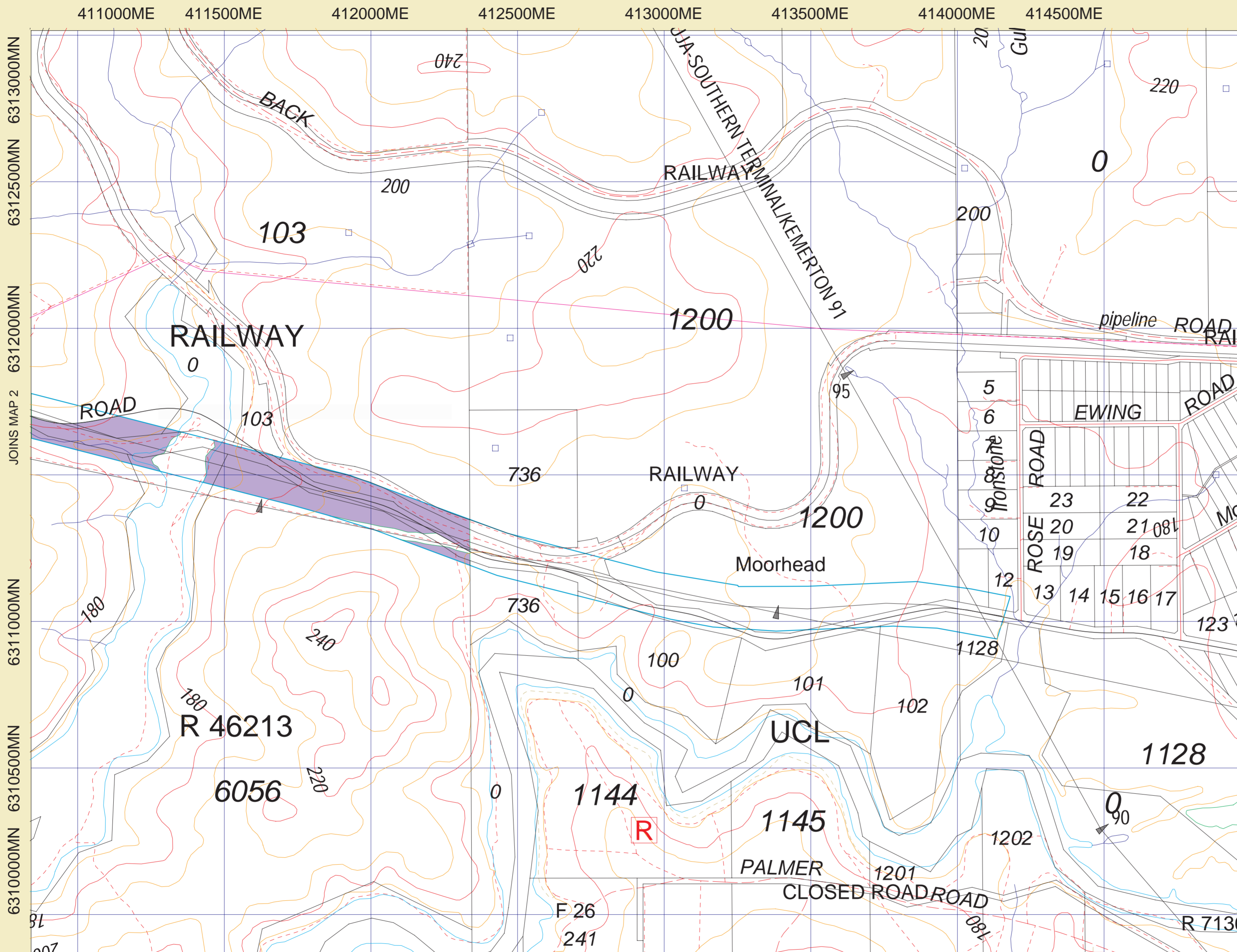
PROJECTION: TRANSVERSE MERCATOR C.M. 117 E ZONE 50
 HORIZONTAL DATUM: GEOCENTRIC DATUM AUSTRALIA 1994
 VERTICAL DATUM: AUSTRALIAN HEIGHT DATUM 1971.



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WELLINGTON DISTRICT
GERVASSE BLOCK

Coalfields Highway 16 - 28 SLK map 3
PHYTOPHTHORA CINNAMOMI
OCCURRENCE MAP



MAP LEGEND

UNINFESTED (PROTECTABLE)
 Determined by a qualified Interpreter to be free of plant disease symptoms which indicates the presence of *P. cinnamomi*.

UNINTERPRETABLE (PROTECTABLE)
 Where susceptible plants are absent or too few to enable the interpretation of *P. cinnamomi* presence or absence.

INFESTED
 Determined by a qualified Interpreter to have plant disease symptoms consistent with the presence of *P. cinnamomi*.

EXCLUDED
 Areas not able to be mapped at the time of interpretation.

BOUNDARY OF INTERPRETATION

AGE LIMITS FOR THIS MAP
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 Areas less than this are symbolised to this size.

MAP METHOD
 Interpreted using strip line survey.
 Boundaries captured using GPS.
 Boundaries positioned relative to map features.

PRODUCT VERSION STATEMENT

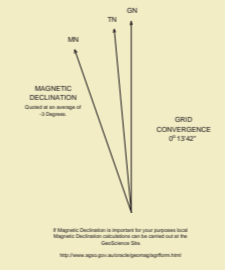
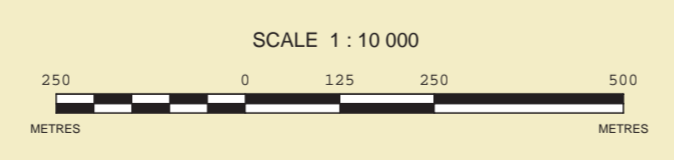
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This Map ID	coalfield11 occ10map3						

AREA STATEMENT

Categories	Area ha	Notes
		See Map I for area statement

LEGEND

	SWAMP
	DAM
	LOADING RAMP
	WATER POINT
	SPOT HEIGHT



PROJECTION: TRANSVERSE MERCATOR G.M. 117 E ZONE 50
 HORIZONTAL DATUM: GEOCENTRIC DATUM AUSTRALIA 1994
 VERTICAL DATUM: AUSTRALIAN HEIGHT DATUM 1971.



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APPENDIX 8

Fauna Assessment Report

Fauna Assessment

Coalfields Highway Realignment (15.9 SLK to 26.3 SLK)

Allanson

MARCH 2013

Version 5

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TABLE OF CONTENTS

SUMMARY

1.	INTRODUCTION	1
2.	SCOPE OF WORKS	1
3.	METHODOLOGY	2
3.1	POTENTIAL FAUNA INVENTORY - DESKTOP STUDY	2
3.1.1	Database Searches.....	2
3.1.2	Previous Fauna Surveys in the Area	3
3.1.3	Existing Publications	3
3.1.4	Fauna of Conservation Significance	5
3.1.5	Invertebrate Fauna	6
3.1.6	Taxonomy and Nomenclature	7
3.2	SITE SURVEYS	7
3.2.1	Fauna Habitat Assessment.....	7
3.2.2	Black Cockatoo Habitat Assessment.....	8
3.2.3	Opportunistic Fauna Observations	8
4.	SURVEY CONSTRAINTS.....	9
5.	RESULTS	10
5.1	POTENTIAL FAUNA INVENTORY - DESKTOP STUDY.....	10
5.2	SITE SURVEYS	10
5.2.1	Fauna Habitat Assessment.....	10
5.2.2	Black Cockatoo Habitat Assessment.....	13
5.2.3	Opportunistic Fauna Observations	13
5.3	FAUNA INVENTORY – SUMMARY	14
5.3.1	Vertebrate Fauna	14

5.3.2	Invertebrate Fauna.....	18
5.3.3	Introduced Feral Fauna.....	18
6.	FAUNA VALUES	19
6.1	CONSERVATION SIGNIFICANCE OF THE STUDY AREA.....	19
6.2	VALUE OF THE STUDY AREA AS AN ECOLOGICAL LINKAGE/WILDLIFE CORRIDOR	21
7.	POTENTIAL IMPACTS	21
8.	LEGISLATIVE OBLIGATIONS.....	24
8.1	WILDLIFE CONSERVATION ACT 1950	24
8.2	ENVIRONMENTAL PROTECTION ACT 1986.....	25
8.3	ENVIRONMENT PROTECTION & BIODIVERSITY CONSERVATION ACT 1999.....	27
8.3.1	Black Cockatoos - Assessment using Significant Impact Guidelines 1.1 (DEWHA 2009b).....	31
8.3.2	Black Cockatoos - Assessment using Referral Guidelines (DSEWPaC 2012).....	33
8.3.3	Other Listed Threatened Fauna Species.....	38
8.3.4	Migratory Species	41
9.	RECOMMENDATIONS	42
10.	CONCLUSION.....	44
11.	BIBLIOGRAPHY	46

FIGURES

- FIGURE 1: Study Area & Surrounds
- FIGURE 2a: Study Area - Air Photo (west)
- FIGURE 2b: Study Area - Air Photo (east)
- FIGURE 3a: Habitat Trees (west)
- FIGURE 3b: Habitat Trees (east)

TABLES

- TABLE 1: Summary of Potential Vertebrate Fauna Species
- TABLE 2: Introduced and Other Problem Animals Recorded in the Wellington National Park Area (from DEC 2008)
- TABLE 3: Likelihood of Occurrence and Possible Impacts – Fauna Species of Conservation Significance

PLATES

- PLATE 1: Open forest to woodland of Jarrah and Marri over low open shrubland.
- PLATE 2: Open woodland of Jarrah and Marri over low woodland of Sheoak and Banksia over shrubland/open heath.
- PLATE 3: Open forest of Blackbutt, Jarrah and Marri over open heath.
- PLATE 4: Cleared Paddocks with scattered trees and degraded ephemeral stream.
- PLATE 5: Open Woodland over low open shrubland.
- PLATE 6: Cleared ephemeral creek that forms part of Wellington Dam when flooded.

APPENDICES

APPENDIX A: Conservation Categories

APPENDIX B: Fauna Observed or Potentially in Study Area

APPENDIX C: NatureMap & EPBC Database Search Results

APPENDIX D: Habitat Tree Details

APPENDIX E: Significant Species Profiles

DISCLAIMER

This fauna assessment report (“the report”) has been prepared in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and Greg Harewood (“the Author”). In some circumstances the scope of services may have been limited by a range of factors such as time, budget, access and/or site disturbance constraints. In accordance with the scope of services, the Author has relied upon the data and has conducted environmental field monitoring and/or testing in the preparation of the report. The nature and extent of monitoring and/or testing conducted is described in the report.

The conclusions are based upon field data and the environmental monitoring and/or testing carried out over a limited period of time and are therefore merely indicative of the environmental condition of the site at the time of preparing the report. Also it should be recognised that site conditions, can change with time.

Within the limitations imposed by the scope of services, the field assessment and preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care ordinarily exercised by reputable environmental consultants under similar circumstances. No other warranty, expressed or implied, is made.

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SUMMARY

This report details the results of a fauna assessment of the proposed realignment of the Coalfields Highway (between SLK 15.9 and 26.3) west of Allanson in south west Western Australia. The study area comprises a ~10.4km long corridor that passes through a combination of uncleared native vegetation, cleared farmland and along the existing road alignment (see Figures).

The scope of works was to conduct a level 1 fauna survey as defined by the Environmental Protection Authority (EPA 2004). Because some listed threatened species (i.e. several species of black cockatoo) are known to occur in the general area, the scope of the survey work was expanded to include targeted assessment of the site's significance to these particular species.

The assessment has included a desktop study and a series of site surveys. Field survey work was carried out by Greg Harewood (B.Sc. Zoology) on the 23-25 and 28 February, 1 March 2011 and the 9 April 2012. During this time the entire length of the proposed realignment was examined at least once.

A description of the broadly defined fauna habitats within the study area (based on vegetation units and observed landforms) is given below. The extent of native forest compared to cleared areas can be seen in Figures 2a and to 2b. Plates 1 to 6 illustrate the nature of the vegetation units/habitats present. More detail on composition of the vegetation can be found within the flora and vegetation report.

- Remnant Native Vegetation: Vegetation is representative of that of the Jarrah forest, displaying a structural homogeneity in overstorey species, dominated by Jarrah (*Eucalyptus marginata*), Marri (*Corymbia calophylla*) and, on deeper valley soils, Blackbutt (*Eucalyptus patens*). Includes remnant vegetation along road verges adjoining paddocks. Vegetation complexes within the study area include:
 1. Dwellingup and Hester Complex (Central and South) - Tall open forest to open forest of Jarrah and Marri. Located on mildly undulating lateritic uplands and ridges. Soil typically ranges from yellow-brown gravelly and loamy sand to Ironstone duricrust pavements, loamy gravels, sandy gravels and outcrops.
 2. Murray Complex - Open forest of Jarrah, Marri and Blackbutt on valley slopes and fringing woodlands of Flooded Gum and Swamp Paperbark on the valley floors. Soils are predominantly red and yellow loamy earths and gravels.
 3. Yarragil Complex - Open forest of Jarrah and Marri on slopes, with Blackbutt on the valley floors. Second storey consists primarily of Sheoak, Bull Banksia and Snottygobble. A shrub and herb storey

is also typical. Soils range from loamy gravels, sandy gravels with some loamy earths and deep sands.

- Existing Cleared Paddocks: These areas are dominated by introduced pasture grasses with occasional scattered trees and degraded sedgelands.
- Ephemeral Streams: Four watercourses along the proposed realignment appear to be all ephemeral streams with variable flows controlled by seasonal conditions. Two stream flow into Wellington Dam and during wetter years fills just past the proposed realignment. The “ultimate” realignment straddles one stream along about 100m of its length up to the point where it enters Wellington Dam (see Figure 3b).

The extent of remnant native vegetation in the vicinity of the study area can be seen in the attached figures. The adjoining Wellington National Park and associated reserves have a total area of over 20,000 ha though there are also other areas of state forest that contribute to the total extent of remnant vegetation in the general area.

The maximum extent of native remnant vegetation within the study area that will require clearing has been estimated to total about 25 ha. Significant sections of the study area are already cleared and primarily consist of cleared paddocks or the existing alignment is comprised of a ~20m wide bitumised road with a cleared gravel verge on both sides.

The habitat tree assessment, which covered a corridor either side of the proposed road centre line and some alternative realignments, identified a total of 1,195 trees with a DBH of >50cms (Figures 3a and 3b). Seventy seven of these trees appeared to contained hollows with large entrances (greater than ~12cm) that maybe big enough and orientated favourably to possibly allow the entry of a black cockatoo into a suitably sized branch/trunk. No evidence of any of these trees actually having been used for nesting by black cockatoos (e.g. chew marks) was however observed. Not all of the identified habitat trees will require clearing. It has been estimated that of the 1195 trees identified, 424 fall within the proposed clearing area. Of these, 28 were classified as having hollows with larger entrances.

Additional details on each habitat tree observed can be found in Appendix D.

Almost all areas of remnant native vegetation present along the proposed road corridor can be considered to represent potential black cockatoo foraging habitat as they contain a range of plant species documented as foraging habitat for one or more of the three black cockatoo species, all of which are known to frequent the area. The degree to which any one section of the route would be utilised for foraging purposes would however vary considerably based on species composition and density. Generally, the most dominant and widespread species are marri and jarrah though in some areas other species are also present (e.g. sheoak and banksia).

Foraging evidence left by all tree species of black cockatoo was observed during the reconnaissance survey and included chewed marri and jarrah fruits. Baudin's black cockatoo and the FRTBC were both observed foraging on several occasions.

It is difficult to calculate the extent of foraging habitat that may require clearing for road construction to proceed as a combination of existing cleared areas, existing roads and remnant bushland are involved. It is however estimated that a maximum of about 25 ha of vegetation may require clearing, most of which represents foraging habitat given the dominance of marri and jarrah with vegetation complexes in the area.

Opportunistic fauna observations are listed in Appendix B. A total of 47 native fauna species were observed (or positively identified from foraging evidence, scats, tracks, skeletons or calls) within the study area. Two introduced species were also observed.

With respect to native vertebrate fauna, 21 mammals (includes nine bat species), 103 bird, 41 reptile, nine frog and three fish species have previously been recorded in the general area, some of which have the potential to occur in or utilise sections of the study area at times.

Of the 184 native animals that are listed as potentially occurring in the area, nine are considered to be endangered/vulnerable or in need of special protection under State and/or Federal law. In addition, three migratory species and six DEC priority species may frequent the area at times.

Based on the habitats present and the maximum extent of clearing likely to be required for the proposed road works the anticipated impacts on species of conservation significance previously recorded in the general area has been assessed, a summary of which is provided in the table below. Additional information on specific fauna species is provided in Appendix E.

Likelihood of Occurrence and Possible Impacts – Fauna Species of Conservation Significance (continues on following pages).

Common Name	Genus & Species	Conservation Status	Habitat Present	Likelihood of Occurrence	Possible Impacts/ Significance of Possible Impacts
Unnamed scorpionfly	<i>Austromerope poultoni</i>	P2	Yes?/Marginal?	Possible but unlikely	Loss/modification of small areas of habitat/Very Low
Unnamed cricket	<i>Pachysaga munggai</i>	P3	Yes?/Marginal?	Possible but unlikely	Loss/modification of small areas of habitat/Very Low
Tingle Trapdoor Spider	<i>Moggridgea tingle</i>	S1	No	Unlikely	None/Nil
Margaret River (Hairy) Marron	<i>Cherax tenuimanus</i>	S1, CR	No	Unlikely	None/Nil

Common Name	Genus & Species	Conservation Status	Habitat Present	Likelihood of Occurrence	Possible Impacts/ Significance of Possible Impacts
Carter's Freshwater Mussel	<i>Westralunio carteri</i>	P4	No	Unlikely	None/Nil
Balston's Pygmy Perch	<i>Nannatherina balstoni</i>	S1, VU	No	Unlikely	None/Nil
Pouched Lamprey	<i>Geotria australis</i>	P1	No	Unlikely	None/Nil
Darling Range Heath Ctenotus	<i>Ctenotus dell</i>	P4	Yes/Marginal. Possibly out of species range	Possible?	Loss/modification of small areas of habitat/Very Low
Southern Carpet Python	<i>Morelia spilota imbricata</i>	S4, P4	Yes	Possible	Loss/modification of small areas of habitat/Very Low
Great Egret	<i>Ardea alba</i>	S3, Mig	Yes/Marginal	Possible	Loss/modification of very small areas of habitat/Very Low
Cattle Egret	<i>Ardea ibis</i>	S3, Mig	Yes/Marginal	Possible	Loss/modification of very small areas of habitat/Very Low
Australasian Bittern	<i>Botaurus poiciloptilus</i>	S1, EN	No	Unlikely	None/Nil
Little Bittern	<i>Ixobrychus minutus</i>	P4	No	Unlikely	None/Nil
Black Bittern	<i>Ixobrychus flavicollis</i>	P3	No	Unlikely	None/Nil
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	S3, Mig	No	Unlikely	None/Nil
Peregrine Falcon	<i>Falco peregrinus</i>	S4	Yes	Possible	Loss/modification of small areas of habitat/Very Low
Bush Stone Curlew	<i>Burhinus grallarius</i>	P4	Yes	Unlikely, Locally extinct	None/Nil
Carnaby's Black Cockatoo	<i>Calyptorhynchus latirostris</i>	S1, EN	Yes	Known to occur	Loss/modification of small areas of habitat/Low
Baudin's Black Cockatoo	<i>Calyptorhynchus baudinii</i>	S1, VU	Yes	Known to occur	Loss/modification of small areas of habitat/Low
Forest Red-tailed Black Cockatoo	<i>Calyptorhynchus banksii naso</i>	S1, VU	Yes	Possible	Loss/modification of small areas of habitat/Low
Masked Owl (SW population)	<i>Tyto n. novaehollandiae</i>	P3	Yes	Possible	Loss/modification of small areas of habitat/Very Low
Fork-tailed Swift	<i>Apus pacificus</i>	S3, Mig	Yes	Unlikely	None/Nil

Common Name	Genus & Species	Conservation Status	Habitat Present	Likelihood of Occurrence	Possible Impacts/ Significance of Possible Impacts
Rainbow Bee-eater	<i>Merops ornatus</i>	S3, Mig	Yes	Possible	Loss/modification of small areas of habitat/Very Low
Western Shrike Tit	<i>Falcunculus frontatus leucogaster</i>	P4	No/Marginal	Unlikely	None/Nil
Chuditch	<i>Dasyurus geoffroii</i>	S1, VU	Yes	Possible	Loss/modification of small areas of habitat/Very Low
Numbat	<i>Myrmecobius fasciatus</i>	S1, VU	Yes	Unlikely - species locally extinct.	None/Nil
Southern Brush-tailed Phascogale	<i>Phascogale tapoatafa ssp</i>	S1	Yes	Possible	Loss/modification of small areas of habitat/Very Low.
Southern Brown Bandicoot	<i>Isoodon obesulus fusciventer</i>	P5	Yes	Possible	Loss/modification of small areas of habitat/Very Low
Bilby	<i>Macrotis lagotis</i>	S1, VU	No	Unlikely - species regionally extinct.	None/Nil
Western Ringtail Possum	<i>Pseudocheirus occidentalis</i>	S1, VU	Yes	Possible	Loss/modification of small areas of habitat/Very Low
Western Brush Wallaby	<i>Macropus irma</i>	P4	Yes	Possible	Loss/modification of small areas of habitat/Very Low
Woylie	<i>Bettongia penicillata ogiby</i>	S1, EN	Yes/Marginal	Possible?	Loss/modification of small areas of habitat/Very Low/Nil
Tammar	<i>Macropus eugenii</i>	P4	No	Unlikely	None/Nil
Quokka	<i>Setonix brachyurus</i>	S1, VU	No	Unlikely	None/Nil
Western False Pipistrelle	<i>Falsistrellus mackenziei</i>	P4	Yes	Possible	Loss/modification of small areas of habitat/Very Low
Water Rat	<i>Hydromys chrysogaster</i>	P4	Yes/Marginal	Possible but unlikely	Loss/modification of small areas of habitat/Very Low/Nil

With respect to fauna in general no substantial impacts are anticipated as a consequence of the upgrade being constructed. In cases where some impact is anticipated, the degree of the impact is only expected to be very low and relates to the loss of a relatively small area of vegetation (~ max 25 ha) the loss of which will be dampened by the presence of a large areas of similar or better quality habitat in adjoining areas (e.g. Wellington National Park and associated reserves - 20,000 ha (DEC 2008)). A series of recommendations aimed at mitigating and minimising potential impacts on fauna and fauna habitat in general are provided in *Section 10*. These should be implemented as part of existing or proposed management plans where considered reasonable and practicable.

Using current DSEWPaC significant impact/referral guidelines, it is the Authors opinion that the proposed road works are unlikely to constitute a “significant impact” on any *EPBC Act* threatened fauna species despite triggering some referral guidelines with respect to black cockatoos.

It is understood that referral of the project to DSEWPaC for assessment is being undertaken to ensure compliance with the *EPBC Act* in this regard.

1. INTRODUCTION

This report details the results of a fauna assessment of the proposed realignment of the Coalfields Highway (between SLK 15.9 and 26.3) west of Allanson in south west Western Australia.

The study area comprises a ~10.4km long corridor that passes through a combination of uncleared native vegetation, cleared farmland and along the existing road alignment (see Figures).

Information obtained as part of this fauna assessment report will be used in conjunction with other environmental investigations to allow regulatory authorities to assess the potential impact of the proposal. The information will enable the formulation of management plans aimed at minimising potential environmental impacts to allow the proposal to gain approval and proceed.

2. SCOPE OF WORKS

After consultation with regulatory authorities the scope of works was defined by RPS and Main Roads WA (MRWA) as:

1. The fauna assessment to be carried out with regard to Environmental Protection Authority (EPA) Position Statements/Guidelines (EPA 2000, 2004). This does not require a trapping program but will require targeted searches and opportunistic recording of species.
2. Target back cockatoos – includes GPS nesting trees / determine actual use & value / tag habitat trees.
3. Opportunistic fauna search – focus on threatened/listed species (Wildlife Conservation (WC) & Environment Protection and Biodiversity Conservation (EPBC) Acts).
4. Report/assess clearing/impacts in respect to fauna under Environmental Protection (EP) Act/Clearing Regulations & the EPBC Act.
5. Habitat assessment for above and identify (map) any habitat areas of significance.
6. An inventory of the vertebrate fauna species in the survey area.



7. Review fauna species considered to be rare or in need of special protection.
8. Consider presence and abundance of pest, declared or feral animals.
9. Assess value of the survey corridor in providing habitat and facilitating movement between conservation areas.
10. Mapping to show habitat trees, significant habitat areas, significant fauna locations e.g. WRP dreys.
11. Management Recommendations.

This survey report has been prepared for use in the EPA's Environmental Impact Assessment (EIA) process (if required) and is considered suitable for this purpose.

Note: For the purposes of this report the term black cockatoo is in reference to Baudin's black cockatoo *Calyptorhynchus baudinii*, Carnaby's black cockatoo *Calyptorhynchus latirostris* and the forest red-tailed black cockatoo (FRTBC) *Calyptorhynchus banksii naso*.

3. METHODOLOGY

3.1 POTENTIAL FAUNA INVENTORY - DESKTOP STUDY

3.1.1 Database Searches

Searches of the following databases were undertaken to aid in the compilation of a list of vertebrate fauna potentially occurring within the study area:

- DEC's NatureMap Database Search (combined data from DEC, Western Australian Museum and Birds Australia) (DEC 2013); and
- Protected matters search tool (Department of Sustainability, Environment, Water, Population and Communities - DSEWPaC 2013).

It should be noted that these lists are based on observations from a broader area than the study site and therefore may include species that would only ever occur as vagrants in the actual study area due to a lack of suitable habitat or the presence of only marginal habitat. The databases also often included very old records and in some cases the species in question have become locally or regionally extinct.



Information from these sources should therefore be taken as indicative only and local knowledge and information needs also to be taken into consideration when determining what actual species may be present within the specific area being investigated.

3.1.2 Previous Fauna Surveys in the Area

Fauna surveys, assessments and reviews have been undertaken in nearby areas in the past, though not all are publically available and could not be referenced. The most significant of those available have been used as the primary reference material for compiling the potential fauna assemblage for the general area. Those reports referred to included, but were not limited to:

- Bancroft, W. and Bamford, M. (2006). Fauna Survey of the Muja South Extension Project. Unpublished report for Griffin Coal.
- Maunsell Australia Pty Ltd (2003). Bluewater's Power Station Flora and Fauna Survey. Unpublished report for Griffin Energy.
- Halpern Glick Maunsell (2002). South West Project Strategic Environmental Review. Unpublished report for Griffin Energy.
- Halpern Glick Maunsell (1994). Ewington Open-cut Mine. Consultative Environmental Review. Unpublished report for Griffin Coal Mining Company Pty Ltd.
- ecologia (1991). Consultative Environmental Review: (Ewington 1) Fauna Survey. Prepared for Halpern Glick Maunsell on behalf of Griffin Coal Mining Company Pty Ltd.

As with the databases searches some reports refer to species that would not occur in the study area due to a lack of suitable habitat (extent and/or quality) and this fact was taken into consideration when compiling the potential fauna species list for the study area. It should also be noted that the NatureMap database is likely to include some records from previous fauna surveys in the area including some of those listed above.

3.1.3 Existing Publications

The following represent the main publications used to identify and refine the potential fauna species list for the study area:



- Barrett, G., Silcocks, A., Barry, S., Cunningham, R. and Poulter, R. (2003). *The New Atlas of Australian Birds*. Royal Australasian Ornithologists Union, Victoria.
- Bush, B., Maryan, B., Browne-Cooper, R. & Robinson, D. (2007). *Reptiles and Frogs in the Bush: Southwestern Australia*. UWA Press, Nedlands.
- Churchill, S. (2008). *Australian Bats*. Second Edition, Allen & Unwin.
- Johnstone, R.E. and Storr, G.M. (1998). *Handbook of Western Australian Birds: Volume 1 – Non-passerines (Emu to Dollarbird)*. Western Australian Museum, Perth Western Australia.
- Johnstone, R.E. and Storr, G.M. (2004). *Handbook of Western Australian Birds: Volume 2 – Passerines (Blue-winged Pitta to Goldfinch)*. Western Australian Museum, Perth Western Australia.
- Menkhorst, P. and Knight, F. (2011). *A Field Guide to the Mammals of Australia*. Oxford University Press, Melbourne.
- Morgan, D.L., Beatty, S.J., Klunzinger, M.W, Allen, M.G. and Burnham, Q.E (2011). *Field Guide to the Freshwater Fishes, Crayfishes and Mussels of South Western Australia*. Published by SERCUL.
- Pizzey, G., & Knight, F. (2011). *The Field Guide to the Birds of Australia*. Harper Collins, Sydney.
- Storr, G.M., Smith, L.A. and Johnstone R.E. (1983). *Lizards of Western Australia II: Dragons and Monitors*. WA Museum, Perth.
- Storr, G.M., Smith, L.A. and Johnstone R.E. (1990). *Lizards of Western Australia III: Geckos and Pygopods*. WA Museum, Perth.
- Storr, G.M., Smith, L.A. and Johnstone R.E. (1999). *Lizards of Western Australia I: Skinks*. Revised Edition, WA Museum, Perth.
- Storr, G.M., Smith, L.A. and Johnstone R.E. (2002). *Snakes of Western Australia*. Revised Edition, WA Museum, Perth.
- Tyler M.J. & Doughty P. (2009). *Field Guide to Frogs of Western Australia*, Fourth Edition, WA Museum, Perth.
- Van Dyck, S. & Strahan, R. Eds (2008). *The Mammals of Australia*. Third edition. Queensland Museum.



- Wilson, S. and Swan, G. (2010). A Complete Guide to Reptiles of Australia. Reed, New Holland, Sydney.

3.1.4 Fauna of Conservation Significance

The conservation significance of fauna species has been assessed using data from the following sources:

- *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*. Administered by the Australian Government Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC);
- *Wildlife Conservation Act 1950 (WC Act)*. Administered by the Western Australian Department of Environment and Conservation (DEC);
- Red List produced by the Species Survival Commission (SSC) of the World Conservation Union (also known as the IUCN Red List - the acronym derived from its former name of the International Union for Conservation of Nature and Natural Resources). The Red List has no legislative power in Australia but is used as a framework for State and Commonwealth categories and criteria; and the
- DEC Priority Fauna list. A non-legislative list maintained by the DEC for management purposes.

The *EPBC Act* also requires the compilation of a list of migratory species that are recognised under international treaties including the:

- Japan Australia Migratory Bird Agreement 1981 (JAMBA);
- China Australia Migratory Bird Agreement 1998 (CAMBA);
- Republic of Korea-Australia Migratory Bird Agreement 2007 (ROKAMBA); and
- Bonn Convention 1979 (The Convention on the Conservation of Migratory Species of Wild Animals).

(Note - Species listed under JAMBA are also protected under Schedule 3 of the *WC Act*.)

All migratory bird species listed in the annexes to these bilateral agreements are protected in Australia as matters of national environmental significance (NES) under the *EPBC Act*.

The conservation status of all vertebrate fauna species listed as occurring or possibly occurring in the vicinity of the Project area has been assessed using the most recent lists published in accordance with the above-mentioned



instruments and is indicated as such in the fauna listings of this report. A full listing of conservation codes are provided in Appendix A.

A number of other species not listed in official lists can also be considered of local or regional conservation significance. These include species that have a restricted range, those that occur in breeding colonies and those at the limit of their range.

While not classified as rare, threatened or vulnerable under any State or Commonwealth legislation, a number of bird species have been listed as of significance on the Swan Coastal portion of the Perth Metropolitan Region (Bush Forever - Government of Western Australia 1998 and 2000). The bird species are often referred to as Bush Forever Decreaser Species. The three categories used for birds within the Bush Forever documents are:

- Habitat specialists with reduced distribution on the Swan Coastal Plain (code Bh)
- Wide ranging Species with reduced population's on the Swan Coastal Plain. (code Bp)
- Extinct in the Perth region (code Be)

While the study area is not located on the Swan Coastal Plain the presence of Bush Forever species should be taken into consideration when determining the fauna values. Bush Forever decreaser species are indicated as such within the species list held in Appendix B.

3.1.5 Invertebrate Fauna

It can be difficult to identify what may be significant invertebrate species (e.g. Short Range Endemics - SREs) as there are uncertainties in determining the range-restrictions of many species due to lack of surveys, lack of taxonomic resolutions within target taxa and problems in identifying certain life stages. Where invertebrates are collected during surveys, a high percentage are likely to be unknown, or for known species there can be limited knowledge or information on their distribution (Harvey 2002).

For this project, the assessment for conservation significant invertebrates has been limited to those listed by the DEC and *EPBC Act* database searches (which rely on distribution records and known habitat preferences). No assessment of the potential for SREs to be present has been made.



3.1.6 Taxonomy and Nomenclature

Taxonomy and nomenclature for fauna species used in this report is generally taken from the DEC's WA Fauna Census Database which is assumed to follow Aplin and Smith (2001) for amphibians and reptiles, How *et al.* (2001) for mammals and Johnstone (2001) for birds.

Common names are taken from the Western Australia Museum (WAM) recognised primary common name listings when specified, though where common names are not provided they have been acquired from other publications. Sources include Van Dyck & Strahan (2008), Bush *et al.* (2007), Wilson and Swan (2010), Bush *et al.* (2002), Tyler *et al.* (2000), Christidis and Boles (1994) and Glauret (1961). Not all common names are generally accepted.

3.2 SITE SURVEYS

Initial field survey work was carried out by Greg Harewood (B.Sc. Zoology) on the 23-25 and 28 February, 1 March 2011 and 9 April 2012. During this time the entire length of the proposed realignment and some alternative realignments was traversed at least once.

3.2.1 Fauna Habitat Assessment

Vegetation units and landforms observed during the site reconnaissance survey and during the flora and vegetation survey have been used to define broad fauna habitat types across the site.

The main aim of the habitat assessment was to determine if it was likely that any species of conservation significance would be utilising the areas that maybe impacted on as a consequence of the proposal proceeding. The habitat information obtained was also used to aid in finalising the overall potential fauna list.

As part of the desktop literature review, available information on the habitat requirements of the species of conservation significance listed as possibly occurring in the area was researched. During the field survey the habitats within the study area were assessed and specific elements identified, if present, to determine the likelihood of listed threatened species utilising the area and its significance to them.



3.2.2 Black Cockatoo Habitat Assessment

The area has the potential to be utilised by black cockatoos (Baudin's, Carnaby's and the forest red-tailed black cockatoo) and therefore a targeted assessment was carried out and included:

- Potential black cockatoo breeding tree survey: This involved the identification of all suitable trees species within 25m either side of the defined road centreline and some adjoining areas that had a Diameter at Breast Height (DBH) of over 50cm (irrespective of the presence/absence of suitable hollows - DSEWPaC criteria (2012)). The location of each tree identified was recorded with a GPS and details on tree species, number and size of hollows (if any) noted.

Target tree species included marri, jarrah or any other suitable *Corymbia/Eucalyptus* species of a suitable size that may be present. Peppermints, banksia, sheoak and melaleuca tree species were not assessed as they typically do not develop hollows that are used by black cockatoos.

For the purposes of this study a potential cockatoo nest hollow was defined as:

Generally any tree which is alive or dead that contains one or more visible hollows (cavities within the trunk or branches) suitable for occupation by any of the three black cockatoo species for the purpose of nesting/breeding. Hollows that had an entrance greater than about 12cm in diameter and would allow the entry of a cockatoo (white tailed or red-tailed) into a suitably orientated and sized branch/trunk, were recorded as a "potential nest hollow".

- Black cockatoo foraging assessment: The location and nature of black cockatoo foraging evidence observed during the field survey was recorded.
- Roosting habitat survey: Direct and indirect evidence of black cockatoos roosting within trees on site was noted if observed.

3.2.3 Opportunistic Fauna Observations

Opportunistic observations of fauna species (including those of birds with binoculars) was made during while traversing the study area on foot. These observations were supplemented by random searching of microhabitats such as logs, rocks, leaf litter and tree bark.



4. SURVEY CONSTRAINTS

No seasonal sampling has been carried out as part of this fauna assessment. The conclusions presented are based upon field data and the environmental monitoring and/or testing carried out over a limited period of time and are therefore merely indicative of the environmental condition of the site at the time of preparing the report. Also it should be recognised that site conditions can change with time.

Some fauna species are reported as potentially occurring within the study area based on there being suitable habitat (quality and extent) within the study area or immediately adjacent. With respect to opportunistic observations, the possibility exists that certain species may not have been detected during field investigations due to:

- seasonal inactivity during the field survey;
- species present within micro habitats not surveyed;
- cryptic species able to avoid detection; and
- transient wide-ranging species not present during the survey period.

Lack of observational data on some species should therefore not necessarily be taken as an indication that a species is absent from the site.

In recognition of survey limitations, a precautionary approach has been adopted for this assessment. Any fauna species that would possibly occur within the study area (or immediately adjacent), as identified through ecological databases, publications, discussions with local experts/residents and the habitat knowledge of the Author, has been assumed to potentially occur in the study area.

The habitat requirements and ecology of many of the species known to occur in the wider area are often not well understood or documented. It can therefore be difficult to exclude species from the potential list based on a lack of a specific habitat or microhabitat within the study area. As a consequence of this limitation the potential fauna list produced is most likely an overestimation of those species that actually utilise the study area for some purpose. Some species may be present in the general area but may only use the study area itself on rare occasions or as vagrants.

During the black cockatoo habitat survey trees with hollows were recorded (i.e. habitat trees). It should be noted that identifying hollows suitable for fauna



species from ground level has limitations. Generally the full characteristics of any hollow seen are not fully evident (e.g. internal dimensions). It is also difficult to locate all hollows within all trees as some are not observable from ground level.

The location of habitat trees was recorded using a handheld GPS. The accuracy of the GPS cannot be guaranteed above a level of about 5 to 10 metres, though it should be noted that in some circumstance the accuracy can be worse or better than this.

5. RESULTS

5.1 POTENTIAL FAUNA INVENTORY - DESKTOP STUDY

A list of expected fauna species likely to occur in the study area was compiled from information obtained during the desktop study and is presented in Appendix B. This listing was refined after information gathered during the site reconnaissance survey was assessed. The results of some previous fauna surveys carried out in the general area are summarised in this species listing as are the DEC NatureMap database search results. The raw database search results from NatureMap (DEC 2013) and the Protected Matters Search Tool (DSEWPaC 2013) are contained within Appendix C.

The list of potential fauna takes into consideration that firstly the species in question is not known to be locally extinct and secondly that suitable habitat for each species, as identified during the habitat assessment, is present within the study area, though compiling an accurate list has limitations (see Section 4). As a consequence of the various limitations the potential fauna list produced is most likely an overestimation of those species that actually utilise the study area for some purpose.

5.2 SITE SURVEYS

5.2.1 Fauna Habitat Assessment

The project area is situated near the northern boundary of the Southern Jarrah Forest Bioregion. The Southern Jarrah Forest (JF2) was defined as part of the revised Interim Biogeographical Regionalisation for Australia (IBRA Version 6.1). IBRA Version 6.1 is the result of refinement of the IBRA Version 5.1 boundaries due to better data availability from some states and territories and some alterations by the states/territories along their borders. The initial boundaries were defined and described in Thackway and Cresswell (1995).



The Southern Jarrah Forest Bioregion is a subset of the original Jarrah Forest (JF) Bioregion defined in IBRA Version 5.1. Within this document the JF is described as being:

“Duricrusted plateau of Yilgarn Craton characterised by Jarrah-Marri forest on laterite gravels and, in the eastern part, by Marri-Wandoo woodlands on clayey soils. Eluvial and alluvial deposits support Agonis shrublands. In areas of Mesozoic sediments, Jarrah forests occur in a mosaic with a variety of species-rich shrublands. Warm Mediterranean climate”.

A description of the Southern Jarrah Forest (JF2) is provided by Hearn *et al* (2002):

“South of Collie the plateau broadens and slopes gently to the south coast. Drainage is still dissected in the west but broadening and levelling of the surface in the east causes poor drainage and large and small wetlands. The ironstone becomes less evident being buried beneath sands.

Rainfall is from 1200 mm in the south-west to 500 mm in the east. Vegetation comprises Jarrah - Marri forest in the west grading to Marri and Wandoo woodlands in the east. There are extensive areas of swamp vegetation in the south-east, dominated by Paperbarks and Swamp Yate.

The understory component of the forest and woodland reflects the more mesic nature of this area. The majority of the diversity in the communities occurs on the lower slopes or near granite soils where there are rapid changes in site conditions. Subregional area of JF2 is 3,160,122ha.” (Hearn *et al.* 2002)

A description of the broadly defined fauna habitats within the study area (based on vegetation units and observed landforms) is given below. The extent of native forest compared to cleared areas can be seen in Figures 2a and to 2b. Plates 1 to 6 illustrate the nature of the vegetation units/habitats present. More detail on composition of the vegetation can be found within the flora and vegetation report.

- Remnant Native Vegetation: Vegetation is representative of that of the jarrah forest, displaying a structural homogeneity in overstorey species, dominated by jarrah (*Eucalyptus marginata*), marri (*Corymbia calophylla*) and, on deeper valley soils, blackbutt (*Eucalyptus patens*). Includes remnant vegetation along road verges adjoining paddocks. Vegetation complexes within the study area include:

1. Dwellingup and Hester Complex (Central and South) - Tall open forest to open forest of Jarrah and Marri. Located on



mildly undulating lateritic uplands and ridges. Soil typically ranges from yellow-brown gravelly and loamy sand to Ironstone duricrust pavements, loamy gravels, sandy gravels and outcrops.

2. Murray Complex - Open forest of Jarrah, Marri and Blackbutt on valley slopes and fringing woodlands of Flooded Gum and Swamp Paperbark on the valley floors. Soils are predominantly red and yellow loamy earths and gravels.
 3. Yarragil Complex - Open forest of Jarrah and Marri on slopes, with Blackbutt on the valley floors. Second storey consists primarily of Sheoak, Bull Banksia and Snottygobble. A shrub and herb storey is also typical. Soils range from loamy gravels, sandy gravels with some loamy earths and deep sands.
- Existing Cleared Paddocks: These areas are dominated by introduced pasture grasses with occasional scattered trees and degraded sedgeland.
 - Ephemeral Streams: Four watercourses along the proposed realignment appear to be all ephemeral streams with variable flows controlled by seasonal conditions. Two streams flow into Wellington Dam and during wetter years fill upstream just past the proposed realignment.

The quality of the various areas of native remnant vegetation along the proposed road realignment varies but most areas show signs of various degrees of historical disturbance from logging, frequent fire, gravel extraction and previous road/track making activities. Remnant vegetation within private landholdings has been open to livestock grazing and vegetation structure has been significantly altered.

The extent of remnant native vegetation in the vicinity of the study area can be seen in the attached figures. The adjoining Wellington National Park and associated reserves have a total area of over 20,000 ha though there are also other areas of state forest that contribute to the total extent of remnant vegetation in the general area.

The maximum extent of native remnant vegetation within the study area that will require clearing has been estimated to total about 25 ha. Significant sections of the study area are already cleared and primarily consist of cleared paddocks or the existing alignment is comprised of a ~20m wide bitumised road with a cleared gravel verge on both sides.



5.2.2 Black Cockatoo Habitat Assessment

The habitat tree assessment identified a total of 1,195 trees with a DBH of >50cms (Figures 3a and 3b). Seventy seven of these trees appeared to contain hollows with larger entrances (greater than ~12cm) that maybe big enough and orientated favourably to possibly allow the entry of a black cockatoo into a suitably sized branch/trunk. No evidence of any of these trees actually having been used for nesting by black cockatoos (e.g. chew marks) was observed. Not all of the identified habitat trees will require clearing. It has been estimated that of the 1,195 trees identified, 424 fall within the proposed clearing area. Of these, 28 were classified as having hollows with larger entrances.

Additional details on each habitat tree observed can be found in Appendix D.

Almost all areas of remnant native vegetation present along the proposed road corridor can be considered to represent potential black cockatoo foraging habitat as they contain a range of plant species documented as foraging habitat for one or more of the three black cockatoo species, all of which are known to frequent the area. The degree to which any one section of the route would be utilised for foraging purposes would however vary considerably based on species composition and density. Generally, the most dominant and widespread species are marri and jarrah though in some areas other species are also present (e.g. sheoak and banksia).

Foraging evidence left by all tree species of black cockatoo was observed during the reconnaissance survey and included chewed marri and jarrah fruits. Baudin's black cockatoo and the FRTBC were both observed foraging on several occasions.

It is difficult to calculate the extent of foraging habitat that may require clearing for road construction to proceed as a combination of existing cleared areas, existing roads and remnant bushland are involved. It is however estimated that a maximum of about 25 ha of vegetation may require clearing, most of which represents foraging habitat given the dominance of marri and jarrah with vegetation complexes in the area.

No existing roosting trees (trees used at night by black cockatoos to rest) were identified during the survey period.

5.2.3 Opportunistic Fauna Observations

Opportunistic fauna observations are listed in Appendix B. A total of 47 native fauna species were observed (or positively identified from foraging evidence,



scats, tracks, skeletons or calls) within the study area. Two introduced species were also observed.

Evidence of four listed threatened/migratory species using the study area was obtained (Baudin’s black cockatoo, Carnaby’s black cockatoo, forest red-tailed black cockatoo and the rainbow bee-eater). No evidence of any DEC priority species using the area was found.

5.3 FAUNA INVENTORY – SUMMARY

5.3.1 Vertebrate Fauna

Table 1 summarises the number of fauna species potentially occurring within the study area, based on results from the desktop study and observations made during the field assessment. A complete list of vertebrate fauna possibly inhabiting or frequenting the study area is located in Appendix B.

