COTERRA ENVIRONMENT



Environmental Assessment Report

Wattle Grove South Local Structure Plan

Rev 0 August 2025

CALIBRE | COMMITMENT | COLLABORATION

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Report Version:	Rev 0
Date:	August 2025

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Executive Summary

The Wattle Grove South Local Structure Plan area ('the site') (Appendix 1) extends over approximately 126 hectares (ha) and is 16 kilometres (km) south-east of the Perth Central Business District (CBD) (Figure 1). The site is located within the area bound by Welshpool Road East and Crystal Brook Road to the north-east, and Tonkin Highway to the west, within the City of Kalamunda in the locality of Wattle Grove (Figure 2).

The landholdings within the Local Structure Plan area are currently undergoing a rezoning under the Perth Metropolitan Region Scheme (MRS). MRS Amendment 1388/57 – Wattle Grove South proposes to rezone the site from Rural to Urban under the MRS, along with a concurrent rezoning to Urban Development under the City of Kalamunda Local Planning Scheme No. 3 (LPS 3).

Following formal assessment of MRS Amendment 1388/57 under Part IV of the Environmental Protection Act 1986, the Environmental Protection Authority (2025) concluded that the MRS Amendment may be implemented, subject to a suite of Environmental Conditions being implemented to protect the site's key environmental values, as well as the Greater Brixton Street Wetlands which is in proximity of the site (Appendix 2). These include:

- Environmental Outcomes to be achieved through avoidance of disturbance to Threatened Ecological Communities (TEC), threatened flora (*Conospermum undulatum)*, and black cockatoo habitat, canopy retention and connectivity and minimising adverse impacts to the Greater Brixton Street Wetlands
- Preparation of Conservation Area Management Plans (CAMPs) prior to subdivision or development, and to include fencing, monitoring, rehabilitation, weed and pathogen control.
- Requirement for black cockatoo surveys for unsurveyed land prior to subdivision or development, retention and replanting of black cockatoo potential nesting trees.
- Preparation of a Tree Canopy Retention and Landscape Management Plan (TCRLMP) prior to subdivision or development, which is aligned with the City of Kalamunda's Urban Forest Strategy.
- Preparation of an Urban Water Management Plan (UWMP) prior to subdivision or development, which is informed by pre-development monitoring.
- Preparation of annual environmental performance reports to Department of Water and Environmental Regulations (DWER), which demonstrate compliance with environmental outcomes.

The Environmental Assessment Report evaluates environmental values of the site, potential environmental impacts associated with the proposed development, and the mitigation strategies proposed to address the following five key environmental factors:

1. Terrestrial Environmental Quality

Key issues:

- Soil contamination risk from historical land uses (e.g. turf and poultry farms).
- Moderate to low risk of Acid Sulfate Soils (ASS).
- Proximity to a remediated landfill site.

Potential impacts:

- Potential disturbance to ASS
- Potential loss of surface soil through wind erosion
- Intercepting areas of potential contamination

Mitigation Hierarchy Assessment:

- Avoidance: No development in areas of high ASS risk.
- Minimisation: ASS and contamination assessments to be conducted at subdivision stage; unexpected finds protocols implemented. Construction Environmental Management Plan (CEMP) will include dust suppression, erosion control, and soil stabilisation.
- Rehabilitation and Offset: None proposed as risks are manageable through standard planning controls.

Predicted Outcome: The site is suitable for urban development with targeted investigations and management measures ensuring the EPA objective for terrestrial environmental quality are met.

2. Inland Waters

Key issues:

- Groundwater mound from historical turf irrigation and local geology of the site.
- Proximity to Greater Brixton Street Wetlands (GBSW) and Yule Brook catchment.
- Surface water flow paths and nutrient export.

Potential impacts:

- alteration of hydrological regimes resulting in impacts to significant wetlands and waterways within and nearby to the site, including the Yule Brook and the GBSW.
- loss of foreshore functions and groundwater and/or surface water dependent vegetation and impacts to other water dependent ecosystems.

Mitigation Hierarchy Assessment:

- Avoidance: No development within GBSW; 100 m buffer maintained via Tonkin Highway and infrastructure corridors.
- Minimisation: Urban Water Management Plan (UWMP) to manage water quality and quantity; biofiltration basins and swales to treat runoff.
- Rehabilitation: Integration of degraded wetlands into public open space.
- Offset: None proposed as hydrological regimes will be maintained and nutrient export will reduced by 60–63% through best practice water-sensitive urban design.

Predicted Outcome: Hydrological regimes and water quality will be maintained or improved, with no significant impact on the GBSW or Yule Brook.

3. Flora and Vegetation

Key issues:

- Presence of following TECs and conservation significant flora within the site:
  - Banksia Woodlands of the Swan Coastal Plain ecological community Federal TEC – Endangered (EPBC Act) and State PEC (Priority 3)
  - FCT 20a *Banksia attenuata* woodlands over species rich dense shrublands (FCT 20a) State TEC – Critically Endangered (BC Act) (FCT 20a)
  - FCT 20c Shrublands and woodlands of the eastern side of the Swan Coastal Plain (FCT 20c) State TEC – Critically Endangered (BC Act) and Federal TEC – Endangered (EPBC Act)
  - *Conospermum undulatum* (T) – Vulnerable (BC Act and EPBC Act)
  - Isopogon autumnalis (P3), previously named Isopogon drummondii.
- Vegetation complexes poorly represented locally and regionally.

Potential impacts:

- Direct and indirect loss of TECs and conservation significant flora, and vegetation complexes poorly represented locally and regionally.
- Fragmentation of existing intact remnant vegetation

Mitigation Hierarchy Assessment:

- Avoidance: 96% of remnant native vegetation retained; all vegetation in Good to Excellent condition preserved. Future surveys required for unsurveyed lots;
- Minimisation: The Conservation Area Management Strategy (CAMS) (Appendix 3) will guide preparation of future Conservation Area Management Plans (CAMPs) to ensure protection and enhancement of Conservation areas.
- Rehabilitation: Rehabilitation programs within Conservation areas to maintain and/or restore TECs, threatened flora and improve condition.
- Offset: Not proposed given residual impacts are not considered to be significant; however, may be required if future development impacts Conservation areas, unsurveyed TECs or threatened flora.

Predicted Outcome: Long-term protection of TECs and conservation significant flora through conservation area management.

4. Terrestrial Fauna

Key fauna values and issues:

- Presence of habitat for the following conservation significant fauna:
  - Forest Red-Tailed black cockatoo *Calyptorhynchus banksii naso* (listed as Vulnerable under the EPBC Act and the BC Act).
  - Carnaby's cockatoo *Zandi latirostris* (listed as Endangered under the EPBC Act and the BC Act).
  - Baudin's cockatoo *Zandi baudinii* - listed as Endangered under the BC Act and the EPBC Act.
  - Quenda *Isoodon fusciventer* (listed as Priority 4 by DBCA) (refer to Figure 9 for locations of Quenda diggings and scat recorded within the site).
- Presence of potential nesting trees and foraging and roosting habitat.

Potential impacts:

- Direct and indirect impacts on conservation significant fauna that may utilise habitat within the area, namely black cockatoos and quenda.
- Fragmentation and degradation of fauna corridors.

Mitigation Hierarchy Assessment:

- Avoidance: High-quality habitat retained in Conservation areas; no impact to known nesting or roosting sites.
- Minimisation: Tree Canopy Retention and Landscaping Management Plan (TCRLMP) to ensure canopy connectivity, and retention and replanting of black cockatoo potential nesting trees.
- Rehabilitation: Revegetation and habitat enhancement within Conservation areas.
- Offset: Not proposed given residual impacts are not considered to be significant; however, may be required if future development results in significant impacts to Conservation areas, TECs, threatened flora and/or black cockatoo habitat.

Predicted Outcome: Fauna habitat values will be maintained or enhanced through conservation area management and tree canopy retention and replanting within the site.

5. Social Surroundings

Key heritage and visual amenity values and issues:

- Brentwood Road Swamp Aboriginal heritage site.
- Visual amenity impacts from urbanisation.

Mitigation Hierarchy Assessment:

  - Avoidance: No development within Aboriginal heritage site; culturally significant trees retained via the TCRLMP.
  - Minimisation and rehabilitation: Landscape design to preserve rural character; engagement with Traditional Owners; measures undertaken in the event artefacts are uncovered in the vicinity of the Brentwood Road Swamp Aboriginal heritage site; visual buffers and native landscaping to restore amenity.
  - Offset: None proposed.

Predicted Outcome: Cultural heritage and visual landscape values will be protected and potential impacts will be appropriately managed.

Future Environmental Reports and Management Plans

The following outlines a suite of environmental reports and management plans to be undertaken and implemented at subdivision or development:

- Urban Water Management Plan (UWMP)
- Conservation Area Management Plan (CAMP)
- Tree Canopy Retention and Landscaping Management Plan (TCRLMP)
- Construction Environmental Management Plan (CEMP)
- Bushfire Management Plan (BMP)
- ASS Assessment and Dewatering Management Plan, if required
- Preliminary Contamination Investigation, if required.

Conclusion

The Wattle Grove South Local Structure Plan (Appendix 1) has been designed to meet the requirements of the Environmental Conditions (Appendix 2), and align with the EPA's objectives and mitigation hierarchy. Through avoidance, minimisation, rehabilitation, and adaptive management, the proposal ensures:

- Protection and management of conservation TECs and significant flora and fauna within Conservation areas through the CAMS (Appendix 3), which will guide future CAMPs for each Conservation Area.
- Tree canopy retention and replanting (including black cockatoo potential nesting trees) within the urban development through the TCRLMP.
- Maintenance of hydrological regimes and likely improvement in water quality via the Local Water Management Strategy, which will guide future UWMPs.
- Preservation of cultural heritage and visual amenity.
- Sustainable urban development which minimises its environmental impact within the site and the nearby GBSW.

Contents

Executive Summary ..... **i**

1 Introduction **10**
1.1 Background 10
1.2 Purpose and scope of this report 10

2 Planning Context **12**
2.1 Zonings and Reserves 12
2.1.1 Metropolitan Region Scheme 12
2.1.2 City of Kalamunda Local Planning Scheme 12
2.2 Land Use Planning Process 12
2.3 Wattle Grove South Local Structure Plan 13
2.3.1 Conservation and Potential Conservation Areas 13

3 Environmental Assessment **14**
3.1 State environmental assessment 14
3.1.1 Environmental Conditions (MRS Amendment 1388/57) 15
3.2 Federal legislation 16
3.3 Associated Technical Reports 16

4 Environmental Assessment Overview **17**
4.1 Principles 17
4.2 Key Environmental factors 18
4.3 Mitigation Hierarchy 20

5 Terrestrial Environmental Quality **21**
5.1 EPA Definition and Objective 21
5.2 Key Policies and Guidance 21
5.3 Receiving Environment 21
5.3.1 Studies and investigations 21
5.3.2 Topography 21
5.3.3 Geology and Soils 21
5.3.4 Land Use 24
5.3.5 Potential Contamination 24
5.3.6 Acid sulfate soils 24
5.4 Potential Impact Identification and Assessment 25
5.4.1 Potential Contamination 25
5.4.2 Acid Sulfate Soils 25
5.5 Impact Mitigation 26
5.6 Predicted Outcome 26

6 Inland Waters **27**
6.1 EPA Definition and Objective 27
6.2 Key Policies and Guidance 27
6.3 Receiving Environment 27
6.3.1 Studies and investigations 27
6.3.2 Groundwater 29
6.3.3 Surface Water 36
6.3.4 Geomorphic Wetlands 38

6.3.5 Greater Brixton Street Wetlands 44
6.4 Potential Impact Identification and Assessment 52
6.4.1 Key Hydrological changes 53
6.4.2 Wetlands within the site (REWs UFI 8037 and portion of UFI 15257) 54
6.4.3 Wetlands adjacent to the site (CCWs [UFI 8026 and UFI 8027] and portion of REW UFI 15257 within Lot 501) 54
6.4.4 GBSW and Yule Brook 55
6.4.5 Cumulative Impacts 59
6.5 Impact Mitigation 60
6.6 Predicted Outcome 63
7 Flora and Vegetation 65
7.1 EPA Definition and Objective 65
7.2 Key Policies and Guidance 65
7.3 Receiving Environment 65
7.3.1 Studies and Investigations 65
7.3.2 IBRA Region 67
7.3.3 Vegetation 69
7.3.4 Flora 74
7.3.5 Conservation Areas and Bush Forever 76
7.3.6 Regional Ecological Linkages 76
7.3.7 Environmentally Sensitive Areas 77
7.3.8 Local Natural Areas 79
7.4 Potential Impact Identification and Assessment 80
7.4.1 Direct impacts 80
7.4.2 Indirect Impacts 84
7.4.3 Cumulative Impacts 86
7.5 Impact Mitigation 86
7.6 Predicted Outcome 89
8 Terrestrial Fauna 91
8.1 EPA Definition and Objective 91
8.2 Key Policies and Guidance 91
8.3 Receiving Environment 91
8.3.1 Studies and Investigations 91
8.3.2 Fauna habitats 95
8.3.3 Fauna habitat linkages 98
8.3.4 Fauna Assemblage 98
8.3.5 Conservation Significant Fauna 100
8.3.6 Black Cockatoo Habitat 103
8.4 Potential Impact Identification and Assessment 109
8.4.1 Direct Impacts 110
8.4.2 Indirect Impacts 114
8.4.3 Cumulative Impacts 117
8.4.4 Impact Mitigation 117
8.5 Predicted Outcome 120
9 Social Surroundings 122
9.1 Key Policies and Guidance 122

9.2 Studies and investigations 122
9.2.1 Cultural Heritage Values and Aboriginal Cultural Heritage 122
9.2.2 Visual amenity 122
9.3 Receiving Environment 123
9.3.1 Aboriginal Heritage 123
9.3.2 Cultural heritage values of the GBSW 125
9.3.3 Visual amenity 125
9.4 Potential Impact Identification and Assessment 127
9.4.1 Aboriginal Heritage 127
9.4.2 Visual Landscape 127
9.5 Impact Mitigation 128
9.6 Predicted Outcome 129
10 Other Matters 130
10.1 Bushfire Risk 130
11 Future Environmental Reports and Management Plans 131
12 References 133

Tables

Table 4-1: *Environmental Protection Act 1986* Principles 17
Table 4-2: EPA Factors and Objectives 18
Table 5-1: Regional geological succession mapping 23
Table 5-2: ASS Investigation Trigger Criteria Assessment 25
Table 5-3: Terrestrial Environmental Quality Mitigation Hierarchy 26
Table 6-1: Wetland management categories, description and management objectives (EPA 2008) 39
Table 6-2: DBCA mapped geomorphic wetlands within and adjacent to the site 39
Table 6-3: Summary of significant wetland features and their attributes (Pentium Water 2024) 41
Table 6-4: Summary of wetland categories and area within the GBSW 44
Table 6-5: Mapped wetlands within 150 m of the site 45
Table 6-7: Nutrient inputs and outputs from the proposed 'Urban' land use (Hyd2o 2024) 57
Table 6-8: Inland Waters Mitigation Hierarchy 60
Table 7-1: Vegetation system associations and extents (GoWA 2019a) 67
Table 7-2: Vegetation complexes and extents (GoWA 2019b) 69
Table 7-3: Vegetation community descriptions 70
Table 7-4: Vegetation community and extents 71
Table 7-5: Vegetation condition and extents 71
Table 7-6: Floristic community type assignment summary (Plantecology 2024) 72
Table 7-7: Summary of ESAs within the site 77
Table 7-8: Vegetation communities within conservation 80
Table 7-9: Vegetation condition within conservation 81

Table 7-10: Extent of Banksia Woodlands TEC remaining and protected in reserves (TSSC 2016) 83
Table 7-11: Flora and Vegetation Mitigation Hierarchy 87
Table 8-1: Fauna habitat descriptions (AECOM 2020) 96
Table 8-2: Fauna habitats within the site 98
Table 8-3: Fauna species observed during field surveys (AECOM 2020) 98
Table 8-4: Black cockatoo foraging habitat value per BCE 2021 scoring method 105
Table 8-5: Summary of foraging habitat scores per black cockatoo species 106
Table 8-6: Foraging habitat value per black cockatoo species in Conservation 112
Table 8-7: Fauna habitat retained within conservation and potential clearing impact 112
Table 8-8: Terrestrial Fauna Mitigation Hierarchy 117
Table 9-1: Aboriginal heritage sites, values and cultural associates 123
Table 9-2: Cultural heritage values of the GBSW 125
Table 9-3: State and regional landscape character values (EPCAD 2024) 126
Table 9-4: Social Surroundings Mitigation Hierarchy 128
Table 11-1: Future Environmental Reporting and Management Plans 131

Plates

Plate 2-1: Extent of land included in MRS Amendment 1388/57 (WAPC 2021a) 12
Plate 5-1: Regional Geology and Geotechnical Investigations (Hyd2o 2024) 22
Plate 5-2: Diagrammatic deeper hydrogeological cross-section (Rockwater 2023) 23
Plate 6-1: DWER regional groundwater contour mapping (Hyd2o 2024) 29
Plate 6-2: Local groundwater mapping (Hyd2o 2024) 31
Plate 6-3: Groundwater contours and geological and geophysical interpretation (Hyd2o 2024) 32
Plate 6-4: Localised groundwater mound (Hyd2o 2024) 34
Plate 6-5: Yule Brook sub-catchment (Hyd2o 2024) 36
Plate 6-6: Original Crystal Brook tributary flow path (1953 aerial photograph) 37
Plate 6-7: Surface water flow pathways and site's sub catchments (Hyd2o 2024) 38
Plate 6-8: Greater Brixton Street Wetlands 44
Plate 6-9: Conceptual Hydrogeology of Brixton Block Located in GBSW (Bourke 2017) 46
Plate 6-10: ERT Transect Within Alison Baird Reserve, East of the Sand Dune (Smith et al 2023) 46
Plate 6-11: GBSW regional groundwater mapping and perched water flow direction (Hyd2o 2024) 48
Plate 6-12: Potential interaction between surface/perched water with the Superficial Aquifer within the GBSW area (Davidson 1995) 49
Plate 6-13: Hydrogeological conceptual model of the GBSW 50
Plate 6-14: Physical Infrastructure separating CCW UFI 14962 and the site 52
Plate 7-1: Lots surveyed within the structure plan area 66
Plate 7-2: Vegetation associations and complexes 68
Plate 7-3: Conservation areas and regional ecological linkages 77

Plate 7-4: ESAs within the site (DWER 2025a) 78
Plate 7-5: Local Biodiversity Strategy LNAs (City of Kalamunda 2023a) 79
Plate 8-1: Lots surveyed within the structure plan area 92
Plate 8-2: Black cockatoo roosting and breeding sites (within 12km) 108
Plate 8-3: Regional black cockatoo foraging habitat 109
Plate 9-1: Location of Aboriginal heritage sites within and external to site 124

Figures

Figure 1 Site Location
Figure 2 Aerial Photograph
Figure 3 Topography and Soils
Figure 4 Wetland Mapping
Figure 5 Vegetation Communities
Figure 6 Vegetation Condition
Figure 7 Conservation Significant Vegetation
Figure 8 Conservation Significant Flora
Figure 9 Fauna Habitat
Figure 10 Carnaby's Cockatoo Foraging Habitat
Figure 11 Forest Red-tailed Black Cockatoo Foraging Habitat
Figure 12 Baudin's Cockatoo Foraging Habitat
Figure 13 Black Cockatoo Potential Nesting Trees

Appendices

Appendix 1 Local Structure Plan
Appendix 2 Draft Environmental Conditions (EPA Report 1788)
Appendix 3 Conservation Area Management Strategy
Appendix 4 Wetland Assessment (Pentium Water 2024)
Appendix 5 Ecological Memo (JBS&G 2024)
Appendix 6 FCT analysis (Plantecology 2024)
Appendix 7 Lot 54 Flora and Vegetation Survey (Plantecology 2025)
Appendix 8 Black Cockatoo Habitat Assessment (Phoenix Environmental 2024)
Appendix 9 Lot 54 Black Cockatoo Habitat Assessment

1 Introduction

1.1 Background

The Wattle Grove South Local Structure Plan area ('the site') extends over approximately 126 hectares (ha) and is 16 kilometres (km) south-east of the Perth Central Business District (CBD) (Figure 1). The site is located within the area bound by Welshpool Road East and Crystal Brook Road to the north-east, and Tonkin Highway to the west, within the City of Kalamunda in the locality of Wattle Grove (Figure 2).

The landholdings within the Local Structure Plan area are currently undergoing a rezoning under the Perth Metropolitan Region Scheme (MRS). MRS Amendment 1388/57 – Wattle Grove South proposes to rezone the site from Rural to Urban under the MRS, along with a concurrent rezoning to Urban Development under the City of Kalamunda Local Planning Scheme No. 3 (LPS 3).

In April 2022, the Environmental Protection Authority (EPA) determined MRS Amendment 1388/57 – Wattle Grove South was to be assessed under Part IV of the *Environmental Protection Act 1986* (EP Act). The EPA issued the Instructions for the Environmental Review (Assessment No. 2335) on 15 August 2022.

The MRS Amendment underwent a formal environmental impact assessment, which was done in accordance with the EPAs Instructions for the Environmental Review (Assessment No. 2335) and resulted in a suite of environmental investigations, technical studies and Environmental Review documentation being prepared for public review and the EPA's assessment. The Western Australian Planning Commission (WAPC) advertised the Environmental Review for a 60 day public review period on 8 October 2024. The Environmental Review provided an assessment against the preliminary key environmental factors identified by the EPA in its Instructions, and addressed the potential impacts, proposed mitigation and environmental outcomes for each factor.

The EPA issued its report and recommendations to the Minister for the Environment on 30 July 2025, which was advertised for a 21 day public appeal period. In summary, the EPA advised the Minister for Environment that it had assessed the potential environmental impacts, considered the proposed management measures being able to mitigate these impacts and recommended that the amendment may be implemented, subject to the recommended environmental conditions (provided in Appendix A of EPA Report 1788). Further discussion on the EPA's assessment report and recommendations to the Minister for Environment is provided in section 3.1.

A Local Structure Plan has been prepared by Element which presents the development layout and precinct boundaries for the landholdings within the site (Appendix 1) and addresses the requirements of the Environmental Conditions set out in the Ministerial Statement for MRS Amendment 1388/57 (hereafter referred to as 'Environmental Conditions') (Appendix 2).

1.2 Purpose and scope of this report

This Environmental Assessment Report (EAR) was prepared to accompany the Local Structure Plan documentation package and address:

- the environmental values of the site
- the environmental conditions of MRS Amendment 1388/57
- the potential environmental impacts associated with the proposed development
- the design, management and mitigation strategies proposed to address these impacts.

The background and technical content presented in this EAR has been compiled from the Environmental Review for MRS Amendment (1388/57) (Coterra et al. 2024) and updated with new studies and detailed project information developed during the local structure planning process.

2 Planning Context

2.1 Zonings and Reserves

2.1.1 Metropolitan Region Scheme

In response to the North-East Sub-regional planning framework, the WAPC initiated MRS Amendment 1388/57 to rezone approximately 126 ha of land in Wattle Grove from the Rural zone to the Urban zone under the MRS (Plate 2-1) to facilitate the concurrent rezoning under the local planning scheme, future structure planning, subdivision, development and use of land for residential associated purposes.

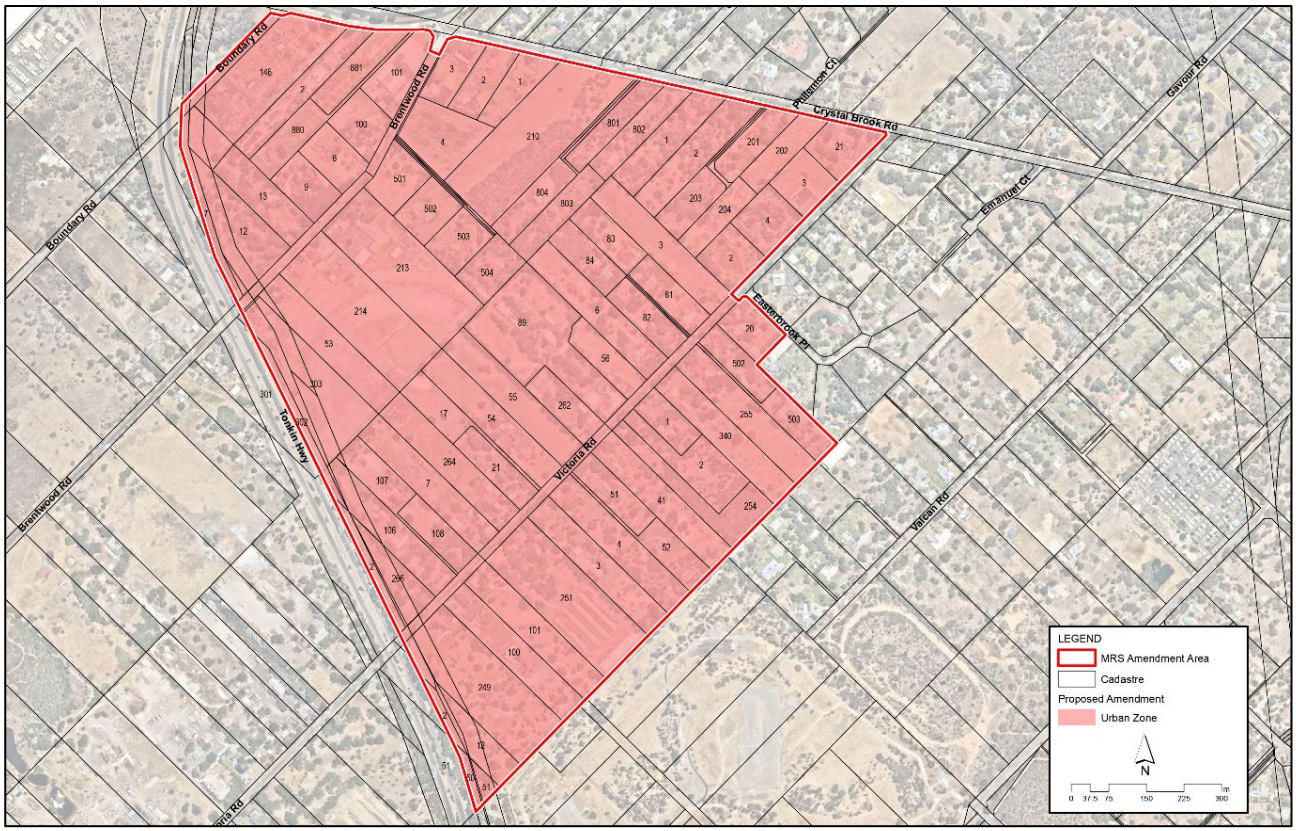


Plate 2-1: Extent of land included in MRS Amendment 1388/57 (WAPC 2021a)

2.1.2 City of Kalamunda Local Planning Scheme

Under the City of Kalamunda LPS 3, the site is zoned Rural, and it is expected that a concurrent amendment to rezone the site will take place once the site is rezoned to Urban under the MRS.

2.2 Land Use Planning Process

The following sets out the land use planning process that will be applied to facilitate future urban development and creation of the Conservation Public Open Space areas:

- Site will be concurrently rezoned to Urban under the MRS and Residential Development under LPS 3.
- Local Structure Plan has been prepared to facilitate development of the urban area to:

- address the relevant Environmental Conditions of the Ministerial Statement for MRS Amendment 1388/57 (Appendix 2)
- outline the Part 1 implementation provisions so that landowners and developers are aware of their obligations when pursing the redevelopment of the land.

- Subdivision or development, will address the Environmental Conditions of the Ministerial Statement for MRS Amendment 1388/57 (i.e. preparation of conservation area management plan) as well as any relevant subdivision conditions (e.g. preparation of construction environmental management plan as a condition of subdivision).

2.3 Wattle Grove South Local Structure Plan

The Wattle Grove South Local Structure Plan has been developed for the site and comprises the following attributes (Appendix 1):

- Precincts (A, B, C, D, E and F)
- Residential
- Light Industry
- Public Purpose – Primary School
- Public Open Space – Conservation (as per Environmental Conditions of MRS Amendment 1388/57)
- Public Open Space – Potential Conservation (as per Environmental Conditions of MRS Amendment 1388/57)
- Public Open Space – Recreation

Concerning the Potential Conservation and Public Open Space areas, the Local Structure Plan notes:

- Conservation and Potential Conservation areas to be investigated further and determined by proponents as part of Local Structure Plan Amendments
- The location of Public Open Space can potentially be modified by a proponent as part of their final design solution, subject to justification being provided through a Structure Plan amendment and/or subdivision application.

2.3.1 Conservation and Potential Conservation Areas

Regarding the creation of these Conservation Areas, the Local Structure Plan has designated these areas as Public Open Space - Conservation and Public Open Space - Potential Conservation. Further investigation and site studies will be required prior to subdivision to:

- confirm the presence and extent of threatened ecological communities (including occurrences that are degraded that can be restored to achieve a condition rating of good or getter), viable populations of threatened flora (including buffers that may be required) and medium to high quality black cockatoo foraging habitat and potential nesting trees
- inform the final boundary and delineation of these Conservation Areas, particularly for the areas designated Public Open Space – Potential Conservation, where site access has been limited and the presence and/or absence of these environmental values is still unknown.

Depending on the extent of the proposed variations to the Structure Plan, the Western Australian Planning Commission and the City of Kalamunda may require a proponent to also amend this Structure Plan prior to the determination of the subdivision application.

Sections 5 of the CAMS (Appendix 3), outlines the management actions required to undertake these studies and define the final boundary of these Conservation Areas.

3 Environmental Assessment

3.1 State environmental assessment

The *Planning and Development Act 2005* (PD Act) requires all proposed schemes and scheme amendments to be referred to the Environmental Protection Authority (EPA) by the Responsible Authority (in this instance the WAPC) for the scheme. Following referral of a scheme amendment, and in accordance with Section 48A of the *Environmental Protection Act 1986* (EP Act), the EPA will determine whether the referred scheme amendment:

- should not be assessed (with advice and recommendations potentially provided)
- should be assessed (i.e. environmental review of the scheme with instructions issued by the EPA concerning the scope and content of the environmental review)
- is by its nature incapable of being made environmentally acceptable.

MRS Amendment 1388/57 was referred to the EPA for its consideration and in April 2022, the EPA determined that the scheme amendment should be formally assessed under Part IV of the EP Act.

The MRS Amendment underwent a formal environmental impact assessment, which was done in accordance with the EPAs Instructions for the Environmental Review (Assessment No. 2335) and resulted in a suite of environmental investigations, technical studies and Environmental Review documentation being prepared for public review and the EPA's assessment of the following values within and nearby the site:

1. Inland waters
    - Waterways and wetlands of conservation significance, including:
        - Yule Brook (Canning River system)
        - Nationally important Greater Brixton Street Wetlands (GBSW)
        - Conservation Category Wetlands (CCW) and Resource Enhancement Wetlands (REW) and associated buffers.
2. Flora and vegetation
    - Vegetation complexes that are poorly represented on the Swan Coastal Plain
    - Threatened ecological communities (TECs) listed under the State *Biodiversity Conservation Act 2016* (BC Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and State listed priority ecological communities (PECs)
    - Habitat for threatened flora listed under the BC Act and EPBC Act, and State listed priority flora.
3. Terrestrial fauna
    - Habitat for threatened fauna listed under the BC Act and EPBC Act, and State listed priority fauna.
4. Social surroundings
    - Aboriginal heritage sites
    - Visual amenity associated with the natural and semi-rural character of the area
    - Social value of the GBSW.

The WAPC advertised the Environmental Review along with the MRS Amendment for a 60 day public review period on 8 October 2024. The WAPC received 108 public submissions and provided their summary of submissions to the EPA on 11 December 2024, and their Response to Submissions on 21 February 2025.

3.1.1 Environmental Conditions (MRS Amendment 1388/57)

The EPA published its report and recommendations on 30 July 2025 (EPA Assessment Report 1788) and advised the Minister for the Environment that the MRS Amendment may be implemented subject to the Environmental Conditions (as they relate to inland waters, flora and vegetation, and terrestrial fauna) being undertaken (Appendix 2) to achieve the following:

Environmental Outcomes (condition 3):

- Avoid disturbance to the following environmental values within retention areas, including:
  - *Banksia attenuata* woodlands over species rich dense shrublands (FCT 20a)
  - Shrublands and Woodlands of the Eastern Swan Coastal Plain (FCT 20c)
  - Threatened flora (*Conospermum undulatum*) and Priority 3 flora (*Isopogon autumnalis*)
  - Medium to high quality black cockatoo foraging habitat
  - Potential nesting trees.
- Avoid disturbance to black cockatoo known nesting trees and roosting sites within the site.
- Tree retention and replacement to ensure canopy coverage across the site and habitat connectivity between retention areas retained black cockatoo habitat.
- Minimise adverse impacts on the GBSW from urban development of the Amendment Area, including impacts to the wetlands' persistency, hydrological regime, water quality, ecological integrity and ecological function.

Conservation Area Management (condition 4):

- Prior to future subdivision or development of areas which include or part of a retention area, the condition requires preparation of a Conservation Area Management Plan, which is consistent with the environmental outcomes set out in condition 3.
- The management plan will provide for appropriate fencing, monitoring of TECs and threatened flora, restoration of degraded TECs, buffers to threatened flora, weed and pathogen control, and development within the retention area is for the purposes for conservation or incidental.

Black cockatoos (conditions 5 and 6):

- Prior to any subdivision or development being approved, the following is required:
  - black cockatoo surveys for unsurveyed land.
  - If potential nesting trees are impacted, they must be assessed, quantified and replaced (2:1).

Tree canopy (condition 7):

- Prior to future subdivision or development being approved, the condition requires preparation of a Tree Canopy Retention and Landscape Management Plan, which is consistent with the environmental outcomes set out in condition 3 and aligned with the City of Kalamunda’s urban forest strategy.
- The management plan will provide detail on location, species, and health of the trees to be retained and planted, the tree planting schedule and an estimate of the percentage of expected canopy coverage.

Water management (condition 8):

- Prior to future subdivision or development being approved, the condition requires preparation of an Urban Water Management Plan, which is consistent with the environmental outcomes set out in condition 3.
- The management plan will be informed by the results of any pre-development monitoring program.

Reporting (conditions 9 and 10):

- Environmental performance reports must be submitted to the Department of Water and Environmental Regulation (DWER) annually.
- Reports must show compliance with the requirements set out in the Ministerial Statement demonstrated the WAPC has acted consistently with the environmental outcomes set out in condition 3.

3.2 Federal legislation

In addition, any proposed action which is likely to result in significant impacts to Matters of National Environmental Significance (MNES) listed under the EPBC Act is required to be referred to the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) to determine whether it requires assessment under the EPBC Act.

The timing of EPBC Act referrals is not directly linked to the state planning processes. In an urban development context, EPBC Act referrals are typically undertaken once detailed design been undertaken and the development layout has been determined (for example, at either the structure plan or subdivision stage).

3.3 Associated Technical Reports

To support the Structure Plan application, the following technical reports have been prepared, including those that were prepared as part of the MRS amendment process. Key information from these documents is referenced in this EAR where relevant:

Structure Plan

- Conservation Area Management Strategy (Coterra Environment 2025) (Appendix 3)
- Local Water Management Strategy (Hyd2o 2025)
- Bushfire Management Plan (Western Environmental 2025)
- Landscape Strategy (EPCAD 2025)
- Traffic Impact Assessment (PTG Consulting 2025)
- Flora and vegetation survey (Lot 54) (Plantecology 2025)
- Black Cockatoo Habitat Assessment (Lot 54) (Phoenix Environmental 2025)

MRS Amendment

- District Water Management Strategy (Hyd2o 2024)
- Wetland Assessment Report (Pentium Water 2024) (Appendix 4)
- Wattle Grove South Ecological Surveys (AECOM 2020)
- Ecological Survey Effort – Technical Memo (JBS&G 2024)
- Wattle Grove Floristic Community Type Analysis (Plantecology 2024)
- Black Cockatoo Habitat Assessment for Wattle Grove (South) (Phoenix Environmental 2024)
- Wattle Grove South SRE Invertebrate Fauna Desktop Assessment (Bennelongia Environmental Consultants 2024)
- Aboriginal and Cultural Heritage Evaluation (Element 2024)
- Visual Landscape Evaluation (EPCAD 2024)

4 Environmental Assessment Overview

4.1 Principles

The objective of the EP Act is to protect the environment of Western Australia, having regard to the principles outlined within section 4A of the Act (EPA 2021). The project design has considered these principles (Table 4-1).

Table 4-1: *Environmental Protection Act 1986* Principles

Principle	Consideration
1. The precautionary principle Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, decisions should be guided by: a. careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and b. an assessment of the risk-weighted consequences of various options.	To address the precautionary principle a range of detailed site-specific investigations, surveys and assessments have been undertaken to: • accurately define the environmental values of the site • provide an understanding of the baseline environmental conditions and potential impacts associated with the future urban development of the site • retain the site's significant environmental values as Public Open Space for conservation. The Local Structure Plan (Appendix 1) has been prepared for the site and responds to the Environmental Conditions (Appendix 2) and the site's significant environmental values through an impact avoidance approach to mitigate and minimise potential environmental impacts.
2. The principle of intergenerational equity The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.	The importance of sustainable development is recognised. The implementation of the Local Structure Plan provides an opportunity for areas of higher environmental value to be retained and quality improved, which will allow these areas to be managed in the long term for conservation and interaction/appreciation by future generations. The Local Structure Plan also provides for strategic development of the wider Wattle Grove area, to manage potential hydrological impacts or urbanisation on the Yule Brook catchment and GBSW, rather than via ad hoc development proposals for individual lots.
3. The principle of the conservation of biological diversity and ecological integrity Conservation of biological diversity and ecological integrity should be a fundamental consideration.	Detailed site investigations of flora and vegetation, fauna and hydrology have been undertaken to understand the site's key environmental features and values and to allow for these to be addressed in the project design. The Local Structure Plan will provide for biological diversity and ecological integrity through the retention and long-term management of the most valuable ecological assets on site within Public Open Space for conservation.

Principle	Consideration
4. Principles relating to improved valuation, pricing and incentive mechanisms a. Environmental factors should be included in the valuation of assets and services. b. The polluter pays principle – those who generate pollution and waste should bear the cost of containment, avoidance or abatement. c. The users of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any wastes. d. Environmental goals, having been established, should be pursued in the most cost-effective way, by establishing incentive structures, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solutions and responses to environmental problems.	The costs associated with environmental actions proposed as part of the development including flora, vegetation and fauna habitat retention, environmental management including revegetation and weed control, and fauna relocation for the avoidance and mitigation of environmental impacts, have all been considered in the planning and feasibility of the Local Structure Plan, and future areas to be subdivided and development The Developer will be responsible for funding the cost of environmental actions.
5. The principle of waste minimisation All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.	It is expected that wastes will be minimised through adoption of the hierarchy of waste controls; avoid, minimise, recycle and safe disposal. The future construction contractor will be required to take all reasonable and practicable measures to reduce waste generation and disposal of construction wastes appropriately. This will be outlined in a Construction Environmental Management Plan (CEMP) to be prepared prior to construction and development of the site.

4.2 Key Environmental factors

The EPA identifies environmental factors as organising principles for EIA, comprising several environmental values. The EPA has 14 environmental factors, organised into fives themes: Sea, Land, Water, Air and People (EPA 2021).

Each factor has an environmental objective. The EPA has regard for these environmental objectives when determining whether the environmental impact of a proposal or scheme may be significant (EPA 2023a).

The EPA's environmental factors and objectives relevant to the site include terrestrial environmental quality, inland waters, flora and vegetation, terrestrial fauna, and social surroundings (Table 4-2).

Table 4-2: EPA Factors and Objectives

EPA Factor	EPA Objective	Applicability to this project	Section of this report
Theme: Sea			
Benthic communities and habitats	To protect benthic communities and habitats so that biological diversity and ecological integrity are maintained.	**No**. The site is located over 8 km from the coast. As such these are not applicable factors	N/A
Coastal processes	To maintain the geophysical processes that shape coastal morphology so that the		

EPA Factor	EPA Objective	Applicability to this project	Section of this report
	environmental values of the coast are protected.		
Marine environmental quality	To maintain the quality of water, sediment and biota so that environmental values are protected.		
Marine fauna	To protect marine fauna so that biological diversity and ecological integrity are maintained.		
Theme: Land			
Terrestrial environmental quality	To maintain the quality of land and soils so that environmental values are protected.	**Yes.** Consideration of the potential for acid sulphate soils will form part of the assessment.	Section 5
Flora and vegetation	To protect flora and vegetation so that biological diversity and ecological integrity are maintained.	**Yes**. This site contains native flora and vegetation.	Section 7
Landforms	To maintain the variety and integrity of distinctive physical landforms so that environmental values are protected.	**No.** The site is relatively flat to undulating without distinctive landform features.	NA
Subterranean fauna	To protect subterranean fauna so that biological diversity and ecological integrity are maintained.	**No.** The site is not identified to be within an area where subterranean fauna may be present.	N/A
Terrestrial fauna	To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.	**Yes.** The site contains vegetation in some areas which provides native fauna habitat opportunities.	Section 6
Theme: Water			
Inland waters	To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.	**Yes.** The site contains wetland areas and is in proximity to the GBSW.	Section 5
Theme: Air			
Air quality	To maintain air quality and minimise emissions so that environmental values are protected.	**No.** The site is not located in proximity to any land uses that emit harmful emissions to air.	N/A
Greenhouse gas emissions	To reduce net greenhouse gas emissions in order to minimise the risk of environmental harm associated with climate change.	Greenhouse gas emissions will be significantly lower than the emissions levels which trigger EPA consideration. As such specific reporting in relation to greenhouse gas is not included in this report.	N/A
Theme: People			
Social surroundings	To protect social surroundings from significant harm.	**Yes.** Whilst there are no registered Aboriginal culture and heritage sites within the site, there is one historical place mapped across southern portion of this site, so this factor will still require consideration during assessment and management.	Section 9

EPA Factor	EPA Objective	Applicability to this project	Section of this report
		The site has significant visual landscape values that are defined by the existing vegetation and sloping landform.	
Human health	To protect human health from significant harm.	**No.** This factor relates solely to impacts to human health arising from the radiation. No radiation emission sources are proposed as part of the redevelopment or occur in nearby areas.	N/A

4.3 Mitigation Hierarchy

The mitigation hierarchy is a sequence of actions to help reduce adverse environmental impacts. The environmental factor mitigation hierarchy as applied by the EPA is as follows (EPA 2021):

- Avoid – avoid the adverse environmental impact altogether. This may include reducing the footprint or changing the location of the footprint to avoid areas with high environmental values.
- Minimise – limit the degree or magnitude of the adverse impact. This may include reducing the footprint or carefully selecting technologies, processes (such as re-use of waste products) and management measures (such as bunding or dust and noise control measures) to reduce the impact.
- Rehabilitate – repair, rehabilitate or restore the impacted site as soon as possible. Adequate rehabilitation information is integral to the mitigation hierarchy to ensure early identification of knowledge gaps and risk as well as development of criteria and research to meet objectives.
- Offset – undertake a measure or measures to provide a compensatory environmental benefit or reduction in environmental impact to counterbalance significant adverse environmental impacts from implementation of a proposal. The measure(s) are taken after all reasonable mitigation measures have been applied and a significant environmental risk or impact remains. Offsets are not appropriate for all proposals and will be determined on a proposal-by-proposal basis.

5 Terrestrial Environmental Quality

5.1 EPA Definition and Objective

The EPA defines Terrestrial Environmental Quality as the chemical, physical, biological and aesthetic characteristics of soils (EPA 2016a).

The EPA objective is to maintain the quality of land and soils so that environmental values are protected (EPA 2021).

5.2 Key Policies and Guidance

Relevant policy and guidance documents for terrestrial environmental quality, which have been used to assess potential impacts, include:

- Environmental Factor Guideline – Terrestrial Environmental Quality (EPA 2016e)
- Acid Sulphate Soils Planning Guidelines (WAPC 2008a)
- Managing Urban Development in Acid Sulfate Soil Areas (DER 2015a)
- Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes (DER 2015b)
- Treatment and Management of Soil and Water in Acid Sulfate Soil Landscapes (DER 2015c)
- Identification, Reporting and Classification of Contaminated Sites in Western Australia (DER 2025)
- Assessment and Management of Contaminated Sites (DWER 2021).

5.3 Receiving Environment

5.3.1 Studies and investigations

The following lists the technical geological and geotechnical studies that have been undertaken to inform the District Water Management Strategy (DWMS) and subsequent Local Water Management Strategy (LWMS) prepared by Hyd2o in 2024 and 2025, respectively:

- Preliminary Geotechnical Investigation Proposed Wattle Grove Development Victoria Road, Wattle Grove (Douglas Partners 2022).
- Preliminary Geotechnical Investigation Proposed Wattle Grove Development Precinct 1, Victoria Road, Wattle Grove (Douglas Partners 2020).
- Geophysical Subsurface Investigation at Proposed Land Development Site Wattle Grove (GBG Group 2024).

Further discussion on the results of the geophysical studies is provided in the LWMS.

5.3.2 Topography

Regional topographic contour mapping indicates that the site is relatively flat to undulating, with elevation ranging from 22 m Australian Height Datum (AHD) in the north of the site to 36 m AHD in the south (Figure 3).

5.3.3 Geology and Soils

5.3.3.1 Regional geology

The regional geology of the site and surrounds, including the Greater Brixton Street Wetlands, is described in the following key geological and hydrogeological reports:

- Landforms and Soils of the Darling System in Atlas of Natural Resources, Darling System, Western Australia (Churchward and McArthur 1980)
- Hydrogeology and Groundwater Resources of the Perth Region, Western Australia. Geological Survey of Western Australia Bulletin 142 (Davidson 1995)
- Perth Regional Aquifer Modelling System (PRAMS) Model Development: Hydrogeology and Groundwater Modelling (Davidson and Yu 2006)

The regional geology confirms:

- The site is near the eastern margin of the Perth Basin and lies about 1 km west of the Darling Scarp.
- The Yoganup Formation is centred on the eastern portion of the site and extends eastward towards the Darling Scarp.
- Bassendean Sand over Guildford Formation is mapped over the western and north-western margins of the site.

The regional geology mapping is shown in Plate 5-1 regional geology as well as the geological investigations that have been undertaken across the site. A summary of the regional geological succession is provided in Table 5-1.

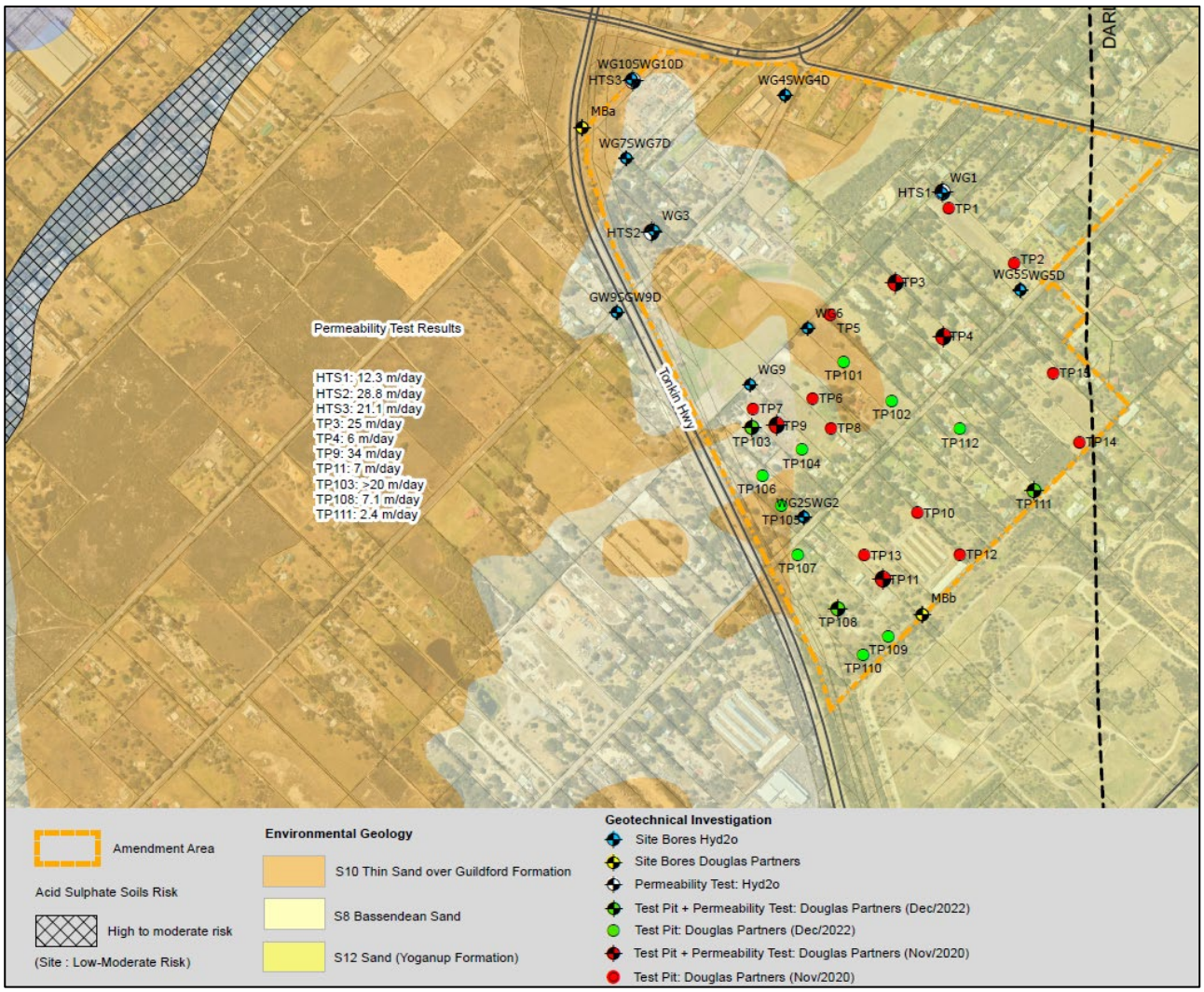


Plate 5-1: Regional Geology and Geotechnical Investigations (Hyd2o 2024)

Table 5-1: Regional geological succession mapping

Stratigraphy	Lithology
Superficial formations	
Bassendean Sand	Sand, minor silt and clay
Guildford Formation	Alluvial sand and clay with shallow-marine and estuarine lenses
Yoganup Formation	Sand with minor clay
Osborne Formation: • Kardinya Shale Member • Henley Sandstone Member	Siltstone and shale, minor sandstone/ claystone

5.3.3.2 Local geology

The local geological formations within the site are defined below:

- The dominant geological unit consist of the Yoganup Formation which extends eastwards from the Darling Scarp.
- Portions of the western and north-western boundary of the site is underlain by thin Bassendean Sand over sandy clay to clayey sand of the Guildford Formation. These sands and clays are interfingering making the geology heterogeneous. Guildford Formation, which is predominantly of fluvial origin and consists of clayey-sands and clays with lenses of coarse sands particularly at the base (Davidson 1995).
- The base of the superficial formations is between 0 m AHD to 8 m AHD, sloping downwards to the west.
- Based on ground surface elevations the superficial formations are about 20 m to 35 m thick.
- The superficial formations are underlain by the Kardinya Shale.

A diagrammatic cross-section of the site showing the superficial formations and deeper stratigraphy is presented as Plate 5-2.

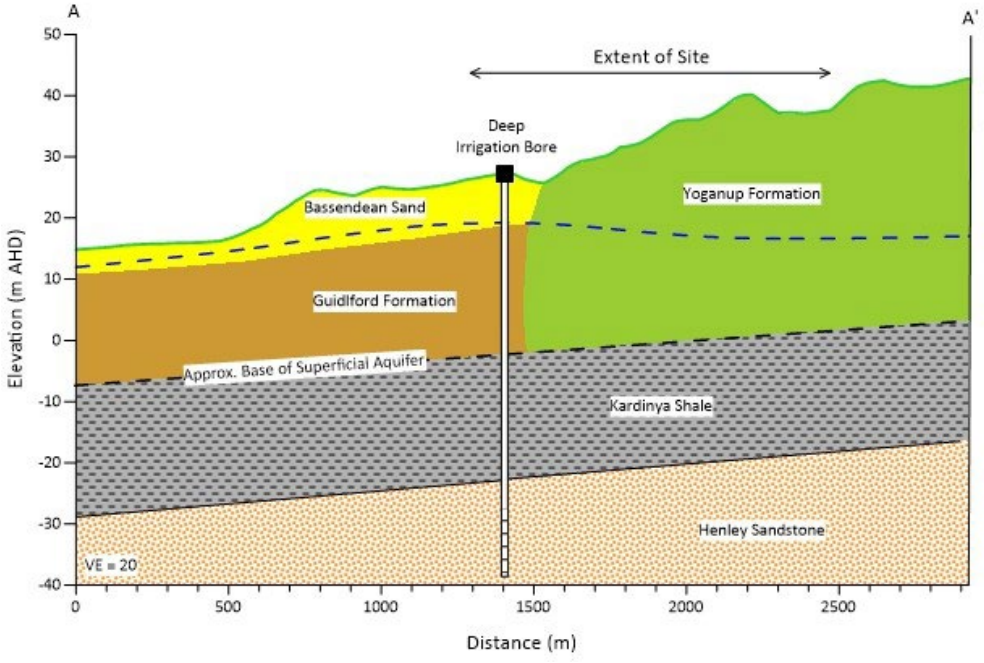


Plate 5-2: Diagrammatic deeper hydrogeological cross-section (Rockwater 2023)

Section 6.3.2.2.1 of this report provides further discussion on how the geophysical conditions influence the site's local hydrological condition and interaction within the GBSW.

5.3.4 Land Use

First available aerial imagery over the site was taken in 1953, where several large rural lots had already been subdivided and cleared for rural land uses. There is evidence of infilling of native vegetation and wetland areas to support market gardens, livestock paddocks and rural dwellings as well as extraction activities in the southern portion of the site between 1953 and 1974.

Remnant vegetation remained present across many lots in the northern and central portions of the site prior to 1974, with the occurrence of some regrowth or planting. Some rural residential dwellings were constructed by 1974, and part of the site is understood to have been developed for horse rearing/breeding and equestrian activities. Most of the clearing within the area had been completed by 1995, and the development of lots for predominantly rural residential and lifestyle uses has continued since this time.

The site comprises numerous landholdings (ranging in size from approximately 1 ha to 5 ha) and is a mixture of land uses, including large residential and rural living lots, composite business along Welshpool Road, landscape supply business and horticulture. A former turf farm is located centrally along the western boundary of the amendment area (Lots 303, 53, 214 and 213) south of Brentwood Road. A former poultry farm (which ceased operations over a decade ago) is located at Lot 251 within the south-western portion of the amendment area, only the poultry farm sheds remain.

The Maddington Kenwick Strategic Employment Area (MKSEA) is located adjacent to the site, on the western side of Tonkin Highway. Following the EPA's assessment and report to the Minister for the Environment in April 2024, the Minister's determination of appeals against the EPA's report, the Minister for the Environment approved the scheme amendment, subject to Environmental Conditions (Ministerial Statements 1238 and 1239) which were issued and published on 6 January 2025. Subsequently, the City of Gosnells Council resolved to support the scheme amendments in February 2025 which is now being considered by the WAPC.

5.3.5 Potential Contamination

A search of the Department of Water and Environmental Regulation (DWER) contaminated sites database did not identify the presence of known contaminated sites within the site; however, immediately adjacent to the southern boundary of the site is the former City of Gosnells landfill which has been classified as 'Remediated for Restricted Use' (DWER 2025b).

The DWER guidance for assessment and management of contaminated sites (DWER 2021) identifies the land uses which have the potential to result in contamination of the soil or underlying groundwater. Examples of land uses which may be relevant to the site include:

- Asbestos products, manufacture, use or disposal
- Fertiliser manufacture or storage
- Intensive agriculture
- Market gardens, orchards, poly tunnels, plant nurseries and viticulture.

Based on the above, there is potential that soil and/or groundwater quality could be impacted by current and historical land uses.

5.3.6 Acid sulfate soils

Acid Sulphate Soil (ASS) is the common name given to naturally occurring soil and sediment containing iron sulfides. When disturbed and exposed to air they oxidise and produce sulfuric acid, iron precipitates, and concentrations of dissolved heavy metals such as aluminium, iron and arsenic. The disturbance of ASS releases acid and metals which can cause significant harm to the environment and infrastructure.

The WAPC's Bulletin 64 (WAPC 2003) ASS risk mapping for the site indicates it is located within an area of moderate to low risk of ASS occurring within 3 m of natural soil surface.

5.4 Potential Impact Identification and Assessment

5.4.1 Potential Contamination

The site has been predominantly for rural residential land uses which are not identified by the Department of Water and Environmental Regulation as a potentially contaminating activity, and therefore the potential for contamination across the majority of the site is not considered to be an issue. A small number of properties within the site have been used for commercial activities, including a former poultry farm and a turf farm. Given the known current and historic land uses, the land within the site is considered to be suitable, or could be made suitable. for the intended residential land use. As such, investigations for contamination are not considered necessary to support the Local Structure Plan, but appropriate investigations will be undertaken at the subdivision stage for the small number of properties where potentially contaminating activities may have been undertaken to demonstrate their suitability for the intended residential land use.

A portion of the south-eastern site abuts the former Kelvin Road landfill. The former landfill has been subject to a number of investigations and a mandatory audit pursuant to the provisions of the Contaminated Sites Act 2003. As a result of the investigations, in June 2022 the lots which comprise the former Kelvin Road landfill footprint were reclassified by the DWER from 'Possibly contaminated – investigation required' to 'Remediated for restricted use'. Information for the former landfill detailed in the publicly available Basic Summary of Records advises that the investigations undertaken across the former landfill have included assessments of soil, groundwater and landfill gas. The classification requires the ongoing implementation of a Site Management Plan including the ongoing operation of a landfill gas extraction system, which was considered suitable to ensure that the risk of migration of landfill gas remains low.

5.4.2 Acid Sulfate Soils

As noted above, the site is mapped as having a moderate to low risk of ASS. Table 5-2 outlines the ASS investigation trigger criteria as provided by DWER (DER 2015b).

Table 5-2: ASS Investigation Trigger Criteria Assessment

Criteria	Comment
Acid sulfate soil disturbing subdivision or development that is subject to conditional approval requiring the investigation and management of acid sulfate soils	No approvals in place at this time.
Soil or sediment disturbance of 100 m^3 or more in an area depicted on an ASS risk map as Class I 'high to moderate risk of ASS occurring within 3 m of natural soil surface' (e.g., construction of roads, foundations, installation of underground infrastructure, drainage works, land forming works, dams and aquaculture ponds or sand or gravel extraction)	No Class I ASS risk areas are present onsite.
Soil or sediment disturbance of 100 m^3 or more with excavation from below the natural water table in an area depicted on an ASS risk map as Class II 'moderate to low risk of ASS occurring within 3m of natural soil surface but high to moderate risk of ASS beyond 3 m of natural soil surface'	To be assessed as part of the subdivision design and construction planning phase.
Lowering of the water table, whether temporary or permanent (e.g., for groundwater abstraction, dewatering, installation of new drainage, modification to existing drainage), in areas depicted in an ASS risk map as Class I 'high to moderate risk of AASS or PASS occurrence' or Class II 'moderate to low risk of AASS or PASS occurrence within 3m of natural soil surface'	To be assessed as part of the subdivision design and construction planning phase.
Any dredging operations	No dredging is proposed.

Criteria	Comment
Extractive industry works (e.g., mineral sand mining) in any of the areas listed in Table 1*	No extractive industries works are proposed.
Flood mitigation works, including construction of levees and flood gates, in any of the areas listed in Table 1*	No flood mitigation works are proposed.

*Source: DER (2015b); *refer to Table 1 in DER (2015b)*

Based on the above, further assessment of the potential need for an ASS investigation will be undertaken at the subdivision design and construction planning stage of the project. This approach is consistent with DWER requirements and potential investigation triggers.

5.5 Impact Mitigation

As noted above, assessment of ASS and potential contamination will occur, as required, at the subdivision stage of the project.

Table 5-3 summarises the impacts and outlines the avoidance and minimisation actions which are proposed in relation to Terrestrial Environmental Quality.

Table 5-3: Terrestrial Environmental Quality Mitigation Hierarchy

Terrestrial Environmental Quality Mitigation Hierarchy: Assessment and Proposed Measures
Potential Impacts
• Potential disturbance to ASS • Potential loss of surface soil through wind erosion • Intercepting areas of potential contamination
Avoidance
• No areas of high to moderate risk ASS are located within the site
Minimisation
• An ASS assessment will be undertaken if the following is to occur onsite: ▪ Soil or sediment disturbance of 100 m^3 or more with excavation from below the natural water table ▪ Lowering of the water table, whether temporary or permanent • An unexpected finds procedure will be provided to site contractors in the case of potential contamination being identified • Should any signs of potential contamination be detected onsite a Potential Contamination Investigation will be undertaken in accordance with the DWER Contaminated Sites Guideline for 'Assessment and management of contaminated sites' • Adjacent former Kelvin Road landfill subject to ongoing implementation of a Site Management Plan including the ongoing operation of a landfill gas extraction system to ensure that the risk of migration of landfill gas remains low • A Construction Environmental Management Plan will be prepared for the site. This will contain, amongst other items, unexpected finds protocol, dust management requirements to prevent loss of surface soils and soil stabilisation requirements.

5.6 Predicted Outcome

Development of the site can be managed to avoid impacts to ASS, spread of dust and potential spread of contamination, should any potentially contaminated areas or sources of contamination be identified.

It is expected that the Structure Plan will continue to meet the EPA's objective for the Terrestrial Environmental Quality factor.

6 Inland Waters

6.1 EPA Definition and Objective

For the purposes of EIA, the EPA defines the factor Inland Waters as the occurrence, distribution, connectivity, movement, and quantity (hydrological regimes) of inland water including its chemical, physical, biological and aesthetic characteristics (quality). Inland waters include groundwater, such as superficial and confined aquifers, and surface water, such as waterways, wetlands and estuaries (EPA 2018).

The EPA objective is to maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected (EPA 2021).

6.2 Key Policies and Guidance

Relevant policy and guidance documents for inland waters, which have informed site-specific investigations and/or have been used to assess potential impacts, include:

- Environmental Factor Guideline – Inland Waters (EPA 2018)
- Environmental Values and Pressures for the Greater Brixton St Wetlands on the Swan Coastal Plain, Advice in accordance with section 16(j) of the Environmental Protection Act 1986 (EPA 2022)
- State Planning Policy 2.9: Water Resources (WAPC 2006)
- Better Urban Water Management (WAPC 2008b)
- Decision Process for Stormwater Management in Western Australia (DER 2017)
- Stormwater Management Manual for Western Australia (DWER 2004; updated 2022)
- A methodology for the evaluation of wetlands on the Swan Coastal Plain, Western Australia (DBCA 2017)
- Draft Guideline for the Determination of Wetland Buffer Requirements (WAPC 2005)

6.3 Receiving Environment

6.3.1 Studies and investigations

The following lists the technical hydrological, hydrogeological, geological, and geotechnical studies that have been used to inform the District Water Management Strategy (DWMS) and subsequent Local Water Management Strategy (LWMS) prepared by Hyd2o in 2024 and 2025, respectively.

- Preliminary Geotechnical Investigation Proposed Wattle Grove Development Victoria Road, Wattle Grove (Douglas Partners 2022).
- Preliminary Geotechnical Investigation Proposed Wattle Grove Development Precinct 1, Victoria Road, Wattle Grove (Douglas Partners 2020).
- Geophysical Subsurface Investigation at Proposed Land Development Site Wattle Grove (GBG Group 2024)
- Water Balance Assessment: Wattle Grove South MRS Amendment (Emerge Associates 2024)
- Potential Salinity and Sodicity Impacts of the Wattle Grove Urban Development on the Greater Brixton St Wetlands (MBS Environmental 2024)
- Wetland Assessment (Pentium Water 2024)
- Surface water monitoring data from the following sources:

- The City of Kalamunda's surface water monitoring program (Urbaqua 2020).
- The hydrological assessment of MRWA's Tonkin Highway upgrade between Roe Highway and Kelvin Rd (Arup 2022).
- Hydrological Study of the Greater Brixton Street Wetlands (Semeniuk 2001).
- MKSEA Surface Water and Groundwater Monitoring and Investigation (Endemic 2012).
- MKSEA Precinct 2 Local Water Management Strategy (Emerge Associates 2022c).
- MKSEA Precinct 3B Local Water Management Strategy (Emerge Associates 2022d).
- Local Water Management Strategy Lot 414 Grove Road, Maddington Kenwick Strategic Employment Area (Emerge Associates 2018a).
- Yule Brook, Swan Canning Catchment Nutrient Report (DWER and DBCA 2016).

Further discussion on the results of the studies is provided in the LWMS.

6.3.1.1 Water Monitoring Program

In recognition of the GBSW's proximity to the site, and the need for a robust monitoring dataset to inform the proposed 'Urban' land use, additional surface and groundwater monitoring program was commenced by Hyd2o in November 2020.

The objectives of this additional monitoring program were to:

- Characterise and define the hydrological and hydrogeological conditions of the site, including establishment of pre-development baseline hydrological and hydrogeological data.
- Characterise groundwater dependent environments and ecosystems within the surrounding locality (i.e. GBSW) that need to be protected.
- Inform the assessment of potential impacts of the proposed change in land use within the site on the hydrology, hydrogeology, and groundwater dependent environments within the broader locality.

The monitoring program developed in consultation with DBCA and DWER and builds on:

- The City of Kalamunda Wattle Grove South 2019 - 2020 monitoring program (Urbaqua 2020)
- DBCA's hydrological dataset within the GBSW area (Bourke 2017)
- MKSEA Precinct (1,2 and 3B) monitoring programs (Endemic 2012; Emerge Associates 2018 and Hyd2o 2022) and the Tonkin Highway monitoring program (Arup 2020).

The local water monitoring program being undertaken includes (Hyd2o 2024):

- Sampling groundwater quality (from 20 bores within and in proximity to the site) and levels (from 23 bores within and in proximity to the site plus 3 DWER bores) within, upstream, and downstream of the site, with the selection of sites to enable a review of data in the context of groundwater quality closer to the GBSW area. The monitoring bores included shallow and deep bores. Paired deep and shallow bores were installed at locations where the local soil types (e.g. Guildford Formation) indicated the possibility of seasonal perching.
- Surface water quality (from nine locations) upstream and downstream of the site, and within the GBSW area where stormwater inflow and outflows occur.

Regional DWER monitoring bores, together with bores at other locations including within the GBSW and the MKSEA areas, were included in the monitoring program to correlate and complement the groundwater and surface water data collected within the site.

6.3.2 Groundwater

6.3.2.1 Regional Groundwater Contours

Until mid-2023, the Perth Groundwater Map regional historical maximum groundwater contours did not cover the site. However, the minimum groundwater level contour dataset shows groundwater levels across the site ranged from approximately 11.5 m AHD in the north-western corner, to 16 m AHD at the elevated eastern boundary. The regional groundwater flow (based on the minimum groundwater level contour dataset) is broadly mapped in a westerly direction (Hyd2o 2024). The groundwater contours, based on May 2003 summer minimum, are also shown in Plate 6-1.

In 2023, DWER amended the Perth Groundwater Map to report only the Gnangara Jandakot maximum and minimum groundwater level contours from their 2019 dataset to account for the seasonal declines and rises in water tables in recent decades and the impacts of current climate trends (Hyd2o 2024). The revised groundwater contours (based on the 2019 dataset) are shown in Plate 6-1.

The revised groundwater contours demonstrate a shift in the regional groundwater flow direction from the site compared to the previous 2003 DWER regional contours. Specifically:

- The nearest bores used for the regional groundwater mapping are located more than 15 km from the site.
- Groundwater flow is broadly mapped in a south-westerly direction from the site as opposed to westerly in previous mapping (Plate 6-1).
- The contours show groundwater flow from the site is largely not flowing in a westerly direction (or towards the GBSW area) when compared to the previous published version of the regional groundwater mapping.
- The regional groundwater depth has maximum seasonal levels within the site ranging from 4 m to 20 m below natural surface.
- Accordingly, due to the absence of local groundwater and geological data in proximity to the site, the DWER regional mapping levels and flow direction is considered indicative only.

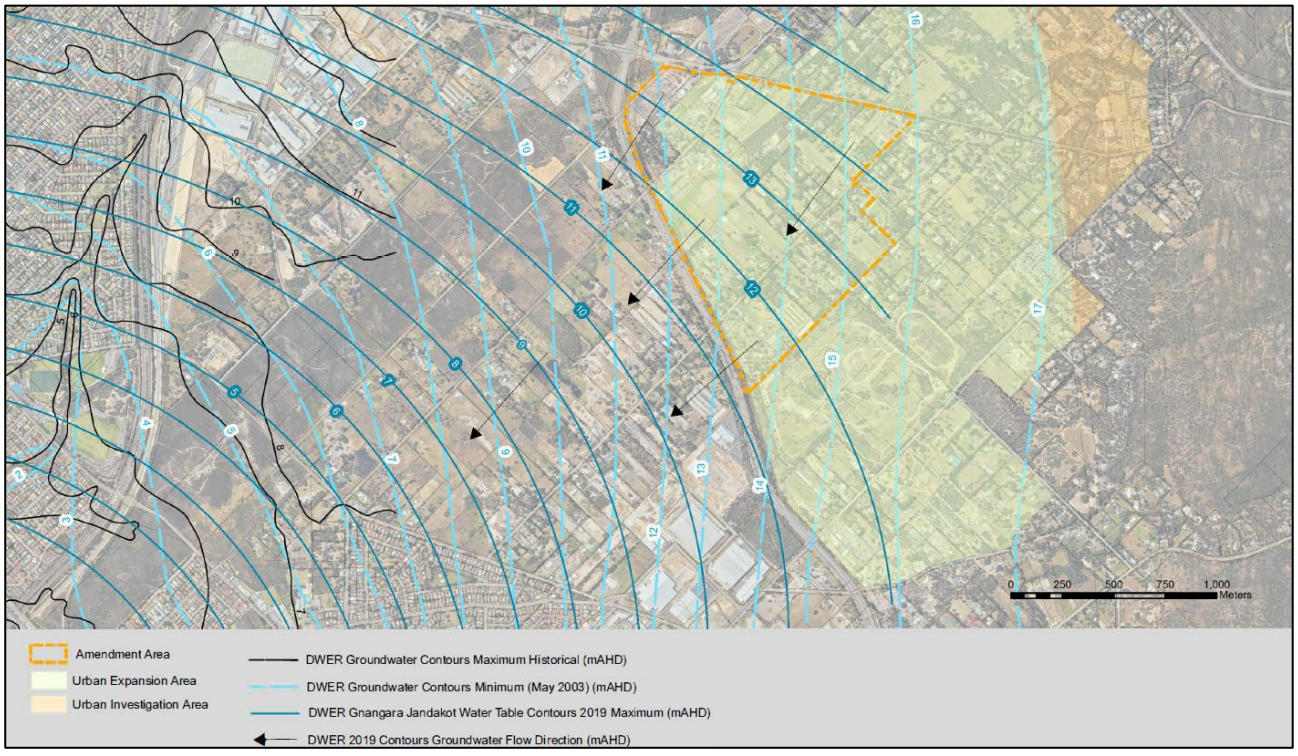


Plate 6-1: DWER regional groundwater contour mapping (Hyd2o 2024)

6.3.2.2 Local groundwater contours

Plate 6-2 presents the local groundwater level contours across the site and immediate surrounds based on four years of seasonal monitoring data, commencing in 2020. The water contour data shows (Hyd2o 2024):

- Contours within the site range from approximately 16 m AHD in the north-eastern region to approximately 19 m AHD on the western boundary.
- The groundwater mound formed as a result of the former turf farm irrigation practices and geological factors which strongly influence the local groundwater flow direction. Specifically, the seasonal groundwater flows confirm a radial flow direction (i.e. flowing north-west to flowing south-east) from the mound.
- Regional groundwater depth ranged from 4 m to 20 m below natural surface.
- Monthly monitoring has shown that the seasonal variation in water table across the site varies.

Most of the site has a seasonal groundwater variation of less than 1.5 m apart from in the north-western corner (near Tonkin Highway), with less seasonal variation along portions of western boundary opposite the GBSW (Hyd2o 2024). This variability is attributed to:

- Depth to the Superficial Aquifer groundwater
- The sub surface geology (i.e. the presence of Guildford Formation) and soil permeability
- The proximity higher permeable soils (Yoganup Formation) with increased recharge.

Specific to the site, the data underpinning the local groundwater contours is based on site specific groundwater monitoring, geological and geophysical investigations (Hyd2o 2024), which confirm the following hydrological and geological elements are directly influencing the local groundwater flow direction within the site:

- Local geology: A steep hydraulic gradient west of the site associated with low permeability geology.
- Groundwater mound: A distinct groundwater mound has been identified and mapped beneath the turf farm located within Lots 303, 53, 214 and 213 Brentwood Road.

6.3.2.2.1 Local geology

The geology along the western and north-western boundary of the site is predominately sand over clayey sand and clay sediments associated with the Bassendean Sands and Guildford Formations. At the depth of the groundwater table these low permeable clayey sediments were shown as zones of high resistivity in the geophysical assessment (Hyd2o 2024).

Plate 6-3 provides a spatial summary of high resistivity (low conductivity) areas and the regional geological mapping within the amendment.

Based on the soil permeability and geophysical studies undertaken within and adjacent to the site, it is concluded that the areas of non-contiguous Guildford Formation clayey soil of low permeable forms hydraulic barrier(s) which locally directs groundwater flows as follows (Hyd2o 2024):

- Limits groundwater flow in a westerly direction.
- Groundwater following pathways of least resistance (and unable to readily flow through the low permeable clay layers), initially flowing radially through the higher permeability Yoganup Formation. Flow within the site was found to generally range from north-west to south-east through sand dominated geology and away from the GBSW. Regional groundwater depth ranged from 4 m to 20 m below natural surface.

Further discussion on these geological and hydrological elements, and their influence on local groundwater flow is provided in the LWMS (Hyd2o 2025).

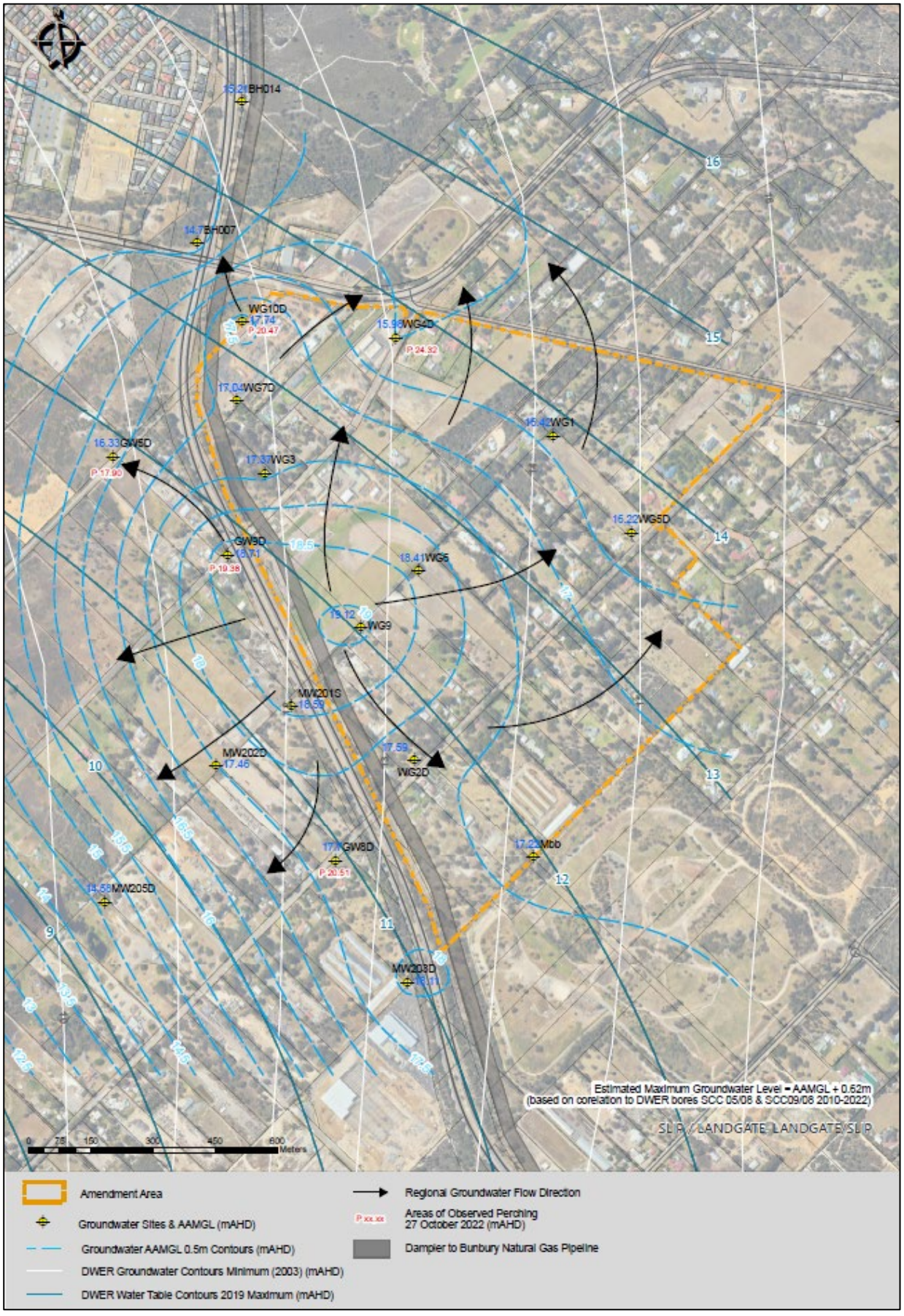


Plate 6-2: Local groundwater mapping (Hyd2o 2024)

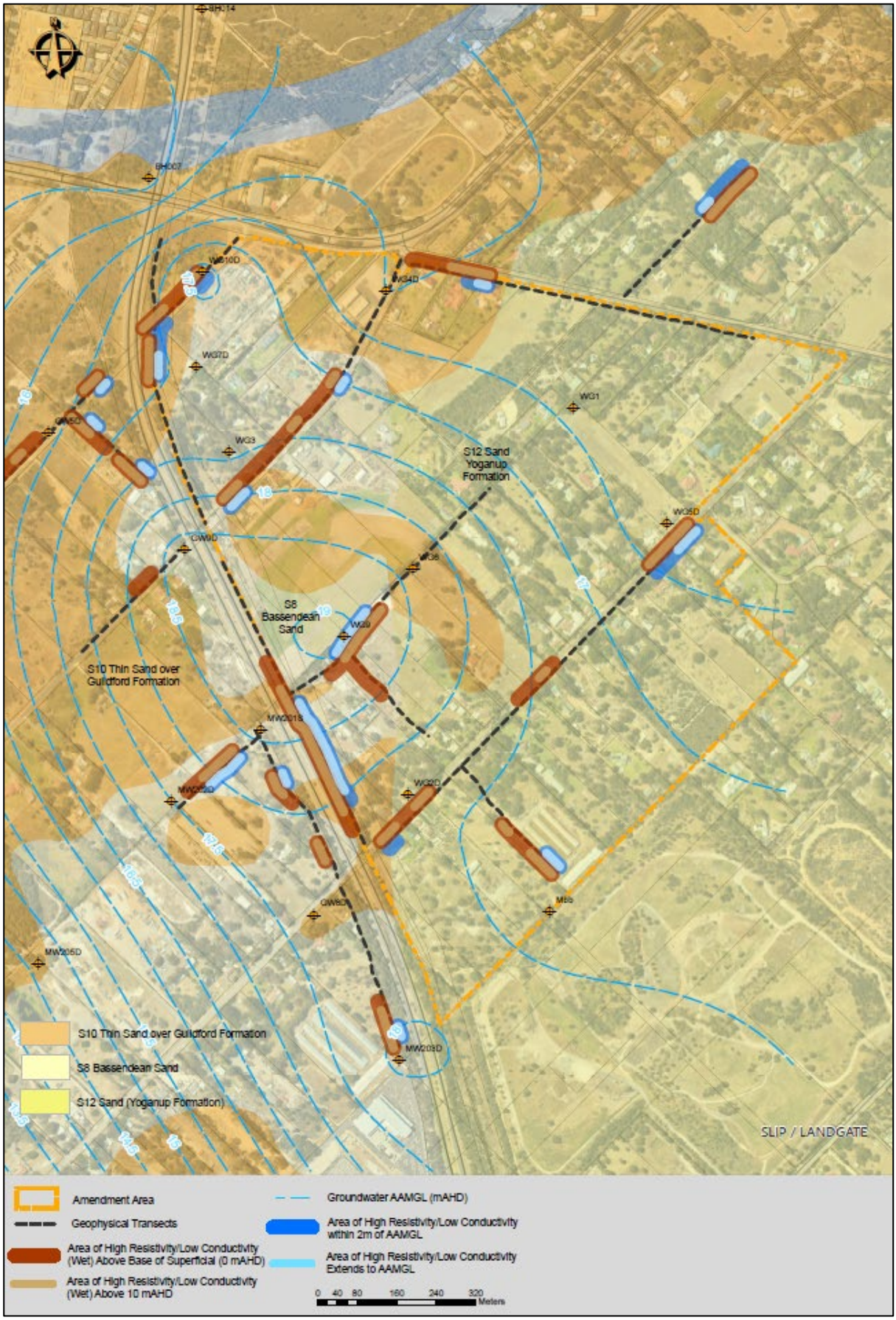


Plate 6-3: Groundwater contours and geological and geophysical interpretation (Hyd2o 2024)

6.3.2.2.2 Groundwater mound

Given the former turf farm's groundwater licence allocation of 176,000 kL/year, rather than observing a reduction in levels locally, monitoring data has confirmed the existence of a distinct groundwater mound centred over the former turf located on the south western boundary (Plate 6-2). DWER's Water Information Reporting database indicates the turf farm operators drilled a bore to approximately -41 m AHD and screened from -30 m AHD to -40 m AHD which would be representative of the Leederville Aquifer.

The groundwater used to irrigate the turf was drawn predominantly from the Henley Sandstone (a member of the Leederville Aquifer). The Kardinya Shale present between the two aquifer systems, impedes downwards movement of infiltrated water, as well as the upward propagation of the drawdown (associated with the groundwater extraction from the Leederville Aquifer) to the Superficial Aquifer, resulting in groundwater mounding in Superficial Aquifer over the long-term, and extends west to north-west (to include the north-eastern portion of the GBSW) for approximately 1.5 km. Plate 6-4 shows the existing groundwater mound contour in metres above the regional Annual Average Maximum Groundwater Levels (AAMGL).

The historical turf farm irrigation program and the resulting groundwater mound (within the Superficial Aquifer) represents the baseline environmental condition and the local hydrological conditions within the site and extending approximately 1.5 km west and north-west into the GBSW.

The turf production and its irrigation ceased around April 2023 and is likely to affect groundwater levels locally. Groundwater monitoring in proximity of the mound confirms water levels in the Superficial Aquifer in the immediate vicinity of the turf farm have reduced. The bore hydrographs in the area of the groundwater mound are provided in LWMS (Hyd2o 2024).

6.3.2.3 Groundwater Flow

The confluence of the localised groundwater mound and the low permeable Guildford Formation geology along portions of the western and north-western boundary of the site has resulted in a deviation of local groundwater flow directions, within and immediately adjacent to the site when compared with DWER's regional groundwater contours.

In summary, the key difference in the local groundwater flow direction when compared with the DWER regional groundwater contours is the local flows were found to be radial from the groundwater mound which originates within the former turf farm which is located centrally along the western boundary. Flow within the site generally ranged from north-west to south-east and away from the GBSW (or westerly direction). The DWER regional mapping indicates a uniform groundwater flow direction to the west and south-west (Hyd2o 2024).

6.3.2.3.1 Groundwater flow towards the GBSW

Groundwater flow in a westerly direction (towards the GBSW) is considered to represent an extremely small contribution of the groundwater flows from the site due to:

- Local geology
  - The Guildford Formation geology occurring as clayey dominated soils along portions of the western and north-western boundary of the site and extend eastward into the Yoganup Formation form areas of low permeable hydraulic barrier(s) which limits westerly groundwater flows (Plate 6-3).
  - Groundwater flow at a local scale follows a pathway of least resistance and tends to be eastward through the more permeable Yoganup Formation before moving predominantly towards the north-west and south-east through sand dominated geology.
- Groundwater mound:
  - The groundwater mound has artificially increased water levels along the north-western periphery of the site including a portion of the GBSW area (Plate 6-4).

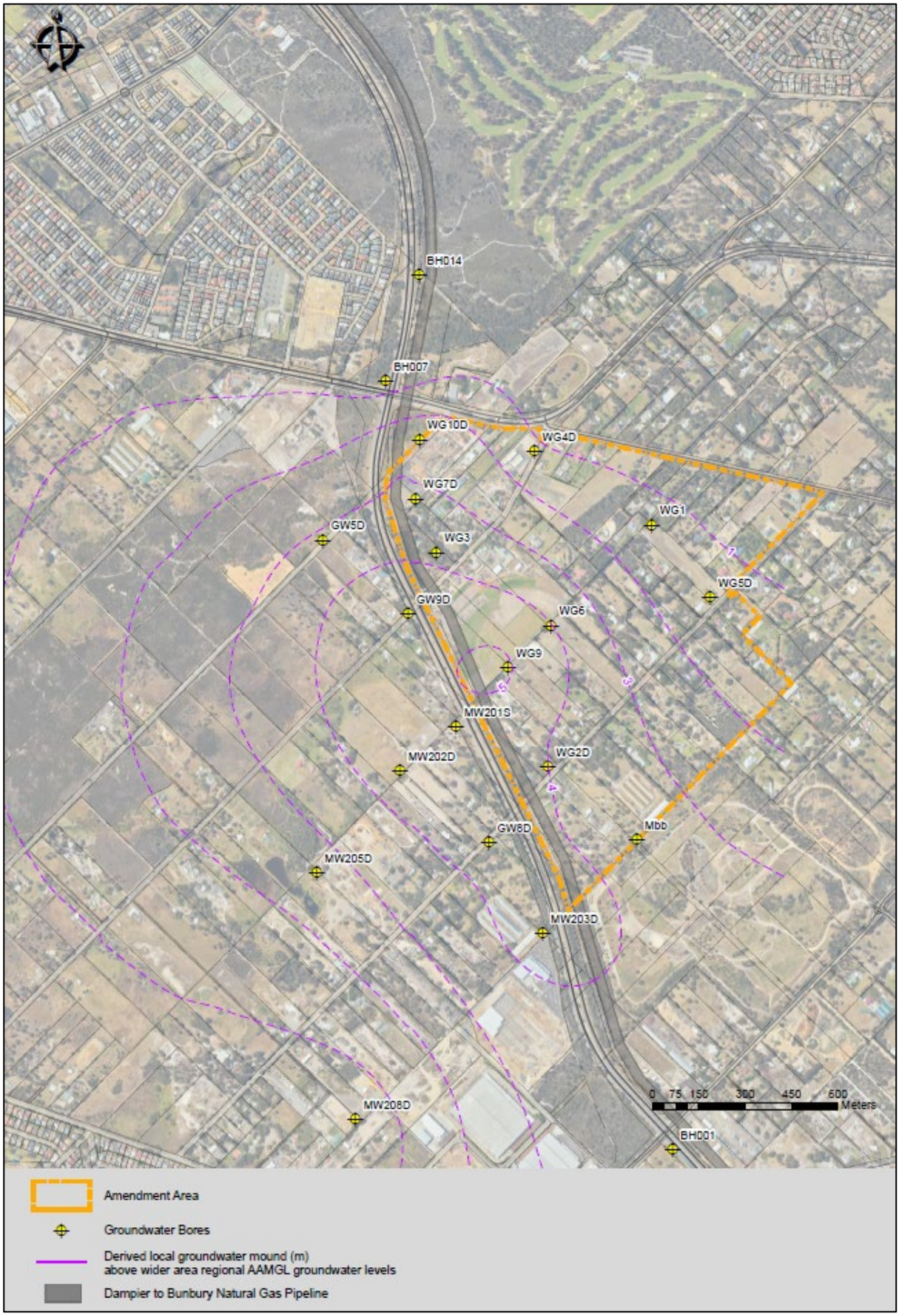


Plate 6-4: Localised groundwater mound (Hyd2o 2024)

6.3.2.4 Perched (shallow) groundwater

Perching was evident in groundwater levels in the north-western corner of the site near Tonkin Highway which is associated with low permeable geology. Perched water was not recorded at most bores within the site (Hyd2o 2024).

The perched water within the site flows through unlined open drains along Boundary Road and Brentwood Road intercept the perched water table (which direct the perched water in a westerly direction toward the culvert(s) under Tonkin Highway), and laterally north or north-west into areas where the geology transitions from clay soils to a deeper sand dominated geology. The change in the geology allows for infiltration of the perched water into the Superficial Aquifer (Hyd2o 2024).

Tonkin Highway acts as an impermeable flow boundary, excluding shallow perched groundwater flows in a westerly direction (given likely removal of the shallow soil profile during construction). The presence of the DBNGP (which required the trenching and backfilling along the gas pipeline alignment) is also expected to facilitate downward infiltration of shallow perched groundwater to the deeper sandy layer (Emerge Associates 2024).

6.3.2.5 Groundwater Quality

The groundwater quality monitoring results were compared to the ANZECC (2000) guidelines for wetland ecosystems in south-west Australia and freshwater ecosystems (Hyd2o 2024).

Nutrient levels in the Superficial Aquifer appear highest around the mounding associated with the former turf farm located at the western boundary of the site (at bores WG9 and GW9D). Nutrient levels were also generally highest at bore GW5D (located within Boundary Road reserve east of the site) and adjacent to the GBSW area (Hyd2o 2024).

Generally, metal levels within the Superficial Aquifer fall within ANZECC trigger values, however higher concentrations are apparent at bore GW9D, which is located at the Brentwood Road cul-de-sac adjacent to Tonkin Highway (Hyd2o 2024).

Perched groundwater nutrient levels within the GBSW area were generally highest at bores GW3 and GW12 are located over 2 km west of the site. within Bickley Road reserve and a rural property on Brook Road, respectively.

6.3.2.6 Groundwater nutrient assessment

Hyd2o (2024) undertook a pre-development nutrient assessment using DWER's Urban Nutrient Decision Outcomes (UNDO) model. The UNDO model is a conceptual decision support tool which evaluates nutrient reduction decisions for urban developments on the Swan Coastal Plain.

The UNDO assessment considered current land uses within and adjacent to the site that have the potential to export nutrients, including the former turf farm, septic tanks, and livestock. The nutrient application rate for bowling greens was used as a surrogate for the existing turf farm, as a specific rate is not provided in the model for this land use. The model also considers soil types, groundwater gradients and depth to groundwater.

The model predicts the pre-development nutrient inputs into the environment are 13,772 kilogram (kg)/year of TN and 1,405 kg/year of Total Phosphorus (TP), with the nutrient export from the site being 329.2 kg/year and 18.8 kg/year of Total Nitrogen (TN) and TP, respectively.

A key conclusion drawn from this UNDO assessment is the proposed urbanisation of the site provides the opportunity to significantly reduce nutrient application within the site and the export of nutrients towards the west, which includes the GBSW and MKSEA areas.

6.3.3 Surface Water

6.3.3.1 Regional surface water

The site is situated within the Yule Brook sub-catchment which forms the northern most section of the larger Swan Avon Canning River Catchment (Plate 6-5). The Yule Brook and its major tributaries (Woodlupine Brook and Crystal Brook) has a total catchment area of 56 km^2, most of which is highly modified and includes industrial and urban uses, such as light to medium industry and residential, as well as agricultural uses.

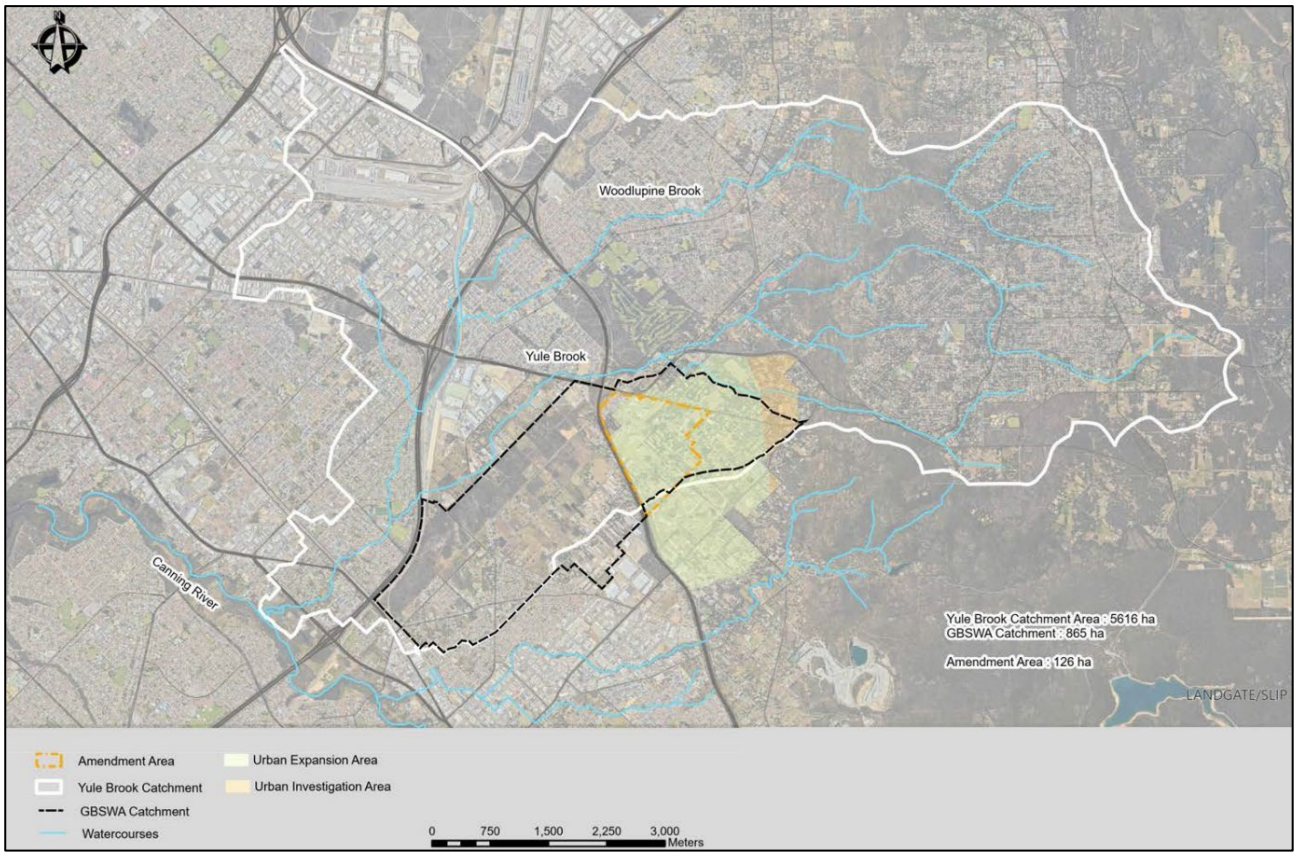


Plate 6-5: Yule Brook sub-catchment (Hyd2o 2024)

The site represents approximately 2% of the total Yule Brook catchment area and 15% of the GBSW sub-catchment; however, the site's surface water contribution to the GBSW is much less than 15%, due to the Yoganup Formation (the dominant geology unit) within the site facilitating the infiltration of surface water into the deeper Superficial Aquifer, reducing the surface water flows towards the GBSW.

6.3.3.1.1 Yule Brook

Yule Brook is a natural watercourse particularly in the upper catchment, however its lower reaches, in proximity to Tonkin Highway and the MKSEA area, has been modified to function as a 'Main Drain' and is managed by the Water Corporation.

Yule Brook is located outside site's sub catchment boundary which at its closest point is approximately 700 m north of the site boundary (Plate 6-5). The regional road network (Welshpool Road and Tonkin Highway) has created a physical barrier between the site and the Yule Brook. The closest surface water flow path from the site is the Boundary Road culvert located approximately 700 m south of Yule Brook. The surface water flow from the Boundary Road culvert and the former Crystal Brook tributary is detailed in Section 6.3.3.2.

Yule Brook annual flow assessment undertaken for the City of Gosnells TPS No. 6 Amendments 166 and 169 concluded flows have declined in recent years (Emerge Associates 2023a). Water quality within Yule Brook varies both seasonally and annually. DWER and DBCA (2016) reported the catchment was generally meeting its long-term TN and TP targets of 1.0 mg/L and 0.1 mg/L respectively (Hyd2o 2024).

The Swan Canning Water Quality Improvement Plan (SCWQIP) seeks to reduce nutrient inputs within the Yule Brook catchment by an additional 25%. (DBCA 2009).

6.3.3.1.2 Former Crystal Brook tributary

Tauss et al (2019) in 'A Jewel in the Crown of a Global Biodiversity Hotspot' (Lambers 2019) provides a comprehensive assessment of the Crystal Brook tributary and the historical alterations in the surface water flow paths. Plate 6-6 illustrates the approximate flow path of the original Crystal Brook tributary on a 1953 aerial photograph and the location of the roadside open drains.

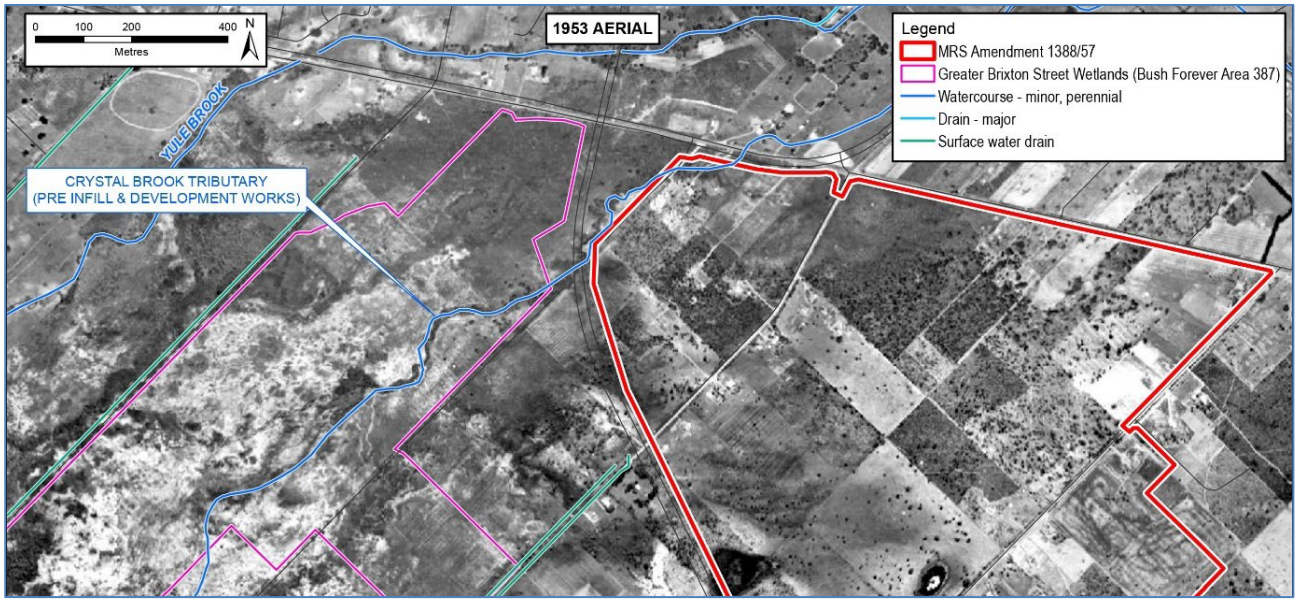


Plate 6-6: Original Crystal Brook tributary flow path (1953 aerial photograph)

Originally, the former Crystal Brook tributary provided a natural surface water flow path from the northern portion of the site into the GBSW; however, in the early 1950s the brook was diverted, via an excavated drain, north of the site into the Yule Brook. Resulting in areas of the former Crystal Brook tributary within the site being cleared and infilled to facilitate semi-rural and commercial land uses, and the construction of Boundary Road and Tonkin Highway. Within the GBSW, the former Crystal Brook tributary was also impacted from historical land clearing and semi-rural land uses.

6.3.3.2 Surface Water Flows

Post seasonal rain events, overland water within the site flows in a north-westerly direction following the topographical gradient. The surface water flow (if it is not infiltrated in the Yoganup Formation sandy soil profile) is intercepted by open roadside drains located along Boundary Road, Brentwood Road and Victoria Road and piped drains within private landholdings.

Plate 6-7 illustrates key topographic catchment boundaries, sub catchment areas, and the location of the three culverts (Brentwood Road, Victoria Road and Boundary Road), which are located above the groundwater table, positioned under Tonkin Highway and link surface water flows to the GBSW area (Hyd2o 2024).

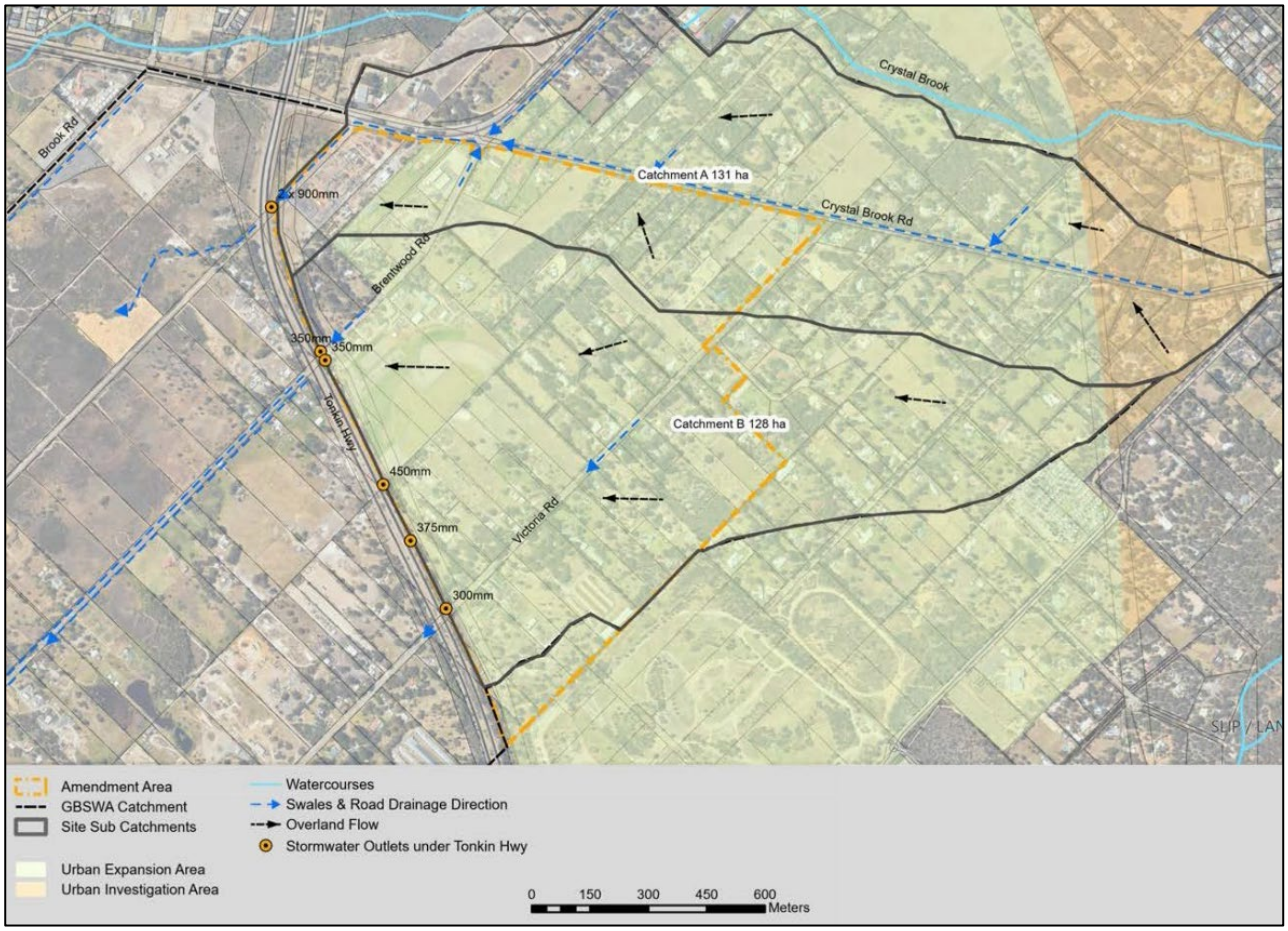


Plate 6-7: Surface water flow pathways and site's sub catchments (Hyd2o 2024)

6.3.3.3 Surface Water Quality

The surface water quality monitoring results were compared to the ANZECC (2000) guidelines for wetland ecosystems in south-west Australia and freshwater ecosystems (Hyd2o 2024). In summary, surface flow upstream of the site generally had the best quality with the least ANZECC guideline exceedances. For locations downstream, the highest nutrient and metal concentrations were at SW7, which is downstream of the GBSW area and prior to discharge to Yule Brook.

The proposed 'Urban' land use provides an opportunity to improve surface water quality and reduce impacts (i.e. from nutrients) on the GBSW through the implementation of the Better Urban Water Management guideline (WAPC 2008b) requirements and the Stormwater management manual for WA (DWER 2004; updated 2022). This includes the establishment of biofiltration basins and swales for treatment and infiltration, and maintenance of pre-development surface water flows.

6.3.4 Geomorphic Wetlands

Wetlands within the Swan Coastal Plain are protected and managed in accordance with the management categories assigned by DBCA (DBCA 2017). These management categories and their objectives are outlined in Table 6-1.

Table 6-1: Wetland management categories, description and management objectives (EPA 2008)

Management category	General description	Management objective
Conservation Wetlands (CCW)	Wetlands which support a high level of attributes and functions	To preserve wetland (natural) attributes and functions.
Resource Enhancement Wetlands (REW)	Wetlands which may have been partially modified but sill support substantial ecological attributes and functions	To restore wetlands through maintenance and enhancement of wetland functions and attributes.
Multiple Use wetlands (MUW)	Wetlands with few remaining important attributes and functions	To use, develop and manage wetlands in the context of water, town, and environmental planning.

Wetlands mapped within the site and the adjacent GBSW, are illustrated in Figure 4 and listed in Table 6-2.

Table 6-2: DBCA mapped geomorphic wetlands within and adjacent to the site

Unique Feature Identifier (UFI)	Management category	Geomorphic classification	Land tenure details	Total area (ha)
Within the site				
8037	REW	Sumpland	• Lot 301 – zoned Primary Regional Road. • Lot 302 – zoned 'Rural' (Water Corporation easement). • Lot 303 - zoned 'Rural' (turf farm). • Dampier to Bunbury Natural Gas Pipeline (DBNGP) easement (D207286). • Lot 107 – zoned 'Rural' predominantly cleared small rural landholding. • Lot 106 – zone 'rural' predominantly cleared small rural landholding.	0.86
Portion of 15257	REW	Palusplain	• Lots 146, 12 - zoned 'Rural' predominantly cleared small rural landholdings. • Lot 302 – zoned 'Rural' (Water Corporation easement). • DBNGP easement.	30.33 (2.06 within site)
North of site (located within Lot 501 located - 30 m north of the site)				
8026	CCW	Palusplain	• Lot 501 - zoned 'Parks and Recreation' and includes Water Corporation and DBNGP easement.	0.38
8027	CCW	Palusplain		0.32
Portion of 15257	REW	Palusplain		30.33 (0.52 in Lot 501).
GBSW area (within 150 m of the site west of Tonkin Highway)				
8025	CCW	Palusplain	• Lot 51 - reserved 'Parks and Recreation' and Bush Forever Site No 387	2.78
8028	CCW	Sumpland	• Lot 340 - reserved 'Parks and Recreation' and Bush Forever Site No 387	1.48
8030	MUW	Palusplain	• Lot 342 - reserved 'Parks and Recreation' and Bush Forever Site No 387	1.29
14962	CCW	Palusplain	• Lot 342 - reserved 'Parks and Recreation' and Bush Forever Site No 387	62.68
Balance of 15257	REW	Palusplain	• Lot 51 - reserved 'Parks and Recreation' and Bush Forever Site No 387	27.75 (being balance of 30.33)

6.3.4.1 Wetland assessment

Pentium Water (2024) undertook a wetland assessment of (Appendix 4):

- Wetlands within the site
- Wetlands with Lot 501, adjacent to the north west boundary of the site.

The values of each wetland feature was documented as part of the wetland assessment and summarised in Table 6-3.

6.3.4.1.1 Wetland assessment recommendations

The assessment of the REWs UFI 8037 and portion of UFI 15257 values concluded (Pentium Water 2024):

- The wetland values are representative of MUW category, in alignment with the wetland advice provided by DBCA i.e. the wetlands are in Completely Degraded condition or have been completely infilled.
- REW 8037 has been subject to historical impacts including clearing of native vegetation and infilling works to facilitate the construction of Tonkin Highway, the Water Corporation pipeline, DBNGP and an operational turf farm.
- The wetland's ecological values are no longer present. There are no groundwater dependent riparian communities present or habitat (or habitat diversity) for aquatic dependent fauna. The mapped wetland contains a commercial turf area and the cleared Water Corporation and DBNGP easements.
- The portion of REW UFI 15257 within the amendment area has been historically cleared of native vegetation and infilled during the construction of Tonkin Highway, the installation of Water Corporation and DBNGP pipelines and the establishment of rural livestock paddocks and commercial landscape supply business. There are no groundwater dependent ecosystems (GDEs) present with only scattered *Melaleuca preissiana* trees located within the Tonkin Highway reserve and the Water Corporation easement or habitat for aquatic dependent fauna. The existing vegetation outside of the Tonkin Highway reserve consists predominantly of River Red Gums planted in the late 1980s along the DBNGP easement and livestock paddock boundaries. The vegetation was surveyed as being in Completely Degraded condition.

In summary, Pentium Water (2024) recommends the two REWs (UFI 8037 and portion of UFI 15257) within site are removed from the Geomorphic Wetlands Swan Coastal Plain dataset.

DBCA is the custodian of this dataset. An application to DBCA to amend the dataset for the two REWs (UFI 8037 and portion of UFI 15257) and remove these two wetlands from the dataset will occur concurrently with the finalisation of the Local Structure Plan and LWMS.

Table 6-3: Summary of significant wetland features and their attributes (Pentium Water 2024)

Wetland Attribute	Wetlands within the site		Wetlands within Lot 501		
Wetland	**REW UFI 8037**	**REW UFI 15257**	**CCW UFI 8026**	**CCW UFI 8027**	**REW UFI 15257**
Area	0.86 ha.	30.33 ha (2.06 ha is within site)	0.38 ha	0.32 ha.	30.33 ha (0.52 ha within Lot 501)
Geomorphology	Bassendean Sand over sandy clay to clayey sand of the Guildford Formation.		Bassendean Sand over sandy clay to clayey sand of the Guildford Formation.		
Hydrology	Sumpland	Palusplain	Palusplain	Palusplain	Palusplain
	Over 90% of the mapped REW has no native vegetation. Native vegetation was historically cleared, and the wetland infilled to establish the rural land uses and then subsequently, for the establishment of a turf farm, construction of Tonkin Highway and Water Corporation and DBNGP easements. The vegetation present is scattered trees approximately 0.08 ha at the periphery of the REW in Lots 106 and 107.	Within the Tonkin Highway reserve and Water Corporation easement: • Stands of *Corymbia calophylla* (Marri) and non-native eucalypt *Eucalyptus camaldulensis* (River Red Gum) over non-native eucalypt *Casuarina cunninghamiana* subsp. *cunninghamiana, Melaleuca preissiana, Jacksonia sternbergiana* and **Schinus terebinthifolia* over introduced species (AECOM 2020 and Woodman Environmental 2021). • Cleared paddocks with *Eucalyptus camaldulensis* (River Red Gum).	80% of Lot 501 has been historically cleared of native vegetation. The remnant vegetation community consists of non-continuous patches of: • Mid open woodland of *Corymbia calophylla* over low woodland of mixed species dominated by *Eucalyptus rudis, Melaleuca rhaphiophylla* and *Melaleuca preissiana* over tall sparse shrubland of mixed species dominated by *Acacia saligna* over mid sparse shrubland of *Acacia pulchella* over mid tussock grassland of mixed species dominated by **Avena barbata, *Eragrostis curvula* and **Ehrharta calycina* over **Watsonia meriana* on grey and brown sandy loam and clay loam on plains, flats, and drainage lines (Woodman Environmental 2021). • Individual or stands of *Corymbia calophylla* over introduced species including **Avena barbata, *Bromus diandrus* and **Ehrharta calycina* on various soils and topographical positions (mostly with REW UFI 15257) (Woodman Environmental 2021).		
Vegetation condition	Completely Degraded condition (AECOM 2020 and Woodman Environmental 2021).	Completely Degraded condition (Woodman Environmental 2021).	Degraded condition (Woodman Environmental 2021).		
TEC	No State and Commonwealth listed TECs surveyed/ observed.	No State and Commonwealth listed TECs surveyed/observed.	No State and Commonwealth listed TECs surveyed/observed.		
Conservation Significant flora	No conservation significant flora present.		No conservation significant flora present.		

Wetland Attribute	Wetlands within the site		Wetlands within Lot 501
Conservation Significant fauna	Lack of dense understorey for Quenda. Limited foraging/roosting/breeding trees for the threatened black cockatoo species within the planted stands of *Eucalyptus camaldulensis* (River Red Gum).		The limited native vegetation, in particular the *Corymbia calophylla* (Marri) trees within the two CCWs (UFI 8026 and UFI 8027) has the potential to provide foraging and roosting habitat to the threatened Carnaby's cockatoo and Forest red-tailed black cockatoo species. Former Crystal Brook tributary and two CCW wetland areas provides habitat for frogs and reptiles.
Heritage sites	The wetland is located within one heritage site: Brentwood Road Swamp (Site ID 4343). This heritage site has historically been high disturbed from the construction of Tonkin Highway, Water Corporation pipeline, DBNGP and the former turf farm.	The wetland is not within an identified as an Aboriginal Heritage Place.	The CCWs (UFI 8026 and UFI 8027) and portion of REW UFI are not within an identified as an Aboriginal Heritage Place.

6.3.4.2 Wetland Buffer Assessment

Pentium Water's (2024) wetland assessment identified there is currently no separation buffer from the two CCWs (UFI 8026 & UFI 8027) and portion of REW UFI 15257 within Lot 501. The mapped wetland and associated buffer area has been subject to historical anthropogenic impacts, specifically the existing infrastructure corridors, which both frame and intrude into the mapped wetlands areas and immediate surrounds within Lot 501. Key infrastructure located immediately adjacent to or within the mapped wetland areas in Lot 501 include Boundary Road reserve, Tonkin Highway reserve and Welshpool Road reserve, Water Corporation water pipeline easement and DBNGP easement.

The existing infrastructure corridors are fixed and operational. These structures essentially frame and contain the limited wetland environmental and ecological values to entirely within Lot 501 without the application of any additional buffers to surrounding land uses i.e. landscape supply yard, Welshpool Road and Tonkin Highway. Importantly, the wetland buffer assessment identified (Pentium Water 2024):

- The wetland/ecological values associated with the mapped CCWs (UFI 8026 and UFI 8027) and REW UFI 15257 do not extend outside of Lot 501.
- Future urbanisation of the site will not alter the existing WAPC land management practices including regular mowing and slashing of the wetland areas to maintain the road reserves/Water Corporation pipeline and DBNGP easement as cleared areas.

In this context, the existing Boundary Road provides an approximate 20 m permanent infrastructure barrier between the two CCWs (UFI 8026 and UFI 8027) within Lot 501 and the commercial landscape supply yard and the semi-rural paddocks within the site.

The wetland assessment concluded the 20 m Boundary Road reserves provides physical separation from the two CCWs (UFI 8026 and UFI 8027) and the portion of REW UFI 15257. The road reserve is managed by the City of Kalamunda and will be maintained in the future.

The conclusion drawn on the status of the wetland and the road separation distance is supported by (Pentium Water 2024):

- The wetland assessment demonstrating the ecological values for the two CCWs (UFI 8026 and UFI 8027) and portion of REW UFI 15257 are more aligned with the management categories for REW and/or MUW. This conclusion was underpinned by the following assessment:
  - Approximately 80% of Lot 501 has been historically cleared of native vegetation and subject to infilling.
  - The historical and current land uses resulting in the establishment of open cleared areas within the mapped wetland areas include Welshpool Road and Tonkin Highway reserves, DBNGP and Water Corporation easements, and Boundary Road reserve.
  - Lot 501 is owned and managed by the WAPC and regularly maintained via slashing and mowing of the open grass and weed areas to uphold the road reserves, Water Corporation and DBNGP easements as cleared open areas.
  - The understorey of the two CCWs (UFI 8026 and UFI 8027) and portion of REW UFI 15257 within Lot 501 is significantly dominated by weed species including *Avena barbata* (wild oats), *Eragrostis curvula* (African lovegrass), *Ehrharta calycina* (perennial veldt grass) and *Watsonia meriana*.
  - The two CCWs (UFI 8026 and UFI 8027) and REW UFI 15257 within Lot 501 are in a Degraded to Completely Degraded condition.
  - The Boundary Road reserve adjacent to Lot 501 is a fixed City of Kalamunda road asset.
  - Future urbanisation of the site does not alter the location or the road reserve land use and the Lot 501 Parks and Recreation land use.

- Immediately south of Boundary Road (i.e. approximately 20 m from the mapped wetlands) are private landholdings ,including a commercial landscape supply yard and cleared semi-rural property and the DBNGP easement, which have been extensively filled and cleared of native vegetation. These land uses (i.e. the privately owned commercial and rural land uses) and the DBNGP easement have been in place for over 20 years.

6.3.5 Greater Brixton Street Wetlands

In proximity to the site and located on the western side of Tonkin Highway is the GBSW. The GBSW comprises a complex of significant wetlands, including areas of seasonally waterlogged flats (palusplain) and seasonally inundated basins (sumplands).

Table 6-4 outlines the DBCA mapped geomorphic wetland features within the GBSW area.

Table 6-4: Summary of wetland categories and area within the GBSW

Management category	Wetland UFI No.	Total Area
CCW	7637, 7646, 7653, 7747, 7748, 7775, 7797, 8025, 8028, 8031, 8032, 8035, 13129, 13131, 13365, 14962, 15255, 15815, 15816.	Approximately 150.1 ha
REW	8036, 15257, 15814, 15983	Approximately 10 ha
MUW	7740, 7744, 7746, 8030, 14964, 15254, 15724	Approximately 6.5 ha

The GBSW, which comprises Bush Forever Site No.387, covers an area of approximately 215 ha (Plate 6-8).

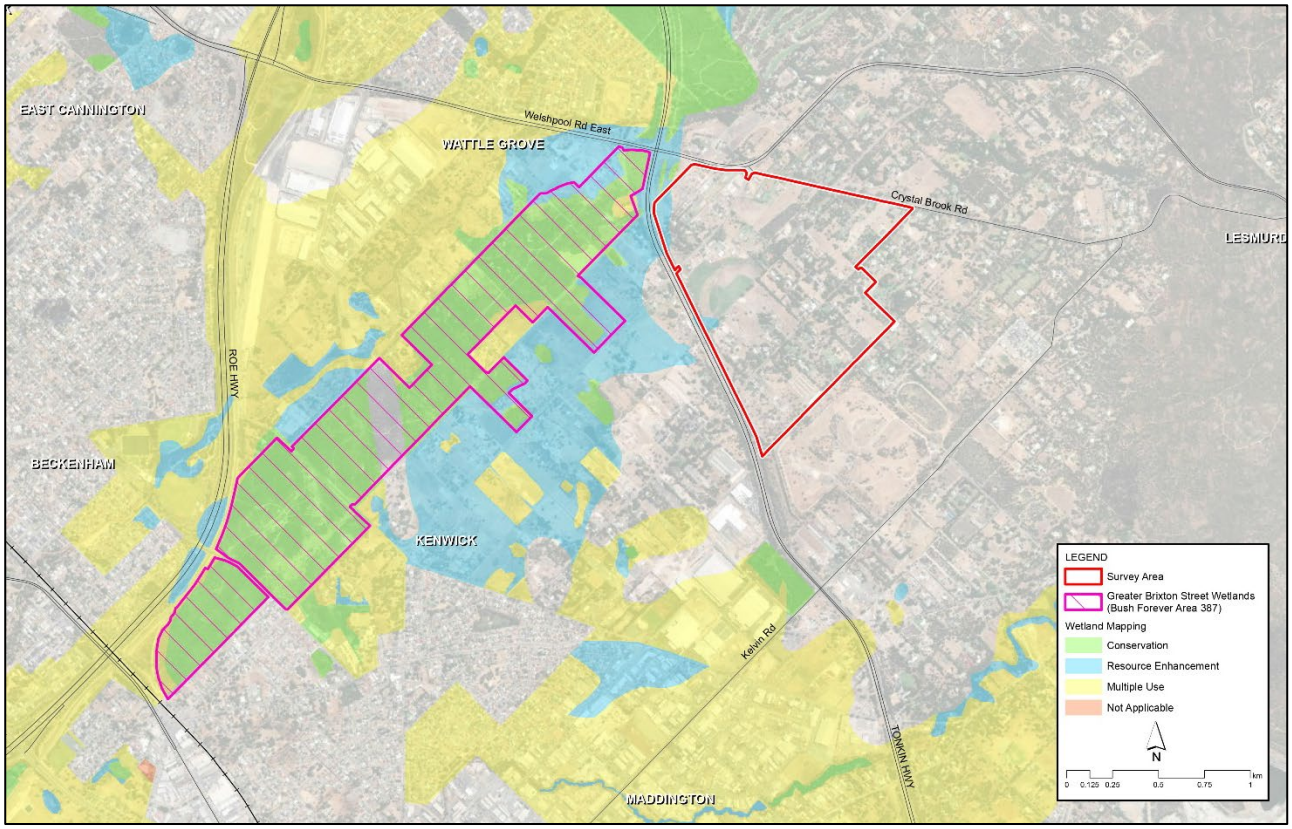


Plate 6-8: Greater Brixton Street Wetlands

The nearest DBCA mapped geomorphic wetland features within the GBSW area and in proximity to the site is outlined in Table 6-5.