Table 1: Summary of Potential Vertebrate Fauna Species (as listed in Appendix B)

Group	Total number of potential species	Potential number of specially protected species	Potential number of migratory species	Potential number of priority species	Number of species observed Level 1 Survey
Fish	7 ⁴	0	0	0	0
Amphibians	9	0	0	0	0
Reptiles	41	1	0	1	3
Birds	106 ³	4	3	1	40 ¹
Non-Volant Mammals	22 ⁷	4	0	3	3 ¹
Volant Mammals (Bats)	9	0	0	1	0
Total	194¹⁰	9	3	6	48²

Superscript = number of introduced species included in total.

Not all species listed as potentially occurring within the study area in existing databases and publications (i.e. *EPBC Act* Threatened Fauna and Migratory species lists, DEC’s NatureMap database and various publications) are shown



in the expected listing in Appendix B. Some species have been excluded from this list based largely on the lack of suitable habitat at the study site and in the general area or known local extinction even if suitable habitat is present.

Despite the omission of some species it should be noted that the list provided is still very likely an over estimation of the fauna species utilising the site (either on a regular or infrequent basis) as a result of the precautionary approach adopted for the assessment.

The review of the *EPBC Act's* threatened fauna list, DEC's Threatened Fauna Database and Priority List, unpublished reports and scientific publications identified 31 specially protected, priority or migratory vertebrate fauna species as potentially occurring in the general vicinity of the study area.

Based on the habitats present and documented distributions it is considered possible that 18 of these species may use the study area for some purpose at times.

In summary, four vertebrate fauna species of conservation significance (listed as State or Federal threatened/migratory species or DEC priority species) were positively identified as utilising the study area for some purpose during the Level 1 reconnaissance survey, these being:

- *Calyptorhynchus baudinii* Baudin's Black Cockatoo - S1 (*WC Act*), Vulnerable (*EPBC Act*)
Observed several times and foraging evidence found during the survey period.
- *Calyptorhynchus latirostris* Carnaby's Cockatoo – S1 (*WC Act*), Endangered (*EPBC Act*)
Foraging evidence attributed to this species found.
- *Calyptorhynchus banksii naso* Forest Red-tailed Black Cockatoo – S1 (*WC Act*), Vulnerable (*EPBC Act*)
Observed several times and foraging evidence found during the survey period.
- *Merops ornatus* Rainbow Bee-eater – S3 (*WC Act*), Migratory (*EPBC Act*)
Group of three birds observed within the study area foraging during the survey period.

An additional 14 species of conservation significance may possibly utilise the study area for some purpose at times but their current status on-site and/or in the general area is, in some cases, difficult to determine because they were not



sighted during the survey period, or evidence of use of the study area was not found. These species are listed below:

Note: Habitat for some of these species on-site, while considered possibly suitable, may be marginal in extent/quality and species listed below may only visit the area for short periods, or as rare/uncommon vagrants.

- *Ctenotus delli* Dell's Ctenotus – P4 (DEC Priority Species)
Status onsite difficult to determine. Southern limit of range.
- *Morelia spilota imbricata* Southern Carpet Python - S4 (WC Act) - P4 (DEC Priority Species)
Status onsite difficult to determine. Typically only occurs in low densities.
- *Ardea alba* Great Egret – S3 (WC Act), Migratory (EPBC Act)
May frequent seasonally flooded creek lines (including Wellington Dam) and associated paddock areas during wetter months of the year in low numbers.
- *Ardea ibis* Cattle Egret – S3 (WC Act), Migratory (EPBC Act)
May frequent seasonally flooded creek lines (including Wellington Dam) and associated paddock areas during wetter months of the year in low numbers.
- *Falco peregrinus* Peregrine Falcon - S4 (WC Act),
Study site may form part of larger home range for individuals of this species. No existing nest sites observed.
- *Tyto novaehollandiae* Masked Owl – P3 (DEC Priority Species)
Status in the general area is difficult to determine. May utilise native forest areas.
- *Pseudocheirus occidentalis* Western Ringtail Possum - S1 (WC Act), Vulnerable (EPBC Act)
No evidence of this species observed which suggests low population densities at best. Most likely habitat limited to where midstorey vegetation is relatively dense.
- *Isodon obesulus fusciventer* Southern Brown Bandicoot – P5 (DEC Priority Species)
Most of the study area appears unsuitable for this species to persist due to a lack of dense groundcover but it may persist at locations where native vegetation provides sufficient cover.



- *Phascogale tapoatafa* ssp Southern Brush-tailed Phascogale - S1 (*WC Act*).
This species is known to persist in state forest and national park areas surrounding Collie and therefore it may frequent the study site.
- *Dasyurus geoffroyi* Chuditch - S1 (*WC Act*), Vulnerable (*EPBC Act*)
This species is known to frequent the general area and therefore may utilise sections of the study area at times.
- *Bettongia penicillata ogibyi* Woylie – S1 (*WC Act*), Endangered (*EPBC Act*)
May frequent some of the more densely vegetated areas (e.g. bushland bordering Wellington Dam) but most of the study area lacks sufficient understory required for this species to persist.
- *Macropus irma* Western Brush Wallaby – P4 (DEC Priority Species)
This species is known to frequent forest areas around Collie in low densities.
- *Hydromys chrysogaster* Water Rat – P4 (DEC Priority Species)
May utilise Wellington Dam and therefore may, on rare occasions, pass through the study area at this point.
- *Falsistrellus mackenziei* Western False Pipistrelle - P4 (DEC Priority Species)
Potentially roosts and forages within forest areas where suitable tree hollows present.

A number of other species of conservation significance, while possibly present in the general area are not listed as potential species due to known localised extinction (and no subsequent recruitment from adjoining areas) and/or lack of suitable habitat.

Details on all conservation species and reasons for their inclusion/exclusion from the potential lists provided in Appendix E, with a summary provided in Table 3.

Thirty eight bird species that potentially frequent or occur in the study area are noted as Bush Forever Decreaser Species in the Perth Metropolitan Region (22 species were sighted/identified as having used the study area during the survey). Decreaser species are a significant issue in biodiversity conservation in the Perth section of the Coastal Plain as there have been marked reductions in range and population levels of many sedentary bird species as a consequence of disturbance and land clearing (Dell & Hyder-Griffiths 2002).



5.3.2 Invertebrate Fauna

Five threatened or priority invertebrate species appeared in the DEC database search (DEC 2013), all of which are listed below. Only two have any potential to be present within the study area. Additional details on each species are provided in Appendix E.

- *Austromerope poultoni* Unnamed scorpionfly – P3 (DEC Priority Species).
Status in the study area difficult to determine. The majority of the study area appears unsuitable for this species as dense understory vegetation is typically absent. Some small areas of potential habitat maybe affected.
- *Pachysaga munggai* Unnamed cricket – P2 (DEC Priority Species).
Status in the study area difficult to determine. The majority of the study area appears unsuitable for this species as dense understory vegetation is typically absent. Some small areas of potential habitat maybe affected.
- *Westralunio carteri* Carter's Freshwater Mussel – P4 (DEC Priority Species).
The ephemeral nature of the small creeks with the study area appear to represent unsuitable habitat for this species. No historical records for the area.
- *Cherax tenuimanus* Margaret River (Hairy) Marron – S1 (*WC Act*), Critically Endangered (*EPBC Act*).
Outside of documented range. NatureMap database error.
- *Moggridgea tingle* Tingle Trapdoor Spider - S1 (*WC Act*)
Outside of documented range. NatureMap database error.

5.3.3 Introduced Feral Fauna

Table 2 lists the range of feral fauna species that have been recorded in or near the study area. The laughing kookaburra, rabbits and feral bees were observed during the survey period.

It is considered unlikely that the proposed realignment of the Coalfields Highway or associated works will contribute to the increase in numbers or range of any of the listed introduced species.



Table 2: Introduced and Other Problem Animals Recorded in the Wellington National Park Area (from DEC 2008)

Common Name	Species	DEC Management Priority
Mammals		
Feral pig*#	<i>Sus scrofa</i>	High
Fox*#	<i>Vulpes vulpes</i>	High
Feral cat#	<i>Felis catus</i>	Medium
Rabbit*#	<i>Oryctolagus cuniculus</i>	Low
House mouse	<i>Mus musculus</i>	Low
Black rat	<i>Rattus rattus</i>	Low
Red deer*	<i>Cervus elaphus</i>	Low
Fallow deer*	<i>Dama dama</i>	Low
Rusa Deer*	<i>Cervus timorensis</i>	Low
Feral dog*	<i>Canis familiaris familiaris</i>	Low
Fish		
Redfin perch	<i>Perca fluviatilis</i>	Low
Rainbow trout	<i>Oncorhynchus mykiss</i>	Low
Brown trout	<i>Salmo gairdneri</i>	Low
Mosquitofish	<i>Gambusia holbrooki</i>	Low
Carp	<i>Cyprinus carpio</i>	Low
Birds		
Laughing Kookaburra Δ	<i>Dacelo novaeguineae</i>	Low
Invertebrates		
Feral honeybees	<i>Apis mellifera</i>	Low
Yabby	<i>Cherax albidus</i>	
Jarrah leafminer	<i>Perthida glyphopa</i>	Low

* Declared species under the ARRPA Act (as of January 2008)

Δ Acclimatised species or fauna living in a wild state as a result of being released or escaping from confinement or because it is the immediate or remoter offspring of fauna that has been released or has escaped from confinement. These species are considered native to Western Australia and are protected under the Wildlife Conservation Act.

These animals are recognised as nation-wide problems and are the subject of threat abatement plans developed through the Commonwealth DSEWPaC.

6. FAUNA VALUES

6.1 CONSERVATION SIGNIFICANCE OF THE STUDY AREA

The conservation significance of the study area has been determined by applying site specific criteria such as:

- Fauna species and/or habitat present that is poorly represented in the general study area;
- Fauna habitat within the general study area supporting species of conservation or other significance; and
- Fauna habitat in better condition than other similar locations in general study area.



The results of the fauna assessment indicate that the study site hosts or potentially hosts a range of fauna species some of which are of special conservation significance. The extent of habitat suitable for those species identified as utilising the study area extends well outside the proposed corridor route itself and these fauna habitats are therefore well represented in adjoining national park and state forest areas. No evidence was gathered that suggest habitats within the proposed realignment corridor are in a significantly better condition than those found in adjoining areas. These facts suggest that the study area itself does not have any specific local conservation significance above that of adjoining areas.

Within the Wellington National Park, Westralia Conservation Park and Wellington Discovery Forest Management Plan (DEC 2008) four significant fauna habitats within the area were identified, these being:

- Granite Outcrops: Small, isolated and disjunct granite outcrop communities are interspersed throughout the planning area, particularly along the lower Collie River valley.
- Wetlands and Riparian Habitats: Important wetland habitats exist as seasonally or permanently inundated features along creek systems.
- Ecologically Mature Forest: Small areas of ecologically mature forest exist along riparian zones of the lower Collie River, where the effects of disturbances such as timber harvesting, road/track construction and clearing are considered negligible.
- Ecotones: Ecotones are transition zones between adjacent but different environments.

No substantial areas of any of these previously identified significant habitats occur within the area that may be directly affected by the proposed road realignment.

The DEC have also indicated that the area of grey sandy soils and associated vegetation around the National Park information bay east of Wellington Dam road is notable and potentially of conservation significance. The naturally restricted extent of this soil-landscape mapping unit may be an indication of a naturally restricted plant community (DEC 2011). It is not however suggested in this correspondence that this particular area has any specific conservation value with respect to fauna, with its possible significance being related to its potentially restricted floristic components only.



6.2 VALUE OF THE STUDY AREA AS AN ECOLOGICAL LINKAGE/WILDLIFE CORRIDOR

The extent of the clearing required is yet to be exactly defined but will require removal of relatively thin, discontinuous sections of vegetation located at various points along the propose 10.4 km road realignment. The degree of clearing required will not fragment any potential fauna habitat to the extent that it would represent a barrier to fauna a movement above that already present in the area (i.e. the existing Coalfields Highway and network of existing roads, tracks and powerline easements).

7. POTENTIAL IMPACTS

In general the most significant potential impacts to fauna of any development include:

- Loss of vegetation/fauna habitat that may be used for foraging, breeding, roosting, or dispersal (includes loss of hollow bearing trees);
- Fragmentation of vegetation/fauna habitat which may restrict the movement of some fauna species;
- Modifications to surface hydrology, siltation of creek lines;
- Changes to fire regimes;
- Pollution (e.g. oil spills);
- Noise/Light/Dust;
- Spread of plant pathogens (e.g. dieback) and weeds;
- Potential increase in the number of predatory introduced species (e.g. cats); and
- Death or injury of fauna during clearing, construction and operation (including road kills).

The most likely potential impacts on fauna of the proposed construction and use of the road realignment are:

- Loss of vegetation/fauna habitat that may be used for foraging, breeding, roosting, or dispersal (includes loss of hollow bearing trees);



- Death or injury of fauna during clearing, construction and operation (including road kills).

It is difficult to calculate the extent of fauna habitat that may require clearing for road construction to proceed as a combination of existing cleared areas, existing roads and remnant bushland are involved. It is however estimated that a maximum of about 25 ha of vegetation may require clearing.

Based on the habitats present and the maximum extent of clearing likely to be required for the proposed road works the anticipated impacts on species of conservation significance previously recorded in the general area has been assessed, a summary of which is provided in Table 3 below. Additional information on specific fauna species is provided in Appendix E.

Table 3: Likelihood of Occurrence and Possible Impacts – Fauna Species of Conservation Significance (continues on following pages).

Common Name	Genus & Species	Conservation Status	Habitat Present	Likelihood of Occurrence	Possible Impacts/ Significance of Possible Impacts
Unnamed scorpionfly	<i>Austromerope poultoni</i>	P2	Yes?/Marginal?	Possible but unlikely	Loss/modification of small areas of habitat/Very Low
Unnamed cricket	<i>Pachysaga munggai</i>	P3	Yes?/Marginal?	Possible but unlikely	Loss/modification of small areas of habitat/Very Low
Tingle Trapdoor Spider	<i>Moggridgea tingle</i>	S1	No	Unlikely	None/Nil
Margaret River (Hairy) Marron	<i>Cherax tenuimanus</i>	S1, CR	No	Unlikely	None/Nil
Carter's Freshwater Mussel	<i>Westralunio carteri</i>	P4	No	Unlikely	None/Nil
Balston's Pygmy Perch	<i>Nannatherina balstoni</i>	S1, VU	No	Unlikely	None/Nil
Pouched Lamprey	<i>Geotria australis</i>	P1	No	Unlikely	None/Nil
Darling Range Heath Ctenotus	<i>Ctenotus dell</i>	P4	Yes/Marginal. Possibly out of species range	Possible?	Loss/modification of small areas of habitat/Very Low
Southern Carpet Python	<i>Morelia spilota imbricata</i>	S4, P4	Yes	Possible	Loss/modification of small areas of habitat/Very Low
Great Egret	<i>Ardea alba</i>	S3, Mig	Yes/Marginal	Possible	Loss/modification of very small areas of habitat/Very Low



Common Name	Genus & Species	Conservation Status	Habitat Present	Likelihood of Occurrence	Possible Impacts/ Significance of Possible Impacts
Cattle Egret	<i>Ardea ibis</i>	S3, Mig	Yes/Marginal	Possible	Loss/modification of very small areas of habitat/Very Low
Australasian Bittern	<i>Botaurus poiciloptilus</i>	S1, EN	No	Unlikely	None/Nil
Little Bittern	<i>Ixobrychus minutus</i>	P4	No	Unlikely	None/Nil
Black Bittern	<i>Ixobrychus flavicollis</i>	P3	No	Unlikely	None/Nil
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	S3, Mig	No	Unlikely	None/Nil
Peregrine Falcon	<i>Falco peregrinus</i>	S4	Yes	Possible	Loss/modification of small areas of habitat/Very Low
Bush Stone Curlew	<i>Burhinus grallarius</i>	P4	Yes	Unlikely, Locally extinct	None/Nil
Carnaby's Black Cockatoo	<i>Calyptorhynchus latirostris</i>	S1, EN	Yes	Known to occur	Loss/modification of small areas of habitat/Low
Baudin's Black Cockatoo	<i>Calyptorhynchus baudinii</i>	S1, VU	Yes	Known to occur	Loss/modification of small areas of habitat/Low
Forest Red-tailed Black Cockatoo	<i>Calyptorhynchus banksii naso</i>	S1, VU	Yes	Possible	Loss/modification of small areas of habitat/Low
Masked Owl (SW population)	<i>Tyto n. novaehollandiae</i>	P3	Yes	Possible	Loss/modification of small areas of habitat/Very Low
Fork-tailed Swift	<i>Apus pacificus</i>	S3, Mig	Yes	Unlikely	None/Nil
Rainbow Bee-eater	<i>Merops ornatus</i>	S3, Mig	Yes	Possible	Loss/modification of small areas of habitat/Very Low
Western Shrike Tit	<i>Falcunculus frontatus leucogaster</i>	P4	No/Marginal	Unlikely	None/Nil
Chuditch	<i>Dasyurus geoffroii</i>	S1, VU	Yes	Possible	Loss/modification of small areas of habitat/Very Low
Numbat	<i>Myrmecobius fasciatus</i>	S1, VU	Yes	Unlikely - species locally extinct.	None/Nil
Southern Brush-tailed Phascogale	<i>Phascogale tapoatafa ssp</i>	S1	Yes	Possible	Loss/modification of small areas of habitat/Very Low.
Southern Brown Bandicoot	<i>Isoodon obesulus fusciventer</i>	P5	Yes	Possible	Loss/modification of small areas of habitat/Very Low



Common Name	Genus & Species	Conservation Status	Habitat Present	Likelihood of Occurrence	Possible Impacts/ Significance of Possible Impacts
Bilby	<i>Macrotis lagotis</i>	S1, VU	No	Unlikely - species regionally extinct.	None/Nil
Western Ringtail Possum	<i>Pseudocheirus occidentalis</i>	S1, VU	Yes	Possible	Loss/modification of small areas of habitat/Very Low
Western Brush Wallaby	<i>Macropus irma</i>	P4	Yes	Possible	Loss/modification of small areas of habitat/Very Low
Woylie	<i>Bettongia penicillata ogiby</i>	S1, EN	Yes/Marginal	Possible?	Loss/modification of small areas of habitat/Very Low/Nil
Tammar	<i>Macropus eugenii</i>	P4	No	Unlikely	None/Nil
Quokka	<i>Setonix brachyurus</i>	S1, VU	No	Unlikely	None/Nil
Western False Pipistrelle	<i>Falsistrellus mackenziei</i>	P4	Yes	Possible	Loss/modification of small areas of habitat/Very Low
Water Rat	<i>Hydromys chrysogaster</i>	P4	Yes/Marginal	Possible but unlikely	Loss/modification of small areas of habitat/Very Low/Nil

A high percentage of the conservation significant species known from the wider area region are unlikely to be impacted on by the proposal due to the fact that the study area does not contain their preferred habitat and therefore they are unlikely to be present. In cases where some habitat is present likely impacts are anticipated to be low primarily due to the relatively small area of clearing required, the large expanse of adjoining bush land (e.g. Wellington National Park and associated reserve areas cover over 20,000 ha (DEC 2008)) and the fact that the relatively small impacts will be spread over several kilometres.

8. LEGISLATIVE OBLIGATIONS

8.1 WILDLIFE CONSERVATION ACT 1950

The objective of the *Wildlife Conservation Act 1950* is to provide for the protection of wildlife. The *WC Act* is administered by the Executive Director of the Department of Environment and Conservation, under the direction and control of the Minister for the Environment. Under section 14, "Protection of Fauna", of this Act, all fauna is wholly protected throughout the State at all times, unless declared by the Minister by notice in the Government Gazette.



Under section 14(2)(ba) of The Act, Fauna Notices are made by the Minister for the Environment listing specially protected fauna.

Disturbance or destruction of any native fauna over and above that reasonably required for construction works and access is considered an offence under the *WC Act* and the proponent should take the necessary steps to inform all those involved in sites works of this fact. The proponent should, as part of a site works fauna management plan implement procedures that will reduce the chances of wildlife being injured or killed during clearing and construction on the site.

8.2 ENVIRONMENTAL PROTECTION ACT 1986

The purpose of the Environmental Protection Act (1986) is “...to provide for an *Environmental Protection Authority, for the prevention, control and abatement of pollution and environmental harm, for the conservation, preservation, protection enhancement and management of the environment and for matters incidental to or connected with the foregoing*”.

The powers of the Environmental Protection Act 1986 are administered by the Department of Environment and Conservation (DEC), which in relevant cases advises to the Environmental Protection Authority (EPA).

Legislation proclaimed on 8 July 2004 protects all native vegetation in Western Australia. Under the law, clearing native vegetation is prohibited, unless a clearing permit is granted by the DEC, or the clearing is for an exempt purpose. These exemptions ensure that low impact day to day activities involving clearing can be undertaken. People that wish to clear are required to submit an application if an exemption does not apply.

Clearing applications are assessed against ten defined clearing principles related to native vegetation in the EP Act. These principles provide a guide for when native vegetation should not be cleared. The DEC must consider these principles in making a decision on whether or not to issue a clearing permit. The DEC has set out the minimum requirements and standards for addressing each of the ten principles in detail in its assessment methodology.

It is understood that the MRWA have a state-wide purpose permit issued under the Native Vegetation Clearing Regulations 2004. The DEC have however made it clear that the use of this permit is only appropriate if any proposed clearing is not at variance to any of the 10 clearing principles, these being:

Native vegetation should not be cleared if

- (a) it comprises a high level of biological diversity;



- (b) it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia;
- (c) it includes, or is necessary for the continued existence of, rare flora;
- (d) it comprises the whole or a part of, or is necessary for the maintenance of a threatened ecological community;
- (e) it is significant as a remnant of native vegetation in an area that has been extensively cleared;
- (f) it is growing in, or in association with, an environment associated with a watercourse or wetland;
- (g) the clearing of the vegetation is likely to cause appreciable land degradation;
- (h) the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area;
- (i) the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water; or
- (j) clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.

One purpose of the assessment reported on here is to provide information relevant to principle (a) & (b). The maximum extent of clearing has been estimate to total about 25 ha. Most of this vegetation has been subject to substantial historical disturbance and similar habitats are common and widespread in the Allanson/Collie Area. (e.g. Wellington National Park and associated reserve areas cover over 20,000 ha (DEC 2008)) The overall faunal assemblage potentially present is therefore unlikely to be of a higher diversity or different to that found in similar habitats located elsewhere in the immediate vicinity. It could therefore be concluded that the area that may need to be cleared does not contain habitats of high ecological significance from a faunal perspective or contain faunal assemblages that are ecologically significant. Also the area to be cleared is spread over a distance of ~10.4 km. The impact of clearing on fauna or fauna habitat in general will therefore be relatively small at any one location.

The DEC will need to consider all available information relating to all 10 clearing principles including those relating to fauna. The demonstrated use of the study area by several species of conservation significance and the potential presence



of several others will influence the DEC decision making process, though it is difficult to predict specific outcomes as some discretion is exercised by the DEC when approving applications. Any proposed offsets are also taken into consideration.

8.3 ENVIRONMENT PROTECTION & BIODIVERSITY CONSERVATION ACT 1999

A number of fauna species known to or potentially present within the study area are listed under the federal *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*. The objective of the *EPBC Act* is to provide for the protection of the environment, especially those aspects that are of national significance, promote ecologically sustainable development, the conservation of biodiversity and a cooperative approach to the protection and management of the environment.

EPBC Act listed fauna species (or their habitat) identified as being present in the study area were:

- *Calyptorhynchus baudinii* Baudin's Black Cockatoo – Vulnerable;
- *Calyptorhynchus latirostris* Carnaby's Black Cockatoo – Endangered;
- *Calyptorhynchus banksii naso* Forest Red-tailed Black Cockatoo – Vulnerable; and
- *Merops ornatus* Rainbow Bee-eater – Migratory;

EPBC Act listed fauna species identified as possibly using the study area (or areas in close proximity) were:

- *Ardea alba* Great Egret – Migratory;
- *Ardea ibis* Cattle Egret – Migratory;
- *Pseudocheirus occidentalis* Western Ringtail Possum – Vulnerable;
- *Dasyurus geoffroyi* Chuditch – Vulnerable; and
- *Bettongia penicillata ogiby* Woylie – Endangered.

A number of other *EPBC Act* listed threatened/migratory fauna species (or their habitat) were determined during the fauna assessment not to be present in the study area despite appearing in database searches (see Table 3 and



Appendix E). Their exclusion from the potential species list is primarily justified by an obvious lack of suitable/important/significant habitat or known local extinction. Some species are not considered “potential” species despite possibly being present on occasions as their frequency of occurrence would be extremely rare and only temporary. It is also very unlikely that vegetation at the site represents habitat critical for the recovery of these particular threatened species in the area. These species will not be discussed further:

If an action (i.e. clearing of native vegetation along propose realignment) is deemed to have a potential “significant impact” on listed species or their habitat, a referral to DSEWPaC is recommended to ensure compliance with the *EPBC Act*.

Currently, for the species in question “significant impact” is defined within one document, this being:

- Department of the Environment, Water, Heritage and the Arts (DEWHA) (2009b). Matters of National Environmental Significance. Significant Impact Guidelines 1.1, *EPBC Act 1999*; and

The significant impact criteria for endangered and vulnerable species are defined in this document as:

An action is likely to have a significant impact on an endangered species (e.g. Carnaby’s black cockatoo/woylie) if there is a real chance or possibility that it will:

- lead to a long-term decrease in the size of a population;
- reduce the area of occupancy of the species, or
- fragment an existing population into two or more populations, or
- adversely affect habitat critical to the survival of a species, or
- disrupt the breeding cycle of a population, or
- modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, or
- result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species’ habitat, or



- introduce disease that may cause the species to decline; or
- interfere with the recovery of the species.

An action is likely to have a significant impact on a vulnerable species (e.g. Baudin's black cockatoo, the FRTBC, western ringtail possum) if there is a real chance or possibility that it will:

- lead to a long-term decrease in the size of an important population of a species;
- reduce the area of occupancy of an important population;
- fragment an existing important population into two or more populations;
- adversely affect habitat critical to the survival of a species;
- disrupt the breeding cycle of an important population;
- modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
- result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;
- introduce disease that may cause the species to decline; or
- interfere substantially with the recovery of the species.

To have a significant impact on an endangered/vulnerable species as defined under these guidelines, any proposed development would need to trigger at least one of the abovementioned significant impact criteria thresholds. The proposed action must have a 'real chance or possibility' of failing one or more of the criteria to be considered a controlled action under the *EPBC Act* ("real" is defined as not remote).

The abovementioned significant impact criteria refer to 'populations' and 'important populations'. These terms have not been defined for black cockatoos, due to the mobile and widely-distributed nature of these species, and the variation in flock compositions (for example, between breeding and non-breeding seasons).



For black cockatoos, DSEWPaC therefore considered it more appropriate to assess significance in terms of impacts on habitat rather than a resident population. For this reason DSEWPaC have recently released referral guidelines for the three threatened black cockatoo species which provides guidance for when one or more “habitat impacts” may trigger the need to refer an “action”. The document in question is titled:

- Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) (2012). *EPBC Act* referral guidelines for three threatened black cockatoo species: Carnaby’s cockatoo (endangered) *Calyptorhynchus latirostris*, Baudin’s cockatoo (vulnerable) *Calyptorhynchus baudinii*, Forest red-tailed black cockatoo (vulnerable) *Calyptorhynchus banksii naso*.

The aim of the document is to provide guidance on what type of actions would be regarded by DSEWPaC as having a high, low or an uncertain risk of significant impact. Actions that have a high or uncertain risk of significant impact are recommended by the DSEWPaC to be referred. The document only provides “referral guidelines” and doesn’t specifically define what significant impact is.

DSEWPaC also have referral guidelines relating to the western ringtail possum:

- Department of the Environment, Water, Heritage and the Arts (DEWHA) (2009a). Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) Policy Statement 3.10 “Significant Impact Guidelines for the vulnerable western ringtail possum (*Pseudocheirus occidentalis*) in the southern Swan Coastal Plain, Western Australia”

As with the black cockatoo guidelines this document also summarises what scale of actions would be considered likely to have a significant impact on WRPs though only in respect to projects undertaken within a specific section of the southern Swan Coastal Plain. The Project area is outside of this policy area and therefore the guidelines contained within this document are not relevant in this instance. The “Principal Significant Impact Guidelines 1.1” (DEH 2009b) must therefore be referred to for guidance on the likelihood of significant impact and the need for referral with respect to western ringtail possums.

An assessment of significant impact on federally listed threatened fauna species and the possible need to refer the project to DSEWPaC using the relevant criteria within the abovementioned documents are provided below.



8.3.1 Black Cockatoos - Assessment using Significant Impact Guidelines 1.1 (DEWHA 2009b)

While DSEWPaC indicate that some of these criteria cannot be applied to black cockatoos because certain terms have not been defined for the species in question, an assessment of the impacts of the proposal on black cockatoos against significant impact criteria is provided below.

Lead to a long-term decrease in the size of a population (or an important population)

The study area contains foraging and potential breeding habitat for black cockatoos but the extent of the proposed clearing at any one location is likely to be relatively small and very unlikely to lead to a long term decrease in the size of a population (or important population).

The proposed works are near large areas of national park and state forest areas and all three species of black cockatoo will continue to utilise the area as they do now despite the road works proceeding. No evidence has been gathered that suggests that the proposal would lead to a decrease in the size of the Carnaby's, Baudin's or the Forest red-tailed black cockatoo population.

It is very unlikely that this criteria will be compromised by the development proceeding.

Reduce the area of occupancy of the species (or an important population)

The extent of the proposed clearing is estimated to be about 25 ha and is made up of a thin discontinuous strip of vegetation located at various points along a 10.4km road alignment. All three black cockatoo species will continue to utilise the area as they do now despite the proposal proceeding. There is no evidence to suggest that the proposed development of the land at the study site would lead to a reduction in the area of occupancy by any of the black cockatoo species.

This criteria will not be compromised by the development proceeding.

Fragment an existing population (or important population) into two or more populations

This degree of clearing could not possibly fragment any potential habitat to the extent that it would represent a barrier to black cockatoo movement.

This criteria will not be compromised by the development proceeding.



Adversely affect habitat critical to the survival of a species

The area of vegetation requiring clearing at any one point is very small and not localised in one area. Substantial nearby areas of potential habitat for all the species in question will remain unaffected by the proposal. Habitat within the study area cannot be regarded as “critical to the survival of a species”.

This criteria will therefore not be compromised by the road development proceeding.

Disrupt the breeding cycle of a population (or important population)

No evidence of black cockatoos breeding within the study area was found. A number of trees were identified in or very near the study area that contained hollows which may possibly be suitable for black cockatoos to utilise for breeding, though no sign of actual use by black cockatoos was seen. It is recommended that clearing, if possible, be undertaken outside of black cockatoo breeding season and/or that all trees be carefully examined prior to removal to reduce the possibility that any actual breeding individuals are affected.

It is unlikely that this criteria will be compromised by the road development proceeding.

Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The study area contains foraging and potential breeding habitat for black cockatoos but the extent of the proposed clearing is relatively small at any one location and unlikely to lead to a long term decrease in the size of a population (or important population).

The proposed works are near large areas of national park and state forest areas and all three species of black cockatoo will continue to utilise the area as they do now despite the road works proceeding. There is no evidence to suggest that the proposed clearing of a small area of vegetation over such a wide area would modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that would cause any of the black cockatoo species population numbers to decline.

It is very unlikely that this criteria will be compromised by the development proceeding.



Result in invasive species that are harmful to endangered/vulnerable species becoming established in the endangered/vulnerable species' habitat

It is extremely unlikely that the proposed development of the land would result in an invasive species that is harmful to any of the species in question would become established on the site or in the vicinity.

This criteria will not be compromised by the development proceeding.

Introduce disease that may cause the species to decline;

It is extremely unlikely that the proposed development of the land would result in the introduction of a disease that would cause any of the species in question to decline.

This criteria will therefore not be compromised by the development proceeding.

Interfere with the recovery of the species

The areas likely to be cleared are small and spread over a 10.4km length of road. Impacts at any one point will be very small/negligible. All of the species in question will continue to utilise the general area as they do now despite the proposal proceeding. There is no evidence to suggest that the proposed road widening and the removal of small areas of vegetation would interfere with the recovery of any of the black cockatoo species.

This criteria will therefore not be compromised by the development proceeding.

In all cases it is considered unlikely that the impact caused by the proposed road works would trigger any of the abovementioned criteria. This is primary because of the relatively small area of clearing likely to be required at any one point, the fact that it is spread over a wide area and the existence of substantial areas of quality habitat areas nearby.

8.3.2 Black Cockatoos - Assessment using Referral Guidelines (DSEWPac 2012)

The following points provide general guidance on what, in DSEWPac's view, may be at high and low risk of requiring a referral to ensure compliance with the *EPBC Act* as well as providing some guidance on uncertainty.



Actions that have a high risk of significant impacts

- Clearing of any known nesting tree.
- Clearing or degradation of any part of a vegetation community known to contain breeding habitat.
- Clearing of more than 1 ha of quality foraging habitat.
- Clearing or degradation (including pruning the top canopy) of a known night roosting site.
- Creating a gap of greater than 4 km between patches of black cockatoo habitat (breeding, foraging or roosting).

Actions that have an uncertain risk of significant impacts

- Degradation (such as through altered hydrology or fire regimes) of more than 1 ha of foraging habitat. Significance will depend on the level and extent of degradation and the quality of the habitat.
- Clearing or disturbance in areas surrounding black cockatoo habitat that has the potential to degrade habitat through introduction of invasive species, edge effects, hydrological changes, increased human visitation or fire.
- Actions that do not directly affect the listed species but that have the potential for indirect impacts such as increasing competitors for nest hollows.
- Actions with the potential to introduce known plant diseases such as *Phytophthora* spp. to an area where the pathogen was not previously known.

Actions that have a low risk of significant impacts

- Actions that do not affect black cockatoo habitat or individuals.
- Actions whose impacts occur outside the modelled distribution of the three black cockatoos.

Each of these is briefly assessed below.



Actions that have a high risk of significant impacts

Clearing of any known nesting tree.

No actual nesting trees were identified within the study area during the field reconnaissance surveys. Seventy seven trees were identified within or near the study area (28 inside works footprint) that contained hollows which may possibly be suitable for black cockatoos to utilise for breeding, though no sign of actual use by black cockatoos was seen. While no evidence of breeding in the area was observed, the possibility cannot be totally discounted at this stage.

Based on observations made to date this criterion will not be compromised by road works proceeding and the assessment of impacts provided in section 8.3.1 suggests that in this case significant impact (as defined by DSEWPaC) is in reality, unlikely.

Clearing or degradation of any part of a vegetation community known to contain breeding habitat.

“Breeding habitat” is defined by DSEWPaC as a tree with either a diameter at breast height of greater than 50 cm (30cm for salmon gum and wandoo), or the presence of a suitable nest hollow (any hollow that appears to be deep enough and with an opening large enough to be used by black cockatoos, or any trees that appear to be likely to have such hollows).

The habitat tree survey (see Section 5.2.2) identified 1,195 trees within or in the vicinity of the propose road corridor that have a DBH of greater than 50cm, all of which represent “breeding habitat” as defined by DSEWPaC (2012).

Not all of the identified breeding habitat will be affected, however as the criteria simply specifies “the clearing or degradation of any part of a vegetation community known to contain breeding habitat” as having a high risk of significant impact this criteria will be compromised by the clearing of just one tree. However, the assessment of impacts provided in section 8.3.1 suggests that in this case significant impact (as defined by DSEWPaC) is in reality, unlikely.

Clearing of more than 1 ha of quality foraging habitat.

Most of the native vegetation remaining within the study area represents potential black cockatoo foraging habitat. The estimated extent of clearing is estimated to be about 25 ha and will therefore exceed the defined threshold.

This criterion will be compromised by road works proceeding and will be deemed by DSEWPaC as having a high risk of significant impact. However, the



assessment of impacts provided in section 8.3.1 suggests that in this case, significant impact (as defined by DSEWPaC) that may result as a consequence of clearing in this area is in reality, unlikely.

Clearing or degradation (including pruning the top canopy) of a known night roosting site.

No roosting trees were identified within the study area during the field reconnaissance survey.

Based on the information gathered to date this criterion will not be compromised by road works proceeding.

Creating a gap of greater than 4 km between patches of black cockatoo habitat (breeding, foraging or roosting).

Road works within the study area at any scale would not compromise this criterion.

Actions that have an uncertain risk of significant impacts

Degradation (such as through altered hydrology or fire regimes) of more than 1 ha of foraging habitat. Significance will depend on the level and extent of degradation and the quality of the habitat.

Degradation of foraging habitat through altered hydrology or fire is considered unlikely to occur as a consequence of the proposed road works.

This criterion will not be compromised by road works proceeding.

Clearing or disturbance in areas surrounding black cockatoo habitat that has the potential to degrade habitat through introduction of invasive species, edge effects, hydrological changes, increased human visitation or fire.

The proposed road works are within identified black cockatoo habitat and so impacts will be direct. Additional indirect impacts, not addressed elsewhere, are considered unlikely.

This criterion is not relevant in this instance.



Actions that do not directly affect the listed species but that have the potential for indirect impacts such as increasing competitors for nest hollows.

It is unlikely that the proposed road works will have indirect impacts such as increasing competition for nest hollows.

It is unlikely that this criterion will be compromised by road works proceeding.

Actions with the potential to introduce known plant diseases such as *Phytophthora* spp. to an area where the pathogen was not previously known.

It is understood that the study area has been assessed for dieback. It has been determined to be dieback infected and uninfected/unprotectable from *Phytophthora* along its entire length. It is therefore considered unlikely that roads works will significantly contribute to any existing, ongoing impacts that are already at play in the area with respect to plant diseases.

While in theory it is possible that this criterion could be compromised by road works proceeding, the area is open to public access and therefore there is no control on the introduction or spread of plant diseases. Areas that aren't already infected have been classified as "unprotectable" and road works are very unlikely to alter this existing situation to a point where significant impact on black cockatoos (as defined by the DSEWPaC) could be considered likely.

Actions that have a low risk of significant impacts

Actions that do not affect black cockatoo habitat or individuals.

Not applicable in this case.

Actions whose impacts occur outside the modelled distribution of the three black cockatoos

Not applicable in this case.

The above assessment using DSEWPaC guidelines for referral suggests that the proposed road works will be regarded by them as an action that has a high risk of significant impact on black cockatoos. However the assessment of significant impact provided in section 8.3.1 suggests that in this case significant impact (as defined by DSEWPaC) is in reality, unlikely.

Nonetheless, it is understood that referral of the project to DSEWPaC for assessment is being undertaken to ensure compliance with the *EPBC Act*.



8.3.3 Other Listed Threatened Fauna Species

Other *EPBC Act* listed species potentially present in the area are:

- *Pseudocheirus occidentalis* Western Ringtail Possum – Vulnerable;
- *Dasyurus geoffroii* Chuditch – Vulnerable; and
- *Bettongia penicillata ogibyi* Woylie – Endangered.

An assessment of likely significant impact using DSEWPaC criteria (DEWHA 2009b) is provided below.

Lead to a long-term decrease in the size of a population (or an important population)

The fauna assessment found no direct evidence of any of the three species in question utilising the study area and significant sections appear at best marginal for western ringtail possums and woylies to utilise. Chuditch are relatively wide ranging species and assuming populations exist in the area, the clearing along the road alignment is unlikely to significantly alter this species use of the area.

The proposed works are near large areas of national park and state forest areas and any populations of the animals in question present will continue to utilise the area as they do now despite the road works proceeding. No evidence has been gathered that suggests that the proposal would lead to a decrease in the size of the western ringtail possum, chuditch or woylie populations.

It is very unlikely that this criteria will be compromised by the development proceeding.

Reduce the area of occupancy of the species (or an important population)

The extent of the proposed clearing is estimated to be about 25 ha and is made up of vegetation located at various points along a 10.4 km alignment. It is considered unlikely that the clearing of this area of vegetation will have any impact whatsoever on populations present in the area and the area of occupancy of the species in question will not in any way be affected.

The proposed works are near large areas of national park and state forest areas and any populations of the animals in question present will continue to utilise the area as they do now despite the road works proceeding. No evidence has been gathered that suggests that the proposal would result in a reduction in the area of occupancy of the western ringtail possum, chuditch or woylie.



This criteria will not be compromised by the development proceeding.

Fragment an existing population (or important population) into two or more populations

The extent of the proposed clearing is estimated to be about 25 ha and is made up of vegetation located at various points along a 10.4 km alignment. This degree of clearing could not possibly fragment any potential habitat to the extent that it would represent a barrier to fauna movement above that which already exists.

This criteria will not be compromised by the development proceeding.

Adversely affect habitat critical to the survival of a species

The area of vegetation requiring clearing at any one point is very small and not localised in one area and significant sections appear at best marginal for western ringtail possums and woylies to utilise. Substantial nearby areas of similar habitat for all the species in question will remain unaffected by the proposal. Habitat within the study area that will require removal cannot be regarded as “critical to the survival of a species” (in this case western ringtail possums, chuditch or woylies) and its removal is not anticipated to have any impact on the status of any of these species in the area.

This criteria will not be compromised by the road development proceeding.

Disrupt the breeding cycle of a population (or important population)

The area of vegetation requiring clearing at any one point is small and not localised in one area. Substantial nearby areas of similar habitat to that present within the study area will remain unaffected by the proposal. Even if the home range of some breeding individuals overlaps the proposed clearing areas the extent of retained/unaffected vegetation is more than sufficient for individuals to persist unaffected and continue their “breeding cycle”.

It is considered unlikely that this criteria will be compromised by the road development proceeding.

Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The extent of the proposed clearing is estimated to be about 25 ha and is made up of vegetation located at various points along a 10.4 km alignment. It is considered unlikely that the removal of this area of vegetation, spread over such a distance will result in a decline in any of the three species in question.



The proposed works are near large areas of national park and state forest areas and populations present will continue to utilise the area as they do now despite the road works proceeding. No evidence has been gathered that suggests that the proposal would cause the species to decline in numbers.

It is considered very unlikely that this criteria will be compromised by the development proceeding.

Result in invasive species that are harmful to endangered/vulnerable species becoming established in the endangered/vulnerable species' habitat

It is extremely unlikely that the proposed road works would result in an invasive species that is harmful to any of the species in question becoming established on the site or in the vicinity.

This criteria will not be compromised by the development proceeding.

Introduce disease that may cause the species to decline;

It is extremely unlikely that the proposed development of the land would result in the introduction of a disease that would cause any of the species in question to decline.

This criteria will therefore not be compromised by the development proceeding.

Interfere with the recovery of the species

The extent of the proposed clearing is estimated to be about 25 ha and is made up of vegetation located at various points along a 10.4 km alignment. It is considered unlikely that the removal of this area of vegetation, spread over such a distance will interfere with the recovery of any of the three species in question.

All of the species in question will continue to utilise the general area as they do now despite the proposal proceeding. There is no evidence to suggest that the proposed road construction and the removal of areas of vegetation would interfere with the recovery of any of the species in question.

This criteria will therefore not be compromised by the development proceeding.

In all cases it is considered unlikely that the impact caused by the proposed road works would trigger any of the abovementioned significant impact criteria.

This is conclusion supported by observations made during the level 1 fauna assessment which suggests that substantial populations of these species do not



or are unlikely to be relying on habitat within the study area to the degree that the removal of some of it would constitute “significant impact” or “likely significant impact” as defined by DSEWPaC (DEWHA 2009b). This conclusion is primarily based on the fact that no individuals of the species in question were observed, the area of potentially suitable habitat for the species in question that may be affected is relatively small and similar (and better) quality habitat is common and widespread in the region.

Also recommendations provided in *Section 9* have been provided and if implemented will minimise direct impacts fauna (including threatened species) that may occur during clearing operations.

8.3.4 Migratory Species

The DSEWPaC document titled “Matters of National Environmental Significance, Principal Significant Impact Guidelines 1.1, (DEWHA 2009b) summarises what scale of actions would be considered likely to have a significant impact on listed migratory species.

Within this document an action has, will have, or is likely to have a significant impact on migratory species if it does, will, or is likely to:

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat of the migratory species;
- result in invasive species that is harmful to the migratory species becoming established in an area of important habitat of the migratory species; or
- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of the species.

An area of important habitat is:

- habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species;
- habitat that is of critical importance to the species at particular life-cycle stages;
- habitat utilised by a migratory species which is at the limit of the species range; or



- habitat within an area where the species is declining.

To have a significant impact on a migratory species as defined under the DSEWPaC Significant Impact Guidelines (DEWHA 2009b), any proposed development would need to trigger at least one of the abovementioned significant impact criteria thresholds.

It is considered unlikely that any of these thresholds relating to migratory species will be compromised by the project proceeding. The habitat within the study area likely to be used by migratory species does not represent “important habitat” and the number of individuals utilising these areas would not, under any circumstances, represent an ecologically significant proportion of the population of any of the species in question.

9. RECOMMENDATIONS

The following recommendations are provided for guidance for the formulation of management plans that should aim to reduce the impact on fauna and fauna habitat as much as reasonable and practicable. This listing is not exhaustive and management plans and possible offsets will need to be finalised after liaison with relevant regulatory authorities (e.g. DEC and DSEWPaC). It is recommended that:

- During clearing operations a suitably experienced “fauna spotter” should be employed to inspect logs, trees and hollows (where possible) before clearing to reduce likelihood of injury to fauna. Trees observed to contain hollows (or possum dreys) should be felled in a manner that reduces the likelihood that fauna present will be injured. Hollows and dreys in fallen trees should be inspected for fauna prior to removal from the site. If feasible any fauna encountered should be relocated to suitable retained habitat nearby.
- During site works areas requiring clearing should be clearly marked and access to other areas restricted to prevent accidental clearing of areas to be retained.
- Design additional project infrastructure, including access routes, vehicle and plant storage and turn around areas, borrow pits etc. so that:
 - previously disturbed areas are used where possible; and
 - areas of sensitive vegetation are avoided.