Table 6-5: Mapped wetlands within 150 m of the site

UFI No.	Management category	Geomorphic classification	Land tenure details	Total area
GBSW area (within 75 m to 150 m of the site)				
8025	CCW	Palusplain	Lot 51 - Zoned 'Parks and Recreation'	2.78 ha
8028	CCW	Sumpland	Lot 340 - Zoned 'Parks and Recreation'	1.48 ha
8030	MUW	Palusplain	Lot 342 - Zoned 'Parks and Recreation'	1.29 ha
14962	CCW	Palusplain	Lot 342 - Zoned 'Parks and Recreation'	62.68 ha
15257	REW	Palusplain	Lot 51 - Zoned 'Parks and Recreation'	30.33 ha

6.3.5.1 GBSW Geology

The unique wetlands and associated ecology of the GBSW are situated atop of the alluvial Pinjarra Plain which is characterised by soils of the Guildford Formation. These include a combination of sand, mud, clay, and mixtures of these soils (Semeniuk 2001). Within areas of the GBSW, the Guildford Formation clay form layers a complex sequence of clay lenses that are laterally and vertically varied.

The Geological Survey of Western Australia (Jordan 1986), indicates the GBSW area is underlain by Guildford Formation and is comprised of:

- Sand (S8): white to pale grey at surface, yellow at depth, fine to medium-grained, moderately sorted, subangular to subrounded, minor heavy minerals, of eolian origin.
- Clayey sand (SC): silty in part, pale grey-brown, medium to coarse, poorly sorted, sub-angular to rounded, frequent heavy minerals, rare feldspar, of alluvial origin.
- Sand (S10): white to pale grey at surface, yellow at depth, fine to medium-grained, moderately well sorted, subangular to subrounded quartz, of eolian origin, over other units.
- Sand (S12): structureless, yellow, fine-grained, subangular, and medium to coarse-grained subrounded to rounded quartz, feldspar and heavy minerals common, minor silt and clay, of colluvial origin.
- Sandy silt (Ms4): cream to pale brown alluvium, clayey in part, fine to medium-grained sand, of alluvial origin.
- Sandy clay (Cs): white-grey to brown, fine to coarse-grained, subangular to rounded sand, clay of moderate plasticity gravel and silt layers near scarp.

6.3.5.1.1 Geophysical assessment

Geophysical resistivity assessment undertaken within the Wanaping block and Brixton Street block demonstrated the presence of near surface low permeability (or high resistivity) clay layers. Cemented clay layers are common within a few metres of the surface of the GBSW. It is these clay layers that underpin the base of the mapped claypan areas within the GBSW (Lane and Evans 2019).

This description of the GBSW geology is supported in the conceptual diagram of the stratigraphy and hydrogeology of the Brixton Block and Wanaping Block (Bourke 2017) (Plate 6-9) and the ERT assessment within Alison Baird Reserve (Plate 6-10). Both assessments identified the presence of near surface perched groundwater table over a clay lens.

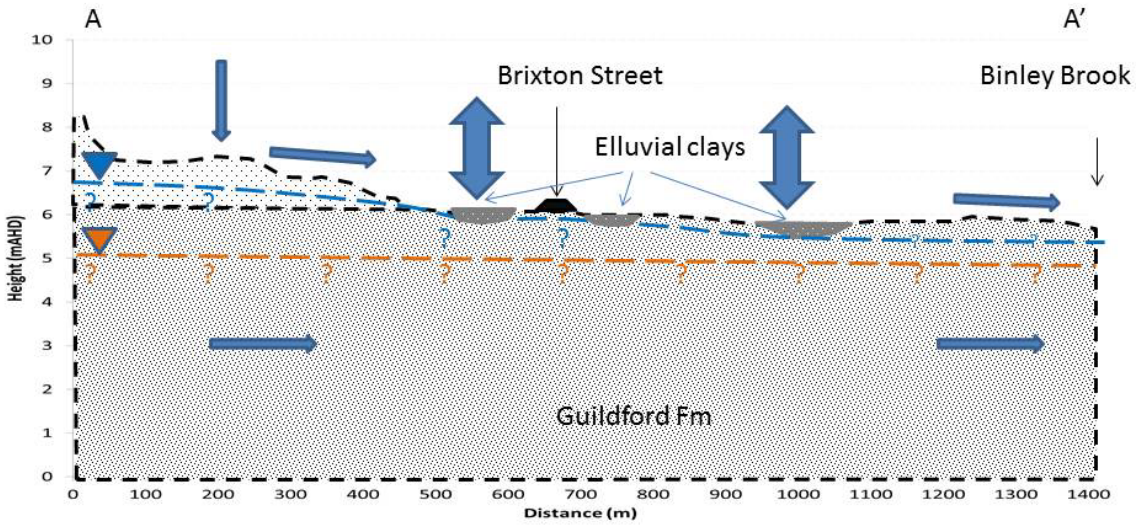


Plate 6-9: Conceptual Hydrogeology of Brixton Block Located in GBSW (Bourke 2017)

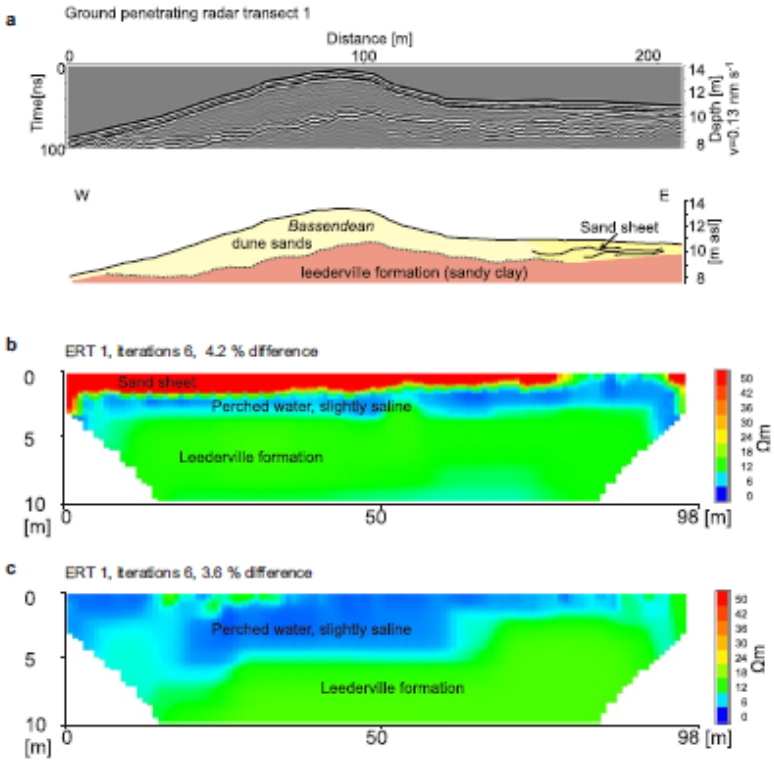


Plate 6-10: ERT Transect Within Alison Baird Reserve, East of the Sand Dune (Smith et al 2023)

6.3.5.1.2 Geotechnical investigations and permeability studies

The geotechnical investigations undertaken within the MKSEA Precinct 2 and 3B and portions of the GBSW conclude (JDSi 2017):

- Soils generally comprise of topsoil or fill to depths ranging from 0.1 m to 1.2 m, overlying sand, clayey, silty, or gravelly materials.
- The depth of higher permeable sand overlying the less permeable geological material ranges from 0 m to over 2 m.

- The clayey and sandy materials encountered include stiff to hard clay or clayey sand/sandy clay.

The soil permeability tests conducted in MKSEA Precincts 3b and 2 confirmed (Emerge Associates 2023a):

- Soil hydraulic conductivity rates ranged between 0.1 to 1.6 m/day at the interface of sand fill and clayey sand.
- Soil hydraulic conductivity rates were measured at >10 m/day rate within Bassendean sand which overlies the alluvial clays.

6.3.5.2 GBSW Surface Water

The GBSW is located within the western portion of the Yule Brook catchment. Two main surface watercourses dissect the catchment Woodlupine Brook and Yule Brook. The Yule Brook catchment has been highly altered by a range of industrial and urban uses, such as light to medium industry and residential, as well as agricultural production (DWER 2019). Both the Woodlupine Brook and Yule Brook watercourses ultimately discharge to the Canning River south-west of the GBSW.

The main hydrological features within and adjacent to the GBSW area are:

- Central channel (referred as the 'central drain') linking Boundary Road and Brook Road.
- Roadside drains (0.5 m to 1 m in depth) present along Brook Road and portions of Boundary Road adjacent to the GBSW.

This drainage infrastructure has resulted in surface water runoff and intercepted perched groundwater being diverted into open drains. Investigations undertaken by V and C Semeniuk Research Group (2001), Tauss et al. (2019) and Emerge Associates (2023a) all drew the conclusion that the open drain infrastructure has substantially altered the original surface water flow patterns into the GBSW. The drains are responsible for reducing surface water runoff volumes accessible to traverse the GBSW and fill wetland areas.

The main contributor of water inflows into the GBSW is direct rainfall. Generally, seasonal surface water entering the GBSW are retained as perched groundwater due to the low permeable clay layers, rather than infiltrating downwards into the underlying Superficial or Leederville Aquifers (Emerge Associates 2023a). The slow movement of water through the clay layers causes the perched water table during the winter months.

Surface water from the site flows via the Boundary Road, Brentwood Road, and Victoria Road culverts towards the proposed MKSEA Precinct 2 landholdings (which currently consists of semi-rural properties, poultry farm, and truck and machinery lay down land uses) adjacent to the GBSW.

6.3.5.3 GBSW Groundwater

A review of publicly available data to assess the thickness of the superficial formation across the GBSW found (Hyd2o 2024):

- The base of the superficial is reported between 0 m AHD (east) and -5 m AHD (west) across the study area.
- LiDAR shows the elevation ranges from 8 m AHD (west) to 25 m AHD (east) across the site.
- DWER historical maximum groundwater level contours indicate maximum water levels between 5 m AHD (west) and 18 m AHD (east), equivalent to 3 – 12 m below ground level.
- ER City of Gosnells TPS No. 6 Amendments 166 and 169 (MKSEA Precinct 2 and 3B) indicated maximum water levels range between 8 m AHD and 22 m AHD, equivalent to 0 m – 5 m below ground level (Emerge Associates 2023a)

Groundwater flows (Superficial Aquifer and indicatively the perched water table) are in a westerly to south-westerly direction towards the Canning River.

Plate 6-11 illustrates the GBSW regional groundwater contours and indicative perched groundwater flow directions. It also highlights the differences in groundwater depth and perched/Superficial Aquifer

interactions at the site, in comparison to the lower lying areas of the GBSW area south of Tonkin Highway, where the Superficial Aquifer is in much closer proximity to the natural surface (Hyd2o 2024).

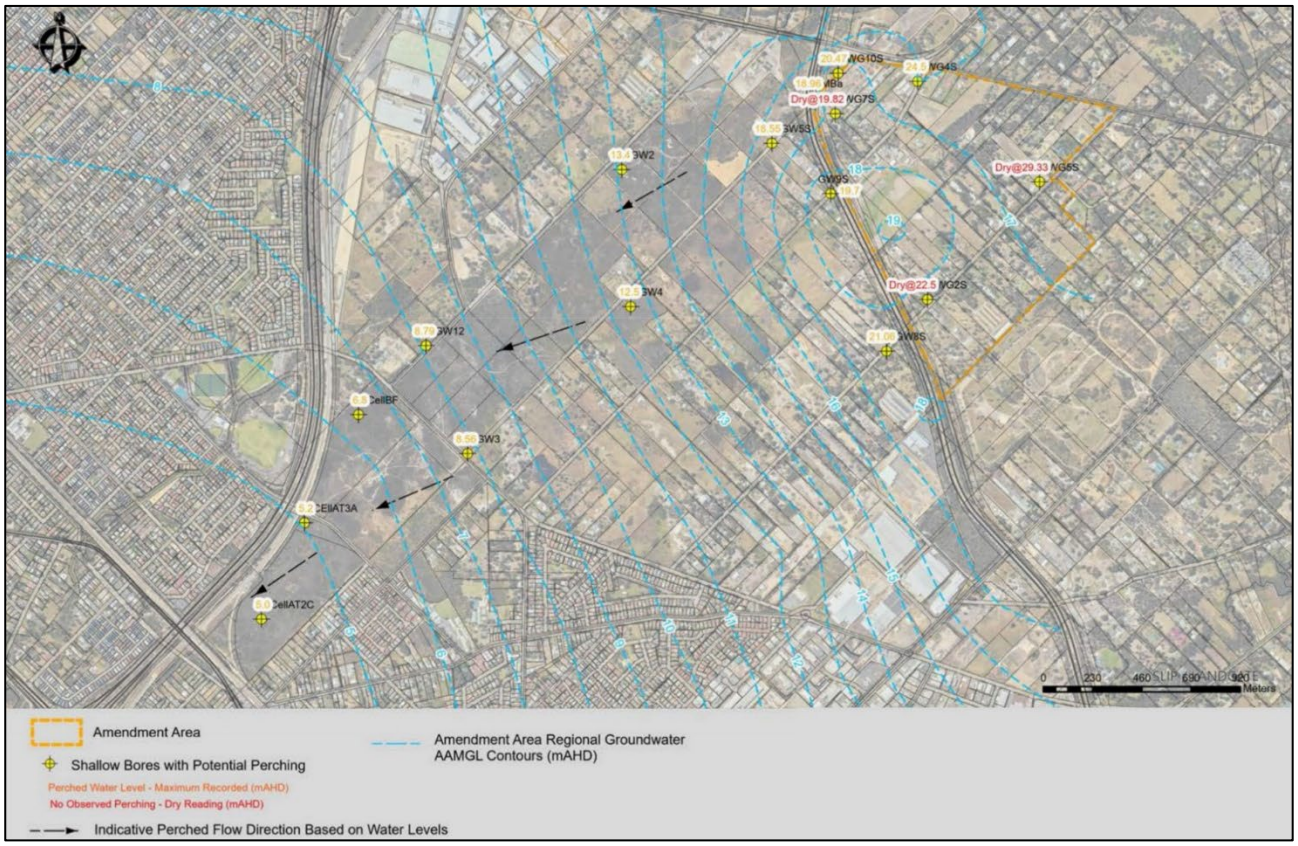


Plate 6-11: GBSW regional groundwater mapping and perched water flow direction (Hyd2o 2024)

6.3.5.3.1 GBSW and Groundwater Connectivity

Regional geology mapping and hydrogeological assessments of the GBSW by Emerge Associates (2023a), V and C Semeniuk Research Group (2001) and Lane and Evans (2019) confirm:

- A hard pan clay layers extends across most of the GBSW, which can limit the hydrological connections between the surface, perched water table and the underlying groundwater of the Superficial Aquifer. The perched water table beneath wetland sediments and topsoils is weakly confined with water flowing upwards and evaporating during summer.
- Areas of low permeable clay geology underpin the perched water table and clay pan wetlands and its associated groundwater dependent vegetation, with the clay pan wetlands flooding in winter and becoming dry in summer.
- The modelled 100-year storm event illustrates the preferred flow pathways for surface water runoff flows and specifically the influence of the constructed drains conveying flows towards the Yule Brook and away from the GBSW. The existing drainage infrastructure has resulted in less surface water being available to traverse wetlands within the GBSW area (Tauss et al. 2019 and Emerge Associates 2023a).
- Surface and rain water which infiltrates below the surface is likely to be maintained as perched groundwater rather than infiltrating further into the underlying Superficial Aquifer primarily due to the presence of low permeable clay substrate layers. The perched groundwater moves laterally

through the catchment, until either intercepted by an open drain or it reaches more permeable soil layers enabling recharge to the Superficial Aquifer.

To understand the connectivity between wetlands, perched water, and the Superficial Aquifer, investigation(s) were undertaken by V and C Semeniuk Research Group (2001) and Bourke (2017), which drew the following theories on the GBSW and groundwater connections (EPA 2022):

- Surface water infiltrates below the surface (until saturation) forming a perched groundwater layer. The alluvial clay geology underpinning the wetlands, and the perched groundwater layer generally acts as barriers between the perched aquifer and the deeper Superficial Aquifer. However, slow downward leakage (due to low permeability of the clay geology) into the Superficial Aquifer could occur from the clay-based wetland areas.
- There are potentially localised areas of higher permeable geology within the GBSW area due to the heterogeneous geology of the Guildford Formation. This would facilitate the upward flow of groundwater from the Superficial Aquifer into the perched groundwater system and discharge into wetland(s), forming a hydrologically connected aquifer.

In both scenarios, the potential interaction between the surface/perched water and the Superficial Aquifer would be dependent on water levels in the Superficial Aquifer at peak levels post winter rainfall events and/or if the perched water layer is saturated.

Plate 6-12 conceptually illustrates the potential interaction between surface/perched water with the Superficial Aquifer within the GBSW area (EPA 2022).

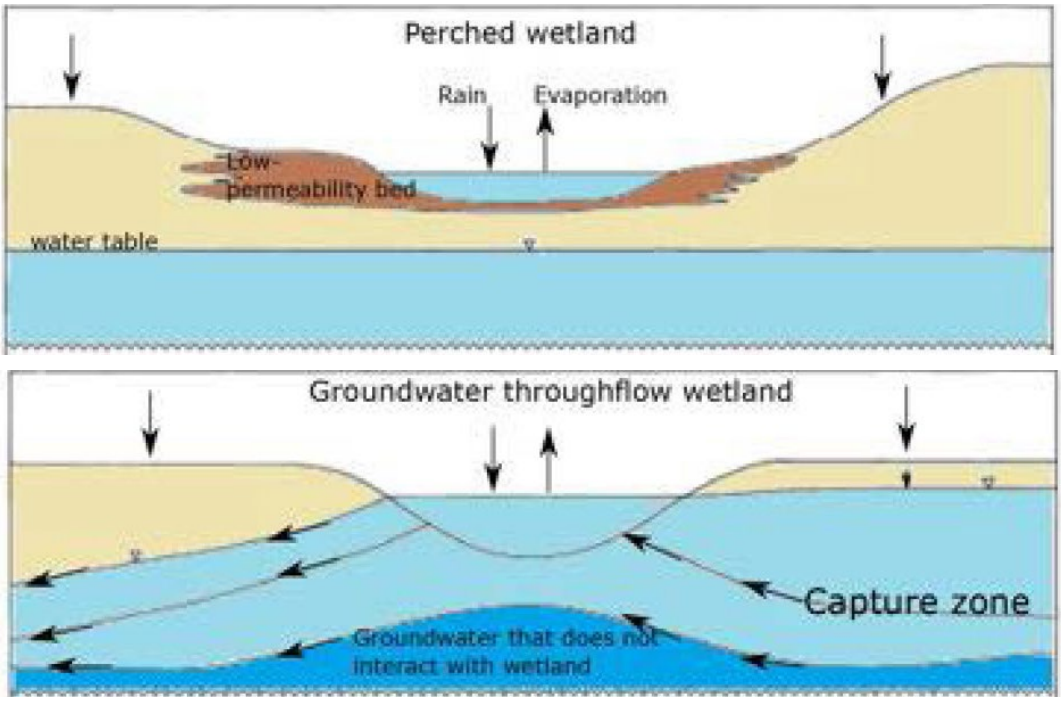


Plate 6-12: Potential interaction between surface/perched water with the Superficial Aquifer within the GBSW area (Davidson 1995)

6.3.5.4 Hydrogeological conceptual model - Summary

6.3.5.4.1 Geology

Geotechnical testing indicates the GBSW area geology is a thin layer of Bassendean Sand (0 m – 3 m) over Guildford Formation. Within the surface sands there is shallow, perched groundwater which variably shows surface expression in low lying areas and drainage channels.

6.3.5.4.2 Hydrology

Rainfall generally only infiltrates the topsoil/sand geology where there is capacity in the surface sands, forming a perched water table with limited recharge into the Superficial Aquifer due to the low hydraulic conductivity (associated with the Guildford heavier alluvial clay layers which overlies the Superficial Aquifer) and high groundwater levels.

Perched water is intercepted by the natural and man-made drainage lines to control the rising groundwater levels associated with the historical clearing and rural land uses.

6.3.5.4.3 Connectivity

There is limited information on the spatial and temporal nature of the perched groundwater. It may be only present seasonally and spatially across the GBSW as there may be areas and/or seasonal times where it connects with the underlying Superficial Aquifer. Limited data suggests any groundwater flow is likely to be downward from the perched groundwater to the Superficial Aquifer (i.e. slow leakage through low permeable clays); however, it is possible that upwards flow occurs in localised areas where clay layer(s) are limited or not present.

Plate 6-13 presents an east to west conceptual hydrogeological cross section extending from the eastern portion of the site to the GBSW. This conceptual hydrogeological cross section provides a spatial understanding of the geological formations and the hydrological systems including the perched and Superficial Aquifer.

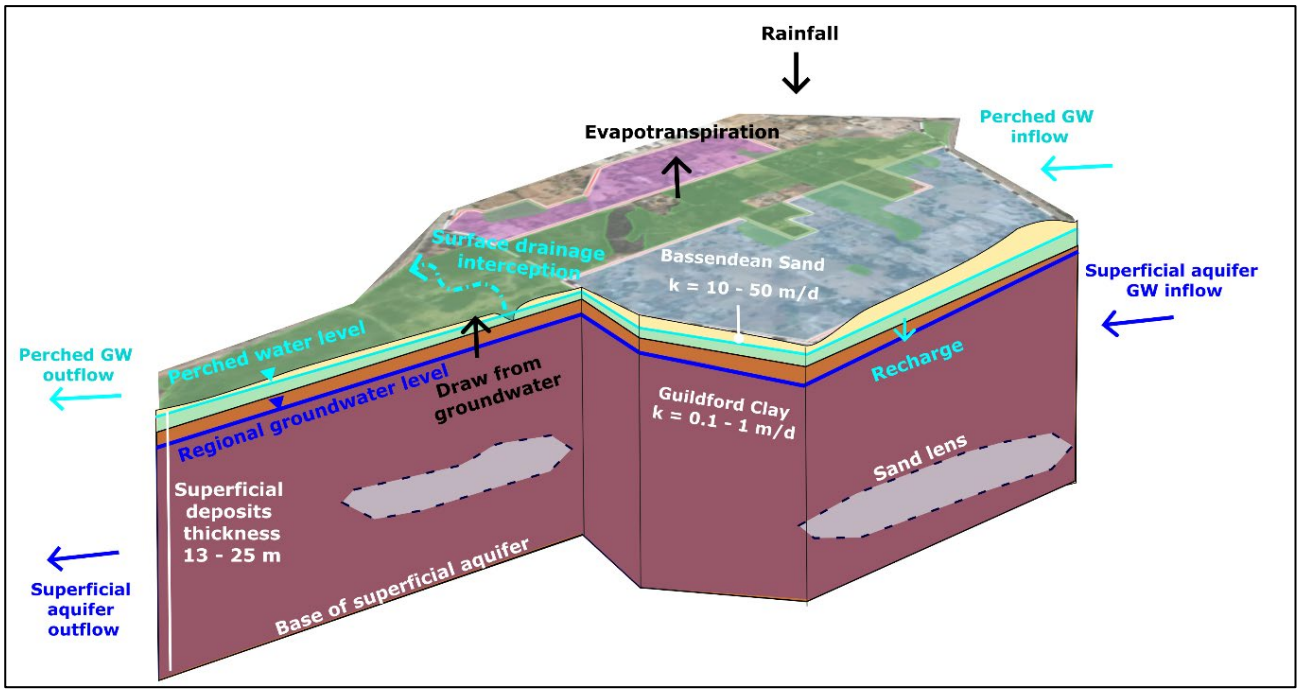


Plate 6-13: Hydrogeological conceptual model of the GBSW

6.3.5.5 Clay pan vegetation and the GBSW hydrological cycle

The Brixton Street Field Herbarium (DBCA 2018) describes the following complex sequence of different flora species which occur across different seasons within the claypan habitats that dominate the GBSW:

- when the claypans are inundated with winter rains and are full, they support a range of native aquatic plants
- as water levels begin to drop, a series of annual and perennial herbs grow and flower
- once the claypans dry out in early summer, different species then emerge, such as sundews and trigger plants
- flat areas surrounding the claypans also support various native herbs, sedges, and rushes, whilst upland areas and sandy rises are characterised by marri and Banksia woodlands with native understoreys.

The GBSW vegetation and flora communities depend significantly on the seasonal rainfall and associated surface water flows, which seasonally fills and waterlogs the low permeable clay layers forming a perched groundwater layer (DBCA 2018).

Variation in depth and duration of inundation is a factor in determining the suite of plant species that occur in a particular clay pan, explaining some of the variation in flora across the extent of the ecological community (Gibson et al. 2005). There is a positive correlation between flora species richness and rainfall with significantly higher species richness in clay pans on flats compared to basins. This is likely a result of a shorter period of inundation and potentially longer wet terrestrial phase (Gibson et al. 1994).

The botanical investigations (i.e. Tauss et al. 2019; Tauss and Weston 2010; and Emerge Associates 2023b) within the GBSW demonstrate the resilience of the flora and vegetation (inclusive of threatened flora species and clay pan communities) to the historical hydrological changes, including alterations in surface water flows from open drains (within and adjacent to the GBSW) and changes in water quality from upgradient land clearing and rural land uses.

6.3.5.6 GBSW Buffer Assessment

Pentium Water (2025) undertook a wetland buffer assessment of the GBSW, and identified that the following infrastructure corridors form a physical barrier between the GBSW area (inclusive of the GBSW numerous mapped wetlands) and the site:

- Tonkin Highway reserve (proposed to be increased to six lane highway)
- Water Corporation water pipeline easement
- DBNGP easement.

The closest wetland (CCW UFI 14962) within the GBSW area (and the Tonkin Highway reserve) is situated approximately 75 m to the west of the site, separated by the four-lane Tonkin Highway.

Plate 6-14 illustrates mapped CCW (UFI 14962) extends into the Tonkin Highway reserve, which is currently subject to grade separated upgrade assessment. The measurement was taken from the CCW (UFI 14962) within the highway reserve. If the upgrade of Tonkin Highway is approved (i.e. increased to six lanes) the separation distance to the site would be further extended by an approximate 30 m.

Within the site, immediately adjacent to Tonkin Highway is the Water Corporation pipeline and DBNGP easements. The *Dampier to Bunbury Pipeline Act 1997*, draft Development Control Policy 4.3 – Planning for High Pressure Gas Pipelines (DPLH 2016), and the Land Use Guidelines Dampier to Bunbury Gas Pipeline Corridor (Department of Lands 2016) generally excludes construction and residential/commercial or industrial development within the easement. These easements further extend the separation distance, from the proposed future residential development, within the site to the closest wetland within the GBSW area,

to approximately 105 m. The rest of the site is located significantly further than 100 m from the GBSW area east of Tonkin Highway.

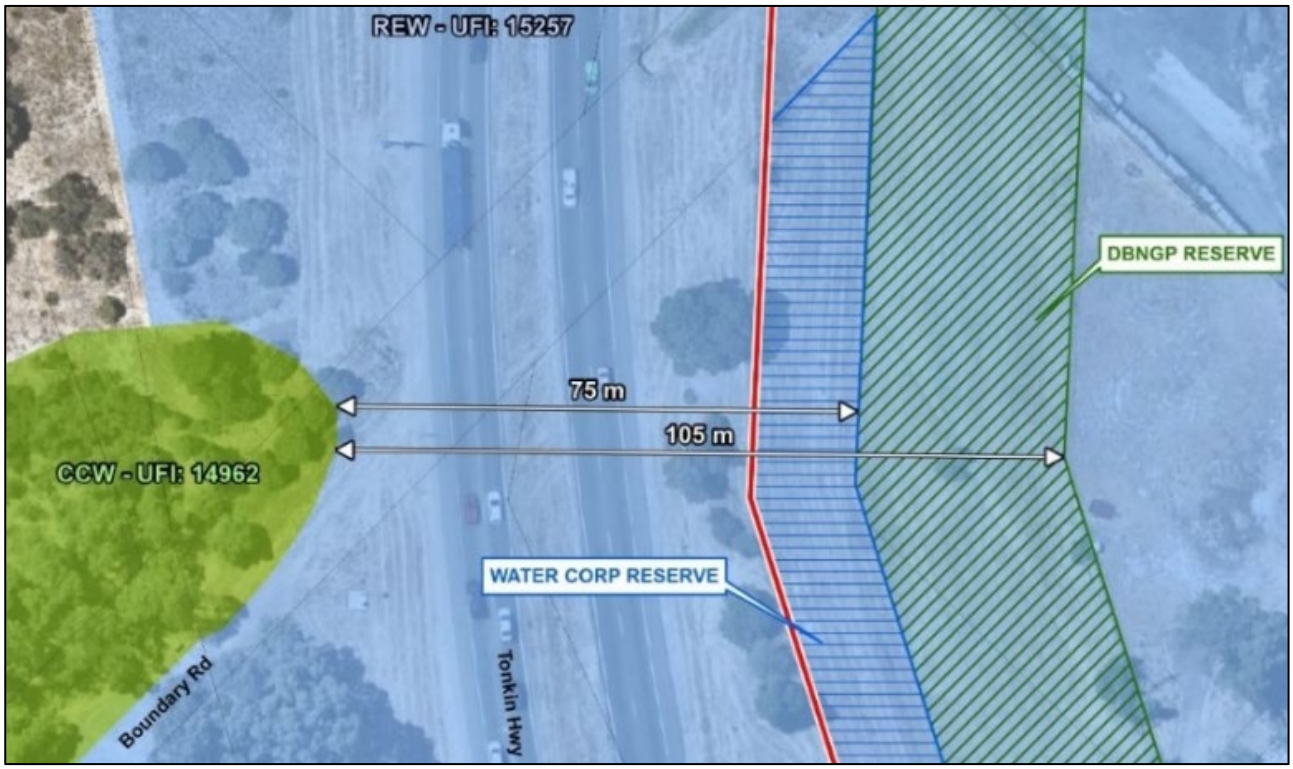


Plate 6-14: Physical Infrastructure separating CCW UFI 14962 and the site

6.4 Potential Impact Identification and Assessment

Future urban development as well as the provision of associated infrastructure, within the site has the potential to directly and indirectly impact inland waters. Potential impacts include:

- Impacts to current surface and groundwater cycles (alteration of hydrological regimes) resulting in impacts to significant wetlands and waterways within and nearby to the site, including the Yule Brook and the GBSW.
- Impacts to water quantity and quality of significant wetlands and waterways within and nearby to the site.
- Impact to the hydrology and biodiversity of the GBSW.
- Loss of foreshore functions and groundwater and/or surface water dependent vegetation and impacts to other water dependent ecosystems.

The following wetlands and waterways that are within and in proximity to the site have potential to be impacted from future urban development:

- REWs (UFI 8037 and portion of UFI 15257) – within the site
- CCWs UFI 8026 and UFI 8027 and portion of REW UFI 15257 – adjacent to the site.
- GBSW comprises a complex of significant wetlands, including areas of seasonally waterlogged flats (palusplain) and seasonally inundated basins (sumplands) – west of Tonkin Highway
- Yule Brook – north and north-west of the site

6.4.1 Key Hydrological changes

Emerge Associates (2024) undertook a Water Balance Assessment (WBA), which informed the DWMS on the hydrological regime and total water cycle of the site and its interrelationship with the GBSW. It quantified and provided a linked assessment of the key hydrological components and included an assessment of the pre-development (existing environment) and post-development ('Urban' zoning) environments. The post development model compares the expected changes to the existing hydrological regime following urbanisation of the site (Emerge Associates 2024).

Post-development, evapotranspiration in the site is reduced, and a minor increase in surface water outflow was modelled. Given the predominately permeable surface soils and infiltration-based water management strategy, the increase in water volume infiltrated results in an increase in groundwater recharge to the Superficial Aquifer. Groundwater outflow from the Superficial Aquifer is predicted to leave the site consistent with existing groundwater flow directions (Hyd2o 2024).

Modelling results are summarised compared to the predevelopment condition as follows:

- Overall, there is an 9.6% reduction in total inflow and outflows for the site post development. Rainfall remains the predominant source of inflow for the site, representing approximately 79.7% of the total inflow. Irrigation is the second largest component at 10.6%.
- Groundwater throughflow and upstream catchment inflows are relatively minor contributions at 2.8% and 3% respectively.
- Aquifer irrigation water use is reduced by 52.5% post development, reduced via the removal of the turf farm.
- In relation to outflows, evapotranspiration is the largest volumetric reduction representing 48.5% of the total outflow for existing land use and 36.9% post development. Groundwater throughflow in the superficial aquifer is increased from 26.9% to 35.3% of total outflow.
- Groundwater throughflow in the superficial aquifer is increased from 26.9% to 35.3% of total outflow.
- Surface water from the site was marginally increased from 7.8% to 9.6% of total outflow.

Overall, the water balance indicates a combined total outflow (groundwater and surface water) of 169,412 kL/year from the site toward the GBSW area, a 10,845 kL/year increase.

Surface water flow changes for flows directly to the GBSW area from the site are negligible (-638 kL/year), with the majority of flow change occurring where the site discharges to the MKSEA Precinct 2 landholdings and open drains (11,489 kL/year) (Emerge Associates 2024).

In the context of the GBSW area, these increases are minor. By comparison, direct rainfall (annual average 758 mm/year) on the surface of the GBSW area (215 ha) contributes 1,629,700 kL/year.

Overall, most of the minor combined outflow increase is due to a modelled increase in groundwater throughflow. It is important to note however that the direction of the modelled flow increase is north-west and toward the far eastern extent of GBSW, and an area where regional groundwater is well below natural surface (Hyd2o 2024).

The minor increases to the GSBW area can be readily amended to the pre-development levels through refinement of stormwater storage designs and adaptive management.

In relation to the Yule Brook's total annual flow of approximately 7.9 GL/year (7,900,000 kL/year). The water balance flow increased estimate of 10,845 kL/year to GBSW and MKSEA represents only 0.14% of the Yule Brook annual flow and is therefore, considered negligible in the context of interannual flow variability.

6.4.2 Wetlands within the site (REWs UFI 8037 and portion of UFI 15257)

The wetland assessment undertaken by Pentium Water (2024) of the REWs (UFI 8037 and 15257) within the site, which concluded these wetlands have:

- been subject to historical clearing of native vegetation and construction works and engineering fill
- no groundwater dependent ecosystems / riparian vegetation or open water areas exist
- no fauna habitat for aquatic dependent fauna species.

Given the above conclusions, Pentium Water (2024) recommended formally removing these wetland portions within the site from DBCA Geomorphic Wetland Swan Coastal Plain (GWSCP) dataset and integrating them within future public open space and stormwater bio-retention basin/swale areas.

Considering the limited wetland values, it is not expected there will be any measurable impacts to the historically cleared and infilled and Completely Degraded REWs UFI 8037 and portion of UFI 15257 within the site as a result of future urban development of the site, due to:

- the depth (4 m) from the natural ground surface to the Superficial Aquifer and urbanisation will not result in a significant rise in groundwater levels
- substantial portions of the mapped REWs areas have been infilled and native vegetation cleared, and surface water flows into this wetland are primarily from overland surface flows during large rainfall events.

6.4.3 Wetlands adjacent to the site (CCWs [UFI 8026 and UFI 8027] and portion of REW UFI 15257 within Lot 501)

Concerning the two CCWs (UFI 8026 and UFI 8027) and portion of REW UFI 15257 within Lot 501, which is adjacent to north west boundary of the site, Pentium Water (2024) advised that the mapped wetland and associated buffer area has been subject to historical anthropogenic impacts, and there is currently no separation buffer from these wetlands. Instead, the existing infrastructure corridors (Boundary Road, Tonkin Highway, Welshpool Road, Water Corporation pipeline and DBNGP easements) all frame and intrude into the mapped wetland areas and immediate surrounds within Lot 501 (Pentium Water 2024).

Pentium Water (2024) advised that Boundary Road provides an approximate 20 m permanent infrastructure barrier between the two CCWs within Lot 501 and the commercial landscape supply yard and semi-rural paddocks within the site.

The wetland assessment concluded the ecological values of these wetlands are more aligned with REW category and/or MUW category wetland, due to (Pentium Water 2024):

- approximately 80% of Lot 501 has been historically cleared
- the historical and current land uses have created open cleared areas within the mapped wetland areas
- Lot 501 is owned and managed by the WAPC and regularly maintained via slashing and mowing of the open grass and weed areas to uphold the road reserves, Water Corporation pipeline and DBNGP easements as cleared open areas.
- significant weed understory dominated by *Avena barbata* (wild oats), *Eragrostis curvula* (African lovegrass), *Ehrharta calycina* (perennial veldt grass) and *Watsonia meriana*.

No proposed physical disturbance to the wetlands, or the portion of the former Crystal Brook tributary located within Lot 501 is proposed as a result of future urban development of the site. The wetlands are separated from the existing land uses within the site, (which includes commercial landscape supply yard and open semi-rural paddocks) by the 20 m Boundary Road reserve (Pentium Water 2024).

Concerning the potential hydrological impacts to these wetlands, these are not expected to be significant, due to:

- the depth (3 – 4 m) from the natural ground surface to the Superficial Aquifer and urbanisation will not result in a significant rise in groundwater levels
- groundwater flow direction in proximity to Lot 501 is predominately in an easterly and then north-westerly direction noting Guildford Formation clays intersect portions of Boundary Road, and form a hydrological barrier (i.e. lower permeability) to Superficial Aquifer flows
- implementation of stormwater management including biofiltration and flood management areas will improve water quality and maintain the pre-development surface water flows towards the former Crystal Brook tributary, wetlands (within Lot 501) and the Boundary Road culvert.

6.4.4 GBSW and Yule Brook

6.4.4.1 Surface water flows

The site represents approximately 2% of the total Yule Brook catchment area and 15% of the GBSW area sub catchment. The site's surface water contribution to the GBSW however is much less than 15%, because the Yoganup Formation (the dominant geology unit) within the site facilitates the infiltration of surface water into the Superficial Aquifer, reducing the surface water flows towards the GBSW.

The surface water flows post-development from the site towards the GBSW area is predicted to marginally increase (24,524 kL/year) from 7.8% pre-development to 9.6% post development of total outflow volumes. This increase is considered minor when compared against:

- Total water balance: The flow increase represents approximately 2% of the total water balance outflows.
- GBSW rainfall: Direct rainfall (annual average 758 mm/year) on the surface of the 215 ha GBSW area contributes 1,629,700 kL/year. The flow increase represents approximately 1.5% of annual rainfall volumes.
- Yule Brook: The Yule Brook has an estimated annual flow of 7,900,000 kL (SRT 2011). The flow increase represents only 0.3% of the Yule Brook estimated annual flow and is therefore considered negligible in comparison to interannual flow variability (Hyd2o 2024).
- If only the site was developed, the surface water changes for flows directly to the GBSW area from the site is negligible (-638 kL/year), with most flow change occurring where the site discharges to the MKSEA Precinct 2 landholdings and open drains (11,488 kL/year) (Emerge Associates 2024).

Given the above, the site contributes a relatively small component of surface water inflow to the GBSW area compared to its other sources.

Surface flows are recognised as a key component of the wetlands hydrological water balance and the principle of maintaining pre and post development flow rates and volumes to the GBSW area has been used to inform the water management strategy and design. The future urbanisation of the site provides an opportunity to improve the hydrological outcomes for the GBSW and Yule Brook by application of best practice urban water management approaches to:

- improve surface water quality
- reduce water quality impacts on the GBSW and the Yule Brook, while maintain existing flow volumes.

Therefore, no significant impacts to surface water cycles and significant downgradient wetlands and waterways (including the Yule Brook and the GBSW) are predicted.

6.4.4.2 Groundwater

6.4.4.2.1 Groundwater mound

The cessation of the turf farm irrigation (from the Leederville Aquifer) has the following unintentional hydrological outcomes for the groundwater mound within the Superficial Aquifer:

- Reduction of the groundwater levels which have been kept at an elevated level (i.e. between 1 m to 5 m for the past 20 years).
- This reduction in groundwater level elevation will extend approximately 1.5 km west and north-west into the GBSW. The extent to which the ceased irrigation at the turf farm from the Leederville Aquifer will impact groundwater levels locally is difficult to quantify given the variable geology of the local area.

The WBA (Emerge Associates 2024) shows that there is a net increase in available water, attributable to the increased areas of impermeable surface and removal of pasture and vegetated areas that will likely occur as a result of urbanisation within the site. These land use changes affect evapotranspiration, surface runoff and drainage which in turn result in an overall increase in available water within the site. The permeability of soils within the site (specifically the Yoganup Formation and Bassendean Sands), and the ability for stormwater management infrastructure to be located within permeable areas, increases the water available to recharge into the Superficial Aquifer.

The predicted minor increase in the post development groundwater throughflow in combination with locating stormwater management areas in the vicinity of the existing groundwater mound underpins the key hydrological objective of maintaining the groundwater mound consistent with the pre-development environment.

By maintaining the influence of the groundwater mound, the post-development groundwater flows will be maintained and will continue to flow radially away from the mound, with flows towards the west remaining consistent with the pre-development hydrological conditions. Accordingly, the minor change from the increase in groundwater recharge balanced by the reduction in the groundwater mound is not expected to significantly impact the GBSW or the Yule Brook.

This increase in recharge will assist, in combination with the LWMS stormwater management approach to maintain the pre-development conditions i.e. the presence of existing groundwater mound. Accordingly, post-development:

- groundwater flows are expected to be comparable with pre-development conditions and will continue to flow radially away from the mound
- groundwater flows towards the west will remain comparable with the pre-development flows and is not expected to impact GBSW (Emerge Associates 2024).

Please refer to the LWMS for further detail.

6.4.4.2.2 Groundwater through flow

A minor increase in Superficial Aquifer through flows (65,976 kL/year) is predicted under a ‘fully developed scenario’. The risk(s) of this minor change to groundwater flow within the Superficial Aquifer is not considered significant due to:

- The recharge flow being within the deeper Superficial Aquifer (i.e. not the shallow perched water table).
- The groundwater through flow will be consistent with the pre-development flow directions, which is predominantly in a north-west to south-east and away from the GBSW area.
- The GBSW is situated atop of the alluvial Pinjarra Plain which is characterised by soils of the Guildford Formation. Within areas of the GBSW, the Guildford Formation clay form layers a complex sequence

of clay lenses that are laterally and vertically varied which form a low permeable barrier between the perched water table, wetlands and the Superficial Aquifer.

- Key conclusions from hydrological assessment within the GBSW area confirm rainfall and ground water perching are the dominant hydrological process, for example:
  - V and C Semeniuk Research Group (2001) reported the wetlands within the GBSW area were maintained by surface and near surface perching of direct precipitation and by infiltration. During periods of below average rainfall groundwater in the Superficial Aquifer was considered likely to play only a minor part on the maintenance of the wetlands, with the major recharge mechanism for the wetlands identified as being direct precipitation, perching, infiltration, and sub surface perching.
  - Bourke (2017) concluded in agreement with previous investigations that the GBSW area was predominately a surface water feature and reliant largely on rainfall and surface water inflow.

The interaction between the Superficial Aquifer and the perched groundwater table within the GBSW is unlikely to be spatially uniform across the GBSW (or the interaction is possibly limited to minor leakage through heavy clay layers).

The Wattle Grove South LWMS (Hyd2o 2025) promotes an adaptive management approach for the site which is underpinned by the continued implementation of the current groundwater and surface water monitoring program.

The monitoring program and reporting framework encapsulates monitoring of the Superficial Aquifer groundwater levels (both near the turf farm and in the GBSW). This will enable:

- a comparative review of seasonal groundwater contours and flow direction pre-and post-development
- the influence of the groundwater mound post development.

Please refer to the LWMS for further detail.

6.4.4.3 Water quality

A nutrient input and export rate assessment using DWER's UNDO model was undertaken for the pre-development and the proposed post development 'Urban' land use. The UNDO modelling of the post development scenario compared with the current land uses is shown in Table 6-7.

Table 6-6: Nutrient inputs and outputs from the proposed 'Urban' land use (Hyd2o 2024)

Nutrient	Annual input (kg)	Annual export (kg)
Total Nitrogen (TN) (kg/yr)	5,148	130.0
% Change (compared to existing land use)	-63%	-61%
Total Phosphorous (TP) (kg/yr)	891	7.5
% Change (compared to existing land use)	-37%	-60%

The post development UNDO modelling shows a positive impact from the proposed land use change with respect to nutrient application and export. The predicted reductions in nutrients exported from the site will significantly benefit the wetlands within the GBSW area and Yule Brook (Hyd2o 2024). Particularly as it is acknowledged the unique vegetation communities associated with the GBSW landscape have evolved to survive in nutrient-poor soils (Lambers 2019).

Compared to the status-quo of continued semi-rural and commercial land uses, the future urbanisation of the site will result in the introduction of contemporary nutrient management controls for existing nutrient

loads. The key controls will be the establishment of drainage swales to provide at source treatment structures, including biofiltration treatment swales/basins, which meet contemporary water sensitive urban design with respect to nutrient management and bio-retention.

The existing 'Rural' land use currently has no water sensitive measures or controls to improve and manage water prior to its discharge to receiving environments. In accordance with appropriate stormwater mitigation measures, the following benefits are anticipated:

- A reduction in nutrients (61% total nitrogen reduction and 60% total phosphorus reduction) exported from the site.
- Implementation of future residential subdivision will be developed with contemporary stormwater management infrastructure that provides treatment of surface water runoff, to remove nutrient loadings through native vegetation biofilters and/or nutrient retaining soils.
- The existing surface water peak flow rates will not exceed pre-development flows. This approach will be subject to agency advice on establishing opportunities for future increased flows to mitigate climate change impacts on declining inflows towards the GBSW area, if required.

The UNDO and water quality assessment predict there will be an overall improvement in water quality of water exiting the site as a result of implementing best practice stormwater management (i.e. stormwater biofiltration basin). This management action reduces water quality risks to significant wetlands and waterways downgradient to the site.

The LWMS will set water quality targets surface water and groundwater for the key post development assessment sites are premised upon the pre-development monitoring data. These targets that will be reviewed and established in consultation with regulatory authorities (i.e. DBCA and DWER). The review of the water quality targets will incorporate the additional surface water and groundwater data from the ongoing monitoring program. Please refer to the LWMS for further detail.

6.4.4.4 Climate Change

Climate change represents the most influential threat to the GBSW hydrology and ecology. The historical and ongoing climate change resulting in a long-term drying trend is an important consideration, given the significant water dependent ecosystems within the GBSW are primarily dependent on direct rainfall, surface water runoff or expressions of perched groundwater.

Based on the WBA undertaken by Emerge Associates (2024), the impact of climate change on the water balance is relatively small for the dry 2050 horizon modelling but more significant for the 2100 horizon. The most significant impact is from the reduction of surface water inflows and outflows from the site (i.e. 7.9% reduction) in the 2050 horizon and a 58.7% reduction by 2100.

The World Biodiversity Association (WBA) highlights the risks to wetlands and the ecology of the GBSW from climate change, including higher temperatures, increased evaporation and reduced rainfall, all of which combine to reduce water flows and hydroperiod within the GBSW. Climate change predictions will alter the hydrological regimes affecting water flux and hydroperiod in wetlands and clay pan systems in the GBSW.

The hydrological assessments and research conducted by Emerge Associates (2023a), Bourke (2017) and V and C Semeniuk Research Group (2001) within the GBSW draw the conclusion that the wetlands and clay pans (and associated groundwater dependent communities) are predominantly dependent on overland surface, and perched water table flows. Specifically, under a drying climate scenario, the wetlands and clay pans within the GBSW area will become further dependent on overland surface flows and change the wetland vegetation dynamics particularly for shallow rooted flora species.

In terms of reduced rainfall directly on the GBSW area, a reduction in rainfall is predicted by 2050 (33 mm) across the GBSW area (215 ha), and by 2100 (254 mm). These predicted changes in rainfall volumes are irrespective of development (Hyd2o 2024).

To counteract the long-term drying trend (as a direct result of climate change), additional surface water flows towards the GBSW (and its seasonally water dependent ecosystems i.e. Clay pans of the Swan Coastal Plain), the LMWS outlines the continuation of the hydrological monitoring program (which informs adaptive management) within the site and the GBSW. The monitoring program will be subject to an annual review and assessment of performance and will also review climate change in the context of climate projections and its impact on GBSW hydrology for the purpose of informing an adaptive management approach.

Please refer to the LWMS for further detail.

6.4.4.5 Separation buffer

There are no existing streamlines within the site. The only remnant stream is a portion of the former Crystal Brook tributary which is in Lot 501 adjacent to the site and extends for approximately 500 m on the western side of Tonkin Highway.

The site is physically separated from the Yule Brook watercourse and wetlands within the GBSW area by Welshpool Road and Tonkin Highway road reserves and intersection, and Water Corporation pipeline and the DBNGP easements.

The Yule Brook is located approximately 250 m from the site at the closest point. Downgradient, west of Tonkin Highway, the Yule Brook is located over 700 m to the north-west from the site.

The GBSW is separated from the amendment area by the 75 m Tonkin Highway reserve (at the closest point). This separation distance is extended by a further 25 m due to the Water Corporation pipeline and DBNGP easements, located along the length of the site's western boundary.

At Brentwood Road there is an at level pedestrian crossing of the four lane Tonkin Highway. The distance to the mapped GBSW boundary from the site along Brentwood Road is approximately 700 m. This pedestrian access would be formally closed either as part of MRWA's proposed Tonkin Highway Grade Separated Interchange (which extends the highway from four to six lanes) or through a future subdivision approval.

Pentium Water's (2024) review of the separation distance between the GBSW and the site identified:

- The existing transport infrastructure (Tonkin Highway) and Water Corporation pipeline and DBNGP easements which provides a physical separation boundary to the site.
- The Tonkin Highway Grade Separated Interchange Proposal, specifically, if the upgrade of Tonkin Highway is approved (i.e. increased to six lanes) the minimum separation distance to the site would be extended by an additional 30 m.
- The site and any proposed future development works do not intrude into the GBSW area and remain on the eastern side of Tonkin Highway.

A minimum 100 m buffer to the GBSW (at the closest point) will be maintained. The Tonkin Highway reserve in combination with the Water Corporation pipeline and DBNGP easements has already established a minimum 100 m physical boundary between the GBSW wetlands and the site at the closest point. If the MRWA Tonkin Highway Grade Separated Interchange Proposal is approved and constructed (creating a six-lane highway) the minimum buffer would extend to approximately 130 m.

Given the above, no impacts or loss of the wetland's foreshore functions, vegetation or other water dependent ecosystems within the GBSW or the Yule Brook is expected.

6.4.5 Cumulative Impacts

The Environmental Review for MRS Amendment 1388/57 presented a summary of the potential impacts from the following proposals and planning scheme amendments in proximity to the site on the site's environmental values and the GBSW:

- Wattle Grove Urban Expansion and Urban Investigation Areas
- Tonkin Highway Grade Separated Interchanges (Hale Road to Welshpool Road)

- Tonkin Highway Grade Separated Interchange (Kelvin Road)
- Tonkin Highway, Guildford Road to Great Eastern Highway Upgrade (Tonkin Gap)
- Maddington Kenwick Strategic Employment Area (MKSEA)

The Environmental Review concluded that there will not be any significant cumulative impacts on the environmental values associated within inland waters within the site and the GBSW, as a result of the proposed change in land use from Rural to Urban.

The EPA (2025) advised that while the cumulative impacts to inland waters values are not at a level that would warrant a recommendation not to implement the amendment, the EPA considers that the incremental impacts to the GBSW by urban and industrial (business development) land uses must be appropriately managed. Therefore, the EPA (2025) recommended the Environmental Conditions (Appendix 2) to ensure the outcome of avoidance and minimisation of adverse impacts to the GBSW from future urban development of the site.

6.5 Impact Mitigation

Impacts to inland waters and how future urban development of the site will manage these impacts have been considered in the context of the EPA's mitigation hierarchy (Table 6-8).

Table 6-7: Inland Waters Mitigation Hierarchy

Inland Waters Mitigation Hierarchy: Assessment and Proposed Actions
Potential Impacts
Future urban development as well as the provision of associated infrastructure, within the site has the potential to directly and indirectly impact inland waters. Potential impacts include: • Impacts to current surface and groundwater cycles (alteration of hydrological regimes) resulting in impacts to significant wetlands and waterways within and nearby to the site, including the Yule Brook and the GBSW. • Impacts to water quantity and quality of significant wetlands and waterways within and nearby to the site. • Impact to the hydrology and biodiversity of the GBSW. • Loss of foreshore functions and groundwater and/or surface water dependent vegetation and impacts to other water dependent ecosystems.
Groundwater • The proposed 'Urban' land use will increase groundwater levels due to reduced evapotranspiration and greater infiltration and recharge of the superficial aquifer, via runoff from roads, roofs, and other hard surfaces. • Cessation of the turf farm irrigation (from the Leederville Aquifer) will alter the groundwater mound resulting in a reduction in groundwater levels from the turf farm extending approximately 1.5 km west and north-west into the GBSW. • Post development, groundwater flow within the Superficial Aquifer will continue to flow radially from the groundwater mound with the dominant flow paths towards the north-west to flowing south-east consistent with the pre-development flows. Groundwater flows to the west will remain comparable to pre-development flows. • Groundwater assessment concludes there will be no impact(s) to Superficial Aquifer groundwater flows towards the GBSW or the Yule Brook from the proposed 'Urban' land use. • The Superficial Aquifer is several metres (4 m plus) below the shallow perched conditions experienced along the western boundary of the site and the portion of GBSW on the western side of Tonkin Highway. Accordingly, the minor change in groundwater recharge will not affect localised perched water conditions beneath GBSW The post-development contours for the Superficial Aquifer are expected to be consistent with the pre-development environment due to: ▪ The increase recharge to the Superficial Aquifer. ▪ The proposed stormwater management approach which maintains the groundwater mound. • The risk(s) post development to the Superficial Aquifer is not significant to the existing groundwater cycles that it would result in impacts to significant wetlands and waterways within the GBSW due to:

Inland Waters Mitigation Hierarchy: Assessment and Proposed Actions
▪ The recharge flow is within the deeper superficial aquifer (i.e. not the shallow perched water table). ▪ The GBSW is situated above the alluvial Pinjarra Plain which is characterised by soils of the Guildford Formation. Within areas of the GBSW, the Guildford Formation clay form layers a complex sequence of clay lenses that are laterally and vertically varied which form a low permeable barrier between the perched water table, wetlands, and the Superficial Aquifer. ▪ The interaction between the Superficial Aquifer and the perched groundwater table within the GBSW is unlikely to be spatially unform across the GBSW (or the interaction is possibly limited to minor leakage through heavy clay layers).
Surface Water • The surface water flows post-development from the site towards the GBSW area is predicted to marginally increase (24,524 kL/year) from 7.8% pre-development to 9.6% post development of total outflow volumes, which is considered minor when the flow increase represents approximately 2% of the total water balance outflows, 1.5% of annual rainfall volumes, 0.3% of the Yule Brook estimated annual flow. • The surface water changes for flows directly to the GBSW area from the site negligible (-638 kL/year), with most flow change occurring whether the site discharges to the MKSEA Precinct 2 landholdings and open drains (11,488 kL/year) • A net reduction in nutrients (61% total nitrogen reduction and 60% total phosphorus reduction) exported towards the GBSW because of the rural land use change and adoption of best practice water sensitive drainage design. • The future urbanisation of the site provides an opportunity to improve the hydrological outcomes for the GBSW and Yule Brook by application of best practice urban water management approaches to: ▪ improve surface water quality ▪ reduce water quality impacts on the GBSW and the Yule Brook, while maintain existing flow volumes. • Therefore, no significant impacts to surface water cycles and significant downgradient wetlands and waterways (including the Yule Brook and the GBSW) are predicted.
Wetlands within and adjacent to the site • Considering the limited wetland values, it is not expected there will be any measurable impacts to the historically cleared and infilled and Completely Degraded REWs UFI 8037 and portion of UFI 15257 within the site as a result of future urban development of the site, due to: ▪ the depth (4 m) from the natural ground surface to the Superficial Aquifer and urbanisation will not result in a significant rise in groundwater levels ▪ substantial portions of the mapped REWs areas have been infilled and native vegetation cleared, and surface water flows into this wetland are primarily from overland surface flows during large rainfall events. • No proposed physical disturbance to the two CCWs (UFI 8026 and UFI 8027) and portion of REW UFI 15257 within Lot 501, or the portion of the former Crystal Brook tributary located within Lot 501 is proposed as a result of future urban development of the site. The wetlands are separated from the existing land uses within the site, (which includes commercial landscape supply yard and open semi-rural paddocks) by the 20 m Boundary Road reserve. • The potential hydrological impacts to these wetlands, is not expected to be significant, due to: ▪ the depth (3 – 4 m) from the natural ground surface to the Superficial Aquifer and urbanisation will not result in a significant rise in groundwater levels ▪ groundwater flow direction in proximity to Lot 501 is predominately in an easterly and then north-westerly direction noting Guildford Formation clays intersect portions of Boundary Road, and form a hydrological barrier (i.e. lower permeability) to Superficial Aquifer flows ▪ implementation of stormwater management including biofiltration and flood management areas will improve water quality and maintain the pre-development surface water flows towards the former Crystal Brook tributary, wetlands (within Lot 501) and the Boundary Road culvert.
Avoidance
GBSW • Future urban development will not change the existing 'Parks and Recreation' and 'Bush Forever' land use within the GBSW area located east of Tonkin Highway.

Inland Waters Mitigation Hierarchy: Assessment and Proposed Actions

- All future approved development works (i.e. civil infrastructure works and earthworks associated with the creation of residential lots, roads, the installation of drainage basins, power, sewer and water infrastructure) will occur within the approved subdivision and/or development application boundary (located entirely within the site) and outside of the GBSW area.
- The Tonkin Highway reserve in combination with the Water Corporation pipeline and DBNGP easements establishes a minimum 100 m physical boundary between the GBSW wetlands and the site at the closest point.

Yule Brook

- The waterway, inclusive of the brook's foreshore area is located outside of the site. Future construction activities within the site will occur east of Tonkin Highway, located over 200 m from the Yule Brook waterway.

CCWs

- The two CCWs (UFI 8026 and UFI 8027) and the portion of REW (UFI 15257) within Lot 501 will be retained along with the Boundary Road reserve.

Minimisation

- The LWMS outlines the best practice urban water management approaches which will be employed in the future UWMP, which will be prepared in accordance with the Environmental Conditions (Appendix 2) and the Local Structure Plan Part 1 provisions.
- The best practice urban water management approaches to be employed, will include (Hyd2o 2024):
  - The implementation of water sensitive urban design in accordance with Better urban water management guidelines (WAPC 2008b) and Stormwater management manual for WA (DWER 2004 updated 2022).
  - The installation of stormwater bioretention basins (which are currently not employed within the site) will improve water quality relative to the current conditions (i.e. existing open rural paddocks/turf farm land uses) and improve downstream ecological conditions.
  - Integrating the surface water and groundwater monitoring program dataset into the future UWMP(s), surface water and groundwater trigger values and the adaptive management framework.
  - The surface water and groundwater monitoring program (as defined in the LWMS) will be continued for the purpose of informing the future water planning and assessment stages, specifically, UWMP.
  - The surface water and groundwater dataset include groundwater levels and quality and surface water quality and flows parameters both within the site and the GBSW areas. Currently, there is over five years of seasonal surface water and groundwater data. The dataset underpins:
    - The application of specific surface water and groundwater trigger values which will be adopted in future water planning stage (i.e. LWMS and UWMP(s)) on advice from regulatory authorities (i.e. DBCA, DWER and the City of Kalamunda).
    - Provides evidence on the performance of the management measures.
    - Agreed triggers for the implementation of adaptive management measures in agreement with the regulatory authorities (i.e. DBCA, DWER and the City of Kalamunda).
    - Reporting to regulatory authorities (i.e. DWER, DBCA and the City of Kalamunda).
  - Advice/feedback from regulatory authorities (i.e. DWER, DBCA and the City of Kalamunda) into the LWMS, and subsequent UWMP(s) inclusive of the following elements:
    - Surface and groundwater monitoring data and monitoring program
    - Geotechnical dataset
    - Water values triggers
    - Surface water modelling (completed as a component of the LWMS)
    - Nutrient modelling (UNDO model)
    - Climate change assessment
    - Biofiltration basin location
    - Adaptive management framework
  - Maintaining the pre-development groundwater recharge and groundwater flow direction.
  - Attenuation of stormwater flow events (in accordance with stormwater modelling) and DWER stormwater management objectives) in bioretention basins designed to align with pre-development flows, facilitate infiltration into the Superficial Aquifer and protect downstream infrastructure.

Inland Waters Mitigation Hierarchy: Assessment and Proposed Actions
▪ Adopting flexible infrastructure arrangements within stormwater bioretention basins with the objective of enabling water flow adjustments to downstream environmental needs (i.e. the GBSW area) if required to address the impacts from climate change. The bioretention drainage basin design will be subject to review from DWER in consultation with DBCA and City of Kalamunda. ▪ Avoid significant imported of fill that could potentially alter catchment hydrology. ▪ Utilisation of reticulated scheme water and wastewater. • Other corresponding management plans which would be triggered at subdivision include: ▪ CEMP. ▪ ASS/contamination investigation and management, if applicable.