- An erosion and sediment control plan should be developed and implemented. Construction in the vicinity of water courses should, if possible, be done within the drier months of the year. Appropriate rehabilitation or erosion control structures should be in place prior to the first winter rains.
- Fuel and chemical storage facilities should be located appropriate distance away from watercourses.
- No dead, standing or fallen timber should be removed unnecessarily. Logs (hollow or not) and other debris resulting from land clearing should be used to enhance fauna habitat in untouched and rehabilitated areas if possible. Where possible, logs are to be retained either by pushing the logs into the surrounding forest, when significant disturbance to the forest can be avoided, or the logs cut so that the length of log outside the clearing area remains insitu.
- All staff working on site should be made aware that native fauna is protected. Personnel working on the project should not be allowed to bring firearms, other weapons or pets onsite.
- Major clearing operations should avoid the peak breeding times of threatened species that utilise tree hollows, fallen hollow logs and burrows. The documented breeding and fledging times of the respective species (see below) suggests that the best time to carry out clearing at the site would be around March/April so as to avoid the peak breeding times for most of the species in question. With respect to black cockatoos it would also be possible to carry out observations of potential nest hollows to establish if they were in use if clearing needed to be undertaken at other times.

Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso*

J	F	M	A	M	J	J	A	S	O	N	D

Baudin’s Black- Cockatoo *Calyptorhynchus baudinii*

J	F	M	A	M	J	J	A	S	O	N	D

Carnaby’s Black- Cockatoo *Calyptorhynchus latirostris*

J	F	M	A	M	J	J	A	S	O	N	D

Chuditch *Dasyurus geoffroii*

J	F	M	A	M	J	J	A	S	O	N	D



Southern Brush-tailed Phascogale *Phascogale tapoatafa ssp.*

J	F	M	A	M	J	J	A	S	O	N	D



Period in which breeding (egg laying/birth) is most likely to commence

Period in which fledging/weening could extend through

- Native fauna injured during clearing or normal site operations should be taken to a designated veterinary clinic or a DEC nominated wildlife carer.
- Any holes, pits or trenches required for services should be kept open for only as long as necessary and suitable escape ramps (45° batter) and bridging provided if the site is to be left unattended for extended periods. Significant sized holes, pits or trenches should be inspected for fauna immediately prior to filling.

10. CONCLUSION

The fauna assessment of the proposed Coalfields Highway Realignment Project was undertaken for the purposes of categorising the fauna assemblages and identifying fauna habitats. Targeted searches to quantify the extent and quality of black cockatoo habitat present were also carried out.

With respect to native vertebrate fauna, 21 mammals (includes nine bat species), 103 bird, 41 reptile, nine frog and three fish species have previously been recorded in the general area, some of which have the potential to occur in or utilise sections of the study area at times.

Of the 184 native animals that are listed as potentially occurring in the area, nine are considered to be endangered/vulnerable or in need of special protection under State and/or Federal law. In addition, three migratory species and six DEC priority species may frequent the area at times.

With respect to fauna in general no substantial impacts are anticipated as a consequence of the upgrade being constructed. In cases where some impact is anticipated, the degree of the impact is only expected to be very low and relates to the loss of a relatively small area of vegetation (~ max 25 ha) the loss of which will be dampened by the presence of a large areas of similar or better quality habitat in adjoining areas (e.g. Wellington National Park and associated reserves - 20,000 ha (DEC 2008)). A series of recommendations aimed at



mitigating and minimising potential impacts on fauna and fauna habitat in general are provided in *Section 9*. These should be implemented as part of existing or proposed management plans where considered reasonable and practicable.

Using current DSEWPaC significant impact/referral guidelines, it is the Authors opinion that the proposed road works are unlikely to constitute a “significant impact” on any *EPBC Act* threatened fauna species despite triggering some referral guidelines with respect to black cockatoos.

It is understood that referral of the project to DSEWPaC for assessment is being undertaken to ensure compliance with the *EPBC Act* in this regard.



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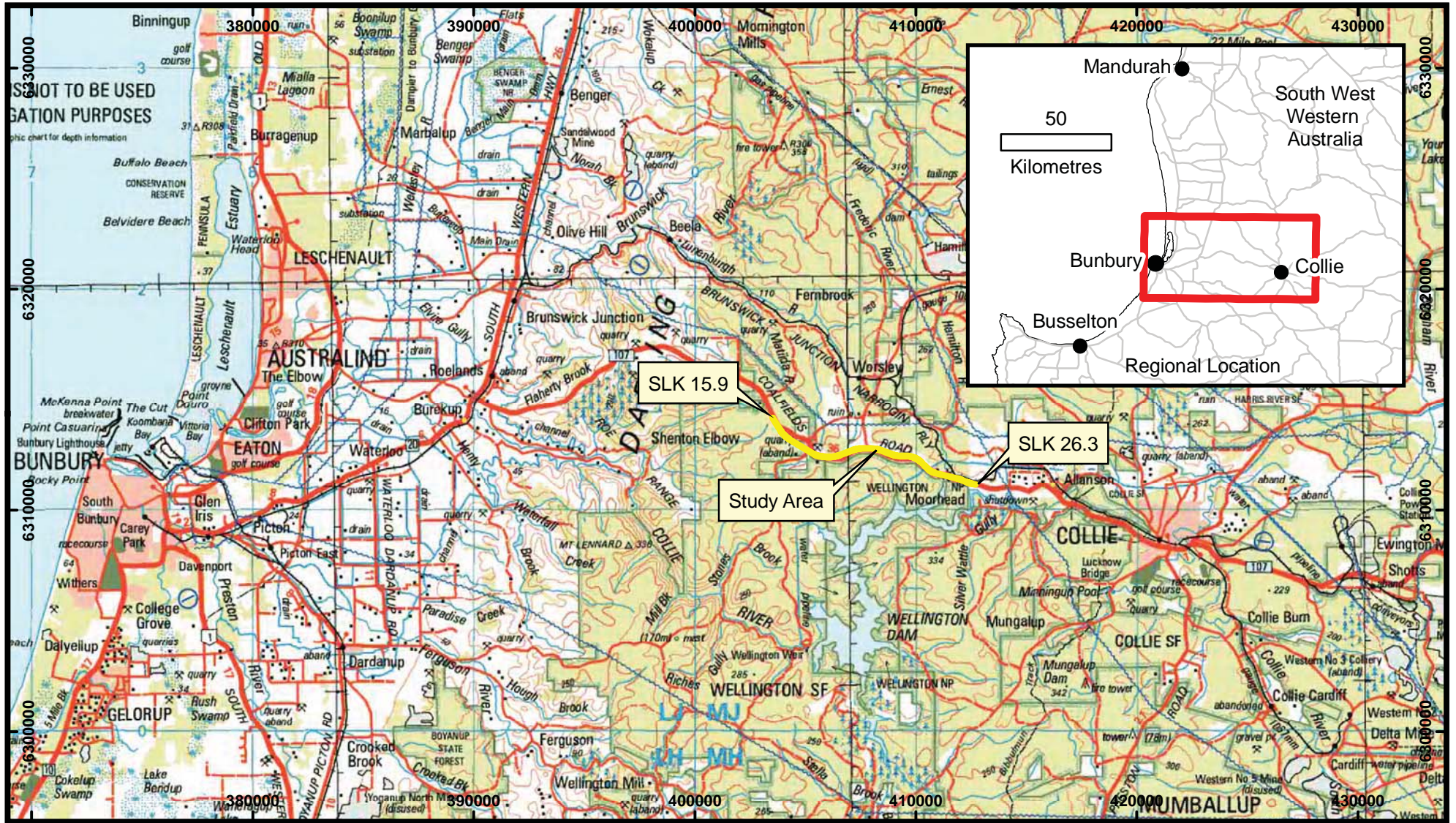
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FIGURES





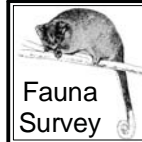
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 Study Area



0 2 4 6 8 10

Kilometres
MGA Zone 50



Fauna
Survey

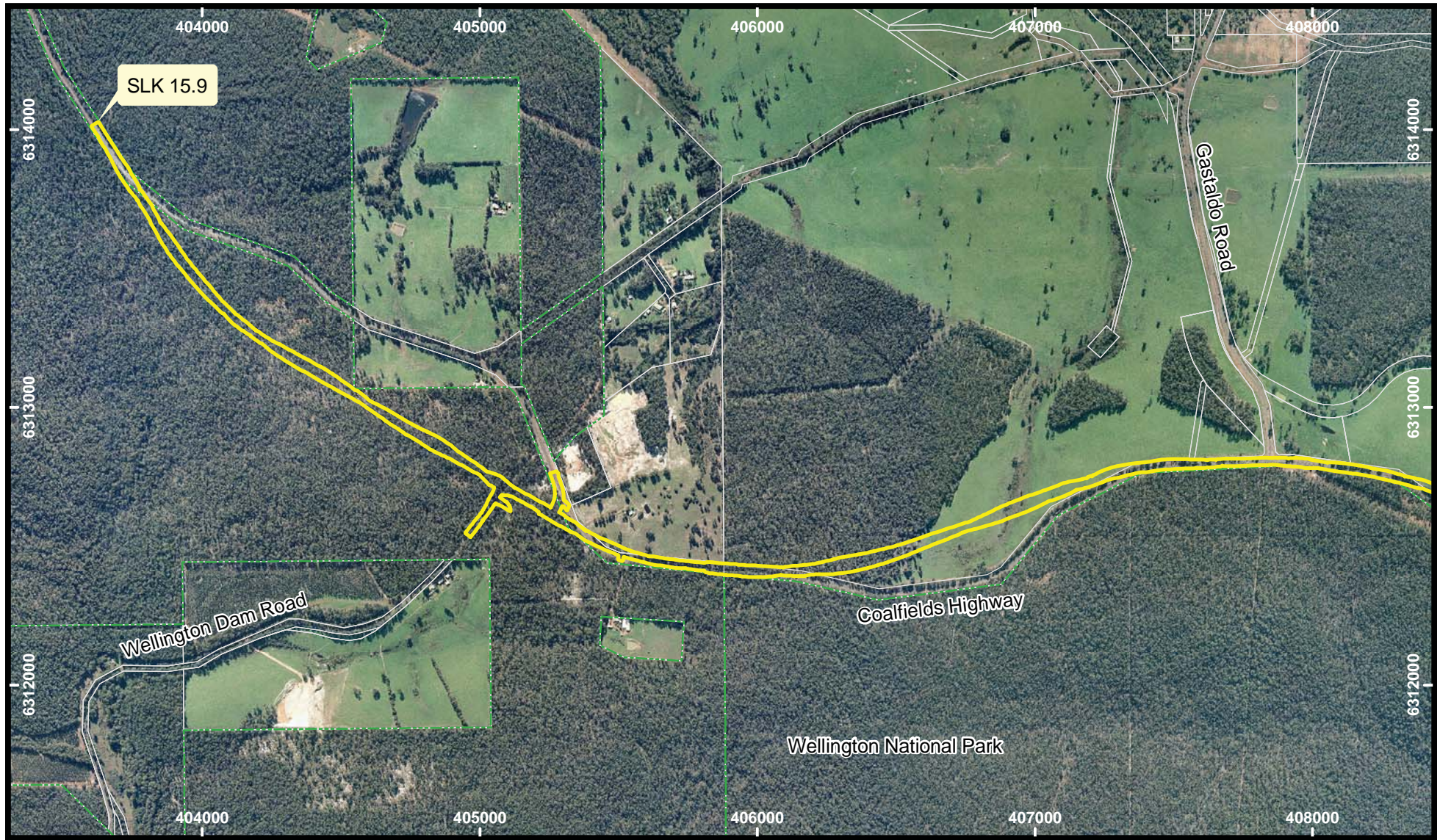
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DATE : Feb 2013

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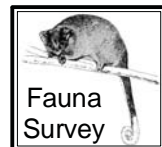
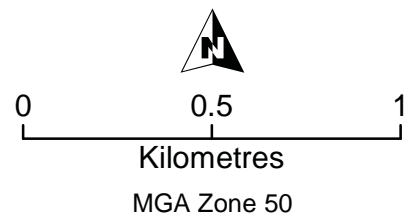
Coalfields Highway
Realignment
(15.9 SLK to 26.3 SLK)

**Study Area
and Surrounds**



Legend

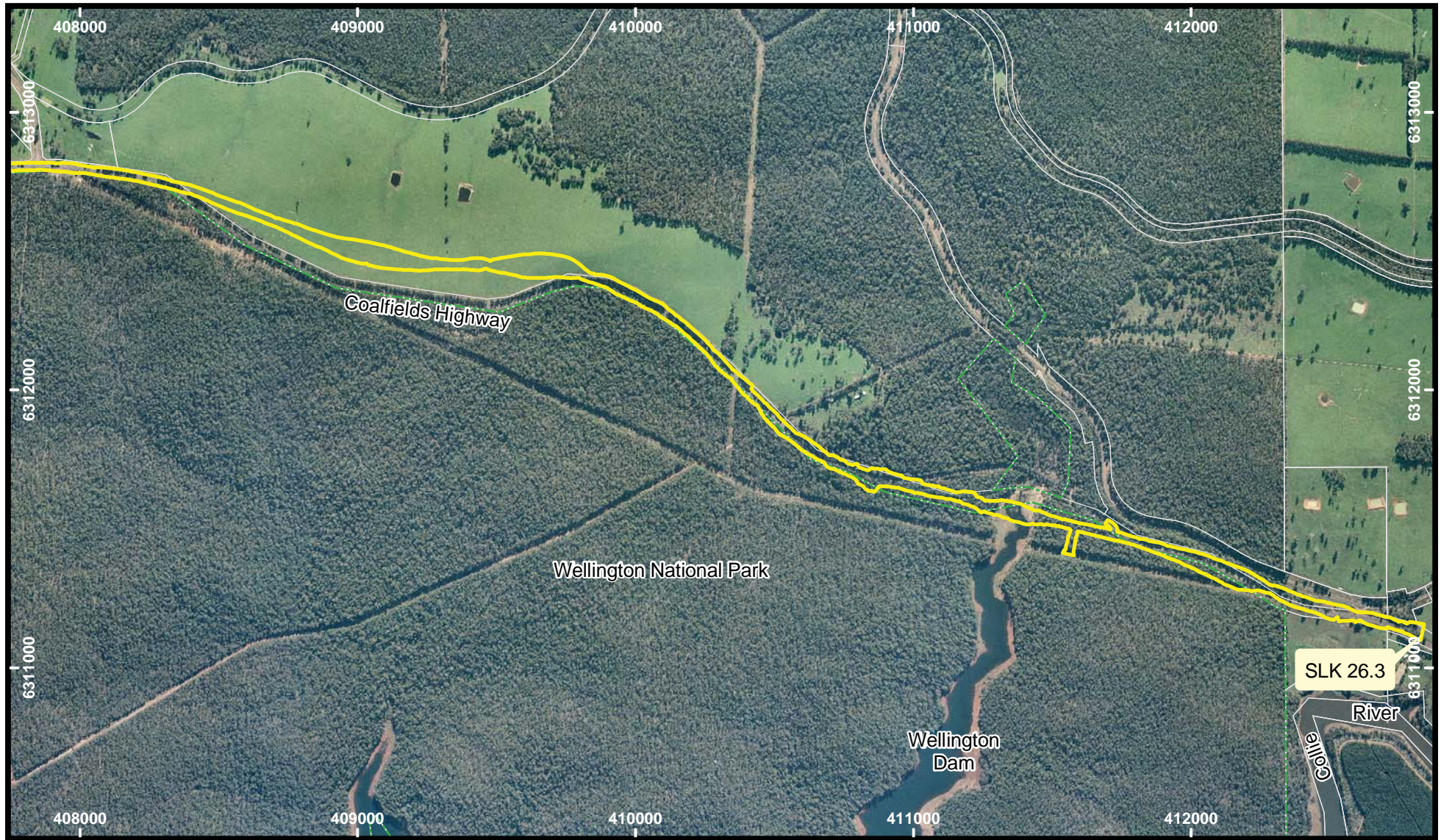
 Study Area/Works Footprint



DRAWN: G Harewood
 DATE : Mar 2013
 SCALE: 1:20,000

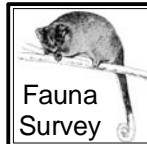
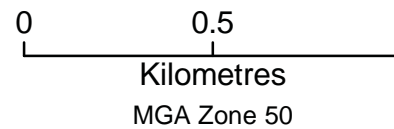
**Coalfields Highway
 Realignment
 (15.9 SLK to 26.3 SLK)
 Study Area
 Air Photo
 (west)**

Figure: 2a



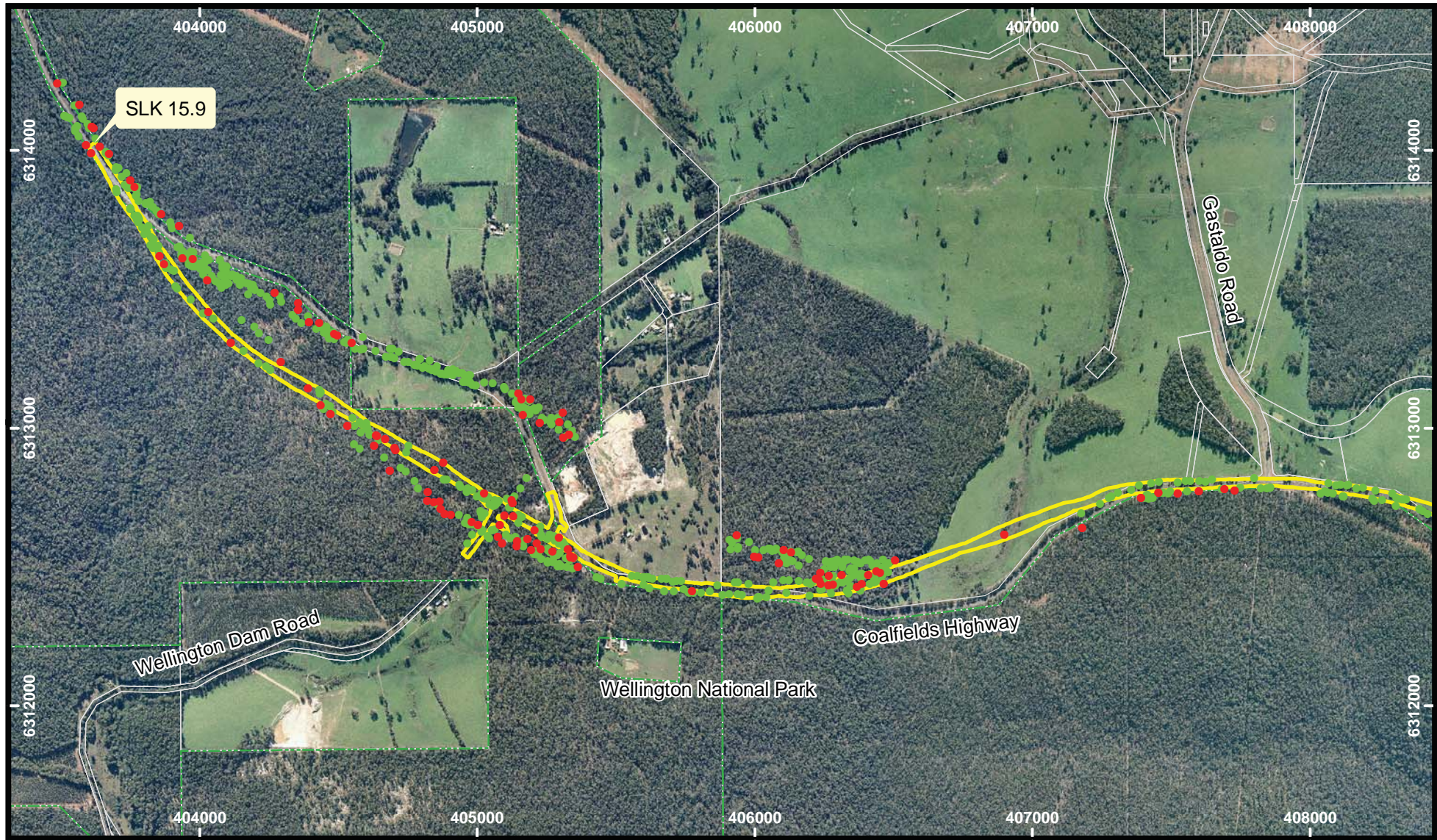
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 Study Area/Works Footprint



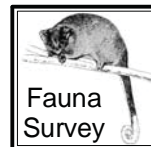
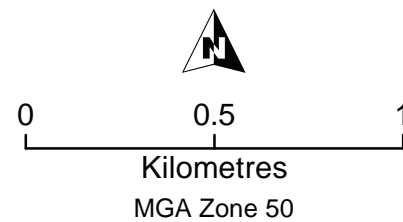
DRAWN: G Harewood
 DATE: Feb 2013
 SCALE: 1:20,000

**Coalfields Highway
 Realignment
 (15.9 SLK to 26.3 SLK)
 Study Area
 Air Photo
 (east)**



Legend

- Study Area/Works Footprint
- Creek Crossings
- >50cm DBH - One or more hollows seen
- >50cm DBH - No hollows seen

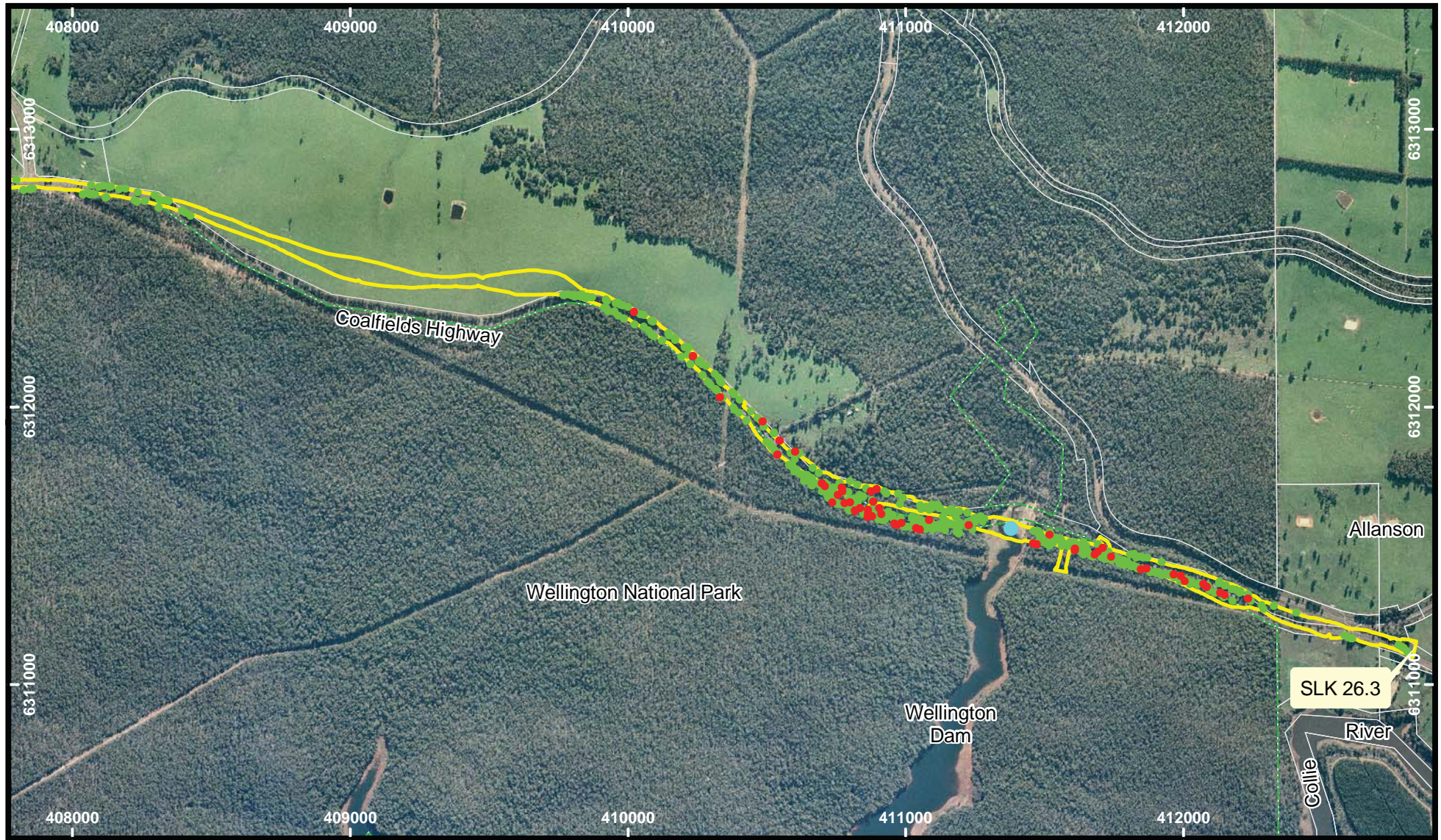


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**Coalfields Highway
 Realignment
 (15.9 SLK to 26.3 SLK)**

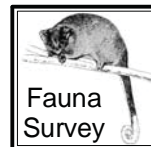
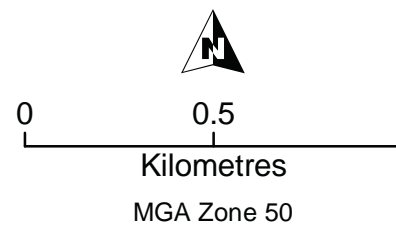
**Habitat Trees
 (west)**

Figure: 3a



Legend

- Study Area/Works Footprint
- Creek Crossings
- >50cm DBH - One or more hollows seen
- >50cm DBH - No hollows seen



DRAWN: G Harewood
 DATE : Mar 2013
 SCALE: 1:20,000

**Coalfields Highway
 Realignment
 (15.9 SLK to 26.3 SLK)**
**Habitat Trees
 (east)**

PLATES





Plate 1: Open forest to woodland of Jarrah and Marri over low open shrubland.



Plate 2: Open woodland of Jarrah and Marri over low woodland of Sheoak and Banksia over shrubland/open heath.



Plate 3: Open forest of Blackbutt, Jarrah and Marri over open heath.



Plate 4: Cleared Paddocks with scattered trees and degraded ephemeral stream.



Plate 5: Open Woodland over low open shrubland.



Plate 6: Cleared ephemeral creek that forms part of Wellington Dam when flooded.

APPENDIX A

CONSERVATION CATEGORIES

EPBC Act (1999) Threatened Fauna Categories

Category	Code	Description
Extinct	E	There is no reasonable doubt that the last member of the species has died.
*Extinct in the wild	EW	A species (a) is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
*Critically endangered	CE	A species is facing an extremely high risk of extinction in the wild in the immediate future.
*Endangered	EN	A species: (a) is not critically endangered; and (b) is facing a very high risk of extinction in the wild in the near future.
*Vulnerable	VU	A species (a) is not critically endangered or endangered; and (b) is facing a high risk of extinction in the wild in the medium-term future.
Conservation dependent	CD	A species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered
*Migratory	Migratory	(a) all migratory species that are: (i) native species; and (ii) from time to time included in the appendices to the Bonn Convention; and (b) all migratory species from time to time included in annexes established under JAMBA, CAMBA and ROKAMBA; and (c) all native species from time to time identified in a list established under, or an instrument made under, an international agreement approved by the Minister.
Marine	Ma	Species in the list established under s248 of the EPBC Act

Note: Only species in those categories marked with an asterisk are matters of national environmental significance under the *EPBC Act*.

Western Australian Wildlife Conservation Act (1950) Threatened Fauna Categories

Category	Code	Description
Schedule 1	S1	Fauna which is rare or likely to become extinct
Schedule 2	S2	Fauna which is presumed extinct
Schedule 3	S3	Birds which are subject to an agreement between the governments of Australia and Japan (JAMBA) relating to the protection of migratory birds and birds in danger of extinction
Schedule 4	S4	Fauna that is otherwise in need of special protection

Note: The *WC Act* also uses the categories defined by the *EPBC Act* to further define the status of species in the S1 category.

Western Australian DEC Priority Fauna Categories

Category	Code	Description
Priority 1	P1	Taxa with few, poorly known populations on threatened lands.
Priority 2	P2	Taxa with few, poorly known populations on conservation lands.
Priority 3	P3	Taxa with several, poorly known populations, some on conservation lands.
Priority 4	P4	Taxa in need of monitoring (Not currently threatened or in need of special protection, but could be if present circumstances change)
Priority 5	P5	Taxa in need of monitoring (Not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years)

IUCN Red List Threatened Species Categories

Category	Code	Description
Extinct	EX	Taxa for which there is no reasonable doubt that the last individual has died.
Extinct in the Wild	EW	Taxa which is known only to survive in cultivation, in captivity or and as a naturalised population well outside its past range and it has not been recorded in known or expected habitat despite exhaustive survey over a time frame appropriate to its life cycle and form.
Critically Endangered	CR	Taxa facing an extremely high risk of extinction in the wild.
Endangered	EN	Taxa facing a very high risk of extinction in the wild.
Vulnerable	VU	Taxa facing a high risk of extinction in the wild.
Near Threatened	NT	Taxa which has been evaluated but does not qualify for CR, EN or VU now but is close to qualifying or likely to qualify in the near future.
Least Concern	LC	Taxa which has been evaluated but does not qualify for CR, EN, VU, or NT but is likely to qualify for NT in the near future.
Data Deficient	DD	Taxa for which there is inadequate information to make a direct or indirect assessment of its risk of extinction based on its distribution and/or population status.

A full list of categories and their meanings are available at:

http://www.iucnredlist.org/info/categories_criteria2001#categories

APPENDIX B

FAUNA OBSERVED OR POTENTIALLY IN STUDY AREA

Fauna Observed or Potentially in Study Area

Coalfields Highway (SLK 15.9 to 26.3), Allanson, W.A. Approx Centroid 33.32316°S and 116.02349°E

Compiled by Greg Harewood - Feb 2013

Harewood, G. (2012). Fauna Assessment Coalfields Highway Realignment (SLK 16 to 28), Allanson. Unpublished report for RPS.

Recorded (Trapped/Sighted/Heard/Signs) = X

Harewood, G. (2010). Fauna Survey (Level 2) Buckingham Way Collie Residential Development. Unpublished report for Stategen.

Bancroft, W. and Bamford, M. (2006). Fauna Survey of the Muja South Extension Project. Unpublished report for Griffin Coal.

Maunsell Australia Pty Ltd (2003). Bluewater's Power Station Flora and Fauna Survey. Unpublished report for Griffin Energy. (Predicted Species List based on HGM 1994/2002 and ecologia 1991)

DEC (2013). NatureMap Database search. "By Circle" 116°01' 24" E,33°19' 23" S – Collie Area (plus 20km buffer). 1 Feb 2013.

Class Family Species	Common Name	Conservation Status	Harewood (12) Coalfields Hwy	Harewood (10) Collie	Bancroft and Bamford. (06) Muja	Maunsell (03) Bluewaters et al	DEC ('13)
Fish							
Percichthyidae Basses and Cods							
<i>Bostockia porosa</i>	Nightfish						
Galaxiidae Galaxiids							
<i>Galaxias occidentalis</i>	Western Minnow						X
Nannopercidae Pygmy Perches							
<i>Edelia vittata</i>	Western Pygmy Perch						X
Pecidae Perches							
<i>Perca fluviatilis</i>	Redfin Perch	Introduced					

WC Act Status - S1 to S4, EPBC Act Status - EN = Endangered, VU = Vulnerable, EX = Extinct, Mig = Migratory, DEC Priority Status - P1 to P5, Int. Agmts - CA = CAMBA, JA = JAMBA, RK = ROKAMBA, Bush Forever Decreaser Species - Bh = habitat specialists, Bp = wide ranging species, Be = extinct in Perth Coastal Plain Region. IUCN Red List Category Definitions see Appendix and <http://www.iucnredlist.org/technical-documents/categories-and-criteria/2001-categories-criteria>

Class Family Species	Common Name	Conservation Status	Harewood (12) Coalfields Hwy	Harewood (10) Collie	Bancroft and Bamford. (06) Muja	Maunsell (03) Bluewaters et al	DEC (13)
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Poeciliidae

Livebearers

<i>Gambusia holbrooki</i>	Mosquito Fish	Introduced					
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Salmonidae

Trout and Salmon

<i>Oncorhynchus mykiss</i>	Rainbow Trout	Introduced					
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<i>Salmo trutta</i>	Brown Trout	Introduced					
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Amphibians

Myobatrachidae

Ground or Burrowing Frogs

<i>Crinia georgiana</i>	Quacking Frog	LC			X	X	X
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<i>Crinia glauerti</i>	Glauert's Froglet	LC			X	X	X
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<i>Crinia pseudinsignifera</i>	Bleating Froglet	LC			X	X	X
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<i>Geocrinia leai</i>	Lea's Frog	LC				X	X
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<i>Heleioporus eyrei</i>	Moaning Frog	LC			X	X	X
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<i>Limnodynastes dorsalis</i>	Banjo Frog	LC			X	X	X
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<i>Pseudophryne guentheri</i>	Güenther's Toadlet	LC			X		
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WC Act Status - S1 to S4, EPBC Act Status - EN = Endangered, VU = Vulnerable, EX = Extinct, Mig = Migratory, DEC Priority Status - P1 to P5, Int. Agmts - CA = CAMBA, JA = JAMBA, RK = ROKAMBA, Bush Forever Decreaser Species - Bh = habitat specialists, Bp = wide ranging species, Be = extinct in Perth Coastal Plain Region. IUCN Red List Category Definitions see Appendix and <http://www.iucnredlist.org/technical-documents/categories-and-criteria/2001-categories-criteria>

Class Family Species	Common Name	Conservation Status	Harewood (^{'12}) Coalfields Hwy	Harewood (^{'10}) Collie	Bancroft and Bamford. (^{'06}) Muja	Maunsell (^{'03}) Bluewaters et al	DEC (^{'13})
Hylidae							
Tree or Water-Holding Frogs							
<i>Litoria adelaidensis</i>	Slender Tree Frog	LC			X	X	
<i>Litoria moorei</i>	Motorbike Frog	LC			X	X	X
Reptiles							
Chelidae							
Side-necked Tortoises							
<i>Chelodina oblonga</i>	Long-necked Tortoise	LC			X	X	
Gekkonidae							
Geckoes							
<i>Christinus marmoratus</i>	Marbled Gecko					X	X
<i>Crenadactylus ocellatus ocellatus</i>	Southwestern Clawless Gecko					X	
<i>Diplodactylus polyophthalmus</i>	Speckled Stone Gecko					X	X
<i>Underwoodisaurus milii</i>	Barking Gecko					X	

WC Act Status - S1 to S4, EPBC Act Status - EN = Endangered, VU = Vulnerable, EX = Extinct, Mig = Migratory, DEC Priority Status - P1 to P5, Int. Agmts - CA = CAMBA, JA = JAMBA, RK = ROKAMBA, Bush Forever Decreaser Species - Bh = habitat specialists, Bp = wide ranging species, Be = extinct in Perth Coastal Plain Region. IUCN Red List Category Definitions see Appendix and <http://www.iucnredlist.org/technical-documents/categories-and-criteria/2001-categories-criteria>

Class Family Species	Common Name	Conservation Status	Harewood (^{'12}) Coalfields Hwy	Harewood (^{'10}) Collie	Bancroft and Bamford. (^{'06}) Muja	Maunsell (^{'03}) Bluewaters et al	DEC (^{'13})
Pygopodidae Legless Lizards							
<i>Aprasia pulchella</i>	Pretty Worm Lizard				X	X	X
<i>Aprasia repens</i>	Sand-plain Worm Lizard				X	X	X
<i>Delma fraseri</i>	Fraser's Delma					X	
<i>Lialis burtonis</i>	Common Snake Lizard					X	
<i>Pygopus lepidopodus</i>	Southern Scaleyfoot					X	
Agamidae Dragon Lizards							
<i>Pogona minor</i>	Western Bearded Dragon				X	X	X
Varanidae Monitor's or Goanna's							
<i>Varanus gouldii</i>	Gould's Sand Monitor				X	X	X
<i>Varanus rosenbergi</i>	Heath Monitor				X	X	X

WC Act Status - S1 to S4, EPBC Act Status - EN = Endangered, VU = Vulnerable, EX = Extinct, Mig = Migratory, DEC Priority Status - P1 to P5, Int. Agmts - CA = CAMBA, JA = JAMBA, RK = ROKAMBA, Bush Forever Decreaser Species - Bh = habitat specialists, Bp = wide ranging species, Be = extinct in Perth Coastal Plain Region. IUCN Red List Category Definitions see Appendix and <http://www.iucnredlist.org/technical-documents/categories-and-criteria/2001-categories-criteria>

Class Family Species	Common Name	Conservation Status	Harewood (^{'12}) Coalfields Hwy	Harewood (^{'10}) Collie	Bancroft and Bamford. (^{'06}) Muja	Maunsell (^{'03}) Bluewaters et al	DEC (^{'13})
Scincidae							
Skinks							
<i>Acritoscincus trilineatum</i>	South-western Cool Skink				X	X	X
<i>Cryptoblepharus buchananii</i>	Fence Skink		X		X	X	X
<i>Ctenotus catenifer</i>	Chain-striped Heath Ctenotus						
<i>Ctenotus delli</i>	Dell's Skink	P4				X	
<i>Ctenotus fallens</i>	West Coast Ctenotus					X	
<i>Ctenotus impar</i>	South-western Odd-striped Ctenotus				X	X	X
<i>Ctenotus labillardieri</i>	Red-legged Skink					X	X
<i>Egernia kingii</i>	King's Skink					X	
<i>Egernia napoleonis</i>	Salmon-bellied Skink		X		X	X	X
<i>Egernia pulchra</i>	Spectacled Rock Skink					X	
<i>Hemiergis gracilipes</i>	Southwestern Mulch Skink					X	X
<i>Hemiergis initialis</i>	Five-toed Earless Skink					X	X
<i>Hemiergis peronii peronii</i>	Four-toed Mulch Skink					X	

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<i>Lerista distinguenda</i>	South-western Four-toed Lerista		X		X	X	X
<i>Lerista microtis microtis</i>	Southwestern Five-toed Lerista					X	X
<i>Menetia greyii</i>	Dwarf Skink				X	X	X
<i>Morethia obscura</i>	Dusky Morethia		X		X	X	X
<i>Tiliqua rugosa rugosa</i>	Western Bobtail		X	X	X	X	X
Typhlopidae							
Blind Snakes							
<i>Ramphotyphlops australis</i>	Southern Blind Snake				X	X	X
Boidae							
Pythons, Boas							
<i>Morelia spilota imbricata</i>	Southern Carpet Python	S4 P4 NT				X	X

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Elapidae Elapid Snakes							
<i>Echiopsis curta</i>	Bardick						X
<i>Elapognathus coronatus</i>	Crowned Snake						X
<i>Neelaps bimaculatus</i>	Black-naped Snake						
<i>Notechis scutatus</i>	Tiger Snake				X	X	X
<i>Parasuta gouldii</i>	Gould's Hooded Snake				X	X	X
<i>Parasuta nigriceps</i>	Black-backed Snake						X
<i>Pseudonaja affinis</i>	Dugite				X	X	X
<i>Simoselaps bertholdi</i>	Jan`s Banded Snake					X	X
Birds							
Casuariidae Emus, Cassowaries							
<i>Dromaius novaehollandiae</i>	Emu	Bp LC					X

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Phasianidae							
Quails, Pheasants							
<i>Coturnix pectoralis</i>	Stubble Quail	LC					X
<i>Coturnix ypsilophora</i>	Brown Quail	LC			X		
Anatidae							
Geese, Swans, Ducks							
<i>Anas gracilis</i>	Grey Teal	LC			X	X	X
<i>Anas superciliosa</i>	Pacific Black Duck	LC			X	X	X
<i>Chenonetta jubata</i>	Australian Wood Duck	LC			X	X	X
<i>Tadorna tadornoides</i>	Australian Shelduck	LC			X	X	X
Phalacrocoracidae							
Cormorants							
<i>Phalacrocorax melanoleucos</i>	Little Pied Cormorant	LC				X	
<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant	LC					X

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Ardeidae Herons, Egrets, Bitterns							
<i>Ardea alba</i>	Great Egret	S3 Mig CA JA					
<i>Ardea ibis</i>	Cattle Egret	S3 Mig CA JA					
<i>Ardea pacifica</i>	White-necked Heron	LC			X	X	
<i>Egretta novaehollandiae</i>	White-faced Heron	LC			X	X	
Threskiornithidae Ibises, Spoonbills							
<i>Threskiornis molucca</i>	Australian White Ibis	LC					X
<i>Threskiornis spinicollis</i>	Straw-necked Ibis	LC					X

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Accipitridae							
Kites, Goshawks, Eagles, Harriers							
<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk	Bp LC	X		X	X	
<i>Accipiter fasciatus</i>	Brown Goshawk	Bp LC			X	X	
<i>Aquila audax</i>	Wedge-tailed Eagle	Bp LC	X		X	X	X
<i>Aquila morphnoides</i>	Little Eagle	Bp LC	X		X	X	
<i>Circus approximans</i>	Swamp Harrier	LC			X	X	
<i>Elanus caeruleus</i>	Black-shouldered Kite	LC	X			X	X
<i>Haliastur sphenurus</i>	Whistling Kite	Bp LC				X	X
<i>Hamirostra isura</i>	Square-tailed Kite	Bp LC				X	
Falconidae							
Falcons							
<i>Falco berigora</i>	Brown Falcon	Bp LC			X	X	X
<i>Falco cenchroides</i>	Australian Kestrel	LC			X	X	X
<i>Falco longipennis</i>	Australian Hobby	LC				X	
<i>Falco peregrinus</i>	Peregrine Falcon	S4 Bp LC				X	X

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Turnicidae Button-quails							
<i>Turnix varia</i>	Painted Button-quail	Bp LC				X	X
Charadriidae Lapwings, Plovers, Dotterels							
<i>Charadrius melanops</i>	Black-fronted Dotterel				X	X	
<i>Vanellus tricolor</i>	Banded Lapwing	LC			X	X	
Columbidae Pigeons, Doves							
<i>Columba livia</i>	Domestic Pigeon	Introduced					
<i>Ocyphaps lophotes</i>	Crested Pigeon	LC			X		
<i>Phaps chalcoptera</i>	Common Bronzewing	Bh LC	X	X	X	X	X
<i>Streptopelia senegalensis</i>	Laughing Turtle-Dove	Introduced					X

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Cacatuidae							
Cockatoos, Corellas							
<i>Calyptorhynchus banksii naso</i>	Forest Red-tailed Black Cockatoo	S1 VU Be LC	X	X	X	X	X
<i>Calyptorhynchus baudinii</i>	Baudin`s Black Cockatoo	S1 EN Bp EN C2a(ii)	X	X		X	X
<i>Calyptorhynchus latirostris</i>	Carnaby`s Black Cockatoo	S1 EN Bp EN A2bcd+3bcd	X		X	X	X
<i>Eolophus roseicapilla</i>	Galah	LC		X			X
Psittacidae							
Parrots							
<i>Glossopsitta porphyrocephala</i>	Purple-crowned Lorikeet	LC			X	X	X
<i>Neophema elegans</i>	Elegant Parrot	LC			X	X	X
<i>Platycercus icterotis icterotis</i>	Western Rosella (Western ssp)	Bp LC	X			X	X
<i>Platycercus spurius</i>	Red-capped Parrot	LC		X	X	X	X
<i>Platycercus zonarius</i>	Australian Ringneck Parrot	LC	X	X	X	X	X
<i>Polytelis anthopeplus</i>	Regent Parrot	LC					X

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Cuculidae Parasitic Cuckoos							
<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo	LC			X	X	X
<i>Chrysococcyx basalis</i>	Horsfield's Bronze Cuckoo	LC			X	X	
<i>Chrysococcyx lucidus</i>	Shining Bronze Cuckoo	LC		X	X	X	X
<i>Cuculus pallidus</i>	Pallid Cuckoo	LC			X	X	
Strigidae Hawk Owls							
<i>Ninox novaeseelandiae</i>	Boobook Owl	LC	X			X	X
Tytonidae Barn Owls							
<i>Tyto alba</i>	Barn Owl	LC				X	
<i>Tyto n. novaehollandiae</i>	Masked Owl (SW population)	P3 Bp					
Podargidae Frogmouths							
<i>Podargus strigoides</i>	Tawny Frogmouth	LC			X	X	X

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Aegothelidae Owlet-nightjars							
<i>Aegotheles cristatus</i>	Australian Owlet-nightjar	LC			X	X	
Halcyonidae Tree Kingfishers							
<i>Dacelo novaeguineae</i>	Laughing Kookaburra	Introduced	X	X	X	X	X
<i>Todiramphus sanctus</i>	Sacred Kingfisher	LC			X	X	X
Meropidae Bee-eaters							
<i>Merops ornatus</i>	Rainbow Bee-eater	S3 Mig JA LC	X		X	X	X
Climacteridae Treecreepers							
<i>Climacteris rufa</i>	Rufous Treecreeper	Bh	X			X	X
Maluridae Fairy Wrens, GrassWrens							
<i>Malurus elegans</i>	Red-winged Fairy-wren	Be LC	X	X		X	X
<i>Malurus splendens</i>	Splendid Fairy-wren	Bh LC	X		X	X	X

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Pardalotidae							
Pardalotes, Bristlebirds, Scrubwrens, Gerygones, Thornbills							
<i>Acanthiza apicalis</i>	Broad-tailed Thornbill	Bh LC	X	X	X	X	X
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill	Bh LC	X		X	X	X
<i>Acanthiza inornata</i>	Western Thornbill	Bh LC	X	X	X	X	X
<i>Gerygone fusca</i>	Western Gerygone	LC	X	X	X	X	X
<i>Pardalotus punctatus</i>	Spotted Pardalote	LC		X	X	X	X
<i>Pardalotus striatus</i>	Striated Pardalote	LC		X	X	X	X
<i>Sericornis frontalis</i>	White-browed Scrubwren	Bh LC	X		X	X	X
<i>Smicrornis brevirostris</i>	Weebill	Bh LC		X	X	X	X

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Meliphagidae							
Honeyeaters, Chats							
<i>Acanthorhynchus superciliosus</i>	Western Spinebill	LC	X	X	X	X	X
<i>Anthochaera carunculata</i>	Red Wattlebird	LC	X	X	X	X	X
<i>Anthochaera lunulata</i>	Western Little Wattlebird	Bp			X	X	X
<i>Epthianura albifrons</i>	White-fronted Chat	LC			X	X	X
<i>Lichenostomus ornatus</i>	Yellow-plumed Honeyeater	Bh LC					
<i>Lichenostomus virescens</i>	Singing Honeyeater	LC			X	X	X
<i>Lichmera indistincta</i>	Brown Honeyeater	LC	X	X	X	X	X
<i>Manorina flavigula</i>	Yellow-throated Miner	Bp LC				X	
<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater	LC					X
<i>Melithreptus chloropsis</i>	Western White-naped Honeyeater	LC	X			X	
<i>Phylidonyris nigra</i>	White-cheeked Honeyeater	Bp LC				X	
<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater	Bp LC		X	X	X	X

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Petroicidae Australian Robins							
<i>Eopsaltria australis</i>	Western Yellow Robin	Bh LC	X		X	X	
<i>Eopsaltria georgiana</i>	White-breasted Robin	Bh LC	X		X		X
<i>Microeca fascinans</i>	Jacky Winter	LC					
<i>Petroica goodenovii</i>	Red-capped Robin	LC				X	X
<i>Petroica multicolor</i>	Scarlet Robin	Bh LC	X	X	X	X	X
Neosittidae Sitellas							
<i>Daphoenositta chrysoptera</i>	Varied Sittella	Bh LC	X	X	X	X	X
Pachycephalidae Crested Shrike-tit, Crested Bellbird, Shrike Thrushes, Whistlers							
<i>Colluricincla harmonica</i>	Grey Shrike-thrush	Bh LC	X		X	X	X
<i>Pachycephala pectoralis</i>	Golden Whistler	Bh LC	X	X	X	X	X
<i>Pachycephala rufiventris</i>	Rufous Whistler	LC		X	X	X	X

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Dicruridae							
Monarchs, Magpie Lark, Flycatchers, Fantails, Drongo							
<i>Grallina cyanoleuca</i>	Magpie-lark	LC	X	X	X	X	X
<i>Rhipidura fuliginosa</i>	Grey Fantail	LC	X	X	X	X	X
<i>Rhipidura leucophrys</i>	Willie Wagtail	LC	X	X	X	X	X
Campephagidae							
Cuckoo-shrikes, Trillers							
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	LC	X	X	X	X	X
<i>Lalage sueurii</i>	White-winged Triller	LC				X	
Artamidae							
Woodswallows, Butcherbirds, Currawongs							
<i>Artamus cinereus</i>	Black-faced Woodswallow	Bp LC					X
<i>Artamus cyanopterus</i>	Dusky Woodswallow	Bp LC	X		X	X	X
<i>Cracticus tibicen</i>	Australian Magpie	LC	X	X	X	X	X
<i>Cracticus torquatus</i>	Grey Butcherbird	LC	X	X	X	X	X
<i>Strepera versicolor</i>	Grey Currawong	Bp LC			X	X	X

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Corvidae Ravens, Crows							
<i>Corvus coronoides</i>	Australian Raven	LC	X	X	X	X	X
Motacillidae Old World Pipits, Wagtails							
<i>Anthus novaeseelandiae</i>	Australian Pipit	LC			X	X	
Dicaeidae Flowerpeckers							
<i>Dicaeum hirundinaceum</i>	Mistletoebird	LC				X	
Hirundinidae Swallows, Martins							
<i>Hirundo neoxena</i>	Welcome Swallow	LC			X	X	X
<i>Hirundo nigricans</i>	Tree Martin	LC	X		X	X	
Sylviidae Old World Warblers							
<i>Cincloramphus cruralis</i>	Brown Songlark	LC					
<i>Cincloramphus mathewsi</i>	Rufous Songlark	LC					

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Zosteropidae White-eyes							
<i>Zosterops lateralis</i>	Grey-breasted White-eye	LC	X	X	X	X	X
Mammals							
Tachyglossidae Echidnas							
<i>Tachyglossus aculeatus</i>	Echidna	LC			X	X	
Dasyuridae Carnivorous Marsupials							
<i>Antechinus flavipes</i>	Yellow-footed Antechinus, Mardo	LC			X	X	X
<i>Dasyurus geoffroii</i>	Chuditch	S1 VU VU C1			X	X	X
<i>Phascogale tapoatafa ssp</i>	Southern Brush-tailed Phascogale	S1 NT				X	X
<i>Sminthopsis gilberti</i>	Gilbert's Dunnart	LC			X	X	X
Peramelidae Bandicoots							
<i>Isodon obesulus fusciventer</i>	Southern Brown Bandicoot	P5 LC			X	X	X
Phalangeridae Brush-tail Possums, Cuscuses							
<i>Trichosurus vulpecula</i>	Common Brushtail Possum	LC	X	X	X	X	X

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Burramyidae Pygmy Possums							
<i>Cercartetus concinnus</i>	Western Pygmy-possum	LC				X	X
Tarsipedidae Honey Possum							
<i>Tarsipes rostratus</i>	Honey Possum	LC				X	
Pseudocheiridae Ringtail Possums							
<i>Pseudocheirus occidentalis</i>	Western Ringtail Possum	S1 VU VU C2a				X	X
Potoroidae Potoroos, Bettongs							
<i>Bettongia penicillata ogilbyi</i>	Brush-tailed Bettong, Woylie	S1 EN EN LR/CD					
Macropodidae Kangaroos, Wallabies							
<i>Macropus fuliginosus</i>	Western Grey Kangaroo	LC	X	X	X	X	X
<i>Macropus irma</i>	Western Brush Wallaby	P4 LR/NT			X	X	X

WC Act Status - S1 to S4, EPBC Act Status - EN = Endangered, VU = Vulnerable, EX = Extinct, Mig = Migratory, DEC Priority Status - P1 to P5, Int. Agmts - CA = CAMBA, JA = JAMBA, RK = ROKAMBA, Bush Forever Decreaser Species - Bh = habitat specialists, Bp = wide ranging species, Be = extinct in Perth Coastal Plain Region. IUCN Red List Category Definitions see Appendix and <http://www.iucnredlist.org/technical-documents/categories-and-criteria/2001-categories-criteria>

Class Family Species	Common Name	Conservation Status	Harewood (^{'12}) Coalfields Hwy	Harewood (^{'10}) Collie	Bancroft and Bamford. (^{'06}) Muja	Maunsell (^{'03}) Bluewaters et al	DEC (^{'13})
Molossidae							
Freetail Bats							
<i>Mormopterus planiceps</i>	Western Freetail Bat	LC		X	X	X	
<i>Tadarida australis</i>	White-striped Freetail-bat	LC		X		X	X
Vespertilionidae							
Ordinary Bats							
<i>Chalinolobus gouldii</i>	Gould`s Wattled Bat	LC		X	X	X	X
<i>Chalinolobus morio</i>	Chocolate Wattled Bat	LC		X		X	X
<i>Falsistrellus mackenziei</i>	Western False Pipistrelle	P4 VU A2c		X		X	X
<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat	LC		X	X	X	X
<i>Nyctophilus gouldi</i>	Gould`s Long-eared Bat	LC					X
<i>Nyctophilus major</i>	Western Long-eared Bat	DD				X	
<i>Vespadelus regulus</i>	Southern Forest Bat	LC		X	X	X	X

WC Act Status - S1 to S4, EPBC Act Status - EN = Endangered, VU = Vulnerable, EX = Extinct, Mig = Migratory, DEC Priority Status - P1 to P5, Int. Agmts - CA = CAMBA, JA = JAMBA, RK = ROKAMBA, Bush Forever Decreaser Species - Bh = habitat specialists, Bp = wide ranging species, Be = extinct in Perth Coastal Plain Region. IUCN Red List Category Definitions see Appendix and <http://www.iucnredlist.org/technical-documents/categories-and-criteria/2001-categories-criteria>

Class Family Species	Common Name	Conservation Status	Harewood (12) Coalfields Hwy	Harewood (10) Collie	Bancroft and Bamford. (06) Muja	Maunsell (03) Bluewaters et al	DEC (13)
Muridae Rats, Mice							
<i>Hydromys chrysogaster</i>	Water Rat	P4 LC					X
<i>Mus musculus</i>	House Mouse	Introduced			X	X	X
<i>Rattus fuscipes</i>	Western Bush Rat	LC				X	
<i>Rattus rattus</i>	Black Rat	Introduced				X	
Canidae Dogs, Foxes							
<i>Canis lupus</i>	Dog	Introduced		X	X		X
<i>Vulpes vulpes</i>	Red Fox	Introduced		X	X	X	X
Felidae Cats							
<i>Felis catus</i>	Cat	Introduced		X		X	X
Suidae Pigs							
<i>Sus scrofa</i>	Pig	Introduced				X	

WC Act Status - S1 to S4, EPBC Act Status - EN = Endangered, VU = Vulnerable, EX = Extinct, Mig = Migratory, DEC Priority Status - P1 to P5, Int. Agmts - CA = CAMBA, JA = JAMBA, RK = ROKAMBA, Bush Forever Decreaser Species - Bh = habitat specialists, Bp = wide ranging species, Be = extinct in Perth Coastal Plain Region. IUCN Red List Category Definitions see Appendix and <http://www.iucnredlist.org/technical-documents/categories-and-criteria/2001-categories-criteria>

Class Family Species	Common Name	Conservation Status	Harewood (^{'12}) Coalfields Hwy	Harewood (^{'10}) Collie	Bancroft and Bamford. (^{'06}) Muja	Maunsell (^{'03}) Bluewaters et al	DEC (^{'13})
Leporidae Rabbits, Hares							
<i>Oryctolagus cuniculus</i>	Rabbit	Introduced	X		X	X	

WC Act Status - S1 to S4, EPBC Act Status - EN = Endangered, VU = Vulnerable, EX = Extinct, Mig = Migratory, DEC Priority Status - P1 to P5, Int. Agmts - CA = CAMBA, JA = JAMBA, RK = ROKAMBA, Bush Forever Decreaser Species - Bh = habitat specialists, Bp = wide ranging species, Be = extinct in Perth Coastal Plain Region. IUCN Red List Category Definitions see Appendix and <http://www.iucnredlist.org/technical-documents/categories-and-criteria/2001-categories-criteria>

APPENDIX C

NATUREMAP & EPBC DATABASE SEARCH RESULTS

NatureMap - Invertebrates - Collie

Created By Greg Harewood on 01/02/2013

Kingdom Animalia
Current Names Only Yes
Core Datasets Only Yes
Species Group Invertebrates
Method 'By Circle'
Centre 116°01' 23" E,33°19' 23" S
Buffer 20km

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
1.	-14144 <i>Aname mainae</i>			
2.	-13324 <i>Aname tepperi</i>			
3.	-14278 <i>Antichiropus variabilis</i>			
4.	-14516 <i>Aponomma fimbriatum</i>			
5.	-13868 <i>Artorioopsis expolita</i>			
6.	33972 <i>Austromerope poultoni</i> (scorpionfly)		P2	
7.	-14139 <i>Baiami tegenarioides</i>			
8.	-14764 <i>Ballarra longipalpus</i>			
9.	-14766 <i>Cercophonius sulcatus</i>			
10.	33939 <i>Cherax cainii</i> (Marron)			
11.	33940 <i>Cherax tenuimanus</i> (Margaret River Marron, Hairy Marron)		T	
12.	-14150 <i>Cormocephalus aurantiipes</i>			
13.	-14371 <i>Cormocephalus strigosus</i>			
14.	-13563 <i>Dingosa serrata</i>			
15.	-14762 <i>Eriophora biapicata</i>			
16.	-14369 <i>Ethmostigmus rubripes</i>			
17.	-14649 <i>Heurodes turritus</i>			
18.	-14540 <i>Hoggicosa storri</i>			
19.	-14140 <i>Isopeda leishmanni</i>			
20.	-13940 <i>Lagynochthonius australicus</i>			
21.	-14078 <i>Lampona brevipes</i>			
22.	-14799 <i>Missulena granulosa</i> subsp. <i>hoggi</i>			
23.	-14517 <i>Mituliodon tarantulinus</i>			
24.	33921 <i>Moggridgea tingle</i> (Tingle Trapdoor Spider)		T	
25.	-14515 <i>Nunciella aspera</i>			
26.	33988 <i>Pachysaga munggai</i> (cricket)		P3	
27.	-13738 <i>Podykipus leptoiuloides</i>			
28.	-13863 <i>Raveniella peckorum</i>			
29.	-14052 <i>Scutigera indecisa</i>			
30.	-13561 <i>Tasmanicosa leuckartii</i>			
31.	-14666 <i>Theridion mortuale</i>			Y
32.	-14585 <i>Trachycosmus sculptilis</i>			
33.	-14745 <i>Urodacus novaehollandiae</i>			
34.	-13948 <i>Venator immansueta</i>			
35.	34113 <i>Westralunio carteri</i> (Carter's Freshwater Mussel)		P4	

Conservation Codes

T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

¹ For NatureMap's purposes, species flagged as endemic are those whose records are wholly contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

NatureMap - Fish - Collie

Created By Greg Harewood on 01/02/2013

Kingdom Animalia
Current Names Only Yes
Core Datasets Only Yes
Species Group Fish
Method 'By Circle'
Centre 116°01' 23" E,33°19' 23" S
Buffer 20km

	Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
1.	-15405	<i>Edelia vittata</i>			
2.	34028	<i>Galaxias occidentalis</i> (Western Minnow)			
3.	34030	<i>Geotria australis</i> (Pouched Lamprey)		P1	

Conservation Codes

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X - Presumed extinct
IA - Protected under international agreement
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1 - Priority 1
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3 - Priority 3
4 - Priority 4
5 - Priority 5

¹ For NatureMap's purposes, species flagged as endemic are those whose records are wholly contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

NatureMap - Frogs - Collie

Created By Greg Harewood on 01/02/2013

Kingdom Animalia
Current Names Only Yes
Core Datasets Only Yes
Species Group Amphibians
Method 'By Circle'
Centre 116°01' 23" E,33°19' 23" S
Buffer 20km

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
1.	34118 <i>Bufo marinus</i> (Cane Toad)	Y		
2.	25398 <i>Crinia georgiana</i> (Quacking Frog)			
3.	25399 <i>Crinia glauerti</i> (Clicking Frog)			
4.	25401 <i>Crinia pseudinsignifera</i> (Bleating Froglet)			
5.	25404 <i>Geocrinia leai</i> (Ticking Frog)			
6.	25410 <i>Heleioporus eyrei</i> (Moaning Frog)			
7.	25411 <i>Heleioporus inornatus</i> (Whooping Frog)			
8.	25415 <i>Limnodynastes dorsalis</i> (Western Banjo Frog)			
9.	25388 <i>Litoria moorei</i> (Motorbike Frog)			

Conservation Codes

- T - Rare or likely to become extinct
- X - Presumed extinct
- IA - Protected under international agreement
- S - Other specially protected fauna
- 1 - Priority 1
- 2 - Priority 2
- 3 - Priority 3
- 4 - Priority 4
- 5 - Priority 5

¹ For NatureMap's purposes, species flagged as endemic are those whose records are wholly contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

NatureMap - Reptiles - Collie

Created By Greg Harewood on 01/02/2013

Kingdom Animalia
Current Names Only Yes
Core Datasets Only Yes
Species Group Reptiles
Method 'By Circle'
Centre 116°01' 23" E,33°19' 23" S
Buffer 20km

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
1.	-19786 <i>Acritoscincus trilineatus</i>			
2.	24990 <i>Aprasia pulchella</i>			
3.	24991 <i>Aprasia repens</i>			
4.	24980 <i>Christinus marmoratus (Marbled Gecko)</i>			
5.	30893 <i>Cryptoblepharus buchananii</i>			
6.	25047 <i>Ctenotus impar</i>			
7.	25049 <i>Ctenotus labillardieri</i>			
8.	41403 <i>Diplodactylus calcicolus (South Coast Gecko)</i>			
9.	24939 <i>Diplodactylus polyophthalmus</i>			
10.	25100 <i>Egernia napoleonis</i>			
11.	30919 <i>Hemiergis gracilipes</i>			
12.	25115 <i>Hemiergis initialis subsp. initialis</i>			
13.	25118 <i>Hemiergis peronii subsp. tridactyla</i>			
14.	25131 <i>Lerista distinguenda</i>			
15.	25154 <i>Lerista microtis subsp. microtis</i>			
16.	25184 <i>Menetia greyii</i>			
17.	25240 <i>Morelia spilota subsp. imbricata (Carpet Python)</i>		S	
18.	25191 <i>Morethia lineocellata</i>			
19.	25192 <i>Morethia obscura</i>			
20.	30941 <i>Nephrurus milii (Barking Gecko)</i>			
21.	25252 <i>Notechis scutatus (Tiger Snake)</i>			
22.	25253 <i>Parasuta gouldii</i>			
23.	25255 <i>Parasuta nigriceps</i>			
24.	24907 <i>Pogona minor subsp. minor</i>			
25.	25259 <i>Pseudonaja affinis subsp. affinis (Dugite)</i>			
26.	25271 <i>Ramphotyphlops australis</i>			
27.	25266 <i>Simoselaps bertholdi (Jan's Banded Snake)</i>			
28.	25519 <i>Tiliqua rugosa</i>			
29.	25207 <i>Tiliqua rugosa subsp. rugosa</i>			
30.	25218 <i>Varanus gouldii (Bungarra or Sand Monitor)</i>			
31.	25225 <i>Varanus rosenbergi (Heath Monitor)</i>			

Conservation Codes

- T - Rare or likely to become extinct
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- IA - Protected under international agreement
- S - Other specially protected fauna
- 1 - Priority 1
- 2 - Priority 2
- 3 - Priority 3
- 4 - Priority 4
- 5 - Priority 5

¹ For NatureMap's purposes, species flagged as endemic are those whose records are wholly contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

NatureMap - Birds - Collie

Created By Greg Harewood on 01/02/2013

Kingdom Animalia
Current Names Only Yes
Core Datasets Only Yes
Species Group Birds
Method 'By Circle'
Centre 116°01' 23" E,33°19' 23" S
Buffer 20km

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
1.	24559 <i>Acanthagenys rufogularis</i> (Spiny-cheeked Honeyeater)			
2.	24260 <i>Acanthiza apicalis</i> (Broad-tailed Thornbill)			
3.	24261 <i>Acanthiza chrysorrhoa</i> (Yellow-rumped Thornbill)			
4.	24262 <i>Acanthiza inornata</i> (Western Thornbill)			
5.	24560 <i>Acanthorhynchus superciliosus</i> (Western Spinebill)			
6.	24312 <i>Anas gracilis</i> (Grey Teal)			
7.	24316 <i>Anas superciliosa</i> (Pacific Black Duck)			
8.	24561 <i>Anthochaera carunculata</i> (Red Wattlebird)			
9.	24562 <i>Anthochaera lunulata</i> (Western Little Wattlebird)			
10.	24285 <i>Aquila audax</i> (Wedge-tailed Eagle)			
11.	25566 <i>Artamus cinereus</i> (Black-faced Woodswallow)			
12.	24353 <i>Artamus cyanopterus</i> (Dusky Woodswallow)			
13.	24319 <i>Biziura lobata</i> (Musk Duck)			
14.	24359 <i>Burhinus grallarius</i> (Bush Stone-curlew)		P4	
15.	25715 <i>Cacatua roseicapilla</i> (Galah)			
16.	25598 <i>Cacomantis flabelliformis</i> (Fan-tailed Cuckoo)			
17.	25717 <i>Calyptorhynchus banksii</i> (Red-tailed Black-Cockatoo)			
18.	24731 <i>Calyptorhynchus banksii</i> subsp. <i>naso</i> (Forest Red-tailed Black-Cockatoo)		T	
19.	24733 <i>Calyptorhynchus baudinii</i> (Baudin's Cockatoo (long-billed black-cockatoo))		T	
20.	24734 <i>Calyptorhynchus latirostris</i> (Carnaby's Cockatoo (short-billed black-cockatoo))		T	
21.	24321 <i>Chenonetta jubata</i> (Australian Wood Duck)			
22.	25601 <i>Chrysococcyx lucidus</i> (Shining Bronze Cuckoo)			
23.	24432 <i>Chrysococcyx lucidus</i> subsp. <i>plagosus</i>			
24.	24396 <i>Climacteris rufa</i> (Rufous Treecreeper)			
25.	25675 <i>Colluricincla harmonica</i> (Grey Shrike-thrush)			
26.	25568 <i>Coracina novaehollandiae</i> (Black-faced Cuckoo-shrike)			
27.	25592 <i>Corvus coronooides</i> (Australian Raven)			
28.	24671 <i>Coturnix pectoralis</i> (Stubble Quail)			
29.	24420 <i>Cracticus nigrogularis</i> (Pied Butcherbird)			
30.	25595 <i>Cracticus tibicen</i> (Australian Magpie)			
31.	25596 <i>Cracticus torquatus</i> (Grey Butcherbird)			
32.	24322 <i>Cygnus atratus</i> (Black Swan)			
33.	30901 <i>Dacelo novaeguineae</i> (Laughing Kookaburra)	Y		
34.	25673 <i>Daphoenositta chrysoptera</i> (Varied Sittella)			
35.	24470 <i>Dromaius novaehollandiae</i> (Emu)			
36.	24290 <i>Elanus caeruleus</i> subsp. <i>axillaris</i> (Australian Black-shouldered Kite)			
37.	24652 <i>Eopsaltria georgiana</i> (White-breasted Robin)			
38.	24567 <i>Epthianura albifrons</i> (White-fronted Chat)			
39.	25621 <i>Falco berigora</i> (Brown Falcon)			
40.	25622 <i>Falco cenchroides</i> (Australian Kestrel)			
41.	25624 <i>Falco peregrinus</i> (Peregrine Falcon)		S	
42.	24475 <i>Falco peregrinus</i> subsp. <i>macropus</i> (Australian Peregrine Falcon)		S	
43.	25727 <i>Fulica atra</i> (Eurasian Coot)			
44.	25729 <i>Gallinula tenebrosa</i> (Dusky Moorhen)			
45.	25530 <i>Gerygone fusca</i> (Western Gerygone)			
46.	24735 <i>Glossopsitta porphyrocephala</i> (Purple-crowned Lorikeet)			
47.	24443 <i>Grallina cyanoleuca</i> (Magpie-lark)			
48.	24295 <i>Haliastur spheurnus</i> (Whistling Kite)			
49.	24491 <i>Hirundo neoxena</i> (Welcome Swallow)			
50.	24347 <i>Ixobrychus flavicollis</i> subsp. <i>australis</i> (Australian Black Bittern)		P3	
51.	24581 <i>Lichenostomus virescens</i> (Singing Honeyeater)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
52.	25661 <i>Lichmera indistincta</i> (Brown Honeyeater)			
53.	25650 <i>Malurus elegans</i> (Red-winged Fairy-wren)			
54.	25654 <i>Malurus splendens</i> (Splendid Fairy-wren)			
55.	25663 <i>Melithreptus brevirostris</i> (Brown-headed Honeyeater)			
56.	24598 <i>Merops ornatus</i> (Rainbow Bee-eater)		IA	
57.	24738 <i>Neophema elegans</i> (Elegant Parrot)			
58.	25748 <i>Ninox novaeseelandiae</i> (Boobook Owl)			
59.	24820 <i>Ninox novaeseelandiae</i> subsp. <i>boobook</i> (Boobook Owl)			
60.	25564 <i>Nycticorax caledonicus</i> (Rufous Night Heron)			
61.	25679 <i>Pachycephala pectoralis</i> (Golden Whistler)			
62.	25680 <i>Pachycephala rufiventris</i> (Rufous Whistler)			
63.	24692 <i>Pachyptila belcheri</i> (Slender-billed Prion)			
64.	25681 <i>Pardalotus punctatus</i> (Spotted Pardalote)			
65.	24626 <i>Pardalotus punctatus</i> subsp. <i>xanthopyge</i> (Yellow-rumped Pardalote)			
66.	25682 <i>Pardalotus striatus</i> (Striated Pardalote)			
67.	24659 <i>Petroica goodenovii</i> (Red-capped Robin)			
68.	25695 <i>Petroica multicolor</i> (Scarlet Robin)			
69.	25697 <i>Phalacrocorax carbo</i> (Great Cormorant)			
70.	24667 <i>Phalacrocorax sulcirostris</i> (Little Black Cormorant)			
71.	24409 <i>Phaps chalcoptera</i> (Common Bronzewing)			
72.	25587 <i>Phaps elegans</i> (Brush Bronzewing)			
73.	24596 <i>Phylidonyris novaehollandiae</i> (New Holland Honeyeater)			
74.	24841 <i>Platalea flavipes</i> (Yellow-billed Spoonbill)			
75.	25720 <i>Platycercus icterotis</i> (Western Rosella)			
76.	24747 <i>Platycercus spurius</i> (Red-capped Parrot)			
77.	25721 <i>Platycercus zonarius</i> (Australian Ringneck)			
78.	25703 <i>Podargus strigoides</i> (Tawny Frogmouth)			
79.	25704 <i>Podiceps cristatus</i> (Great Crested Grebe)			
80.	24681 <i>Poliocephalus poliocephalus</i> (Hoary-headed Grebe)			
81.	25722 <i>Polytelis anthopeplus</i> (Regent Parrot)			
82.	25731 <i>Porphyrio porphyrio</i> (Purple Swamphen)			
83.	25613 <i>Rhipidura fuliginosa</i> (Grey Fantail)			
84.	25614 <i>Rhipidura leucophrys</i> (Willie Wagtail)			
85.	25534 <i>Sericornis frontalis</i> (White-browed Scrubwren)			
86.	30948 <i>Smicrornis brevirostris</i> (Weebill)			
87.	24645 <i>Stagonopleura oculata</i> (Red-eared Firetail)			
88.	25597 <i>Strepera versicolor</i> (Grey Currawong)			
89.	25590 <i>Streptopelia senegalensis</i> (Laughing Turtle-Dove)	Y		
90.	25705 <i>Tachybaptus novaehollandiae</i> (Australasian Grebe)			
91.	24331 <i>Tadorna tadornoides</i> (Australian Shelduck)			
92.	24844 <i>Threskiornis molucca</i> (Australian White Ibis)			
93.	24845 <i>Threskiornis spinicollis</i> (Straw-necked Ibis)			
94.	25549 <i>Todiramphus sanctus</i> (Sacred Kingfisher)			
95.	24849 <i>Turnix varia</i> subsp. <i>varia</i>			
96.	25765 <i>Zosterops lateralis</i> (Grey-breasted White-eye)			

Conservation Codes

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X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna

1 - Priority 1
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NatureMap - Mammals - Collie

Created By Greg Harewood on 01/02/2013

Kingdom Animalia
Current Names Only Yes
Core Datasets Only Yes
Species Group Mammals
Method 'By Circle'
Centre 116°01' 23" E,33°19' 23" S
Buffer 20km

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
1.	24088 <i>Antechinus flavipes subsp. leucogaster</i> (Mardo)			
2.	24162 <i>Bettongia penicillata subsp. ogilbyi</i> (Woylie, Brush-tailed Bettong)		T	
3.	30883 <i>Canis lupus subsp. familiaris</i> (Dog)	Y		
4.	24086 <i>Cercartetus concinnus</i> (Western Pygmy-possum)			
5.	24186 <i>Chalinolobus gouldii</i> (Gould's Wattled Bat)			
6.	24187 <i>Chalinolobus morio</i> (Chocolate Wattled Bat)			
7.	24092 <i>Dasyurus geoffroyi</i> (Chuditch, Western Quoll)		T	
8.	24189 <i>Falsistrellus mackenziei</i> (Western False Pipistrelle)		P4	
9.	24041 <i>Felis catus</i> (Cat)	Y		
10.	24215 <i>Hydromys chrysogaster</i> (Water-rat)		P4	
11.	24153 <i>Isoodon obesulus subsp. fusciventer</i> (Quenda, Southern Brown Bandicoot)		P5	
12.	24131 <i>Macropus eugenii subsp. derbianus</i> (Tammar Wallaby (WA subsp))		P5	
13.	24132 <i>Macropus fuliginosus</i> (Western Grey Kangaroo)			
14.	24133 <i>Macropus irma</i> (Western Brush Wallaby)		P4	
15.	24168 <i>Macrotis lagotis</i> (Bilby)		T	
16.	24184 <i>Mormopterus planiceps</i> (Southern Freetail-bat)			
17.	24223 <i>Mus musculus</i> (House Mouse)	Y		
18.	24042 <i>Mustela putorius</i> (European Polecat)	Y		
19.	24146 <i>Myrmecobius fasciatus</i> (Numbat)		T	
20.	24194 <i>Nyctophilus geoffroyi</i> (Lesser Long-eared Bat)			
21.	24195 <i>Nyctophilus gouldi</i> (Gould's Long-eared Bat)			
22.	24099 <i>Phascogale tapoatafa subsp. tapoatafa</i> (Southern Brush-tailed Phascogale, Wambenger)		T	
23.	24166 <i>Pseudocheirus occidentalis</i> (Western Ringtail Possum)		T	
24.	24145 <i>Setonix brachyurus</i> (Quokka)		T	
25.	24111 <i>Sminthopsis gilberti</i> (Gilbert's Dunnart)			
26.	-19485 <i>Sminthopsis murina</i>			
27.	24185 <i>Tadarida australis</i> (White-striped Freetail-bat)			
28.	24158 <i>Trichosurus vulpecula subsp. vulpecula</i> (Common Brushtail Possum)			
29.	24206 <i>Vespadelus regulus</i> (Southern Forest Bat)			
30.	24040 <i>Vulpes vulpes</i> (Red Fox)	Y		

Conservation Codes

T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

¹ For NatureMap's purposes, species flagged as endemic are those whose records are wholly contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.



EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 01/02/13 15:52:30

[Summary](#)

[Details](#)

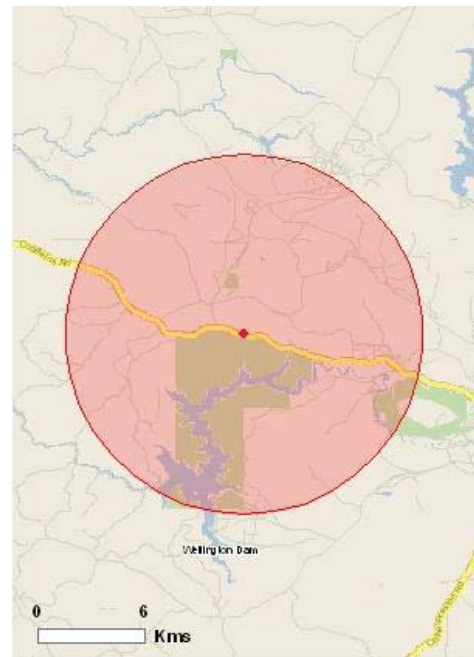
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

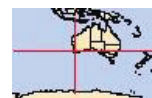
[Acknowledgements](#)



This map may contain data which are
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[Coordinates](#)

Buffer: 10.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	13
Listed Migratory Species:	8

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As [heritage values](#) of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate.

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	5
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

Place on the RNE:	3
State and Territory Reserves:	2
Regional Forest Agreements:	1
Invasive Species:	11
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo [67034]	Vulnerable	Species or species habitat may occur within area
Calyptorhynchus baudinii Baudin's Black-Cockatoo, Long-billed Black-Cockatoo [769]	Vulnerable	Breeding known to occur within area
Calyptorhynchus latirostris Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Breeding likely to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
Fish		
Nannatherina balstoni Balston's Pygmy Perch [66698]	Vulnerable	Species or species habitat may occur within area
Mammals		
Bettongia penicillata ogilbyi Woylie [66844]	Endangered	Species or species habitat known to occur within area
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area
Pseudocheirus occidentalis Western Ringtail Possum [25911]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Setonix brachyurus Quokka [229]	Vulnerable	Species or species habitat may occur within area

Plants

Centrolepis caespitosa [6393]	Endangered	Species or species habitat may occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat known to occur within area
Drakaea elastica Glossy-leaved Hammer-orchid, Praying Virgin [16753]	Endangered	Species or species habitat likely to occur within area

Listed Migratory Species

[[Resource Information](#)]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
------	------------	------------------

Migratory Marine Birds

Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area

Migratory Terrestrial Species

Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area

Migratory Wetlands Species

Ardea alba Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species

[[Resource Information](#)]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
------	------------	------------------

Birds

Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
---	--	--

Name	Threatened	Type of Presence
Ardea alba Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area

Extra Information

Places on the RNE [[Resource Information](#)]

Note that not all Indigenous sites may be listed.

Name	State	Status
Natural		
Lennard Management Priority Area	WA	Indicative Place
South West Irrigation Area	WA	Indicative Place
Westralia Management Priority Area	WA	Indicative Place

State and Territory Reserves [[Resource Information](#)]

Name	State
Wellington	WA
Westralia	WA

Regional Forest Agreements [[Resource Information](#)]

Note that all areas with completed RFAs have been included.

Name	State
South West WA RFA	Western Australia

Invasive Species [[Resource Information](#)]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resources Audit, 2001.

Name	Status	Type of Presence
Mammals		
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area

Plants

Name	Status	Type of Presence
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area

Coordinates

-33.32316 116.02349

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [Department of Environment, Climate Change and Water, New South Wales](#)
- [Department of Sustainability and Environment, Victoria](#)
- [Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [Department of Environment and Natural Resources, South Australia](#)
- [Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts](#)
- [Environmental and Resource Management, Queensland](#)
- [Department of Environment and Conservation, Western Australia](#)
- [Department of the Environment, Climate Change, Energy and Water](#)
- [Birds Australia](#)
- [Australian Bird and Bat Banding Scheme](#)
- [Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [Museum Victoria](#)
- [Australian Museum](#)
- [SA Museum](#)
- [Queensland Museum](#)
- [Online Zoological Collections of Australian Museums](#)
- [Queensland Herbarium](#)
- [National Herbarium of NSW](#)
- [Royal Botanic Gardens and National Herbarium of Victoria](#)
- [Tasmanian Herbarium](#)
- [State Herbarium of South Australia](#)
- [Northern Territory Herbarium](#)
- [Western Australian Herbarium](#)
- [Australian National Herbarium, Atherton and Canberra](#)
- [University of New England](#)
- [Ocean Biogeographic Information System](#)
- [Australian Government, Department of Defence](#)
- [State Forests of NSW](#)
- [Geoscience Australia](#)
- [CSIRO](#)
- Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.

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APPENDIX D

HABITAT TREE DETAILS

Habitat Trees
Datum: GDA94

Count	Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Hollow Type 3	Hollow Size 3 (cm)	Hollow Type 4	Hollow Size 4 (cm)	Hollow Type 5	Hollow Size 5 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
1	wpt001	50H	403488	6314243	Jarrah	20+	>50	2	Branch	10-20	Spout Trunk	20+							No Signs	No Signs	Yes	Depth of hollow unknown
2	wpt001a	50H	403699	6313860	Jarrah	20+	>50	0											No Signs	No Signs	No	
3	wpt002	50H	403507	6314246	Jarrah	15-20	>50	0											No Signs	No Signs	No	
4	wpt002a	50H	403701	6313850	Marri	15-20	>50	0											No Signs	No Signs	No	
5	wpt003	50H	403550	6314164	Jarrah	15-20	>50	0											No Signs	No Signs	No	
6	wpt003a	50H	403750	6313793	Jarrah	20+	>50	0											No Signs	No Signs	No	
7	wpt004	50H	403567	6314165	Jarrah	20+	>50	5+	Branch	5-10	Branch	5-10	Branch	5-10	Branch	5-10	Branch	5-10	No Signs	No Signs	No	
8	wpt004a	50H	403750	6313789	Marri	15-20	>50	0											No Signs	No Signs	No	
9	wpt005	50H	403578	6314116	Jarrah	20+	>50	0											No Signs	No Signs	No	
10	wpt005a	50H	403765	6313767	Marri	15-20	>50	0											No Signs	No Signs	No	
11	wpt006	50H	403575	6314125	Marri	20+	>50	0											No Signs	No Signs	No	
12	wpt006a	50H	403775	6313767	Marri	15-20	>50	0											No Signs	No Signs	No	
13	wpt007	50H	403595	6314098	Jarrah	20+	>50	0											No Signs	No Signs	No	
14	wpt007a	50H	403778	6313760	Jarrah	20+	>50	0											No Signs	No Signs	No	
15	wpt008	50H	403611	6314086	Marri	20+	>50	2	Spout Branch	10-20	Spout Branch	10-20						No Signs	No Signs	No		
16	wpt008a	50H	403774	6313753	Jarrah	20+	>50	0											No Signs	No Signs	No	
17	wpt009	50H	403600	6314082	Jarrah	15-20	>50	0											No Signs	No Signs	No	
18	wpt009a	50H	403782	6313754	Marri	15-20	>50	0											No Signs	No Signs	No	
19	wpt010	50H	403617	6314080	Jarrah	20+	>50	1	Knot Hole	5-10								No Signs	No Signs	No		
20	wpt010a	50H	403779	6313744	Marri	15-20	>50	0											No Signs	No Signs	No	
21	wpt011	50H	403625	6314045	Marri	15-20	>50	0											No Signs	No Signs	No	
22	wpt011a	50H	403792	6313724	Marri	15-20	>50	0											No Signs	No Signs	No	
23	wpt012	50H	403640	6314015	Marri	20+	>50	2	Knot Hole	5-10								No Signs	No Signs	No		
24	wpt012a	50H	403816	6313728	Marri	15-20	>50	0											No Signs	No Signs	No	
25	wpt013	50H	403661	6313996	Jarrah	15-20	>50	0											No Signs	No Signs	No	
26	wpt013a	50H	403811	6313705	Marri	20+	>50	0											No Signs	No Signs	No	
27	wpt014	50H	403662	6313992	Jarrah	15-20	>50	0											No Signs	No Signs	No	
28	wpt014a	50H	403800	6313702	Marri	20+	>50	0											No Signs	No Signs	No	
29	wpt015	50H	403673	6313987	Jarrah	20+	>50	3	Branch	10-20	Branch	10-20	Branch	10-20				No Signs	No Signs	No		
30	wpt015a	50H	403824	6313689	Marri	20+	>50	0											No Signs	No Signs	No	
31	wpt016	50H	403671	6313982	Marri	20+	>50	0											No Signs	No Signs	No	
32	wpt016a	50H	403835	6313683	Jarrah	20+	>50	0											No Signs	No Signs	No	
33	wpt017a	50H	403833	6313657	Marri	20+	>50	0											No Signs	No Signs	No	
34	wpt018	50H	403699	6313941	Jarrah	20+	>50	0											No Signs	No Signs	No	
35	wpt018a	50H	403844	6313656	Marri	20+	>50	0											No Signs	No Signs	No	
36	wpt019	50H	403708	6313938	Marri	20+	>50	0											No Signs	No Signs	No	
37	wpt019a	50H	403849	6313657	Marri	20+	>50	0											No Signs	No Signs	No	
38	wpt020	50H	403698	6313929	Marri	15-20	>50	0											No Signs	No Signs	No	
39	wpt020a	50H	403852	6313658	Jarrah	20+	>50	0											No Signs	No Signs	No	
40	wpt021	50H	403736	6313919	Dead Jarrah	15-20	>50	0											No Signs	No Signs	No	
41	wpt021a	50H	403853	6313633	Jarrah	20+	>50	0											No Signs	No Signs	No	
42	wpt022	50H	403720	6313908	Jarrah	20+	>50	0											No Signs	No Signs	No	
43	wpt022a	50H	403854	6313622	Jarrah	20+	>50	1	Fissure	10-20								No Signs	No Signs	No		
44	wpt023a	50H	403872	6313591	Jarrah	20+	>50	?											No Signs	No Signs	No	
45	wpt024	50H	403729	6313878	Marri	20+	>50	0											No Signs	No Signs	No	
46	wpt024a	50H	403878	6313594	Jarrah	20+	>50	0											No Signs	No Signs	No	
47	wpt025	50H	403742	6313871	Jarrah	20+	>50	0											No Signs	No Signs	No	
48	wpt025a	50H	403878	6313580	Jarrah	20+	>50	0											No Signs	No Signs	No	Likely to contain hollows
49	wpt026	50H	403750	6313895	Marri	20+	>50	4	Knot Hole	5-10	Knot Hole	10-20	Knot Hole	5-10	Knot Hole	10-20		Bees	No Signs	Yes	Depth of hollow unknown	
50	wpt026a	50H	403881	6313580	Jarrah	20+	>50	0											No Signs	No Signs	No	
51	wpt027	50H	403765	6313870	Marri	20+	>50	1	Branch	10-20									No Signs	No Signs	No	
52	wpt027a	50H	403883	6313579	Jarrah	20+	>50	0											No Signs	No Signs	No	
53	wpt028	50H	403775	6313869	Jarrah	20+	>50	0											No Signs	No Signs	No	

Count	Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Hollow Type 3	Hollow Size 3 (cm)	Hollow Type 4	Hollow Size 4 (cm)	Hollow Type 5	Hollow Size 5 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
54	wpt028a	50H	403900	6313570	Jarrah	20+	>50	0											No Signs	No Signs	No	
55	wpt029	50H	403766	6313864	Marri	20+	>50	0											No Signs	No Signs	No	
56	wpt029a	50H	403908	6313567	Jarrah	20+	>50	0											No Signs	No Signs	No	
57	wpt030	50H	403774	6313861	Jarrah	20+	>50	0											No Signs	No Signs	No	
58	wpt030a	50H	403913	6313514	Marri	20+	>50	0											No Signs	No Signs	No	
59	wpt031	50H	403774	6313844	Jarrah	20+	>50	0											No Signs	No Signs	No	
60	wpt031a	50H	403919	6313505	Jarrah	20+	>50	0											No Signs	No Signs	No	
61	wpt032	50H	403770	6313838	Jarrah	20+	>50	0											No Signs	No Signs	No	
62	wpt032a	50H	403968	6313464	Jarrah	20+	>50	0											No Signs	No Signs	No	
63	wpt033	50H	403781	6313820	Marri	15-20	>50	0											No Signs	No Signs	No	
64	wpt033a	50H	404031	6313418	Jarrah	20+	>50	5+	Knot Hole	5-10	Branch	5-10	Branch	10-20	Branch	5-10	Branch	10-20	No Signs	No Signs	No	
65	wpt034	50H	403742	6313867	Jarrah	20+	>50	0											No Signs	No Signs	No	
66	wpt034a	50H	404012	6313414	Marri	20+	>50	0											No Signs	No Signs	No	
67	wpt035	50H	403746	6313867	Jarrah	20+	>50	0											No Signs	No Signs	No	
68	wpt035a	50H	404050	6313396	Marri	20+	>50	0											No Signs	No Signs	No	
69	wpt036	50H	403610	6313991	Marri	20+	>50	5+	Branch	5-10	Branch	10-20	Branch	5-10	Branch	10-20	Branch	5-10	No Signs	No Signs	No	
70	wpt036a	50H	404112	6313309	Marri	20+	>50	5+	Spout Trunk	20+	Spout Branch	20+	Branch	5-10	Branch	10-20	Branch	5-10	No Signs	No Signs	Yes	Depth of hollow unknown
71	wpt037	50H	403591	6314022	Dead Unknown	20+	>50	4	Knot Hole	20+	Spout Branch	10-20	Spout Branch	20+	Spout Branch	10-20			No Signs	No Signs	Yes	Depth of hollow unknown
72	wpt037a	50H	404157	6313279	Marri	20+	>50	0											No Signs	No Signs	No	
73	wpt038	50H	403563	6314051	Jarrah	20+	>50	0											No Signs	No Signs	No	
74	wpt038a	50H	404239	6313223	Jarrah	15-20	>50	0											No Signs	No Signs	No	
75	wpt039	50H	403551	6314071	Jarrah	20+	>50	0											No Signs	No Signs	No	
76	wpt039a	50H	404255	6313211	Marri	20+	>50	0											No Signs	No Signs	No	
77	wpt040	50H	403551	6314083	Jarrah	20+	>50	0											No Signs	No Signs	No	
78	wpt040a	50H	404550	6313038	Jarrah	20+	>50	0											No Signs	No Signs	No	
79	wpt041	50H	403559	6314089	Jarrah	20+	>50	0											No Signs	No Signs	No	
80	wpt041a	50H	404576	6313022	Jarrah	20+	>50	0											No Signs	No Signs	No	
81	wpt042	50H	403531	6314117	Jarrah	20+	>50	0											No Signs	No Signs	No	
82	wpt042a	50H	404586	6313015	Marri	20+	>50	0											No Signs	No Signs	No	
83	wpt043	50H	403522	6314122	Jarrah	20+	>50	0											No Signs	No Signs	No	
84	wpt043a	50H	404600	6313019	Jarrah	20+	>50	0											No Signs	No Signs	No	
85	wpt044	50H	403513	6314126	Jarrah	20+	>50	0											No Signs	No Signs	No	
86	wpt044a	50H	404599	6312999	Marri	20+	>50	0											No Signs	No Signs	No	
87	wpt045	50H	403512	6314127	Jarrah	20+	>50	0											No Signs	No Signs	No	
88	wpt045a	50H	404603	6313006	Marri	20+	>50	0											No Signs	No Signs	No	
89	wpt046	50H	403821	6313807	Jarrah	15-20	>50	0											No Signs	No Signs	No	
90	wpt046a	50H	404607	6312997	Marri	20+	>50	0											No Signs	No Signs	No	
91	wpt047	50H	403821	6313817	Jarrah	15-20	>50	0											No Signs	No Signs	No	
92	wpt047a	50H	404611	6312978	Marri	20+	>50	0											No Signs	No Signs	No	
93	wpt048	50H	403805	6313812	Marri	15-20	>50	0											No Signs	No Signs	No	
94	wpt048a	50H	404636	6312974	Marri	10-15	>50	1	Spout Branch	20+									No Signs	No Signs	Yes	Depth of hollow unknown
95	wpt049	50H	403805	6313810	Marri	15-20	>50	0											No Signs	No Signs	No	
96	wpt049a	50H	404638	6312972	Marri	15-20	>50	1	Spout Branch	20+									No Signs	No Signs	Yes	Depth of hollow unknown
97	wpt050	50H	403831	6313800	Jarrah	15-20	>50	0											No Signs	No Signs	No	
98	wpt050a	50H	404646	6312959	Jarrah	20+	>50	0											No Signs	No Signs	No	
99	wpt051	50H	403844	6313784	Marri	20+	>50	0											No Signs	No Signs	No	
100	wpt051a	50H	404667	6312962	Jarrah	15-20	>50	1	Spout Branch	20+									No Signs	No Signs	No	Too shallow
101	wpt052	50H	403852	6313770	Marri	15-20	>50	0											No Signs	No Signs	No	
102	wpt052a	50H	404702	6312930	Dead Jarrah	15-20	>50	1	Spout Trunk	10-20									No Signs	No Signs	No	
103	wpt053	50H	403861	6313772	Marri	10-15	>50	1	Spout Trunk	20+									No Signs	No Signs	Yes	Depth of hollow unknown
104	wpt053a	50H	404704	6312923	Jarrah	20+	>50	5+	Branch	5-10	Branch	10-20	Branch	5-10	Branch	10-20	Branch	5-10	No Signs	No Signs	No	
105	wpt054	50H	403893	6313742	Marri	15-20	>50	0											No Signs	No Signs	No	
106	wpt054a	50H	404753	6312939	Jarrah	20+	>50	0											No Signs	No Signs	No	
107	wpt055	50H	403899	6313730	Dead Marri	15-20	>50	0											No Signs	No Signs	No	
108	wpt055a	50H	404744	6312913	Marri	20+	>50	0											No Signs	No Signs	No	
109	wpt056	50H	403900	6313721	Marri	15-20	>50	0											No Signs	No Signs	No	