6.6 Predicted Outcome

Following implementation of the proposed mitigation measures, the predicated outcomes for inland waters include:

- Post development the groundwater quantity flowing towards the GBSW will be consistent with the pre-development flow.
- The urban development of the site will result in a net increase in surface water and groundwater. This is attributable to the increased areas of impermeable surface and removal of pasture and/or vegetated areas that will likely occur because of urbanisation within the site.
- This increase in water recharge into the Superficial Aquifer will assist (in combination with the DWMS stormwater management approach) to maintain the pre-development conditions
- Maintaining the existing hydrological regime and maintain existing groundwater flows post development.
- Accordingly, post-development groundwater flows will be comparable with pre-development conditions and will continue to flow radially away from the groundwater mound flowing north-west flowing south-east and away from the GBSW area.
- Further, the risk(s) post development to the Superficial Aquifer is not considered significant to the existing groundwater cycles that it would result in impacts to significant wetlands and waterways within the GBSW due to:
    - Groundwater flow post development will be in alignment with pre-development flow direction and will move radially away from the groundwater mound with dominant flows towards the north-west to flowing south-east and away from the GBSW area.
    - The recharge flow is within the deeper Superficial Aquifer (i.e. not the shallow perched water table).
- The GBSW is situated atop of the alluvial Pinjarra Plain which is characterised by soils of the Guildford Formation. Within areas of the GBSW, the Guildford Formation clay form layers a complex sequence of clay lenses that are laterally and vertically varied which form a low permeable barrier between the perched water table, wetlands, and the Superficial Aquifer.
- Any potential interaction between the Superficial Aquifer and the perched groundwater table within the GBSW is unlikely to be spatially unform across the GBSW (or the interaction is possibly limited to minor leakage through heavy clay layers).
- The Wattle Grove South DWMS (Hyd2o 2024) promotes an adaptive management approach for the site which is underpinned by the continued implementation of the current groundwater and surface water monitoring program.

- The monitoring program and reporting framework encapsulates monitoring of the Superficial Aquifer groundwater levels and quality (near the turf farm and the GBSW). This will enable:
  - Comparative and ongoing review of seasonal groundwater contours and flow direction pre-and post- development
  - The influence of the groundwater mound post development.
  - Comparative and ongoing review of groundwater quality.
- There will not be any measurable impacts to the existing Completely Degraded REWs (UFI 8037 and UFI 15257). Portions of the former wetland areas will be integrated into POS and stormwater bioretention basin areas.
- The two CCWs (UFI 8026 and UFI 8027) and the portion of REW (UFI 15257) within Lot 501 will be retained along with the Boundary Road reserve.

Based on the above, and the application of the inland waters' mitigation management measures in accordance with the Better urban water management guidelines (WAPC 2008b) and the Environmental Conditions (Appendix 2) it is expected that the proposal can continue to meet the EPA's objective for Inland Waters.

7 Flora and Vegetation

7.1 EPA Definition and Objective

For the purposes of EIA, the EPA defines flora as native vascular plants. Vegetation is defined as groupings of different flora patterned across the landscape that occur in response to environmental conditions (EPA 2016a).

The EPA objective is to protect flora and vegetation so that biological diversity and ecological integrity are maintained (EPA 2021).

7.2 Key Policies and Guidance

Relevant policy and guidance documents for vegetation and flora, which have informed site-specific investigations and/or have been used to assess potential impacts, include:

- Environmental Factor Guideline – Flora and Vegetation (EPA 2016a)
- Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016b)
- Guidance Statement No. 33 – Environmental Guidance for Planning and Development (EPA 2008)
- Methods for Survey and Identification of Western Australian Threatened Ecological Communities (DBCA 2023)
- State Planning Policy 2.8 Bushland Policy for the Perth Metropolitan Region (WAPC 2010)
- State Planning Policy 3.7 Planning in Bushfire Prone Areas (WAPC 2024a)
- Local Biodiversity Strategy 2023 – 2043 (City of Kalamunda 2023a)
- Urban Forest Strategy 2023 – 2043 (City of Kalamunda 2023b)
- Public Open Space Strategy (City of Kalamunda 2018a)
- Local Planning Policy 32 – Public Open Space (City of Kalamunda 2018b)

7.3 Receiving Environment

7.3.1 Studies and Investigations

Initial site surveys and assessment for flora, vegetation and fauna were conducted by AECOM (2020) across the site as part of a consideration of the broader Wattle Grove (South) locality. AECOM undertook an ecological spring survey, incorporating flora and vegetation in October 2019 (AECOM 2020). The survey recorded data from twelve quadrats and eight relevés, covering a broader area of the Wattle Grove locality than the site.

The AECOM survey did not survey every allotment within the site and has been augmented by the further survey work undertaken by JBS&G (2024) as part of the MRS amendment for the site. JBS&G undertook the following supplementary surveys of the site during 2021 and 2022:

- Tree survey (February 2021): Habitat tree survey of various lots and the Victoria Road reserve.
- Targeted flora survey (August 2021): *Drakaea elastica* on Lot 254 Victoria Road
- Supplementary vegetation and flora assessment (October 2021): Various lots
- Reconnaissance vegetation and flora assessment (January 2022): Various lots, including from lot boundaries

- Further reconnaissance vegetation and flora assessment of targeted lots (October 2022)
- Reconnaissance vegetation and flora survey of Lot 54 Victoria Road (May 2025).

JBS&G (2024) drafted an ecological memo which provides an overview of the above flora, vegetation and fauna surveys and assessment that have been undertaken within the structure plan area (Appendix 5).

Plantecology Consulting (2024) (Appendix 6) undertook the numerical analysis and assignment of AECOM (2020) and JBS&G (2024) plot data to existing Floristic Community Types (FCT) of the Swan Coast Plain and assigned the probable FCTs within the structure plan area. This FCT analysis was done in accordance with the methods outlined in Methods for Survey and Identification in Western Australian Threatened Ecological Communities (DBCA 2023).

Plantecology Consulting (2025) (Appendix 7) undertook a reconnaissance flora and vegetation survey of Lot 54 Victoria Road on 27 May 2025 to intercept the flowering period of the Threatened species *Conospermum undulatum* and the Priority 3 taxon *Isopogon autumnalis*, both of which have been known to occur in the wider Wattle Grove area.

Plate 7-1 presents the combined survey effort by AECOM, JBS&G and Plantecology within the site, which were done in accordance with EPA (2016b) Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment.

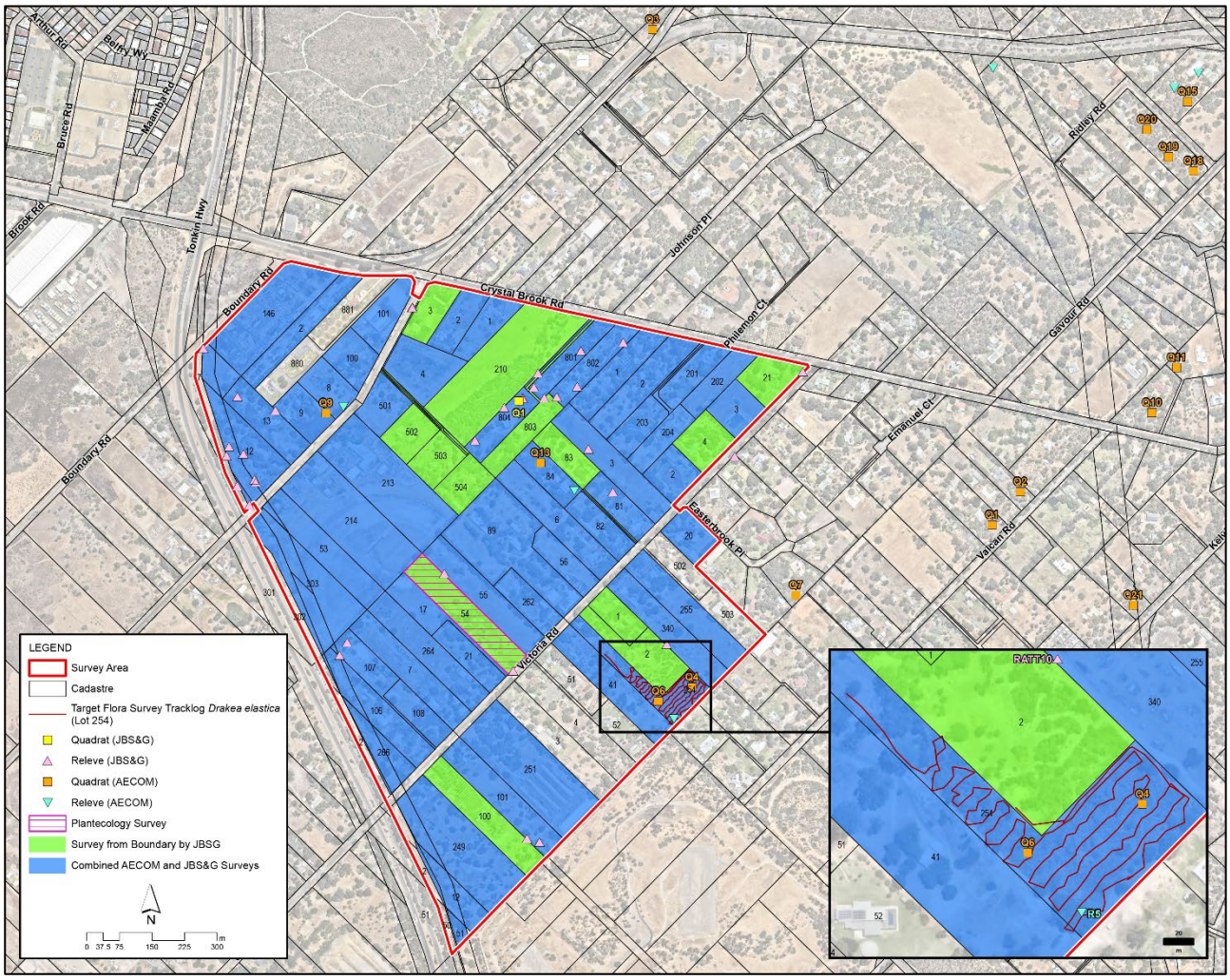


Plate 7-1: Lots surveyed within the structure plan area

A total of eight lots within the site were unable to be surveyed and 12 lots were surveyed based on observations made from the fence line of adjacent lots and road reserve, so there may be some limitations with the survey data that has been collected for these lots.

Notwithstanding the above, the majority of the site (~92%) has been subject to some form of an ecological assessment, and consequently, the ecological values of the area are well understood. The survey efforts have found that vegetation within the site is predominantly cleared, and now consists primarily of lawns/ paddocks, planted trees, garden beds and fragmented areas of scattered native trees, with some small discrete areas of remnant native vegetation ranging from Degraded to Excellent condition.

To ensure that any limitations in the flora and vegetation survey data collected to date does not compromise future planning decisions, any future subdivision and development application within the structure plan area for a lot that has not already been subject to survey, will be accompanied by a suitable flora and vegetation survey undertaken in accordance with current EPA policy and guidelines. The requirement for this flora and vegetation survey is highlighted as a provision in the structure plan documentation, under Part 1 implementation.

Undertaking the required flora and vegetation surveys will ensure any conservation significant flora and/or vegetation within these currently unsurveyed lots is identified and appropriately avoided and mitigated as part of the assessment and determination of all future subdivision and development proposals for the unsurveyed lots and managed through subdivision or development conditions of approval.

7.3.2 IBRA Region

The Interim Biogeographic Regionalisation for Australia (IBRA) defines 89 regions based on climate, geology, landforms and characteristic vegetation and fauna (DCCEEW 2022). The site is located within the Perth sub-region (SW02) of the Swan Coastal Plain, under the Interim Biogeographic Regionalisation of Australia (IBRA).

7.3.2.1 Vegetation Associations

Vegetation occurring within the region was initially mapped at a broad scale (1:1000 000) by Beard during the 1970s. This dataset formed the basis of several regional mapping systems, including the biogeographic region dataset for Western Australia and the physiographic regions defined by Beard (1975). The vegetation for the site has been identified as belonging to two sub-associations of the Pinjarra vegetation system (Beard et al. 2013), as shown in Table 7-1 and Plate 7-2.

Most of the Pinjarra vegetation system on the Swan Coastal Plain has been historically cleared. Table 7-1 shows that of the two sub-associations of the Pinjarra system that are representative of the site, there is only 10,583 ha in total remaining on the Swan Coastal Plain. This accounts for only 7% of the pre-European extent of these two sub-associations, in aggregate. This is largely consistent with the extent of pre-European vegetation clearing that has historically occurred within the site. The area has been significantly cleared and now consists primarily of lawns/paddocks, planted trees and garden beds, with intact remnant native vegetation (in Good or better condition) making up approximately 2.9% of the site.

Table 7-1: Vegetation system associations and extents (GoWA 2019a)

Region	Vegetation system association	Pre-European extent	Current extent	Current extent (DBCA management lands)
Western Australia (Report 1b)	Pinjarra 3.2	15,738.25 ha	1,844.72 ha (11.72%)	271.60 ha (1.73%)
	Pinjarra 968.3	137,184.58 ha	9,172.10 ha (6.69%)	2,009.62 ha (1.46%)
Swan Coastal Plain (IBRA Region) (Report 2b)	Pinjarra 3.2	13,738.98 ha	1,586.73 ha (11.55%)	262.92 ha (1.91%)
	Pinjarra 968.3	135,999.02 ha	8,996.33 ha (6.61%)	1,948.40 (1.43%)
Perth (IBRA Subregion) (Report 3b)	Pinjarra 3.2	13,738.98 ha	1,586.73 ha (11.55%)	262.92 ha (1.91%)
	Pinjarra 968.3	135,999.02 ha	8,996.33 ha (6.61%)	1,948.40 ha (1.43%)

Region	Vegetation system association	Pre-European extent	Current extent	Current extent (DBCA management lands)
City of Kalamunda (Report 4b)	Pinjarra 3.2	265.40 ha	36.09 ha (13.60%)	-
	Pinjarra 968.3	487.50 ha	74.76 ha (15.33%)	1.19 ha (0.24%)

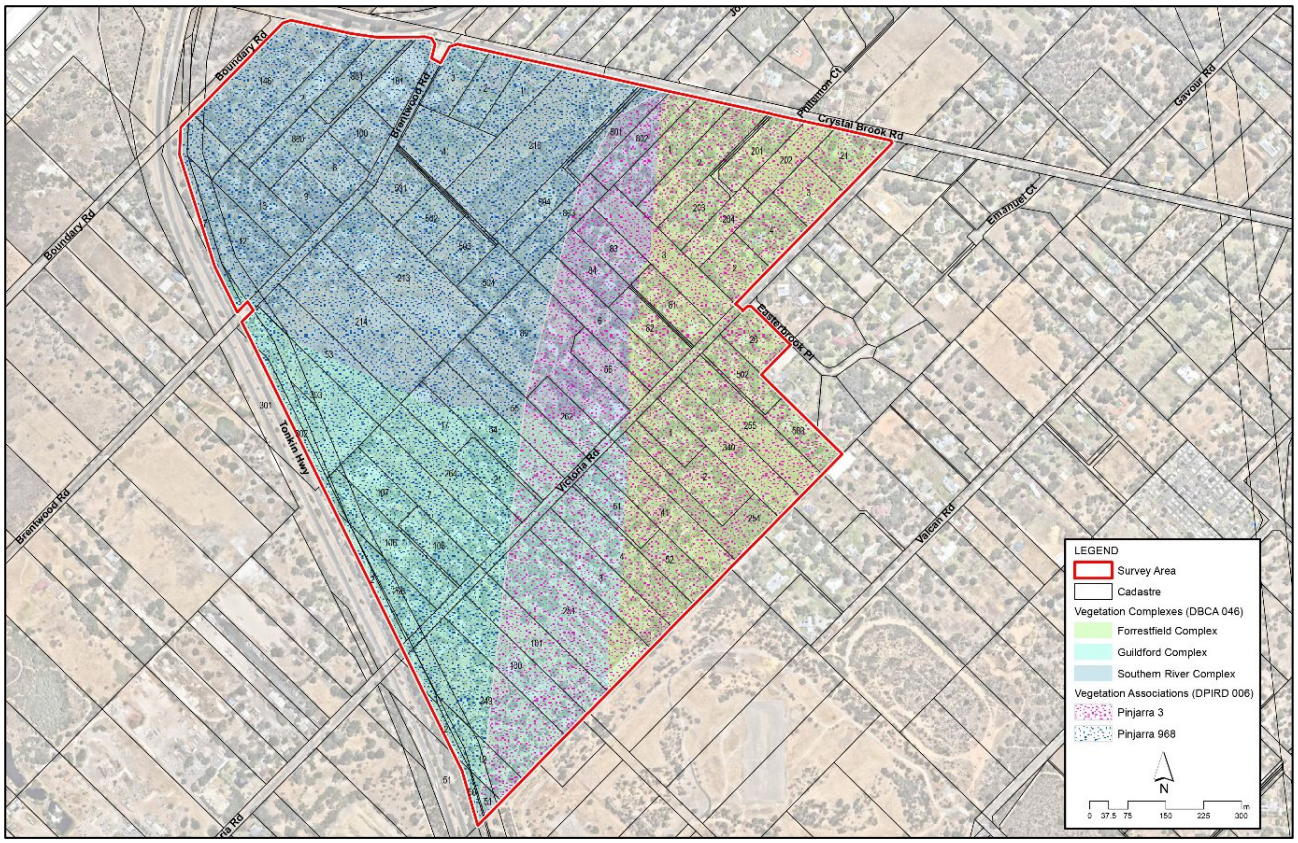


Plate 7-2: Vegetation associations and complexes

7.3.2.2 Vegetation Complexes

Vegetation complex mapping of the Swan Coastal Plain was completed by Heddle et al. (1980) and considers soils, landforms and floristics. The site straddles the Forrestfield, Guildford, and Southern River Complexes on the Ridge Hill Shelf, fluviatile deposits (deposited by watercourses) and aeolian deposits (wind-driven deposits) as shown on Plate 7-2.

The Forrestfield Complex is dominated by open forest or woodland of Marri (*Corymbia calophylla*), Wandoo (*Eucalyptus wandoo*) and Jarrah (*Eucalyptus marginata*) on heavier, gravelly soils, as well as Jarrah, Marri, and Sheoak (*Allocasuarina* spp.) on sandier soils. The Guildford Complex is dominated by open forest to woodland of Marri, Wandoo, and Jarrah, with areas of just Wandoo. The Southern River Complex is an open woodland of Marri, Jarrah, and Banksia. Woodlands of flooded gum (*Eucalyptus rudis*) and Swamp Paperbark (*Melaleuca raphiophylla*) occur in wet areas in all three complexes (Heddle et al. 1980).

Most of the Guildford Complex has been historically cleared with less than 10% remaining (Table 7-2) on the Swan Coastal Plain and within the Perth Metropolitan Region, which again is largely consistent with the pre-European vegetation clearing that has taken place within the site and consequently, there is no intact remnant vegetation within the area mapped as Guildford Complex.

Table 7-2: Vegetation complexes and extents (GoWA 2019b)

Region	Vegetation complex	Pre-European extent	Current extent	Current extent protected for conservation
Swan Coastal Plain (IBRA Region)	Forrestfield	22,812.92 ha	2,803.36 ha (12.29)	359.71 ha (1.58%)
	Guildford	90,513.13 ha	4,607.91 ha (5.09)	297.86 (0.33%)
	Southern River	58,781.49 ha	10,832.18 ha (18.43)	480.48 ha (2.42%)
Perth (IBRA Subregion)	Forrestfield	13,332.94 ha	1,396.26 ha (10.47)	226.23 ha (1.70%)
	Guildford	24,300.38 ha	1,219.79 ha (5.02)	230.66 ha (0.95%)
	Southern River	31,146.06 ha	4,359.94 ha (14.00)	21.98 ha (0.49%)
City of Kalamunda	Forrestfield	1,924.36 ha	209.26 ha (10.87)	-
	Guildford	77.51 ha	8.47 ha (10.93)	-
	Southern River	2,317.00 ha	224.15 ha (9.67)	-

The National Objectives and Targets for Biodiversity Conservation 2001-2005 recognises that retention of 30% or more of the pre-clearing extent of each ecological community is necessary if Australia's biological diversity is to be protected (ANECC 2000). However, State Planning Policy 2.8 – Bushland policy for the Perth Metropolitan Region (WAPC 2010) and EPA Guidance Statement 33 (EPA 2008) recognises the Perth Metropolitan Region as a 'constrained area' and establishes a target of 10% retention for vegetation complexes.

As can be seen from the remaining extents presented above for the vegetation associations and complexes within the site, all of them are well below the national target of 30% retention for vegetation. Regarding the modified objective to achieve a 10% target within constrained areas, there are those that exceed the 10% target and some that fall below the 10% depending on the IBRA region, IBRA subregion and local government locality (Table 7-1 and Table 7-2). It is apparent that all of the above vegetation associations and complexes are poorly represented in existing conservation reserves across the IBRA region, IBRA subregion and local government locality.

Again, this is largely consistent with the extent of pre-European vegetation clearing that has historically occurred within the site, which is now highly modified and consists primarily of lawns/paddocks, planted trees and garden beds. The small areas of remnant native vegetation (in Good or better condition) make up approximately 2.9% of the total site area.

7.3.3 Vegetation

7.3.3.1 Vegetation communities

Six native vegetation communities were described and mapped by AECOM (2020) for the broader Wattle Grove South area. Of these, three occur within the site. These communities fall into the broad category of Banksia Woodlands and *Eucalyptus marginata* Woodlands (AECOM 2020). The native vegetation communities within the site are mapped in Figure 5 and presented in Table 7-3.

Five vegetation communities (representing three native vegetation and two highly modified or planted) have been mapped consistent with those identified in the AECOM (2020) survey. Areas not subject to a site survey were extrapolated by JBS&G (2024) based on adjacent ecological values, review of aerial imagery and where possible visual assessment from adjoining lots and road reserves.

Native vegetation on Lots 8 and 9 Brentwood Road was cleared following the surveys undertaken by AECOM (2020) and JBS&G (2024), which mapped the vegetation as BmXpEc and ranged from Degraded to Very Good condition. Figure 5 reflects the recent clearing and illustrates the current extent of BmXpEc. Table 7-4 reflects

the updated vegetation community areas and percentages for BmXpEc and Cleared Land as a result of this clearing and revision to the vegetation mapping. Similarly, the vegetation condition mapping (Figure 6) has been amended to reflect the areas cleared within Lots 8 and 9. Table 7-5 reflects the revised areas and percentages for vegetation condition.

As a result of these amendments, the areas provided in Table 7-4 and Table 7-5 will have a minor variation to the areas presented in JBS&G (2024) Technical Memo (Appendix 5).

Table 7-3: Vegetation community descriptions

Description (ACEOM 2020)	Photograph (AECOM 2020)
Remnant native vegetation	
BaEpPf Banksia Woodland *Banksia attenuata*, *Banksia menziesii* and *Eucalyptus todtiana* low open woodland over *Eremaea pauciflora* var. *pauciflora*, *Hibbertia hypericoides* and *Allocasuarina humilis* low shrubland over *Phlebocarya filifolia*, *Mesomelaena pseudostygia* and *Lepidosperma leptostachyum* low sedgeland. Supports the Threatened *Conospermum undulatum* and Priority 3 *Isopogon autumnalis*.	
BmXpEc Banksia Woodland *Banksia menziesii*, *Allocasuarina fraseriana* and *Eucalyptus todtiana* low open woodland over *Xanthorrhoea preissii*, *Eremaea pauciflora* var. *pauciflora* and *Stirlingia latifolia* low open shrubland over *Ehrharta calycina**, *Dasypogon bromeliifolius* and *Anigozanthos manglesii* subsp. *manglesii* mixed grass and forbland.	
EmMpLp *Eucalyptus marginata* Woodland *Eucalyptus marginata* subsp. *marginata* and *Allocasuarina fraseriana* mid open forest over *Mesomelaena pseudostygia* and *Tetraria octandra* low sedgeland with *Lomandra preissii*, *Tricoryne elatior* and *Dampiera linearis* low open forbland.	
Highly modified vegetation	
Planted Planted and maintained gardens Condition considered Completely Degraded	NA
Trees Scattered trees, includes both native and introduced. Condition considered Completely Degraded.	NA

The vegetation community extents within the site, which include the three native vegetation communities, as well as two other highly modified vegetation communities described as ‘Trees’ and ‘Planted and Maintained Gardens’, are provided in Table 7-4. Areas that have been subject to clearing or development have been mapped as ‘Cleared’ and include the recent clearing on Lots 8 and 9. As a result, the areas provided in the table below will have a minor variation to the areas presented in JBS&G (2024) ecological memo.

Table 7-4: Vegetation community and extents

Vegetation community	Area	Percentage of total
Remnant native vegetation		
BaEpPf	4.23 ha	3.37%
BmXpEc	0.28 ha	0.22%
EmMpLp	0.05 ha	0.04%
Total Remnant Native Vegetation	4.56 ha	3.63%
Highly modified vegetation		
Planted and Maintained Gardens	2.59 ha	2.06%
Scattered Trees	26.94 ha	21.45%
Other		
Cleared Land	91.49 ha	72.85%
Total	**125.58 ha**	**100%**

7.3.3.2 Vegetation Condition

Vegetation condition within the site varies from Excellent to Completely Degraded as shown in Table 7-5 and mapped in Figure 6. As previously advised, the areas provided in the table below will have a minor variation to the areas presented in JBS&G (2024) ecological memo.

Table 7-5: Vegetation condition and extents

Vegetation Condition	Area	Percentage of total
Remnant native vegetation		
Excellent	3.41 ha	2.72%
Very Good	0.05 ha	0.04%
Good	0.15 ha	0.12%
Degraded	0.13 ha	0.11%
Completely Degraded	0.82 ha	0.65%
Highly modified vegetation		
Completely Degraded	23.93 ha	19.05%
Other		
Cleared	97.09 ha	77.31%
Total	**125.58 ha**	**100.00%**

The vegetation condition within the site is predominantly Completely Degraded and Cleared, which is characteristic of the highly modified environment and current land uses within the area, comprising a mixture of residential and semi-rural living, composite business along Welshpool Road and horticulture. A former turf farm was located on Lots 303, 53, 213 and 214 Brentwood Road. There is also a former poultry farm located at Lot 251 within the south-east portion of the area, which ceased operations over a decade ago. The DBNGP also runs along the western edge of the area, adjacent to Tonkin Highway. The majority of semi-rural residences comprise cleared grasslands/paddocks, lawn and maintained gardens.

Due to the historical and current land use, only 2.72% of the area comprises vegetation in Excellent condition, and 0.16% of the area contains vegetation in Good or Very Good condition.

7.3.3.3 Floristic Community Types

The FCT analysis undertaken by AECOM (2020) used the Keighery (2012) dataset to assign likely FCTs, whereas JBS&G (2024) used the Keighery et al, (2020) to infer likely FCTs. Neither analysed the quadrat species data against the original Gibson et al. (1994) dataset which is a key component of the DBCA (2023) Methods for Survey and Identification of Western Australian Threatened Ecological Communities.

Subsequently, an FCT analysis was undertaken by Plantecology (2024) (Appendix 6) in accordance with DBCA (2024). The FCT assignment used the Gibson et al. (1994) and Keighery et al. (2012) datasets, and assignment was done by minimum dissimilarity between the AECOM and JBS&G plot data and plots from two regional datasets (nearest neighbour) (Plantecology 2024).

The FCT analysis incorporated relevant quadrats from the broader AECOM (2020) study area. Although some of the quadrats themselves were outside of the site and within the wider Wattle Grove area (Plate 7-1), using these quadrats enabled a better and more robust analysis of FCT. All but one of these quadrats were surveyed by AECOM (2020), with the other quadrat surveyed by JBS&G (2024).

Table 7-6 presents the summary results of the FCT analysis and shades in grey the following quadrats, which are located within the site (Plate 7-1):

- AECOM Quadrat 4 (Q4) – located within Lot 254 Victoria Road
- AECOM Quadrat 6 (Q6) – located within Lot 254 Victoria Road
- AECOM Quadrat 9 (Q9) – previously located in Lot 9 Brentwood Road but vegetation has now been cleared
- AECOM Quadrat 13 (Q13) – located within Lot 84 Victoria Road
- JBS&G Quadrat 1 (S01) – located within Lot 804 Crystal Brood Road and represents part of a larger patch of vegetation located on Lot 210 that could not be directly accessed for survey purposes.

Table 7-6: Floristic community type assignment summary (Plantecology 2024)

Quadrat / Plot	Assignment to Gibson et al. (1994)	Assignment to Keighery et al. (2012)	Nearest neighbour	Probable FCT
AECOM Q1 (outside)	3b	3b	20b	3b
AECOM Q4	20a	20a	20a	20a
AECOM Q6	20a	20a	20c	20a
AECOM Q7 (outside)	3b	3 / 20	3b	3b
AECOM Q9 (vegetation cleared)	20c	Undetermined	20c	20c
AECOM Q10 (outside)	3b	3b	3b	3b
AECOM Q11 (outside)	3b	3b	3b	3b
AECOM Q13	20a	20a	20a	20a
AECOM Q15 (outside)	3b	S09 / S16	20c	3b
AECOM Q18 (outside)	20c	20b	20b	20c
AECOM Q19 (outside)	20c	20c	20b	20c
AECOM Q20 (outside)	20c	Undetermined	20b	20c
JBSG_S01	20a	20a	20a	20a

To determine the probable FCTs and produce clearer and more consistent results, most weight was given assignment to the original Gibson et al. (1994) dataset (Plantecology 2024) (Appendix 6). Whereas

comparison to the Keighery et al. (2012) dataset was mostly similar there was more disruption to the original classification and therefore, a reduction in confidence of the results (Table 7-6). It should be noted that the least weight was given to the nearest neighbour assignments as these were less consistent with the analyses against the Gibson et al. (1994) and Keighery (2012) datasets.

Within the site, the probable FCTs assigned from the analysis undertaken by Plantecology (2024) include:

- FCT 20a *Banksia attenuata* woodlands over species rich dense shrublands (FCT 20a) State TEC – Critically Endangered (BC Act) (FCT 20a)
- FCT 20c Shrublands and woodlands of the eastern side of the Swan Coastal Plain (FCT 20c) State TEC – Critically Endangered (BC Act) and Federal TEC – Endangered (EPBC Act)

Regarding the remaining patch of vegetation (BmXpEc) mapped within Lot 8, a targeted survey and FCT analysis of the flora and vegetation within this patch will be undertaken in accordance with DBCA (2024) Methods for Survey and Identification of Western Australian Threatened Ecological Communities, prior to any future subdivision application being lodged over this patch of vegetation to verify if it represents FCT 20c and therefore, require retention and rehabilitation in accordance with the Environmental Condition (Appendix 2). Further, the requirement for this flora and vegetation survey is highlighted as a provision in the structure plan documentation for Precinct A, under Part 1 implementation.

7.3.3.4 Threatened ecological communities

JBS&G (2024) undertook a desktop assessment which identified 6 TECs listed under the EPBC Act and 11 TECs listed under the BC Act and 3 Priority Ecological Communities (PECs) listed by the DBCA as having a likely or greater chance of occurrence in the site (refer to Table 2-2 of Appendix 5). Of these, the following have been recorded within the site:

- Banksia Woodlands of the Swan Coastal Plain ecological community Federal TEC – Endangered (EPBC Act) and State PEC (Priority 3)
- FCT 20a *Banksia attenuata* woodlands over species rich dense shrublands (FCT 20a) State TEC – Critically Endangered (BC Act) (FCT 20a)
- FCT 20c Shrublands and woodlands of the eastern side of the Swan Coastal Plain (FCT 20c) State TEC – Critically Endangered (BC Act) and Federal TEC – Endangered (EPBC Act)

Native vegetation was mapped over 4.56 ha within the site. The FCT analysis undertaken by Plantecology (2024) (Appendix 6) and the Banksia Woodlands Assessment undertaken by JBS&G (2024) (Appendix 5) was used to determine the presence of any conservation-significant ecological communities within the four major vegetation patches (Figure 7) occurring within the site. Three of these include TECs (Patches 1, 2 and 4), and another one (Patch 3) previously included TEC vegetation that has been recently cleared:

- Patch 1, contains:
  - 1.8 ha of Banksia Woodland – BaEpPf across Lots 254 and Lot 2 Victoria Road
  - BaEpPf is assigned as probably being FCT 20a State TEC – Critically Endangered (BC Act)
  - Banksia Woodlands of the Swan Coastal Plain TEC
  - Supports occurrences of threatened flora species *Conospermum undulatum* (Vulnerable) and priority flora *Isopogon autumnalis* (Priority 3).
- Patch 2, contains:
  - 0.35 ha of Banksia Woodland – BaEpPf
  - BaEpPf is assigned as probably being FCT 20a State TEC – Critically Endangered (BC Act)
  - Banksia Woodlands of the Swan Coastal Plain TEC

- Supports occurrences of threatened flora species *Conospermum undulatum* (Vulnerable) and priority flora *Isopogon autumnalis* (Priority 3).

- Patch 3, previously contained:
  - 0.05 ha of Banksia Woodland – BmXpEc, use to comprise of approximately 0.3 ha of BmXpEc
  - BmXpEc assigned as probably being FCT 20c State TEC – Critically Endangered (BC Act) and Federal TEC – Endangered (EPBC Act)
- Patch 4, contains:
  - 2.07 ha of Banksia Woodland – BaEpPf
  - BaEpPf is assigned as probably being FCT 20a State TEC – Critically Endangered (BC Act)
  - Banksia Woodlands of the Swan Coastal Plain TEC
  - Supports occurrences of threatened flora species *Conospermum undulatum* (Vulnerable) and priority flora *Isopogon autumnalis* (Priority 3).

7.3.4 Flora

7.3.4.1 Conservation Significant Flora

AECOM (2020) recorded 165 native vascular flora taxa from the broader survey area and 21 introduced flora taxa, many of which are not expected to occur within the site.

JBS&G (2024) undertook a desktop assessment for both Threatened and Priority flora, and based on their assessment and general habitat requirements and distribution, 20 Threatened and 61 Priority flora species were considered to have potential to occur within the site (refer to Table 2-1 of Appendix 5), of which the following two conservation significant flora taxa have been recorded concentrated in two localised areas within the site (Figure 8):

- *Conospermum undulatum* (T) – Vulnerable (BC Act and EPBC Act)
- *Isopogon autumnalis* (P3), previously named *Isopogon drummondii*.

Conospermum undulatum (waxy-leaved smokebush) is an erect shrub which grows to 1.5 m height and is characterised by its fibrous, longitudinally fissured stems and wide leaves with wavy margins. It is listed as Vulnerable under the BC Act and EPBC Act and is ranked as Vulnerable (VU) under World Conservation Union (IUCN 1994) Red List criterion B1+2c, with its main threats being listed as further land clearing, poor habitat quality, road and firebreak maintenance, inappropriate fire regimes, weeds, recreational activities and rabbit grazing (DEC 2009). It occurs on sand and sandy clay soils, often over laterite, on flat or gently sloping sites between the Swan and Canning Rivers. A few records are from slightly swampy habitat. Habitat critical to the survival of *Conospermum undulatum* includes the area of occupancy of important populations and areas of similar habitat surrounding important populations (DEC 2009). Important populations of *Conospermum undulatum* are listed in the species' recovery plan.

Isopogon autumnalis is an erect shrub growing to 1 m height with cream-yellow flowers and mostly terete leaves (Rye and MacFarlane 2019). It is listed as a Priority 3 taxon by DBCA. It is known from a large range extending from the southern Lesueur Sandplains through the Swan Coastal Plain and Dandaragan Plateau to the Northern Jarrah Forrest. It prefers white, grey or yellow sand, often over laterite. It was previously known as *Isopogon drummondii* but was renamed in 2019 due to lack of a type specimen and descriptions being based on cultivated specimens (Rye and MacFarlane 2019).

The AECOM (2020) field survey was undertaken at an appropriate time to identify conservation significant orchid species if present, however, the survey only gained access to approximately 50% of lots and recognised that there is potential for conservation significant flora taxa to have been missed if present. JBS&G (2024) conducted flora and vegetation surveys, incorporating both previously surveyed and unsurveyed lots within the site. JBS&G recorded observations of conservation significant flora from the boundary of Lots 210 and

801. Observations of Lot 210 and Lot 801 noted the presence of *Conospermum undulatum* (T) and *Isopogon autumnalis* (P3).

Drakaea elastica is a Threatened orchid species that is known to grown within areas of Banksia Woodlands. It is listed as Critically Endangered under the BC Act and Endangered under the EPBC Act. On 25 August 2021, a targeted survey was conducted on Lot 254 Victoria Road, the only accessible site with Banksia Woodlands at the time. The ecologist traversed the area at 10 m intervals (Plate 7-1), observing the ground for *Drakaea elastica* leaves, but none were found (JBS&G 2024).

The dense understory and deep leaf litter (~20 cm) reduced light penetration and visibility, making it unlikely for *Drakaea elastica* to thrive or be detected (JBS&G 2024). Despite the absence of this particular orchid, *Conospermum undulatum* and *Isopogon autumnalis* were observed in abundance within Lot 254 and the adjacent Lot 2, indicating the ecological value of the area.

7.3.4.2 Potential survey limitations for conservation significant flora

To date a total of 104 individuals of conservation significant flora have been identified during surveys of the site, including (Figure 8):

- 84 *Conospermum undulatum* (T).
- 20 *Isopogon autumnalis* (P3).

Both species are known to occur within fragmented remnant bushland; however, on review of recent aerial imagery, it is evident that:

- of the eight lots that have not been surveyed to date, seven of them (Lots 3, 51, 52, 502 and 503 Victoria Road and Lots 880 and 881 Welshpool Road East) are predominantly cleared with little to no extant trees or vegetation. It is therefore considered highly unlikely that conservation significant flora will be present on these landholdings.
- due to the recent clearing that took place on Lots 8 and 9 Brentwood Road, it is considered unlikely that the two occurrences of *Conospermum undulatum* located on these lots remain.
- within Lots 802, 803 and 804 there are 3 occurrences of *Conospermum undulatum* and 3 occurrences of *Isopogon autumnalis* that are located either adjacent to the boundary of the proposed Conservation area or may have been historically cleared.

The one remaining unsurveyed lot (Lot 4 (No.95) Victoria Road) is situated in the vicinity of recorded locations for conservation significant flora; however, the scattered trees present on Lot 4 have been noticeably disturbed so it is also considered unlikely there will be conservation significant flora on this lot.

Of the 12 lots that have been subject to a survey from the fence line, five lots (Lots 3 and 21 Crystal Brook Road, 502 and 503 Brentwood Road and 100 Victoria Road) have been predominantly cleared and contain little to no extant trees or vegetation. The presence of conservation significant flora on these lots is also considered to be highly unlikely.

Five other lots that were surveyed from the fence line (Lot 803 Crystal Brook Road, Lots 1, 4 (No.36) and 83 Victoria Road and 504 Brentwood Road) are within the vicinity of recorded locations for conservation significant flora; however, the scattered trees present on these lots have also been noticeably disturbed so the presence of conservation significant flora on these lots is considered unlikely.

The remaining two lots that were surveyed from the boundary are Lot 210 Crystal Brook Road and Lot 2 (No. 75) Victoria Road. During these surveys, *Conospermum undulatum* was visible and flowering in both lots and *Isopogon autumnalis* was also observed flowering in Lot 210. It is likely further individuals of these conservation significant flora will be identified when a full site survey is undertaken .

Notwithstanding, the remnant Banksia Woodlands on both Lot 210 Crystal Brook Road and Lot 2 (No. 75) Victoria Road will be retained for Conservation. Thereby, ensuring the protection of any *Conospermum undulatum*, *Isopogon autumnalis* and/or *Drakaea elastica* within these lots.

As previously advised in section 7.3.1, any future subdivision and development application for these lots will be accompanied by a suitable flora and vegetation field survey undertaken in accordance with current EPA policy and guidelines. The requirement for this flora and vegetation survey is highlighted as a provision in the structure plan documentation, under Part 1 implementation.

Undertaking the required flora and vegetation surveys will ensure any conservation significant flora within these currently unsurveyed lots is identified and appropriately avoided and mitigated as part of the assessment and determination of all future subdivision and development proposals for the unsurveyed lots and managed through subdivision or development conditions of approval.

The EPA (2025) advised that should future development propose significant impacts on the environmental values within the site (through an amendment to Local Structure Plan or future subdivision proposal), there may be requirement to refer the future proposal (i.e. subdivision) under section 38 of the EP Act to the EPA. Depending on the significance of the residual impacts, an Environmental Offset Plan may be required (EPA 2025). The requirement for an Environmental Offset Plan is highlighted as a as a provision in the structure plan documentation, under Part 1 implementation.

7.3.4.3 Introduced Flora

Two Declared Pest plants were identified by AECOM (2020) as occurring within the broader survey area, **Asparagus asparagoides* (bridal creeper) and **Rubus ulmifolius* (blackberry). AECOM (2020) did not include a location for these weed species, so it is not known whether AECOM identified them as occurring within the site. JBS&G (2024) recorded **Asparagus asparagoides* (bridal creeper) on Lot 254 Victoria Road, and also noted that Lot 801 is a significant source of weeds invading remnant vegetation on Lot 210, including but not limited to **Leptospermum laevigatum*. Plantecology (2025) recorded **Gomphocarpus fruticosus* (Narrowleaf cottonbush) on Lot 54 Victoria Road.

7.3.5 Conservation Areas and Bush Forever

State Planning Policy 2.8: Bushland Policy for the Perth Metropolitan Region (SPP 2.8) aims to provide a policy and implementation framework that ensures bushland protection and management matters throughout the Perth Metropolitan Region are adequately addressed and integrated with broader land use planning and decision-making (WAPC 2010). In accordance with SPP 2.8, scheme amendments and development proposals must recognise regionally significant bushland and outline methods by which they will avoid, minimise, and offset any likely adverse impacts on regionally significant bushland. SPP 2.8 predominantly deals with two distinct subjects, Bush Forever areas and local bushland.

There are no DBCA managed lands within the site, with the nearest conservation reserve being the GBSW, which is approximately 100 m west of the site boundary (Plate 7-3).

No Bush Forever sites occur within the site (Plate 7-3). The closest points of the nearest Bush Forever sites are approximately 100 m to the west on the opposite side of Tonkin Highway (Site 387, the Greater Brixton Street Wetlands) and approximately 90 m to the north-west on the opposite side of Welshpool Road East (Site 320, Hartfield Road Bushland) (Plate 7-3).

7.3.6 Regional Ecological Linkages

Ecological corridors have been identified in the Perth metropolitan region to limit the effects of fragmentation across areas of remnant bushland. In relation to the site, there is one regional ecological linkage located along the north-western perimeter of the site (Link ID: 40), which connects the GBSW and the Hartfield Road Bushland (Molloy, et.al. 2009). The small portion of the regional ecological linkage which falls within the site (specifically within portions of Lot 146 Welshpool Road East and Lot 12 Brentwood Road) has been extensively cleared of native vegetation and filled. An approved commercial landscape supply yard occurs within Lot 146 Welshpool Road East. Plate 7-3 Illustrates the regional ecological linkages in proximity to the site.

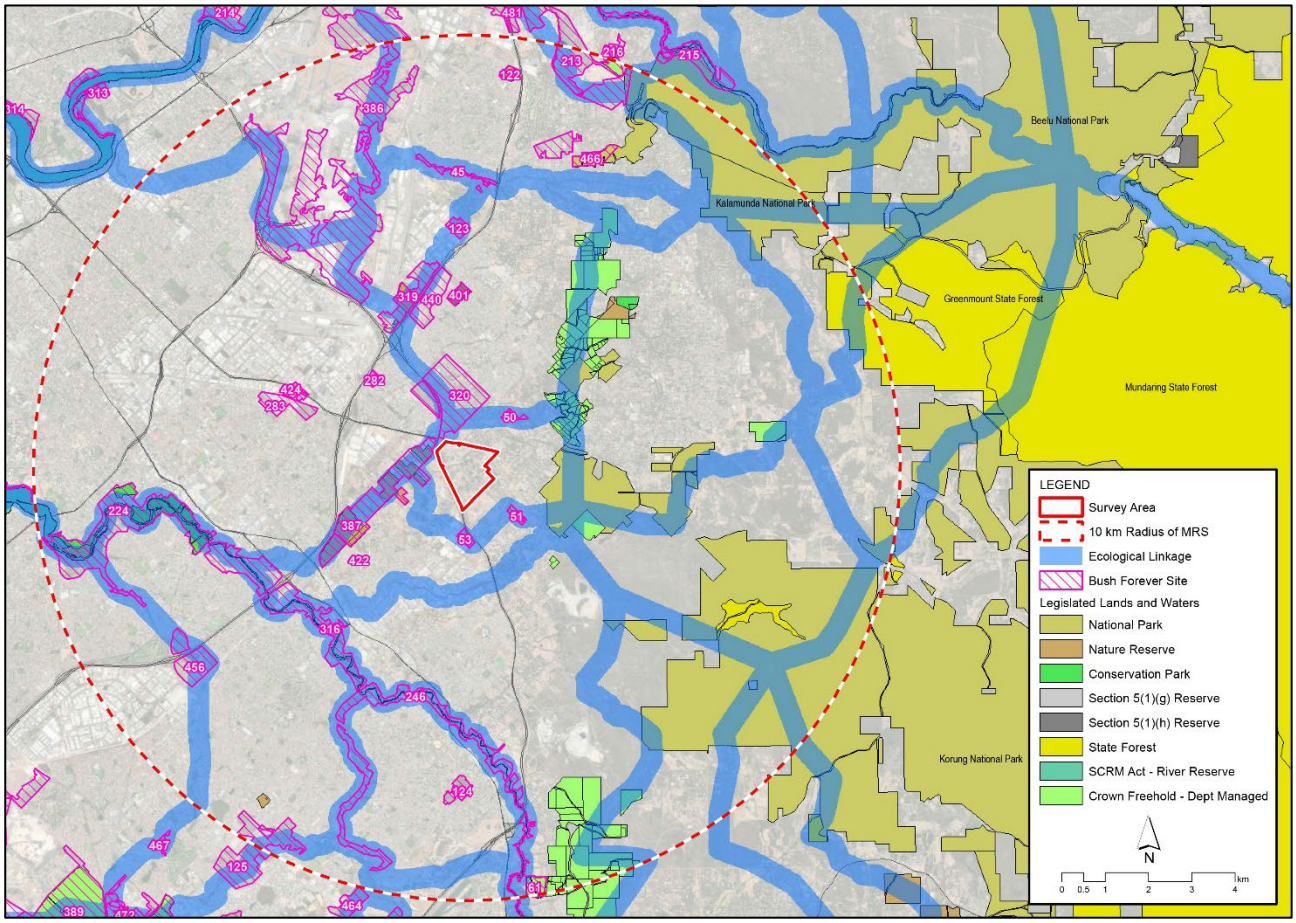


Plate 7-3: Conservation areas and regional ecological linkages

7.3.7 Environmentally Sensitive Areas

Environmentally sensitive areas (ESAs) are declared by the Minister for Environment under section 15b of the EP Act. ESAs are classes or areas of native vegetation where exemptions for clearing vegetation under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* do not apply.

Eight ESAs are mapped within the site according to the dataset available through DWER (2025a) Environment Online (Table 7-7 and Plate 7-4). Many of the ESAs mapped within the site are associated with the locations of historically recorded declared rare flora; however, based on surveys undertaken by AECOM (2020) many of these areas have since been cleared and the Threatened flora associated with the ESA boundary appear to be no longer present.

Table 7-7: Summary of ESAs within the site

Object ID	ESA purpose	Comment
8712	Within 50 m of CCW	Associated within the small area of mapped CCW on Lot 501 external to the site that is within/adjacent the proposed Tonkin Highway/Welshpool Road East intersection upgrade. Further, Lot 501 has historically been significantly altered including clearing of native vegetation and infilling of wetland areas to establish transport corridors and the construction (and maintenance) of DBGNP and Water Corporation pipeline easements.
17271	Within 50 m of CCW and	Associated with the small area of mapped CCW on Lot 501 external to the site. This CCW is within/adjacent to the proposed Tonkin Highway/Welshpool Road East intersection

Object ID	ESA purpose	Comment
	associated with TEC	upgrade. Lot 501 has historically been significantly altered including clearing of native vegetation and infilling of wetland areas to establish transport corridors and the construction (and maintenance) of DBNGP and Water Corporation pipeline easement. ESA is also associated with an inferred TEC associated with GBSW. The association between this wetland (or Lot 501) and the GBSW has been severed with the construction of the four lane Tonkin Highway and the construction (and maintenance) of DBNGP and Water Corporation pipeline easement. This CCW is located over 100 m from the GBSW separated by Tonkin Highway.
10050	Associated with TEC	Associated with TEC located within the mapped GBSW area which is located on the western side of Tonkin Highway and is more than 100 m west of the site however, a buffer area to the TEC falls within the north west corner of the site. Portions of this mapped ESA within the site have been significantly altered through historical clearing and associated semi-rural land uses which includes livestock paddocks and residential dwellings.
10045	Associated with TEC	Associated with TEC located on the western side of Tonkin Highway and is more than 400 m south of the site; however, a buffer area to the TEC slightly falls within the southernmost corner of the site.
11904 11907 11908	Threatened or Rare Flora	Associated with the historic records of a *Conospermum undulatum* in this location. This area has been significantly altered through historical clearing and associated semi-rural land uses which includes livestock paddocks and residential dwellings. There is no evidence of this flora being present at this location (within the site) from the AECOM (2020) flora and vegetation.
11905	Threatened or Rare Flora	Associated with the historic record of a *Conospermum undulatum* in this location. Remnant vegetation in the immediate area has been identified as locally significant vegetation and is proposed to be retained.

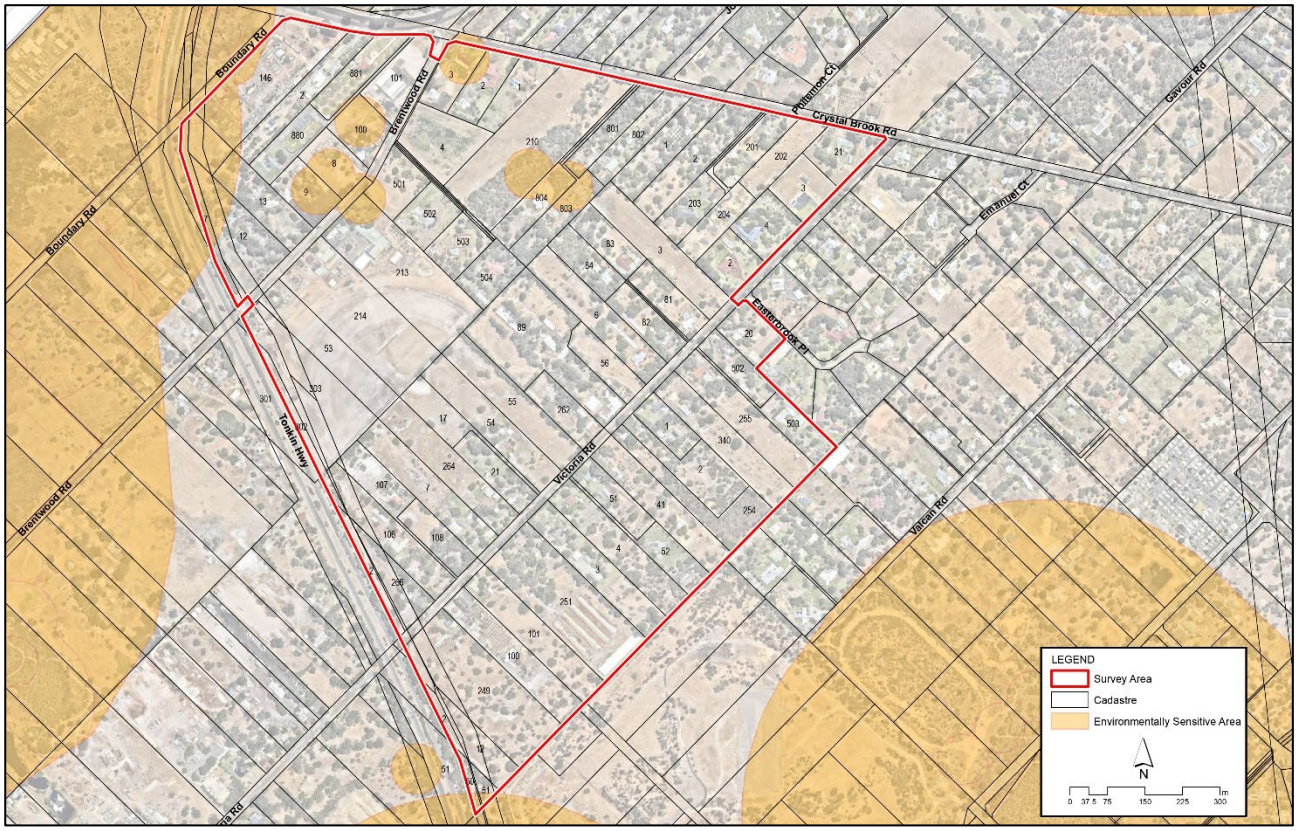


Plate 7-4: ESAs within the site (DWER 2025a)

7.3.8 Local Natural Areas

The City of Kalamunda (2023a) Local Biodiversity Strategy refer to Local Natural Areas (LNAs) as areas containing endemic species or ecological communities in a relatively natural state and are inferred as potentially having high biodiversity values. It also recognises LNAs as native vegetation, vegetated or open wetlands (lakes and swamps) and waterways (rivers, streams, creeks and estuaries), and seeks to retain, protect, manage, enhance and rehabilitate LNAs to improve the quality and quantity of biodiversity values (City of Kalamunda 2023a).

The City of Kalamunda (2023a) Local Biodiversity Strategy has mapped a number of LNAs within the site as shown in Plate 7-5. LNAs are natural areas held outside of the State's conservation estate and have formed the primary focus of the Local Biodiversity Strategy.

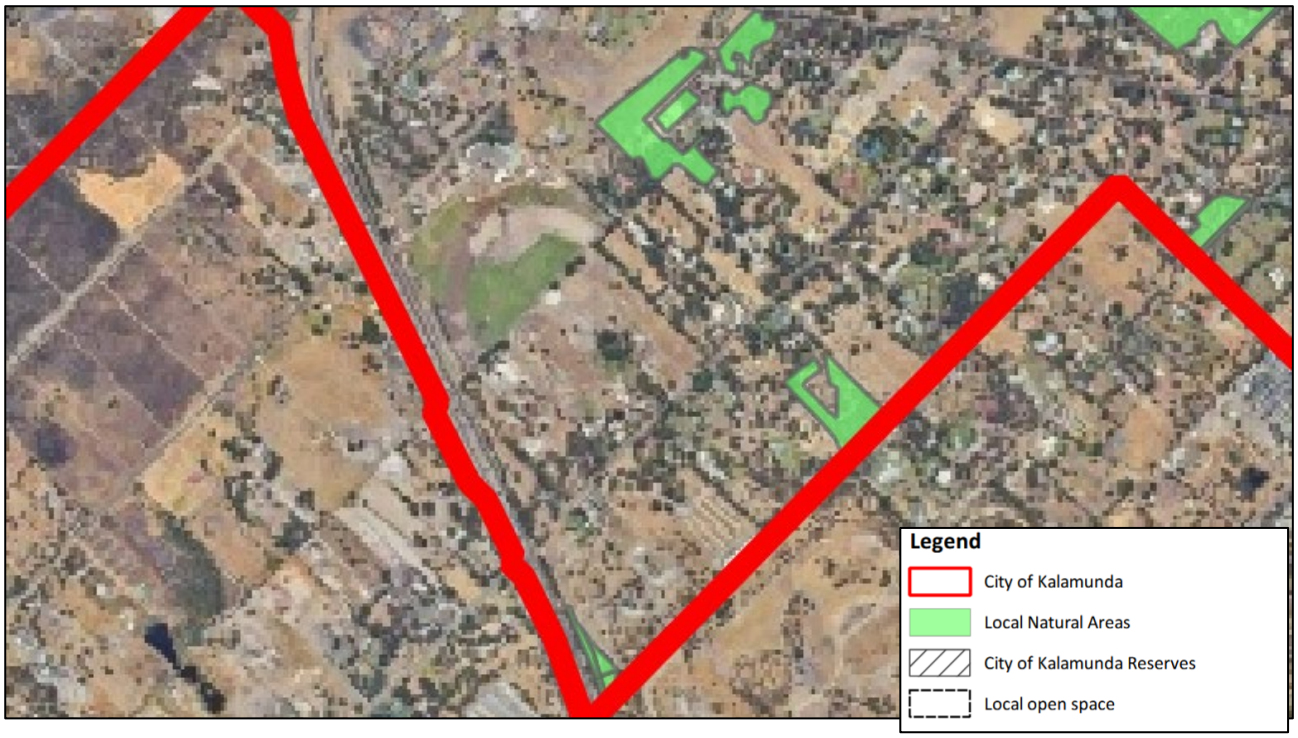


Plate 7-5: Local Biodiversity Strategy LNAs (City of Kalamunda 2023a)

The Local Biodiversity Strategy has allocated the LNAs within the site as having an 'I Management Category', which is for LNA on varied rural lots (of any size) and on Rural Conservation and Rural Landscape Interest on blocks less than 6 ha. LNAs within this management category have the following recommended planning conservation action:

- Any future development / subdivision should be within the provisions of the Scheme and the proposed Local Planning Policy for Biodiversity Conservation (e.g. High Conservation Value LNAs to be retained as Local Open Space for conservation).

As an outcome of the MRS Amendment process, and in accordance with the Environmental Conditions (Appendix 2), future residential development of the site will result in retention and protection of all intact remnant vegetation which fall within the areas identified as LNAs, as well as some areas of remnant vegetation that have not been identified as LNA. Based on the surveys undertaken by AECOM (2020) and JBS&G (2024), it is worthwhile to note that the remaining areas of LNAs outside of those mapped as remnant vegetation within the site contain scattered trees (Figure 5).

7.4 Potential Impact Identification and Assessment

Future urban development as well as the provision of associated infrastructure, within the site has the potential to directly and indirectly impact flora and vegetation. Potential impacts (direct and indirect loss of significant flora and vegetation, including threatened and priority ecological communities, threatened and priority flora, and vegetation complexes poorly represented in existing conservation reserves (Guildford Complex and Forrestfield and Southern River Complex) include:

- Direct loss through clearing
- Loss of fauna habitat (vegetation loss) short and long term
- Impacts to wetland and riparian vegetation and ground water dependant ecosystems within and nearby to the site (including GBSW) through changes to hydrology
- Spread or intensification of weeds and Phytophthora dieback
- Fragmentation.

7.4.1 Direct impacts

Direct impacts are predominantly limited to clearing activities during development. Indirect impacts may also occur as a result of construction activities during the development phase, or as a result of increased population and human activity in the post development phase.

The potential direct impacts to flora and vegetation are presented below.

7.4.1.1 Vegetation Retention and Clearing

Clearing activities for future urban development may decrease connectivity between nearby areas of intact native vegetation, as well as reduce available fauna habitat, and impact regional scale vegetation retention.

Surveys of the site have shown there is 4.56 ha of remnant native vegetation that could be impacted by clearing activities associated with the proposed change in land use. The extent of these vegetation communities within the site and to be retained in Conservation areas are presented in Table 7-8 and illustrated in Figure 5.

Table 7-8: Vegetation communities within conservation

Vegetation community	Extent within site	Conservation	Potential Future Conservation	Total area and percentage (Conservation and Potential Future Conservation)
BaEpPf	4.23 ha	3.41 ha	0.74 ha	4.15 ha (98% of BaEpPf area)
BmXpEx	0.28 ha	0.15 ha	0.05 ha	0.20 ha (71% of BmXpEx area)
EmMpLp	0.05 ha	0.05 ha	0.0 ha	0.05 ha (100% of EmMpLp area)
Total	**4.56 ha**	**3.61 ha**	**0.79 ha**	**4.40 ha (96% of total remnant vegetation area)**

Future urban development will result in 0.08 ha of Banksia Woodland - BmXpEx in Degraded condition (which is located along the battle axe for Lot 504) and 0.08 ha of Banksia Woodland - BaEpPf in Completely Degraded condition being cleared. Due to the degraded condition of these two areas of Banksia Woodland, neither are considered to be a TEC. Given the small extent and condition of this vegetation, the EPA (2025) considered the loss of this vegetation to not be a significant impact.

Accounting the area of remnant vegetation recently cleared on Lots 8 and 9, vegetation condition mapped as being in Good or better condition within the site is 3.61 ha. Table 7-9 and Figure 6 demonstrates that all

vegetation in Good or better condition will be retained in Conservation. Of the 0.16 ha of remnant native vegetation proposed to be cleared, 0.08 ha is in Degraded condition and 0.08 ha is in Completely Degraded.

Table 7-9: Vegetation condition within conservation

Vegetation condition	Extent within site	Conservation	Potential Future Conservation	Total area (Conservation and Potential Future Conservation)
Remnant Native Vegetation				
Excellent	3.41 ha	3.41 ha	0.00 ha	3.41 ha
Very Good	0.05 ha	0.05 ha	0.00 ha	0.05 ha
Good	0.15 ha	0.15 ha	0.00 ha	0.15 ha
Degraded	0.13 ha	0.00 ha	0.05 ha	0.05 ha
Completely Degraded	0.82 ha	0.00 ha	0.74 ha	0.74 ha
Total	**4.56 ha**	**3.61 ha**	**0.79 ha**	**4.40 ha**

Regarding the remaining Degraded 0.05 ha patch of vegetation (BmXpEc) within Lot 8, and given the results of the FCT analysis for Q9 which was previously located on Lot 9, this area has been identified as Potential Conservation (Figure 7).

As previously advised, prior to any subdivision and development a flora and vegetation survey and FCT analysis will be required to confirm if this remaining patch represents FCT 20c Shrublands and woodlands of the eastern side of the Swan Coastal Plain WA TEC – Critically Endangered (BC Act) and Federal TEC – Endangered (EPBC Act) and therefore, require retention in accordance with the Environmental Conditions (Appendix 2).