Count	Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Hollow Type 3	Hollow Size 3 (cm)	Hollow Type 4	Hollow Size 4 (cm)	Hollow Type 5	Hollow Size 5 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
110	wpt056a	50H	404845	6312851	Dead Unknown	5-10	>50	1	Spout Trunk	20+									No Signs	No Signs	No	Too shallow
111	wpt057	50H	403926	6313730	Marri	20+	>50	2	Branch	10-20	Branch	10-20							No Signs	No Signs	No	
112	wpt057a	50H	404880	6312816	Jarra	20+	>50	0											No Signs	No Signs	No	
113	wpt058	50H	403964	6313687	Jarra	15-20	>50	0											No Signs	No Signs	No	
114	wpt058a	50H	404889	6312816	Jarra	15-20	>50	0											No Signs	No Signs	No	
115	wpt059	50H	404019	6313623	Marri	15-20	>50	0											No Signs	No Signs	No	
116	wpt059a	50H	404935	6312799	Marri	15-20	>50	0											No Signs	No Signs	No	
117	wpt060	50H	404023	6313609	Jarra	20+	>50	0											No Signs	No Signs	No	
118	wpt060a	50H	404939	6312791	Marri	20+	>50	0											No Signs	No Signs	No	
119	wpt061	50H	404032	6313606	Jarra	15-20	>50	0											No Signs	No Signs	No	
120	wpt061a	50H	404962	6312780	Marri	20+	>50	0											No Signs	No Signs	No	
121	wpt062	50H	404074	6313606	Marri	15-20	>50	0											No Signs	No Signs	No	
122	wpt062a	50H	404962	6312771	Jarra	15-20	>50	0											No Signs	No Signs	No	
123	wpt063	50H	404082	6313587	Jarra	20+	>50	0											No Signs	No Signs	No	
124	wpt063a	50H	404966	6312784	Jarra	15-20	>50	0											No Signs	No Signs	No	
125	wpt064	50H	404084	6313583	Jarra	20+	>50	0											No Signs	No Signs	No	
126	wpt064a	50H	404982	6312778	Jarra	20+	>50	0											No Signs	No Signs	No	
127	wpt065	50H	404082	6313578	Jarra	20+	>50	0											No Signs	No Signs	No	
128	wpt065a	50H	405003	6312756	Marri	20+	>50	0											No Signs	No Signs	No	
129	wpt066	50H	404097	6313585	Jarra	15-20	>50	0											No Signs	No Signs	No	
130	wpt066a	50H	404998	6312755	Marri	20+	>50	0											No Signs	No Signs	No	
131	wpt067	50H	404095	6313568	Jarra	20+	>50	0											No Signs	No Signs	No	
132	wpt067a	50H	405015	6312766	Marri	20+	>50	0											No Signs	No Signs	No	
133	wpt068	50H	404113	6313549	Marri	20+	>50	0											No Signs	No Signs	No	
134	wpt068a	50H	405025	6312766	Marri	20+	>50	1	Spout Trunk	20+									No Signs	No Signs	Yes	Depth of hollow unknown
135	wpt069	50H	404117	6313556	Jarra	20+	>50	0											No Signs	No Signs	No	
136	wpt069a	50H	405020	6312749	Marri	20+	>50	0											No Signs	No Signs	No	
137	wpt070	50H	404133	6313550	Jarra	15-20	>50	0											No Signs	No Signs	No	
138	wpt070a	50H	405029	6312747	Marri	20+	>50	0											No Signs	No Signs	No	
139	wpt071	50H	404132	6313536	Jarra	15-20	>50	0											No Signs	No Signs	No	
140	wpt071a	50H	405039	6312753	Marri	20+	>50	0											No Signs	No Signs	No	
141	wpt072	50H	404149	6313541	Marri	15-20	>50	0											No Signs	No Signs	No	
142	wpt072a	50H	405044	6312728	Marri	20+	>50	0											No Signs	No Signs	No	
143	wpt073	50H	404156	6313526	Jarra	15-20	>50	0											No Signs	No Signs	No	
144	wpt073a	50H	405012	6312704	Jarra	20+	>50	0											No Signs	No Signs	No	
145	wpt074	50H	404170	6313521	Jarra	20+	>50	0											No Signs	No Signs	No	
146	wpt074a	50H	405013	6312695	Jarra	20+	>50	0											No Signs	No Signs	No	
147	wpt075	50H	404180	6313520	Jarra	20+	>50	0											No Signs	No Signs	No	
148	wpt075a	50H	405017	6312681	Jarra	20+	>50	0											No Signs	No Signs	No	
149	wpt076	50H	404185	6313508	Jarra	15-20	>50	0											No Signs	No Signs	No	
150	wpt076a	50H	405027	6312694	Jarra	20+	>50	0											No Signs	No Signs	No	
151	wpt077	50H	404191	6313506	Marri	20+	>50	0											No Signs	No Signs	No	
152	wpt077a	50H	405057	6312721	Marri	20+	>50	0											No Signs	No Signs	No	
153	wpt078	50H	404192	6313518	Jarra	20+	>50	0											No Signs	No Signs	No	
154	wpt078a	50H	405063	6312722	Jarra	20+	>50	0											No Signs	No Signs	No	
155	wpt079	50H	404195	6313506	Jarra	15-20	>50	0											No Signs	No Signs	No	
156	wpt079a	50H	405098	6312687	Jarra	20+	>50	5+	Branch	5-10	Branch	10-20	Branch	5-10	Branch	10-20	Branch	5-10	No Signs	No Signs	No	
157	wpt080	50H	404199	6313500	Jarra	15-20	>50	0											No Signs	No Signs	No	
158	wpt080a	50H	405129	6312683	Jarra	20+	>50	1	Fissure	20+									No Signs	No Signs	Yes	Depth of hollow unknown
159	wpt081	50H	404219	6313488	Marri	10-15	>50	0											No Signs	No Signs	No	
160	wpt081a	50H	405149	6312660	Jarra	20+	>50	0											No Signs	No Signs	No	
161	wpt082	50H	404241	6313474	Jarra	15-20	>50	0											No Signs	No Signs	No	
162	wpt082a	50H	405206	6312633	Jarra	15-20	>50	1	Spout Branch	20+									No Signs	No Signs	Yes	Depth of hollow unknown
163	wpt083	50H	404251	6313461	Marri	15-20	>50	0											No Signs	No Signs	No	
164	wpt083a	50H	405210	6312632	Jarra	15-20	>50	0											No Signs	No Signs	No	
165	wpt084	50H	404254	6313446	Jarra	15-20	>50	0											No Signs	No Signs	No	

Count	Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Hollow Type 3	Hollow Size 3 (cm)	Hollow Type 4	Hollow Size 4 (cm)	Hollow Type 5	Hollow Size 5 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
166	wpt084a	50H	405225	6312628	Jarrah	15-20	>50	0											No Signs	No Signs	No	
167	wpt085	50H	404269	6313490	Marri	20+	>50	5+	Branch	10-20	Branch	10-20	Branch	10-20	Branch	10-20	Spout Trunk	20+	No Signs	No Signs	Yes	Depth of hollow unknown
168	wpt085a	50H	405231	6312616	Jarrah	15-20	>50	0											No Signs	No Signs	No	
169	wpt086	50H	404294	6313455	Jarrah	15-20	>50	0											No Signs	No Signs	No	
170	wpt086a	50H	405231	6312610	Jarrah	15-20	>50	0	Branch	20+									No Signs	No Signs	Yes	Depth of hollow unknown
171	wpt087	50H	404289	6313476	Marri	15-20	>50	0											No Signs	No Signs	No	
172	wpt087a	50H	405252	6312602	Jarrah	20+	>50	0											No Signs	No Signs	No	
173	wpt088	50H	404334	6313409	Marri	15-20	>50	0											No Signs	No Signs	No	
174	wpt088a	50H	405279	6312596	Jarrah	20+	>50	0											No Signs	No Signs	No	
175	wpt089	50H	404355	6313429	Jarrah	20+	>50	2	Spout Branch	10-20	Branch	10-20							No Signs	No Signs	No	
176	wpt089a	50H	405294	6312585	Marri	20+	>50	0											No Signs	No Signs	No	
177	wpt090	50H	404354	6313453	Dead Jarrah	20+	>50	2	Spout Branch	10-20	Branch	10-20							No Signs	No Signs	No	
178	wpt090a	50H	405307	6312591	Jarrah	15-20	>50	0											No Signs	No Signs	No	
179	wpt091	50H	404346	6313396	Marri	15-20	>50	0											No Signs	No Signs	No	
180	wpt091a	50H	405307	6312582	Jarrah	20+	>50	0											No Signs	No Signs	No	
181	wpt092	50H	404390	6313403	Marri	15-20	>50	0											No Signs	No Signs	No	
182	wpt092a	50H	405311	6312582	Jarrah	20+	>50	0											No Signs	No Signs	No	
183	wpt093	50H	404430	6313382	Jarrah	20+	>50	2	Spout Branch	10-20	Spout Branch	10-20							No Signs	No Signs	No	
184	wpt093a	50H	405310	6312587	Jarrah	20+	>50	0											No Signs	No Signs	No	
185	wpt094	50H	404394	6313383	Jarrah	20+	>50	2	Knot Hole	5-10	Branch	5-10							No Signs	No Signs	No	
186	wpt094a	50H	405316	6312582	Jarrah	20+	>50	0											No Signs	No Signs	No	
187	wpt095	50H	404435	6313365	Marri	10-15	>50	0											No Signs	No Signs	No	
188	wpt095a	50H	405312	6312574	Jarrah	20+	>50	0											No Signs	No Signs	No	
189	wpt096	50H	404421	6313359	Jarrah	15-20	>50	0											No Signs	No Signs	No	
190	wpt096a	50H	405326	6312565	Marri	15-20	>50	3	Branch	5-10	Branch	10-20	Spout Trunk	20+					No Signs	No Signs	Yes	Depth of hollow unknown
191	wpt097	50H	404448	6313345	Jarrah	15-20	>50	0											No Signs	No Signs	No	
192	wpt097a	50H	405294	6312607	Jarrah	15-20	>50	5+	Branch	5-10	Branch	5-10	Branch	5-10	Branch	5-10	Branch	5-10	No Signs	No Signs	Yes	Depth of hollow unknown
193	wpt098	50H	404453	6313356	Marri	20+	>50	0											No Signs	No Signs	No	
194	wpt098a	50H	405278	6312613	Jarrah	20+	>50	0											No Signs	No Signs	No	
195	wpt099	50H	404456	6313366	Jarrah	15-20	>50	0											No Signs	No Signs	No	
196	wpt099a	50H	405260	6312617	Jarrah	20+	>50	0											No Signs	No Signs	No	
197	wpt100	50H	404460	6313351	Jarrah	20+	>50	0											No Signs	No Signs	No	
198	wpt100a	50H	405226	6312648	Jarrah	20+	>50	0											No Signs	No Signs	No	
199	wpt101	50H	404458	6313340	Dead Jarrah	15-20	>50	0											No Signs	No Signs	No	
200	wpt101a	50H	405160	6312682	Jarrah	15-20	>50	0											No Signs	No Signs	No	
201	wpt102	50H	404471	6313340	Marri	20+	>50	0											No Signs	No Signs	No	
202	wpt102a	50H	405148	6312689	Jarrah	15-20	>50	0											No Signs	No Signs	No	
203	wpt103	50H	404477	6313343	Marri	20+	>50	0											No Signs	No Signs	No	
204	wpt103a	50H	405115	6312715	Jarrah	20+	>50	0											No Signs	No Signs	No	
205	wpt104	50H	404481	6313345	Jarrah	15-20	>50	0											No Signs	No Signs	No	
206	wpt104a	50H	405118	6312716	Jarrah	20+	>50	0											No Signs	No Signs	No	
207	wpt105	50H	404484	6313341	Dead Unknown	20+	>50	5+	Branch	10-20	Branch	10-20	Branch	20+	Branch	10-20	Branch	20+	No Signs	No Signs	Yes	Depth of hollow unknown
208	wpt105a	50H	405126	6312733	Jarrah	20+	>50	0											No Signs	No Signs	No	
209	wpt106	50H	404486	6313340	Marri	20+	>50	0											No Signs	No Signs	No	
210	wpt106a	50H	405127	6312731	Jarrah	20+	>50	1	Fissure	10-20									No Signs	No Signs	No	Hollow butt
211	wpt107	50H	404495	6313335	Dead Unknown	20+	>50	5+	Branch	5-10	Branch	10-20	Branch	5-10	Branch	10-20	Branch	5-10	No Signs	No Signs	No	
212	wpt107a	50H	405123	6312742	Marri	20+	>50	2	Knot Hole	5-10	Knot Hole	5-10							No Signs	No Signs	No	
213	wpt108	50H	404588	6313328	Marri	15-20	>50	0											No Signs	No Signs	No	
214	wpt108a	50H	405133	6312754	Jarrah	20+	>50	0											No Signs	No Signs	No	
215	wpt109	50H	404685	6313288	Marri	15-20	>50	0											No Signs	No Signs	No	
216	wpt109a	50H	405155	6312784	Jarrah	20+	>50	0											No Signs	No Signs	No	
217	wpt110	50H	404694	6313286	Marri	15-20	>50	0											No Signs	No Signs	No	
218	wpt110a	50H	405178	6312821	Marri	15-20	>50	0											No Signs	No Signs	No	
219	wpt111	50H	404716	6313278	Marri	15-20	>50	0											No Signs	No Signs	No	
220	wpt111a	50H	405106	6312747	Marri	20+	>50	0											No Signs	No Signs	No	
221	wpt112	50H	404792	6313250	Marri	15-20	>50	0											No Signs	No Signs	No	

Count	Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Hollow Type 3	Hollow Size 3 (cm)	Hollow Type 4	Hollow Size 4 (cm)	Hollow Type 5	Hollow Size 5 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
222	wpt112a	50H	405073	6312733	Jarrah	20+	>50	0											No Signs	No Signs	No	
223	wpt113	50H	404794	6313249	Marri	15-20	>50	0											No Signs	No Signs	No	
224	wpt113a	50H	405078	6312739	Jarrah	20+	>50	0											No Signs	No Signs	No	
225	wpt114	50H	404829	6313244	Marri	15-20	>50	0											No Signs	No Signs	No	
226	wpt114a	50H	405062	6312742	Jarrah	20+	>50	0											No Signs	No Signs	No	
227	wpt115	50H	404853	6313224	Marri	15-20	>50	0											No Signs	No Signs	No	
228	wpt115a	50H	404878	6312879	Dead Unknown	5-10	>50	1	Spout Trunk	20+									No Signs	No Signs	No	Too shallow
229	wpt116	50H	404895	6313212	Marri	15-20	>50	0											No Signs	No Signs	No	
230	wpt116a	50H	404212	6313234	Marri	15-20	>50	0											No Signs	No Signs	No	
231	wpt117	50H	404911	6313214	Marri	20+	>50	0											No Signs	No Signs	No	
232	wpt117a	50H	403831	6313648	Marri	15-20	>50	0											No Signs	No Signs	No	
233	wpt118	50H	404923	6313208	Marri	15-20	>50	0											No Signs	No Signs	No	
234	wpt118a	50H	403822	6313660	Marri	20+	>50	0											No Signs	No Signs	No	
235	wpt119	50H	404934	6313200	Marri	20+	>50	0											No Signs	No Signs	No	
236	wpt119a	50H	406009	6312389	Marri	15-20	>50	0											No Signs	No Signs	No	
237	wpt120	50H	404946	6313200	Marri	15-20	>50	0											No Signs	No Signs	No	
238	wpt120a	50H	406010	6312394	Marri	15-20	>50	0											No Signs	No Signs	No	
239	wpt121	50H	404954	6313191	Marri	15-20	>50	0											No Signs	No Signs	No	
240	wpt121a	50H	406015	6312394	Marri	15-20	>50	0											No Signs	No Signs	No	
241	wpt122	50H	404969	6313192	Marri	15-20	>50	0											No Signs	No Signs	No	
242	wpt122a	50H	406041	6312392	Marri	15-20	>50	0											No Signs	No Signs	No	
243	wpt123	50H	404974	6313191	Marri	20+	>50	0											No Signs	No Signs	No	
244	wpt123a	50H	406196	6312399	Marri	15-20	>50	0											No Signs	No Signs	No	
245	wpt124	50H	405024	6313165	Marri	15-20	>50	0											No Signs	No Signs	No	
246	wpt124a	50H	406235	6312420	Marri	20+	>50	0											No Signs	No Signs	No	
247	wpt125	50H	405056	6313163	Marri	20+	>50	0											No Signs	No Signs	No	
248	wpt125a	50H	406274	6312405	Jarrah	20+	>50	0											No Signs	No Signs	No	
249	wpt126	50H	405096	6313149	Marri	20+	>50	0											No Signs	No Signs	No	
250	wpt126a	50H	406281	6312438	Jarrah	15-20	>50	5+	Branch	5-10	Branch	5-10	Branch	5-10	Branch	5-10	Branch	5-10	No Signs	No Signs	No	
251	wpt127	50H	405100	6313142	Marri	20+	>50	0											No Signs	No Signs	No	
252	wpt127a	50H	406331	6312418	Marri	20+	>50	0											No Signs	No Signs	No	
253	wpt128	50H	405125	6313127	Jarrah	20+	>50	0											No Signs	No Signs	No	
254	wpt128a	50H	406337	6312406	Marri	20+	>50	0											No Signs	No Signs	No	
255	wpt129	50H	405148	6313128	Dead Jarrah	15-20	>50	5+	Branch	5-10	Branch	5-10	Branch	5-10	Branch	5-10	Branch	5-10	No Signs	No Signs	No	
256	wpt129a	50H	406344	6312433	Jarrah	20+	>50	0											No Signs	No Signs	No	
257	wpt130	50H	405145	6313109	Jarrah	15-20	>50	0											No Signs	No Signs	No	
258	wpt130a	50H	406368	6312432	Marri	15-20	>50	3	Knot Hole	10-20	Branch	5-10	Spout Trunk	20+				No Signs	No Signs	Yes	Depth of hollow unknown	
259	wpt131	50H	405159	6313104	Jarrah	10-15	>50	1	Spout Trunk	10-20									No Signs	No Signs	Yes	Depth of hollow unknown
260	wpt131a	50H	406379	6312418	Marri	20+	>50	0											No Signs	No Signs	No	
261	wpt132	50H	405172	6313107	Marri	15-20	>50	0											No Signs	No Signs	No	
262	wpt132a	50H	406384	6312441	Marri	15-20	>50	1	Spout Trunk	20+									No Signs	No Signs	Yes	Depth of hollow unknown
263	wpt133	50H	405191	6313104	Marri	15-20	>50	1	Branch	10-20									No Signs	No Signs	No	
264	wpt133a	50H	406414	6312442	Marri	20+	>50	0											No Signs	No Signs	No	
265	wpt134	50H	405187	6313098	Marri	20+	>50	0											No Signs	No Signs	No	
266	wpt134a	50H	406456	6312452	Marri	20+	>50	0											No Signs	No Signs	No	
267	wpt135	50H	405195	6313068	Marri	20+	>50	0											No Signs	No Signs	No	
268	wpt135a	50H	406464	6312442	Marri	20+	>50	2	Knot Hole	5-10	Spout Branch	20+							No Signs	No Signs	Yes	Depth of hollow unknown
269	wpt136	50H	405205	6313073	Marri	20+	>50	0											No Signs	No Signs	No	
270	wpt136a	50H	406435	6312448	Marri	20+	>50	0											No Signs	No Signs	No	
271	wpt137	50H	405221	6313077	Marri	15-20	>50	0											No Signs	No Signs	No	
272	wpt137a	50H	406429	6312445	Marri	20+	>50	0											No Signs	No Signs	No	
273	wpt138	50H	405211	6313069	Jarrah	20+	>50	0											No Signs	No Signs	No	
274	wpt138a	50H	406382	6312422	Jarrah	20+	>50	0											No Signs	No Signs	No	
275	wpt139	50H	405211	6313064	Jarrah	20+	>50	0											No Signs	No Signs	No	
276	wpt139a	50H	410580	6311792	Marri	20+	>50	0											No Signs	No Signs	No	
277	wpt140	50H	405267	6313039	Jarrah	20+	>50	0											No Signs	No Signs	No	

Count	Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Hollow Type 3	Hollow Size 3 (cm)	Hollow Type 4	Hollow Size 4 (cm)	Hollow Type 5	Hollow Size 5 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
278	wpt140a	50H	410588	6311788	Marri	20+	>50	0											No Signs	No Signs	No	
279	wpt141	50H	405289	6313038	Jarra	15-20	>50	0											No Signs	No Signs	No	
280	wpt141a	50H	410599	6311770	Marri	20+	>50	0											No Signs	No Signs	No	
281	wpt142	50H	405307	6313056	Marri	15-20	>50	1	Spout Trunk	20+									No Signs	No Signs	Yes	Depth of hollow unknown
282	wpt142a	50H	410618	6311762	Marri	5-10	>50	0											No Signs	No Signs	No	
283	wpt143	50H	405296	6313022	Jarra	15-20	>50	3	Branch	10-20	Spout Branch	10-20	Spout Branch	10-20					No Signs	No Signs	No	
284	wpt143a	50H	410626	6311761	Marri	20+	>50	0											No Signs	No Signs	No	
285	wpt144	50H	405327	6313016	Jarra	20+	>50	0											No Signs	No Signs	No	
286	wpt144a	50H	410638	6311757	Blackbutt	20+	>50	0											No Signs	No Signs	No	
287	wpt145	50H	405342	6312991	Marri	15-20	>50	0											No Signs	No Signs	No	
288	wpt145a	50H	410640	6311757	Blackbutt	20+	>50	0											No Signs	No Signs	No	
289	wpt146	50H	405351	6312969	Jarra	20+	>50	0											No Signs	No Signs	No	
290	wpt146a	50H	410650	6311736	Blackbutt	20+	>50	0											No Signs	No Signs	No	
291	wpt147	50H	405330	6312976	Jarra	15-20	>50	3	Branch	5-10	Branch	10-20							No Signs	No Signs	No	
292	wpt147a	50H	410662	6311746	Blackbutt	20+	>50	0											No Signs	No Signs	No	
293	wpt148	50H	405320	6312972	Jarra	15-20	>50	0											No Signs	No Signs	No	
294	wpt148a	50H	410669	6311729	Blackbutt	20+	>50	0											No Signs	No Signs	No	
295	wpt149	50H	405314	6312966	Dead Marri	20+	>50	0											No Signs	No Signs	No	
296	wpt149a	50H	410666	6311725	Blackbutt	20+	>50	0											No Signs	No Signs	No	
297	wpt150	50H	405309	6312967	Jarra	20+	>50	5+	Branch	5-10	Branch	5-10	Branch	5-10	Branch	5-10	Branch	5-10	No Signs	No Signs	No	
298	wpt150a	50H	410662	6311720	Dead Blackbutt	10-15	>50	0											No Signs	No Signs	No	
299	wpt151	50H	405292	6312995	Marri	20+	>50	0											No Signs	No Signs	No	
300	wpt151a	50H	410659	6311722	Blackbutt	20+	>50	0											No Signs	No Signs	No	
301	wpt152	50H	405267	6313014	Marri	20+	>50	0											No Signs	No Signs	No	
302	wpt152a	50H	410686	6311728	Jarra	20+	>50	0											No Signs	No Signs	No	
303	wpt153	50H	405264	6313024	Jarra	15-20	>50	0											No Signs	No Signs	No	
304	wpt153a	50H	410691	6311723	Blackbutt	20+	>50	0											No Signs	No Signs	No	
305	wpt154	50H	405241	6313031	Jarra	20+	>50	0											No Signs	No Signs	No	
306	wpt154a	50H	410708	6311717	Blackbutt	20+	>50	1	Spout Trunk	20+									No Signs	No Signs	Yes	Depth of hollow unknown
307	wpt155	50H	405233	6313038	Marri	20+	>50	0											No Signs	No Signs	No	
308	wpt155a	50H	410717	6311721	Blackbutt	20+	>50	0											No Signs	No Signs	No	
309	wpt156	50H	405224	6313020	Jarra	20+	>50	5+	Branch	10-20	Branch	10-20	Branch	10-20	Branch	10-20	Branch	10-20	No Signs	No Signs	No	
310	wpt156a	50H	410721	6311708	Marri	20+	>50	0											No Signs	No Signs	No	
311	wpt157	50H	405188	6313053	Marri	20+	>50	0											No Signs	No Signs	No	
312	wpt157a	50H	410726	6311699	Marri	20+	>50	0											No Signs	No Signs	No	
313	wpt158	50H	405183	6313056	Marri	20+	>50	0											No Signs	No Signs	No	
314	wpt158a	50H	410733	6311708	Marri	20+	>50	0											No Signs	No Signs	No	
315	wpt159	50H	405181	6313059	Marri	20+	>50	0											No Signs	No Signs	No	
316	wpt159a	50H	410740	6311699	Marri	20+	>50	0											No Signs	No Signs	No	
317	wpt160	50H	405164	6313050	Marri	20+	>50	2	Spout Branch	10-20	Spout Branch	10-20							No Signs	No Signs	No	
318	wpt160a	50H	410734	6311687	Wandoo	20+	>50	0											No Signs	No Signs	No	
319	wpt161	50H	405164	6313063	Jarra	10-15	>50	0											No Signs	No Signs	No	
320	wpt161a	50H	410737	6311689	Marri	20+	>50	0											No Signs	No Signs	No	
321	wpt162	50H	405170	6313065	Jarra	15-20	>50	0											No Signs	No Signs	No	
322	wpt162a	50H	410739	6311683	Marri	20+	>50	0											No Signs	No Signs	No	
323	wpt163	50H	405176	6313071	Marri	15-20	>50	0											No Signs	No Signs	No	
324	wpt163a	50H	410755	6311686	Dead Unknown	15-20	>50	1	Spout Trunk	20+									No Signs	No Signs	Yes	Depth of hollow unknown
325	wpt164	50H	405169	6313076	Marri	15-20	>50	0											No Signs	No Signs	No	
326	wpt164a	50H	410794	6311671	Marri	20+	>50	0											No Signs	No Signs	No	
327	wpt165	50H	405161	6313080	Jarra	20+	>50	0											No Signs	No Signs	No	
328	wpt165a	50H	410800	6311658	Blackbutt	20+	>50	3	Knot Hole	20+	Branch	10-20	Spout Branch	10-20					No Signs	No Signs	Yes	Depth of hollow unknown
329	wpt166	50H	405157	6313078	Jarra	15-20	>50	0											No Signs	No Signs	No	
330	wpt166a	50H	410814	6311672	Blackbutt	20+	>50	0											No Signs	No Signs	No	
331	wpt167	50H	405147	6313077	Marri	20+	>50	0											No Signs	No Signs	No	
332	wpt167a	50H	410825	6311664	Blackbutt	20+	>50	0											No Signs	No Signs	No	
333	wpt168	50H	405152	6313085	Marri	15-20	>50	0											No Signs	No Signs	No	

Count	Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Hollow Type 3	Hollow Size 3 (cm)	Hollow Type 4	Hollow Size 4 (cm)	Hollow Type 5	Hollow Size 5 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
334	wpt168a	50H	410826	6311662	Blackbutt	20+	>50	0											No Signs	No Signs	No	
335	wpt169	50H	405138	6313094	Jarrah	20+	>50	0											No Signs	No Signs	No	
336	wpt169a	50H	410823	6311659	Blackbutt	20+	>50	0											No Signs	No Signs	No	
337	wpt170	50H	404994	6313155	Marri	20+	>50	0											No Signs	No Signs	No	
338	wpt170a	50H	410835	6311638	Blackbutt	20+	>50	1	Spout Trunk	20+									No Signs	No Signs	Yes	Depth of hollow unknown
339	wpt171	50H	404992	6313154	Marri	15-20	>50	0											No Signs	No Signs	No	
340	wpt171a	50H	410845	6311632	Blackbutt	20+	>50	0											No Signs	No Signs	No	
341	wpt172	50H	404981	6313157	Marri	20+	>50	0											No Signs	No Signs	No	
342	wpt172a	50H	410864	6311632	Blackbutt	20+	>50	2	Knot Hole	20+	Spout Trunk	20+							No Signs	No Signs	Yes	Depth of hollow unknown
343	wpt173	50H	404974	6313166	Marri	15-20	>50	0											No Signs	No Signs	No	
344	wpt173a	50H	410882	6311638	Blackbutt	20+	>50	0											No Signs	No Signs	No	
345	wpt174	50H	404972	6313167	Marri	15-20	>50	0											No Signs	No Signs	No	
346	wpt174a	50H	410883	6311627	Jarrah	20+	>50	0											No Signs	No Signs	No	
347	wpt175	50H	404969	6313165	Marri	15-20	>50	0											No Signs	No Signs	No	
348	wpt175a	50H	410904	6311638	Dead Unknown	0-5	>50	1	Spout Trunk	20+									No Signs	No Signs	Yes	Depth of hollow unknown
349	wpt176	50H	404958	6313170	Marri	15-20	>50	0											No Signs	No Signs	No	
350	wpt176a	50H	410908	6311629	Blackbutt	20+	>50	0											No Signs	No Signs	No	
351	wpt177	50H	404953	6313169	Marri	15-20	>50	0											No Signs	No Signs	No	
352	wpt177a	50H	410936	6311624	Blackbutt	20+	>50	0											No Signs	No Signs	No	
353	wpt178	50H	404949	6313168	Marri	15-20	>50	0											No Signs	No Signs	No	
354	wpt178a	50H	410941	6311618	Blackbutt	20+	>50	0											No Signs	No Signs	No	
355	wpt179	50H	404950	6313170	Marri	15-20	>50	0											No Signs	No Signs	No	
356	wpt179a	50H	410953	6311612	Blackbutt	20+	>50	0											No Signs	No Signs	No	
357	wpt180	50H	404912	6313191	Marri	15-20	>50	0											No Signs	No Signs	No	
358	wpt180a	50H	410954	6311603	Blackbutt	20+	>50	0											No Signs	No Signs	No	
359	wpt181	50H	404892	6313195	Marri	15-20	>50	0											No Signs	No Signs	No	
360	wpt181a	50H	410981	6311602	Marri	20+	>50	0											No Signs	No Signs	No	
361	wpt182	50H	404882	6313195	Marri	15-20	>50	0											No Signs	No Signs	No	
362	wpt182a	50H	411025	6311599	Blackbutt	20+	>50	0											No Signs	No Signs	No	
363	wpt183	50H	404873	6313196	Marri	20+	>50	0											No Signs	No Signs	No	
364	wpt183a	50H	411025	6311609	Blackbutt	20+	>50	0											No Signs	No Signs	No	
365	wpt184	50H	404868	6313199	Marri	20+	>50	0											No Signs	No Signs	No	
366	wpt184a	50H	411023	6311601	Blackbutt	20+	>50	0											No Signs	No Signs	No	
367	wpt185	50H	404851	6313205	Marri	15-20	>50	0											No Signs	No Signs	No	
368	wpt185a	50H	411034	6311592	Blackbutt	20+	>50	0											No Signs	No Signs	No	
369	wpt186	50H	404848	6313206	Marri	15-20	>50	0											No Signs	No Signs	No	
370	wpt186a	50H	411040	6311599	Blackbutt	20+	>50	0											No Signs	No Signs	No	
371	wpt187	50H	404845	6313210	Marri	15-20	>50	0											No Signs	No Signs	No	
372	wpt187a	50H	411043	6311599	Blackbutt	20+	>50	0											No Signs	No Signs	No	
373	wpt188	50H	404839	6313213	Marri	15-20	>50	0											No Signs	No Signs	No	
374	wpt188a	50H	411052	6311586	Blackbutt	20+	>50	0											No Signs	No Signs	No	
375	wpt189	50H	404836	6313211	Marri	15-20	>50	0											No Signs	No Signs	No	
376	wpt189a	50H	411053	6311595	Blackbutt	20+	>50	0											No Signs	No Signs	No	
377	wpt190	50H	404825	6313215	Marri	15-20	>50	0											No Signs	No Signs	No	
378	wpt190a	50H	411066	6311589	Blackbutt	20+	>50	0											No Signs	No Signs	No	
379	wpt191	50H	404809	6313224	Marri	20+	>50	0											No Signs	No Signs	No	
380	wpt191a	50H	411083	6311582	Blackbutt	20+	>50	0											No Signs	No Signs	No	
381	wpt192	50H	404803	6313219	Marri	20+	>50	0											No Signs	No Signs	No	
382	wpt192a	50H	411084	6311581	Blackbutt	20+	>50	0											No Signs	No Signs	No	
383	wpt193	50H	404784	6313226	Marri	20+	>50	0											No Signs	No Signs	No	
384	wpt193a	50H	411085	6311594	Blackbutt	20+	>50	5+	Branch	5-10	Branch	10-20	Branch	5-10	Branch	10-20	Branch	5-10	No Signs	No Signs	No	
385	wpt194	50H	404778	6313229	Marri	15-20	>50	0											No Signs	No Signs	No	
386	wpt194a	50H	411092	6311585	Blackbutt	20+	>50	0											No Signs	No Signs	No	
387	wpt195	50H	404773	6313231	Marri	15-20	>50	0											No Signs	No Signs	No	
388	wpt195a	50H	411108	6311576	Blackbutt	20+	>50	0											No Signs	No Signs	No	
389	wpt196	50H	404750	6313239	Marri	20+	>50	0											No Signs	No Signs	No	

Count	Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Hollow Type 3	Hollow Size 3 (cm)	Hollow Type 4	Hollow Size 4 (cm)	Hollow Type 5	Hollow Size 5 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
390	wpt196a	50H	411127	6311582	Blackbutt	20+	>50	0											No Signs	No Signs	No	
391	wpt197	50H	404737	6313241	Marri	20+	>50	0											No Signs	No Signs	No	
392	wpt197a	50H	411127	6311577	Marri	20+	>50	0											No Signs	No Signs	No	
393	wpt198	50H	404701	6313252	Marri	20+	>50	0											No Signs	No Signs	No	
394	wpt198a	50H	411138	6311574	Blackbutt	20+	>50	0											No Signs	No Signs	No	
395	wpt199	50H	404689	6313257	Marri	15-20	>50	0											No Signs	No Signs	No	
396	wpt199a	50H	411145	6311578	Blackbutt	20+	>50	0											No Signs	No Signs	No	
397	wpt200	50H	404688	6313259	Marri	20+	>50	0											No Signs	No Signs	No	
398	wpt200a	50H	411147	6311582	Marri	20+	>50	0											No Signs	No Signs	No	
399	wpt201	50H	404671	6313260	Marri	20+	>50	0											No Signs	No Signs	No	
400	wpt201a	50H	411156	6311581	Blackbutt	20+	>50	0											No Signs	No Signs	No	
401	wpt202	50H	404633	6313279	Marri	15-20	>50	0											No Signs	No Signs	No	
402	wpt202a	50H	411146	6311589	Blackbutt	20+	>50	0											No Signs	No Signs	No	
403	wpt203	50H	404590	6313287	Marri	20+	>50	0											No Signs	No Signs	No	
404	wpt203a	50H	411160	6311580	Blackbutt	20+	>50	0											No Signs	No Signs	No	
405	wpt204	50H	404580	6313284	Jarrah	15-20	>50	0											No Signs	No Signs	No	
406	wpt204a	50H	411168	6311579	Blackbutt	20+	>50	0											No Signs	No Signs	No	
407	wpt205	50H	404560	6313287	Marri	20+	>50	0											No Signs	No Signs	No	
408	wpt205a	50H	411183	6311575	Blackbutt	20+	>50	0											No Signs	No Signs	No	
409	wpt206	50H	404548	6313309	Jarrah	20+	>50	5+	Spout Branch	10-20	Spout Branch	20+	Spout Branch	10-20	Spout Branch	20+	Spout Branch	10-20	No Signs	No Signs	Yes	Depth of hollow unknown
410	wpt206a	50H	411186	6311566	Blackbutt	20+	>50	0											No Signs	No Signs	No	
411	wpt207	50H	404528	6313308	Marri	20+	>50	0											No Signs	No Signs	No	
412	wpt207a	50H	411195	6311574	Marri	20+	>50	0											No Signs	No Signs	No	
413	wpt208	50H	404534	6313320	Marri	15-20	>50	0											No Signs	No Signs	No	
414	wpt208a	50H	411199	6311581	Blackbutt	20+	>50	0											No Signs	No Signs	No	
415	wpt209	50H	404520	6313311	Marri	20+	>50	0											No Signs	No Signs	No	
416	wpt209a	50H	411222	6311574	Blackbutt	20+	>50	0											No Signs	No Signs	No	
417	wpt210	50H	404485	6313322	Jarrah	15-20	>50	0											No Signs	No Signs	No	
418	wpt210a	50H	411240	6311560	Blackbutt	20+	>50	0											No Signs	No Signs	No	
419	wpt211	50H	404466	6313325	Jarrah	15-20	>50	0											No Signs	No Signs	No	
420	wpt211a	50H	411459	6311509	Marri	20+	>50	?											No Signs	No Signs	No	Potential for hollows
421	wpt212	50H	404366	6313380	Jarrah	15-20	>50	0											No Signs	No Signs	No	
422	wpt212a	50H	411472	6311508	Dead Unknown	20+	>50	2	Branch	5-10	Branch	5-10							No Signs	No Signs	No	
423	wpt213	50H	404175	6313483	Jarrah	20+	>50	0											No Signs	No Signs	No	
424	wpt213a	50H	411192	6311548	Blackbutt	20+	>50	0											No Signs	No Signs	No	
425	wpt214	50H	404144	6313518	Jarrah	20+	>50	0											No Signs	No Signs	No	
426	wpt214a	50H	411190	6311548	Blackbutt	20+	>50	0											No Signs	No Signs	No	
427	wpt215	50H	404103	6313521	Jarrah	20+	>50	0											No Signs	No Signs	No	
428	wpt215a	50H	411182	6311552	Blackbutt	20+	>50	0											No Signs	No Signs	No	
429	wpt216	50H	404096	6313517	Jarrah	20+	>50	0											No Signs	No Signs	No	
430	wpt216a	50H	411141	6311558	Blackbutt	20+	>50	0											No Signs	No Signs	No	
431	wpt217	50H	404095	6313525	Jarrah	15-20	>50	0											No Signs	No Signs	No	
432	wpt217a	50H	411138	6311567	Blackbutt	20+	>50	0											No Signs	No Signs	No	
433	wpt218	50H	404094	6313526	Jarrah	15-20	>50	0											No Signs	No Signs	No	
434	wpt218a	50H	411122	6311565	Blackbutt	20+	>50	0											No Signs	No Signs	No	
435	wpt219	50H	404092	6313539	Jarrah	20+	>50	0											No Signs	No Signs	No	
436	wpt219a	50H	411105	6311569	Marri	20+	>50	0											No Signs	No Signs	No	
437	wpt220	50H	404091	6313543	Jarrah	20+	>50	0											No Signs	No Signs	No	
438	wpt220a	50H	411099	6311562	Marri	20+	>50	0											No Signs	No Signs	No	
439	wpt221	50H	404086	6313547	Jarrah	20+	>50	0											No Signs	No Signs	No	
440	wpt221a	50H	411096	6311560	Blackbutt	20+	>50	0											No Signs	No Signs	No	
441	wpt222	50H	404076	6313552	Marri	15-20	>50	0											No Signs	No Signs	No	
442	wpt222a	50H	411072	6311562	Blackbutt	20+	>50	0											No Signs	No Signs	No	
443	wpt223	50H	404029	6313570	Jarrah	15-20	>50	0											No Signs	No Signs	No	
444	wpt223a	50H	411068	6311567	Blackbutt	20+	>50	0											No Signs	No Signs	No	
445	wpt224	50H	404016	6313593	Marri	20+	>50	0											No Signs	No Signs	No	

Count	Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Hollow Type 3	Hollow Size 3 (cm)	Hollow Type 4	Hollow Size 4 (cm)	Hollow Type 5	Hollow Size 5 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
446	wpt224a	50H	411062	6311574	Marri	20+	>50	0											No Signs	No Signs	No	
447	wpt225	50H	404007	6313597	Jarra	15-20	>50	0											No Signs	No Signs	No	
448	wpt225a	50H	411058	6311575	Blackbutt	20+	>50	0											No Signs	No Signs	No	
449	wpt226	50H	410057	6312292	Marri	15-20	>50	0											No Signs	No Signs	No	
450	wpt226a	50H	411051	6311561	Jarra	20+	>50	5+	Branch	5-10	Branch	10-20	Branch	5-10	Branch	10-20	Branch	5-10	No Signs	No Signs	No	
451	wpt227	50H	403978	6313612	Marri	20+	>50	0											No Signs	No Signs	No	
452	wpt227a	50H	411036	6311566	Dead Blackbutt	20+	>50	5+	Branch	5-10	Branch	10-20	Branch	5-10	Branch	10-20	Spout Branch	10-20	No Signs	No Signs	No	
453	wpt228	50H	403964	6313626	Jarra	15-20	>50	0											No Signs	No Signs	No	
454	wpt228a	50H	411022	6311571	Marri	20+	>50	0											No Signs	No Signs	No	
455	wpt229	50H	403948	6313628	Jarra	15-20	>50	0											No Signs	No Signs	No	
456	wpt229a	50H	411019	6311571	Blackbutt	20+	>50	0											No Signs	No Signs	No	
457	wpt230	50H	403977	6313636	Jarra	15-20	>50	0											No Signs	No Signs	No	
458	wpt230a	50H	411026	6311576	Blackbutt	20+	>50	0											No Signs	No Signs	No	
459	wpt231	50H	403969	6313637	Marri	15-20	>50	0											No Signs	No Signs	No	
460	wpt231a	50H	411007	6311571	Jarra	20+	>50	0											No Signs	No Signs	No	
461	wpt232	50H	405909	6312600	Jarra	15-20	>50	0											No Signs	No Signs	No	
462	wpt232a	50H	410994	6311573	Blackbutt	20+	>50	0											No Signs	No Signs	No	
463	wpt233	50H	405917	6312589	Marri	20+	>50	0											No Signs	No Signs	No	
464	wpt233a	50H	410984	6311584	Blackbutt	10-15	>50	1	Spout Trunk	20+									No Signs	No Signs	Yes	Depth of hollow unknown
465	wpt234	50H	405935	6312614	Marri	20+	>50	5+	Branch	5-10	Branch	10-20	Branch	5-10	Branch	10-20	Branch	5-10	No Signs	No Signs	No	
466	wpt234a	50H	410975	6311586	Blackbutt	20+	>50	0											No Signs	No Signs	No	
467	wpt235	50H	405936	6312604	Jarra	15-20	>50	0											No Signs	No Signs	No	
468	wpt235a	50H	410974	6311593	Blackbutt	20+	>50	0											No Signs	No Signs	No	
469	wpt236	50H	405978	6312590	Jarra	15-20	>50	0											No Signs	No Signs	No	
470	wpt236a	50H	410972	6311591	Blackbutt	20+	>50	0											No Signs	No Signs	No	
471	wpt237	50H	406000	6312564	Jarra	15-20	>50	0											No Signs	No Signs	No	
472	wpt237a	50H	410959	6311593	Marri	20+	>50	0											No Signs	No Signs	No	
473	wpt238	50H	406031	6312563	Jarra	15-20	>50	0											No Signs	No Signs	No	
474	wpt238a	50H	410959	6311583	Marri	20+	>50	?											No Signs	No Signs	No	Potential for hollows
475	wpt239	50H	406049	6312568	Marri	20+	>50	0											No Signs	No Signs	No	
476	wpt239a	50H	410967	6311578	Dead Unknown	20+	>50	1	Spout Trunk										No Signs	No Signs	Yes	Depth of hollow unknown
477	wpt240	50H	406054	6312566	Marri	20+	>50	0											No Signs	No Signs	No	
478	wpt240a	50H	410927	6311603	Blackbutt	20+	>50	0											No Signs	No Signs	No	
479	wpt241	50H	406061	6312560	Marri	20+	>50	0											No Signs	No Signs	No	
480	wpt241a	50H	410923	6311594	Blackbutt	20+	>50	0											No Signs	No Signs	No	
481	wpt242	50H	406073	6312564	Marri	20+	>50	0											No Signs	No Signs	No	
482	wpt242a	50H	410912	6311616	Dead Unknown	20+	>50	?											No Signs	No Signs	No	
483	wpt243	50H	406076	6312569	Jarra	15-20	>50	0											No Signs	No Signs	No	
484	wpt243a	50H	410926	6311601	Blackbutt	20+	>50	0											No Signs	No Signs	No	
485	wpt244	50H	406098	6312554	Jarra	15-20	>50	0											No Signs	No Signs	No	
486	wpt244a	50H	410908	6311615	Blackbutt	20+	>50	0											No Signs	No Signs	No	
487	wpt245	50H	406104	6312562	Jarra	10-15	>50	1	Spout Trunk	20+									No Signs	No Signs	No	Appears too shallow
488	wpt245a	50H	410915	6311596	Blackbutt	20+	>50	0											No Signs	No Signs	No	
489	wpt246	50H	406106	6312536	Marri	20+	>50	0											No Signs	No Signs	No	
490	wpt246a	50H	410901	6311598	Marri	20+	>50	0											No Signs	No Signs	No	
491	wpt247	50H	406111	6312539	Marri	20+	>50	0											No Signs	No Signs	No	
492	wpt247a	50H	410897	6311605	Blackbutt	20+	>50	0											No Signs	No Signs	No	
493	wpt248	50H	406118	6312539	Marri	20+	>50	0											No Signs	No Signs	No	
494	wpt248a	50H	410887	6311613	Marri	20+	>50	0											No Signs	No Signs	No	
495	wpt249	50H	406130	6312554	Jarra	15-20	>50	4	Branch	5-10	Branch	10-20	Branch	5-10	Spout Branch	10-20			No Signs	No Signs	No	
496	wpt249a	50H	410885	6311620	Blackbutt	20+	>50	0											No Signs	No Signs	No	
497	wpt250	50H	406127	6312557	Marri	15-20	>50	0											No Signs	No Signs	No	
498	wpt250a	50H	410877	6311607	Dead Unknown	20+	>50	5+	Branch	5-10	Branch	10-20	Branch	5-10	Branch	10-20	Spout Branch	20+	No Signs	No Signs	Yes	Depth of hollow unknown
499	wpt251	50H	406151	6312555	Marri	15-20	>50	0											No Signs	No Signs	No	
500	wpt251a	50H	410864	6311620	Blackbutt	20+	>50	2	Branch	5-10	Branch	10-20							No Signs	No Signs	No	
501	wpt252	50H	406156	6312559	Jarra	15-20	>50	0											No Signs	No Signs	No	