The CAMS (Appendix 3) provides a guide to the future preparation of the CAMP for each Conservation Area and requires the following to be undertaken:

- confirmation and delineation of the final boundary of the Conservation area
- baseline vegetation assessment to confirm, map and assess the current condition and extent of occurrences of TEC/s
- if required include a revegetation program tailored to increase the extent (within degraded areas) as well as maintain and/or enhance (where practicable) the condition of the TEC/s within the Conservation Areas.

Thereby ensuring the environmental outcomes set out in the Environmental Conditions can be met and there are no adverse impacts on conservation significant vegetation within the site.

7.4.1.2 Conservation Significant Flora Retention and Clearing

Two conservation significant flora taxa are also present within the site (Figure 8):

- *Conospermum undulatum* (T)
- *Isopogon autumnalis* (P3)

Surveys to date have identified the presence of 84 individuals of *Conospermum undulatum* and 20 individuals of *Isopogon autumnalis*. Of these:

- 76 *Conospermum undulatum* (T) and 14 *Isopogon autumnalis* (P3) are located within Conservation
- 3 *Conospermum undulatum* (T) and 1 *Isopogon autumnalis* (P3) are located within Potential Future Conservation

- 2 *Conospermum undulatum* (T) and 2 *Isopogon autumnalis* (P3) located on Lot 803 and 804 Crystal Brook Road are mapped as being adjacent to Conservation but may have been potentially cleared
- 1 *Conospermum undulatum* (T) and 1 *Isopogon autumnalis* (P3) located on Lot 804 Crystal Brook Road are mapped as being adjacent to Conservation
- 2 *Conospermum undulatum* (T) located within Lots 8 and 9 Brentwood Road are presumed to be cleared given the extent of recent clearing that has taken place
- 1 *Isopogon autumnalis* (P3) located along the northern boundary of Lot 201 Crystal Brook Road and is adjacent to the road reserve.
- 1 *Isopogon autumnalis* (P3) located outside the site's eastern boundary and is within a narrow strip of land between Tonkin Highway and the DBNGP corridor, which is owned by the Water Corporation and houses a water main and therefore, will not be developed for urban purpose.

As part of the EPA's assessment of the MRS Amendment, the EPA considered the potential impacts of the 5 individuals of *Conospermum undulatum* and 5 individuals of *Isopogon autumnalis* (Figure 7) in road reserves and Water Corporation infrastructure corridor and advised that the potential residual impacts to these significant flora species does not warrant a condition to ensure the environmental outcomes is consistent with the EPA objective for this factor for the following reasons (EPA 2025):

- there are several local populations of *Conospermum undulatum* within conservation and retention areas (including Bush Forever sites like Hartfield Park and GBSW, and areas under the City of Gosnells Town Planning Scheme 6 Amendments 166 and 169), and the impact on five individual plants is considered unlikely to significantly affect the species' local or regional extent of occurrence (EOO) or area of occupancy (AOO).
- *Isopogon autumnalis* has an extensive EOO and AOO, and is found within local Bush Forever sites and therefore, the proposed clearing is unlikely to significantly affect its local or regional distribution or conservation status.

In accordance with the Environmental Conditions (Appendix 2), the Conservation and Potential Conservation boundaries have potential to be extended following detailed design and further flora and vegetation surveys being undertaken (where site access has been limited) to:

- retain individuals that occur within close proximity of the Conservation and Potential Conservation areas (Figure 8)
- extend the final design and boundary of the Conservation areas to retain adjacent *Conospermum undulatum* (T) and *Isopogon autumnalis* (P3).

The CAMS (Appendix 3) provides a guide to the future preparation of the CAMP for each Conservation area and requires the following to be undertaken:

- confirmation and delineation of the final boundary of the Conservation area
- targeted baseline flora surveys to record occurrences of conservation significant flora within the Conservation area
- the establishment and maintenance of buffers to threatened flora within the Conservation area.

Thereby ensuring the environmental outcomes set out in the Environmental Conditions can be met, and there are no adverse impacts on conservation significant flora within the site.

However, should future development propose significant impacts on the environmental values within the site (through an amendment to Local Structure Plan or future subdivision proposal), the EPA (2025) has advised there may be requirement to refer the future proposal (i.e. subdivision or development) under Section 38 of the EP Act. Depending on the significance of the residual impacts, an Environmental Offset Plan

may be required (EPA 2025). The requirement for an Environmental Offset Plan is highlighted as a provision in the structure plan documentation, under Part 1 implementation.

7.4.1.3 Regional Context Analysis

7.4.1.3.1 Vegetation Complexes

At a regional level, clearing 0.16 ha of Degraded and Completely Degraded native vegetation represents the following:

- 0.009% (1,875 ha) of native vegetation within 5 km of the site
- 0.002% (9,169 ha) of native vegetation within 10 km of the site
- 0.001% (22,828 ha) of native vegetation within 15 km of the site

Given the above, the proposed clearing is not considered to be significant at a local and regional level.

Conversely, the addition of 4.40 ha of native vegetation to conservation represents the following:

- 0.27% increase in the current extent of native vegetation in conservation (1,609 ha) within 5 km of the site
- 0.03% increase in the current extent of native vegetation in conservation (13,328 ha) within 10 km of the site
- 0.03% increase in the current extent of native vegetation in conservation (16,768 ha) within 15 km of the site.

In relation to vegetation complexes, clearing of 0.08 ha of Banksia Woodland - BmXpEx in Degraded condition vegetation represents approximately 0.001% of the current extent of the Southern River vegetation complex remaining on the Swan Coastal Plain. For the portion of 0.08 ha of Banksia Woodland - BaEpPf in Completely Degraded condition vegetation, clearing this area represents approximately 0.003% of the current extent of Forrestfield vegetation complex remaining on the Swan Coastal Plain. Given the small extent and condition of this vegetation, the EPA (2025) considered the loss of this vegetation to not be a significant impact.

The proposed clearing will not reduce the extent of these vegetation complexes below the modified objective to retain at least 10% of the current extents within defined constrained areas including the Perth metropolitan region.

7.4.1.3.2 Banksia Woodlands

Banksia Woodlands communities are largely restricted to the Perth (SWA02) and Dandaragan (SWA01) subregions of the Swan Coastal Plain IBRA bioregion. An estimate of the extent of Banksia Woodlands that remain within these subregions (including within reserves) is provided in the Approved Conservation Advice for Banksia Woodlands of the Swan Coastal Plain (TSSC 2016). An assessment of the extent of Banksia Woodlands (in Good or better condition) that remain within the site, as a proportion of these estimates for the Perth subregion, is presented in Table 7-10.

Table 7-10: Extent of Banksia Woodlands TEC remaining and protected in reserves (TSSC 2016)

Subregion	Current Extent (ha)	Extent within site (ha)	Proportion retained in site (%)	Proportion Remaining in Reserves (ha)	Proportion Remaining in Reserves (%)
Perth (SWA02)	253,540.6 ha	3.61 ha	<0.002%	57,054.9 ha	22.5%

In accordance with the Environmental Conditions (Appendix 2) and the CAMS (Appendix 3), retention of remnant native vegetation within the Conservation and Potential Conservation areas will ensure the following TECs are avoided and conserved for the long-term (Figure 7):

- Banksia Woodlands of the Swan Coastal Plain ecological community - Endangered (EPBC Act) and Priority 3 (DBCA listing)
- Probable FCT 20a State TEC – Critically Endangered (BC Act)
- Probable FCT 20c State TEC – Critically Endangered (BC Act) and Federal TEC – Endangered (EPBC Act) (if confirmed).

7.4.2 Indirect Impacts

The inhabitants of new urban communities have the potential to indirectly impact on areas of retained native vegetation through uncontrolled access (by vehicles and pedestrians), littering, dumping and through the spread of weeds or disease and fire risk.

All of these impacts may also occur as a result of construction activities during the development phase. Construction activities can also indirectly impact on flora and vegetation through dust deposition.

Other potential indirect impacts of urbanisation of the site include fragmentation, degradation of ecological linkages, hydrological changes and erosion. Consideration of these potential indirect impacts is provided below.

7.4.2.1 Fragmentation

The site is largely cleared or highly modified (approximately 96.4%) due to historical clearing and development, with only 3.6% comprising fragmented remnant native vegetation. There is potential for further fragmentation of the areas of intact remnant native vegetation within the site through indirect impacts from future construction and urban development of the site.

The Local Structure Plan has placed remaining intact vegetation within designated Conservation areas (Appendix 1). In accordance with the Environmental Conditions (Appendix 2), the Local Structure Plan Part 1 provisions, and guided by the CAMS (Appendix 3), a CAMP will be developed and implemented to prevent further fragmentation and support ongoing environmental management to protect, maintain and enhance the environmental values of the Conservation Areas as urban subdivision or development of the site progresses.

7.4.2.2 Hydrological changes

Urbanisation of the site is expected to increase groundwater recharge due to reduced evapotranspiration and increased infiltration and recharge of the superficial aquifer, via runoff from roads, roofs, and hard surfaces. However, the rise in groundwater levels is predicted to be minimal, as the site's vegetation is not groundwater dependent due to the significant depth to groundwater (4–20 m below surface). Additionally, the predicted recharge increase is offset by the cessation of artificial recharge previously caused by irrigation at the now-disused turf farm, which had been contributing to groundwater mounding in the superficial aquifer.

Post-development modelling indicates that urbanisation will not significantly raise groundwater levels, and stormwater runoff can be managed to maintain existing annual recharge in the area of the mound to retain groundwater flows and direction toward the GBSW. Given the depth to groundwater and the limited impact of urbanisation on aquifer recharge, no significant residual impacts on flora and vegetation are expected from the proposed residential development.

Furthermore, no significant residual impacts to wetlands and riparian vegetation, and groundwater dependent ecosystems within and nearby to the site (such as within the GBSW where there is shallow depth to groundwater that is associated with localised perched groundwater systems) because of changes to the current surface water and groundwater cycles are anticipated.

The LWMS aims to maintain the hydrological regimes and provides an opportunity to significantly reduce nutrient application from the site and the export of nutrients towards the GBSW. Given the hydrological complexities of the site, the LWMS also promotes an adaptive management approach for the site which is underpinned by the continued implementation of the current water monitoring program. The monitoring program and reporting framework encapsulates monitoring of the Superficial Aquifer groundwater levels and quality (near the turf farm and the GBSW), which will enable ongoing review of seasonal groundwater contours and flow direction pre-and post- development, the influence of the groundwater mound post development, and review of groundwater quality.

In accordance with the Environmental Conditions (Appendix 2), the Local Structure Plan Part 1 provisions, and guided by the LWMS, Urban Water Management Plans (UWMPs) will be prepared as part of future subdivision and development of the site to minimise adverse impacts to the GBSW from urban development of the site, including impacts to the wetlands' persistency, hydrological regime, water quality, ecological integrity and ecological function

7.4.2.3 Erosion and sedimentation

The site is relatively flat to gently undulating with elevation ranging from approximately 22 m AHD in the west to 36 m AHD in the east. Therefore, there is unlikely to be a significant reduction in surface level during construction associated with future potential urban development. Erosion impacts (such as sheet erosion) on flora and vegetation are therefore considered unlikely.

Notwithstanding this, appropriate actions to mitigate any potential impacts due to erosion will be addressed through the preparation, approval and implementation of a CEMP at subdivision or development, during construction works for each stage of the development.

7.4.2.4 Dust deposition

Construction activities associated with the urbanisation of the site may generate fugitive dust emissions, which in turn may result in dust deposition impacts to native vegetation, including:

- Leaf damage through abrasion
- Blocking the stoma of plants
- Dust accumulation on leaves, limiting photosynthesis capability.

Management measures to mitigate dust impacts can be addressed through the preparation, approval and implementation of a CEMP at subdivision and development and implemented during construction works, which is a standard condition of subdivision and development.

7.4.2.5 Weeds and pathogens

Urbanisation can lead to the introduction and spread of weeds and pathogens, such as Dieback (*Phytophthora cinnamomi*), which can indirectly impact vegetation in the site.

The application of standard dieback management actions will minimise the potential introduction and/or spread of weeds and pathogens within the site. Implementation of these management measures will be done through the implementation of a CEMP at subdivision and development, during construction works for each stage of development, which is a standard condition of subdivision and development.

In accordance with the Environmental Conditions (Appendix 2), the Local Structure Plan Part 1 provisions, and guided by the CAMS (Appendix 3), a CAMP will be developed and implemented to minimise the potential introduction and spread of weeds and pathogens to vegetation within each Conservation area.

7.4.2.6 Uncontrolled vehicle and pedestrian access, littering, dumping and fire risk

With urbanisation comes an increase in population and in turn an increased risk of human activity, which can indirectly impact on areas containing conservation significant flora and vegetation.

The most common impacts of increased human activity include degradation to flora and vegetation as a result of uncontrolled vehicle and pedestrian access, as well as littering, dumping and increased fire risk. These same impacts can also be caused by construction personnel, vehicles, plant and equipment during construction activities associated with urban development.

Management measures to appropriately control and minimise the impacts of increased human activity, both during the development and post development phases, can be addressed through the CEMP during the construction phase for each stage of subdivision and development, which is a standard condition of subdivision and development.

In accordance with the Environmental Conditions (Appendix 2), the Local Structure Plan Part 1 provisions, and guided by the CAMS (Appendix 3), a CAMP will be developed and implemented to minimise the potential impacts of uncontrolled vehicle and pedestrian access, littering, dumping and increased fire risk.

7.4.3 Cumulative Impacts

The Environmental Review for MRS Amendment 1388/57 presented a summary of the potential impacts from the following proposals and planning scheme amendments in proximity to the site:

- Wattle Grove Urban Expansion and Urban Investigation Areas
- Tonkin Highway Grade Separated Interchanges (Hale Road to Welshpool Road)
- Tonkin Highway Grade Separated Interchange (Kelvin Road)
- Tonkin Highway, Guildford Road to Great Eastern Highway Upgrade (Tonkin Gap)
- Maddington Kenwick Strategic Employment Area (MKSEA)
- Roe Highway and Great Eastern Highway Bypass

Given the retention of remaining patches of native vegetation, which contain TECs and threatened flora, the Environmental Review concluded that there will not be any significant cumulative impacts on conservation significant flora and vegetation, as a result of the proposed change in land use from Rural to Urban.

The EPA (2025) evaluated both existing and reasonably foreseeable cumulative impacts on conservation-significant flora and vegetation values from nearby developments around the amendment area. The EPA's assessment considered a range of threats and pressures, examining whether the environment affected by the proposed land use change holds significant value due to successive, incremental, and interactive cumulative impacts within the broader assessment area. Based on the implementation of the concept plan (Figure 2 within Appendix 2), the EPA (2025) advised that the proposed change in land use is not expected to result in cumulative impacts on TECs or occurrences of significant flora.

7.5 Impact Mitigation

Impacts to flora and vegetation and how future urban development of the site will manage these impacts have been considered in the context of the EPA's mitigation hierarchy (Table 7-11).

However, should future development propose significant impacts on the environmental values within the site (through an amendment to Local Structure Plan or future subdivision proposal), the EPA (2025) has advised there may be a requirement to refer the future proposal (i.e. subdivision or development) under section 38 of the EP Act to the EPA. Depending on the significance of the residual impacts, an Environmental Offset Plan may be required (EPA 2025). The requirement for an Environmental Offset Plan is highlighted as a provision in the structure plan documentation, under Part 1 implementation.

Table 7-11: Flora and Vegetation Mitigation Hierarchy

Flora and Vegetation Mitigation Hierarchy: Assessment and Proposed Measures
Potential Impact
• Potential impacts (direct and indirect loss of significant flora and vegetation, including threatened and priority ecological communities, threatened and priority flora, and vegetation complexes poorly represented in existing conservation reserves (Guildford Complex and Forrestfield and Southern River Complex) include: ▪ Direct loss through clearing ▪ Loss of fauna habitat (vegetation loss) short and long term ▪ Impacts to wetland and riparian vegetation and ground water dependant ecosystems within and nearby to the site (including GBSW) through changes to hydrology ▪ Fragmentation ▪ Spread or intensification of weeds and pathogens ▪ Erosion and sedimentation ▪ Dust deposition ▪ Uncontrolled access, littering, dumping and fire risk. • Future urban development will result in 0.16 ha of Banksia Woodland (BmXpEx and BaEpPf) in Degraded and Completely Degraded condition being cleared, neither of which are considered to be a TEC. • At a regional level, clearing of vegetation represents approximately 0.001% of the current extent of the Southern River vegetation complex remaining on the Swan Coastal Plain and approximately 0.003% of the current extent of Forrestfield vegetation complex remaining on the Swan Coastal Plain. Proposed clearing will not reduce the extent of these vegetation complexes below the modified objective to retain at least 10% of the current extents within defined constrained areas including the Perth metropolitan region. • The potential loss of up to 5 individuals of *Conospermum undulatum* (T) and 5 individuals are *Isopogon autumnalis* (P3). However, there will be opportunities at later and more detailed stages of the planning process (i.e. Local Structure Plan amendments, subdivision and development) to undertake future surveys and investigate the final boundary of Conservation areas to retain these individuals. • Given that the depth to groundwater within the site is already several metres below natural surface and it has been predicted that the physical process of urbanisation will not lead to a significant rise in groundwater levels, it is expected there will not be any significant hydrological impacts on flora and vegetation retained within the site due to future urban development. • As there will be no significant hydrological changes, there will be no significant impacts to wetland and riparian vegetation and groundwater dependant ecosystems in proximity to the site (including the GBSW).
Avoidance
Vegetation retention • All vegetation (BaEpPf, BmXpEx and EmMpLp) in Good or better condition will be retained in Conservation (Table 7-8**.** and Figure 6). • Retention of all remnant patches of Banksia Woodlands, representing the following threatened and priority ecological communities: ▪ Banksia Woodlands of the Swan Coastal Plain TEC - Endangered (EPBC Act) and Priority 3 (DBCA listing). ▪ Probable FCT 20a State TEC – Critically Endangered (BC Act) ▪ Probable FCT 20c State TEC – Critically Endangered (BC Act) and Federal TEC – Endangered (EPBC Act). • Possible retention and rehabilitation of degraded vegetation (BaEpPf) located on Lot 2 Victoria Road pending further survey and FCT analysis to confirm conservation status of vegetation and flora (Figure 7) • Higher order protection of remnant native vegetation, by virtue of its retention within Conservation Public Open Space and road reserves under the care and management of the City of Kalamunda. • Based on the estimate of the extent of Banksia Woodlands that remain within the Perth (SWA01) subregion (including within reserves) provided in the Approved Conservation Advice for Banksia Woodlands of the Swan Coastal Plain (TSSC 2016), the proportion retained within the site represents <0.002%. • All Southern River Complex and Forrestfield complex vegetation in good or better condition will be avoided, protected and managed. There are no areas of intact remnant vegetation mapped within Guildford complex.

Flora and Vegetation Mitigation Hierarchy: Assessment and Proposed Measures

Flora retention
• Retention of conservation significant flora taxa within conservation including at least:
  ▪ 79 individuals of *Conospermum undulatum* (T).
  ▪ 15 individuals of *Isopogon autumnalis* (P3).
• No impact to one individual of *Isopogon autumnalis* (P3) located on Water Corporation land (adjacent to Tonkin Highway) that will not be developed for urban uses.
• Possible retention of up to another 3 individuals of conservation significant flora representing the two flora taxa above, during later and more detailed stages of the planning process to investigate the final design and boundary of the Conservation and Potential Conservation areas.

Future flora and vegetation survey/s • Any future subdivision and/or development proposals for the eight unsurveyed lots and the 12 lots surveyed from the boundary of adjacent lots (Plate 7-1) will be accompanied by a suitable flora and vegetation field survey at the time of application to ensure that the presence of any conservation significant flora and TECs within these lots is appropriately identified, retained within the Conservation areas and appropriately mitigated in accordance with the Environmental Conditions (Appendix 2), the Local Structure Plan Part 1 provisions and the CAMS (Appendix 3).
Future Local Structure Plan Amendment • The Local Structure Plan notes the Public Open Space areas for Conservation and Potential Conservation areas to be investigated further and determined by proponents as part of Local Structure Plan Amendments.
Bushfire management • Bushfire management will be undertaken without impact to areas of retained vegetation (see Bushfire Management Plan).
Minimisation

Conservation area management
• Clearing boundaries will be clearly demarcated on the ground to avoid unauthorised clearing to protect the retained vegetation.
• Hard-edge separation between development and Conservation Public Open Space, which will assist with environmental management, including minimisation of weed spread.
• In accordance with the Environmental Conditions (Appendix 2), the Local Structure Part 1 provisions, and the CAMS (Appendix 3) a CAMP will be prepared for vegetation and flora retention within each Conservation area, and include:
  ▪ Objectives, targets and environment outcomes to be achieved
  ▪ Baseline information required to confirm the environmental values to be protected (baseline ecological surveys) and the key threats (i.e. weed and pathogen surveys, etc) to be managed within Conservation Area
  ▪ Address the potential impacts and identify the mitigation measures to be implemented through during subdivision and development of the site
  ▪ Detail how the Conservation Areas will be protected, and significant values will be maintained and enhanced
  ▪ Detail the monitoring, evaluation and response mechanisms to be implemented.
  ▪ Roles and responsibilities
  ▪ Indicative timeframes for implementation of the management actions.

Construction management
• Prior to subdivision and development, a CEMP will be prepared to address the following during the construction phase of future development:
  ▪ Clear demarcation and fencing of all remnant vegetation, individual trees and conservation significant flora identified for retention, prior to the commencement of construction works
  ▪ Management controls for erosion and sediment, dust, weed and pathogen
  ▪ Bushfire prevention
  ▪ Waste management, including uncontrolled littering and dumping
  ▪ Inductions to educate construction personnel on the above management measures.

Flora and Vegetation Mitigation Hierarchy: Assessment and Proposed Measures
Tree retention and landscaping • Prior to subdivision and/or development, a Tree Canopy Retention and Landscaping Management Plan (TCRLMP) will be prepared, in accordance with the Environmental Conditions (Appendix 2), to address the following: ▪ Preparation of a tree canopy analysis to identify existing canopy values, and include a survey of all existing trees on the relevant lot(s). Identify the location, species, size and structural health of any trees to be retained ▪ Identify which trees will be retained and removed as a result of the subdivision or development proposal, prioritising the retention and revegetation of Black cockatoo habitat trees. ▪ Demonstrate how development design has avoided impacts on trees suitable for retention (through the location of public open space, road reserves, pedestrian access ways and drainage design) to ensure their viability within an urban landscape. ▪ Demonstrate how the impact of any required clearing will be mitigated based on pre and post development canopy values. ▪ Identify measures that will be used to protect trees identified for retention during development and subdivision works (i.e. tree protection zones, tree labelling, physical barriers being erected and maintained through construction, etc. ▪ Demonstrate how the minimum tree canopy coverage post subdivision or development will be achieved. ▪ Wherever possible, potential nesting trees are to be retained as part of the subdivision design, to facilitate the retention of trees with a DBH of >500 mm and /or that are foraging species for black cockatoos. Where it is not possible to retain such trees, they will be replaced with black cockatoo potential nesting tree species. ▪ Identify the location, species, number, planting size, mature height and spread of trees to be planted. ▪ Identify the planting schedule for the trees to be planted. ▪ Estimate the percentage of canopy coverage expected to be achieved through implementation of the plan. Achieve a minimum canopy target of 20% per Planning Precinct in accordance with the City of Kalamunda (2023) Urban Forest strategy, which will be contingent on: o water availability o bushfire management o local government support and incentives o land developer incentives (garden packages including trees) o resident engagement and education ▪ Provide tree and landscape maintenance requirements post planting.
Rehabilitation
• In accordance with the Environmental Conditions (Appendix 2) and the CAMS (Appendix 3), the CAMP will include a rehabilitation program, revegetation measures, weed and pathogen control, access control and signage requirements, completion criteria, monitoring, evaluation and response mechanisms, roles and responsibilities and indicative timeframes.
Offset
• Implementation of the avoidance, minimisation and rehabilitation measures, the residual impacts are not considered to be significant and therefore, offsets are not proposed.

7.6 Predicted Outcome

Following implementation of the proposed mitigation measures, in accordance with the Environmental Conditions (Appendix 2) and CAMS (Appendix 3), the predicated outcomes for flora and vegetation, include:

- Retention of all vegetation in Good to Excellent condition.
- Retention of all remnant patches of Banksia Woodlands, representing the following threatened and priority ecological communities:
  - Banksia Woodlands of the Swan Coastal Plain TEC - Endangered (EPBC Act) and Priority 3 (DBCA listing).

    - Probable FCT 20a *Banksia attenuata* woodlands over species rich dense shrublands State TEC – Critically Endangered (BC Act).
    - Probable FCT 20c State TEC – Critically Endangered (BC Act) and Federal TEC – Endangered (EPBC Act)
- Rehabilitation program within the Conservation areas will:
    - Maintain and protect TEC vegetation for the long term
    - restore TEC vegetation in degraded condition so that the vegetation condition rating of Good or better is achieved
    - maintain or increase populations of threatened flora.
- Protection and maintenance for remnant vegetation retained within Conservation POS and future management to be guided by the implementation of the CAMP at subdivision and development.
- Retention of conservation significant flora taxa within conservation including at least:
    - 79 individuals of *Conospermum undulatum* (T).
    - 15 individuals of *Isopogon autumnalis* (P3).
- No impact to one individual of *Isopogon autumnalis* (P3) located on Water Corporation land (adjacent to Tonkin Highway) that will not be developed for urban uses.
- Possible retention of up to another 3 individuals of conservation significant flora representing the two flora taxa above, during subdivision and development within the Conservation areas.
- All Southern River Complex and Forrestfield complex vegetation in good or better condition will be avoided, protected and managed. Note: there are no areas of intact remnant vegetation within the area mapped as Guildford complex.
- Given that the depth to groundwater within the site is already several metres below natural surface and it has been predicted that the physical process of urbanisation will not lead to a significant rise in groundwater levels, it is expected there will not be any hydrological impacts on flora and vegetation from future residential development.
- As there will be no significant hydrological changes, there will be no significant impacts to wetland and riparian vegetation and groundwater dependant ecosystems in proximity to the site (including the GBSW).

Based on the above and in consideration of the degraded state of vegetation onsite, the extent of native vegetation in surrounding areas and retention of TECs and conservation significant flora onsite, it is expected that the EPA's objective for the Flora and vegetation factor will continue to be met.

8 Terrestrial Fauna

8.1 EPA Definition and Objective

The EPA defines terrestrial fauna as animals living on land or using land (including aquatic systems) for all or part of their lives. Terrestrial fauna includes vertebrate (birds, mammals including bats, reptiles, amphibians, and freshwater fish) and invertebrate (arachnids, crustaceans, insects, molluscs and worms) groups (EPA 2016c).

The EPA objective is to protect terrestrial fauna so that biological diversity and ecological integrity are maintained (EPA 2021).

8.2 Key Policies and Guidance

Relevant policy and guidance documents for terrestrial fauna, which have informed site-specific investigations and/or have been used to assess potential impacts, include:

- Environmental Factor Guideline – Terrestrial Fauna (EPA 2016c)
- Technical Guidance - Sampling of short range endemic invertebrate fauna (EPA 2016d)
- Technical Guidance – Terrestrial vertebrate fauna surveys for environmental impact assessment (EPA 2020)
- EPBC Act Referral guidelines for three threatened black cockatoo species: Carnaby's cockatoo, Baudin's cockatoo and Forest red-tailed black cockatoo (DSEWPaC 2012)

8.3 Receiving Environment

8.3.1 Studies and Investigations

Initial site surveys and assessment for flora, vegetation and fauna were conducted by AECOM (2020) across the site as part of a consideration of the broader Wattle Grove (South) locality.

The AECOM survey did not survey every allotment within the site and as a result, JBS&G undertook the following supplementary surveys of the site during 2021 and 2022:

- Supplementary fauna surveys in 2021 and 2022, which corroborated the findings of the AECOM surveys within the site and provided additional data on some areas previously not surveyed by AECOM.
- Targeted black cockatoo survey (August 2021): Various lots
- Significant tree and black cockatoo habitat assessment (February 2021): Various lots
- Reconnaissance black cockatoo habitat survey (January 2022): Various lots, including from lot boundaries

JBS&G (2024) drafted an ecological memo which provides an overview of the above flora, vegetation and fauna surveys and assessment that have been undertaken within the structure plan area (Appendix 5).

In addition to the above, the following supplementary assessments have also been undertaken:

- Phoenix Environmental Services (Phoenix Environmental) (2024) undertook a black cockatoo habitat assessment (Appendix 8), which included the following:
  - review habitat mapping with respect to consistency with the vegetation type and condition mapping and black cockatoo species foraging habitat

- review the potential nesting tree dataset
- hollow inspection
- undertake black cockatoo species foraging habitat quality scoring per the 'Bamford Method' (BCE 2021).

- Phoenix Environmental (2025) undertook a black cockatoo habitat assessment of Lot 54 Victoria Road (Appendix 9)
- Bennelongia Environmental Consultants (Bennelongia) (2024) - Wattle Grove South SRE Invertebrate Fauna Desktop Assessment.

Plate 8-1 presents the combined survey effort by AECOM, JBS&G and Phoenix Environmental within the site, which were done in accordance with EPAs Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA 2016b and EPA 2020).

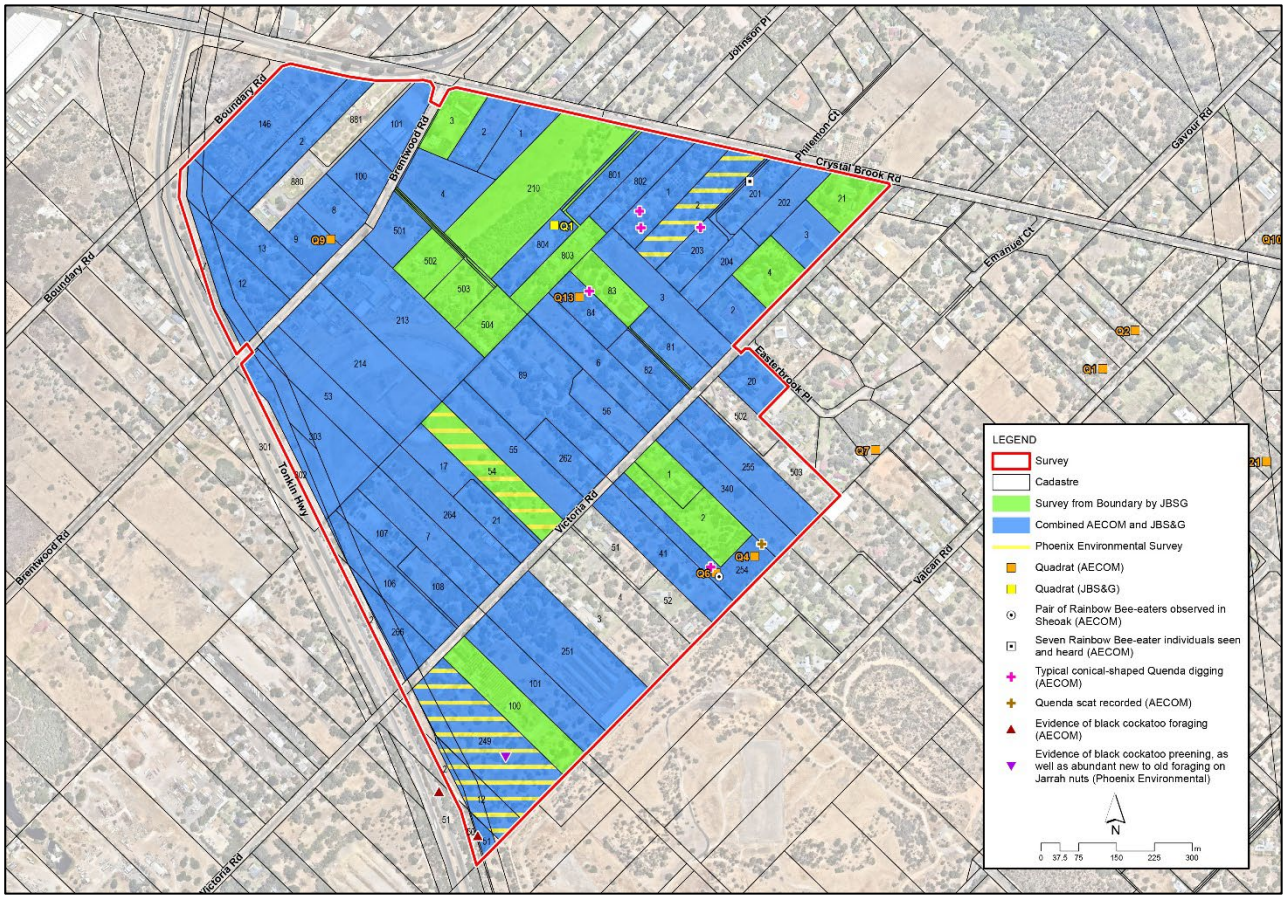


Plate 8-1: Lots surveyed within the structure plan area

A total of eight lots within the site have not been surveyed and 12 lots were surveyed based on observations made from the fence line of adjacent lots and road reserve, so there may be some limitations with the survey data that has been collected for these lots.

Notwithstanding the above, the majority of the site (~92%) has been subject to some form of an ecological assessment, and consequently, the ecological values of the area are well understood. The survey efforts have found that vegetation within the site is predominantly cleared, and now consists primarily of lawns, planted trees, garden beds and fragmented areas of scattered native trees, with some small discrete areas of remnant native vegetation ranging from Degraded to Excellent condition.

To ensure that any limitations in the survey data collected to date does not compromise future planning decisions, Environmental Conditions (Appendix 2) require that any future subdivision and development application of lots not subject to survey within the site will be accompanied by a suitable black cockatoo. This is also highlighted as a requirement under the Local Structure Plan Part 1 provisions.

Undertaking the required black cockatoo surveys will ensure any high quality black cockatoo habitat and potential nesting trees will be identified and appropriately mitigated in accordance with requirements of the Environmental Conditions (Appendix 2) as part of the assessment and determination of all future subdivision and development proposals for the unsurveyed lots and managed through future subdivision and development conditions of approval.

8.3.1.1 Fauna surveys

AECOM (2020) conducted a Level 1 fauna survey in conjunction with the detailed flora and vegetation surveys that they also completed during spring 2019. Conducting the two surveys concurrently enabled consistent and clear mapping of fauna habitats and vegetation communities.

A targeted black cockatoo survey was also conducted in conjunction with the Level 1 fauna survey and detailed flora and vegetation survey by AECOM ecologists and botanist. This survey was conducted over multiple mobilisations due to site accessibility, including 9 and 10 September 2019, 1 to 4 and 8 October 2019 and 18 and 21 November 2019.

8.3.1.2 Short-range endemic invertebrates

Short-range endemic (SRE) invertebrates have naturally small distribution, which can be influenced by several factors including life history, physiology, habitat requirements, dispersal capabilities, biotic and abiotic interactions, and historical conditions. These not only influence their distribution but also the tendency for differentiation and speciation (Ponder and Colgan 2002).

The SRE status of each species within the site was determined by Bennelongia in 2024 using a modified version of the Western Australian Museum's (WAMs) SRE classification system. The modifications used by Bennelongia aim to account for the fact that many recorded species have limited available data on their taxonomy, range, habitat preferences, and/or natural history.

As a first step in classification, SRE species were assigned to the following categories (Bennelongia 2024):

- Confirmed SREs have a known range <10,000 km^2. The taxonomy is well known, and the group well represented in collection and/or via comprehensive sampling.
- Potential SREs are species for which there are gaps in knowledge, either because they are not well represented in collections, taxonomic knowledge is incomplete, or the distribution is poorly understood due to insufficient sampling.
- Widespread (not an SRE) species have a known distribution range >10,000 km^2. The taxonomy is well known, and the group well represented in collections via comprehensive sampling.

Potential SREs were then assigned as likely or unlikely potential SREs based on the following information (if available) (Bennelongia 2024):

- Habitat indicators and degree of specialisation (e.g. occur only in habitat typical of SREs; occur in one or multiple habitats).
- Research and expertise (assigned by expert; use expert information of the biology and ecology of related species); and/or
- Molecular evidence regarding the genetic variability within sampling areas.

If species are data deficient in all these areas, the precautionary approach was taken of assigning them as data deficient likely potential SREs; although these species were highlighted in the results, noting the lack of available data (Bennelongia 2024).

The desktop search over an area of the Swan Coastal Plain extending 50 km north and south of the site returned 2 confirmed SRE species, 135 likely potential SRE species (with 37 of these due to data deficiency), 17 unlikely SRE species and 425 widespread species. The list of species with some possibility of being SREs includes 52 species of araneomorph spider, 37 species of mygalomorph spider, 20 species of millipede, 18 species of slater, seven species of pseudoscorpion, six species each of scorpion, centipede and land snail, and two species of harvestman (Bennelongia 2024).

Additionally, eight listed Threatened or Priority species have been recorded within the 100 km search area, including two trapdoor spiders and six species of bees; however, only limited (or no) occurrences of most of these species have been found in close proximity of the site.

Vegetation assessment undertaken in the site identified some remnants of *Banksia attenuata* woodlands and a small remnant of *Eucalyptus marginata* woodland, in Good and better condition, which are likely to provide the most suitable habitat for SRE fauna. However, these habitats exist as small discrete fragments occupying less than 4% of the site. Most of the vegetation within the site is in Degraded and Completely Degraded condition represented by scattered native and planted trees, planted gardens, and cleared areas, which provide more limited value habitat for SRE invertebrate. For that reason, although a diverse community of potentially restricted species occurs within the extended desktop search area, the small areas of residual habitat appropriate for SRE species in the site are considered to be less suitable for maintaining a large diverse structured SRE community within the site. Moreover, larger areas of SRE suitable habitat are more diverse and abundant outside the site than within it. Notwithstanding, as the remnant areas of *Banksia attenuata* and *Eucalyptus marginata* identified as being in Good or better condition are proposed to be retained and managed in Conservation areas, they will continue to function to provide residual SRE suitable habitat and will not contribute to further fragmentation of SRE suitable habitat on the Swan Coastal Plain. (Bennelongia 2024)

For these reasons, overall, the proposal to develop the site for urban purpose is not expected to have significant impacts on the conservation values of SREs or other significant terrestrial invertebrates.

8.3.1.3 Significant tree and black cockatoo habitat assessments

A targeted black cockatoo survey was undertaken by JBS&G in August 2021 involving Lots 12 and 13 Brentwood Road, 81, 106 and 107 Victoria Road and 804 Crystal Brook Road. The targeted black cockatoo survey was conducted to identify potential breeding, roosting and foraging habitat for the three threatened black cockatoo species that occur in WA, as all three species have the potential to utilise the habitats present in the site.

The three species are Carnaby's cockatoo *Zanda latirostris* (Endangered under the EPBC Act and the BC Act), Baudin's cockatoo *Zanda baudinii* (Endangered under the EPBC Act and the BC Act) and the Forest Red-tailed black cockatoo *Calyptorhynchus banksii naso* (Vulnerable under the EPBC Act and the BC Act).

The survey was undertaken by two ecologists from JBS&G with relevant experience in accordance with the guidance current at the time – EPBC Act Referral guidelines for three threatened black cockatoo species (DSEWPaC 2012). The (then) draft DotEE (2017) referral guidelines were also utilised.

JBS&G also undertook a significant tree and black cockatoo habitat assessment in February 2021, incorporating additional areas of the site to result in a combined survey area covering 116 ha. The survey also provided further context to support habitat mapping over the balance of the site.

In January 2022, JBS&G also undertook reconnaissance flora and vegetation surveys from the boundaries of previously unsurveyed lots within the site, noting the quality and extent of black cockatoo habitat observed therein.

Phoenix Environmental (2024) undertook hollow inspections on 19 January 2024 of seven potential nesting trees within Lots 12 and 249 Victoria Road and Lot 2 Crystal Brook Road (Appendix 8). The purpose of this inspection was to confirm the location and suitability of hollows as nests for black cockatoos, which was based on previous biological surveys undertaken by AECOM (2020) and JBS&G (2024); however, no targeted

investigations of these trees had been undertaken by AECOM (2020) and JBS&G (2024) during the time of these surveys. None of the trees inspected were considered to have hollows suitable for black cockatoo nesting (Phoenix Environmental 2024).

Utilising the data collected by AECOM (2020) and JBS&G (2024), Phoenix Environmental (2024) undertook a black cockatoo habitat assessment for the site with consideration of the following guidelines and guidance:

- Referral guideline for 3 WA threatened black cockatoo species Carnaby's cockatoo (*Zanda latirostris*), Baudin's cockatoo (*Zanda baudinii*) and the FRTBC (*Calyptorhynchus banksii naso*) (DAWE 2022a).
- Black cockatoos and development in South-West Western Australia (DAWE 2022b).
- Scoring System for the Assessment of Foraging Value of Vegetation for Black-Cockatoos (Bamford 2021).

In May 2025, Phoenix Environmental (2025) also recently undertook a black cockatoo habitat assessment for Lot 54 (Appendix 9).

8.3.2 Fauna habitats

The AECOM (2020) terrestrial fauna survey primarily focused on mapping of fauna habitat and assessing this habitat for their potential to be used by conservation significant fauna species within the wider Wattle Grove area. Fauna habitats were assessed for specific habitat components, including consideration of structural diversity and refuge opportunities for fauna.

Records of all observed fauna species, identified from distinctive calls and details of indirect evidence such as scats, tracks and diggings, were documented. Particular attention was given to searching for conservation significant species that had been identified in desktop assessments as having potential to occur in the area. All observations were made between daylight hours of 0700 and 1700.

The AECOM (2020) survey broadly defined and mapped six fauna habitats within the wider area of Wattle Grove South area. Of these, only four of these habitats were mapped within the site, including:

- Banksia Woodlands
- Eucalypt Woodlands
- Scattered Trees
- Planted and Maintained Gardens

Fauna habitat within the site has been highly modified through historical and ongoing land uses, which have resulted in the clearing of the majority of native vegetation. The small areas of remnant vegetation that remain within the site provide the greatest significant fauna habitat and comprise mostly Banksia Woodlands, which exists in four distinct patches, as well as one very small patch of Eucalyptus Woodland in Very Good condition (Figure 9).

The habitat types of 'Planted and Maintained Gardens' and 'Scattered Trees' are both highly disturbed and completely degraded. These habitat types contain a mixture of native and non-native Eucalyptus trees, as well as other introduced species such as Cape Lilac and Jacaranda. The main distinction between the two habitat types is the understorey; understorey is not present in the 'Scattered Trees' habitat and is variable in the 'Planted and Maintained Gardens' habitat. These habitat types have limited value for species of conservation significance.

Based on the results of the AECOM (2020) terrestrial fauna survey, the majority of the site is lacking in natural attributes and is now predominantly used by generally common and widespread fauna species with non-specific requirements, which allow them to persist in disturbed to highly disturbed habitats.

As a result, the fauna diversity is well below levels that would have been present prior to historical clearing and disturbance having occurred. Due to these factors, most of the site has very little conservation significance to fauna in general.

These survey results were further confirmed by JBS&Gs surveys undertaken in 2021 and 2022 (JBS&G 2024). The fauna habitat types that have been recorded within the site are presented in Table 8-1.

Table 8-1: Fauna habitat descriptions (AECOM 2020)

Fauna habitat	Description
Banksia Woodland	This habitat generally comprises a low open woodland of Banksia and Eucalyptus over a low open shrubland on loamy, sandy brown soil. The habitat is generally considered high quality due to the presence of Banksia, its complexity and limited disturbance levels. Habitat quality is reduced where areas are significantly degraded due to impacts from clearing and edge effects. Fauna habitat characteristics include: • Dense understorey common • Logs of various sizes are common. • Fine and course leaf litter common to abundant • Bare ground occasionally present • Absence of stones and boulders ▪ Large mature trees in occasional abundance (hollows absent). 
	Conservation significant species with potential to utilise habitat: • Generally good quality foraging habitat for Carnaby's cockatoo and Baudin's cockatoo • Low to moderate quality foraging habitat for the Forest Red-tailed black cockatoo • Contains occasional breeding tree for black cockatoos • Habitat for Quenda
Eucalypt Woodland	This habitat typically contains a Eucalypt woodland / open forest over a low shrubland over sandy brown soils. This habitat is variable throughout the survey area though generally contains a Eucalyptus woodland / open forest over a low shrubland over sandy brown soils. This habitat is considered high to moderate (depending on degree of degradation) quality due to the structural complexity and disturbance levels. Significant habitat characteristics include: • presence of large mature eucalypts • dense understorey occasionally present • logs of various sizes in variable abundance • fine and course leaf litter common • bare ground occasionally present • absence of stones and boulders • large hollows occasionally present, small hollows common • soils of areas at base of Darling scarp contained pea-gravel. 
	Conservation significant species with potential to utilise habitat: • Potential foraging, breeding and roosting habitat for: ▪ Forest Red-tailed black cockatoo ▪ Carnaby's cockatoo ▪ Baudin's cockatoo. • Habitat for Quenda

Fauna habitat	Description
Planted and Maintained Gardens	Highly variable habitat including areas of planted and maintained native and introduced vegetation. The habitat is considered low to moderate quality due to disturbance levels and limited habitat complexity. Significant habitat characteristics include: • mature trees rare • variability of understorey, with areas of dense understorey generally absent • general lack of hollows • bare sandy ground abundant • absence of stones, boulders and rock crevices. 
	Conservation significant species with potential to utilise habitat: • Potential foraging, breeding and roosting habitat for: ▪ Forest Red-tailed black cockatoo ▪ Carnaby's cockatoo ▪ Baudin's cockatoo. • Habitat for Quenda
Scattered Trees	This habitat is varied and contains large mature native and non-native eucalypt trees, as well as other introduced species such as Cape Lilac and Jacaranda. Trees were generally recorded over cleared areas. The significant fauna habitat characteristics include: • presence of large mature trees • absence of dense understorey • small hollows are common, large hollows are rare • logs of all sizes are rare to occasionally present • course and fine litter are present but generally only under trees. • bare sandy ground abundant • absence of stones, boulders and rock crevices. 
	Conservation significant species with potential to utilise habitat: • Potential foraging, breeding and roosting habitat for: ▪ Forest Red-tailed black cockatoo ▪ Carnaby's cockatoo ▪ Baudin's cockatoo. • Marginal habitat for Quenda
Cleared	Generally, consists of areas which have been cleared (e.g. paddocks) and now comprise bare soil and / or weeds (may contain the occasional shrub/ tree), or hardstand areas (e.g. roads). Habitat is considered very low quality. Conservation significant species with potential to utilise habitat: • This habitat may contain the occasional individual foraging tree/ shrub for black cockatoos. 

Regarding the clearing that has taken place on Lots 8 and 9 Brentwood Road there was a mapping discrepancy identified on Lot 2 Victoria Road. Table 8-2 and Figure 9 reflects the updated fauna habitat areas for Banksia Woodland, Eucalyptus Woodland and Cleared land as a result of this clearing and revision to the mapping.

Table 8-2: Fauna habitats within the site

Vegetation community	Area	Percentage of site
Remnant Native Vegetation		
Banksia Woodlands	4.51 ha	3.59%
Eucalyptus Woodland	0.05 ha	0.04%
Total Remnant Native Vegetation	4.56 ha	3.63%
Highly Modified Vegetation		
Planted and Maintained Gardens	2.59 ha	2.06%
Scattered Trees	26.94 ha	21.45%
Other		
Cleared Land	91.49 ha	72.85%
Total	125.58 ha	100%

8.3.3 Fauna habitat linkages

Habitat linkages are typically areas or corridors of vegetation that link (larger) areas of fauna habitat. Linkages are important as they enable fauna to move freely between remnant bushland patches, therefore increasing gene-flow between populations. A study conducted by Gilbert et al. (1998) found that corridors and/or linkages do maintain species richness in fragmented landscapes.

The site is located on the edge of the Perth metropolitan area and comprises significant amounts of cleared and highly modified land. AECOM (2020) found that the site is unlikely to contain any significant habitat linkages, due to clearing, habitat fragmentation and arterial roads bisecting the area, but it does contain degraded roadside drainage lines that may enable some fauna taxa to move through the area.

The site is located near the GBSW and habitat within Bush Forever Site 320, associated with the Hartfield Golf Club, however the linkage is broken by the major arterial roads of Tonkin Highway and Welshpool Road, which provide a physical separation between the site and the GBSW and Hartfield Golf Club.

8.3.4 Fauna Assemblage

Fifty-one vertebrate fauna species were recorded within the site or in adjacent areas during the AECOM (2020) field survey. This comprised 36 bird, 11 mammal, one amphibian and three reptile species. The species observed during the field survey for the wider Wattle Grove are presented in Table 8-3.

Table 8-3: Fauna species observed during field surveys (AECOM 2020)

Species	Common Name	Status	Observations
Birds			
Anas superciliosa	Pacific Black Duck	Native	Observed in artificial ponds
Anthochaera carunculata	Red Wattlebird	Native	Commonly seen and heard throughout survey area
Cacatua roseicapilla	Galah	Native	Observed multiple times during survey

Species	Common Name	Status	Observations
Cacatua sanguinea	Western Corella	Native	Small flock observed in trees
Cacomantis flabelliformis	Fan-tailed Cuckoo	Native	Heard in trees in paddock
Calyptorhynchus banksii naso	Forest Red-tailed black cockatoo	Native	Two birds observed foraging in Marri tree, multiple birds seen flying over area, multiple observations of foraging evidence
Chenonetta jubata	Australia Wood Duck	Native	Observed multiple times during survey
Chalcites (formerly Chrysococcyx) basalis	Horsfield's Bronze Cuckoo	Native	Heard multiple times
Colluricincla harmonica	Grey Shrike thrush	Native	Heard in Flooded Gums adjacent drainage line
Corvus coronoides	Australian Raven	Native	Commonly seen and heard throughout survey
Gymnorhina tibicen	Australian Magpie	Native	Commonly seen and heard throughout survey
Cracticus torquatus	Grey Butcherbird	Native	Observed flying through maintained gardens
Dacelo novaeguineae	Laughing Kookaburra	Naturalised exotic	Commonly seen and heard throughout survey area
Dromaius novaehollandiae	Emu	Native	Individual observed in an enclosure
Petrochelidon nigricans	Tree Martin	Native	Flock of 10 birds observed flying in survey area
Gerygone fusca	Western Gerygone	Native	Seen in survey area
Grallina cyanoleuca	Magpie Lark	Native	Commonly seen and heard throughout Survey
Gavicalis virescens	Singing Honeyeater	Native	Common throughout survey area
Malurus splendens	Splendid Fairywren	Native	Seen and heard twice in survey area
Merops ornatus	Rainbow Bee-Eater	Native	Multiple observations recorded throughout survey area
Ocyphaps lophotes	Crested Pigeon	Native	Observed several times
Pardalotus striatus	Striated Pardalote	Native	Commonly seen and heard throughout survey area
Pavo cristatus	Common Peafowl	Introduced	Heard several times
Phaps chalcoptera	Common Bronzewing	Native	Observed several times in survey area
Phylidonyris niger	White-cheeked Honeyeater	Native	Observed multiple times in survey area
Phylidonyris novaehollandiae	New Holland Honeyeater	Native	Commonly seen and heard throughout survey
Purpureicephalus spurius	Red-capped Parrot	Native	Observed individuals and foraging evidence multiple times
Barnardius zonarius	Australian Ringneck	Native	Commonly seen and heard throughout survey area
Rhipidura leucophrys	Willie Wagtail	Native	Commonly seen and heard throughout survey area
Spilopelia senegalensis	Laughing Turtle Dove	Introduced	Seen and heard multiple times in trees and flying over survey area

Species	Common Name	Status	Observations
Taeniopygia guttata	Zebra Finch	Native	Two finches observed in Jarrah tree
Threskiornis moluccus	Australian White Ibis	Native	Observed multiple times during survey
Todiramphus sanctus	Sacred Kingfisher	Native	Individual in tree in maintained garden
Zanda latirostris	Carnaby's cockatoo	Native	Foraging evidence observed
Zosterops lateralis	Silver-eye	Native	Observed twice in survey area, flying through trees and in banksia woodland
Mammals			
Canis familiaris	Dog	Introduced	Common throughout survey area
Capra hircus	Goat	Introduced	Observed in paddock
Equus asinus	Donkey	Introduced	Observed in field
Equus caballus	Horse	Introduced	Horses observed in multiple paddocks in survey area
Felis catus	Cat	Introduced	Seen once during survey
Isoodon fusciventer	Quenda	Native	Observed directly and indirectly (conical digging and scat) several times in survey area
Lama glama	Llama	Introduced	Observed in field
Macropus fuliginosus	Western Grey Kangaroo	Native	Observed directly and indirectly several times in survey area
Oryctolagus cuniculus	Rabbit	Introduced	Observed directly and indirectly several times in survey area
Ovis aries	Sheep	Introduced	Observed in paddock
Vulpes vulpes	Red Fox	Introduced	Multiple scats recorded
Amphibians			
Crinia glauerti	Clicking Froglet	Native	Multiple
Reptiles			
Cryptoblepharus buchananii	Buchanan's Snake- Eyed Skink	Native	Seen multiple times on trees throughout survey area
Pogona minor minor	Dwarf Bearded Dragon	Native	Observed in survey area
Tiliqua rugosa	Bobtail	Native	Observed twice during survey

8.3.5 Conservation Significant Fauna

JBS&G (2024) undertook a desktop assessments which identified a total of 34 fauna taxa of conservation significance as potentially occurring within a 10 km buffer of the site and of these 16 species were considered to have potential to occur based on presence of suitable habitat, including 9 species (including 5 migratory species) listed under both the BC and EPBC Act (See Table 2-3 of Appendix 5).

The following five conservation significant fauna species recorded within the site:

- Forest Red-Tailed black cockatoo *Calyptorhynchus banksii naso* (listed as Vulnerable under the EPBC Act and the BC Act).
- Carnaby's cockatoo *Zandi latirostris* (listed as Endangered under the EPBC Act and the BC Act).
- Quenda *Isoodon fusciventer* (listed as Priority 4 by DBCA) (refer to Figure 9 for locations of Quenda diggings and scat recorded within the site).

- Rainbow Bee-Eater *Merops ornatus* (listed as Marine under the EPBC Act).

Whilst not observed during the survey, an additional conservation significant fauna species is also considered to have the potential to utilise the habitats within the survey area:

- Baudin's cockatoo *Zandi baudinii* - listed as Endangered under the BC Act and the EPBC Act.

8.3.5.1 Rainbow Bee-eater

Whilst the Rainbow Bee-eater has historically been listed as a migratory species of conservation significance, it has since been removed from the EPBC Act migratory species list. Currently the Rainbow Bee-eater is only listed under the EPBC Act as 'Marine' and therefore is only considered conservation significant in Commonwealth marine environments. In addition, the Rainbow Bee-eater is currently considered to be a low priority for management – although population size and trends have not been quantified, the population size is assumed to be reasonably large and there is little documented evidence of population declines (DAWE 2021).

Subsequently, this species is not considered to be conservation significant in the context of the site. Two sightings of the Rainbow Bee-eater bird were recorded within the site during the AECOM (2020) survey, one of which was on Lot 254 Victoria Road and another near the boundary of Lots 2 and 201 Crystal Brook Road (Plate 8-1).

8.3.5.2 Quenda

The quenda (*Isoodon obesulus*) is a medium-sized ground dwelling marsupial of the bandicoot and bilby family (Marsupialia: Peramelemorphia) and is endemic to the south-west of Western Australia. The species is found in forest, woodland, heath and shrub communities, and its preferred habitat usually consists of a combination of sandy soils and dense heathy vegetation.

This species is listed as a 'Priority 4' species at a state level by DBCA; however, it is not listed as threatened or endangered under either the BC Act (State) or EPBC Act (Federal). Like many small to medium sized Australian marsupials, quenda have suffered a population decline post European settlement and it is estimated that their historical range distribution has contracted by approximately 40% (Abbott 2008). The Priority 4 listing means that this species is categorised as 'rare, near threatened and other species in need of monitoring'.

Quenda are known to inhabit urban backyards, urban parklands, bush fragments and conservation reserves, even where no predator control programs occur (Bryant, Kobryn, Hardy, and Fleming 2017; Howard et al. 2014; Valentine et al. 2013). However, they prefer dense, understory vegetation and are found in both open forest and dense vegetation near swamps and watercourses (Valentine et al. 2013). They are currently found in an arc along the Swan Coastal Plain, with some sightings near Geraldton in the north, extending past Cape Naturaliste and Cape Leeuwin to the south, through to Albany and Esperance in the south-east.

The habitat types of 'Cleared' and 'Scattered Trees' within the site does not provide favourable habitat for quenda, as they lack the dense understorey vegetation and cover that the species prefers. The preferred quenda habitat within the site is Banksia Woodlands (4.51 ha), with 'Planted and Maintained Gardens' (2.59 ha) also offering some habitat value. Six observations of the presence of quenda were recorded during the AECOM (2020) survey, including two observations on Lot 1 Crystal Brook Road, two observations on Lot 254 Victoria Road, one observation at the boundary of Lots 2 and 203 Crystal Brook Road and one observation on Lot 84 Victoria Road.

8.3.5.3 Black cockatoos

8.3.5.3.1 Carnaby's cockatoo

Carnaby's cockatoo (*Zanda latirostris*) is listed as Endangered under the EPBC Act (Federal) and Endangered under the BC Act (State). The species is endemic to the south-west of Western Australia, extending from the Murchison River to Esperance, and inland to Coorow, Kellerberrin and Lake Cronin. This black cockatoo has

a white patch on its cheek, white bands on its tail and a strong curved bill. Carnaby's cockatoo is a seasonal visitor to the Swan Coastal Plain, which provides important foraging and roosting habitat during the non-breeding season.

Carnaby's cockatoo feeds on seeds, nuts and flowers of a variety of native and exotic plants. Feed plants include the various proteaceous species (e.g. Banksia, Grevillea and Hakea), Marri (*Corymbia calophylla*), Jarrah (*Eucalyptus marginata*), and seeds from the cones of Pine (*Pinus* sp.) trees. Cockatoo flocks follow vegetation corridors and actively avoid cleared and open areas when moving between roosting, water and food resources. Habitat fragmentation increases the distances cockatoos need to travel between resources. Proximity of foraging habitat and water has been demonstrated to be critical to support roosting and breeding sites (Le Roux 2017).

Carnaby's cockatoo displays strong pair bonds and nest in the hollows of live or dead mature Eucalypts including Salmon Gum (*Eucalyptus salmonophloia*), York Gum (*Eucalyptus loxophleba* subsp. *Loxophleba*), Flooded Gum (*Eucalyptus rudis*), Karri (*Eucalyptus diversicolor)*, Wandoo (*Eucalyptus wandoo*), Tuart (*Eucalyptus gomphocephala*) and Marri (*Corymbia calophylla*), (DSEWPaC 2012). Nest hollows generally range from 2.5-12 m above ground, size of entrance from 23-30 cm and depth of hollows from 1-2.5 m (Johnstone and Storr 1998).

Carnaby's cockatoo has undergone a dramatic decline of approximately 50 percent in the past 45 years, with the main contributing factors the clearing of core breeding habitat in the Wheatbelt, the deterioration of nesting hollows and clearing of foraging habitat.

Breeding habitat for this species occurs in the Wheatbelt, Jarrah Forest and South Coast regions, and the species is expanding its current breeding range with small patches of breeding habitat now being utilised across the Swan Coastal Plain. After breeding, Carnaby's cockatoo disperse to the higher rainfall coastal areas of the south-west of Western Australia to feed in late December to July. Breeding has been recorded from early July to mid-December.

Carnaby's cockatoos were not directly observed during the AECOM (2020) field survey, however probable foraging evidence was recorded at three locations, one of which was located within the south-western corner of the site. Whilst undertaking a hollow inspection of several trees within the site in January 2024, Phoenix Environmental also found evidence of old and new foraging evidence on Jarrah nuts and at least 4 preened black cockatoo feathers under a tree (ID 491) within the south-western corner of the site (Phoenix Environmental 2024).

8.3.5.3.2 Forest Red-tailed black cockatoo

The Forest Red-tailed black cockatoo (*Calyptorhynchus banksii naso*) is listed as Vulnerable under the EPBC Act (Federal) and Vulnerable under the BC Act (State). The species is endemic to the south-west humid and semi-humid zones of Western Australia, where it inhabits dense Jarrah, Karri and Marri forests which receive more than 600 mm average annual rainfall (DSEWPaC 2012). It has a pair of black central tail feathers and a bright red, orange or yellow barring on the tail.

This species predominantly feeds in eucalypt forests, preferring Marri (*Corymbia calophylla*) and Jarrah (*Eucalyptus marginata*) seeds, but also feeding on Blackbutt (*Eucalyptus patens*), Albany Blackbutt (*Eucalyptus staeri*), Karri (*Eucalyptus diversicolor)*, Sheoak (*Allocasuarina* sp.) and Snottygobble (*Persoonia longifolia*) (Johnstone and Kirkby 2016).

Forest Red-tailed black cockatoo is monogamous and pairs nest in tree hollows from 6.5 to 33 m above ground. Most nests are in very large and very old, mature Marri (Johnstone, Kirkby and Sarti 2013), though they will nest in other Eucalypts such as Tuart (Johnstone and Kirkby 2016). Breeding habitat for this species occurs in the eastern margins of the Jarrah forests of the Wheatbelt, and within the Jarrah Forest regions. The Forest Red-tailed black cockatoo is also expanding its current breeding range with small patches of breeding habitat now being utilised across the Swan Coastal Plain.