Count	Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Hollow Type 3	Hollow Size 3 (cm)	Hollow Type 4	Hollow Size 4 (cm)	Hollow Type 5	Hollow Size 5 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
502	wpt252a	50H	410856	6311614	Blackbutt	20+	>50	0											No Signs	No Signs	No	
503	wpt253	50H	406170	6312543	Jarrah	15-20	>50	0											No Signs	No Signs	No	
504	wpt253a	50H	410863	6311606	Marri	20+	>50	5+	Knot Hole	20+	Knot Hole	20+	Knot Hole	20+	Knot Hole	10-20	Branch	10-20	Black Cockatoo	Cockatoos	Yes	Chew marks = Cockatoos?
505	wpt254	50H	406195	6312530	Jarrah	15-20	>50	0											No Signs	No Signs	No	
506	wpt254a	50H	410855	6311613	Blackbutt	20+	>50	0											No Signs	No Signs	No	
507	wpt255	50H	406256	6312523	Jarrah	15-20	>50	0											No Signs	No Signs	No	
508	wpt255a	50H	410848	6311617	Marri	20+	>50	0											No Signs	No Signs	No	
509	wpt256	50H	406256	6312520	Marri	15-20	>50	0											No Signs	No Signs	No	
510	wpt256a	50H	410817	6311628	Marri	20+	>50	2	Branch	5-10	Branch	10-20							No Signs	No Signs	No	
511	wpt257	50H	406267	6312518	Marri	15-20	>50	0											No Signs	No Signs	No	
512	wpt257a	50H	410807	6311640	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
513	wpt258	50H	406272	6312519	Marri	15-20	>50	0											No Signs	No Signs	No	
514	wpt258a	50H	410797	6311630	Blackbutt	20+	>50	0											No Signs	No Signs	No	
515	wpt259	50H	406276	6312520	Marri	15-20	>50	0											No Signs	No Signs	No	
516	wpt259a	50H	410793	6311640	Blackbutt	20+	>50	0											No Signs	No Signs	No	
517	wpt260	50H	406284	6312522	Marri	20+	>50	0											No Signs	No Signs	No	
518	wpt260a	50H	410780	6311656	Blackbutt	20+	>50	?											No Signs	No Signs	No	Potential for hollows
519	wpt261	50H	406296	6312521	Jarrah	15-20	>50	0											No Signs	No Signs	No	
520	wpt261a	50H	410770	6311652	Marri	20+	>50	0											No Signs	No Signs	No	
521	wpt262	50H	406296	6312528	Jarrah	15-20	>50	0											No Signs	No Signs	No	
522	wpt262a	50H	410755	6311653	Marri	20+	>50	0											No Signs	No Signs	No	
523	wpt263	50H	406302	6312520	Jarrah	15-20	>50	0											No Signs	No Signs	No	
524	wpt263a	50H	410750	6311653	Marri	20+	>50	0											No Signs	No Signs	No	
525	wpt264	50H	406305	6312518	Jarrah	15-20	>50	0											No Signs	No Signs	No	
526	wpt264a	50H	410736	6311658	Blackbutt	20+	>50	5+	Branch	5-10	Branch	10-20	Branch	20+	Branch	5-10	Branch	10-20	No Signs	No Signs	Yes	Large hollow butt
527	wpt265	50H	406320	6312520	Jarrah	15-20	>50	0											No Signs	No Signs	No	
528	wpt265a	50H	410744	6311671	Blackbutt	20+	>50	0											No Signs	No Signs	No	
529	wpt266	50H	406323	6312528	Jarrah	15-20	>50	0											No Signs	No Signs	No	
530	wpt266a	50H	410742	6311676	Blackbutt	20+	>50	0											No Signs	No Signs	No	
531	wpt267	50H	406333	6312528	Jarrah	15-20	>50	0											No Signs	No Signs	No	
532	wpt267a	50H	410721	6311676	Blackbutt	20+	>50	0											No Signs	No Signs	No	
533	wpt268	50H	406357	6312524	Jarrah	15-20	>50	0											No Signs	No Signs	No	
534	wpt268a	50H	410722	6311678	Marri	20+	>50	0											No Signs	No Signs	No	
535	wpt269	50H	406370	6312520	Jarrah	15-20	>50	0											No Signs	No Signs	No	
536	wpt269a	50H	410719	6311685	Marri	20+	>50	0											No Signs	No Signs	No	
537	wpt270	50H	406368	6312520	Marri	15-20	>50	0											No Signs	No Signs	No	
538	wpt270a	50H	410698	6311698	Blackbutt	20+	>50	0											No Signs	No Signs	No	
539	wpt271	50H	406377	6312515	Jarrah	15-20	>50	0											No Signs	No Signs	No	
540	wpt271a	50H	410634	6311734	Blackbutt	20+	>50	0											No Signs	No Signs	No	
541	wpt272	50H	406381	6312516	Jarrah	15-20	>50	0											No Signs	No Signs	No	
542	wpt272a	50H	404980	6312619	Marri	15-20	>50	0											No Signs	No Signs	No	
543	wpt273	50H	406396	6312526	Jarrah	15-20	>50	0											No Signs	No Signs	No	
544	wpt273a	50H	404964	6312587	Marri	20+	>50	0											No Signs	No Signs	No	
545	wpt274	50H	406410	6312528	Jarrah	15-20	>50	0											No Signs	No Signs	No	
546	wpt275	50H	406415	6312522	Jarrah	15-20	>50	0											No Signs	No Signs	No	
547	wpt276	50H	406423	6312506	Jarrah	15-20	>50	0											No Signs	No Signs	No	
548	wpt277	50H	406438	6312515	Jarrah	15-20	>50	0											No Signs	No Signs	No	
549	wpt278	50H	406461	6312527	Jarrah	15-20	>50	0											No Signs	No Signs	No	
550	wpt279	50H	406505	6312526	Marri	20+	>50	2	Branch	10-20	Spout Trunk	20+							No Signs	No Signs	Yes	Depth of hollow unknown
551	wpt281	50H	406480	6312514	Jarrah	15-20	>50	0											No Signs	No Signs	No	
552	wpt282	50H	406482	6312515	Jarrah	15-20	>50	0											No Signs	No Signs	No	
553	wpt283	50H	406471	6312504	Marri	15-20	>50	0											No Signs	No Signs	No	
554	wpt284	50H	406462	6312500	Jarrah	15-20	>50	0											No Signs	No Signs	No	
555	wpt285	50H	406453	6312495	Jarrah	15-20	>50	0											No Signs	No Signs	No	
556	wpt286	50H	406358	6312496	Marri	15-20	>50	0											No Signs	No Signs	No	
557	wpt287	50H	406346	6312496	Jarrah	20+	>50	0											No Signs	No Signs	No	

Count	Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Hollow Type 3	Hollow Size 3 (cm)	Hollow Type 4	Hollow Size 4 (cm)	Hollow Type 5	Hollow Size 5 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments	
558	wpt288	50H	406341	6312488	Jarrah	15-20	>50	0											No Signs	No Signs	No		
559	wpt289	50H	406315	6312503	Jarrah	20+	>50	0												No Signs	No Signs	No	
560	wpt290	50H	406287	6312502	Jarrah	15-20	>50	0												No Signs	No Signs	No	
561	wpt291	50H	406273	6312501	Marri	15-20	>50	0												No Signs	No Signs	No	
562	wpt292	50H	406250	6312494	Marri	15-20	>50	0												No Signs	No Signs	No	
563	wpt293	50H	406235	6312481	Marri	20+	>50	5+	Branch	5-10	Branch	10-20	Branch	5-10	Branch	10-20	Spout Branch	20+	No Signs	No Signs	Yes	Depth of hollow unknown	
564	wpt294	50H	406158	6312505	Marri	15-20	>50	0												No Signs	No Signs	No	
565	wpt295	50H	406136	6312523	Marri	15-20	>50	0												No Signs	No Signs	No	
566	wpt296	50H	406113	6312520	Marri	15-20	>50	0												No Signs	No Signs	No	
567	wpt297	50H	406113	6312515	Marri	15-20	>50	0												No Signs	No Signs	No	
568	wpt298	50H	406086	6312516	Marri	10-15	>50	1	Branch	10-20										No Signs	No Signs	No	
569	wpt299	50H	406012	6312537	Dead Jarrah	20+	>50	3	Branch	10-20	Branch	10-20	Spout Branch	20+						No Signs	No Signs	Yes	Depth of hollow unknown
570	wpt300	50H	405996	6312539	Marri	15-20	>50	1	Branch	5-10										No Signs	No Signs	No	
571	wpt302	50H	405938	6312567	Marri	15-20	>50	0												No Signs	No Signs	No	
572	wpt303	50H	405939	6312571	Jarrah	15-20	>50	0												No Signs	No Signs	No	
573	wpt304	50H	405912	6312565	Jarrah	20+	>50	0												No Signs	No Signs	No	
574	wpt305	50H	406898	6312617	Dead Unknown	20+	>50	5+	Branch	10-20	Branch	10-20	Branch	10-20	Branch	10-20	Branch	20+	No Signs	No Signs	Yes	In open Paddock	
575	wpt306	50H	407179	6312643	Marri	20+	>50	1	Knot Hole	10-20										Black Cockatoo	No Signs	Yes	FRTBCs investigating
576	wpt307	50H	407176	6312693	Marri	15-20	>50	0												No Signs	No Signs	No	
577	wpt308	50H	407243	6312730	Marri	15-20	>50	0												No Signs	No Signs	No	
578	wpt309	50H	407275	6312752	Marri	15-20	>50	0												No Signs	No Signs	No	
579	wpt310	50H	407283	6312755	Marri	15-20	>50	0												No Signs	No Signs	No	
580	wpt311	50H	407308	6312770	Marri	5-10	>50	0												No Signs	No Signs	No	
581	wpt312	50H	407355	6312780	Marri	15-20	>50	0												No Signs	No Signs	No	
582	wpt313	50H	407384	6312795	Marri	15-20	>50	0												No Signs	No Signs	No	
583	wpt314	50H	407427	6312803	Marri	15-20	>50	0												No Signs	No Signs	No	
584	wpt315	50H	407455	6312807	Marri	15-20	>50	0												No Signs	No Signs	No	
585	wpt316	50H	407522	6312805	Marri	15-20	>50	0												No Signs	No Signs	No	
586	wpt317	50H	407552	6312811	Marri	15-20	>50	0												No Signs	No Signs	No	
587	wpt318	50H	407569	6312810	Marri	15-20	>50	0												No Signs	No Signs	No	
588	wpt319	50H	407601	6312812	Marri	15-20	>50	0												No Signs	No Signs	No	
589	wpt320	50H	407622	6312809	Marri	15-20	>50	0												No Signs	No Signs	No	
590	wpt321	50H	407647	6312816	Marri	15-20	>50	0												No Signs	No Signs	No	
591	wpt322	50H	407798	6312821	Marri	15-20	>50	0												No Signs	No Signs	No	
592	wpt323	50H	408066	6312802	Marri	15-20	>50	0												No Signs	No Signs	No	
593	wpt324	50H	408094	6312795	Marri	15-20	>50	0												No Signs	No Signs	No	
594	wpt325	50H	408111	6312798	Marri	15-20	>50	0												No Signs	No Signs	No	
595	wpt326	50H	408133	6312795	Marri	15-20	>50	0												No Signs	No Signs	No	
596	wpt327	50H	408138	6312797	Marri	15-20	>50	0												No Signs	No Signs	No	
597	wpt328	50H	408166	6312785	Marri	15-20	>50	0												No Signs	No Signs	No	
598	wpt329	50H	408190	6312788	Marri	15-20	>50	0												No Signs	No Signs	No	
599	wpt330	50H	408235	6312776	Marri	15-20	>50	0												No Signs	No Signs	No	
600	wpt331	50H	408296	6312765	Marri	15-20	>50	0												No Signs	No Signs	No	
601	wpt332	50H	408310	6312751	Marri	15-20	>50	0												No Signs	No Signs	No	
602	wpt333	50H	408314	6312748	Marri	15-20	>50	0												No Signs	No Signs	No	
603	wpt334	50H	408331	6312745	Marri	15-20	>50	0												No Signs	No Signs	No	
604	wpt335	50H	408343	6312745	Marri	15-20	>50	0												No Signs	No Signs	No	
605	wpt336	50H	408346	6312744	Marri	15-20	>50	0												No Signs	No Signs	No	
606	wpt337	50H	408393	6312710	Marri	15-20	>50	0												No Signs	No Signs	No	
607	wpt338	50H	408397	6312707	Marri	15-20	>50	0												No Signs	No Signs	No	
608	wpt339	50H	408407	6312702	Marri	15-20	>50	0												No Signs	No Signs	No	
609	wpt340	50H	408424	6312692	Marri	15-20	>50	0												No Signs	No Signs	No	
610	wpt341	50H	408308	6312721	Marri	20+	>50	0												No Signs	No Signs	No	
611	wpt342	50H	408259	6312742	Jarrah	15-20	>50	0												No Signs	No Signs	No	
612	wpt343	50H	408231	6312740	Jarrah	15-20	>50	0												No Signs	No Signs	No	
613	wpt344	50H	408223	6312748	Jarrah	15-20	>50	0												No Signs	No Signs	No	

Count	Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Hollow Type 3	Hollow Size 3 (cm)	Hollow Type 4	Hollow Size 4 (cm)	Hollow Type 5	Hollow Size 5 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
614	wpt345	50H	408120	6312756	Marri	15-20	>50	0											No Signs	No Signs	No	
615	wpt346	50H	408117	6312756	Jarrah	15-20	>50	0											No Signs	No Signs	No	
616	wpt348	50H	408081	6312767	Marri	15-20	>50	0											No Signs	No Signs	No	
617	wpt349	50H	408062	6312768	Marri	15-20	>50	0											No Signs	No Signs	No	
618	wpt350	50H	408058	6312772	Jarrah	15-20	>50	0											No Signs	No Signs	No	
619	wpt351	50H	408052	6312773	Marri	20+	>50	0											No Signs	No Signs	No	
620	wpt352	50H	408037	6312767	Marri	20+	>50	0											No Signs	No Signs	No	
621	wpt353	50H	407857	6312789	Jarrah	15-20	>50	0											No Signs	No Signs	No	
622	wpt354	50H	407854	6312789	Marri	15-20	>50	0											No Signs	No Signs	No	
623	wpt355	50H	407844	6312784	Jarrah	15-20	>50	0											No Signs	No Signs	No	
624	wpt356	50H	407822	6312783	Marri	20+	>50	0											No Signs	No Signs	No	
625	wpt357	50H	407748	6312788	Jarrah	15-20	>50	0											No Signs	No Signs	No	
626	wpt358	50H	407727	6312777	Marri	20+	>50	5+	Branch	5-10	Branch	10-20	Branch	5-10	Branch	10-20	Branch	5-10	No Signs	No Signs	Yes	Depth of hollow unknown
627	wpt359	50H	407690	6312782	Jarrah	20+	>50	1	Knot Hole	5-10									No Signs	No Signs	No	
628	wpt360	50H	407681	6312782	Jarrah	15-20	>50	0											No Signs	No Signs	No	
629	wpt361	50H	407598	6312774	Jarrah	20+	>50	1	Spout Branch	10-20									No Signs	No Signs	Yes	Depth of hollow unknown
630	wpt362	50H	407556	6312773	Marri	15-20	>50	0											No Signs	No Signs	No	
631	wpt363	50H	407522	6312765	Jarrah	20+	>50	1	Spout Branch	20+									No Signs	No Signs	Yes	Depth of hollow unknown
632	wpt364	50H	407495	6312773	Marri	20+	>50	0											No Signs	No Signs	No	
633	wpt365	50H	407489	6312764	Marri	20+	>50	0											No Signs	No Signs	No	
634	wpt366	50H	407471	6312768	Marri	20+	>50	0											No Signs	No Signs	No	
635	wpt367	50H	407466	6312768	Marri	20+	>50	0											No Signs	No Signs	No	
636	wpt368	50H	407453	6312770	Marri	20+	>50	1	Knot Hole	10-20									No Signs	No Signs	Yes	Depth of hollow unknown
637	wpt369	50H	407433	6312750	Jarrah	20+	>50	0											No Signs	No Signs	No	
638	wpt370	50H	407417	6312748	Jarrah	20+	>50	0											No Signs	No Signs	No	
639	wpt371	50H	407415	6312756	Jarrah	15-20	>50	0											No Signs	No Signs	No	
640	wpt372	50H	407415	6312762	Marri	15-20	>50	0											No Signs	No Signs	No	
641	wpt373	50H	407410	6312759	Jarrah	15-20	>50	0											No Signs	No Signs	No	
642	wpt374	50H	407403	6312750	Jarrah	15-20	>50	0											No Signs	No Signs	No	
643	wpt375	50H	407390	6312752	Dead Marri	20+	>50	5+	Branch	5-10	Branch	5-10	Branch	5-10	Branch	5-10	Spout Trunk	20+	No Signs	No Signs	Yes	Depth of hollow unknown
644	wpt376	50H	410024	6312299	Marri	15-20	>50	0											No Signs	No Signs	No	
645	wpt377	50H	409986	6312321	Marri	15-20	>50	0											No Signs	No Signs	No	
646	wpt378	50H	409965	6312331	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
647	wpt379	50H	409951	6312348	Marri	15-20	>50	0											No Signs	No Signs	No	
648	wpt380	50H	409928	6312347	Marri	15-20	>50	0											No Signs	No Signs	No	
649	wpt381	50H	409923	6312358	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
650	wpt382	50H	409922	6312355	Marri	15-20	>50	0											No Signs	No Signs	No	
651	wpt383	50H	409919	6312356	Marri	15-20	>50	0											No Signs	No Signs	No	
652	wpt384	50H	409914	6312360	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
653	wpt385	50H	409768	6312405	Marri	15-20	>50	0											No Signs	No Signs	No	
654	wpt386	50H	409766	6312405	Marri	15-20	>50	0											No Signs	No Signs	No	
655	wpt387	50H	409783	6312407	Marri	15-20	>50	0											No Signs	No Signs	No	
656	wpt388	50H	409794	6312406	Marri	15-20	>50	0											No Signs	No Signs	No	
657	wpt389	50H	409805	6312402	Jarrah	15-20	>50	0											No Signs	No Signs	No	
658	wpt390	50H	409808	6312403	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
659	wpt391	50H	409808	6312401	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
660	wpt392	50H	409824	6312402	Marri	15-20	>50	0											No Signs	No Signs	No	
661	wpt393	50H	409829	6312401	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
662	wpt394	50H	409828	6312406	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
663	wpt395	50H	409832	6312408	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
664	wpt396	50H	409837	6312406	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
665	wpt397	50H	409836	6312401	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
666	wpt398	50H	409841	6312397	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
667	wpt399	50H	409841	6312397	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
668	wpt400	50H	409849	6312396	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
669	wpt401	50H	409853	6312398	Marri	15-20	>50	0											No Signs	No Signs	No	

Count	Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Hollow Type 3	Hollow Size 3 (cm)	Hollow Type 4	Hollow Size 4 (cm)	Hollow Type 5	Hollow Size 5 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
670	wpt402	50H	409869	6312397	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
671	wpt403	50H	409870	6312397	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
672	wpt404	50H	409920	6312390	Marri	15-20	>50	0											No Signs	No Signs	No	
673	wpt405	50H	409924	6312384	Marri	15-20	>50	0											No Signs	No Signs	No	
674	wpt406	50H	409954	6312376	Marri	15-20	>50	0											No Signs	No Signs	No	
675	wpt407	50H	409963	6312379	Marri	15-20	>50	0											No Signs	No Signs	No	
676	wpt408	50H	409966	6312375	Marri	15-20	>50	0											No Signs	No Signs	No	
677	wpt409	50H	409972	6312371	Marri	15-20	>50	0											No Signs	No Signs	No	
678	wpt410	50H	409981	6312368	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
679	wpt411	50H	409999	6312362	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
680	wpt412	50H	410020	6312345	Marri	20+	>50	5+	Branch	5-10	Branch	10-20	Branch	5-10	Branch	10-20	Branch	5-10	No Signs	No Signs	No	
681	wpt413	50H	410042	6312336	Blackbutt	20+	>50	0											No Signs	No Signs	No	
682	wpt414	50H	410057	6312334	Marri	15-20	>50	0											No Signs	No Signs	No	
683	wpt415	50H	410083	6312312	Marri	15-20	>50	0											No Signs	No Signs	No	
684	wpt416	50H	410091	6312309	Marri	20+	>50	0											No Signs	No Signs	No	
685	wpt417	50H	410145	6312266	Marri	15-20	>50	0											No Signs	No Signs	No	
686	wpt418	50H	410148	6312260	Marri	15-20	>50	0											No Signs	No Signs	No	
687	wpt419	50H	410168	6312252	Marri	15-20	>50	0											No Signs	No Signs	No	
688	wpt420	50H	410169	6312244	Marri	15-20	>50	0											No Signs	No Signs	No	
689	wpt421	50H	410204	6312215	Marri	15-20	>50	0											No Signs	No Signs	No	
690	wpt422	50H	410219	6312216	Marri	15-20	>50	0											No Signs	No Signs	No	
691	wpt423	50H	410216	6312191	Marri	20+	>50	0											No Signs	No Signs	No	
692	wpt424	50H	410235	6312185	Marri	20+	>50	5+	Branch	5-10	Branch	5-10	Branch	5-10	Branch	5-10	Spout Branch	10-20	Brush-tailed Possum	No Signs	No	
693	wpt425	50H	410256	6312168	Marri	20+	>50	0											No Signs	No Signs	No	
694	wpt426	50H	410255	6312165	Jarra	20+	>50	0											No Signs	No Signs	No	
695	wpt427	50H	410266	6312154	Marri	20+	>50	0											No Signs	No Signs	No	
696	wpt428	50H	410281	6312149	Marri	15-20	>50	0											No Signs	No Signs	No	
697	wpt429	50H	410312	6312122	Marri	20+	>50	0											No Signs	No Signs	No	
698	wpt430	50H	410326	6312108	Marri	20+	>50	0											No Signs	No Signs	No	
699	wpt431	50H	410331	6312095	Marri	20+	>50	0											No Signs	No Signs	No	
700	wpt432	50H	410336	6312089	Marri	20+	>50	0											No Signs	No Signs	No	
701	wpt433	50H	410374	6312055	Marri	15-20	>50	0											No Signs	No Signs	No	
702	wpt434	50H	410384	6312047	Marri	20+	>50	0											No Signs	No Signs	No	
703	wpt435	50H	410401	6312029	Marri	20+	>50	0											No Signs	No Signs	No	
704	wpt436	50H	410442	6311985	Jarra	20+	>50	0											No Signs	No Signs	No	
705	wpt437	50H	410467	6311963	Marri	15-20	>50	0											No Signs	No Signs	No	
706	wpt438	50H	410484	6311950	Marri	20+	>50	1	Spout Branch	20+									No Signs	No Signs	Yes	Depth of hollow unknown
707	wpt439	50H	410489	6311931	Blackbutt	20+	>50	0											No Signs	No Signs	No	
708	wpt440	50H	410526	6311907	Marri	15-20	>50	0											No Signs	No Signs	No	
709	wpt441	50H	410525	6311909	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
710	wpt443	50H	410546	6311882	Blackbutt	20+	>50	5+	Knot Hole	5-10	Knot Hole	5-10	Branch	10-20	Branch	10-20	Spout Trunk	20+	Bees	No Signs	No	Too low/shallow
711	wpt444	50H	410585	6311836	Blackbutt	10-15	>50	0											No Signs	No Signs	No	
712	wpt445	50H	410601	6311842	Marri	20+	>50	5+	Branch	5-10	Branch	10-20	Branch	5-10	Branch	10-20	Branch	5-10	No Signs	No Signs	No	
713	wpt446	50H	410600	6311815	Marri	20+	>50	0											No Signs	No Signs	No	
714	wpt447	50H	410617	6311834	Blackbutt	20+	>50	0											No Signs	No Signs	No	
715	wpt448	50H	410665	6311784	Blackbutt	20+	>50	0											No Signs	No Signs	No	
716	wpt449	50H	410686	6311765	Marri	20+	>50	0											No Signs	No Signs	No	
717	wpt450	50H	410761	6311726	Blackbutt	20+	>50	0											No Signs	No Signs	No	
718	wpt451	50H	410762	6311727	Blackbutt	20+	>50	0											No Signs	No Signs	No	
719	wpt452	50H	410800	6311737	Blackbutt	20+	>50	0											No Signs	No Signs	No	
720	wpt453	50H	410825	6311722	Blackbutt	20+	>50	0											No Signs	No Signs	No	
721	wpt454	50H	410857	6311710	Blackbutt	20+	>50	0											No Signs	No Signs	No	
722	wpt455	50H	410875	6311700	Blackbutt	20+	>50	2	Branch	5-10	Branch	10-20							No Signs	No Signs	No	
723	wpt456	50H	410894	6311706	Blackbutt	20+	>50	5+	Branch	5-10	Branch	10-20	Branch	5-10	Branch	10-20	Spout Branch	20+	No Signs	No Signs	Yes	Depth of hollow unknown
724	wpt457	50H	410924	6311697	Marri	20+	>50	0											No Signs	No Signs	No	
725	wpt458	50H	410930	6311689	Marri	20+	>50	0											No Signs	No Signs	No	

Count	Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Hollow Type 3	Hollow Size 3 (cm)	Hollow Type 4	Hollow Size 4 (cm)	Hollow Type 5	Hollow Size 5 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
726	wpt459	50H	410972	6311691	Marri	20+	>50	0											No Signs	No Signs	No	
727	wpt460	50H	410990	6311673	Marri	20+	>50	0											No Signs	No Signs	No	
728	wpt461	50H	411052	6311646	Marri	20+	>50	0											No Signs	No Signs	No	
729	wpt462	50H	411056	6311635	Blackbutt	20+	>50	0											No Signs	No Signs	No	
730	wpt463	50H	411073	6311643	Blackbutt	20+	>50	0											No Signs	No Signs	No	
731	wpt464	50H	411094	6311650	Blackbutt	20+	>50	0											No Signs	No Signs	No	
732	wpt465	50H	411093	6311638	Blackbutt	20+	>50	0											No Signs	No Signs	No	
733	wpt466	50H	411085	6311631	Blackbutt	20+	>50	0											No Signs	No Signs	No	
734	wpt467	50H	411121	6311636	Blackbutt	20+	>50	0											No Signs	No Signs	No	
735	wpt468	50H	411124	6311636	Blackbutt	20+	>50	0											No Signs	No Signs	No	
736	wpt469	50H	411116	6311645	Blackbutt	20+	>50	0											No Signs	No Signs	No	
737	wpt470	50H	411114	6311651	Blackbutt	20+	>50	0											No Signs	No Signs	No	
738	wpt471	50H	411142	6311624	Blackbutt	20+	>50	0											No Signs	No Signs	No	
739	wpt472	50H	411161	6311623	Blackbutt	20+	>50	0											No Signs	No Signs	No	
740	wpt473	50H	411162	6311635	Blackbutt	20+	>50	0											No Signs	No Signs	No	
741	wpt474	50H	411169	6311629	Blackbutt	20+	>50	0											No Signs	No Signs	No	
742	wpt475	50H	411193	6311626	Blackbutt	20+	>50	0											No Signs	No Signs	No	
743	wpt476	50H	411222	6311621	Blackbutt	20+	>50	0											No Signs	No Signs	No	
744	wpt477	50H	411245	6311601	Marri	20+	>50	0											No Signs	No Signs	No	
745	wpt478	50H	411246	6311597	Blackbutt	20+	>50	0											No Signs	No Signs	No	
746	wpt479	50H	411245	6311596	Blackbutt	20+	>50	0											No Signs	No Signs	No	
747	wpt480	50H	411237	6311592	Marri	20+	>50	0											No Signs	No Signs	No	
748	wpt481	50H	411235	6311593	Blackbutt	20+	>50	0											No Signs	No Signs	No	
749	wpt482	50H	411251	6311596	Blackbutt	20+	>50	0											No Signs	No Signs	No	
750	wpt483	50H	411253	6311602	Blackbutt	20+	>50	0											No Signs	No Signs	No	
751	wpt484	50H	411268	6311609	Blackbutt	20+	>50	0											No Signs	No Signs	No	
752	wpt485	50H	411271	6311598	Marri	20+	>50	0											No Signs	No Signs	No	
753	wpt486	50H	411277	6311591	Blackbutt	20+	>50	0											No Signs	No Signs	No	
754	wpt487	50H	411282	6311600	Blackbutt	20+	>50	0											No Signs	No Signs	No	
755	wpt488	50H	411249	6311587	Marri	20+	>50	0											No Signs	No Signs	No	
756	wpt489	50H	411227	6311575	Blackbutt	20+	>50	1	Knot Hole	10-20									No Signs	No Signs	Yes	Depth of hollow unknown
757	wpt490	50H	411224	6311584	Marri	20+	>50	0											No Signs	No Signs	No	
758	wpt491	50H	411222	6311587	Marri	20+	>50	0											No Signs	No Signs	No	
759	wpt492	50H	411192	6311587	Blackbutt	20+	>50	0											No Signs	No Signs	No	
760	wpt493	50H	411180	6311605	Blackbutt	20+	>50	0											No Signs	No Signs	No	
761	wpt494	50H	411133	6311604	Blackbutt	20+	>50	0											No Signs	No Signs	No	
762	wpt495	50H	410980	6311653	Blackbutt	20+	>50	0											No Signs	No Signs	No	
763	wpt496	50H	410882	6311662	Dead Unknown	20+	>50	1	Spout Trunk	20+									No Signs	No Signs	Yes	Depth of hollow unknown
764	wpt497	50H	410878	6311665	Blackbutt	20+	>50	0											No Signs	No Signs	No	
765	wpt498	50H	410848	6311679	Marri	20+	>50	0											No Signs	No Signs	No	
766	wpt499	50H	410834	6311686	Blackbutt	20+	>50	0											No Signs	No Signs	No	
767	wpt500	50H	410793	6311695	Marri	20+	>50	0											No Signs	No Signs	No	
768	wpt501	50H	410777	6311696	Blackbutt	20+	>50	0											No Signs	No Signs	No	
769	wpt502	50H	410771	6311698	Marri	15-20	>50	1	Spout Branch	10-20									No Signs	No Signs	No	
770	wpt503	50H	410770	6311711	Blackbutt	15-20	>50	1	Spout Branch	20+									No Signs	No Signs	Yes	Possibly too low
771	wpt504	50H	410740	6311711	Marri	20+	>50	0											No Signs	No Signs	No	
772	wpt505	50H	410708	6311729	Blackbutt	20+	>50	0											No Signs	No Signs	No	
773	wpt506	50H	410698	6311726	Marri	20+	>50	?											No Signs	No Signs	No	Hollows likely
774	wpt507	50H	410656	6311749	Blackbutt	20+	>50	0											No Signs	No Signs	No	
775	wpt508	50H	410645	6311757	Blackbutt	20+	>50	0											No Signs	No Signs	No	
776	wpt509	50H	410605	6311779	Marri	20+	>50	0											No Signs	No Signs	No	
777	wpt510	50H	410592	6311793	Marri	20+	>50	0											No Signs	No Signs	No	
778	wpt511	50H	410537	6311830	Marri	20+	>50	?											No Signs	No Signs	No	Hollows likely
779	wpt512	50H	410530	6311844	Blackbutt	20+	>50	0											No Signs	No Signs	No	
780	wpt513	50H	410527	6311846	Marri	15-20	>50	0											No Signs	No Signs	No	
781	wpt514	50H	410516	6311858	Marri	20+	>50	0											No Signs	No Signs	No	

Count	Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Hollow Type 3	Hollow Size 3 (cm)	Hollow Type 4	Hollow Size 4 (cm)	Hollow Type 5	Hollow Size 5 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
782	wpt515	50H	410508	6311870	Blackbutt	20+	>50	0											No Signs	No Signs	No	
783	wpt516	50H	410498	6311876	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
784	wpt517	50H	410425	6311952	Jarrah	15-20	>50	0											No Signs	No Signs	No	
785	wpt518	50H	410398	6311982	Marri	20+	>50	0											No Signs	No Signs	No	
786	wpt519	50H	410383	6311992	Jarrah	15-20	>50	0											No Signs	No Signs	No	
787	wpt520	50H	410379	6311999	Marri	20+	>50	0											No Signs	No Signs	No	
788	wpt521	50H	410341	6312036	Marri	15-20	>50	0											No Signs	No Signs	No	
789	wpt522	50H	410330	6312037	Dead Unknown	15-20	>50	5+	Branch	10-20	Branch	10-20	Branch	10-20	Branch	10-20	Spout Trunk	20+	No Signs	No Signs	Yes	Depth of hollow unknown
790	wpt523	50H	410321	6312060	Marri	20+	>50	0											No Signs	No Signs	No	
791	wpt524	50H	410315	6312065	Marri	20+	>50	0											No Signs	No Signs	No	
792	wpt525	50H	410296	6312082	Marri	20+	>50	0											No Signs	No Signs	No	
793	wpt526	50H	410286	6312092	Marri	20+	>50	0											No Signs	No Signs	No	
794	wpt527	50H	410268	6312116	Marri	20+	>50	0											No Signs	No Signs	No	
795	wpt528	50H	410224	6312154	Marri	20+	>50	0											No Signs	No Signs	No	
796	wpt529	50H	410191	6312181	Marri	20+	>50	0											No Signs	No Signs	No	
797	wpt530	50H	410122	6312239	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
798	wpt531	50H	410094	6312257	Marri	20+	>50	0											No Signs	No Signs	No	
799	wpt532	50H	410083	6312261	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
800	wpt533	50H	410073	6312279	Marri	15-20	>50	0											No Signs	No Signs	No	
801	wpt534	50H	413855	6311046	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
802	wpt535	50H	413880	6311049	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
803	wpt536	50H	413882	6311046	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
804	wpt537	50H	413894	6311050	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
805	wpt538	50H	413900	6311049	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
806	wpt539	50H	413906	6311051	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
807	wpt540	50H	413902	6311057	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
808	wpt541	50H	413927	6311060	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
809	wpt542	50H	413937	6311063	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
810	wpt543	50H	413975	6311055	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
811	wpt544	50H	413983	6311056	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
812	wpt545	50H	414003	6311060	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
813	wpt546	50H	414099	6311047	Marri	15-20	>50	?											No Signs	No Signs	No	Hollows likely
814	wpt547	50H	414104	6311048	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
815	wpt548	50H	414109	6311038	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
816	wpt549	50H	414119	6311040	Marri	15-20	>50	0											No Signs	No Signs	No	
817	wpt550	50H	414122	6311044	Marri	15-20	>50	0											No Signs	No Signs	No	
818	wpt551	50H	414130	6311042	Marri	15-20	>50	0											No Signs	No Signs	No	
819	wpt552	50H	414147	6311036	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
820	wpt553	50H	414156	6311033	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
821	wpt554	50H	414001	6311030	Marri	15-20	>50	0											No Signs	No Signs	No	
822	wpt555	50H	413982	6311034	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
823	wpt556	50H	413955	6311032	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
824	wpt557	50H	413953	6311033	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
825	wpt558	50H	413488	6311034	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
826	wpt559	50H	413480	6311037	Jarrah	15-20	>50	0											No Signs	No Signs	No	
827	wpt560	50H	413476	6311044	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
828	wpt561	50H	413473	6311044	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
829	wpt562	50H	413278	6311080	Dead Jarrah	15-20	>50	5+	Knot Hole	5-10	Knot Hole	5-10	Branch	5-10	Branch	5-10	Branch	5-10	No Signs	No Signs	No	
830	wpt563	50H	413263	6311088	Dead Jarrah	20+	>50	0											No Signs	No Signs	No	
831	wpt564	50H	413223	6311090	Dead Jarrah	20+	>50	0											No Signs	No Signs	No	
832	wpt565	50H	412989	6311086	Dead Unknown	20+	>50	0											No Signs	No Signs	No	
833	wpt566	50H	412998	6311078	Blackbutt	20+	>50	0											No Signs	No Signs	No	
834	wpt567	50H	413002	6311075	Blackbutt	20+	>50	0											No Signs	No Signs	No	
835	wpt568	50H	412999	6311072	Blackbutt	20+	>50	0											No Signs	No Signs	No	
836	wpt569	50H	412993	6311077	Blackbutt	20+	>50	0											No Signs	No Signs	No	
837	wpt570	50H	412995	6311071	Dead Unknown	15-20	>50	3	Spout Branch	20+	Spout Branch	20+	Spout Branch	20+					No Signs	No Signs	Yes	Depth of hollow unknown

Count	Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Hollow Type 3	Hollow Size 3 (cm)	Hollow Type 4	Hollow Size 4 (cm)	Hollow Type 5	Hollow Size 5 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
838	wpt571	50H	412982	6311067	Marri	20+	>50	0											No Signs	No Signs	No	
839	wpt572	50H	411460	6311555	Marri		15-20	>50	0										No Signs	No Signs	No	
840	wpt573	50H	411477	6311556	Blackbutt	20+	>50	0											No Signs	No Signs	No	
841	wpt574	50H	411484	6311546	Blackbutt	20+	>50	0											No Signs	No Signs	No	
842	wpt575	50H	411484	6311539	Blackbutt	20+	>50	0											No Signs	No Signs	No	
843	wpt576	50H	411499	6311527	Blackbutt	20+	>50	0											No Signs	No Signs	No	
844	wpt577	50H	411501	6311524	Blackbutt	20+	>50	0											No Signs	No Signs	No	
845	wpt578	50H	411505	6311521	Blackbutt	20+	>50	0											No Signs	No Signs	No	
846	wpt579	50H	411517	6311542	Blackbutt	20+	>50	1	Spout Branch	20+									No Signs	No Signs	Yes	Depth of hollow unknown
847	wpt580	50H	411517	6311550	Blackbutt	20+	>50	0											No Signs	No Signs	No	
848	wpt581	50H	411519	6311550	Blackbutt	20+	>50	0											No Signs	No Signs	No	
849	wpt582	50H	411523	6311537	Blackbutt	20+	>50	0											No Signs	No Signs	No	
850	wpt583	50H	411518	6311526	Blackbutt	20+	>50	0											No Signs	No Signs	No	
851	wpt584	50H	411523	6311515	Marri	20+	>50	0											No Signs	No Signs	No	
852	wpt585	50H	411537	6311526	Blackbutt	20+	>50	0											No Signs	No Signs	No	
853	wpt586	50H	411541	6311532	Blackbutt	20+	>50	0											No Signs	No Signs	No	
854	wpt587	50H	411546	6311527	Blackbutt	20+	>50	0											No Signs	No Signs	No	
855	wpt588	50H	411556	6311528	Blackbutt	20+	>50	0											No Signs	No Signs	No	
856	wpt589	50H	411560	6311519	Blackbutt	20+	>50	0											No Signs	No Signs	No	
857	wpt590	50H	411568	6311511	Blackbutt	20+	>50	0											No Signs	No Signs	No	
858	wpt591	50H	411569	6311504	Blackbutt	20+	>50	0											No Signs	No Signs	No	
859	wpt592	50H	411593	6311516	Blackbutt	20+	>50	0											No Signs	No Signs	No	
860	wpt593	50H	411607	6311515	Blackbutt	20+	>50	0											No Signs	No Signs	No	
861	wpt594	50H	411619	6311507	Blackbutt	20+	>50	0											No Signs	No Signs	No	
862	wpt595	50H	411615	6311501	Blackbutt	20+	>50	0											No Signs	No Signs	No	
863	wpt596	50H	411613	6311496	Blackbutt	20+	>50	0											No Signs	No Signs	No	
864	wpt597	50H	411628	6311501	Blackbutt	20+	>50	0											No Signs	No Signs	No	
865	wpt598	50H	411629	6311505	Blackbutt	20+	>50	0											No Signs	No Signs	No	
866	wpt599	50H	411640	6311515	Marri	15-20	>50	0											No Signs	No Signs	No	
867	wpt600	50H	411649	6311501	Blackbutt	20+	>50	0											No Signs	No Signs	No	
868	wpt601	50H	411653	6311486	Blackbutt	20+	>50	0											No Signs	No Signs	No	
869	wpt602	50H	411681	6311471	Marri	20+	>50	5+	Branch	10-20	Branch	10-20	Branch	10-20	Branch	10-20	Branch	20+	No Signs	No Signs	Yes	Depth of hollow unknown
870	wpt603	50H	411693	6311483	Dead Marri	20+	>50	5+	Branch	5-10	Branch	10-20	Branch	5-10	Branch	10-20	Branch	5-10	No Signs	No Signs	No	
871	wpt604	50H	411693	6311508	Blackbutt	20+	>50	0											No Signs	No Signs	No	
872	wpt605	50H	411709	6311494	Blackbutt	20+	>50	1	Spout Branch	20+									No Signs	No Signs	Yes	Depth of hollow unknown
873	wpt606	50H	411709	6311474	Blackbutt	20+	>50	0											No Signs	No Signs	No	
874	wpt607	50H	411707	6311473	Blackbutt	20+	>50	0											No Signs	No Signs	No	
875	wpt608	50H	411710	6311457	Blackbutt	20+	>50	0											No Signs	No Signs	No	
876	wpt609	50H	411729	6311482	Blackbutt	20+	>50	0											No Signs	No Signs	No	
877	wpt610	50H	411740	6311464	Marri	20+	>50	5+	Knot Hole	5-10	Branch	5-10	Branch	10-20	Branch	5-10	Branch	5-10	No Signs	No Signs	No	
878	wpt611	50H	411753	6311460	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
879	wpt612	50H	411808	6311471	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
880	wpt613	50H	411823	6311472	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
881	wpt614	50H	411829	6311461	Marri	20+	>50	0											No Signs	No Signs	No	
882	wpt615	50H	411837	6311464	Marri	20+	>50	0											No Signs	No Signs	No	
883	wpt616	50H	411850	6311462	Marri	20+	>50	0											No Signs	No Signs	No	
884	wpt617	50H	411855	6311459	Marri	20+	>50	0											No Signs	No Signs	No	
885	wpt618	50H	411870	6311461	Marri	20+	>50	0											No Signs	No Signs	No	
886	wpt619	50H	411922	6311443	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
887	wpt620	50H	412128	6311368	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
888	wpt621	50H	412130	6311373	Marri	20+	>50	0											No Signs	No Signs	No	
889	wpt622	50H	412148	6311359	Marri	20+	>50	0											No Signs	No Signs	No	
890	wpt623	50H	412153	6311359	Blackbutt	20+	>50	0											No Signs	No Signs	No	
891	wpt624	50H	412175	6311347	Blackbutt	20+	>50	0											No Signs	No Signs	No	
892	wpt625	50H	412189	6311344	Blackbutt	20+	>50	0											No Signs	No Signs	No	
893	wpt626	50H	412205	6311338	Marri	20+	>50	0											No Signs	No Signs	No	

Count	Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Hollow Type 3	Hollow Size 3 (cm)	Hollow Type 4	Hollow Size 4 (cm)	Hollow Type 5	Hollow Size 5 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
894	wpt627	50H	412202	6311332	Blackbutt	20+	>50	0											No Signs	No Signs	No	
895	wpt628	50H	412232	6311329	Blackbutt	20+	>50	0											No Signs	No Signs	No	
896	wpt629	50H	412232	6311312	Dead Unknown	10-15	>50	1	Spout Trunk	20+									No Signs	No Signs	Yes	Depth of hollow unknown
897	wpt630	50H	412237	6311308	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
898	wpt631	50H	412242	6311304	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
899	wpt632	50H	412282	6311287	Marri	20+	>50	0											No Signs	No Signs	No	
900	wpt633	50H	412288	6311276	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
901	wpt634	50H	412325	6311285	Blackbutt	20+	>50	0											No Signs	No Signs	No	
902	wpt635	50H	412407	6311260	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
903	wpt636	50H	412784	6311139	Marri	15-20	>50	0											No Signs	No Signs	No	
904	wpt637	50H	412793	6311134	Jarrah	20+	>50	0											No Signs	No Signs	No	
905	wpt638	50H	412807	6311121	Marri	15-20	>50	0											No Signs	No Signs	No	
906	wpt639	50H	412809	6311113	Marri	15-20	>50	0											No Signs	No Signs	No	
907	wpt640	50H	412774	6311145	Marri	15-20	>50	0											No Signs	No Signs	No	
908	wpt641	50H	412608	6311169	Blackbutt	20+	>50	0											No Signs	No Signs	No	
909	wpt642	50H	412605	6311169	Marri	20+	>50	0											No Signs	No Signs	No	
910	wpt643	50H	412604	6311169	Blackbutt	20+	>50	0											No Signs	No Signs	No	
911	wpt644	50H	412592	6311174	Unknown Euc	15-20	>50	0											No Signs	No Signs	No	
912	wpt645	50H	412579	6311179	Unknown Euc	15-20	>50	0											No Signs	No Signs	No	
913	wpt646	50H	412176	6311305	Marri	15-20	>50	0											No Signs	No Signs	No	
914	wpt647	50H	412147	6311325	Marri	20+	>50	5+	Branch	5-10	Branch	10-20	Branch	5-10	Branch	10-20	Branch	5-10	No Signs	No Signs	Yes	Depth of hollow unknown
915	wpt648	50H	412144	6311319	Blackbutt	20+	>50	0											No Signs	No Signs	No	
916	wpt649	50H	412145	6311320	Blackbutt	20+	>50	0											No Signs	No Signs	No	
917	wpt650	50H	412132	6311331	Marri	20+	>50	5+	Branch	5-10	Branch	10-20	Branch	20+	Branch		Spout Trunk	20+	No Signs	No Signs	Yes	Depth of hollow unknown
918	wpt651	50H	412113	6311331	Marri	20+	>50	0											No Signs	No Signs	No	
919	wpt652	50H	412095	6311342	Blackbutt	20+	>50	0											No Signs	No Signs	No	
920	wpt653	50H	412089	6311360	Blackbutt	20+	>50	0											No Signs	No Signs	No	
921	wpt654	50H	412083	6311354	Dead Unknown	15-20	>50	2	Branch	20+	Branch	20+							No Signs	No Signs	Yes	Depth of hollow unknown
922	wpt655	50H	412072	6311364	Blackbutt	20+	>50	5+	Branch	10-20	Branch	10-20	Branch	10-20	Branch	20+	Branch	20+	No Signs	No Signs	Yes	Depth of hollow unknown
923	wpt656	50H	412058	6311367	Marri	20+	>50	0											No Signs	No Signs	No	
924	wpt657	50H	412050	6311362	Blackbutt	20+	>50	0											No Signs	No Signs	No	
925	wpt658	50H	412033	6311371	Blackbutt	20+	>50	0											No Signs	No Signs	No	
926	wpt659	50H	412029	6311369	Jarrah	20+	>50	0											No Signs	No Signs	No	
927	wpt660	50H	412022	6311365	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
928	wpt661	50H	412015	6311377	Blackbutt	20+	>50	0											No Signs	No Signs	No	
929	wpt662	50H	412003	6311376	Blackbutt	20+	>50	1	Knot Hole	20+									No Signs	No Signs	No	Too Low
930	wpt663	50H	412005	6311384	Blackbutt	20+	>50	0											No Signs	No Signs	No	
931	wpt664	50H	411991	6311394	Dead Unknown	20+	>50	5+	Branch	5-10	Branch	10-20	Branch	5-10	Branch	10-20	Branch	5-10	No Signs	No Signs	No	
932	wpt665	50H	411990	6311375	Blackbutt	20+	>50	0											No Signs	No Signs	No	
933	wpt666	50H	411988	6311376	Blackbutt	20+	>50	0											No Signs	No Signs	No	
934	wpt667	50H	411967	6311389	Blackbutt	20+	>50	0											No Signs	No Signs	No	
935	wpt668	50H	411964	6311399	Dead Marri	20+	>50	5+	Branch	5-10	Branch	5-10	Branch	5-10	Branch	5-10	Branch	5-10	No Signs	No Signs	No	
936	wpt669	50H	411951	6311402	Blackbutt	20+	>50	0											No Signs	No Signs	No	
937	wpt670	50H	411950	6311398	Blackbutt	20+	>50	0											No Signs	No Signs	No	
938	wpt671	50H	411940	6311399	Blackbutt	20+	>50	0											No Signs	No Signs	No	
939	wpt672	50H	411920	6311396	Blackbutt	15-20	>50	0											No Signs	No Signs	No	
940	wpt673	50H	411928	6311399	Marri	20+	>50	0											No Signs	No Signs	No	
941	wpt674	50H	411911	6311407	Marri	20+	>50	0											No Signs	No Signs	No	
942	wpt675	50H	411902	6311405	Jarrah	20+	>50	0											No Signs	No Signs	No	
943	wpt676	50H	411895	6311406	Jarrah	20+	>50	0											No Signs	No Signs	No	
944	wpt677	50H	411880	6311408	Jarrah	20+	>50	0											No Signs	No Signs	No	
945	wpt678	50H	411867	6311422	Dead Blackbutt	20+	>50	5+	Knot Hole	20+	Branch	10-20	Branch	10-20	Branch	10-20	Branch	5-10	No Signs	No Signs	Yes	Depth of hollow unknown
946	wpt679	50H	411852	6311420	Jarrah	20+	>50	0											No Signs	No Signs	No	
947	wpt680	50H	411846	6311416	Marri	20+	>50	5+	Branch	5-10	Branch	5-10	Branch	5-10	Branch	5-10	Branch	5-10	No Signs	No Signs	No	
948	wpt681	50H	411835	6311422	Marri	20+	>50	0											No Signs	No Signs	No	
949	wpt682	50H	411829	6311426	Marri	20+	>50	0											No Signs	No Signs	No	

Count	Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Hollow Type 3	Hollow Size 3 (cm)	Hollow Type 4	Hollow Size 4 (cm)	Hollow Type 5	Hollow Size 5 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
950	wpt683	50H	411816	6311428	Marri	20+	>50	0											No Signs	No Signs	No	
951	wpt684	50H	411810	6311429	Marri	20+	>50	0											No Signs	No Signs	No	
952	wpt685	50H	411819	6311432	Blackbutt	20+	>50	0											No Signs	No Signs	No	
953	wpt686	50H	411799	6311440	Blackbutt	20+	>50	0											No Signs	No Signs	No	
954	wpt687	50H	411798	6311439	Marri	20+	>50	0											No Signs	No Signs	No	
955	wpt688	50H	411799	6311446	Marri	20+	>50	0											No Signs	No Signs	No	
956	wpt689	50H	411786	6311451	Marri	20+	>50	0											No Signs	No Signs	No	
957	wpt690	50H	411784	6311448	Blackbutt	20+	>50	0											No Signs	No Signs	No	
958	wpt691	50H	411788	6311434	Blackbutt	20+	>50	0											No Signs	No Signs	No	
959	wpt692	50H	411784	6311434	Blackbutt	20+	>50	0											No Signs	No Signs	No	
960	wpt693	50H	411771	6311440	Blackbutt	20+	>50	0											No Signs	No Signs	No	
961	wpt694	50H	411768	6311439	Blackbutt	20+	>50	0											No Signs	No Signs	No	
962	wpt695	50H	411774	6311449	Blackbutt	20+	>50	0											No Signs	No Signs	No	
963	wpt696	50H	411769	6311446	Blackbutt	20+	>50	0											No Signs	No Signs	No	
964	wpt697	50H	411761	6311456	Marri	20+	>50	0											No Signs	No Signs	No	
965	wpt698	50H	411742	6311450	Blackbutt	20+	>50	0											No Signs	No Signs	No	
966	wpt699	50H	411736	6311453	Blackbutt	20+	>50	0											No Signs	No Signs	No	
967	wpt700	50H	411721	6311455	Blackbutt	20+	>50	0											No Signs	No Signs	No	
968	wpt701	50H	411702	6311462	Blackbutt	20+	>50	0											No Signs	No Signs	No	
969	wpt702	50H	411674	6311464	Blackbutt	20+	>50	0											No Signs	No Signs	No	
970	wpt703	50H	411669	6311465	Blackbutt	20+	>50	0											No Signs	No Signs	No	
971	wpt704	50H	411664	6311470	Blackbutt	20+	>50	0											No Signs	No Signs	No	
972	wpt705	50H	411655	6311475	Blackbutt	20+	>50	0											No Signs	No Signs	No	
973	wpt706	50H	411641	6311470	Blackbutt	20+	>50	0											No Signs	No Signs	No	
974	wpt707	50H	411632	6311481	Marri	20+	>50	0											No Signs	No Signs	No	
975	wpt708	50H	411609	6311486	Marri	20+	>50	5+	Branch	10-20	Branch	10-20	Branch	10-20	Branch	10-20	Branch	10-20	No Signs	No Signs	No	
976	wpt709	50H	411612	6311492	Blackbutt	20+	>50	0											No Signs	No Signs	No	
977	wpt710	50H	411610	6311492	Dead Unknown	20+	>50	1	Branch	10-20									No Signs	No Signs	No	
978	wpt711	50H	411606	6311491	Blackbutt	20+	>50	0											No Signs	No Signs	No	
979	wpt712	50H	411589	6311501	Marri	20+	>50	0											No Signs	No Signs	No	
980	wpt713	50H	411580	6311501	Marri	20+	>50	0											No Signs	No Signs	No	
981	wpt714	50H	411565	6311501	Blackbutt	20+	>50	0											No Signs	No Signs	No	
982	wpt715	50H	411562	6311501	Blackbutt	20+	>50	0											No Signs	No Signs	No	
983	wpt716	50H	411532	6311513	Blackbutt	20+	>50	0											No Signs	No Signs	No	
984	wpt717	50H	411518	6311503	Blackbutt	20+	>50	0											No Signs	No Signs	No	
985	wpt718	50H	411509	6311508	Blackbutt	20+	>50	0											No Signs	No Signs	No	
986	wpt719	50H	411505	6311513	Blackbutt	20+	>50	0											No Signs	No Signs	No	
987	wpt720	50H	411492	6311514	Blackbutt	20+	>50	0											No Signs	No Signs	No	
988	wpt721	50H	411487	6311523	Blackbutt	20+	>50	0											No Signs	No Signs	No	
989	wpt722	50H	411481	6311522	Blackbutt	20+	>50	0											No Signs	No Signs	No	
990	wpt723	50H	403921	6313652	Jarrah	20+	>50	0											No Signs	No Signs	No	
991	wpt724	50H	403928	6313656	Jarrah	15-20	>50	0											No Signs	No Signs	No	
992	wpt725	50H	403938	6313641	Jarrah	20+	>50	0											No Signs	No Signs	No	
993	wpt726	50H	403934	6313629	Marri	20+	>50	0											No Signs	No Signs	No	
994	wpt727	50H	403934	6313620	Jarrah	20+	>50	0											No Signs	No Signs	No	
995	wpt728	50H	403937	6313613	Jarrah	20+	>50	1	Spout Trunk	20+									No Signs	No Signs	Yes	Depth of hollow unknown
996	wpt729	50H	403951	6313614	Jarrah	20+	>50	0											No Signs	No Signs	No	
997	wpt730	50H	403958	6313611	Jarrah	20+	>50	0											No Signs	No Signs	No	
998	wpt731	50H	403958	6313615	Jarrah	20+	>50	0											No Signs	No Signs	No	
999	wpt732	50H	403958	6313620	Jarrah	20+	>50	0											No Signs	No Signs	No	
1000	wpt733	50H	403965	6313618	Marri	20+	>50	0											No Signs	No Signs	No	
1001	wpt734	50H	403975	6313609	Dead Jarrah	20+	>50	4	Knot Hole	5-10	Knot Hole	10-20	Branch	10-20	Branch	5-10	Spout Branch	20+	No Signs	No Signs	Yes	Depth of hollow unknown
1002	wpt735	50H	403976	6313609	Jarrah	20+	>50	0											No Signs	No Signs	No	
1003	wpt736	50H	403975	6313606	Jarrah	20+	>50	0											No Signs	No Signs	No	
1004	wpt737	50H	403974	6313593	Jarrah	20+	>50	0											No Signs	No Signs	No	
1005	wpt738	50H	403964	6313589	Marri	20+	>50	0											No Signs	No Signs	No	

Count	Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Hollow Type 3	Hollow Size 3 (cm)	Hollow Type 4	Hollow Size 4 (cm)	Hollow Type 5	Hollow Size 5 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
1006	wpt739	50H	403960	6313591	Jarrah	20+	>50	0											No Signs	No Signs	No	
1007	wpt740	50H	403974	6313583	Marri	20+	>50	0											No Signs	No Signs	No	
1008	wpt741	50H	403981	6313583	Jarrah	20+	>50	0											No Signs	No Signs	No	
1009	wpt742	50H	403989	6313585	Jarrah	20+	>50	0											No Signs	No Signs	No	
1010	wpt743	50H	404002	6313576	Marri	20+	>50	0											No Signs	No Signs	No	
1011	wpt744	50H	404008	6313576	Marri	20+	>50	0											No Signs	No Signs	No	
1012	wpt745	50H	404013	6313556	Jarrah	20+	>50	0											No Signs	No Signs	No	
1013	wpt746	50H	404026	6313535	Jarrah	20+	>50	0											No Signs	No Signs	No	
1014	wpt747	50H	404027	6313534	Jarrah	20+	>50	2	Branch	5-10	Branch	5-10							No Signs	No Signs	No	
1015	wpt748	50H	404042	6313545	Jarrah	20+	>50	0											No Signs	No Signs	No	
1016	wpt749	50H	404043	6313551	Jarrah	20+	>50	0											No Signs	No Signs	No	
1017	wpt750	50H	404056	6313532	Jarrah	20+	>50	0											No Signs	No Signs	No	
1018	wpt751	50H	404069	6313522	Jarrah	20+	>50	0											No Signs	No Signs	No	
1019	wpt752	50H	404082	6313522	Jarrah	20+	>50	0											No Signs	No Signs	No	
1020	wpt753	50H	404078	6313511	Jarrah	20+	>50	0											No Signs	No Signs	No	
1021	wpt754	50H	404079	6313508	Jarrah	20+	>50	0											No Signs	No Signs	No	
1022	wpt755	50H	404197	6313366	Marri	20+	>50	0											No Signs	No Signs	No	
1023	wpt756	50H	404213	6313342	Marri	20+	>50	0											No Signs	No Signs	No	
1024	wpt757	50H	404247	6313320	Marri	20+	>50	0											No Signs	No Signs	No	
1025	wpt758	50H	404390	6313145	Jarrah	20+	>50	1	Knot Hole	10-20									No Signs	No Signs	No	
1026	wpt759	50H	404431	6313139	Marri	20+	>50	0											No Signs	No Signs	No	
1027	wpt760	50H	404435	6313130	Marri	20+	>50	0											No Signs	No Signs	No	
1028	wpt761	50H	404433	6313127	Marri	20+	>50	0											No Signs	No Signs	No	
1029	wpt762	50H	404436	6313083	Marri	20+	>50	1	Knot Hole	5-10									No Signs	No Signs	No	
1030	wpt763	50H	404445	6313070	Marri	20+	>50	0											No Signs	No Signs	No	
1031	wpt764	50H	404454	6313090	Jarrah	20+	>50	0											No Signs	No Signs	No	
1032	wpt765	50H	404470	6313079	Marri	20+	>50	0											No Signs	No Signs	No	
1033	wpt766	50H	404478	6313060	Marri	20+	>50	0											No Signs	No Signs	No	
1034	wpt767	50H	404471	6313052	Marri	20+	>50	1	Branch	10-20									No Signs	No Signs	No	
1035	wpt768	50H	404532	6313010	Dead Unknown	20+	>50	5+	Branch	10-20	Branch	20+	Branch	10-20	Branch	10-20	Branch	10-20	No Signs	No Signs	Yes	Depth of hollow unknown
1036	wpt769	50H	404558	6313010	Jarrah	20+	>50	0											No Signs	No Signs	No	
1037	wpt770	50H	404580	6312986	Marri	15-20	>50	0											No Signs	No Signs	No	
1038	wpt771	50H	404629	6312938	Jarrah	20+	>50	1	Spout Branch	20+									No Signs	No Signs	Yes	Too low/shallow?
1039	wpt772	50H	404664	6312897	Marri	15-20	>50	0											No Signs	No Signs	No	
1040	wpt773	50H	404723	6312860	Marri	15-20	>50	0											No Signs	No Signs	No	
1041	wpt774	50H	404742	6312846	Marri	15-20	>50	0											No Signs	No Signs	No	
1042	wpt775	50H	404774	6312813	Marri	15-20	>50	0											No Signs	No Signs	No	
1043	wpt776	50H	404786	6312785	Marri	15-20	>50	0											No Signs	No Signs	No	
1044	wpt777	50H	404822	6312771	Dead Unknown	5-10	>50	1	Spout Branch	20+									No Signs	No Signs	Yes	Depth of hollow unknown
1045	wpt778	50H	404844	6312735	Marri	20+	>50	5+	Branch	10-20	Branch	10-20	Branch	10-20	Branch	10-20	Branch	20+	No Signs	No Signs	Yes	Depth of hollow unknown
1046	wpt779	50H	404856	6312727	Marri	20+	>50	0											No Signs	No Signs	No	
1047	wpt780	50H	404864	6312736	Marri	20+	>50	3	Branch	10-20	Spout Branch	10-20	Spout Branch	20+					No Signs	No Signs	Yes	Depth of hollow unknown
1048	wpt781	50H	404868	6312711	Jarrah	15-20	>50	1	Spout Trunk	20+									No Signs	No Signs	Yes	Depth of hollow unknown
1049	wpt782	50H	404883	6312692	Marri	15-20	>50	1	Spout Trunk	20+									No Signs	No Signs	Yes	Depth of hollow unknown
1050	wpt783	50H	404933	6312690	Marri	20+	>50	0											No Signs	No Signs	No	
1051	wpt784	50H	404964	6312679	Marri	20+	>50	0											No Signs	No Signs	No	
1052	wpt785	50H	404971	6312666	Marri	20+	>50	0											No Signs	No Signs	No	
1053	wpt786	50H	404979	6312663	Marri	15-20	>50	1	Branch	10-20									No Signs	No Signs	No	
1054	wpt787	50H	404981	6312655	Jarrah	20+	>50	0											No Signs	No Signs	No	
1055	wpt788	50H	404998	6312652	Jarrah	20+	>50	0											No Signs	No Signs	No	
1056	wpt789	50H	404997	6312650	Jarrah	20+	>50	0											No Signs	No Signs	No	
1057	wpt790	50H	405003	6312651	Marri	10-15	>50	1	Spout Branch	20+									No Signs	No Signs	No	Too shallow
1058	wpt791	50H	405015	6312636	Marri	20+	>50	0											No Signs	No Signs	No	
1059	wpt792	50H	405018	6312634	Jarrah	20+	>50	0											No Signs	No Signs	No	
1060	wpt793	50H	405014	6312629	Marri	20+	>50	0											No Signs	No Signs	No	
1061	wpt795	50H	405052	6312635	Jarrah	20+	>50	0											No Signs	No Signs	No	

Count	Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Hollow Type 3	Hollow Size 3 (cm)	Hollow Type 4	Hollow Size 4 (cm)	Hollow Type 5	Hollow Size 5 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
1062	wpt796	50H	405062	6312636	Marri	20+	>50	0											No Signs	No Signs	No	
1063	wpt797	50H	405080	6312651	Jarrah	20+	>50	5+	Branch	5-10	Branch	5-10	Branch	5-10	Branch	5-10	Branch	5-10	No Signs	No Signs	No	
1064	wpt798	50H	405103	6312618	Jarrah	20+	>50	0											No Signs	No Signs	No	
1065	wpt799	50H	405118	6312605	Jarrah	20+	>50	0											No Signs	No Signs	No	
1066	wpt800	50H	405137	6312611	Jarrah	20+	>50	0											No Signs	No Signs	No	
1067	wpt801	50H	405144	6312593	Jarrah	15-20	>50	2	Branch	10-20	Branch	10-20							No Signs	No Signs	No	
1068	wpt802	50H	405146	6312585	Jarrah	20+	>50	0											No Signs	No Signs	No	
1069	wpt803	50H	405141	6312577	Jarrah	15-20	>50	1	Spout Trunk	20+									No Signs	No Signs	Yes	Depth of hollow unknown
1070	wpt804	50H	405165	6312576	Marri	15-20	>50	0											No Signs	No Signs	No	
1071	wpt805	50H	405169	6312596	Jarrah	20+	>50	0											No Signs	No Signs	No	
1072	wpt806	50H	405180	6312602	Jarrah	15-20	>50	1	Spout Branch	20+									No Signs	No Signs	Yes	Depth of hollow unknown
1073	wpt807	50H	405194	6312562	Jarrah	15-20	>50	1	Spout Branch	20+									No Signs	No Signs	Yes	Depth of hollow unknown
1074	wpt808	50H	405214	6312587	Jarrah	15-20	>50	5+	Branch	5-10	Branch	5-10	Branch	5-10	Branch	5-10	Branch	5-10	No Signs	No Signs	No	
1075	wpt809	50H	405219	6312573	Marri	20+	>50	0											No Signs	No Signs	No	
1076	wpt810	50H	405228	6312565	Marri	10-15	>50	1	Spout Branch	10-20									No Signs	No Signs	Yes	Too shallow
1077	wpt811	50H	405253	6312561	Jarrah	20+	>50	0											No Signs	No Signs	No	
1078	wpt812	50H	405253	6312568	Jarrah	20+	>50	0											No Signs	No Signs	No	
1079	wpt813	50H	405262	6312554	Marri	15-20	>50	0											No Signs	No Signs	No	
1080	wpt814	50H	405270	6312559	Jarrah	15-20	>50	2	Knot Hole	10-20	Branch	10-20							No Signs	No Signs	No	
1081	wpt815	50H	405276	6312542	Marri	20+	>50	0											No Signs	No Signs	No	
1082	wpt816	50H	405287	6312544	Jarrah	15-20	>50	0											No Signs	No Signs	No	
1083	wpt817	50H	405297	6312551	Jarrah	20+	>50	0											No Signs	No Signs	No	
1084	wpt818	50H	405319	6312532	Jarrah	20+	>50	0											No Signs	No Signs	No	
1085	wpt819	50H	405331	6312524	Jarrah	20+	>50	0											No Signs	No Signs	No	
1086	wpt820	50H	405337	6312536	Marri	20+	>50	5+	Branch	5-10	Branch	10-20	Branch	5-10	Branch	10-20	Branch	5-10	No Signs	No Signs	No	
1087	wpt821	50H	405335	6312541	Marri	20+	>50	2	Branch	5-10	Branch	10-20							No Signs	No Signs	No	
1088	wpt822	50H	405347	6312534	Marri	5-10	>50	1	Spout Branch	10-20	Spout Trunk	10-20							No Signs	No Signs	No	
1089	wpt823	50H	405350	6312537	Jarrah	20+	>50	0											No Signs	No Signs	No	
1090	wpt825	50H	405430	6312463	Jarrah	20+	>50	0											No Signs	No Signs	No	
1091	wpt826	50H	405362	6312500	Jarrah	20+	>50	5+	Branch	5-10	Branch	5-10	Branch	10-20	Branch	10-20	Spout Branch	20+	No Signs	No Signs	Yes	Depth of hollow unknown
1092	wpt827	50H	405344	6312496	Marri	20+	>50	0											No Signs	No Signs	No	
1093	wpt828	50H	405323	6312500	Marri	20+	>50	0											No Signs	No Signs	No	
1094	wpt829	50H	405302	6312504	Marri	20+	>50	0											No Signs	No Signs	No	
1095	wpt830	50H	405295	6312511	Marri	20+	>50	0											No Signs	No Signs	No	
1096	wpt831	50H	405289	6312504	Jarrah	20+	>50	0											No Signs	No Signs	No	
1097	wpt832	50H	405275	6312521	Marri	20+	>50	0											No Signs	No Signs	No	
1098	wpt833	50H	405269	6312521	Marri	20+	>50	0											No Signs	No Signs	No	
1099	wpt834	50H	405254	6312518	Marri	20+	>50	0											No Signs	No Signs	No	
1100	wpt835	50H	405253	6312522	Jarrah	20+	>50	0											No Signs	No Signs	No	
1101	wpt836	50H	405230	6312531	Jarrah	20+	>50	0											No Signs	No Signs	No	
1102	wpt837	50H	405220	6312548	Jarrah	20+	>50	0											No Signs	No Signs	No	
1103	wpt838	50H	405213	6312546	Jarrah	15-20	>50	0											No Signs	No Signs	No	
1104	wpt839	50H	405202	6312550	Jarrah	15-20	>50	0											No Signs	No Signs	No	
1105	wpt840	50H	405090	6312585	Jarrah	20+	>50	5+	Branch	5-10	Branch	10-20	Branch	5-10	Branch	10-20	Branch	5-10	No Signs	No Signs	No	
1106	wpt841	50H	405074	6312611	Jarrah	20+	>50	5+	Branch	5-10	Branch	10-20	Branch	5-10	Branch	10-20	Spout Trunk	20+	No Signs	No Signs	Yes	Marginal
1107	wpt842	50H	405044	6312605	Jarrah	20+	>50	0											No Signs	No Signs	No	
1108	wpt843	50H	405036	6312613	Marri	15-20	>50	0											No Signs	No Signs	No	
1109	wpt844	50H	404969	6312654	Jarrah	20+	>50	0											No Signs	No Signs	No	
1110	wpt845	50H	404955	6312659	Marri	20+	>50	0											No Signs	No Signs	No	
1111	wpt847	50H	404904	6312691	Marri	20+	>50	2	Branch	5-10	Branch	10-20							No Signs	No Signs	No	
1112	wpt848	50H	404820	6312739	Marri	10-15	>50	1	Spout Trunk	10-20									No Signs	No Signs	No	
1113	wpt849	50H	404685	6312848	Dead Jarrah	5-10	>50	3	Branch	5-10	Branch	5-10	Branch	5-10					No Signs	No Signs	No	
1114	wpt850	50H	404576	6312927	Marri	15-20	>50	0											No Signs	No Signs	No	
1115	wpt851	50H	404555	6312944	Marri	15-20	>50	0											No Signs	No Signs	No	
1116	wpt852	50H	404292	6313239	Jarrah	20+	>50	3	Branch	5-10	Branch	5-10	Branch	10-20					No Signs	No Signs	No	
1117	wpt853	50H	404151	6313389	Jarrah	15-20	>50	0											No Signs	No Signs	No	

Count	Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Hollow Type 3	Hollow Size 3 (cm)	Hollow Type 4	Hollow Size 4 (cm)	Hollow Type 5	Hollow Size 5 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
1118	wpt854	50H	403999	6313592	Jarrah	15-20	>50	0											No Signs	No Signs	No	
1119	wpt855	50H	405631	6312458	Marri	15-20	>50	0											No Signs	No Signs	No	
1120	wpt856	50H	405663	6312459	Marri	15-20	>50	0											No Signs	No Signs	No	
1121	wpt857	50H	405682	6312460	Marri	15-20	>50	0											No Signs	No Signs	No	
1122	wpt858	50H	405680	6312459	Marri	15-20	>50	0											No Signs	No Signs	No	
1123	wpt859	50H	405704	6312450	Marri	15-20	>50	0											No Signs	No Signs	No	
1124	wpt860	50H	405717	6312451	Marri	15-20	>50	0											No Signs	No Signs	No	
1125	wpt861	50H	405734	6312452	Marri	15-20	>50	0											No Signs	No Signs	No	
1126	wpt862	50H	405865	6312436	Marri	15-20	>50	0											No Signs	No Signs	No	
1127	wpt863	50H	405927	6312446	Marri	15-20	>50	0											No Signs	No Signs	No	
1128	wpt864	50H	405939	6312444	Jarrah	20+	>50	0											No Signs	No Signs	No	
1129	wpt865	50H	405976	6312442	Jarrah	15-20	>50	0											No Signs	No Signs	No	
1130	wpt866	50H	406066	6312446	Jarrah	15-20	>50	0											No Signs	No Signs	No	
1131	wpt867	50H	406101	6312454	Marri	15-20	>50	0											No Signs	No Signs	No	
1132	wpt868	50H	406123	6312453	Marri	20+	>50	0											No Signs	No Signs	No	
1133	wpt869	50H	406158	6312452	Marri	20+	>50	0											No Signs	No Signs	No	
1134	wpt870	50H	406187	6312445	Jarrah	15-20	>50	0											No Signs	No Signs	No	
1135	wpt871	50H	406200	6312442	Marri	15-20	>50	0											No Signs	No Signs	No	
1136	wpt872	50H	406208	6312450	Marri	15-20	>50	0											No Signs	No Signs	No	
1137	wpt873	50H	406220	6312460	Marri	10-15	>50	1	Spout Trunk	20+									No Signs	No Signs	Yes	Depth of hollow unknown
1138	wpt874	50H	406233	6312454	Jarrah	20+	>50	5+	Branch	5-10	Branch	5-10	Branch	5-10	Branch	5-10	Branch	5-10	No Signs	No Signs	No	
1139	wpt875	50H	406238	6312440	Marri	10-15	>50	1	Spout Trunk	20+									No Signs	No Signs	Yes	Depth of hollow unknown
1140	wpt876	50H	406243	6312442	Marri	15-20	>50	0											No Signs	No Signs	No	
1141	wpt877	50H	406250	6312454	Marri	20+	>50	0											No Signs	No Signs	No	
1142	wpt878	50H	406241	6312458	Marri	20+	>50	0											No Signs	No Signs	No	
1143	wpt879	50H	406266	6312468	Jarrah	20+	>50	1	Branch	5-10									No Signs	No Signs	No	
1144	wpt880	50H	406281	6312469	Marri	15-20	>50	0											No Signs	No Signs	No	
1145	wpt881	50H	406280	6312448	Marri	20+	>50	0											No Signs	No Signs	No	
1146	wpt882	50H	406281	6312445	Marri	20+	>50	0											No Signs	No Signs	No	
1147	wpt883	50H	406311	6312474	Dead Marri	20+	>50	1	Spout Trunk	20+									No Signs	No Signs	Yes	Depth of hollow unknown
1148	wpt884	50H	406342	6312462	Marri	20+	>50	0											No Signs	No Signs	No	
1149	wpt885	50H	406358	6312471	Marri	15-20	>50	0											No Signs	No Signs	No	
1150	wpt886	50H	406368	6312475	Dead Marri	5-10	>50	0											No Signs	No Signs	No	
1151	wpt887	50H	406370	6312475	Jarrah	20+	>50	0											No Signs	No Signs	No	
1152	wpt888	50H	406381	6312461	Jarrah	20+	>50	0											No Signs	No Signs	No	
1153	wpt889	50H	406384	6312479	Jarrah	20+	>50	0											No Signs	No Signs	No	
1154	wpt890	50H	406398	6312474	Jarrah	20+	>50	0											No Signs	No Signs	No	
1155	wpt891	50H	406409	6312471	Jarrah	20+	>50	1	Knot Hole	10-20									No Signs	No Signs	No	
1156	wpt892	50H	406437	6312486	Jarrah	15-20	>50	1	Spout Branch	10-20									No Signs	No Signs	No	
1157	wpt893	50H	406450	6312481	Jarrah	15-20	>50	1	Knot Hole	10-20									No Signs	No Signs	No	
1158	wpt894	50H	406461	6312471	Jarrah	15-20	>50	0											No Signs	No Signs	No	
1159	wpt895	50H	406479	6312482	Marri	20+	>50	0											No Signs	No Signs	No	
1160	wpt896	50H	406432	6312464	Jarrah	20+	>50	0											No Signs	No Signs	No	
1161	wpt897	50H	406427	6312463	Jarrah	20+	>50	0											No Signs	No Signs	No	
1162	wpt898	50H	406332	6312451	Marri	20+	>50	0											No Signs	No Signs	No	
1163	wpt899	50H	406317	6312447	Marri	20+	>50	0											No Signs	No Signs	No	
1164	wpt900	50H	406305	6312445	Jarrah	20+	>50	0											No Signs	No Signs	No	
1165	wpt901	50H	406290	6312434	Jarrah	20+	>50	0											No Signs	No Signs	No	
1166	wpt902	50H	406272	6312424	Jarrah	20+	>50	0											No Signs	No Signs	No	
1167	wpt903	50H	406264	6312436	Marri	15-20	>50	1	Spout Trunk	20+									No Signs	No Signs	Yes	Depth of hollow unknown
1168	wpt904	50H	406243	6312423	Marri	20+	>50	0											No Signs	No Signs	No	
1169	wpt905	50H	406114	6312410	Marri	20+	>50	0											No Signs	No Signs	No	
1170	wpt906	50H	406049	6312416	Marri	20+	>50	0											No Signs	No Signs	No	
1171	wpt907	50H	405952	6312400	Marri	20+	>50	0											No Signs	No Signs	No	
1172	wpt908	50H	405937	6312404	Jarrah	15-20	>50	0											No Signs	No Signs	No	
1173	wpt909	50H	405907	6312402	Jarrah	15-20	>50	0											No Signs	No Signs	No	

Count	Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Hollow Type 3	Hollow Size 3 (cm)	Hollow Type 4	Hollow Size 4 (cm)	Hollow Type 5	Hollow Size 5 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
1174	wpt910	50H	405884	6312400	Jarrah	20+	>50	0											No Signs	No Signs	No	
1175	wpt911	50H	405838	6312414	Marri	15-20	>50	0											No Signs	No Signs	No	
1176	wpt912	50H	405806	6312410	Jarrah	15-20	>50	0											No Signs	No Signs	No	
1177	wpt913	50H	405778	6312409	Marri	20+	>50	0											No Signs	No Signs	No	
1178	wpt914	50H	405773	6312415	Jarrah	15-20	>50	1	Spout Trunk	10-20									No Signs	No Signs	No	
1179	wpt915	50H	405764	6312410	Marri	20+	>50	0											No Signs	No Signs	No	
1180	wpt916	50H	405760	6312412	Marri	20+	>50	0											No Signs	No Signs	No	
1181	wpt917	50H	405743	6312423	Marri	15-20	>50	0											No Signs	No Signs	No	
1182	wpt918	50H	405708	6312415	Marri	15-20	>50	0											No Signs	No Signs	No	
1183	wpt919	50H	405674	6312415	Marri	20+	>50	0											No Signs	No Signs	No	
1184	wpt920	50H	405620	6312425	Jarrah	20+	>50	0											No Signs	No Signs	No	
1185	wpt921	50H	405599	6312438	Marri	15-20	>50	0											No Signs	No Signs	No	
1186	wpt922	50H	405519	6312442	Marri	15-20	>50	0											No Signs	No Signs	No	
1187	wpt923	50H	405444	6312460	Jarrah	15-20	>50	0											No Signs	No Signs	No	
1188	wpt925	50H	405557	6312470	Marri	15-20	>50	0											No Signs	No Signs	No	
1189	wpt926	50H	405575	6312468	Marri	10-15	>50	0											No Signs	No Signs	No	
1190	wpt927	50H	405596	6312463	Marri	20+	>50	0											No Signs	No Signs	No	
1191	wpt928	50H	405600	6312465	Marri	20+	>50	0											No Signs	No Signs	No	
1192	wpt929	50H	405609	6312464	Marri	20+	>50	0											No Signs	No Signs	No	
1193	wpt930	50H	405611	6312464	Marri	20+	>50	0											No Signs	No Signs	No	
1194	wpt931	50H	405616	6312464	Marri	20+	>50	0											No Signs	No Signs	No	
1195	wpt932	50H	405618	6312462	Marri	20+	>50	0											No Signs	No Signs	No	

APPENDIX E

SIGNIFICANT SPECIES PROFILES

Unnamed scorpionfly *Austromerope poultoni*

Status and Distribution: Listed as Priority 2 by the DEC. Distribution is poorly documented. NatureMap database contains widely scattered records from Eneabba to Walpole.

Habitat: Occurs predominantly in dense understorey vegetation in high rainfall forest where it has been collected from beneath forest debris (logs, rocks) and in pitfall traps. Most NatureMap records are in the Jarrah forest belt.

Likely presence in study area: Status in the study area difficult to determine. The majority of the study area appears to be unsuitable for this species as dense understorey vegetation is typically absent.

Potential impact of proposed development: Loss of a small area of potential habitat. It is however unlikely that any part of the proposed realignment that passes through native forest would represent an area of significance for this species given the extent of similar habitat in surrounding areas.

Unnamed cricket *Pachysaga munggai*

Status and Distribution: Listed as Priority 3 by the DEC. Distribution is poorly documented. NatureMap database contains only five records, one of which is in close proximity to the study area (near intersection of Coalfields Highway and Wellington Dam turn off - DEC 2011).

Habitat: Heathland habitat with occasional eucalypts and abundant leaf litter. Vegetation and leaf litter must be sufficient to provide this ground dwelling species with cover. Most NatureMap records are in the Jarrah forest belt.

Likely presence in study area: Status in the study area difficult to determine. The majority of the study area appears unsuitable for this species as heathland and leaf litter are typically absent.

Potential impact of proposed development: Loss of a small area of potential habitat. It is however unlikely that any part of the proposed realignment that passes through native forest would represent an area of significance for this species given the extent of similar habitat in surrounding areas.

Carter's Freshwater Mussel *Westralunio carteri*

Status and Distribution: Listed as Priority 4 by DEC and as Vulnerable under ICUN. Carter's freshwater Mussel is the only freshwater mussel species endemic to south-western WA, ranging from the Moore River to the south coast, west of Esperance (Graf and Cummings, 2009).

Habitat: Freshwater mussels seem to prefer inland rivers and streams with sandy bottoms and flowing water, although habitat preferences have not been precisely determined (Lymbery *et al.* 2008).

Likely presence in study area: The ephemeral nature of the small creeks that pass through the study area appear to represent unsuitable habitat for this species. There are no NatureMap database records within the Collie River (or its tributaries) upstream of Wellington Dam.

Potential impact of proposed development: No impact on this species or its habitat is considered likely.

Margaret River (Hairy) Marron *Cherax tenuimanus*

Status and Distribution: Listed as Scheduled 1 (Critically Endangered) under the *WC Act* (1950) and as Critically Endangered under the *EPBC Act*. The species is currently known from only eleven sites along a section of the Margaret River and occurs in an area less than 50 km in length.

Habitat: Information on the current distribution of the Hairy Marron indicates that the species requires relatively good quality water and a diversity of habitat structure (e.g. they generally prefer sandy areas, particularly where organic matter accumulates and access to shelter and refuge sites) and may struggle to persist in disturbed habitats.

Likely presence in study area: This species does not occur in this area. The inclusion of this species in the NatureMap database for the area searched appears to be an error.

Potential impact of proposed development: No impact on this species will occur.

Tingle Trapdoor Spider *Moggridgea tingle*

Status and Distribution: Listed as Scheduled 1 (Endangered) under the *WC Act*. This spider is found at four sites in the Walpole-Nornalup National Park residing in the soil or the bark of a eucalyptus tree, the Red tingle *Eucalyptus jacksonii*.

Habitat: The spider's habitat is located within the Tingle and Karri (*Eucalyptus diversicolor*) forests of the Warren region. *Moggridgea tingle* live within the topsoil or in the fibrous bark of *Eucalyptus jacksonii* (Tingle trees), constructing nests of silk tubes. These tubes, up 20 mm long, have an opening at the surface of the bark or soil with a hinged 'trapdoor' cover made of moss, bark and the spider's silk. It is found in damp and shady locations.

Likely presence in study area: This species does not occur in this area. The inclusion of this species in the NatureMap database for the area searched appears to be an error.

Potential impact of proposed development: No impact on this species will occur.

Pouched Lamprey *Geotria australis*

Status and Distribution: Listed as Priority 1 by CALM. Status is secure but abundance has decreased due to proliferation of obstacles to upstream spawning migration such as dams and weirs. Western Australian distribution includes coastal drainages of the south west from Perth to Albany (Allen *et al.* 2003).

Habitat: This species lives in mud burrows in the upper reaches of coastal streams for the first 4 years of life until migrating to the sea. Adults migrate up to 60km upstream during spawning (Allen *et al.* 2003).

Likely presence in study area: This species may occur in the lower reaches of the Collie River, below Wellington Dam, but as its lifecycle requires access to the sea populations could not persist upstream of the Wellington Dam itself. It would therefore not be found in any of the streams traversed by the proposed alignment even if they represented suitable habitat.

Potential impact of proposed development: No impact on this species or its preferred habitat will occur.

Balston's Pygmy Perch *Nannatherina balstoni*

Status and Distribution: Listed as Scheduled 1 under the *WC Act (1950)* and as Vulnerable under the *EPBC Act (1999)*. Morgan *et al.* (1996) states that this fish is the rarest of all the endemic fish of the south west. Status is defined as fairly secure by Allen *et al.* (2003) presumably given that, on the south coast, significant areas of habitat are within national parks. Confined to drainages and wetlands near the coast from between Margaret River and Two Peoples Bay. Historical records from Moore River.

Habitat: Acidic, tannin stained freshwater pools, streams and lakes within 30km of the coast, typically situated amongst peat flats. Prefers shallow water and is commonly found in association with tall sedge thickets (Allen *et al.* 2003). Morgan (1996) found them most common in shallow pools and creeks that often dry up in summer. Lower numbers were observed in the permanent major rivers surveyed.

Likely presence in study area: This species has never been recorded in the Collie River catchment or nearby catchments and it would therefore be unlikely to be present. No suitable habitat within the propose realignment corridor.

Potential impact of proposed development: No impact on this species will occur.

Darling Range Heath Ctenotus *Ctenotus delli*

Status and Distribution: Listed as Priority 4 by DEC. Main distribution is in the Darling Range from the Darlington/Mundaring area to near Collie (Storr *et al* 1999).

Habitat: Humid zone, mainly laterite and clays (Storr *et al* 1999) supporting jarrah/marri woodland with a shrub dominated understorey, sheltering in dense vegetation, inside grass trees and beneath rocks, sometimes in burrows (Nevill 2005). Occasionally found on granite outcrops (Bush 2002).

Likely presence in study area: Actual status onsite is difficult to determine. Study area is near the southern limit of this species main documented range. Closest NatureMap records are east of Collie. Most areas probably represent marginal habitat due to history of disturbance.

Potential impact of proposed development: If this species is present then development may result in the loss of some habitat though it is unlikely to alter the species overall status given the relatively small area involved.

Southern Carpet Python *Morelia spilota imbricata*

Status and Distribution: The south western population is classified as Priority 4 by the DEC and is also listed in Schedule 4 under the *WC Act*. This subspecies has wide distribution within the south west but is uncommon. Occurs north to Geraldton and Yalgoo and east to Pinjin, Kalgoorlie, Fraser Range and Eyre (Storr *et al*, 2002).

Habitat: This species has been recorded from semi-arid coastal and inland habitats, Banksia woodland, Eucalypt woodlands, and grasslands. Most often found utilising hollow logs in addition the burrows of other animals for shelter. Often arboreal and will also use tree hollows for refuge.

Likely presence in study area: Status onsite difficult to determine. Very few records near Collie. Most habitats looks marginal due to sparse nature of groundcover and the lack of fallen hollow logs. Typically only occurs in low densities.

Potential impact of proposed development: Loss of an area of potential habitat. Low probability but the potential for individuals to be killed or injured during clearing.

Great Egret *Ardea alba*

Status and Distribution: This species of egret is listed as migratory under the *EPBC Act* and under international agreements to which Australia is a signatory. The Great Egret is common and very widespread in any suitable permanent or temporary habitat (Morcombe, 2003).

Habitat: Wetlands, flooded pasture, dams, estuarine mudflats, mangroves and reefs (Morcombe 2003).

Likely presence in study area: May frequent seasonally flooded creek lines (including Wellington Dam) and associated paddock areas during wetter months of the year in low numbers. Would not breed within the study area.

Potential impact of proposed development: No impact on this species is anticipated. Habitat that this species is likely to use in the study area is comprised of highly degraded creek lines in paddocks and the banks of Wellington Dam.

Cattle Egret *Ardea ibis*

Status and Distribution: This species of egret is listed as migratory under the *EPBC Act* and under international agreements to which Australia is a signatory. The Cattle Egret is common in the north sections of its range but is an irregular visitor to the better watered parts of the state (Johnstone and Storr 1998). The population is expanding (Morcombe 2003).

Habitat: Moist pastures with tall grasses, shallow open wetlands and margins, mudflats (Morcombe 2003).

Likely presence in study area: May frequent seasonally flooded creek lines (including Wellington Dam) and associated paddock areas during wetter months of the year in low numbers. Would not breed within the study area.

Potential impact of proposed development: No impact on this species is anticipated. Habitat that this species is likely to use in the study area is comprised of highly degraded creek lines in paddocks and the banks of Wellington Dam.

Australasian Bittern *Botaurus poiciloptilus*

Status and Distribution: Classified as Schedule 1 under the *WC Act* and as Endangered under the *EPBC Act (1999)*. The species is uncommon to rare (Morcombe, 2003), but locally common in wetter parts of south west (Johnstone and Storr 1998). Occurs north to Moora and east to Mt Arid (Johnstone and Storr 1998).

Habitat: Freshwater wetlands, occasionally estuarine; prefers heavy vegetation (Morcombe 2003) such as beds of tall dense *Typha*, *Baumea* and sedges in freshwater swamps (Johnstone and Storr 1998).

Likely presence in study area: No suitable habitat.

Potential impact of proposed development: No impact on this species or its habitat is anticipated.

Black Bittern *Ixobrychus flavicollis*

Status and Distribution: Listed as Priority 3 by DEC. Occurs north to Yanchep and Northam and east to Albany (Johnstone and Storr 1998).

Habitat: Freshwater pools, swamps and lagoons, well screened with trees. Shelters in dense waterside vegetation (Johnstone and Storr 1998).

Likely presence in study area: No suitable habitat.

Potential impact of proposed development: No impact on this species or its habitat is anticipated.

Little Bittern *Ixobrychus minutus*

Status and Distribution: Listed as Priority 4 by DEC. Occurs north to Moora and east to Two Peoples Bay; accidental or on migration further north and east and on Rottnest Island and central district (Condingup district) (Johnstone and Storr 1998).

Habitat: Dense vegetation surrounding/within freshwater pools, swamps and lagoons, well screened with trees. Shelters in dense beds of *Typha*, *Baumea* and tall rushes in freshwater swamps around lakes and along rivers (Johnstone and Storr 1998).