During the AECOM field survey, two individuals of the Forest Red-tailed black cockatoo were observed foraging in a Marri tree outside of the site and multiple birds were seen and heard flying over the wider survey area. Multiple observations of old and recent foraging evidence were also recorded, including at two locations within the site (adjacent to Crystal Brook Road and in the south-western corner adjacent to Tonkin Highway) (AECOM 2020). As previously advised, Phoenix Environmental also found evidence of old and new foraging evidence on Jarrah nuts and at least 4 preened black cockatoo feathers under a tree (ID 491) within the south-western corner of the site (Phoenix Environmental 2024).

8.3.5.3.3 Baudin's cockatoo

Baudin's cockatoo (*Zanda baudinii*) is listed as Endangered under the EPBC Act (Federal) and the BC Act (State). The species is distributed throughout the south-western humid and subhumid zones of Western Australia, from the northern Darling Range and adjacent far east of the Swan Coastal Plain (south of the Swan River), south to Bunbury and across to Albany (Johnstone and Storr 1998). It is a large black cockatoo with rectangular white patches in the tail. Males have a pink eye ring, the female a dark eye ring.

Baudin's cockatoo forages primarily in Eucalypt forest, where it feeds on seeds, flowers, nectar and buds from Marri (*Corymbia calophylla*), and seeds of Eucalyptus and proteaceous species (e.g. Banksia and Hakea), as well as orchard fruits and Pines (*Pinus* sp). It also takes insect larvae and insects (including beetle, wasp and moth larvae) from under bark and in wood of live and dead trees, from galls and from flower spikes of Xanthorrhoea and the pith of *Anigozanthos flavidus* (Johnstone and Kirkby 2008).

This black cockatoo primarily nests in tree hollows in live or dead Karri (*Eucalyptus diversicolor*), Marri (*Corymbia calophylla*), Wandoo (*Eucalyptus wandoo*) and Tuart (*Eucalyptus gomphocephala*) (DSEWPaC 2012). Baudin's cockatoo nests in spring in the deep south-west of Western Australia.

No Baudin's cockatoo or foraging evidence of this species has been observed in or adjacent to the site. Baudin's cockatoo is considered far less likely to occur within the site and instead, may occur occasionally as vagrants from the Perth foothills where there are records further west on the Swan Coastal Plain (BCE 2019 as cited in Phoenix Environmental 2024)

8.3.6 Black Cockatoo Habitat

8.3.6.1 Foraging Habitat

The site contains both native and introduced vegetation, of varying quality, some of which may be suitable for foraging for all three black cockatoo species, as described in Table 7-4. The suitability of this habitat for foraging varies, depending on the type of habitat and its condition.

AECOM (2020) previously assessed the black cockatoo foraging habitat for wider Wattle Grove area using the (then) DAWE (2017) draft referral guideline scoring tool. The factors applied to this scoring tool include foraging potential, connectivity, proximity to known breeding and roosting sites and plant disease and because all of these factors favour the site and therefore, within the site a larger area was considered to have Very High and High foraging habitat value for all 3 species of black cockatoo (Phoenix Environmental 2024). However, in reality the abundance of forage species is minimal for both high quality forage species such as Banksia, Marri and Pine (predominantly <10% foliage cover), as well as lower quality forage species such as small fruited eucalypts and introduced fruit trees (Phoenix Environmental 2024).

AECOM (2020) also recorded the presence of trees with potentially suitable nest hollows (in the south-west corner and along the eastern boundary of the site), which contributed towards a higher foraging habitat value score (as the DEE (2017) scoring tool requires a factor of 3 to be added to the overall score if there are any trees with suitable nest hollows); however, upon closer inspection of the hollows by Phoenix Environmental during their site visit in January 2024 it was discovered that the trees did not contain any suitable hollows (Phoenix Environmental 2024).

As part of the further black cockatoo habitat assessment undertaken by Phoenix Environmental (2024) for the site, the Bamford Consulting Ecologists (BCE) (2021) scoring system was used instead of the DAWE (2022a) scoring tool.

Whilst the BCE (2021) scoring may derive a lower score than those presented in AECOM (2020), it is considered a more accurate depiction of the foraging habitat value and the predicted distribution (Phoenix Environmental 2024). Further, it takes into consideration the condition of the foraging habitat, whereas the former DEE (2017) and current DAWE (2022) scoring tools do not include this as a factor. The presence of weeds and introduced forage species does provide an indication of low value forage habitat due to their sparse coverage and/or poor-quality food source and poor accessibility, especially when compared to native forage species found in remnant native patches which are generally higher in quality and abundance (Phoenix Environmental 2024).

Phoenix Environmental has used the data collected by AECOM (2020) and JBS&G (2024), which included site surveys undertaken by AECOM in 2019 and JBS&G in 2021 and 2022 and determined the foraging habitat value using the BCE (2021) scoring system for all three black cockatoos within the site.

At the time of the surveys undertaken by AECOM (2020) and JBS&G (2024), there were no records of fire and therefore, is unlikely to have impacted forage species coverage scores (Phoenix Environmental 2024).

The BCE (2021) scoring system provides a foraging value score that reflects the significance of vegetation as foraging habitat for black cockatoos and a numerical value that is designed to assess potential impact significance and offset requirements. The foraging value of the vegetation is dependent on the following components:

- Site condition – a score out of six is determined based on the vegetation composition, condition and structure.
- Site context – a score out of three is determined for the context of the site, which is a function of site size, availability of nearby habitat and breeding area, as well as consideration of connectivity to access foraging sites.
- Species stocking rate – a score out of one is determined based on upon the black cockatoo species being either abundant or not-abundant (i.e. a score of 1 is used when the species is reported regularly and/or there is abundant foraging evidence and a score of 0 is used when the species is recorded or reported very infrequently, and there is little or no foraging evidence).
- Determining the total score out of 10, which may require moderation for context and species density with respect to the site condition (vegetation) score. Moderation also includes consideration of pine plantations as a special case for foraging value

Site condition is scored out of 6 and is the biggest factor in the overall score. Site condition varied between species of black cockatoo and vegetation communities, with higher scores being attributed to those vegetation communities/habitats with a higher density of foraging species (Phoenix Environmental 2024).

The site context was assigned by Phoenix Environmental (2024) as 3 to all polygons, given:

- Carnaby's cockatoo: local breeding is also known and 32.9% of native vegetation remains within 15 km of the site.
- Baudin's cockatoo: no local breeding is known or likely, but 32.9% of native vegetation remains within 15 km of the site
- Forest Red-tailed black cockatoo: no local breeding is known or likely, but 32.9% of native vegetation remains within 15 km of the site.

The following stocking rates were calculated by Phoenix Environmental as:

- Carnaby's cockatoo: stocking rate = 1 as observed feeding and multiple recent and historic evidence of feeding activity were recorded (i.e. AECOM 2020; DBCA 2023; JBS&G 2024 and here).

- Baudin's cockatoo: stocking rate = 0 as no feeding was directly observed, nor was recent or historical evidence found, and desktop records are also absent within 15 km of the site
- Forest Red-tailed black cockatoo: stocking rate = 1 as observed feeding and multiple recent and historic evidence of feeding activity were recorded (i.e. AECOM 2020; DBCA 2023; JBS&G 2024 and here).

The moderation values were applied to parts of the habitat polygons that did not record a known forage species (native or introduced) (Phoenix Environmental 2024).

The resultant foraging habitat scores for all three black cockatoos area according to the vegetation communities (Figure 5) is presented in Table 8-4 and summarised in Table 8-5. For further detail on the resultant site scores and how they were derived according to the vegetation community for each black cockatoo species, please refer to Appendix 8.

The spatial distribution of the foraging habitat value is show in Figure 10 (Carnaby's cockatoo), Figure 11 (Forest Red-tailed black cockatoo) and Figure 12 (Baudin's cockatoo).

Based on the density of suitable foraging species, most of the site (ranging from 95.96% for Carnaby's cockatoo to 97.01% for Forest Red-tailed black cockatoo) is comprised of low foraging habitat value for all three Black cockatoos (Table 8-4). The Banksia Woodland (BaEpPf and BmXpEc) and Eucalyptus Woodland (EmMpLp) scored the highest at either 7 or 8 out of 10. There were some discrete areas that were of medium foraging habitat value for Carnaby's cockatoo (located on Lot 801 and Lot 2) and Baudin's cockatoo (located on Lots 84, 504, 803 and 804).

Table 8-4: Black cockatoo foraging habitat value per BCE 2021 scoring method

Vegetation community	Rating*	Carnaby's cockatoo		Baudin's cockatoo		Forest Red-tailed black cockatoo	
		Score	Sum area (ha)	Score	Sum area (ha)	Score	Sum area (ha)
BaEpPf	Low	-	0	2	0.82	3	0.82
	Medium	6	0.82	5	1.34	-	0
	High	8	3.41	7	2.07	8	3.41
BmXpEc	High	-	0	7	0.15 (pre clearing 0.29)	7	0 (pre clearing 0.05)
		8	0.15 (pre clearing 0.29)	-	0	8	0.15 (pre clearing 0.24)
EmMpLp	Low	2	0.08	3	0.08	3	0.08
	High	8	0.05	7	0.05	8	0.05
Trees	Low	2	20.43	2	21.62	2	20.61
		3	5.84	3	4.48	3	6.30
	Medium	5	0.59	5	0.81	-	0
		6	0.05	-	0	-	0
Planted	Low	2	2.80	3	2.80	2	2.80
Cleared	Low	2	91.37 (pre clearing 91.23)	2	91.37 (pre clearing 91.23)	2	91.37 (pre clearing 91.23)
Total area (ha)		**125.59**		**125.59**		**125.59**	

*** Relative Rating**

- Low value habitat (red) is 1 to 3 out of 10
- Medium value habitat (yellow) is 4 to 6 out of 10
- High value habitat (green) is 7 to 10 out of 10

Table 8-5: Summary of foraging habitat scores per black cockatoo species

Rating	Score	Carnaby's cockatoo		Baudin's cockatoo		Forest Red-tailed black cockatoo	
		Area (ha)	%	Area (ha)	%	Area (ha)	%
Low	2	114.68	91.32	113.81	90.63	114.78	91.39
	3	5.84	4.65	7.36	5.79	7.20	5.73
Subtotal		120.52	95.97	121.17	96.49	121.97	97.13
Medium	5	0.59	0.47	2.15	1.70	-	-
	6	0.87	0.69	-	-	-	-
Subtotal		1.46	1.16	2.15	1.70	-	-
High	7	-	-	2.27	1.81	0.00	-
	8	3.61	2.87	-		3.61	2.87
Subtotal		3.61	2.87	2.27	1.81	3.61	2.87
Total area (ha)		**125.59**	**100.00**	**125.59**	**100.00**	**125.59**	**100.00**

Given the results of the habitat assessment, Phoenix Environmental (2024) recommended that all of the high-quality TEC remnant vegetation present within the site is retained to support local breeding, roosting and foraging for Carnaby's cockatoo and Forest Red-tailed black cockatoo as the remaining areas offer little value to those species.

Areas that have been subject to clearing or development have been mapped as 'Cleared', and include the recent clearing on Lots 8 and 9. As a result, the areas provided in the table below will have a minor variation to the areas presented in the Phoenix Environmental (2024) black cockatoo habitat assessment report (Appendix 8).

The recent black cockatoo habitat assessment undertaken by Phoenix Environmental (2025) for Lot 54 Victoria Road, confirmed the existing foraging habitat values to be low with a score of 2 for all three black cockatoos.

8.3.6.2 Potential Breeding Habitat

Potential nesting trees, in the context of black cockatoos, are defined by DAWE (2022) as native trees of suitable species with a diameter at breast height (DBH) greater than 500 mm (or >300 mm for Salmon Gum and Wandoo). Trees with a DBH greater than 500 mm (or >300 mm for Salmon Gum and Wandoo) are large enough to potentially contain hollows suitable for nesting black cockatoos or have the potential to develop suitable hollows over the next 50 years.

Based on the AECOM (2020) and JBS&G (2024) surveys, and the more recent Phoenix Environmental (2025) survey, a total 158 potential nesting trees have been recorded within the site (Figure 13).

The majority of potential nesting trees are scattered in areas of degraded habitat or cleared land/paddocks and consist of native trees known to support breeding such as Jarrah, Marri, Tuart and Flooded Gums (Phoenix Environmental 2024).

8.3.6.2.1 Tree hollow inspection

As part of Phoenix Environmental (2024) analysis of the black cockatoo data collected from the site surveys by AECOM (2020) and JBS&G (2020), seven potential nesting trees were identified as requiring re-inspection to confirm location and suitability of hollows as nests for black cockatoos (Appendix 8). Phoenix Environmental (2024) inspected the seven potential nesting trees on 19 January 2024 with a GoPro pole camera and recorded tree species, DBH, number of hollows present, hollow heights present, hollow height

and orientation, hollow suitability (e.g. size of entrance, condition of outside of the hollow), and evidence of use (Phoenix Environmental 2024).

None of the inspected trees are suitable for black cockatoo nesting, and of the seven trees visited (Phoenix Environmental 2024):

- two are considered to be erroneous and should be removed from the dataset (NewID = 0)
- tree 417 is no longer present; given its age and comments, it is assumed that this tree had deteriorated
- tree 482 was in poor condition and no longer contained suitable hollows
- the remaining three trees (438, 491, 561) contained unsuitable hollows (too small and/or inhabited by bees). It is worthwhile to note that abundant forging evidence was seen under habitat tree 491.

In order to be suitable for black cockatoos, hollow entrances need to be at least 100 mm in diameter. Hollows in Jarrah tend to be smaller than those found in Marri, consequently black cockatoos, particularly Forest Red-tailed black cockatoos, breed predominantly in Marri, in the Jarrah-Marri forest of the south-west (Whitford 2002; Johnstone et al 2013). On the Swan Coastal Plain most black cockatoo breeding records, particularly for Carnaby's cockatoo, are in Tuart (Johnstone and Kirkby 2011).

Given the semi-urban nature of the local environment and the outcome of the hollow inspection undertaken by Phoenix Environmental (2024), it is unlikely that the site represents breeding habitat for any of the 3 black cockatoo species especially in the absence of confirmed or historic breeding observations and the absence of any trees with suitable hollows.

The site does contain small areas of high-quality foraging habitat, as well as water sources and roosting site in close proximity, and so whilst the site could be considered high quality future breeding habitat, the site comprises semi-rural residential land that has been heavily developed and highly modified (Phoenix Environmental 2024). Subsequently, numerous potential nesting trees have been lost over the past few years due to age and condition and therefore, in the consideration of the current land use, it is considered highly unlikely that the current crop of trees will still be standing in 50 to 100 years, which is when they may begin to develop larger hollows suitable for breeding (Phoenix Environmental 2024).

8.3.6.3 Potential Roosting Habitat

Carnaby's and Baudin's cockatoos roost in or near riparian environments or near other permanent water sources, generally within any tall trees, but particularly Flat-topped Yate, Salmon Gum, Wandoo, Marri, Karri, Blackbutt, Tuart, introduced Eucalypts and introduced Pines. The Forest Red-tailed black cockatoo prefers the edges of forests for roosting, within any tall trees, but particularly tall Jarrah, Marri, Blackbutt, Tuart and introduced Eucalypt trees (DotEE 2017).

Within 12 km of the site, there are 50 confirmed roosting sites (23 Forest Red-tailed black cockatoo roosting sites, 7 White tailed black cockatoo roosting sites and 20 White-tailed and Forest Red-tailed roosting sites) and 10 unconfirmed roosting sites (Plate 8-2) (Birdlife 2024, as cited in Phoenix Environmental 2024).

Located 250 m east from the site is an unconfirmed roosting site (KALWATR001), which means roosting black cockatoos have been provided but there has been no positive count recorded during any of the Great Cocky Count census (Birdlife 2024, as cited in Phoenix Environmental 2024). The following 2 roosting sites occur to the east and are within 1 km of the site (Plate 8-2) (Phoenix Environmental 2024):

- Confirmed site (KALWATR002) is located 850 m east of the site and is known to support FRTBC roosting of up to 150 individuals (Great Cocky Count Census 2016, 2018) (DBCA 2023), with lower numbers recorded in subsequent years (2019 – 23, 2021 – 87, 2022 – 0 and 2023 – 35).
- Unconfirmed site (KALWATR001) is located 250 m east of the site. An unconfirmed black cockatoo roosting site is where roosting has been reported but there has been no positive count recorded during any of the Great Cocky Count census (Birdlife 2024, as cited in Phoenix Environmental 2024).

The habitat assessment undertaken by AECOM (2020) determined that 29.8 ha of suitable roosting habitat was present, consisting of remnant native vegetation, planted gardens and scattered trees; however, these have been found to be of largely low value (Phoenix Environmental 2024).

Numerous surveys have been undertaken within the site since 2019, as well as numerous sites in close proximity are part of annual black cockatoo monitoring, and to date no roosting sites for black cockatoo species have been identified within the site (Plate 8-2). So, while there may be suitable roosting habitat, it does not appear to be used as such, at least not for the last decade (Phoenix Environmental 2024).

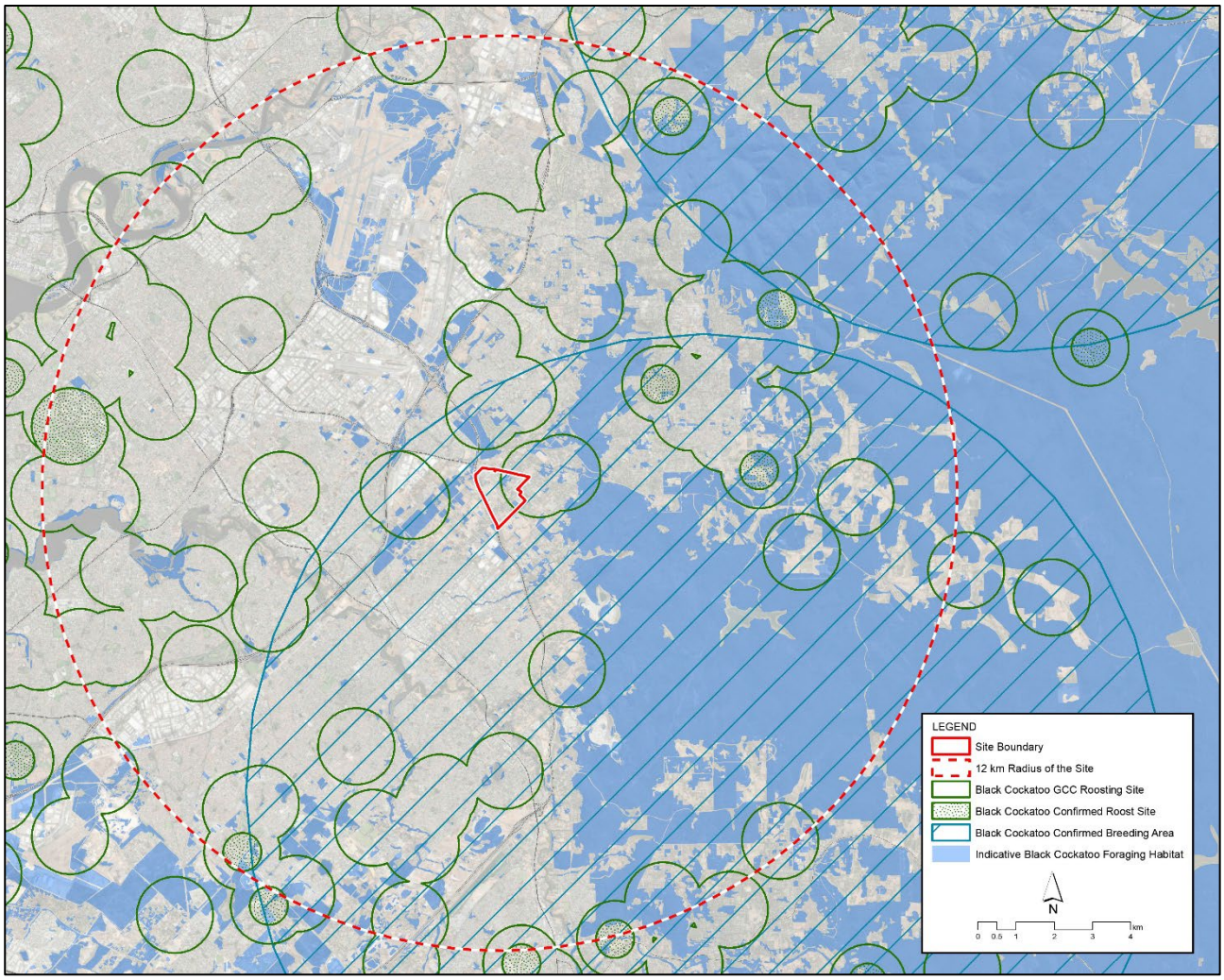


Plate 8-2: Black cockatoo roosting and breeding sites (within 12km)

8.3.6.4 Regional Context Analysis

Plate 8-3 shows the regional context of black cockatoo foraging habitat. A total of 14,251 ha of potential black cockatoo foraging habitat has been identified within 12 km of the site extent, with 43% of this within the following DBCA managed reserves:

- Korung National Park (4,101.46 ha)
- Beelu National Park (1,016.77 ha)
- Greenmount State Forest (883.55 ha)
- Kalamunda National Park (375.60 ha)
- Greenmount National Park (70.44 ha)

The site comprises 0.03% of the potential foraging habitat within this extent, which is not considered significant in a regional context.

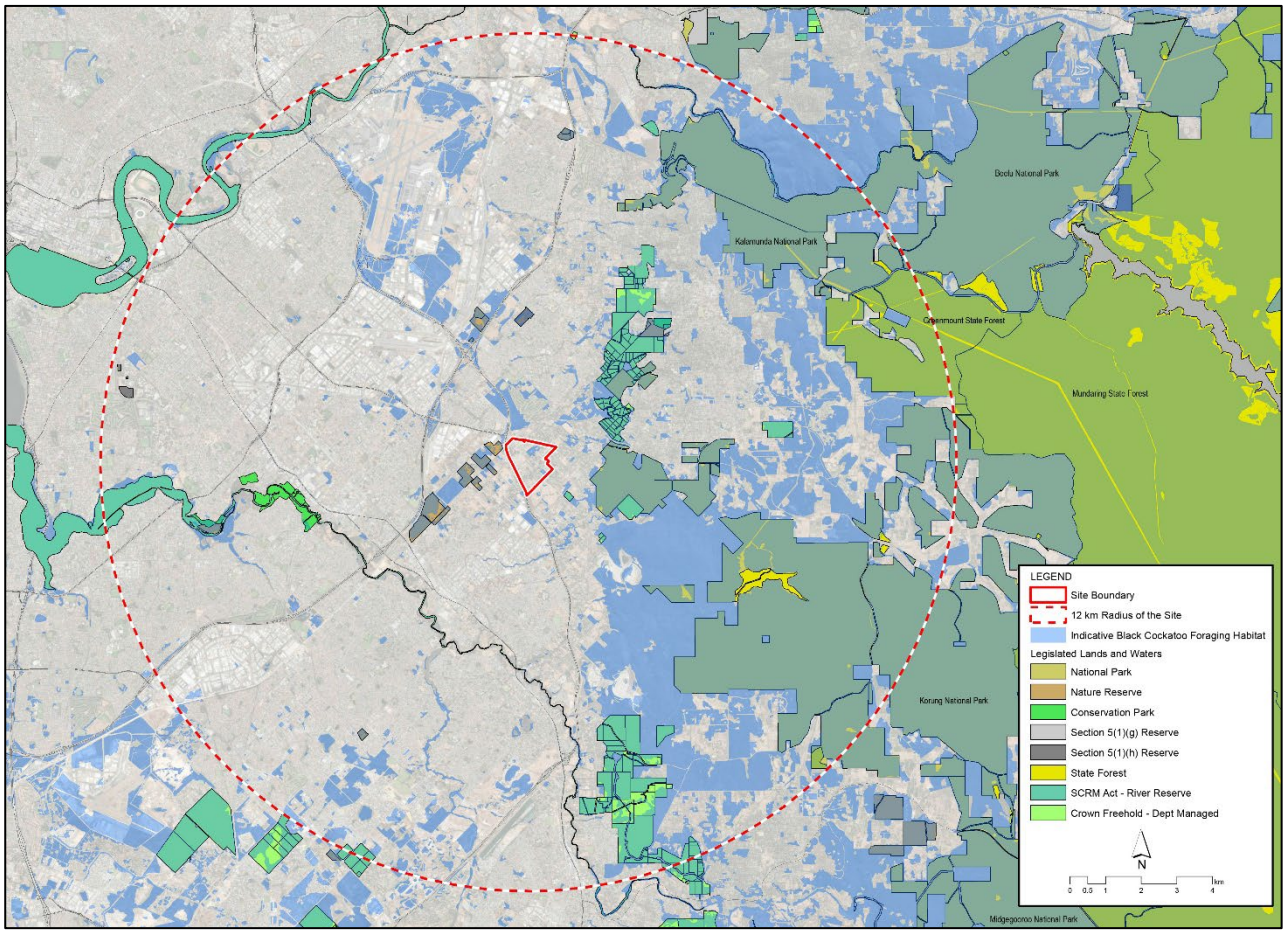


Plate 8-3: Regional black cockatoo foraging habitat

8.4 Potential Impact Identification and Assessment

Future urban development as well as the provision of associated infrastructure, within the site has the potential to directly and indirectly impact conservation significant fauna that may utilise habitat within the area, namely black cockatoos and quenda. Potential impacts include:

- Loss of significant fauna habitat including black cockatoo breeding, roosting and foraging habitat.
- Direct or indirect impacts or loss of other significant fauna and fauna habitat.
- Fragmentation of fauna habitat and loss of ecological connectivity.
- Degradation of fauna habitat and habitat modification from introduction and increased spread of weeds and/or disease, altered surface water flows, altered groundwater and edge effects.
- Fauna mortality as a result of construction activities.
- Disturbance to waterbirds (including migratory species) from impacts to wetlands.
- Altered fauna behaviour due to noise, lighting and human presence.
- Change in feral animal abundance and/or movement.

8.4.1 Direct Impacts

Direct impacts are predominantly limited to clearing activities during development. Indirect impacts may also occur as a result of construction activities during the development phase, or as a result of increased population and human activity in the post development phase.

The potential impacts to conservation significant fauna are presented below.

8.4.1.1 Clearing of Fauna Habitat

The clearing of native and non-native vegetation within the site has the potential to directly impact conservation significant fauna, through the loss and/or dispersal of breeding and foraging habitat. The direct impacts to conservation significant fauna and fauna habitat have been considered in the context of the most conservative scenario of vegetation clearing.

In relation to black cockatoo foraging habitat, Table 8-6 lists the foraging habitat area and quality for each black cockatoo species and those that will be retained in Conservation areas. The areas provided also accounts for the clearing on Lots 8 and 9 Brentwood Road and the mapping discrepancy on Lot 2 Victoria Road. The table demonstrates that all areas containing high quality foraging habitat for all three black cockatoos will be retained for conservation.

Table 8-7 presents the most conservative clearing scenario and are summarised as follows:

- Clearing 0.72 ha and 0.80 ha of medium quality foraging habitat for Carnaby's cockatoo and Baudin's cockatoo, respectively, represents 0.006% of black cockatoo foraging habitat within 12 km of the site, this. Whereas, clearing of low-quality foraging habitat for Carnaby's cockatoo (29.28 ha), Baudin's cockatoo (29.93 ha) and Forest Red-tailed black cockatoo (30.74 ha) represents approximately 0.2% of the existing black cockatoo foraging habitats within 12 kms of the site.
- Most areas to be developed comprise of Cleared or highly modified land that has to be categorised as low-quality foraging habitat with 120.51 ha (95.97%) for Carnaby's cockatoo, 121.16 ha (96.48%) for Baudin's cockatoo and 121.97 ha (97.12%) for Forest Red-tailed black cockatoo.
- Clearing of 0.16 ha of Degraded to Completely Degraded condition Banksia Woodlands, representing habitat for quenda.
- Clearing of individual scattered trees dispersed across 26.9 ha of disturbed land, representing low quality habitat for quenda due to the predominant absence of dense understorey.
- Clearing of individual trees and plants dispersed within 2.8 ha of planted and maintained gardens, with low quality foraging habitat for all three black cockatoo species but offering some potential habitat for quenda.
- Of the individual trees that are proposed to be cleared, 151 trees are potential nesting trees of which none have suitable breeding hollows.

It is worthwhile to note that the Local Structure Plan has located a number of Public Open Space areas over clusters of potential nesting trees within the site with the aim of retaining these trees (where practicable) (Figure 13).

The Local Structure Plan includes a Tree Retention and Canopy Strategy, and sets out the following:

- **Conservation and Avoidance Principles:** the allocation of Conservation Areas to retain areas of remnant vegetation containing threatened ecological communities, threatened/priority flora and black cockatoo habitat, in accordance with Environmental Conditions set under the Ministerial Statement.
- **Placement of Public Open Space Pockets:** Clusters of foraging trees are being retained within new public open space areas. Placement of recreation and informal active public open spaces shall protect and enhance significant flora and vegetation.

- **Canopy Corridors:** Street designs and street blocks are configured, sited and aligned to allow for the retention of existing canopy trees within the public realm, employing wide verges and adapting the road alignment to accommodate canopy trees.
- **Lot Design and Development Provisions:** to facilitate future tree planting within front setbacks of private lots.
- **Minimising Earthworks:** The site benefits from a minimal requirement for cut and fill earthworks. Carefully considered earthworks design shall facilitate the area of remnant scattered trees being retained.

Additionally, the Environmental Conditions (Appendix 2) and the Local Structure Plan Part 1 provisions, require the preparation of a TCRLMP prior to subdivision or development to ensure the retention and replacement of potential nesting trees within the site creates connectivity between the retention areas and retained black cockatoo habitat.

Regarding fauna and black cockatoo habitats within the Conservation areas, the CAMS (Appendix 3) provides a guide to the future preparation of the CAMP for each Conservation Area and requires the following to be undertaken:

- confirmation and delineation of the final boundary of the Conservation area
- baseline fauna habitat and black cockatoo habitat assessment to confirm, map and assess the current condition and habitat quality,
- develop management measures to maintain or enhance (where practicable) the quality and/or available habitat within the Conservation Areas.

Thereby ensuring the environmental outcomes set out in the Environmental Conditions can be met and there are no adverse impacts on conservation significant vegetation within the site.

Table 8-6: Foraging habitat value per black cockatoo species in Conservation

Rating/ Score		Carnaby's cockatoo			Baudin's cockatoo			Forest Red-tailed black cockatoo		
		Extent in Site	Conservation	Potential Conservation	Extent in Site	Conservation	Potential Conservation	Extent in Site	Conservation	Potential Conservation
Low	2	114.68 ha (91.32%)	-	0.05 ha (0.04%)	113.81 ha (90.63%)	-	0.79 ha (0.63%)	114.78 ha (91.39%)	-	0.05 ha (0.04%)
	3	5.84 ha (4.65%)	-	-	7.36 ha (5.79%)	-	-	7.20 ha (5.73%)		0.74 ha (0.59%)
Subtotal		120.52 ha (95.97%)	-	-	121.17 ha (96.48%)		-	121.97 ha (97.12%)	0.60 ha (0.48%)	-
Med.	5	0.59 ha (0.47%)	-	-	2.15 ha (1.71%)	1.34 ha (1.06%)	-	-	-	-
	6	0.87 ha (0.69%)		0.74 ha (0.59%)	-	-	-	-	-	-
Subtotal		1.46 ha (1.16%)		-	2.15 ha (1.71%)	1.34 ha (1.06%)	-	-	-	-
High	7	-	-	-	2.27 ha (1.81%)	2.27 ha (1.81%)	-	-	-	-
	8	3.61 ha (2.88%)	3.61 ha (2.87%)	-	-	-	-	3.61 ha (2.87%)	3.61 ha (2.87%)	-
Subtotal		3.61 ha (2.88%)	3.61 ha (2.87%)		2.27 ha (1.81%)	2.27 ha (1.81%)	-	3.61 ha (2.87%)	3.61 ha (2.87%)	
Total		**125.59 ha (100%)**	**3.61 ha (2.87%)**	**0.79 ha (0.63%)**	**125.59 ha (100%)**	**3.61 ha (2.87%)**	**0.79 ha (0.63%)**	**125.58 ha (100%)**	**3.61 ha (2.87%)**	**0.79 ha (0.63%)**

Table 8-7: Fauna habitat retained within conservation and potential clearing impact

Habitat values	Area	Retained within Conservation	Potential clearing impact (conservative clearing scenario)
Banksia Woodland			
• Low, medium and high-quality foraging habitat for Carnaby's cockatoo and Baudin's cockatoo. • Low and high-quality foraging habitat for the Forest Red-tailed black cockatoo. • 3 potential nesting trees for black cockatoos. • Habitat for quenda.	4.51 ha	4.35 ha (96% of all remnant native vegetation) which includes: • 3.56 ha of Good to Excellent condition vegetation • Medium to high quality foraging habitat for Carnaby's cockatoo and Baudin's cockatoo • Low- and high-quality foraging habitat for Forest Red-tailed black cockatoo • 3 potential nesting trees for black cockatoos • Habitat for quenda	0.16 ha (4% of all remnant native vegetation) of: • Degraded to Completely Degraded condition vegetation • Low quality foraging habitat Baudin's and Forest Red-tailed black cockatoo • Low and medium quality foraging habitat for Carnaby's • 0 potential nesting trees for black cockatoos • Habitat for quenda

Habitat values	Area	Retained within Conservation	Potential clearing impact (conservative clearing scenario)
Eucalyptus Woodlands			
• High quality foraging habitat for all three black cockatoo species. • 4 potential nesting trees for black cockatoos. • Habitat for quenda.	0.05 ha	0.05 ha which includes: • High quality foraging habitat for all three black cockatoo species. • 4 potential nesting trees for black cockatoos. • Habitat for quenda	0 ha
Scattered Trees			
• Low quality foraging habitat for all 3 black cockatoo species. • 0.72 ha and 0.80 ha of medium quality foraging habitat for Carnaby's cockatoo and Baudin's cockatoo, respectively • Comprising 140 potential nesting trees for black cockatoos. • Low quality habitat for quenda due to the absence of dense understorey.	26.90 ha	0.32 ha of which includes: • Medium to low quality foraging habitat for Carnaby's cockatoo • Low quality foraging habitat for Baudin's cockatoo and Forest Red-tailed black cockatoo	26.58 ha of individual trees (both native and introduced species) scattered across the site, which comprise: • mostly low-quality foraging habitat for all three black cockatoos • 0.72 ha and 0.80 ha of medium quality foraging habitat for Carnaby's and Baudin's cockatoo, respectively • 145 potential nesting trees for black cockatoos • Low quality habitat for quenda due to the absence of dense understorey.
Planted and Maintained Gardens			
• Low quality foraging habitat for all 3 black cockatoo species. • 6 potential nesting trees for black cockatoos. • Potential habitat for quenda.	2.80 ha	0 ha	2.8 ha of trees and plants (both native and introduced species) dispersed across planted gardens in the site, which comprise: • low quality foraging habitat for all three black cockatoos • 6 potential nesting trees for black cockatoos • potential habitat for quenda
Cleared Ground			
• Low quality foraging habitat for all 3 black cockatoo species. • Nil to negligible quality habitat for quenda	91.32 ha	NA	NA
	Total	**4.72 ha**	**29.54 ha**

8.4.2 Indirect Impacts

The inhabitants of new urban communities have the potential to indirectly impact on fauna and fauna habitat through uncontrolled access (by vehicles and pedestrians), littering, dumping, the introduction of feral and predatorial animals and through the spread of weeds or disease and increased fire risk. Many of these impacts may also occur during construction activities during the development phase.

Other potential indirect impacts of urbanisation of the site include fragmentation of fauna habitat, dust deposition and erosion. Consideration of these potential indirect impacts is provided below.

It should be noted that all indirect impacts as a result of urbanisation of the site will be managed through the preparation, approval and implementation of the CEMP, at subsequent stages of the planning process (i.e. subdivision or development) and during construction works, which is a standard condition of subdivision.

8.4.2.1 Fragmentation of fauna habitat and edge effects

Fragmentation is the process by which contiguous areas of habitat are interrupted or separated into two or more smaller areas. The outcome from fragmentation is changes to fauna movement patterns and the impact it has on their ability to disperse. Fragmentation can result in genetic isolation and increased pressure for limited resources. Ultimately, fragmentation leads to a reduction in ecological integrity and a species resilience.

The site comprises significantly altered areas, including cleared, planted and handstand areas, with approximately 91.23 ha (73%) of land already cleared. Areas of remnant native vegetation with moderate to high fauna habitat value within the site are small, comprising approximately 3.6% of the total area. All other vegetation types within the site are highly disturbed and have low fauna habitat value.

Therefore, new urban development from the proposed change in land use will not cause fragmentation of the remaining areas of native vegetation with moderate to high fauna habitat value, as they are proposed to be retained in their entirety within future Conservation areas, thereby ensuring no further fragmentation will occur.

Concerning edge effects, given the high level of fragmentation that has already occurred around the remaining areas of remnant vegetation and associated fauna habitat within the site there is potential for additional edge effects as future urban development proceeds.

The Local Structure Plan has placed the remaining areas of native vegetation with high fauna habitat value within Conservation areas. In accordance with the Environmental Conditions (Appendix 2), In accordance with the Environmental Conditions (Appendix 2), the Local Structure Plan Part 1 provisions, and guided by the CAMS (Appendix 3), a CAMP will be developed and implemented to prevent further fragmentation and edge effects and support ongoing environmental management to protect, maintain and enhance the environmental values of the Conservation Areas as urban subdivision or development of the site progresses.

8.4.2.2 Ecological linkages

Ecological corridors have been identified in the Perth metropolitan region to limit the effects of fragmentation across areas of remnant bushland. As previously identified, there is one Regional Ecological Linkage at the north-westernmost extent of the site (Link ID: 40), which connects the GBSW and the Hartfield Road Bushland (WALGA 2008) (Plate 7-3); however, the small portion of this Regional Ecological Linkage which falls within the site (over portions of Lot 146 Welshpool Road East and Lot 12 Brentwood Road) has been predominantly cleared.

Notwithstanding the above, in accordance with the Environmental Conditions (Appendix 2) and the Local Structure Plan Part 1 provisions, the TCRLMP will be prepared at subdivision and development to ensure that as many trees are retained within the urban landscape, as well as prioritising the retention and revegetation of black cockatoo habitat trees within the site.

Therefore, urbanisation of the site will not impact the regional ecological linkage, and any functions currently facilitated by the linkage will still be maintained and could be enhanced through future urbanisation of the site.

8.4.2.3 Hydrological changes

As previously discussed, urbanisation of the site is expected to increase groundwater recharge due to reduced evapotranspiration and increased infiltration and recharge of the superficial aquifer, via runoff from roads, roofs, and hard surfaces. However, the rise in groundwater levels is predicted to be minimal, as the site's vegetation is not groundwater dependent due to the significant depth to groundwater (4–20 m below surface). Additionally, the predicted recharge increase is offset by the cessation of artificial recharge previously caused by irrigation at the now-disused turf farm, which had been contributing to groundwater mounding in the superficial aquifer.

Post-development modelling indicates that urbanisation will not significantly raise groundwater levels, and stormwater runoff can be managed to maintain existing annual recharge in the area of the mound to retain groundwater flows and direction toward the GBSW. Given the depth to groundwater and the limited impact of urbanisation on aquifer recharge, no significant residual impacts on flora and vegetation are expected from the proposed residential development.

The LWMS aims to maintain the hydrological regimes and provides an opportunity to significantly reduce nutrient application from the site and the export of nutrients towards the Greater Brixton Street Wetlands. Given the hydrological complexities of the site, the LWMS also promotes an adaptive management approach for the site which is underpinned by the continued implementation of the current water monitoring program. The monitoring program and reporting framework encapsulates monitoring of the Superficial Aquifer groundwater levels and quality (near the turf farm and the GBSW), which will enable ongoing review of seasonal groundwater contours and flow direction pre-and post- development, the influence of the groundwater mound post development, and review of groundwater quality.

In accordance with the Environmental Conditions (Appendix 2), the Local Structure Plan Part 1 provisions, and guided by the LWMS, the UWMPs will be prepared as part of future subdivision and development of the site to minimise adverse impacts to the GBSW from urban development of the site, including impacts to the wetlands' persistency, hydrological regime, water quality, ecological integrity and ecological function.

Therefore, no significant impacts to fauna habitats associated with wetlands and riparian vegetation, and groundwater dependent ecosystems within and nearby to the site (including the GBSW) are anticipated.

8.4.2.4 Dust Deposition

Construction activities associated with the urbanisation of the site may generate fugitive dust emissions, which in turn may result in dust deposition impacts to native vegetation and fauna habitat, including:

- Leaf damage through abrasion.
- Blocking the stoma of plants.
- Dust accumulation on leaves, limiting photosynthesis capability.

Management measures to mitigate dust impacts can be addressed through the preparation, approval and implementation of a CEMP at subdivision and development and implemented during construction works, which is a standard condition of subdivision and development.

8.4.2.5 Weeds and Pathogens

Urbanisation can lead to the introduction and spread of weeds and pathogens, such as Dieback (*Phytophthora cinnamomi*), which can indirectly impact vegetation in the site.

The application of standard dieback management actions will minimise the potential introduction and/or spread of weeds and pathogens within the site. Implementation of these management measures will be done

through the implementation of a CEMP at subdivision and development, during construction works for each stage of development, which is a standard condition of subdivision and development.

In accordance with the Environmental Conditions (Appendix 2), the Local Structure Plan Part 1 provisions, and guided by the CAMS (Appendix 3), a CAMP will be developed and implemented to minimise the potential introduction and spread of weeds and pathogens to vegetation within each Conservation area.

8.4.2.6 Altered fauna behaviour due to noise, lighting and human presence

With urbanisation comes an increase in population and in turn an increased risk of human activity, which can indirectly impact on Conservation areas containing fauna habitats.

Future urbanisation of the site will result in increased levels of noise and light emissions, which potentially may impact fauna species by affecting their foraging and reproductive behaviours', reducing animal fitness, increasing the risk of predation and reducing reproductive success (Newport et al. 2014).

Rich and Longcore (2013) examine a number of studies which demonstrate the impact of artificial night lighting on fauna and identifies that lighting has the potential to affect fauna behaviour more than noise.

Newport et al. (2014) recommends implementing measures that:

- strategically plan the types of development and associated activities next to protected areas
- use shields and barriers (i.e. covers for lights) or using dense native vegetation screens that still allow movement of animals.

In relation to human presence, other human activities that have the potential alter fauna behaviour is degradation to vegetation and associated fauna habitats as a result of uncontrolled vehicle and pedestrian access, as well as littering, dumping and increased fire risk. These same impacts can also be caused by construction personnel, vehicles, plant and equipment during construction activities associated with urban development.

Management measures to appropriately control and minimise the impacts of increased noise and light emissions and human presence, both during the development and post development phases, can be addressed through the implementation of a CEMP at subdivision and development, during construction works for each stage of development, which is a standard condition of subdivision and development.

In accordance with the Environmental Conditions (Appendix 2), the Local Structure Plan Part 1 provisions, and guided by the CAMS (Appendix 3), a CAMP will be developed and implemented to minimise the potential impacts of increased human activities within the dedicated Conservation areas.

8.4.2.7 Change in feral animal abundance and/or movement

Introduced fauna, such as those recorded within the site (Table 8-3), often thrive in disturbed or modified habitats and may compete with local species for food and habitat resources. Increased predation by feral cats and foxes can result in changes to species assemblage, resulting in the loss of conservation significant fauna native species such as Quenda, which is known to occur within the site and are the most susceptible to predation by feral cats.

The City of Kalamunda's Keeping and Control of Cats Local Law 2023 lists conservation reserves within the City as being ‘cat prohibited areas’. It is anticipated that once the Conservation areas within the site are established that these will be listed within Schedule 3 of the City’s local law, which would then provide the City with powers to target control of domestic and feral cats in the site, as well as penalise any cat owners if their cats are found within the Conservation areas. Furthermore, the City’s local law places limits on the number of cats allowed on each residential premise and is intended to prevent the harmful nuisance of cats and thereby, reduce their impacts on local native fauna.

Inappropriate management of waste, particularly putrescible waste, generated within new urban communities may provide additional food source for scavengers, including feral cats, vermin house mice and rats, which are all likely to occur within the site.

In accordance with the Environmental Conditions (Appendix 2), the Local Structure Plan Part 1 provisions, and guided by the CAMS (Appendix 3), a CAMP will be developed and implemented to undertake fauna and pest management measures and waste management measures.

8.4.3 Cumulative Impacts

The Environmental Review for MRS Amendment 1388/57 presented a summary of the potential impacts from the following proposals and planning scheme amendments in proximity to the site:

- Wattle Grove Urban Expansion and Urban Investigation Areas
- Tonkin Highway Grade Separated Interchanges (Hale Road to Welshpool Road)
- Tonkin Highway Grade Separated Interchange (Kelvin Road)
- Tonkin Highway, Guildford Road to Great Eastern Highway Upgrade (Tonkin Gap)
- Maddington Kenwick Strategic Employment Area (MKSEA)
- Roe Highway and Great Eastern Highway Bypass

Given the retention and of remaining patches of native vegetation, which contain medium to high quality foraging habitat for black cockatoos, 7 potential nesting trees and habitat for quenda, and the landscape-led approach to facilitate the retention of as many existing scattered and planted trees, including potential nesting trees, the Environmental Review concluded that there will not be any significant cumulative impacts on conservation significant fauna and fauna habitats, as a result of the proposed change in land use from Rural to Urban.

The EPA (2025) advised that while the cumulative impacts to black cockatoo habitat are not at a level that would warrant a decision to allow no clearing of this value, it considers the incremental loss of foraging habitat across the species' range requires appropriate management and therefore has recommended Environmental Conditions (Appendix 2) to retain values within the Conservation areas.

8.4.4 Impact Mitigation

Impacts to terrestrial fauna and fauna habitat, and how the future urban development of the site will manage these impacts, have been considered in the context of the EPA's mitigation hierarchy (Table 8-8).

However, should future development propose significant impacts on the environmental values within the site (through an amendment to Local Structure Plan or future subdivision proposal), the EPA (2025) has advised there may be a requirement to refer the future proposal (i.e. subdivision or development) under section 38 of the EP Act to the EPA. Depending on the significance of the residual impacts, an Environmental Offset Plan may be required (EPA 2025). The requirement for an Environmental Offset Plan is highlighted as a provision in the structure plan documentation, under Part 1 implementation.

Table 8-8: Terrestrial Fauna Mitigation Hierarchy

Terrestrial Fauna Mitigation Hierarchy: Assessment and Proposed Measures
Potential Impacts
• Potential impacts (direct and indirect loss of conservation significant fauna that may utilise habitat within the area, namely black cockatoos and quenda) include: ▪ Loss of significant fauna habitat including black cockatoo breeding, roosting and foraging habitat. ▪ Direct or indirect impacts or loss of other significant fauna and fauna habitat. ▪ Fragmentation of fauna habitat and loss of ecological connectivity. ▪ Degradation of fauna habitat and habitat modification from introduction and increased spread of weeds and/or disease, altered surface water flows, altered groundwater and edge effects. ▪ Fauna mortality as a result of construction activities.

Terrestrial Fauna Mitigation Hierarchy: Assessment and Proposed Measures

- Altered fauna behaviour due to noise, lighting and human presence.
- Change in feral animal abundance and/or movement.

- Assuming the most conservative clearing scenario (Table 8-7):
  - Clearing 0.72 ha and 0.80 ha of medium quality foraging habitat for Carnaby's cockatoo and Baudin's cockatoo, respectively, represents 0.006% of black cockatoo foraging habitat within 12 km of the site. Whereas, clearing of low-quality foraging habitat for Carnaby's cockatoo (29.28 ha), Baudin's cockatoo (29.93 ha) and Forest Red-tailed black cockatoo (30.74 ha) represents approximately 0.2% of the existing black cockatoo foraging habitats within 12 kms of the site.
  - Most areas to be developed comprise of Cleared or highly modified land that has to be categorised as low-quality foraging habitat with 120.51 ha (95.97%) for Carnaby's cockatoo, 121.16 ha (96.48%) for Baudin's cockatoo and 121.97 ha (97.12%) for Forest Red-tailed black cockatoo.
  - Clearing of 0.16 ha of Degraded to Completely Degraded condition Banksia Woodlands, representing habitat for quenda.
  - Clearing of individual scattered trees dispersed across 26.9 ha of disturbed land, representing low quality habitat for quenda due to the predominant absence of dense understorey.
  - Clearing of individual trees and plants dispersed within 2.8 ha of planted and maintained gardens, with low quality foraging habitat for all three black cockatoo species but offering some potential habitat for quenda.
  - Of the individual trees that are proposed to be cleared, 151 trees are potential nesting trees of which none have suitable breeding hollow; however, the Local Structure Plan has located a number of Public Open Space areas over clusters of potential nesting trees within the site with the aim of retaining these trees (where practicable) (Figure 13), so it is likely that there will retention of some of these trees within future public open space and road reserves.
- Given that the depth to groundwater within the site is already several metres below natural surface and it has been predicted that the physical process of urbanisation will not lead to a significant rise in groundwater levels, it is expected there will not be any hydrological impacts on flora and vegetation retained within the site due to future urban development.

Avoidance

Fauna habitat retention

- Retention of 4.35 ha of Banksia Woodland habitat (96% of all remnant native vegetation) within Conservation, which includes:
  - 3.56 ha of Good to Excellent condition vegetation
  - Medium to high quality foraging habitat for Carnaby's cockatoo and Baudin's cockatoo
  - Low- and high-quality foraging habitat for Forest Red-tailed black cockatoo
  - 3 potential nesting trees for black cockatoos
  - Habitat for quenda
- Retention of 0.05 ha of Eucalyptus Woodland habitat within Conservation, which includes:
  - High quality foraging habitat for all three black cockatoo species.
  - 4 potential nesting trees for black cockatoos.
  - Habitat for quenda.
- Potential retention 0.32 ha of Scattered Trees within Potential Conservation, which includes:
  - Medium to low quality foraging habitat for Carnaby's cockatoo
  - Low quality foraging habitat for Baudin's cockatoo and Forest Red-tailed black cockatoo

Tree Retention

- The Local Structure Plan has located a number of Public Open Space areas over clusters of potential nesting trees within the site with the aim of retaining these trees (where practicable) (Figure 13)
- Likely retention of further individual scattered native trees, providing medium and low-quality foraging habitat for black cockatoos, potential nesting trees and potential roosting habitat in future public open spaces and road reserves.

Terrestrial Fauna Mitigation Hierarchy: Assessment and Proposed Measures
Future black cockatoo habitat assessment • Any future subdivision and/or development proposals for the eight unsurveyed lots or the 12 lots surveyed from the boundary of adjacent lots (Plate 8-1) will be accompanied by a black cockatoo survey at the time of application to ensure the black cockatoo habitat values within these lots are identified and appropriately mitigated in accordance with the Environmental Conditions (Appendix 2), the Local Structure Plan Part 1 provisions.
Future Local Structure Plan Amendment • The Local Structure Plan notes Conservation and Potential Conservation areas to be investigated further and determined by proponents as part of Local Structure Plan Amendments.
Bushfire management • Bushfire management can be undertaken without impact to areas of retained vegetation or revegetation (see Bushfire Management Plan).
Minimisation
Conservation area management • Clearing boundaries will be clearly demarcated on the ground to avoid unauthorised clearing to protect the retained vegetation and fauna habitat. • Hard-edge separation between development and Conservation Area, which will assist with environmental management, including minimisation of weed spread. • In accordance with the Environmental Conditions (Appendix 2), the Local Structure Part 1 provisions, and the CAMS (Appendix 3) a CAMP will be prepared for vegetation and flora retention within each Conservation area, and include: ▪ Objectives, targets and environment outcomes to be achieved ▪ Baseline information required to confirm the environmental values to be protected (baseline ecological surveys) and the key threats (i.e. weed and pathogen surveys, etc) to be managed within the Conservation Area ▪ Address the potential impacts and identify the mitigation measures to be implemented through during subdivision and development of the site ▪ Detail how the Conservation Areas will be protected, and significant environmental values will be maintained and enhanced ▪ Detail the monitoring, evaluation and response mechanisms to be implemented. ▪ Roles and responsibilities ▪ Indicative timeframes for implementation of the management actions.
Construction management • Prior to subdivision and development, a CEMP will be prepared to address the following during the construction phase of future development: ▪ Clear demarcation and fencing of all remnant vegetation, individual trees and conservation significant flora identified for retention, prior to the commencement of construction works ▪ Erosion and sediment control ▪ Dust control ▪ Weed and pathogen control ▪ Bushfire prevention ▪ Waste management, including uncontrolled littering and dumping ▪ Inductions to educate construction personnel on the above management measures.

Terrestrial Fauna Mitigation Hierarchy: Assessment and Proposed Measures
Tree retention and landscaping • Prior to subdivision and/or development, a Tree Canopy Retention and Landscaping Management Plan (TCRLMP) will be prepared, in accordance with the Environmental Conditions (Appendix 2), to address the following: ▪ Preparation of a tree canopy analysis to identify existing canopy values, and include a survey of all existing trees on the relevant lot(s). Identify the location, species, size and structural health of any trees to be retained ▪ Identify which trees will be retained and removed as a result of the subdivision or development proposal, prioritising the retention and revegetation of Black cockatoo habitat trees. ▪ Demonstrate how development design has avoided impacts on trees suitable for retention (through the location of public open space, road reserves, pedestrian access ways and drainage design) to ensure their viability within an urban landscape. ▪ Demonstrate how the impact of any required clearing will be mitigated based on pre and post development canopy values. ▪ Identify measures that will be used to protect trees identified for retention during development and subdivision works (i.e. tree protection zones, tree labelling, physical barriers being erected and maintained through construction, etc. ▪ Demonstrate how the minimum tree canopy coverage post subdivision or development will be achieved. ▪ Wherever possible, potential nesting trees are to be retained as part of the subdivision design, to facilitate the retention of trees with a DBH of >500 mm and /or that are foraging species for black cockatoos. Where it is not possible to retain such trees, they will be replaced with black cockatoo potential nesting tree species. ▪ Identify the location, species, number, planting size, mature height and spread of trees to be planted. ▪ Identify the planting schedule for the trees to be planted. ▪ Estimate the percentage of canopy coverage expected to be achieved through implementation of the plan. Achieve a minimum canopy target of 20% per Planning Precinct in accordance with the City of Kalamunda (2023) Urban Forest strategy, which will be contingent on: o water availability o bushfire management o local government support and incentives o land developer incentives (garden packages including trees) o resident engagement and education ▪ Provide tree and landscape maintenance requirements post planting.
Rehabilitate
• In accordance with the Environmental Conditions (Appendix 2) and the CAMS (Appendix 3), the CAMP will include a rehabilitation program, revegetation measures, weed and pathogen control, access control and signage requirements, completion criteria, monitoring, evaluation and response mechanisms, roles and responsibilities and indicative timeframes.
Offset
• Implementation of the avoidance, minimisation and rehabilitation measures, the residual impacts are not considered to be significant and therefore, offsets are not proposed.

8.5 Predicted Outcome

Following implementation of the proposed mitigation measures, the predicated outcomes for terrestrial fauna:

- Retention of all remnant native vegetation in Good to Excellent condition, including:
  - 4.16 ha of Banksia Woodland containing medium and high quality foraging habitat for Carnaby's cockatoo and Baudin's cockatoo, and high quality foraging habitat for Forest-Red-tailed black cockatoo

  - 0.05 ha of Eucalyptus Woodland high quality foraging habitat all 3 black cockatoos
  - seven potential nesting trees for black cockatoos
  - habitat for quenda
- Rehabilitation program within Conservation areas will seek to maintain or increase available foraging habitat for black cockatoos.
- Protection and maintenance for fauna habitats retained within Conservation POS and future management to be guided by the implementation of the CAMP at subdivision and development.
- Likely retention of further individual scattered native trees, providing medium and low-quality foraging habitat for black cockatoos, potential nesting trees and potential roosting habitat in future public open spaces and road reserves, through the preparation and implementation of the TCRLMP at subdivision and development.
- Where it is not possible to retain potential nesting trees, they will be replaced with suitable potential black cockatoo nesting tree species, in accordance with the Environmental Conditions (Appendix 2) and the Local Structure Plan Part 1 provisions, which require the preparation of a TCRLMP prior to subdivision or development.
- Higher order protection for retained and replanted trees, by virtue of their location within public open spaces and road reserves future management to be guided by the implementation of the TCRLMP at subdivision and development.
- Re-establishment of potential quenda habitat (i.e. garden beds with dense understorey) across areas of local public open space, road reserves and new residential lots.

Based on the above and in consideration of the degraded state of fauna habitat onsite, the extent of black cockatoo habitat in surrounding areas and retention of potential nesting trees within the development and the retention of moderate and high quality black cockatoo habitat within the Conservation areas, it is expected that the EPA's objective for the Terrestrial Fauna factor will continue to be met.

9 Social Surroundings

9.1 Key Policies and Guidance

Relevant policy and guidance documents for social surroundings, which have informed site-specific investigations and/or have been used to assess potential impacts, include:

- Environmental Factor Guideline – Social Surroundings (EPA 2023b)
- EPA Guidance Statement No. 3 Separation Distances between Industrial and Sensitive Land Uses (EPA 2005)
- State Planning Policy 2.4 Basic Raw Materials (SPP 2.4) (WAPC 2021b)
- State Planning Policy 5.4 Road and Rail Noise (SPP 5.4) (WAPC 2019)
- *Aboriginal Heritage Act 1972*
- Visual Landscape Planning in Western Australia (WAPC 2007).

9.2 Studies and investigations

9.2.1 Cultural Heritage Values and Aboriginal Cultural Heritage

Element Advisory (Element) was engaged to undertake an evaluation of Aboriginal cultural heritage within the site and the surrounding region, as well as the natural, social and historic cultural heritage values of the GBSW (Element 2024).

The following research and consultation methods were used to characterise Aboriginal heritage sites, values and cultural associations relevant to the site, as well as the cultural heritage values of the GBSW:

- Review of Aboriginal heritage sites registered under the *Aboriginal Heritage Act 1972*.
- Review of heritage registers and inventories administered under the *Heritage Act 2018*.
- Review of documentary evidence, including publications, research papers, government policy documents, archaeological surveys, historical maps and plans and social media.
- Consultation and site visit with a group of Whadjuk Traditional Owners, who hold the kaartdijin (knowledge) about the site and the surrounding region.

The Traditional Owner group consulted during the study was established under the guidance of consultant Brendan Moore, acting as the Noongar Group Facilitator. The consultation took place on 5 December 2022.

9.2.2 Visual amenity

EPCAD was engaged to undertake an evaluation of the visual amenity values (hereafter referred to as 'landscape values') of the natural and semi-rural character of the site. The study was undertaken in accordance with the WAPC's Visual Landscape Planning in Western Australia (VLPWA) manual (November 2007), which included the following detail and scope:

- Broad inventory and assessment of regional scale patterns and landscape characteristics.
- Understanding of visual landscape character, community perceptions, values and issues.
- Recommendations to address broad-scale landscape issues and generalised community attitudes and values.

9.3 Receiving Environment

9.3.1 Aboriginal Heritage

Through the documentary research, site visit and consultation with Traditional Owners that was undertaken, a range of Aboriginal heritage sites, values and cultural associations in and around the site were identified. Table 9-1 summarises the heritage sites, along with their values and cultural associations (Plate 9-1).

Table 9-1: Aboriginal heritage sites, values and cultural associates

Place name or description	Heritage listings	Heritage sites, values and cultural associations
Within the site		
Brentwood Road Swamp	Registered Aboriginal Heritage Site (#4343)	Artefacts scatter (archaeological significance)
External to the site		
Brentwood Road Quarry	Registered Aboriginal Heritage Site (#4342)	Artefacts scatter and quarry (archaeological significance)
Boundary Road, Wattle Grove	Registered Aboriginal Heritage Site (#4342)	Artefacts scatter and quarry (archaeological significance)
Maamba Reserve, Forrestfield (now known as Hartfield Park)	Registered Aboriginal Heritage Site (#3824)	Artefacts scatter (archaeological significance)
Yule Brook / Mandoorn	Registered Aboriginal Heritage Site (#3773)	Former camp site of significance to the Whadjuk Noongar people of the region, attributed upon the basis of tradition, historical association and sentiment
Trees endemic to the GBSW and surrounding region	Registered Aboriginal Heritage Site (#36929)	Mythological site renowned for its association with the mythological water serpent, the Waugyl

9.3.1.1 Brentwood Road Swamp

Brentwood Road Swamp is a registered Aboriginal heritage site (#4343), thought to be an artefacts scatter of archaeological significance. No archaeological evidence was found at the site during an archaeological survey undertaken by Archae-aus and Ethnosciences in 2019. Similarly, no artefacts were identified during the visit to the site with Traditional Owners on 5 December 2022.

However, during the site visit, the Traditional Owners discussed that the site was closely related to the Brentwood Road Quarry site (#4342), on the western side of Tonkin Highway. The two sites are situated within only 200 m of one another, albeit they are now physically separated by Tonkin Highway. Archaeological evidence was found at the Brentwood Road Quarry site on the western side of Tonkin Highway during the 2019 Archae-aus and Ethnosciences survey.