Likely presence in study area: No suitable habitat.

Potential impact of proposed development: No impact on this species or its habitat is anticipated.

White-bellied Sea Eagle *Haliaeetus leucogaster*

Status and Distribution: This species is listed as Schedule 3 under the *WC Act* and as migratory under the *EPBC Act* and under international agreements to which Australia is a signatory. White-bellied sea eagles are moderately common to common on Kimberley and Pilbara islands, coasts and estuaries, on Bernier, Dorre and Dirk Hartog Is., in Houtman Abrolhos and in the Archipelago of the Recherche; rare to uncommon elsewhere (Johnstone and Storr 1998). Also

found in New Guinea, Indonesia, China, southeast Asia and India. Scarce near major coastal cities (Morcombe 2003).

Species or species habitat listed as likely to occur in general area within EPBC database search.

Habitat: They nest and forage usually near the coast over islands, reefs, headlands, beaches, bays, estuaries, mangroves, but will also live near seasonally flooded inland swamps, lagoons and floodplains, often far inland on large pools of major rivers. Established pairs usually sedentary, immatures dispersive (Morcombe 2003). White-bellied Sea-Eagles build a large stick nest, which is used for many seasons in succession.

Likely presence in study area: This species may very occasionally fly up the Collie River and over Wellington Dam but the area does not represent habitat typically used by this species.

Potential impact of proposed development: No impact on this species is anticipated.

Peregrine Falcon *Falco peregrinus*

Status and Distribution: This species is listed as Schedule 4 under the *WC Act*. Individuals of this species are uncommon/rare but wide ranging across Australia. Moderately common at higher levels of the Stirling Range, uncommon in hilly, north west Kimberley, Hamersley and Darling Ranges; rare or scarce elsewhere (Johnstone and Storr 1998).

Habitat: Diverse from rainforest to arid shrublands, from coastal heath to alpine (Morcombe 2003). Mainly about cliffs along coasts, rivers and ranges and about wooded watercourses and lakes (Johnstone and Storr 1998). The species utilises the ledges, cliff faces and large hollows/broken spouts of trees for nesting. It will also occasionally use the abandoned nests of other birds of prey.

Likely presence in study area: Individuals of this species potentially utilises some sections of the study area as part of a much larger home range.

Potential impact of proposed development: Modification of potential foraging habitat and potential for the loss of potential breeding sites (i.e. tall trees with broken spouts).

Bush Stone Curlew *Burhinus grallarius*

Status and Distribution: Listed as Priority 4 by DEC. Occurs over much of the western half of the state (and Kimberley) but rare to uncommon in the south of its range due to fox predation (Johnstone and Storr 1998).

Habitat: Lightly wooded country (including partly cleared forests) near daytime shelter e.g. thickets or long grass (Johnstone and Storr 1998).

Likely presence in study area: Generally considered to be locally extinct. The closest NatureMap record, just west of Collie, is from 1962.

Potential impact of proposed development: No impact on this species will occur as it is unlikely to be present.



Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso*

Status and Distribution: Listed as Scheduled 1 under the *WC Act* and as Vulnerable under the *EPBC Act*. Found in the humid and subhumid south west, mainly hilly interior, north to Gingin and east to Mt Helena, Christmas Tree Well, North Bannister, Mt Saddleback, Rock Gully and the upper King River (Johnstone and Storr 1998).

Habitat: Eucalypt forests, feeds on Marri, Jarrah, Blackbutt, Karri, Sheoak and Snottygobble. The Forest Red-tailed Black Cockatoo nests in the large hollows of Marri, Jarrah and Karri (Johnstone and Kirkby 1999). In Marri, the nest hollows of the Forest Red-tailed Black Cockatoo range from 8-14m above ground, the entrance is 12 – 41cm in diameter and the depth is one to five metres (Johnstone and Storr 1998).

Breeding commences in winter/spring. There are few records of breeding in the Forest Red-tailed Black Cockatoo (Johnstone and Storr 1998), but eggs are laid in October and November (Johnstone 1997; Johnstone and Storr 1998). Recent data however indicates that breeding in all months of the year occurs with peaks in spring and autumn–winter (Ron Johnstone pers comms). Incubation period 29 – 31 days. Young fledge at 8 to 9 weeks (Simpson and Day 2004).

J	F	M	A	M	J	J	A	S	O	N	D

 Period in which breeding is most likely to commence
 Period in which fledging/weening could extend through

Likely presence in study area: Sighted numerous times within the survey area and nearby. Foraging evidence found. Almost all the remnant vegetation within the study area presents potential foraging habitat for this species. Larger trees (>50cm DBH) can be considered potential breeding habitat. One pair observed investigating a hollow near the extreme boundary of the study area. This species may also roost on site on occasions though no roost trees observed.

Potential impact of proposed development: Loss of foraging, breeding and roosting opportunities.



Baudin’s Black- Cockatoo *Calyptorhynchus baudinii*

Status and Distribution: Listed as Scheduled 1 under the *WC Act* and as Vulnerable under the *EPBC Act*. Confined to the south-west of Western Australia, north to Gidgegannup, east to Mt Helena, Wandering, Quindanning, Kojonup, Frankland and King River and west to the eastern strip of the Swan Coastal Plain including West Midland, Byford, Nth Dandalup, Yarloop, Wokalup and Bunbury (Johnstone and Storr 1998). On the southern Swan Coastal Plain this cockatoo is in some areas resident but mainly a migrant moving from the deep south-west to the central and northern Darling Range. Between March and September most flocks move north and are concentrated in the northern parts of the Darling Range. During this period birds forage well out onto the southern Swan Coastal Plain to areas such as Harvey, Myalup, Bunbury, Capel, Dunsborough and Meelup. While generally more common in the Darling Range this species can also be common on parts of the southern Swan Coastal Plain especially in mid-August – September when flocks begin to return to their breeding quarters (Johnstone 2008).

Habitat: Mainly eucalypt forests where it feeds primarily on the Marri seeds, (Morcombe, 2003), Banksia, Hakeas and *Erodium* sp. Also strips bark from trees in search of beetle larvae (Johnstone and Storr 1998). This species of cockatoo nests in large tree hollows, 30–40 cm in diameter and more than 30 cm deep (Saunders 1974).

Baudin's Black-Cockatoo breeds in late winter and spring, from August to November or December (Gould 1972; Johnstone 1997; Saunders 1974; Saunders *et al.* 1985). Eggs laid in October (Johnstone and Storr 1998). Based on observations at currently known nest sites breeding mainly occurs within the October-December period (Ron Johnstone pers comms). Incubation is 28 – 30 days. Young fledge at 8 to 9 weeks (Simpson and Day 2004).

J	F	M	A	M	J	J	A	S	O	N	D

 Period in which breeding is most likely to commence
 Period in which fledging/weening could extend througho

Likely presence in study area: Sighted several times within the survey area and nearby. Foraging evidence found. Almost all the remnant vegetation within the study area presents potential foraging habitat for this species. Larger trees (>50cm DBH) can be considered potential breeding habitat. This species may also roost on site on occasions though no roost trees observed.

Potential impact of proposed development: Loss of foraging, breeding and roosting opportunities.

Carnaby’s Black- Cockatoo *Calyptorhynchus latirostris*



Status and Distribution: Carnaby’s Black Cockatoo is listed as Scheduled 1 under the *WC Act* and as Endangered under the *EPBC Act*. Confined to the south-west of Western Australia, north to the lower Murchison River and east to Nabawa, Wilroy, Waddi Forest, Nugadong, Manmanning, Durokoppin, Noongar (Moorine Rock), Lake Cronin, Ravensthorpe Range, head of Oldfield River, 20 km ESE of Condingup and Cape Arid; also casual on Rottnest Island (Johnstone and Storr 1998).

Habitat: Forests, woodlands, heathlands, farms; feeds on Banksia, Hakeas and Marri. Carnaby’s Cockatoo has specific nesting site requirements. Nests are mostly in smoothed-barked eucalypts with the nest hollows ranging from 2.5 to 12m above the ground, an entrance from 23-30cm diameter and a depth of 0.1-2.5m (Johnstone and Storr, 1998).

Breeding occurs in winter/spring mainly in eastern forest and wheatbelt where they can find mature hollow bearing trees to nest in (Morcombe, 2003). Judging from records in the Storr-Johnstone Bird Data Bank, this species is currently expanding its breeding range westward and south into the Jarrah – Marri forest of the Darling Scarp and into the Tuart forests of the Swan Coastal Plain including the region between Mandurah and Bunbury. Carnaby’s Black Cockatoo has been known to breed close to the town of Mandurah, as well as at Dawesville, Lake Clifton and Baldivis (pers. comm., Ron Johnstone, WA Museum) and there are small resident populations on the southern Swan Coastal Plain near Mandurah, Lake Clifton and near Bunbury. At each of these sites the birds forage in remnant vegetation and adjacent pine plantations (Johnstone 2008).

Carnaby’s Black-Cockatoo lays eggs from July or August to October or November, with most clutches being laid in August and September (Saunders 1986). Birds in inland regions may begin laying up to three weeks earlier than those in coastal areas (Saunders 1977). The female incubates the eggs over a period of 28-29 days. The young depart the nest 10–12 weeks after hatching (Saunders 1977; Smith & Saunders 1986).

J	F	M	A	M	J	J	A	S	O	N	D

 Period in which breeding is most likely to commence
 Period in which fledging/weening could extend through

Likely presence in study area: Not observed during the survey period but foraging evidence found. Remnant vegetation represents foraging habitat. Potential to also breed in the area but probability of this occurring can be

considered to be low. This species may also roost on site on occasions though no roost trees observed.

Potential impact of proposed development: Loss of foraging, breeding and roosting opportunities.

Masked Owl *Tyto novaehollandae novaehollandae*

Status and Distribution: Listed as Priority 3 by DEC. Found north to Yanchep and east to Yealering, Gnowangerup and Albany, casual further north. Locally common in south west but generally uncommon (Johnstone and Storr 1998).

Habitat: Roosts and nests in heavy forest, hunts over open woodlands and farmlands (Morcombe, 2003). Probably breeding in forested deep south west with some autumn–winter wanderings northwards (Johnstone and Storr 1998).

Likely presence in study area: Status on the site and in the general area difficult to determine. May frequent the area at times.

Potential impact of proposed development: Modification of potential foraging habitat and the loss of potential breeding and roosting opportunities.

Fork-tailed Swift *Apus pacificus*

Status and Distribution: The Fork-tailed Swift is listed as Schedule 3 under the *WC Act* and as migratory under the *EPBC Act* as migratory under the *EPBC Act 1999* and under international agreements to which Australia is a signatory. It is a summer migrant (Oct-Apr) to Australia (Morcombe 2003).

Habitat: Low to very high airspace over varied habitat from rainforest to semi desert (Morcombe 2003).

Likely presence in study area: It is potentially an occasional summer visitor to the study area but is entirely aerial and largely independent of terrestrial habitats.

Potential impact of proposed development: No impact on this species is anticipated.

Rainbow Bee-eater *Merops ornatus*

Status and Distribution: This species is listed as Schedule 3 under the *WC Act* and as migratory under the *EPBC Act* and under international agreements to which Australia is a signatory. The Rainbow Bee-eater is a common summer migrant to southern Australia but in the north they are resident (Morcombe 2003).

Habitat: Open Country, of woodlands, open forest, semi arid scrub, grasslands, clearings in heavier forest, farmlands (Morcombe 2003). Breeds underground in areas of suitable soft soil firm enough to support tunnel building.

Likely presence in study area: Observed within the study area during the survey period. Common seasonal visitor to south west. Potentially breeds in some areas where ground conditions permit (e.g. sandy areas where natural vegetation has been cleared/thinned.)

Potential impact of proposed development: Modification and/or loss of some habitat but impact will not be significant. This species can be expected to continue to utilise the area, as it does now, despite any future development.

Western Shrike Tit *Falcunculus frontatus leucogaster*

Status and Distribution: Listed as Priority 4 by DEC. The species is locally common (e.g. Boyup Brook) but generally scarce or rare and locally extinct (e.g. Swan Coastal Plain and much of wheatbelt). Occurs mainly in southern subhumid and semiarid interior from Moora, Kodj Kodjin, Narembeen, Bank Rock and Newman Rock, south to Pemberton, Lake Muir, Porongurup Range, lower Fitzgerald River, Forrestania, Maggie Hays Hill and Little Jam Hill and west to Julimar, Christmas Tree Well, Mt Sadelback and Boyup Brook (Johnstone and Storr 1998).

Habitat: Woodlands, scrubs and more open forest of *Eucalyptus*, especially of wandoo (*E. wandoo*), flat topped yate (*E. occidentalis*), karri (*E. diversicolor*), tingle (*E. jacksonii*), flooded gum (*E. rudis*), salmon gum (*E. salmonaphloia*). This species occurs at low densities and requires large home ranges, characters that make it susceptible to habitat fragmentation.

Likely presence in study area: In this general area more commonly recorded in Wandoo woodlands east of Collie. There are no NatureMap records in or near the study area.

Potential impact of proposed development: No impact on this species is anticipated.

Chuditch *Dasyurus geoffroii*

Status and Distribution: Listed as Scheduled 1 under the *WC Act* and as Vulnerable under the *EPBC Act*. Formerly occurred over nearly 70 per cent of Australia. The Chuditch now has a patchy distribution throughout the Jarrah forest and mixed Karri/Marri/Jarrah forest of southwest Western Australia. Also occurs in very low numbers in the Midwest, Wheatbelt and South Coast Regions with records from Moora to the north, Yellowdine to the east and south to Hopetoun.

Habitat: Chuditch are known to have occupied a wide range of habitats from woodlands, dry sclerophyll (leafy) forests, riparian vegetation, beaches and deserts. Riparian vegetation appears to support higher densities of Chuditch, possibly because food supply is better or more reliable and better cover is offered by dense vegetation. Chuditch appear to utilise native vegetation along road sides in the wheatbelt (CALM 1994). The estimated home range of a male Chuditch is over 15 km² whilst that for females is 3-4 km² (Sorena and Soderquist 1995).

Likely presence in study area: This species is known to persist in state forest and national park areas surrounding Collie and therefore it may frequent the study site.

Potential impact of proposed development: Loss of some potential habitat. Some possibility that individuals maybe killed or injured during clearing operations.

Numbat *Myrmecobius fasciatus*

Status and Distribution: Listed as Scheduled 1 under the *WC Act* (1950) and as Vulnerable under the *EPBC Act* (1999). Once occurred across much of arid and semi arid southern Australia, now restricted to a few remnant forests of Wandoo, Powderbark Wandoo or jarrah in South west WA (Menkhorst & Knight 2001). Rare, scattered. Found only at Dryandra, Perup and six other translocation sites (Van Dyck & Strahan 2008).

Habitat: Generally dominated by eucalypts that provide hollow logs and branches for shelter and termites for food (Van Dyck & Strahan 2008).

Likely presence in study area: Available evidence suggests this species is locally and regionally extinct.

Potential impact of proposed development: No impact on this species is anticipated.

Southern Brush-tailed Phascogale *Phascogale tapoatafa ssp*

Status and Distribution: Listed as Scheduled 1 under the *WC Act*. Present distribution is believed to have been reduced to approximately 50 per cent of its former range. Current document distribution is from Perth and south to Albany, west of Albany Highway. Occurs at low densities in the northern Jarrah forest. Highest densities occur in the Perup/Kingston area, Collie River valley, and near Margaret River and Busselton (DEC information pamphlet). Records are less common from wetter forests.

Habitat: This subspecies has been observed in dry sclerophyll forests and open woodlands that contain hollow-bearing trees but a sparse ground cover. A nocturnal carnivore relying on tree hollows as nest sites. The home range for a female Brush-tailed Phascogale is estimated at between 20 and 70 ha, whilst that for males is given as twice that of females. In addition, they tend to utilise a large number (approximately 20) of different nest sites throughout their range (Soderquist, 1995).

Likely presence in study area: This species is known to persist in state forest and national park areas surrounding Collie and therefore it may frequent the study site.

Potential impact of proposed development: Loss of some potential habitat. Some possibility that individuals maybe killed or injured during clearing operations.

Quenda *Isoodon obesulus fusciventer*

Status and Distribution: Listed as Priority 5 by DEC. Widely distributed in the south west from near Cervantes north of Perth to east of Esperance, patchy distribution through the Jarrah and Karri forest and on the Swan Coastal Plain, and inland as far as Hyden. Has been translocated to Julimar State Forest, Hills Forest Mundaring, Tutanning Nature Reserve, Boyagin Nature Reserve, Dongolocking Nature Reserve, Leschenault Conservation Park, and Karakamia and Paruna Sanctuaries (DEC information pamphlet) and Nambung National Park (DEC pers. coms.)

Habitat: Dense scrubby, often swampy, vegetation with dense cover up to one metre high, often feeds in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and cropland lying close to dense cover. Populations inhabiting Jarrah and Wandoo forests are usually associated with watercourses. Quendas can thrive in more open habitat subject to exotic predator control (DEC information pamphlet).

Likely presence in study area: Most of the study area appears unsuitable for this species to persist due to a lack of dense groundcover but it may persist at locations where native vegetation provides sufficient cover.

Potential impact of proposed development: Loss of some potential habitat. Some possibility that individuals maybe killed or injured during clearing operations.

Western Ringtail Possum *Pseudocheirus occidentalis*

Status and Distribution: Listed as Scheduled 1 under the *WC Act* and as Vulnerable under the *EPBC Act*. Common in suitable habitat (de Tores 2008).

The highest densities of this species are recorded in Peppermint habitat near Busselton area; relatively high densities are found in Jarrah/Marri forest at Perup (de Tores 2008).

The Western Ringtail Possum (WRP) has a restricted distribution in south-western Western Australia. Most known populations (natural and translocated) are now restricted to near coastal areas of the south west from the Dawesville area to the Waychinicup National Park. Inland, it is also known to be relatively common in a small part of the lower Collie River valley, the Perup Nature Reserve and surrounding forest blocks near Manjimup. It has also been recorded in stands of Peppermint near the Harvey River and in Jarrah/Marri forest near Collie; however, the long term persistence of the species in these areas is not confirmed (de Tores *et al* 2004). The Western Ringtail was formerly more widespread: in the 1970s it was known from Casuarina woodlands in the wheatbelt near Pingelly (south-east of Perth), and it is thought to have once occurred throughout much of south-western Western Australia (but not necessarily continuously distributed) (Maxwell *et al.* 1996; de Tores 2008).

The species is widespread and relatively common in vegetated remnants within the Swan Coastal Plain and along the Whicher Scarp between Bunbury and Busselton (G. Harewood *per. obs.*). The most northern known natural coastal population is centred on the Binningup townsite.

Habitat: The Western Ringtail Possum was once located in a variety of habitats including Coastal Peppermint, Coastal Peppermint-Tuart, Jarrah-Marri associations, Sheoak woodland, and eucalypt woodland and mallee. Coastal populations mostly inhabit Peppermint-Tuart associations with highest densities in habitats with dense, relatively lush vegetation. In these areas the main determinants of suitable habitat for WRPs appears to be the presence of *Agonis flexuosa* either as the dominant tree or as an understorey component of Eucalypt forest or woodland (Jones *et al.* 1994a). Inland, the largest known populations occur in the Upper Warren area east of Manjimup (Wayne *et al* 2005). In this area the peppermint tree is naturally absent and jarrah-marri associations constitute the species refuge and foraging habitat. In areas where Peppermint is absent or rare WRPs have been observed feeding predominately on young Jarrah, *Nuytsia floribunda* and *Allocasuarina fraseriana* (G Harewood *pers. obs.*).

Likely presence in study area: Despite targeted searching for dreys, scats and individuals no evidence of this species within study area was found. This evidence and observations of vegetation structure and composition suggest that WRPs are either absent from the study or are present in low densities, at only a few locations.

In general terms the vegetation along the proposed road realignment appears largely unsuitable or at best marginal for WRPs to utilise. This is primarily based

on the fact that the majority of the vegetation is dominated by young, relatively tall trees with an overall structure that lacks a significant density of midstorey vegetation/canopy and therefore connectivity between trees is compromised. This would make it difficult for WRPs to move through the vegetation without coming to ground.

Western Ringtails Possums are however known to occur in the general area and therefore their presence within some sections of the study area, if only infrequently, cannot be discounted. They are most likely to be found utilising areas with the best quality midstorey vegetation (i.e. highest density and high species variation). WRPs also use hollows in trees and Grass Trees/Balga Bushes for daytime refuge and this should be taken into consideration during clearing operations.

Potential impact of proposed development: Loss of some potential habitat. Some possibility that individuals maybe killed or injured during clearing operations.

Quokka *Setonix brachyurus*

Status and Distribution: Listed as Scheduled 1 under the *WC Act* and as Vulnerable under the *EPBC Act*. Rare and restricted in south west W.A. from south of Perth to Two Peoples Bay. The distribution of the Quokka includes Rottnest and Bald Islands, and at least 25 known sites on the mainland, including Two Peoples Bay Nature Reserve, Torndirrup National Park, Mt Manypeaks National Park, Walpole-Nornalup National Park, and various swamp areas through the south-west forests from Jarrahdale to Walpole. As of 2008 there were nine known quokka populations in the Wellington National Park area (DEC 2008). One population, north of the Collie River, is considered to be the largest in the northern jarrah forest, although numbers appear to be declining (DEC 2008).

Habitat: Mainland populations of this species are currently restricted to densely vegetated coastal heaths, swamps, riverine habitats including tea-tree thickets on sandy soils along creek systems where they are less vulnerable to predation. The species is nocturnal.

Likely presence in study area: There is no suitable habitat for this species within the study area.

Potential impact of proposed development: No impact on this species is anticipated.

Bilby *Macrotis lagotis*

Status and Distribution: The Bilby is listed as Schedule 1 under the *WC Act* and as Vulnerable under the *EPBC Act*. Current distribution in suitable habitat from Tanami Desert west to near Broome and south to Warburton. Former distribution extended south to Margaret River, though apparently absent from the coastal plain (Burbidge 2004).

Habitat: Current habitat included Acacia shrublands, spinifex and hummock grassland (Menkhorst *et al.*, 2001).

Likely presence in study area: Regionally extinct.

Potential impact of proposed development: No impact on this species will occur as a consequence of the proposal proceeding.

Woylie *Bettongia penicillata ogibyi*

Status and Distribution: Listed as Schedule 1 under the *WC Act* and as Endangered under the *EPBC Act*. Restricted to remnant habitat patches in south west WA where populations are managed by way of fox control and reintroduction programs (e.g. Batalling State forest, Avon Valley, Walyunga National Park and Paruna Sanctuary). Woylie populations have declined by about 80% since 2001. The declines of affected populations in Western Australia and South Australia have been rapid, substantial (>90% lost) and apparently biased toward the largest and most important populations. The declines are continuing in some areas and as yet there have been no clear signs of a sustained post decline recovery. Most of the remaining unaffected populations are small (<300 individuals), isolated and inherently vulnerable (DEC 2009).

Habitat: Open forest and woodland with a low, dense, understorey of tussock grasses or woody scrub. Formerly occurred in a wider range of habitats including spinifex hummock grasslands.

Likely presence in study area: May frequent some of the more densely vegetated areas (e.g. bushland bordering Wellington Dam) but most of the study area lacks sufficient understorey required for this species to persist.

Potential impact of proposed development: Loss of a small area of potential habitat.

Tammar *Macropus eugenii derbianus*

Status and Distribution: Listed as Priority 5 by DEC. Formerly widespread in SW WA and Eyre Peninsula SA, now reduced to tiny populations on the mainland and some offshore islands. The Tammar Wallaby is currently known to inhabit

three islands in the Houtman Abrolhos group, Garden Island near Perth, Middle and North Twin Peak Islands in the Archipelago of the Recherche, and at least nine sites on the mainland — including, Dryandra, Boyagin, Tutanning, Batalling (reintroduced), Perup, private property near Pingelly, Jaloran Road timber reserve near Wagin, Hopetoun, Stirling Range National Park, and Fitzgerald River National Park. The species remains relatively abundant at these sites which are subject to fox control. They have also been reintroduced to the Darling scarp near Dwellingup, Julimar Forest near Bindoon, Avon Valley National Park and to Karakamia and Paruna Sanctuaries (DEC information pamphlet, nd)

Habitat: Inhabits dense coastal heath and scrub and some dry sclerophyll forest with dense patches of cover.

Likely presence in study area: Very few records from the area suggest a population of this species does not persist in or near the study area. Extent of suitable habitat appears limited.

Potential impact of proposed development: No impact on this species is anticipated as it is unlikely to be present within the study area.

Western Brush Wallaby *Macropus irma*

Status and Distribution: Listed as Priority 4 by DEC. The Western Brush Wallaby is distributed across the south-west of Western Australia from north of Kalbarri to Cape Arid (DEC information pamphlet nd).

Habitat: The species optimum habitat is open forest or woodland, particularly favouring open, seasonally wet flats with low grasses and open scrubby thickets. It is also found in some areas of mallee and heathland, and is uncommon in karri forest (DEC information pamphlet nd).

Likely presence in study area: This species is relatively common in the Collie area and is likely to frequent sections of the study area at times.

Potential impact of proposed development: Loss of small areas of potential habitat.

Western False Pipistrelle *Falsistrellus mackenziei*

Status and Distribution: Listed as Priority 4 by DEC. Listed as vulnerable by the ICUN. Confined to south west W.A. south of Perth and east to the wheat belt. Most records from Karri forests but also recorded in wetter stands of jarrah and tuart and woodlands on the Swan Coastal Plain (Menkhorst and Knight 2001). Range appears to be contracting southwards, presumably due to drying climate.

Habitat: This species of bat occurs in high forest and coastal woodlands. It roosts in small colonies in tree hollows and forages at canopy level and in the cathedral-like spaces between trees.

Likely presence in study area: Potentially present with the study area when it is likely to forage and possibly roost given presence of suitable tree hollows.

Potential impact of proposed development: Loss/modification of foraging habitat and loss of potential roosting habitat.

Water Rat *Hydromys chrysogaster*

Status and Distribution: Listed as Priority 4 by DEC. The water rat is widely distributed around Australia and its offshore islands, New Guinea and some adjacent islands. It occurs in fresh brackish water habitats in the south-west of Western Australia, but occurs in marine environments along the Pilbara coastline and offshore islands. Previous survey work in the south west suggested this species was relatively common and widespread though difficult to capture (Christensen *et al.* 1985, How *et al.* 1987).

Habitat: The water rat occupies habitat in the vicinity of permanent water, fresh, brackish or marine. Likely to occur in all major rivers and most of the larger streams as well as bodies of permanent water in the lower south west (Christensen *et al.* 1985).

Likely presence in study area: Area of most likely potential habitat is limited to that section of the Wellington Dam that passes through the study area. This area is in most years dry and unlikely to be utilised by water rats.

Potential impact of proposed development: Modification of a small area of very marginal habitat.

APPENDIX 9

Environmental Management Plan

APPENDIX 9: Environmental Management Plan

Project Phase	Environmental Aspect	Management Measure	Expected Outcome	Responsibility
Overall Project	Environmental Management	Main Roads South West Region is responsible for managing the Coalfields Highway realignment project in line with the environmental management measures detailed in this EMP.	Project is managed in accordance with this EMP to avoid, minimise and manage impacts to the receiving environment.	Main Roads Project Manager
		Main Roads should include EMP information and management measures in project tender documentation and site induction materials for all personnel, contractors and service providers involved in the project.	Environmental management considerations and measures are incorporated into relevant project documentation and site induction materials all personnel involved.	Main Roads Project Manager
		Main Roads should ensure all agencies and contractors involved with service relocations are provided a copy of the EMP and comply with its requirements throughout the project.	Promote and monitor compliance with the EMP.	Main Roads Project Manager
Pre-construction/ Design Phase	Environmental Approvals	Main Roads should continue to liaise with any affected landholders and agencies to resolve land acquisition/excision requirements, prior to the progressing of any clearing offset package with DEC/DSEWPaC.	Provide certainty to agencies during their assessment of proposed clearing offsets.	Main Roads Project Manager
		Main Roads should liaise with DSEWPaC to define requirements for referring the project under the EPBC Act in respect to the loss of Black Cockatoo habitat through project clearing.	Compliance with EPBC Act 1999.	Main Roads Project Manager/ Environment Officer
		Main Roads should refer the project to the EPA under Section 38 of the WA Environmental Protection Act	Compliance with EP Act 1986	Main Roads Project Manager/ Environment Officer
		If the project is not formally assessed by the EPA, Main Roads should seek to have the project clearing approved under its state-wide project 'Clearing Permit' (CPS 818/5).	Compliance with the EPA Environmental Protection (Clearing of Native Vegetation) Regulations 2004.	Main Roads Project Manager/ Environment Officer
		Main Roads should discuss the need for a Bed and Banks Permit with the DoW, subject to the outcomes of the detailed design.	Compliance with the <i>Rights in Water and Irrigation Act 1914</i> .	Main Roads Project Manager/ Environment Officer
		Main Roads should continue the process of investigating Aboriginal heritage matters and apply for formal section 18 approval to disturb Aboriginal sites.	Compliance with the Western Australian <i>Aboriginal Heritage Act 1972</i> .	Main Roads Project Manager/ Environment Officer
	Land use	<ul style="list-style-type: none"> Main Roads should liaise with the DEC's Wellington District Office in respect to affecting the Munda Biddi Trail crossing with regards to possible future signage, public notification of works and any need to reposition the trail crossing to accommodate works and maximise public safety. Main Roads should liaise with the DEC's Wellington District Office/Shire of Collie in respect to any alignment impact on the Visitor Information Bay situated off Wellington Dam Road. 	Plan to minimise impacts on DEC managed assets and public recreation.	Main Roads Project Manager
	Acid Sulfate Soils	Main Roads should undertake further preliminary site assessment for ASS – only if project activities require soil disturbance in the Wellington Dam area.	Identify and manage any ASS.	Main Roads Project Manager
	Hydrology and Drainage	<ul style="list-style-type: none"> Road design should be developed to maintain existing surface water flows and incorporate appropriate erosion control measures. Ensure adequate culverts are installed to maintain existing surface water flows. Maintain existing cross-road culverts within the project area and extend/construct new culverts, to facilitate water movements. Construction in the vicinity of water bodies/courses should, if possible, be scheduled within the drier months of the year to avoid/minimise turbidity from erosion. Also refer item below: Fuels and Chemical Storage for other related management measures. 	Maintain existing surface water drainage flows and stabilise soil surfaces to mitigate potential erosion.	Main Roads Project Manager
	Vegetation and Clearing	<ul style="list-style-type: none"> Design the realignment to minimise clearing, utilise previously disturbed areas and avoid sensitive vegetation where possible. Minimise clearing in the dampland vegetation units (EmCcBl and EmCcTI) as this vegetation has a propensity to be associated with significant flora species. Main Roads should continue liaison with the DEC in respect to environmental management of project clearing within the Wellington National Park. Main Roads should discuss clearing operations and opportunities to harvest timber/salvage firewood with the DEC and Forest Products Commission. 	Minimise and manage clearing impacts.	Main Roads Project Manager
Weeds	<ul style="list-style-type: none"> Weed hygiene will be integrated into a Topsoil Management Plan developed for the project. Inform the Contractor and Main Roads Integrated Service Agreement (ISA) Partner of the need to control any known Declared Plants within the road reserve as well as the known locations of native Threatened Flora to minimise impacts to them (where possible) during any weed control. 	Relevant contractors are informed of weed locations and non-target significant flora locations.	Main Roads Project Manager	
Dieback	<ul style="list-style-type: none"> Main Roads should arrange a meeting with DEC Wellington District to finalise any "Protectable" areas and to determine practicable hygiene management for the project. Incorporate the dieback hygiene requirements into the project's contractual documents, site induction materials and overall site environmental / topsoil management plan. Update dieback hygiene mapping within 12 months prior to construction activities. 	Plan to minimise the introduction and spread of dieback during project activities.	Main Roads Project Manager	

Project Phase	Environmental Aspect	Management Measure	Expected Outcome	Responsibility
	Topsoil Management	Main Roads should prepare a Topsoil Management Plan that includes relevant weed and dieback hygiene management.	Plan to manage and optimise topsoil movement during road works.	Main Roads Project Manager
	Revegetation and Landscape Management	<ul style="list-style-type: none"> Main Roads should prepare and implement a Revegetation and Landscaping Plan for the project that includes local provenance native seed (where possible). Main Roads should consider visual landscape management in consultation with the DEC. 	Plan to manage revegetation and landscaping with relevant agency stakeholders.	Main Roads Project Manager
Construction Phase Management	Workforce Inductions and Education	Provide site inductions and tool box meetings for construction staff and contractors to inform them of their environmental management responsibilities in line with the EMP.	All site personnel and contractors are made aware of site environmental management responsibilities.	Main Roads Project Manager/ Main Roads Construction Manager/Construction Contractor
	Surface and Groundwater	<p>Impacts to surface and groundwater should be managed by:</p> <ul style="list-style-type: none"> Complying with any required Bed and Banks Permit issued by the DoW. Undertaking construction in the vicinity of water bodies/courses, if possible, during drier months of the year to avoid/minimise turbidity from erosion. No bulk on-site storage of fuel, oils and other contaminant materials should be permitted during road construction. Any temporary on-site refuelling or storage of fuel, oils and other contaminant materials should be done on a pre-designated hardstand area located a minimum of 100 m from any surface water, drainage line or perimeter of the Wellington Dam Reservoir. Spill clean-up materials will be kept on site for the clean-up of any accidental spillages. Major vehicle and plant servicing will not be permitted on the project site. Any minor servicing is to be undertaken in pre-designated refuelling areas as defined above. Overnight parking of machinery and vehicles shall be on a dedicated hardstand area that is not in proximity to any watercourse, the Wellington Dam Reservoir or any wetland. 	Comply with the requirements of any project Bed and Banks Permit, and minimise potential impacts on surface/groundwater.	Main Roads Project Manager/ Main Roads Construction Manager/Construction Contractor
	Vegetation Clearing	<p>Clearing operations should be managed in the following manner:</p> <ul style="list-style-type: none"> Clearing operations should be conducted in accordance with the Topsoil Management Plan and Dieback/Weed hygiene requirements. Main Roads should liaise with DEC's Wellington District Office to provide regular field notice on staff movements, ensure vehicle and machinery hygiene is adequate, and to satisfy <i>Bushfires Act 1954</i> requirements. Clearing should be kept to the minimum within the clearing envelope, with consideration for use of "internal clearing permits" to manage clearing operations. The limits of clearing should be clearly marked on site and relevant plans to inform site personnel to contain all activities in the clearing envelope. Significant trees to be retained shall be clearly marked prior to the start of clearing operations to minimise impact to potential fauna habitat and a fauna specialist should be present to manage any impact to native fauna. Trees to be removed should be felled in a manner that ensures they fall within the approved clearing envelope. The remainder of cleared vegetation should be salvaged, chipped on site for in situ site rehabilitation and/or soil stabilisation (note: consider the dieback and weed status of the material and its location of dispersal). Existing cleared areas should be utilised for locating site access, site offices and any temporary lay-down areas (but not adjacent to waterways or drainage lines). No burning of cleared vegetation should be permitted on site. 	Minimise and manage clearing impacts whilst utilising available forest products.	Main Roads Project Manager/ Main Roads Construction Manager/Construction Contractor
	Weed Management	<p>Preventing the introduction and spread of weeds should be managed as follows:</p> <ul style="list-style-type: none"> Adhere to the Topsoil Management Plan and apply standard weed control measures during all activities, including any requirements if operating under Main Roads Clearing Permit CPS 818. Main Roads should manage any newly identified Declared Plants within the road reserve in line with its responsibilities under the <i>Agriculture and Related Resources Protection Act 1976</i>. Declared Plants should be treated according to their Control Codes and advice from the DEC/Agriculture and Food WA. Vehicles/machinery/equipment should be cleaned free of weeds prior to arrival onsite. Prior to entering works within the Wellington National Park, vehicles, machinery and equipment should be cleaned in a designated clean-down area and inspected to ensure they are free of weeds, seeds or soil material. 	Minimise the risk of introducing and spreading weeds and manage existing weeds.	Main Roads Construction Manager/Construction Contractor
	Dieback Management	<p>Dieback should be managed during operations by:</p> <ul style="list-style-type: none"> Complying with any Main Roads Clearing Permit CPS 818 requirements and the Hygiene Management Plan / Topsoil Management Plan developed for the project. Dieback hygiene management requirements should be included within site induction materials and relevant contractual documentation for the workforce. Monitor the implementation and compliance of site personnel with dieback hygiene measures. 	Minimise the risk of introducing and spreading <i>Phytophthora</i> dieback as a result of project activities.	Main Roads Project Manager/ Main Roads Construction Manager/Construction Contractor

Project Phase	Environmental Aspect	Management Measure	Expected Outcome	Responsibility
	Topsoil Management	Conduct all works in line with the Topsoil Management Plan that should incorporate relevant weed and dieback hygiene requirements.	Minimise the introduction and spread of weeds within and adjacent to the project area.	Main Roads Construction Manager/Construction Contractor
	Fauna Management	<p>Native fauna impacts should be minimised and managed as follows:</p> <ul style="list-style-type: none"> ▪ Adhere to any Clearing Permit/Agency Approval requirements under State and/or Federal legislation. ▪ Provide site inductions and “tool-box meetings” to all site personnel/contractors to inform them that all native fauna is protected and of their environmental management obligations. ▪ Do not permit site personnel to bring firearms, other weapons or pets on site. ▪ Schedule major clearing operations to avoid peak breeding times of threatened species that utilise tree hollows, fallen hollow logs and burrows – where possible. Based on documented breeding and fledging times, this would be during April. ▪ Prior to clearing operations, a suitably experienced “fauna spotter” should be employed to inspect logs, trees and hollows (where possible) to reduce likelihood of injury to fauna. ▪ Any trees observed to contain hollows (or possum dreys) should be felled in a manner that reduces the likelihood that fauna present will be injured. ▪ If any native fauna is disturbed during clearing it should be allowed to make its own way to adjacent vegetated area and if injured it should be taken to a designated veterinary clinic or a DEC nominated wildlife carer. ▪ Any holes, pits or trenches required for services should be kept open for the minimum period necessary with escape ramps (45° batter) and bridging provided if left unattended for extended periods. Significant sized holes, pits or trenches should be inspected regularly and any fauna present should be safely removed immediately prior to filling. 	Minimise and manage clearing impacts upon native fauna.	Main Roads Construction Manager/Construction Contractor
	Aboriginal Heritage	<ul style="list-style-type: none"> ▪ Main Roads should comply with any section 18 approval conditions applicable to operations that will disturb Aboriginal sites. ▪ Main Roads should ensure all site personnel are aware of their obligations under the <i>Aboriginal Heritage Act 1972</i>, in contractual documents and site inductions prior to commencing site work. ▪ If during clearing/construction, materials of likely significance to Aboriginal people are encountered, works should cease in the vicinity of the area and Main Roads Environment Officer and the DIA should be notified immediately. If skeletal material is uncovered, the Western Australian Police shall be advised immediately. 	Compliance with the Western Australian <i>Aboriginal Heritage Act 1972</i> and any approved section 18 conditions.	Main Roads Project Manager/ Main Roads Construction Manager/Construction Contractor
	Land Use	Where land is acquired from private property, existing fences will be replaced by Main Roads/Contractor, with the type of fence to be determined in consultation with the individual landowners.	Replace existing fences to the satisfaction of landowners.	Main Roads Construction Manager/Construction Contractor
	Roadside Memorials	Main Roads should ensure management of roadside memorials complies with its Roadside Memorials Policy and Guidelines.	Due consideration is given to Roadside Memorials during works.	Main Roads Construction Manager/Construction Contractor
	Contaminated Material Management	If any suspected contaminated material is encountered during project implementation, works should cease in the area and the site Superintendent/Environment Officer be contacted for advice.	Safe management planning for any unexpected contaminated material encountered.	Main Roads Construction Manager/Construction Contractor/Environment Officer
	Temporary Construction-related Impacts Management	<p>The Construction Contractor should nominate a person responsible for reviewing and monitoring all operations that should be managed as follows:</p> <ul style="list-style-type: none"> ▪ <u>Works Notification to Owners/Occupiers</u> The Construction Contractor should write to the owners/occupants of properties within 200 m of the limits of the work site, informing them of the nature and timing of the works and providing contact details for complaints. Main Roads Superintendent will approve a copy of the letter, mailing list and delivery dates prior to the commencement of road works. The Construction Contractor should provide occupants of adjacent properties with at least 24 hours warning when construction work is planned outside the hours of 7.00 am and 7.00 pm or on Sundays or public holidays. ▪ <u>Complaints Management</u> The Construction Contractor should detail in the Quality Plan, procedures for dealing with complaints regarding public nuisance or property damage. These procedures must ensure that the Superintendent is informed in a timely manner of any such complaint, the progress made in dealing with it, and of the re-instatement or repairs to damage carried out. ▪ <u>Construction Noise Management</u> The Construction Contractor should observe its obligations under the <i>Environmental Protection Act 1986</i>, the Environmental Protection (Noise) Regulations 1997 and section 6 of AS 2436 – 1981: <i>Guide to Noise Control on Construction, Maintenance and Demolition Sites</i>. For construction work between 7.00 am and 7.00 pm (excluding Sunday and public holidays), the construction contractor should minimise the effects of noise on the occupants of adjacent properties. This may include using silenced plant, operating plant as far away as practicable from occupied properties, or by limiting working hours on those construction activities which generate significant noise. At least seven days prior to any after-hours construction works commencing, the Construction Contractor should submit a Noise Management Plan for approval by the Chief Executive Officer of the Shire of Collie. 	Manage, minimise and monitor temporary/nuisance impacts arising during construction to avoid disturbance to landholders and the public.	Main Roads Project Manager/ Main Roads Construction Manager/Construction Contractor

Project Phase	Environmental Aspect	Management Measure	Expected Outcome	Responsibility
		<ul style="list-style-type: none"> ▪ <u>Vibration Management</u> Vibration impacts are not likely to require detailed site management within the current Stage 1 project area. The Construction Contractor should take necessary precautions during its operations to limit ground particle velocities from vibratory compaction or percussion equipment so that they do not become a public nuisance or result in property damage. The use of vibrating rollers in vibratory mode will not be permitted within the nominated distances of any building as detailed below <ul style="list-style-type: none"> – all residential buildings – 50 m – old/historic buildings or where residents show concern – 100 m. Prior to the start of any operation that may cause vibration or result in damage, the Construction Contractor should conduct property inspections to establish their pre-works condition. The Construction Contractor is liable for any vibration damage caused to buildings and property adjacent to the works, and will take all necessary precautions to prevent such damage. If damage is caused due to the Construction Contractor's operations, they are responsible to take all necessary action to rectify the damage. • <u>Dust Management</u> The Construction Contractor should employ construction methods that will keep dust lift to a minimum, and as required provide for the management of dust such as by watering of the works area and of roads, streets and other areas immediately adjacent to the works. Where it is found that vehicles leaving the site have dropped excessive soil material onto the road these sections should be swept on an as needs basis to reduce the potential for dust generation and maintain traffic safety. 		
	Traffic Access and Safety	<ul style="list-style-type: none"> ▪ To maintain safe thoroughfare of local traffic and private property during all road works, the Construction Contractor will develop and implement a certified Traffic Management Plan to conform to current Main Roads traffic management requirements for works on roads. ▪ All traffic control measures shall be in place and fully operational before the Construction Contractor commences any work activity that affects existing roadways. 	Maintain safe thoroughfare for traffic on Coalfields Highway and private property accesses.	Main Roads Project Manager/ Main Roads Construction Manager/Construction Contractor
	Fire Management	<ul style="list-style-type: none"> ▪ The Construction Contractor should confirm and adhere to any specific requirements for fire prevention requested by the Shire Collie, DEC and the Department of Fire and Emergency Services. ▪ No fires or burning of cleared vegetation permitted on site. ▪ Vehicles should be equipped with fire-extinguishers and machinery such as water carts made available in the event of any bushfire during project activities. ▪ Machines and vehicles should be restricted and parked within designated cleared areas. 	Compliance with relevant agency/legislative requirements and reduced fire risk.	Main Roads Construction Manager/Construction Contractor
	Fuel and Chemical Storage	<ul style="list-style-type: none"> ▪ No on-site storage of fuel, oils and other contaminant materials should be permitted during road construction. ▪ Any temporary on-site refuelling or storage of fuel, oils and other contaminant materials should be done on a pre-designated hardstand area located a minimum of 100 m from any surface water, drainage line or perimeter of the Wellington Dam Reservoir. ▪ Spill clean-up materials will be kept on site for the clean-up of any accidental spillages. ▪ Major vehicle and plant servicing will not be permitted on the project site. ▪ Any minor servicing is to be undertaken in pre-designated refuelling areas as defined above. ▪ Overnight parking of machinery and vehicles shall be on a dedicated hardstand area that is not in proximity to any watercourse, the Wellington Dam Reservoir or any wetland. 	Avoid hazardous chemical storage on the site and manage any accidental spillage.	Main Roads Construction Manager/Construction Contractor
	Waste Disposal	Domestic and site generated waste will not be disposed of by burning. All waste associated with the project shall be disposed of at an authorised waste site, or site agreed with the Shire of Collie.	Waste is managed and disposed of appropriately leaving the site free of construction generated waste.	Main Roads Construction Manager/Construction Contractor
	Environmental Monitoring	During the projects construction phase compliance with environmental management measures will be regularly monitored. Any non-conformances will be addressed at the first opportunity, while the non-conformance and any improvement actions implemented will be detailed in appropriate construction superintendent documentation.	Monitor compliance with environmental management measures.	Main Roads Project Manager/ Environment Officer/ Construction Contractor
Post-construction	Revegetation	Main Roads should implement the Revegetation and Landscape Plan and monitor its success for any relevant defects period or agency reporting requirements.	Optimise the success of Revegetation and Landscaping.	Main Roads Project Manager/ Environment Officer
	Weed Management	Longer term management of weeds within the project area will be conducted during the annual herbicide and weed management program conducted by Main Roads Integrated Service Agreement (ISA) Partner.	Long-term weed monitoring and management within the project area.	Main Roads Term Network Contractor