9.3.1.2 Brentwood Road Quarry

Brentwood Road Quarry is a registered Aboriginal heritage site (#4342), known to be an artefacts scatter and quarry of archaeological significance. Archaeological evidence was found at the site during an archaeological survey undertaken by Archae-aus and Ethnosciences in 2019. Although it is closely associated with the Brentwood Road Swamp heritage site, it is physically severed from this site by Tonkin Highway and is external to the site.

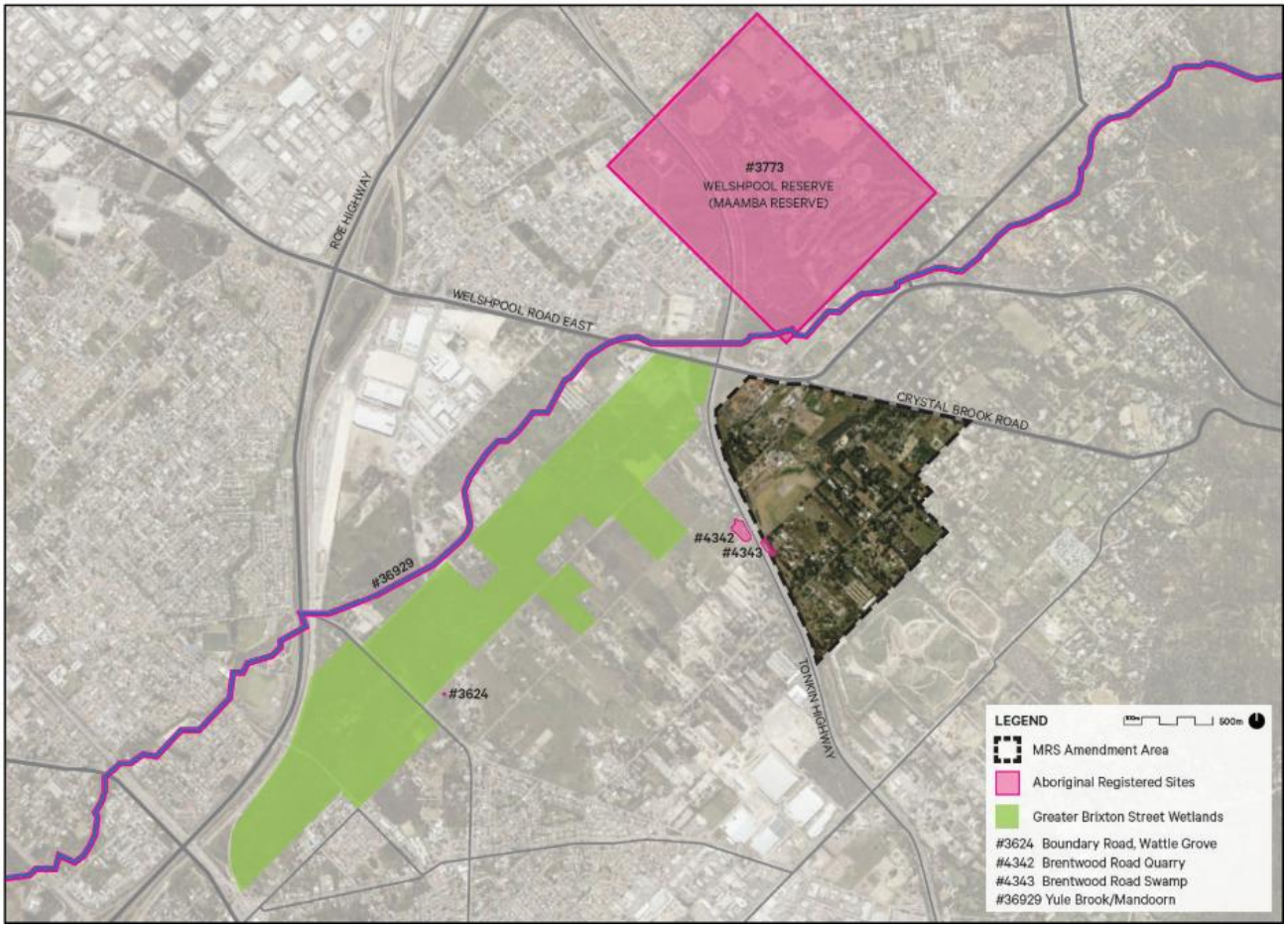


Plate 9-1: Location of Aboriginal heritage sites within and external to site

9.3.1.3 Boundary Road, Wattle Grove

Boundary Road, Wattle Grove is a registered Aboriginal heritage site (#4343), thought to be an artefacts scatter of archaeological significance. A 2011 archaeological survey reported that earlier recorded artefacts could not be found due to ground disturbance. The site is situated near the corner of Boundary and Bickley Roads. It is situated approximately 2 km west of the site, on the opposite (western) side of Tonkin Highway.

9.3.1.4 Mamba Reserve (now Hartfield Park), Forrestfield

Maamba Reserve (now Hartfield Park) in Forrestfield is a registered Aboriginal heritage site (#3773), recognised for its significance as a former camp site with special meaning to the Whadjuk Noongar people of the region, for its historical associations and sentimental value.

In the mid to late 1800s, the Aboriginal people who had survived the first few decades of introduced disease or violence, were displaced and forced to live on the fringes of towns, away from their traditional lands. Maamba Reserve was set aside in the late 1800s as a 'native reserve' or 'retreat for the surviving Perth Nyungars' as it was known at the time. It became a camping ground for the Aboriginal people of the region, where they lived until 1928, when the reserve was declared as a 'recreation reserve' and they were subsequently forced to leave.

Today Maamba Reserve is known as Hartfield Park and is predominantly occupied by a public golf course, however the place continues to hold strong family connections, historical associations and sentiment for the Whadjuk Noongar people of the region. Yule Brook traverses the south-western corner of the Reserve – it was a water source for the population who camped there.

9.3.1.5 Yule Brook / Mandoorn

Yule Brook / Mandoorn is a registered Aboriginal heritage site, known for its association with the mythological water serpent, the Waugyl. Waterways such as Mandoorn were particularly important to the Noongar people as abundant sources of seasonal food from animal and plant life, and for their mythological and spiritual association with the Waugyl, a powerful figure in the form of a rainbow serpent that formed the landscape and waterways.

The Waugyl is recognised today as the power that creates and maintains the fresh flow of drinking water for humans in all watercourses and springs. During the site visit and consultation with Traditional Owners on 5 December 2022, it was identified that the water flows of Yule Brook / Mandoorn have cultural heritage value and are to be protected and respected.

9.3.1.6 Trees Endemic to the GBSW and Surrounding Region

Endemic trees of the GBSW and surrounding region are valued by the Whadjuk Noongar people for a variety of cultural associations. Below are a few examples (that are not intended as an exhaustive list) identified through documentary research and consultation with Traditional Owners:

- The use of the branches of the Spearwood tree in spear making.
- The Christmas tree as a sacred resting place for the spirits of ancestors.
- Paperbark trees as a sign of underground water.

9.3.2 Cultural heritage values of the GBSW

Through the documentary research, site visit and consultation with Traditional Owners that was undertaken came an understanding of the natural, social and historical heritage values of the GBSW. These values are summarised in Table 9-2 below.

Table 9-2: Cultural heritage values of the GBSW

Place Name or Description	Heritage Listings	Heritage Values
Greater Brixton Street Wetlands	City of Gosnells Local Heritage List (Lot 808 of Reserve 49200 only)	The GBSW is a place of special meaning for a cross section of groups and individuals in the community. The cultural heritage values of the wetlands include the following: • Educational values for researchers and scientists. • Social and historical values held by individuals and community groups, who have come together for over three decades, to conserve and enhance the wetlands for future generations. • Social value for its aesthetic natural beauty. • Its natural water flows, which have been identified as having cultural heritage value to the Whadjuk Noongar people of the region.

9.3.3 Visual amenity

9.3.3.1 State and regional landscape character values

Utilising the methodology in the VLPWA for characterising the level of significance of viewing experiences, three viewing experiences of the site were categorised as being of state or regional significance (EPCAD 2024):

- Views experienced from vehicles on Tonkin Highway.

- Views experienced from vehicles on Welshpool Road East and Crystal Brook Road.
- Views experienced by visitors to Lions Lookout in the Korung National Park.

These three viewing experiences were evaluated in detail to determine if there were any visual features or views of the site that contributed to the overall value of the regional landscape and/or the Western Australian landscape.

The landscape character values of state and regional significance that were identified for the site are summarised in Table 9-3.

Table 9-3: State and regional landscape character values (EPCAD 2024)

Viewing location	How the landscape is experienced	Typical view	Landscape character values
Tonkin Highway Interface	As a passenger or driver of a vehicle travelling at 100 km/h. Views into the site from Tonkin Highway are experienced obliquely and at high speeds. Quality of views experienced as a driver are low, as their line of sight is predominantly on the road with only peripheral views of the site. Remnant vegetation within the site that is visible from Tonkin Highway may have some value, not as an isolated or individual view, but as part of an overall viewing experience when travelling along Tonkin Highway.		Natural Woodland Views
Welshpool Road East Interface	As a passenger or driver of a vehicle travelling at 80 km/h. Views are limited to the junction of Welshpool Road East, Crystal Brook Road and Brentwood Avenue. Views into site from vehicles travelling along Welshpool Road East dominated by large landscape salvage yard, industrial sheds, cleared areas and hard stand areas. These views are of little to no value.		Natural Woodland Views
Crystal Brook Road Interface Crystal Brook Road Interface	As a passenger or driver of a vehicle travelling at 70 km/h Views into the site from vehicles travelling along Crystal Brook Road are dominated by vegetation and rural style boundary fences, including post and rail and post and wire fences. Intermittent views into the site become available when there are breaks in the		Natural Woodland Views

Viewing location	How the landscape is experienced	Typical view	Landscape character values
	vegetation – these views include homestead style houses, sheds and open paddocks. Visual characteristics that contribute to the landscape value of Crystal Brook Road include the aesthetic of the road itself (e.g. un-engineered, no kerbing, gravel shoulders) and the rural aesthetic of built form and boundary fencing visible from the road. Mature tree canopy and areas of remnant woodland that dominate views of the site from vehicles travelling along Crystal Brook Road is considered of most value.		Rural look and feel of the landscape, dominated by views of mature tree canopy and rural style boundary fencing
Lions Lookout, Korung National Park	From public lookout and walking trails – the site is barely distinguishable in the context of the entire viewshed. The low-rise nature of existing built form within the site sits comfortably within the vast and relatively consistent horizontal scale of the panoramic views from the lookout. It is this vast horizontal scale that makes the views from the lookout unique and sought after.		Vast horizontal scale and expansiveness of views of the Perth metropolitan area and CBD skyline

9.4 Potential Impact Identification and Assessment

9.4.1 Aboriginal Heritage

The potential direct impacts to Aboriginal heritage are:

- Potential alteration of one registered Aboriginal heritage site within the site – the artefacts scatter known as Brentwood Road Swamp (#4343).
- Clearing of endemic trees within the site that may hold important cultural associations for the Whadjuk Noongar people of the region.

9.4.2 Visual Landscape

The proposed urbanisation of the site will change the physical surroundings and has the potential to change the landscape character within the site, from a semi-rural setting to an urban setting, has the potential to impact on the landscape character values of state and regional significance that have been identified in the following ways:

- Clearing of remnant vegetation and new urban development may impact the overall viewing experiences for travellers in vehicles along Tonkin Highway, Welshpool Road East and Crystal Brook Road.
- The rural look and feel of Crystal Brook Road evolving into a more urban aesthetic, as a result of new urban development.
- The panoramic views from Lions Lookout in Korung National Park being negatively impacted by future development within the site that is noticeably inconsistent with the predominant scale and height of existing urban settlement visible within those views (i.e. 1 to 3 storeys).

9.5 Impact Mitigation

Impacts to social surroundings and how future urban development of the site will manage these impacts have been considered in the context of the EPA's mitigation hierarchy (Table 9-4).

Table 9-4: Social Surroundings Mitigation Hierarchy

Social Surroundings Mitigation Hierarchy: Assessment and Proposed Measures
Potential Impacts
Aboriginal Heritage • Potential alteration of one registered Aboriginal heritage site within the site – the artefacts scatter known as Brentwood Road Swamp (#4343). • Clearing of endemic trees within the site that may hold important cultural associations for the Whadjuk Noongar people of the region.
Visual Amenity and Landscape • Clearing of remnant vegetation and new urban development may impact the overall viewing experiences for travellers in vehicles along Tonkin Highway, Welshpool Road East and Crystal Brook Road. • The rural look and feel of Crystal Brook Road evolving into a more urban aesthetic, as a result of new urban development. • The panoramic views from Lions Lookout in Korung National Park being negatively impacted by future development within the site that is noticeably inconsistent with the predominant scale and height of existing urban settlement visible within those views (i.e. 1 to 3 storeys).
Avoidance
Aboriginal Heritage • Brentwood Road Swamp artefacts scatter and registered heritage site is situated within the easement for the Dampier to Bunbury Natural Gas Pipeline (DBNGP). There are significant statutory limitations that apply to development and excavation of land within the DBNGP corridor will largely protect the Brentwood Road Swamp heritage site from risk of physical disturbance. • Potential any existing trees within the area that may have important cultural associations for the Whadjuk Noongar people be identified, and if possible, retained within future public open spaces and road reserves.
Minimisation and Rehabilitation
Aboriginal Heritage • Potential for archaeological evidence to be present in the land surrounding the site (particularly in any undisturbed sandy areas). If required, future subdivision or development within the vicinity of the Brentwood Road heritage site will be subject to an application for Section 18 approval, pursuant to the *Aboriginal Heritage Act 1972*. • Engagement with Traditional Owners and if required, an Archaeological Site Survey (and Archaeological Management Strategy in the event artefacts are uncovered) also be submitted with the application. • Through the Section 18 process, conditions can be placed on any subdivision or development proposals to avoid or minimise potential impacts on the Brentwood Road Swamp heritage site. • Where retention of endemic trees is not possible or practical, it is proposed that this be ameliorated through the relevant tree species being afforded recognition and respect in the: ▪ TCRLMP at subdivision stage.
Visual Amenity and Landscape • Measures to retain the integrity of the existing 'rural look and feel' and viewing experience (dominated by the mature tree canopy) along Crystal Brook Road. • Measures to retain natural woodland views from Tonkin Highway where possible. • Measures to ensure the height and scale of future urban development does not interrupt or impact on the integrity of the panoramic views from Lions Lookout in Korung National Park (albeit that this is very unlikely to be a consequence of future urban development).

9.6 Predicted Outcome

Following the implementation of the proposed mitigation measures, the predicted outcomes for social surroundings are:

- Protection and conservation of the Brentwood Road Swamp artefacts scatter (registered Aboriginal heritage site #4343) located within the site (if it still exists).
- No impacts to other registered Aboriginal heritage sites in the region surrounding the site.
- Retention and/or replanting of any endemic trees within the site that may hold important cultural associations for the Whadjuk Noongar people of the region.
- Protection and conservation of the natural, social and historical cultural heritage values of the GBSW.
- Appropriate management of potential impacts to visual amenity / landscape values during later stages of the planning process, including:
  - Measures to retain the integrity of the existing 'rural look and feel' and viewing experience (dominated by the mature tree canopy) along Crystal Brook Road.
  - Measures to retain natural woodland views from Tonkin Highway where possible.
  - Measures to ensure the height and scale of future urban development does not interrupt or impact on the integrity of the panoramic views from Lions Lookout in Korung National Park (albeit that this is very unlikely to be a consequence of future urban development).

10 Other Matters

10.1 Bushfire Risk

The site is mapped as a bushfire prone area (Area 2) as per the Western Australia State Map of Bush Fire Prone Areas (DFES 2025) These areas are defined as being subject to, or likely to be subject to, bushfire attack, and are identified by the presence of and proximity to bushfire prone vegetation and includes both the area containing the bushfire prone vegetation and a 100 m buffer zone immediately surrounding it (Landgate 2025). Additional planning and building requirements may apply to development within these areas (DFES 2025).

A Bushfire Management Plan (BMP) has been prepared by Western Environmental Approvals Pty Ltd (WEPL) in support of the Local Structure Plan. This BMP has prepared in accordance with SPP 3.7, associated guidelines and standards (WAPC 2024a; WAPC 2024b; Standards Australia 2018). The BMP should be considered in its entirety, in conjunction with this report.

Overall, WEPL (2025) advised the following:

- the bushfire hazards within and adjacent to the subject site and the associated bushfire risk is readily manageable through standard management responses and compliance with acceptable solutions outlined in the Guidelines.
- Bushfire management measures will need to be factored into the development design as early as possible to ensure a suitable, compliant and effective bushfire management outcome is achieved to ensure protection of future life and property assets.
- Demonstration of compliance with the relevant requirements of SPP 3.7, the Guidelines and AS 3959: 2018 at future planning stages will also depend on the developer's ability to coordinate the timing and staging of clearing and development works within the subject site with the aim of avoiding bushfire impacts from temporary, retained vegetation.

Please refer to the BMP for further detail regarding future management considerations for the subdivision of individual precincts.

11 Future Environmental Reports and Management Plans

To ensure the proposed development is appropriately managed, Table 11-1 outlines the various environmental reports and management plans, identified in the impact mitigation sections of this report, that will be undertaken, approved and implemented at the subsequent planning stages.

Table 11-1: Future Environmental Reports and Management Plans

Report / Management Plan	Timing / Stage of Project	Approval Required	Legislation or Agreement Regulating the Activity	Decision Making Authority	Environmental Management Outcome
Urban Water Management Plan	Subdivision or Development stage	Approval of plan prior to construction commencing	Environmental Condition (Appendix 2) *Planning and Development Act 2005* implemented as a condition of the approval of subdivision	DWER and DBCA	Implementation of the UWMP will ensure the strategies and goals of the LWMS are achieved in relation to water management
Conservation Area Management Plan	Subdivision or Development stage	Approval of plan prior to commencement of site work in relevant stages of the development	Environmental Condition (Appendix 2) *Planning and Development Act 2005* implemented as a condition of the approval of subdivision	City of Kalamunda, on advice from DWER and DBCA, where relevant	Implementation of the plan will prevent and manage impacts of urban development on areas of retained TEC vegetation, threatened flora and black cockatoo habitat.
Tree Retention and Landscaping Management Plan	Subdivision or Development stage	Approval of plan prior to commencement of site work in relevant stages of the development	Environmental Condition (Appendix 2) *Planning and Development Act 2005* implemented as a condition of the approval of subdivision	City of Kalamunda, on advice from DWER, where relevant	
Bushfire Management Plan	Subdivision or Development stage	Approval of plan as prior to construction commencing Clearance that subdivision construction has met the requirements of the plan prior to issue of Certificate of Title	*Planning and Development Act 2005* implemented as a condition of the approval of subdivision	DFES / City of Kalamunda	Implementation of the plan will ensure that bushfire risks to the surrounding environment and future residents are addressed in accordance with SPP 3.7 to achieve an acceptable outcome

Report / Management Plan	Timing / Stage of Project	Approval Required	Legislation or Agreement Regulating the Activity	Decision Making Authority	Environmental Management Outcome
Construction Environment Management Plan	Subdivision or Development stage	Approval of plan prior to commencement of site work	*Planning and Development Act 2005* implemented as a condition of the approval of subdivision	City of Kalamunda	Implementation of the plan will ensure appropriate management of key environmental factors as discussed in Sections 3 to 7 to mitigate risk to the surrounding environment
ASS Assessment and Dewatering Management Plan, if required	Subdivision stage or Development Stage	Approval of plan prior to commencement of site work	*Planning and Development Act 2005* implemented as a condition of the approval of subdivision	DWER	Implementation of the plan will mitigate the risk of any disturbance to ASS that may have a detrimental impact on the surrounding environment.
Preliminary Contamination Investigation	Subdivision or Development stage	Approval of PSI, or identification of additional investigation, reporting and/or remediation requirements to be addressed	*Contaminated Site Act 2003*	DWER	The PSI will identify if any additional contamination investigations are required. Should detailed investigation or remediation be required the associated reports would be approved by DWER to ensure potential environmental risks are managed.

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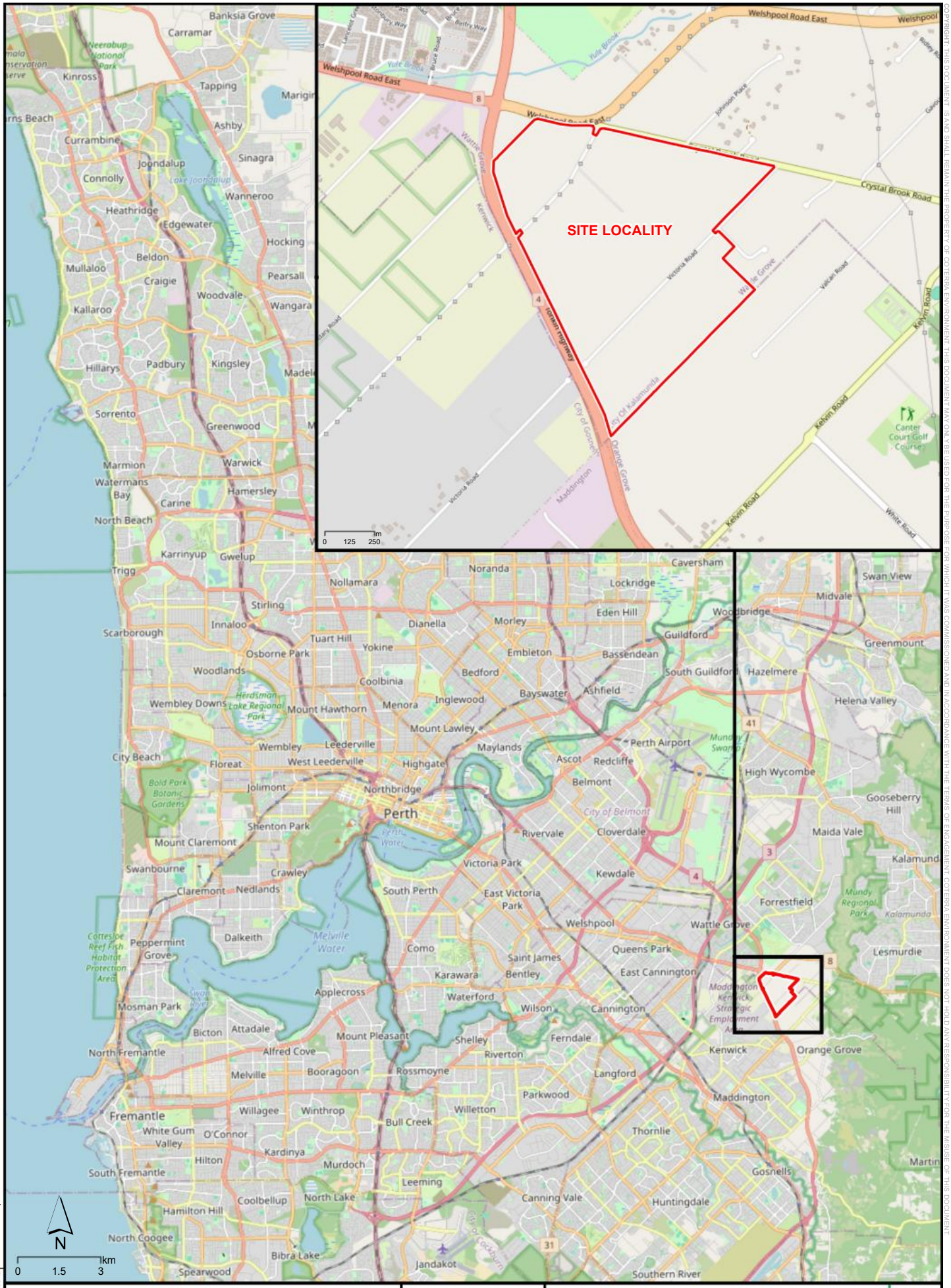
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Figures



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Hesperia
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WATTLE GROVE SOUTH LSP

SITE LOCATION

Figure 1

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LEGEND

Local Structure Plan Area

Cadastre

N

0 25 50 100 150 200 m

Scale: 1:6,000 @ A3

GDA2020 MGA Zone 50

Welshpool Rd East

Boundary Rd

Brentwood Rd

Johnson Pl

Philemon Ct

Crystal Brook Rd

Emanuel Ct

Easterbrook Pl

Tonkin Hwy

Victoria Rd

Valcan Rd

Kelvin Rd

Source: Cadastre - Landgate
Orthophoto - NearMaps, 17.03.25

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WATTLE GROVE SOUTH LOCAL STRUCTURE PLAN

AERIAL PHOTOGRAPH

Figure 2

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LEGEND

- Local Structure Plan Area
- Cadastre
- Contour (mAHD)

Geology

- Mgs2: GRAVELLY SILT - strong brown, tough, common pebbles of fine to coarse-grained, subrounded granite, some dolerite and rare sandstone (SS), variable sand content.
- Ms4: SANDY SILY - cream to pale brown alluvium, clayey in part, fine to medium-grained sand, of alluvial origin.
- S8: SAND - white to pale grey at surface, yellow at depth, fine to medium-grained, moderately sorted, subangular to subrounded, minor heavy minerals, of eolian origin.
- S10: SAND - as S8 over sandy clay to clayey sand of the Guildford Formation, of eolian origin.
- S12: SAND - structureless, yellow, fine-grained, subangular and medium to coarse-grained subrounded to rounded quartz, feldspar and heavy minerals common, minor silt and clay, of colluvial origin.

N

0 50 100 200 300 400 m

Scale: 1:7,500 @ A3
GDA2020 MGA Zone 50

Source: Cadastre - Landgate
Orthophoto - NearMaps, 17.03.25
Geology and Topography - DPIRD

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TOPOGRAPHY AND SOILS

Figure 3

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YULE BROOK

Rivervale Wattle Grove Link

Bruce Rd

Brook Rd

Boundary Rd

Brentwood Rd

Tonkin Hwy

Welshpool Rd East

Johnson Pl

Philemon Ct

Crystal Brook Rd

Emanuel Ct

Easterbrook Pl

Victoria Rd

Valcan Rd

Canter Ct

UFI 7793 UFI 13619 UFI 15020 UFI 13619 UFI 15021 UFI 7771 UFI 15257 UFI 8025 UFI 8027 UFI 8026 UFI 15816 UFI 8028 UFI 15814 UFI 15815 UFI 8030 UFI 7775 UFI 14962 UFI 8032 UFI 8031 UFI 8033 UFI 8034 UFI 8035 UFI 14964 UFI 8036 UFI 7795 UFI 15983 UFI 13825 UFI 13825 UFI 15987 UFI 8045 UFI 15984 UFI 15986 UFI 15985 UFI 8046 UFI 8037

LEGEND

- Local Structure Plan Area
- Cadastre
- Major Tributary

Wetland Mapping

- Conservation
- Resource Enhancement
- Multiple Use

N

0 50 100 200 300 400 m

Scale: 1:7,500 @ A3
GDA2020 MGA Zone 50

Source: Cadastre - Landgate
Orthophoto - NearMaps, 17.03.25
Wetlands - DBCA | Hydrography - DWER

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WETLAND MAPPING

Figure 4

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LEGEND

- Local Structure Plan Area
- Cadastre
- Public Open Space – Conservation
- Public Open Space – Potential Conservation

Vegetation Communities

- BaEpPf
- BmXpEc
- EmMpLp
- Trees
- Planted
- Cleared
- BmXpEc Recently Cleared

N

0 37.5 75 150 225 300 m

Scale: 1:6,000 @ A3
GDA2020 MGA Zone 50

Source: Cadastre - Landgate
Orthophoto - NearMaps, 17.03.25

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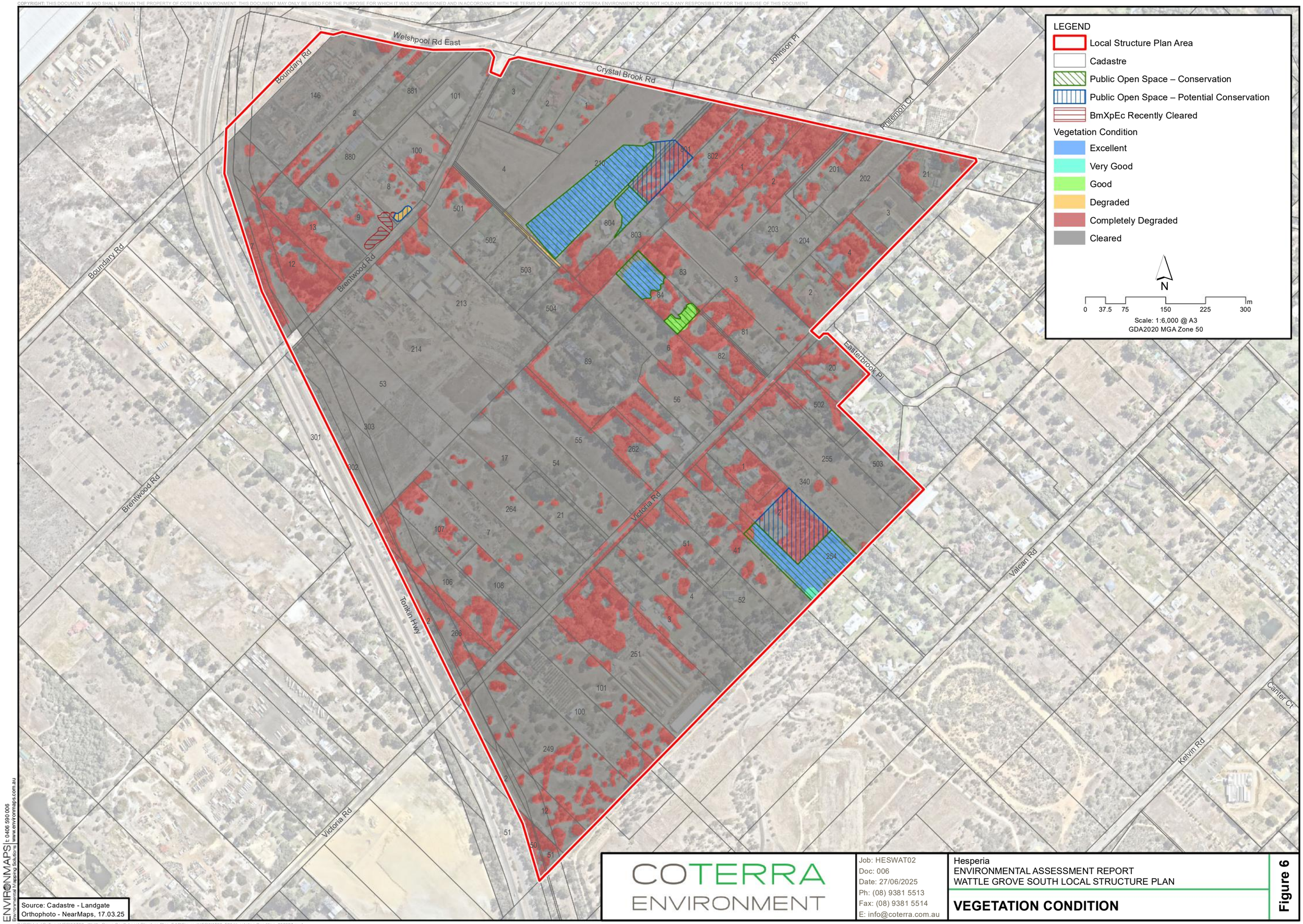
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VEGETATION COMMUNITIES

Figure 5

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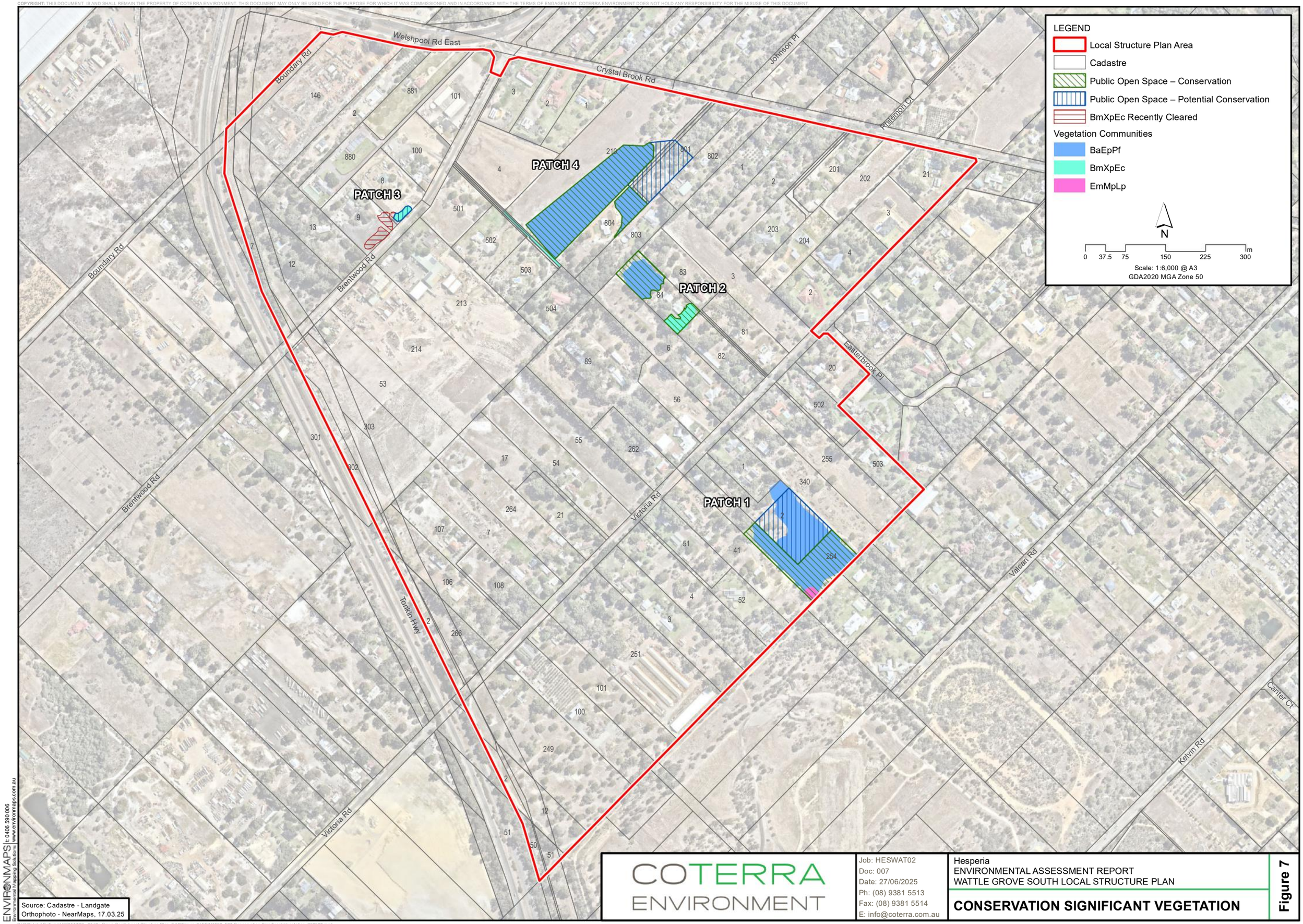
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VEGETATION CONDITION

Figure 6

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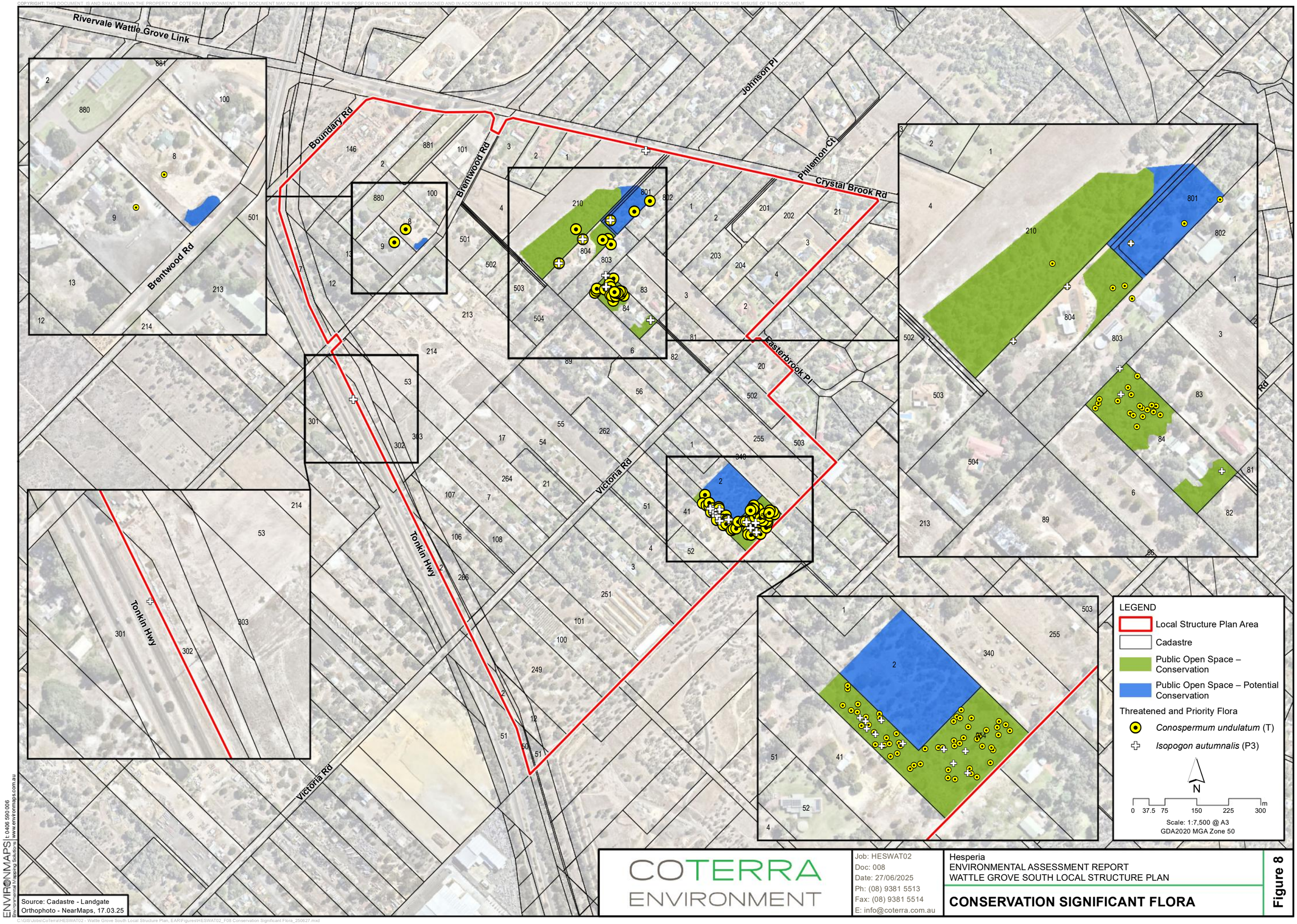
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Hesperia
ENVIRONMENTAL ASSESSMENT REPORT
WATTLE GROVE SOUTH LOCAL STRUCTURE PLAN

CONSERVATION SIGNIFICANT VEGETATION

Figure 7

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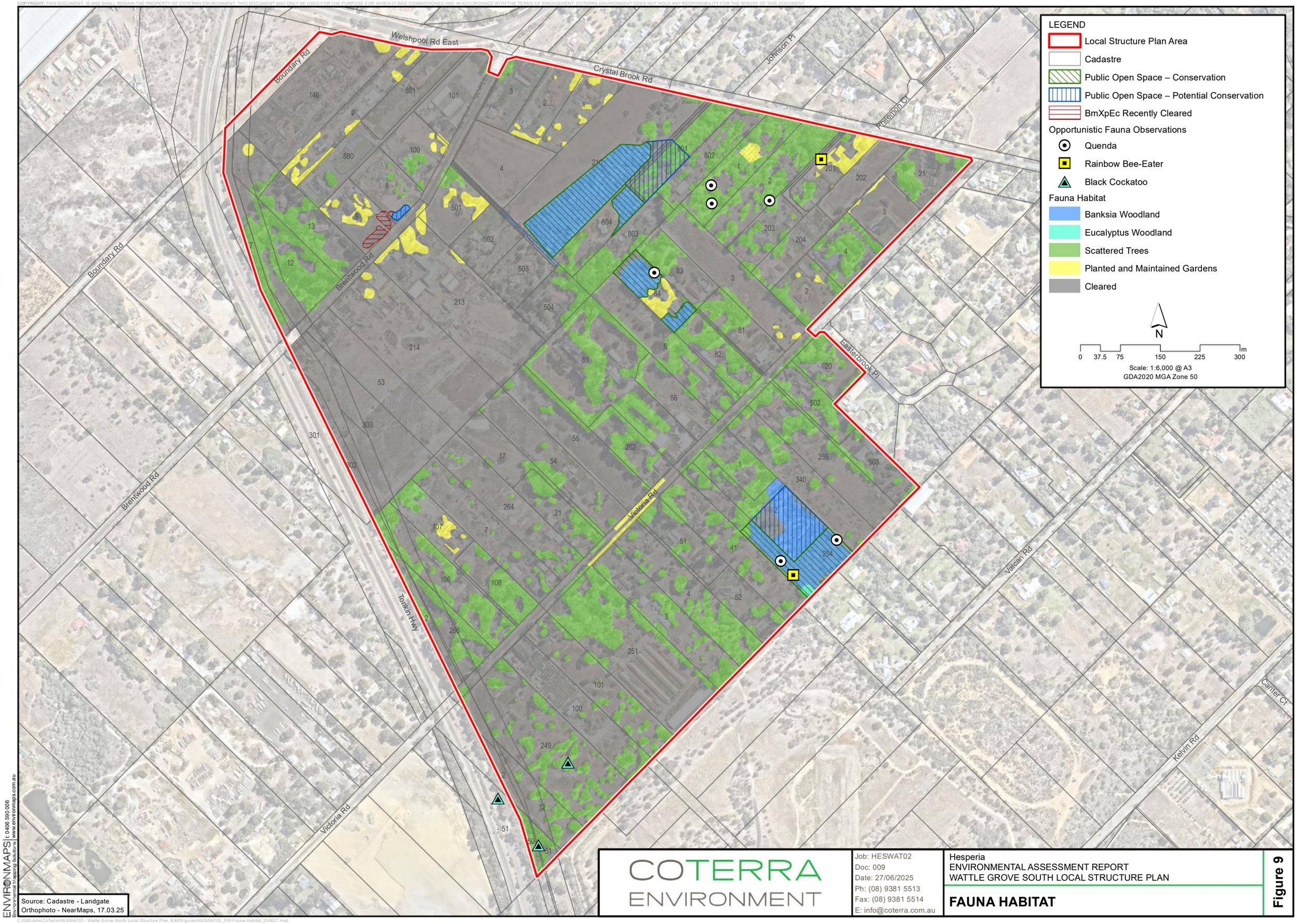
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WATTLE GROVE SOUTH LOCAL STRUCTURE PLAN

CONSERVATION SIGNIFICANT FLORA

Figure 8

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FAUNA HABITAT

Figure 9

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LEGEND

- Local Structure Plan Area
- Cadastre
- Public Open Space – Conservation
- Public Open Space – Potential Conservation
- BmXpEc Recently Cleared

Carnaby's Cockatoo Foraging Habitat

- 2
- 3
- 5
- 6
- 8

N

0 37.5 75 150 225 300 m

Scale: 1:6,000 @ A3
GDA2020 MGA Zone 50

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CARNABY'S COCKATOO FORAGING HABITAT

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LEGEND

- Local Structure Plan Area
- Cadastre
- Public Open Space – Conservation
- Public Open Space – Potential Conservation
- BmXpEc Recently Cleared

Forest Red-tailed Black Cockatoo Foraging Habitat

- 2
- 3
- 7
- 8

N

0 37.5 75 150 225 300 m

Scale: 1:6,000 @ A3
GDA2020 MGA Zone 50

Welshpool Rd East
Crystal Brook Rd
Johnson Pl
Pittemon Ct
Boundary Rd
Brentwood Rd
Easterbrook Pl
Victoria Rd
Tonkin Hwy
Valcan Rd
Canter Ct
Kelvin Rd

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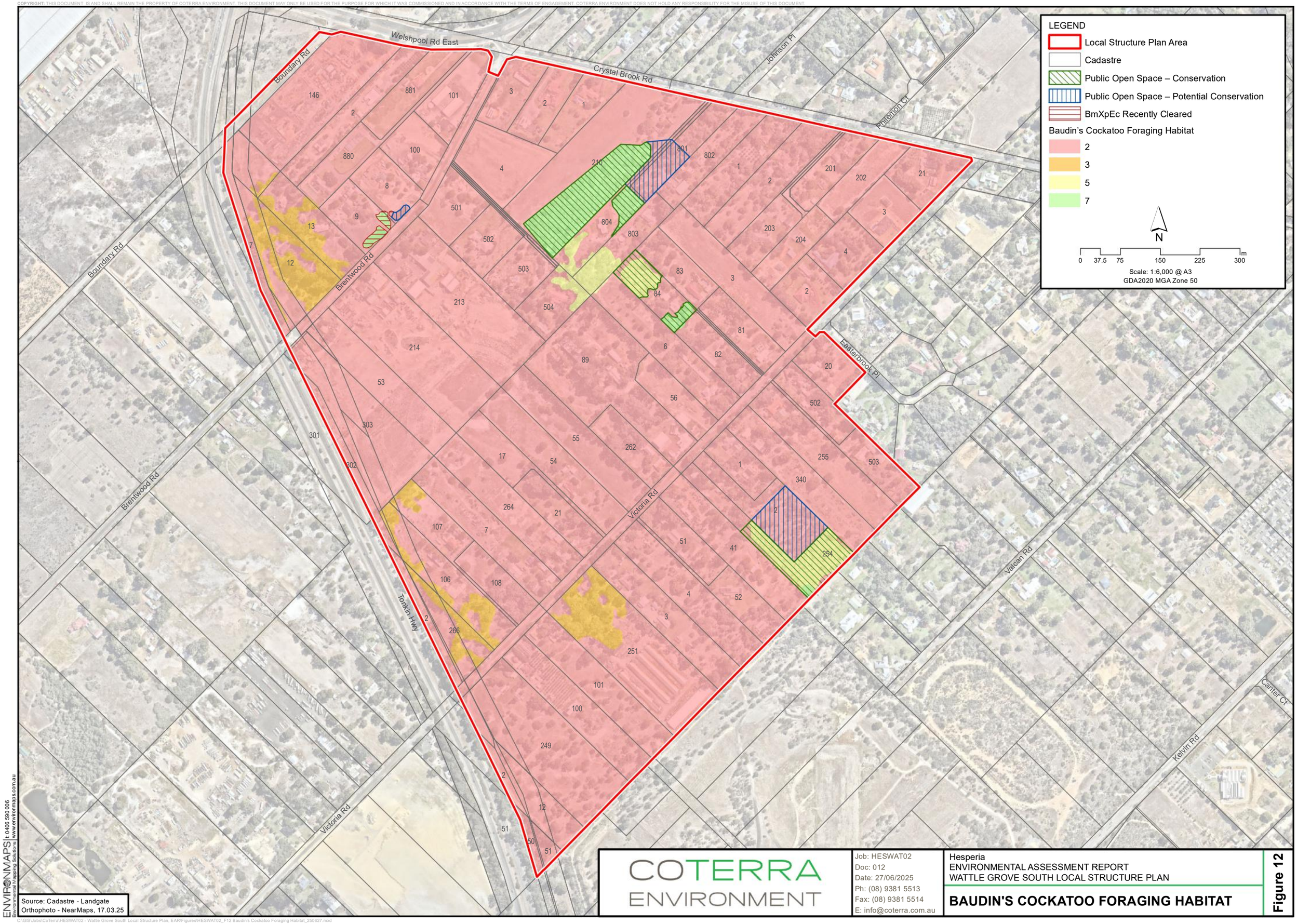
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FOREST RED-TAILED BLACK COCKATOO FORAGING HABITAT

Figure 11

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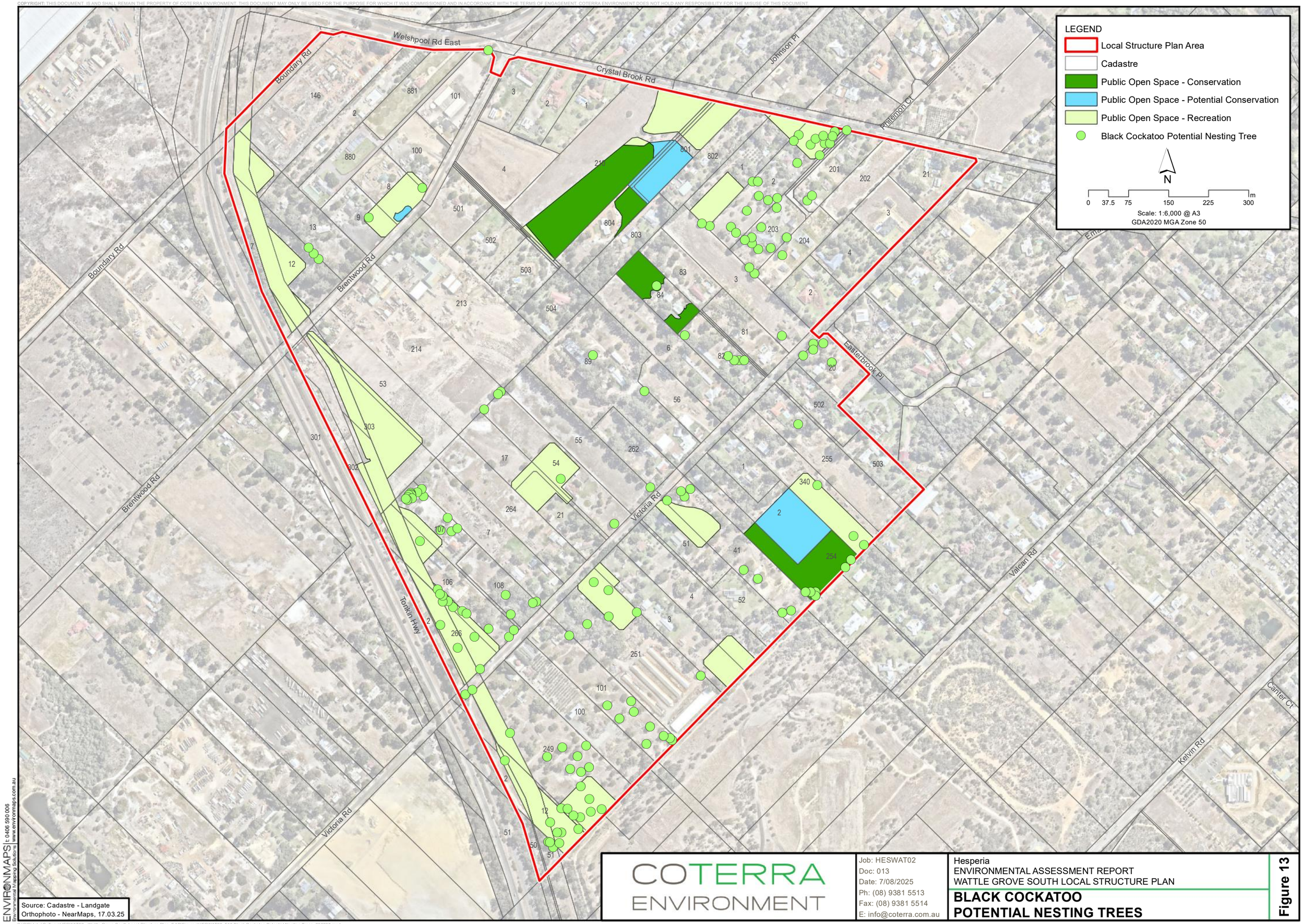
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BAUDIN'S COCKATOO FORAGING HABITAT

Figure 12

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BLACK COCKATOO POTENTIAL NESTING TREES

Figure 13

C:\GIS\Jobs\CoTerra\HESWAT02 - Wattle Grove South Local Structure Plan, EAR\Figures\HESWAT02_F13 Black Cockatoo Potential Nesting Trees_250807.mxd

Appendix 1 Local Structure Plan



Legend

- Local Structure Plan & MRS Amendment Boundary
- Precinct Boundaries
- High Pressure Gas Pipeline Easment
- Water Corporation Land
- Resource Enhancement Wetland
  (DBCA advice to WAPC 26 August 2021 indicaties values commensurate with Multiple Use Wetland. UFI 8037 and portion of UFI 15257) subject to reclassification with DBCA)
- Residential R20 - R40
- Residential R80
- Light Industry
- Public Purpose - Primary School
- Public Open Space - Conservation
  (As per EPA Assessment Report 1788)
- Public Open Space - Potential Conservation
  (As per EPA Assessment Report 1788 - See Note 1)
- Public Open Space - Recreation
- Existing Road
- Neighbourhood Connector A (22m)
- Neighbourhood Connector B (20m)
- Access Road (18m)
- Access Road (15m)
- Access Road (12m)
- Lane (6m)
- Potential Neighbourhood Activity Centre
- Intersection: Full Movement
- Intersection: Left In/Left Out

Notes

1. Conservation and Potential Conservation areas to be investigated further and determined by proponents as part of Local Structure Plan Amendments.
2. Landowners are not forced to redevelop their land. It is their individual choice whether they wish to proceed to develop or remain as-is.
3. The location of Public Open Space can potentially be modified by a proponent as part of their final design solution, subject to justification being provided through a Structure Plan amendment and/or subdivision application.
4. Upgrades to Welshpool Road intersection will be required in the future in accordance with the Transport Impact Assessment (PTG 2025) - proposed roundabout, subject to detailed design with City of Kalamunda and Main Roads WA.
5. Opportunity for Neighbourhood Activity Centre in Precinct A – subject to further investigations undertaken by Precinct A landowners.

Local Structure Plan

Wattle Grove

0 20 40m

Date: 11 Aug 2025 Scale: 1:7000@ A3 1:3500 @ A1 File: **20-119 ST1-1** Staff: MR GW Checked: MR

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Appendix 2 Draft Environmental Conditions (EPA Report 1788)

Appendix A: Recommended conditions

STATEMENT THAT A SCHEME MAY BE IMPLEMENTED
***(Environmental Protection Act 1986*)**

METROPOLITAN REGION SCHEME AMENDMENT 1388/57 –
WATTLE GROVE (SOUTH) URBAN PRECINCT

Scheme Purpose:	The Metropolitan Region Scheme (MRS) Amendment proposed to rezone land in Wattle Grove South from the 'Rural' zone to the 'Urban' zone. The proposed 'Urban' zone will facilitate future residential development, areas of public open space and retention areas (conservation of environmental values) following a Local Planning Scheme (LPS) amendment, structure planning and subdivision and development approval.
Responsible Authority:	Western Australian Planning Commission (WAPC) Australian Company Number (ACN) 35 482 341 493
Responsible Authority address:	Gordon Stephenson House, 140 William St, Perth WA 6000
Assessment number:	2335

Report of the Environmental Protection Authority: 1788

Introduction: Subject to the following conditions being incorporated into the Metropolitan Region Scheme (MRS), the Amendment to which the above Report 1788 of the Environmental Protection Authority (EPA) relates may be implemented.

ENVIRONMENTAL CONDITIONS FOR MRS AMENDMENT 1388/57

Environmental outcomes

1. Within the **Amendment Area**, it is an objective of this scheme that **subdivision** and **development** is consistent with the achievement of the environmental outcomes in condition 3.

2. The **Responsible Authority** must act consistently with:

   (1) the requirements of **Ministerial Statement XXX**; and

   (2) the achievement of the environmental outcomes in condition 3;

   when exercising powers under this scheme or when determining an application to **subdivide** land in the **Amendment Area.**

3. The environmental outcomes are:

   (1) Avoid disturbance to the following environmental values within **retention areas** (Figure 1), except when undertaking **low impact activities:**

      (a) Banksia attenuata woodlands over species rich dense shrublands (**FCT** 20a);

      (b) Shrublands and Woodlands of the Eastern Swan Coastal Plain (**FCT** 20c);

      (c) **Viable populations** of *Conospermum undulatum;*

      (d) **Viable populations** of *Isopogon autumnalis;*

      (e) **medium to high quality foraging habitat** for carnaby's cockatoo (*Zanda latirostris*) and baudin's cockatoo (*Zanda baudinii*); and

      (f) **potential nesting trees**.

   (2) Avoid disturbance to black cockatoo **known nesting trees** and **roosting sites** within the **Amendment Area.**

   (3) Retain trees or, where retention is not practicable, replace trees in the **Amendment Area** to:

      (a) achieve a generally even distribution of trees across parts of the **Amendment Area** that are not within **retention areas**; and

      (b) to create connectivity between **retention areas** and retained black cockatoo habitat.

   (4) Avoid or where not practicable, minimise adverse impacts to the **Greater Brixton Street Wetlands** from urban development of the **Amendment Area**, including impacts to the wetlands' persistency, hydrological regime, water quality, ecological integrity and ecological function.

Conservation Area Management Plans

4. The Responsible Authority must not approve any subdivision (other than minor subdivision) or development for land that includes all or part of a retention area unless it is satisfied, after consulting with DWER, DBCA and the local government, that:

(1) a Conservation Area Management Plan has been prepared for the **retention area**; and

(2) the Conservation Area Management Plan is consistent with the achievement of the environmental outcomes in condition 3 and:

(a) provides for the installation and maintenance of appropriate fencing around the periphery of the **retention area**;

(b) provides for the monitoring of occurrences of **Threatened Ecological Community** (**TECs)** and populations of **threatened** flora; and

(c) identifies actions that will be implemented to ensure that:

(i) occurrences of **TECs** that are in 'degraded' condition are restored to achieve a condition rating of 'good' or better, in accordance with **Keighery 1994**;

(ii) populations of **threatened** flora are maintained or increased;

(iii) buffers to **threatened** flora are established and maintained;

(iv) the spread of existing weed species and pathogens, and the introduction of new weed species and pathogens, is minimised;

(d) provides that the only **development** to occur within the **retention area** is to be **development** for the purposes of conservation or incidental purposes; and

(3) satisfactory arrangements have or will be made for the implementation of the Conservation Area Management Plan.

Black cockatoos

5. The **Responsible Authority** must not approve any **subdivision** (other than **minor subdivision**) or **development** for any land in the **Amendment Area** that is **unsurveyed land** unless it is satisfied that a **black cockatoo** survey that meets the requirements of **DWER** has been carried out for that **unsurveyed land.**

6. The **Responsible Authority** must not approve any **subdivision** or **development** for any land in the **Amendment Area**, if the subdivision or development is likely to impact a **potential nesting tree** unless it is satisfied, after consulting with **DWER**, that:

(1) an assessment has been carried out to determine the number of **potential nesting trees** likely to be impacted;

(2) the number of **potential nesting trees** likely to be impacted has been quantified; and

(3) at least twice the number of **potential nesting trees** likely to be impacted will be replaced by planting within the **Amendment Area**.

Tree canopy

7. The **Responsible Authority** must not approve any **subdivision** (other than **minor subdivision**) or **development** for any land in the **Amendment Area** unless it is satisfied that:

(1) a Tree Canopy Retention and Landscape Management Plan for the land has been prepared, having regard to any urban forest strategy adopted by the City of Kalamunda; and

(2) the Tree Canopy Retention and Landscape Management Plan is consistent with the achievement of the environmental outcomes in condition 3 and:

(a) identifies the location, species, size and structural health of any trees to be retained;

(b) identifies the location, species, number, planting size, mature height and spread of trees to be planted;

(c) identifies the planting schedule for the trees to be planted; and

(d) estimates the percentage of canopy coverage expected to be achieved through implementation of the plan; and

(3) satisfactory arrangements have or will be made for the implementation of the Tree Canopy Retention and Landscape Management Plan,

unless the **Responsible Authority** considers that a plan, or a plan that meets all the requirements in condition 7(2), is not required.

Water management

8. The **Responsible Authority** must not approve any **subdivision** (other than **minor subdivision**) or **development** unless it is satisfied, after consulting with **DWER** and the local government, that:

(1) an **Urban Water Management Plan** (**UWMP**) has been prepared; and

(2) the **UWMP** is:

(a) consistent with the achievement of the environmental outcome in condition 3(4); and

(b) is informed by the **results of any pre development monitoring program;** and

(3) satisfactory arrangements have or will be made for the implementation of the **UWMP**,

unless the **Responsible Authority** considers, after consulting with **DWER**, that a **UWMP**, or a **UWMP** that meets the requirements in condition 8(2), is not required.

Reporting

9. The **Responsible Authority** must submit an environmental performance report which is inclusive of all **subdivisions** within the **Amendment Area** to **DWER** within three months after the end of the **Initial Report Year** and subsequently within three months after the end of each **Report Period** or by such later date as **DWER** confirms in writing, until **DWER** confirms in writing that reports no longer need to be submitted under this condition.

10. An environmental performance report must:

(1) identify any **structure plan** approved by the **Responsible Authority** for all or part of the **Amendment Area**; and

(2) demonstrate, in relation to the preceding **Report Period** how the **Responsible Authority** has acted consistently with the requirements of **Ministerial Statement XXX** and the achievement of the environmental

outcomes in condition 3 when exercising powers under this scheme or when determining an application to **subdivide** land in the **Amendment Area.**

Definitions

11. Defined terms in these conditions have the meaning set out in Table 1 of **Ministerial Statement XXX.**

Hon Matthew Swinbourn MLA
MINISTER FOR ENVIRONMENT

Responsible Minister consulted under section 48F(1):
Minister for Planning

Table 1: Definitions

Acronym or abbreviation	Definition or term
Adverse impacts	Negative change that is neither trivial nor negligible that could result in a reduction in health, diversity or abundance of the receptor/s being impacted, or a reduction in environmental value. Adverse impacts can arise from direct or indirect impacts, or other impacts from the implementation of the scheme. In relation to flora and vegetation and terrestrial fauna, includes but is not limited to change in hydrology, altered fire regime and edge effects.
Amendment	MRS Amendment 1388/57
Amendment area	The land subject of MRS Amendment 1388/57. As depicted on Figure 1
Black cockatoo	Includes carnaby's cockatoo (*Zanda latirostris*), forest red-tailed black cockatoo (*Calyptorhynchus banksii naso*) and baudin's cockatoo (*Zanda baudinii*).
Buffer	Adequate area adjacent to the environmental value important for protecting its integrity and providing protection from direct disturbance, to reduce the risk of significant adverse impact.
DBCA	Department of Biodiversity, Conservation and Attractions
Development	As defined in the *Planning and Development Act 2005*
Disturb/ disturbance	Directly has or materially contributes to the disturbance effect on health, diversity or abundance of the receptor/s being impacted or on an environmental value. In relation to flora, vegetation, or fauna habitat, includes to result in death, destruction, removal, severing or doing substantial damage to. In relation to fauna, includes to have the effect of altering the natural behaviour of fauna to its detriment. In relation to inland waters, includes to have the effect of altering hydrological regimes or water quality to the detriment of the environmental values supported by or dependent on surface water and/or groundwater.
DWER	Department of Water and Environmental Regulation
Environmental Review Document (ERD)	Coterra Environment, Pentium Water, Hyd2o, Emerge Associates, Phoenix Environmental Services, JBS&G, EPCAD Pty Ltd, Element, CLE Town Planning + Design, MBS Environmental, GBG Group, Douglas Partners, Bennelongia Environmental Consultants 2024, Environmental Review Metropolitan Region Scheme Amendment 1388/57 – Wattle Grove South. EPA Assessment No: 2335. Rev 4 (September).

FCT	Floristic Community Type
Greater Brixton Street Wetlands (GBSW)	As depicted in Figure 1 of the EPA 2022. Environmental values and pressures for the Greater Brixton Street Wetlands on the Swan Coastal Plain Advice in accordance with section 16(j) of the *Environmental Protection Act 1986, EPA, WA.*
Initial Report Year	The 12 month period commencing on the date the first **subdivision** within the **Amendment Area** is first approved.
Keighery 1994	Keighery, B.J. (1994). Bushland Plant Survey: a Guide to Plant Community Survey for the Community. Wildflower Society of WA (Inc.), Nedlands, Western Australia
Known nesting trees	Trees (live or dead but still standing) which contains a hollow where black cockatoo breeding has been recorded or which demonstrates evidence of breeding (i.e. showing evidence of use through scratches, chew marks or feathers).
Low impact activities	Activities involving minimal disturbance of ground or vegetation, including revegetation, rehabilitation monitoring of fauna, vegetation or water, or management activities associated with feral fauna control or weed control.
Medium to High quality foraging habitat	As defined in Table 7-10 of **Environmental Review Document (ERD)**.
Ministerial Statement XXX	Statement that a Scheme may be Implemented No. XXX published on XXX 2025.
Minor subdivision	Subdivision of a minor nature that does not involve any subdivision works and does not impede the achievement of the environmental outcomes in **Ministerial Statement XXX.**
MRS Amendment Area	The land the subject of MRS Amendment 1388/57, as shown in Figure 1.
Potential nesting trees	Trees that have a Diameter at Breast Height greater than 300mm but do not currently have hollows.

Recovery plan	Plans that outline the actions that are needed to help threatened species or ecological communities survive and 'recover' to a healthy level, including: • Department of Parks and Wildlife (2016). *Banksia attenuata* woodlands over species rich dense shrublands (Swan Coastal Plain community type 20a – Gibson et al. 1994). Interim Recovery Plan No. 359. Parks and Wildlife, Kensington, Western Australia. • Department of Environment and Conservation (2009). Wavy-leaved smokebush (*Conospermum undulatum*) Recovery Plan. Commonwealth Department of the Environment, Water, Heritage and the Arts, Canberra.
Report Period	The 36 month period commencing on the date of conclusion of the **Initial Report Year**, and every subsequent 36 month period.
Responsible authority	Western Australian Planning Commission (WAPC)
Results of any pre development monitoring program	Any results of pre development monitoring associated with implementation of: • Hyd_2o 2024, WATTLE GROVE SOUTH District Water Management Strategy. Ref: H22076Bv8, 19 July 2024, or any subsequent District Water Management Strategy that includes the **Amendment Area**; and • any local water management strategy prepared for the relevant land.
Retention area(s)	Retention area(s) as shown in Figure 1
Roosting site	Habitat that contains one, or a group of, known or potential roosting trees as defined in Department of Agriculture, Water and the Environment (DAWE) 2022, Referral guideline for 3 WA threatened black cockatoo species Carnaby's Cockatoo, Baudin's Cockatoo and the Forest Red-tailed Black cockatoo, Department of Agriculture, Water and the Environment, Canberra.
Structure Plan	As defined in the *Planning and Development (Local Planning Scheme) Regulations 2015*
Subdivide/Subdivision(s)	Division or amalgamation of lots as approved by the WAPC under the *Strata Titles Act 1985 / Planning and Development Act 2005*
Threatened	Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or a rediscovered species to be regarded as threatened species under section 26(2) of the *Biodiversity Conservation Act 2016* (WA).
Threatened Ecological Community (TEC)	A Threatened Ecological Community is a vegetation community which is found to fit into one of the following categories; "presumed totally destroyed", "critically endangered", "endangered" or "vulnerable" under the *Biodiversity Conservation Act 2016* (WA) and/or *Environment Protection and Biodiversity Conservation Act 1999* (Cth).
Unsurveyed Land	Areas depicted as "Unsurveyed Areas" in Figure 2.

Urban Water Management Plan (UWMP)	Water management document prepared in accordance with the relevant guideline and informed by any local water management strategy, to support a land-use planning proposal at the **subdivision** or **development** stage. *Better Urban Water Management (WAPC 2008); Urban water management plans – Guidelines for preparing plans and for complying with subdivision conditions* (DoW 2008).
Viable populations	The viability of a population (including in relation to species function, habitat requirements and buffers, and population stability) is to be determined in consultation with **DBCA** consistently with any relevant **recovery plan.**

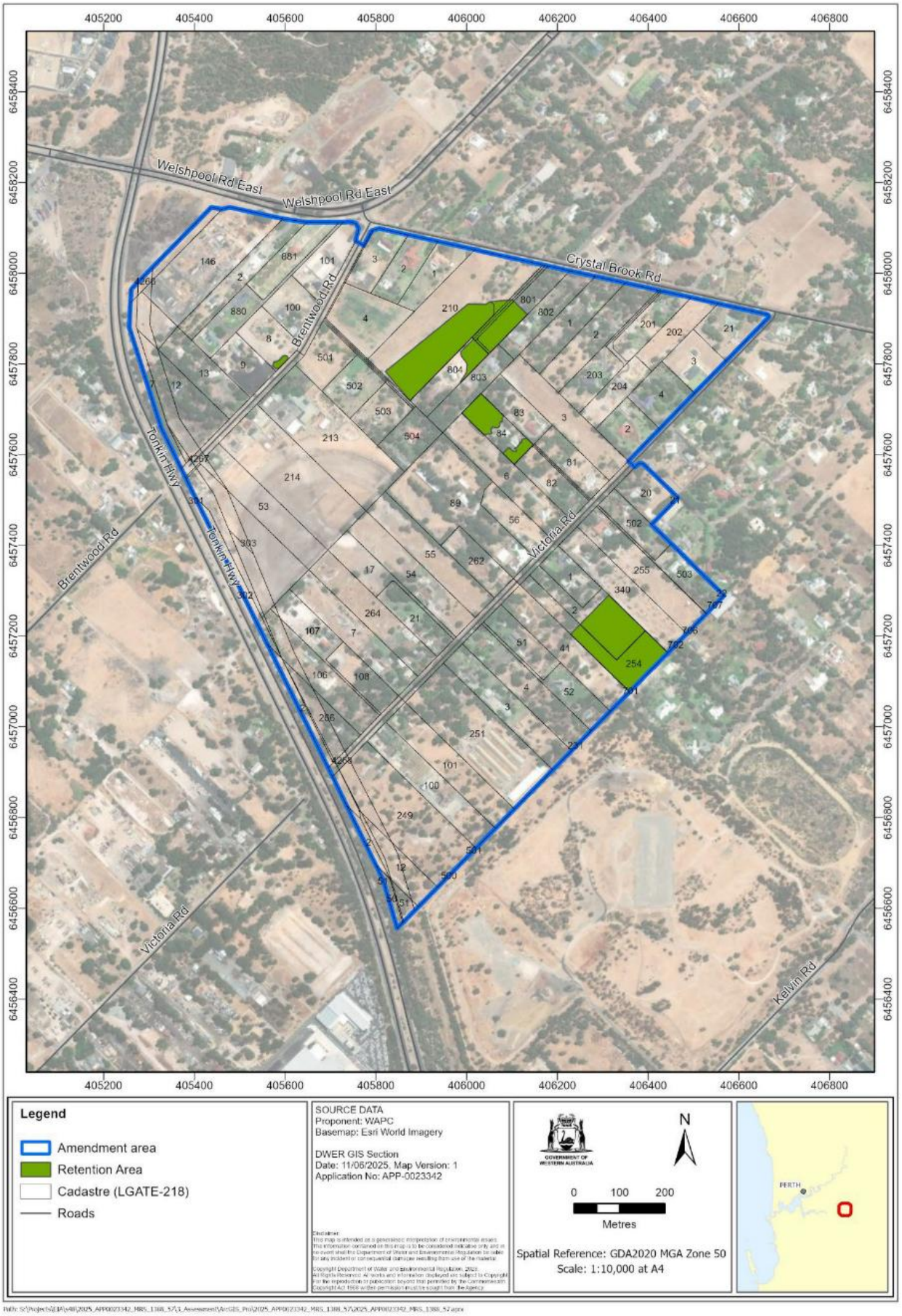


Figure 1: Amendment area and retention area

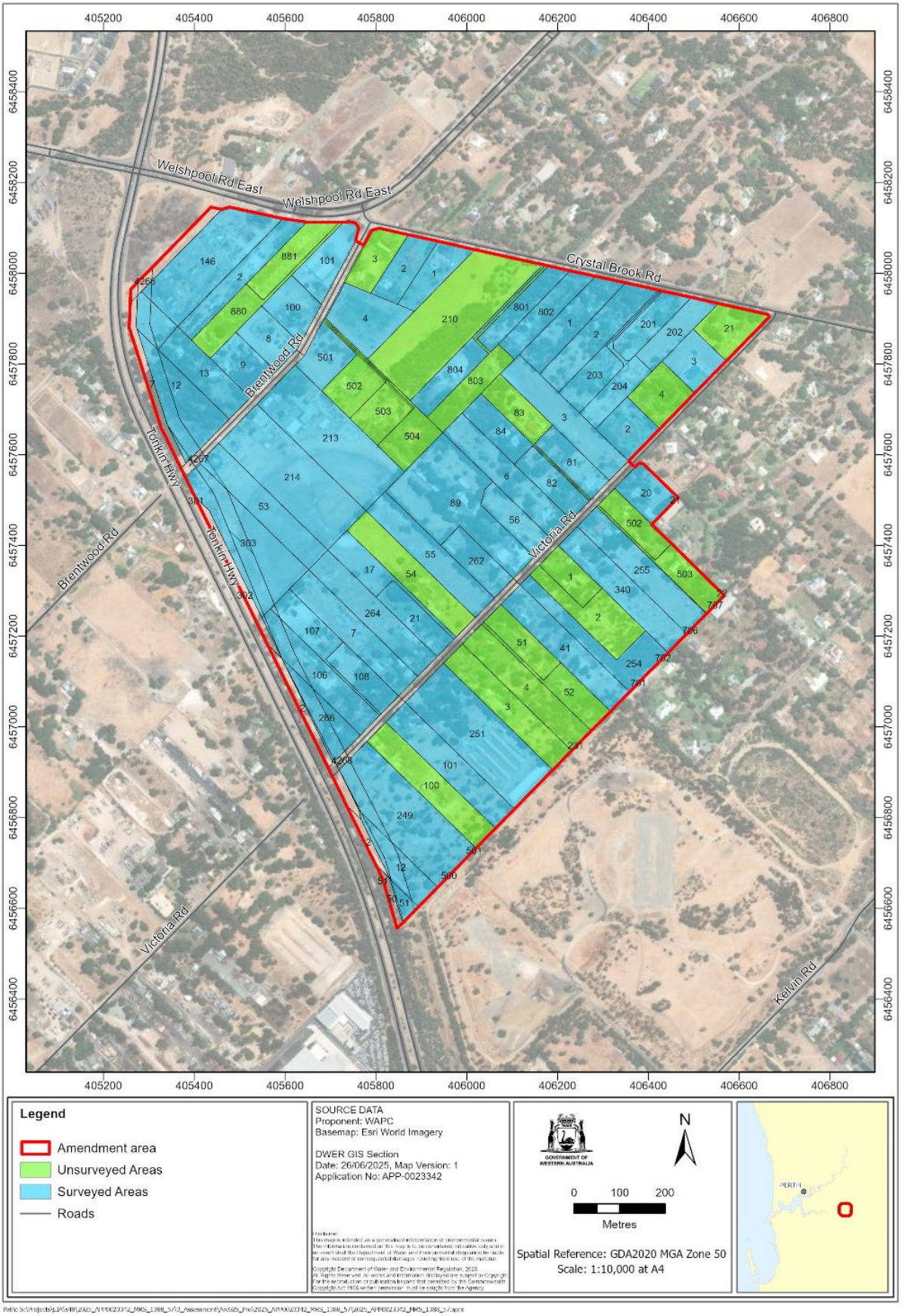


Figure 2: Unsurveyed areas (source: ERD)

Appendix 3 Conservation Area Management Strategy

COTERRA ENVIRONMENT



Conservation Area Management Strategy

Wattle Grove South Local Structure Plan

Rev 0 August 2025

CALIBRE | COMMITMENT | COLLABORATION

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ABN: ABN: 92 143 411 456
Our Ref: HESWAT02
Author(s): K. Choo and C. Norman
Reviewer: K. Watts
Report Version: Rev 0
Date: August 2025

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Contents

1 Introduction 1
1.1 Project Overview 1
1.2 Environmental Assessment 1
1.2.1 Environmental Conditions (MRS Amendment 1388/57) 1
1.3 Conservation Areas 2
1.4 Objective 3
1.5 Purpose and Scope 3
1.6 Land Use Planning Process 4
1.7 Wattle Grove South Local Structure Plan 4
2 Legislation, Policies and Guidance 5
2.1 Commonwealth 5
2.2 State 5
2.3 Local 5
2.4 Conservation Advice and Recovery Plans 5
3 Existing Environment 6
3.1 Regional and Local Context 6
3.1.1 Swan Coastal Plain 6
3.1.2 Regional climate 6
3.1.3 Topography 6
3.1.4 Geology 6
3.1.5 Hydrology 7
3.1.6 Conservation Areas and Bush Forever 9
3.1.7 Regional Ecological Linkages 10
3.1.8 Environmentally Sensitive Areas 10
3.1.9 Local Natural Areas 11
3.2 Vegetation 12
3.2.1 Vegetation associations and complexes 12
3.2.2 Vegetation Communities 13
3.2.3 Vegetation Condition 15
3.2.4 Floristic Community Types 15
3.2.5 Threatened Ecological communities 16
3.3 Flora 17
3.3.1 Conservation Significant Flora 17
3.3.2 Introduced Flora 17
3.4 Terrestrial Fauna 17
3.4.1 Fauna habitats 17
3.4.2 Fauna Assemblage 20
3.4.3 Conservation Significant Fauna 20
3.4.4 Black Cockatoo Habitat 21
4 Conservation Areas 27
4.1 Environmental objective 27
4.2 Environmental values 27
4.2.1 Threatened Ecological Communities 27

4.2.2 Conservation Significant Flora 31
4.2.3 Black cockatoos 32
5 Management 36
5.1 Key threats and management issues 36
5.2 Management provisions 36
5.2.1 Delineation and access management 36
5.2.2 Threatened ecological communities 38
5.2.3 Threatened flora 40
5.2.4 Waste management 42
5.2.5 Weed and pathogen management 43
5.2.6 Fauna and pest management 45
5.2.7 Bushfire management 47
6 Monitoring and assessment 48
7 Response actions 50
8 Reporting 52
9 References 53

Tables

Table 3-1: Surface geological units within the site 7
Table 3-2: Summary of ESAs within the site 11
Table 3-3: Vegetation community descriptions 14
Table 3-4: Vegetation community and extents in Conservation Areas 15
Table 3-5: Vegetation condition and extents in Conservation Areas 15
Table 3-6: Fauna habitat descriptions (AECOM 2020) 18
Table 3-8: Fauna habitats and extents in Conservation Areas 20
Table 3-9: Black cockatoo foraging habitat value per BCE 2021 scoring method 22
Table 3-10: Foraging habitat value per black cockatoo species in Conservation 23
Table 4-1: Relevance to the interim recovery plan for FCT 20a 27
Table 4-2: Relevance to the interim recovery plan for FCT 20c 29
Table 4-3: Relevance to the Recovery Plan for *Conospermum undulatum* 31
Table 4-4: Relevance to the recovery plan for Carnaby's cockatoo 33
Table 5-1: Delineation and access management actions 37
Table 5-2: TECs management actions 38
Table 5-3: Conservation significant flora management actions 40
Table 5-4: Waste management actions 42
Table 5-5: Weed and pathogen management actions 43
Table 5-6: Fauna and pest management actions 45
Table 5-7: Bushfire management actions 47
Table 6-1: Monitoring actions 48
Table 7-1: Response actions 50

Plates

Plate 3-1: Conservation areas and regional ecological linkages 9
Plate 3-2: ESAs within the site (DWER 2025) 10
Plate 3-3: Local Biodiversity Strategy LNAs (City of Kalamunda 2023a) 12
Plate 3-4: Vegetation associations and complexes 13
Plate 3-5: Black cockatoo roosting and breeding sites (within 12km) 25

Figures

Figure 1 Site Location
Figure 2 Aerial Photograph
Figure 3 Topography and Soils
Figure 4 Wetland Mapping
Figure 5 Vegetation Communities
Figure 6 Vegetation Condition
Figure 7 Conservation Significant Vegetation
Figure 8 Conservation Significant Flora
Figure 9 Fauna Habitat
Figure 10 Carnaby's Cockatoo Foraging Habitat
Figure 11 Forest Red-tailed Black Cockatoo Foraging Habitat
Figure 12 Baudin's Cockatoo Foraging Habitat
Figure 13 Black Cockatoo Potential Nesting Trees
Figure 14 Key Environmental Values

Appendices

Appendix 1 Local Structure Plan
Appendix 2 Environmental Conditions
Appendix 3 Ecological Memo (JBS&G 2024)
Appendix 4 FCT analysis (Plantecology 2024)
Appendix 5 Black Cockatoo Habitat Assessment (Phoenix Environmental 2024)

1 Introduction

1.1 Project Overview

The Wattle Grove South Local Structure Plan area ('the site') extends over approximately 126 hectares (ha) and is 16 kilometres (km) south-east of the Perth Central Business District (CBD) (Figure 1) (Appendix 1). The site is located within the area bound by Welshpool Road East and Crystal Brook Road to the north-east, and Tonkin Highway to the west, within the City of Kalamunda in the locality of Wattle Grove (Figure 2).

The landholdings within the site are currently undergoing a rezoning under the Perth Metropolitan Region Scheme (MRS), (MRS Amendment 1388/57 – Wattle Grove South), with the proposed rezoning changing the site from Rural to Urban under the MRS, along with a concurrent rezoning to Urban Development under the City of Kalamunda Local Planning Scheme No. 3 (LPS 3).

1.2 Environmental Assessment

The MRS Amendment was assessed by the Environmental Protection Authority (EPA) at the level of Environmental Review under Division 3, Part IV of the *Environmental Protection Act 1986* (EP Act)

The MRS Amendment underwent a formal environmental impact assessment, which was done in accordance with the EPAs Instructions for the Environmental Review (Assessment No. 2335) and resulted in a suite of environmental investigations, technical studies and Environmental Review documentation being prepared for public review and the EPA's assessment.

Concerning the site's significant ecological values, and to ensure the EPAs objectives for Flora and Vegetation, and Terrestrial Fauna could be met and that the proposed rezoning will not result in significant residual impacts on significant flora and vegetation (including threatened ecological communities and threatened/priority flora), and fauna habitat (including black cockatoo habitat), the EPAs mitigation hierarchy of avoid, minimise and rehabilitate was applied as part of the environmental assessment of the MRS amendment. This resulted in the following environmental outcomes being achieved and potential impacts being:

1. **Avoided** by retaining areas of remnant vegetation containing threatened ecological communities, threatened/priority flora and black cockatoo habitat and placing them within Conservation Areas (i.e. Conservation POS).
2. **Minimised** by preparing and implementing a Conservation Area Management Strategy at the local structure plan stage to establish the objectives and information required for each Conservation Area Management Plan during the future urban subdivision or development of the site.
3. **Rehabilitated** by managing Conservation Areas containing threatened ecological communities, threatened/priority flora, and black cockatoo habitat and restoring threatened ecological communities and black cockatoo habitat in degraded condition so that the vegetation condition rating of good or better is achieved.

1.2.1 Environmental Conditions (MRS Amendment 1388/57)

The EPA published its report and recommendations on 30 July 2025 (EPA Assessment Report 1788) and advised the Minister for the Environment that the MRS Amendment may be implemented subject to the Environmental Conditions (as they relate to inland waters, flora and vegetation, and terrestrial fauna) being undertaken (Appendix 2) to achieve the following:

Environmental Outcomes (condition 3):

- Avoid disturbance to the following environmental values within retention areas, including:

- *Banksia attenuata* woodlands over species rich dense shrublands (FCT 20a)
- Shrublands and Woodlands of the Eastern Swan Coastal Plain (FCT 20c)
- Viable populations of Threatened flora (*Conospermum undulatum*) and Priority 3 flora (*Isopogon autumnalis*)
- Medium to high quality black cockatoo foraging habitat
- Potential nesting trees

- Avoid disturbance to black cockatoo known nesting trees and roosting sites within the site.
- Tree retention and replacement to ensure canopy coverage across the site and habitat connectivity between retention areas retained black cockatoo habitat.
- Minimise adverse impacts on the Greater Brixton Street Wetlands from urban development of the Amendment Area, including impacts to the wetlands' persistency, hydrological regime, water quality, ecological integrity and ecological function.

Conservation Area Management (condition 4):

- Prior to future subdivision or development of areas which include or part of a retention area, the condition requires preparation of a Conservation Area Management Plan, which is consistent with the environmental outcomes set out in condition 3.
- The management plan will provide for appropriate fencing, monitoring of Threatened Ecological Communities (TECs) and threatened flora, restoration of degraded TECs, buffers to threatened flora, weed and pathogen control, and development within the retention area is for the purposes for conservation or incidental.

1.3 Conservation Areas

As a part of the site's future urban development, and in accordance with the Environmental Conditions, Conservation Areas have been identified within the site for future conservation to protect the site's highest environmental values, which include:

- Remnant vegetation (BaEpPf, BmXpEc and EmMpLp) in Good or better condition.
- Probable FCT 20a B*anksia attenuata* woodlands over species rich dense shrublands – State TEC listed as Critically Endangered (*Biodiversity Conservation Act 2016* [BC Act]).
- Probable FCT 20c Shrublands and Woodlands of the eastern side of the Swan Coastal Plain State TEC listed as Critically Endangered (BC Act) and Federal TEC listed as Endangered (*Environment Protection and Biodiversity Conservation Act 1999* [EPBC Act]).
- Banksia Woodlands of the Swan Coastal Plain ecological community – Federal TEC listed as Endangered (EPBC Act)and State Priority 3 (DBCA listing).
- Occurrences of TECs that are in degraded condition and have potential to be restored to Good or better condition.
- Viable populations of *Conospermum undulatum* – Threatened flora listed as Vulnerable (BC Act and EPBC Act)
- Viable populations of *Isopogon autumnalis* – State Priority 3 (DBCA listing)
- Medium to high quality foraging habitat for:
  - Carnaby's' cockatoo (*Zanda latirostris*) – Endangered
  - Baudin's cockatoo (*Zanda baudinii)* – Endangered (BC Act and EPBC Act)

- Forest Red-tailed black cockatoo (*Calyptorhynchus banksii naso*) – Vulnerable (BC Act and EPBC Act)
- High quality vegetation which provides habitat for other conservation significant fauna (e.g., *Isoodon fusciventer*; Quenda).

Regarding the creation of these Conservation Areas, the Local Structure Plan (Appendix 1) has designated these areas as Public Open Space - Conservation and Public Open Space - Potential Conservation. Further investigation and site studies will be required prior to subdivision to:

- confirm the presence and extent of threatened ecological communities (including occurrences that are degraded that can be restored to achieve a condition rating of good or getter), viable populations of threatened flora (including buffers that may be required) and medium to high quality black cockatoo foraging habitat and potential nesting trees
- inform the final boundary and delineation of these Conservation Areas, particularly for the areas designated Public Open Space – Potential Conservation, where site access has been limited and the presence and/or absence of these environmental values is still unknown.

Depending on the extent of the proposed variations to the Structure Plan, the Western Australian Planning Commission and the City of Kalamunda may require a proponent to also amend this Structure Plan prior to the determination of the subdivision application.

Sections 5.2.1, 5.2.2, 5.2.3 and 5.2.6 outline the management actions required to undertake these studies and define the final boundary of these Conservation Areas.

1.4 Objective

The objective of this Conservation Area Management Strategy (CAMS) is to provide a framework and facilitate on ground management to protect, maintain and enhance the environmental values of the Conservation Areas as urban subdivision and development of the site progresses.

1.5 Purpose and Scope

The purpose and scope of this CAMS is to inform the:

- design and creation of future Conservation Areas at subdivision and/or development stage
- development of the Conservation Area Management Plan (CAMP) for each Conservation Area within the site.

The CAMS aims to:

- establish the objectives, targets and environment outcomes to be achieved
- establish the information that each CAMP will be required to provide (i.e. baseline surveys, etc) to confirm the environmental values to be protected (baseline ecological surveys) and the key threats (i.e. weed and pathogen surveys, etc) to be managed within the Conservation Area
- address the potential impacts and identify the mitigation measures to be implemented through the CAMP during the subdivision and/or development stage
- detail how the Conservation Areas will be protected, and significant environmental values will be maintained and enhanced
- detail monitoring, evaluation and response mechanisms to be implemented.

The background and technical content presented in this document has been compiled from the Environmental Review for MRS Amendment (1388/57) (Coterra et al. 2024) and updated with detailed project information developed during the local structure planning process.

1.6 Land Use Planning Process

The following sets out the land use planning process that will be applied to facilitate future urban development and creation of the Conservation Public Open Space areas:

- Site will be concurrently rezoned to Urban under the MRS and Residential Development under LPS 3.
- Local Structure Plan has been prepared to facilitate development of the urban area to:
  - address the relevant Environmental Conditions of the Ministerial Statement for MRS Amendment 1388/57 (Appendix 2)
  - outline the Part 1 implementation provisions so that landowners and developers are aware of their obligations when pursing the redevelopment of the land.
- Subdivision or development, will address the Environmental Conditions of the Ministerial Statement for MRS Amendment 1388/57 (i.e. preparation of conservation area management plan) as well as any relevant subdivision conditions (e.g. preparation of construction environmental management plan as a condition of subdivision).

1.7 Wattle Grove South Local Structure Plan

The Wattle Grove South Local Structure Plan has been developed for the site and comprises the following attributes (Appendix 1):

- Precincts (A, B, C, D, E and F)
- Residential
- Light Industry
- Public Purpose – Primary School
- Public Open Space – Conservation (as per the Environmental Conditions of MRS Amendment 1388/57)
- Public Open Space – Potential Conservation (as per the Environmental Conditions of MRS Amendment 1388/57)
- Public Open Space - Recreation

Concerning the Conservation and Potential Conservation areas, the Local Structure Plan notes that these areas will be investigated further and determined by proponents as part of Local Structure Plan Amendments.

2 Legislation, Policies and Guidance

The following legislation, policy and guidelines have been utilised in preparation of this CAMS.

2.1 Commonwealth

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- Referral Guidelines for 3 WA Threatened Black Cockatoo Species (DAWE 2022)
- EPBC Referral Guidance – Banksia Woodlands of the Swan Coastal Plain ecological community

2.2 State

- *Biodiversity Conservation Act* 2016 (BC Act)
- *Environmental Protection Act* 1986 (EP Act)
- *Planning and Development Act* 2005 (PD Act)
- State Planning Policy 2.8 – Bushland Policy for the Perth Metropolitan Region (WAPC 2010)
- State Planning Policy 3.7 Planning in Bushfire Prone Areas (WAPC 2024)

2.3 Local

- Local Biodiversity Strategy 2023 – 2043 (City of Kalamunda 2023a)
- Urban Forest Strategy 2023 – 2043 (City of Kalamunda 2023b)
- Public Open Space Strategy (City of Kalamunda 2018a)
- Local Planning Policy 32 – Public Open Space (City of Kalamunda 2018b)

2.4 Conservation Advice and Recovery Plans

- Carnaby's Cockatoo (*Calyptorhynchus latirostris*) Recovery Plan. Department of Parks and Wildlife, Perth, Western Australia (DPaW 2013)
- Approved Conservation Advice for *Calyptorhynchus banksii naso* (Forest Red-tailed Black Cockatoo) (DWEHA 2009)
- Conservation Advice *Calyptorhynchus baudinii* Baudin's Cockatoo (TSSC 2018)
- Forest Black Cockatoo (Baudin's Cockatoo *Calyptorhynchus baudinii* and Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso*) Recovery Plan (DEC 2008)
- Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community (TSSC 2016)
- Waxy-leaved smokebush (Conospermum undulatum) recovery plan (DEC 2009)
- Approved Conservation Advice for Shrublands and Woodlands of the eastern Swan Coastal Plain (DCCEEW 2017)

3 Existing Environment

3.1 Regional and Local Context

3.1.1 Swan Coastal Plain

The Interim Biogeographic Regionalisation for Australia (IBRA) describe a system of 85 'biogeographic regions' (bioregions) and 405 subregions covering the entirety of the Australian continent (DCCEEW 2022). Bioregions are defined on the basis of climate, geology, landforms, vegetation and fauna.

The site is located within the Perth subregion (SWA02) of the Swan Coastal Plain bioregion of Western Australia, which is described by Mitchell et al. (2002) as:

> 'The Swan Coastal Plain is a low lying coastal plain, mainly covered with woodlands. It is dominated by Banksia or Tuart on sandy soils, *Casuarina obesa* on outwash plains, and paperbark in swampy areas. In the east, the plain rises to duricrusted Mesozoic sediments dominated by Jarrah woodland. The climate is Warm Mediterranean. Three phases of marine sand dune development provide relief. The outwash plains, once dominated by *Casuarina obesa*-marri woodlands and Melaleuca shrublands, are extensive only in the south.'

The Perth subregion is composed of colluvial and aeolian sands, alluvial river flats, coastal limestone. Heath and/or Tuart woodlands on limestone, Banksia and Jarrah-Banksia woodlands on Quaternary marine dunes of various ages, Marri on colluvial and alluvial. Rainfall ranges between 600 and 1000 mm annually and the climate is Mediterranean. The subregional area is 1,333,901 ha.

3.1.2 Regional climate

The climate of the Swan Coastal Plain subregion is Mediterranean with wet winters and dry hot summers. The mean maximum temperatures range from 18.0°C in July to 31.8°C in January (Hyd2o 2024).

Based on Bureau of Meteorology Station 009172 (Jandakot Aero), the long-term average annual rainfall since 1973 has been 818 mm (BOM, 2025). Since 2000, the average annual rainfall has declined to 758 mm, a reduction of 7%. Most of the rainfall occurs between the months of May and September (Hyd2o 2024).

3.1.3 Topography

Regional topographic contour mapping indicates that the site is relatively flat to undulating, with elevation ranging from 22 m Australian Height Datum (AHD) in the north of the site to 36 m AHD in the south (Figure 3).

3.1.4 Geology

3.1.4.1 Regional geology

The Swan Coastal Plain comprises five major geomorphologic systems that lie parallel to the coast: the Quindalup Dunes, Spearwood Dunes, Bassendean Dunes, Pinjarra Plain and Ridge Hill Shelf (Churchward and McArthur 1980; Gibson et al. 1994). Each major system is further subdivided into detailed geomorphologic units (Churchward and McArthur 1980; Semeniuk et al. 1990; Gibson et al 1994).

3.1.4.2 Local geology

The local geological formations within the site are defined below:

- The dominant geological unit consist of the Yoganup Formation which extends eastwards from the Darling Scarp.
- Portions of the western and north-western boundary of the site is underlain by thin Bassendean Sand over sandy clay to clayey sand of the Guildford Formation. These sands and clays are interfingering

making the geology heterogeneous. Guildford Formation, which is predominantly of fluvial origin and consists of clayey-sands and clays with lenses of coarse sands particularly at the base (Davidson 1995).

- The base of the superficial formations is between 0 m AHD to 8 m AHD, sloping downwards to the west.
- Based on ground surface elevations the superficial formations are about 20 m to 35 m thick.
- The superficial formations are underlain by the Kardinya Shale.

Table 3-1 provides a summary of the surface geological units within the site (Figure 3).

Table 3-1: Surface geological units within the site

Unit	Description	Equivalent regional geological unit
S8	Sand – white to pale grey at surface, yellow at depth, fine to medium-grained, moderately sorted, subangular to subrounded, minor heavy minerals, of eolian origin.	Bassendean Sand (Qpb)
S10	Sand – S8 (sand) over sandy clay to clayey sandy of the Guildford Formation, of eolian origin.	Thin Bassendean Sand over Guildford Formation (Qpb/Qpa)
S12	Sand – structureless, yellow, fine-grained, subangular, and medium to coarse grained subrounded to rounded quartz, feldspar and heavy minerals common, minor silt and clay, of colluvial origin.	Yoganup Formation (Qpr)
Mgs2	Gravelly silt – strong brown, tough, common pebbles of fine to coarse-grained, sub-rounded granite, some dolerite and rare sandstone (SS), variable sand content.	Colluvium (Qc)
Ms4	Sandy silt – cream to pale brown, angular to rounded sand, low cohesion, of alluvial origin.	Alluvium (Qha)

Source: Jordan, 1986

3.1.5 Hydrology

3.1.5.1 Groundwater

Local water monitoring data shows that the groundwater depth ranges from 4 m to 20 m below natural surface, the seasonal fluctuation in water table varies across the site, and the presence of a distinct groundwater mound centred over the former turf located on the western boundary of the site.

The groundwater used for turf irrigation was drawn predominantly from the Leederville Aquifer, which is below the Superficial Aquifer. There is limited movement of groundwater between the two Aquifers due to the presence of the Kardinya Shale which acts as a barrier. As a result of the former turf farm irrigation practices and geological factors, the groundwater drawn from the Leederville Aquifer and used for irrigation then infiltrated and accumulated in the Superficial Aquifer, resulting in groundwater mounding in the Superficial Aquifer over the long term.

Additionally, the geology along the western and north-western boundary of the site is predominately sand over clayey sand and clay sediments associated with the Bassendean Sands and Guildford Formations. Based on the soil permeability and geophysical studies undertaken within and adjacent to the site, the presence of non-contiguous Guildford Formation clayey soil forms a hydraulic barrier which strongly influence local groundwater flow, with the seasonal groundwater flows confirming a radial flow direction (i.e., flowing north-west to flowing south-east) from the mound and limiting groundwater flow in a westerly direction.

Cessation of the turf farm is likely to affect groundwater levels locally, with recent groundwater monitoring in proximity of the mound confirms water levels have reduced.

3.1.5.2 Surface Water

The site is within the catchment of Yule Brook, and is located between the Yule Brook Main Drain (approximately 200 m to the north) and Bickley Brook Main Drain (approximately 1.8 km to the south), which are both external to the site.

Post seasonal rain events, overland water within the site flows in a north-westerly direction following the topographical gradient. The surface water flow (if it is not infiltrated in the Yoganup Formation sandy soil profile) is intercepted by open roadside drains located along Boundary Road, Brentwood Road and Victoria Road and piped drains within private landholdings. The roadside drains are located above the groundwater table (Hyd2o 2024). These drains direct the surface water in a westerly to south-westerly direction towards three culvert outlets, positioned under Tonkin Highway, located at the western ends of Brentwood Road, Victoria Road and Boundary Road.

Please refer to LWMS for further detail on the site's hydrological conditions.

3.1.5.3 Geomorphic Wetlands

The wetlands on the Swan Coastal Plain have been evaluated and assigned a management category, providing guidance on how they should be managed and protected (EPA 2008):

- Conservation (CCW) – Wetlands that support a high level of attributes and functions. These wetlands are afforded the highest level of priority and protection.
- Resource Enhancement (REW) – Wetlands which may have been partially modified but still support substantial ecological attributes and functions. These wetlands are afforded priority with an emphasis on retention and rehabilitation.
- Multiple Use (MUW) – Wetlands with few remaining important attributes and functions. Land use, development and management of such wetlands should be considered in the context of ecologically sustainable development.

Within the site are two REWs (UFI 8037 and 15257), which were evaluated by Pentium Water (2024) as part of the MRS amendment process, and confirmed that both wetlands are in Completely Degraded condition or in the case of REW UFI 8037 within Tonkin Highway reserve, DBNGP easement and the former turf farm has been completed infilled and cleared of all native vegetation. Furthermore, DBCA's preliminary advice on the proposed Wattle Grove south MRS amendment, and specific to the two REWs within the site is summarised below (WAPC 2021):

- The portion of REW (UFI 15257) has been significantly modified from the construction of Tonkin Highway, the Water Corporation pipeline and DBNGP easements.
- REW (UFI 8037) has been cleared and filled (from the turf farm land use) and no longer exists.
- The environmental values of the two REWs (UFI 8037 and UFI 15257), using available regional scale data are commensurate with a MUW.

Concerning the Conservation Areas, there are no geomorphic wetlands mapped within these areas.

In proximity to the site, are the Greater Brixton Street Wetlands (GBSW) in Kenwick, which is approximately 100 m west of the site at the closest point and separated by Tonkin Highway (Figure 4). The GBSW are of international, national and regional environmental significance and are one of the most important wetlands on the Swan Coastal Plain, with biodiversity attributed to the unique geological, geomorphic and hydrological characteristics (EPA 2022). The extent of the GBSW includes the combined boundaries of A Directory of Important Wetlands in Australia (DIWA) (Brixton Street Swamps) and Bush Forever Site 387. The GBSW are also included on the Register of the National Estate.

The GBSW are characterised by outstanding and unique botanical diversity, with over 650 plant species recorded, including locally restricted species and distinct vegetation communities supporting conservation significant fauna, attributed to the specialised plant adaptations to the complex soils, chemistry and hydrology of the site (EPA 2022). The wetlands, located at the base of the Darling Scarp, are supported by Crystal Brook and Yule Brook and other surface and sub-surface water inputs. The area supports naturally vegetated wetlands that are rare or no longer exist elsewhere, and it is one of the largest consolidated wetland areas of high conservation value on the Swan Coastal Plain (EPA 2022).

3.1.6 Conservation Areas and Bush Forever

State Planning Policy 2.8: Bushland Policy for the Perth Metropolitan Region (SPP 2.8) aims to provide a policy and implementation framework that ensures bushland protection and management matters throughout the Perth Metropolitan Region are adequately addressed and integrated with broader land use planning and decision-making (WAPC 2010). In accordance with SPP 2.8, scheme amendments and development proposals must recognise regionally significant bushland and outline methods by which they will avoid, minimise, and offset any likely adverse impacts on regionally significant bushland. SPP 2.8 predominantly deals with two distinct subjects, Bush Forever areas and local bushland.

There are no DBCA managed lands within the site, with the nearest conservation reserve being the GBSW, which is approximately 100 m west of the site boundary (Plate 3-1).

No Bush Forever sites occur within the site (Plate 3-1). The closest points of the nearest Bush Forever sites are approximately 100 m to the west on the opposite side of Tonkin Highway (Site 387, the Greater Brixton Street Wetlands) and approximately 90 m to the north-west on the opposite side of Welshpool Road East (Site 320, Hartfield Road Bushland) (Plate 3-1).

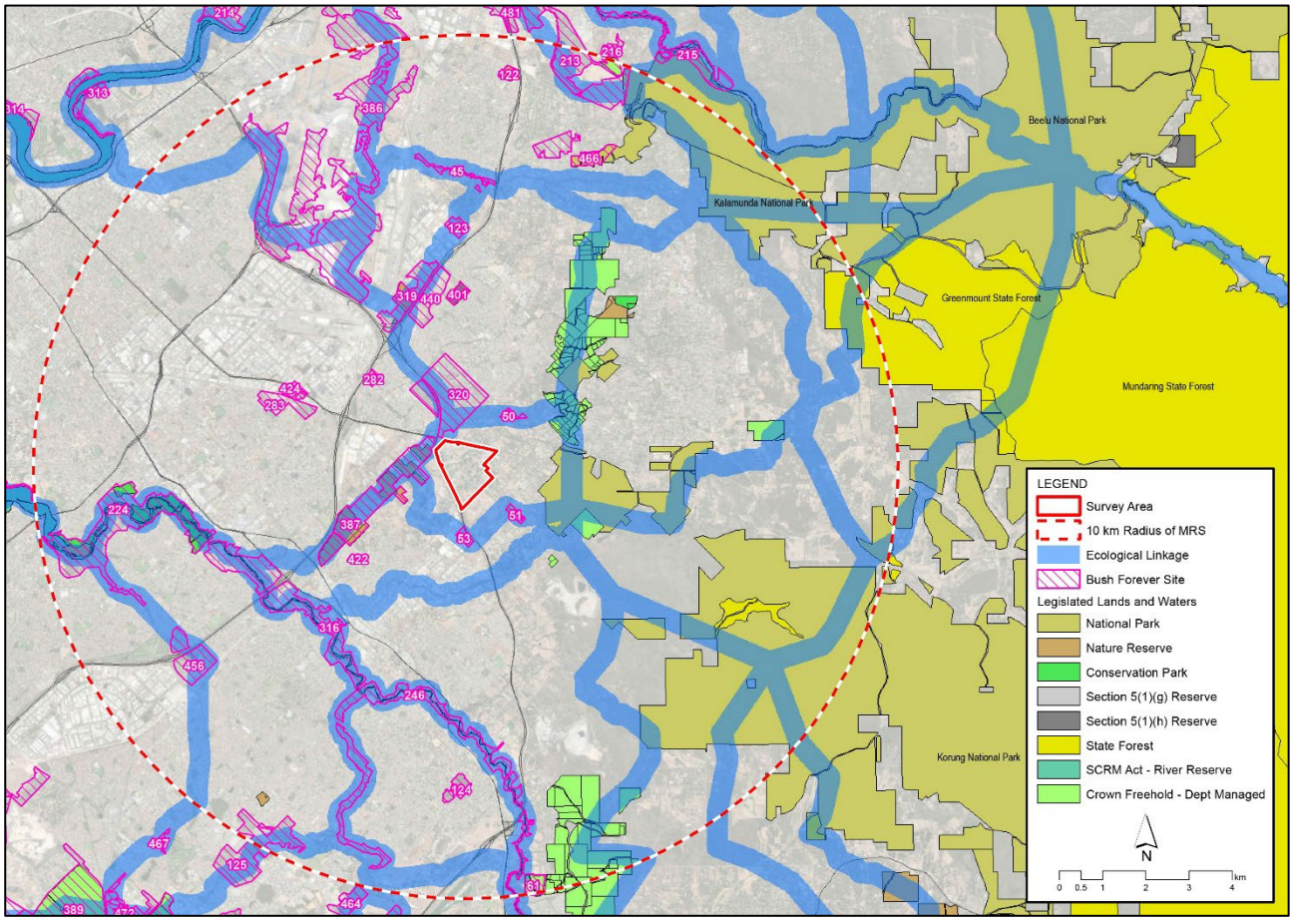


Plate 3-1: Conservation areas and regional ecological linkages

3.1.7 Regional Ecological Linkages

Ecological corridors have been identified in the Perth metropolitan region to limit the effects of fragmentation across areas of remnant bushland. In relation to the site, there is one regional ecological linkage located along the north-western perimeter of the site (Link ID: 40), which connects the GBSW and the Hartfield Road Bushland (Molloy, et.al. 2009). The small portion of the regional ecological linkage which falls within the site (specifically within portions of Lot 146 Welshpool Road East and Lot 12 Brentwood Road) has been extensively cleared of native vegetation and filled. An approved commercial landscape supply yard occurs within Lot 146 Welshpool Road East. Plate 3-1 illustrates the regional ecological linkages in proximity to the site.

3.1.8 Environmentally Sensitive Areas

Environmentally sensitive areas (ESAs) are declared by the Minister for Environment under Section 15b of the EP Act. ESAs are classes or areas of native vegetation where a number of the exemptions for clearing vegetation under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* do not apply.

Eight ESAs are mapped within the site according to the dataset available through DWER (2025) Environment Online (Plate 3-2).

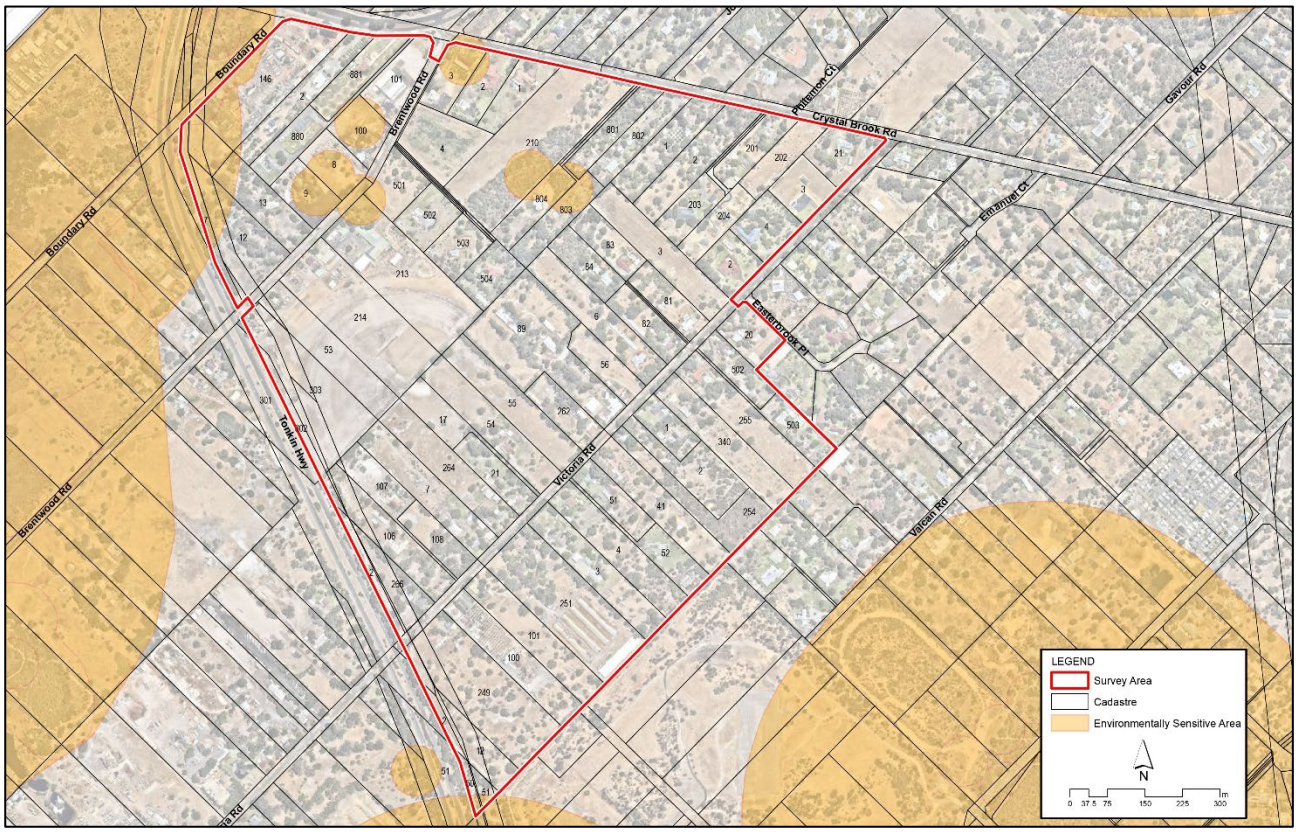


Plate 3-2: ESAs within the site (DWER 2025)

Each ESA is described in Table 3-2. Many of the ESAs mapped within the site are associated with the locations of historically recorded declared rare flora; however, based on surveys undertaken by AECOM (2020) many of these areas have since been cleared and the Threatened flora associated with the ESA boundary appear to be no longer present.

Table 3-2: Summary of ESAs within the site

Object ID	ESA purpose	Comment
8712	Within 50 m of CCW	Associated within the small area of mapped CCW on Lot 501 external to the site that is within/adjacent the proposed Tonkin Highway/Welshpool Road East intersection upgrade. Further, Lot 501 has historically been significantly altered including clearing of native vegetation and infilling of wetland areas to establish transport corridors and the construction (and maintenance) of DBGNP and Water Corporation pipeline easements.
17271	Within 50 m of CCW and associated with TEC	Associated with the small area of mapped CCW on Lot 501 external to the site. This CCW is within/adjacent to the proposed Tonkin Highway/Welshpool Road East intersection upgrade. Lot 501 has historically been significantly altered including clearing of native vegetation and infilling of wetland areas to establish transport corridors and the construction (and maintenance) of DBNGP and Water Corporation pipeline easement. ESA is also associated with an inferred TEC associated with GBSW. The association between this wetland (or Lot 501) and the GBSW has been severed with the construction of the four lane Tonkin Highway and the construction (and maintenance) of DBNGP and Water Corporation pipeline easement. This CCW is located over 100 m from the GBSW separated by Tonkin Highway.
10050	Associated with TEC	Associated with the TEC located within the mapped GBSW area which is located on the western side of Tonkin Highway and is more than 100 m west of the site however, a buffer area to the TEC falls within the north west corner of the site. Portions of this mapped ESA within the site have been significantly altered through historical clearing and associated semi-rural land uses which includes livestock paddocks and residential dwellings.
10045	Associated with TEC	Associated with the TEC located on the western side of Tonkin Highway and is more than 400 m south of the site; however, a buffer area to the TEC slightly falls within the southernmost corner of the site.
11904	Threatened or Rare Flora	Associated with the historic records of a *Conospermum undulatum* in this location. This area has been significantly altered through historical clearing and associated semi-rural land uses which includes livestock paddocks and residential dwellings. There is no evidence of this flora being present at this location (within the site) from the AECOM (2020) flora and vegetation.
11907		
11908		
11905	Threatened or Rare Flora	Associated with the historic record of a *Conospermum undulatum* in this location. Remnant vegetation in the immediate area has been identified as locally significant vegetation and is proposed to be retained.

3.1.9 Local Natural Areas

The City of Kalamunda (2023a) Local Biodiversity Strategy refers to Local Natural Areas (LNAs) as areas containing endemic species or ecological communities in a relatively natural state and are inferred as potentially having high biodiversity values. It also recognises LNAs as native vegetation, vegetated or open wetlands (lakes and swamps) and waterways (rivers, streams, creeks and estuaries), and seeks to retain, protect, manage, enhance and rehabilitate LNAs to improve the quality and quantity of biodiversity values (City of Kalamunda 2023a).

The City of Kalamunda (2023a) Local Biodiversity Strategy has mapped a number of LNAs within the site as shown in Plate 3-3. LNAs are natural areas held outside of the State's conservation estate and have formed the primary focus of the Local Biodiversity Strategy.

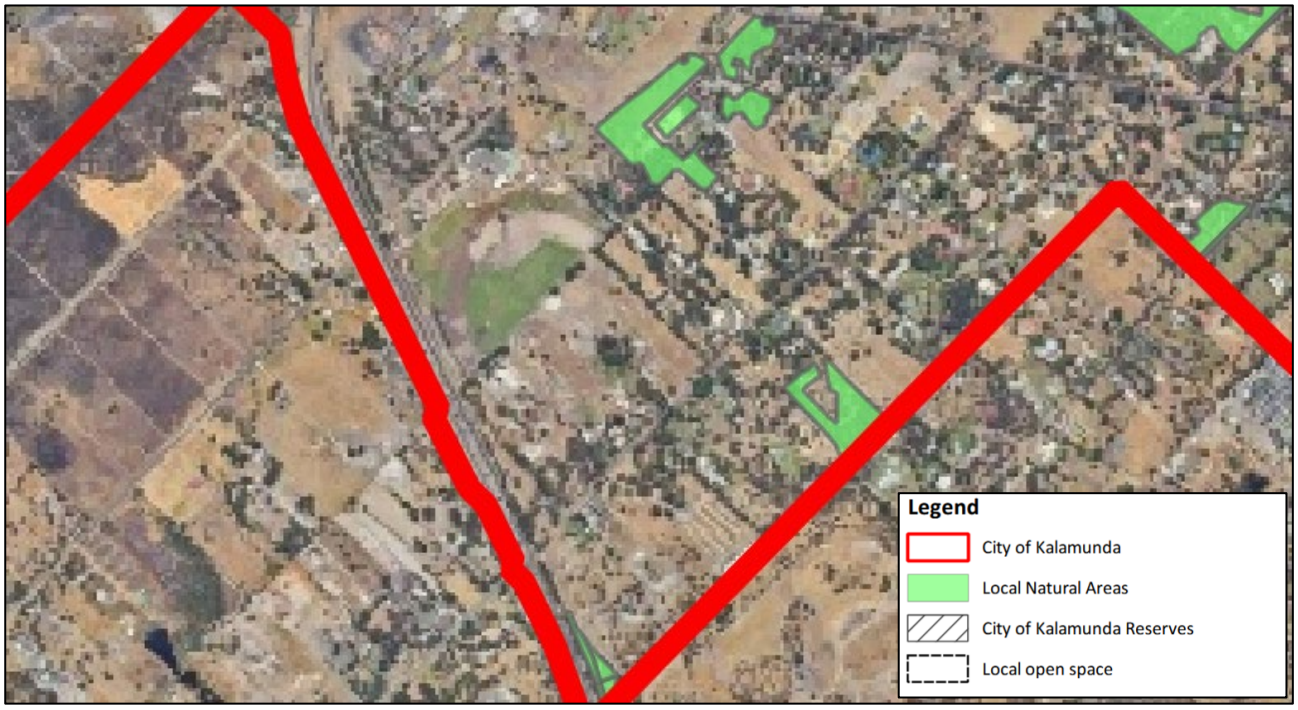


Plate 3-3: Local Biodiversity Strategy LNAs (City of Kalamunda 2023a)

The Local Biodiversity Strategy has allocated the LNAs within the site as having an 'I Management Category', which is for LNA on varied rural lots (of any size) and on Rural Conservation and Rural Landscape Interest on blocks less than 6 ha. LNAs within this management category have the following recommended planning conservation action:

- Any future development / subdivision should be within the provisions of the Scheme and the proposed Local Planning Policy for Biodiversity Conservation (e.g. High Conservation Value LNAs to be retained as Local Open Space for conservation).

As an outcome of the MRS Amendment process, future residential development of the site will result in retention and protection of all intact remnant vegetation which fall within the areas identified as LNAs, as well as some areas of remnant vegetation that have not been identified as LNA. Based on the surveys undertaken by AECOM (2020) and JBS&G (2024), it is worthwhile to note that the remaining areas of LNAs outside of those mapped as remnant vegetation within the site contain scattered trees (refer to Section 3.2.2).

3.2 Vegetation

3.2.1 Vegetation associations and complexes

Vegetation occurring within the region was initially mapped at a broad scale (1:1000 000) by Beard during the 1970s. This dataset formed the basis of several regional mapping systems, including the biogeographic region dataset for Western Australia (available via data.gov.au) and the physiographic regions defined by Beard (1975). The vegetation for the site has been identified as belonging to two sub-associations of the Pinjarra vegetation system (Beard et al. 2013), as shown in Plate 3-4.

Most of the Pinjarra vegetation system on the Swan Coastal Plain has been historically cleared, and of the two sub-associations of the Pinjarra system that are representative of the site, there is only 10,583 ha in total remaining on the Swan Coastal Plain, which accounts for only 7% of the pre-European extent of these two sub-associations, in aggregate (GoWA 2019a).

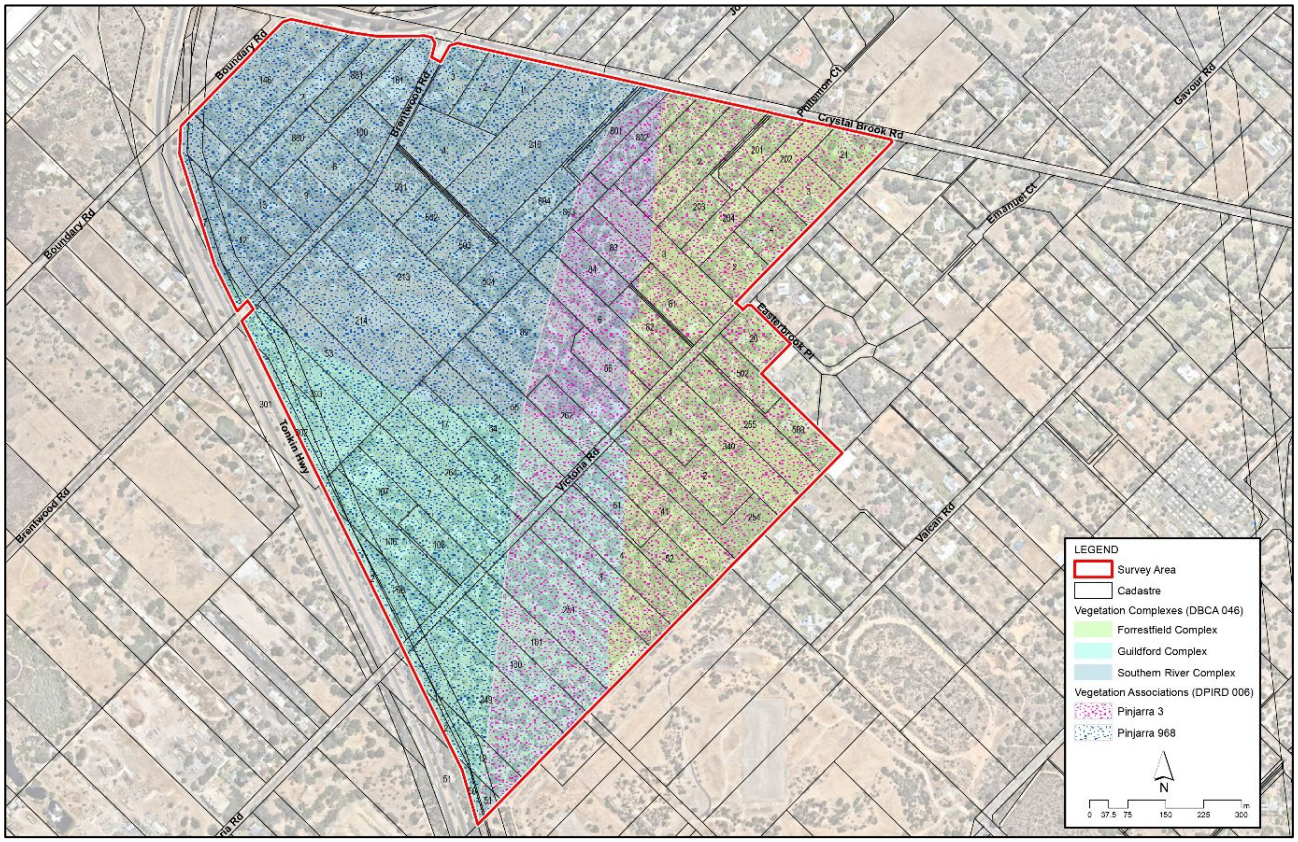


Plate 3-4: Vegetation associations and complexes

This is largely consistent with the extent of pre-European vegetation clearing that has historically occurred within the site. The area has been significantly cleared and now consists primarily of lawns/paddocks, planted trees and garden beds, with intact remnant native vegetation (in Good or better condition) making up approximately 2.9% of the site.

Vegetation complex mapping of the Swan Coastal Plain was completed by Heddle et al. (1980) and considers soils, landforms and floristics. The site straddles the Forrestfield, Guildford, and Southern River Complexes on the Ridge Hill Shelf, fluviatile deposits (deposited by watercourses) and aeolian deposits (wind-driven deposits) as shown on Plate 3-4.

The Forrestfield Complex is dominated by open forest or woodland of Marri (*Corymbia calophylla*), Wandoo (*Eucalyptus wandoo*) and Jarrah (*Eucalyptus marginata*) on heavier, gravelly soils, as well as Jarrah, Marri, and Sheoak (*Allocasuarina* spp.) on sandier soils. The Guildford Complex is dominated by open forest to woodland of Marri, Wandoo, and Jarrah, with areas of just Wandoo. The Southern River Complex is an open woodland of Marri, Jarrah, and Banksia. Woodlands of flooded gum (*Eucalyptus rudis*) and Swamp Paperbark (*Melaleuca raphiophylla*) occur in wet areas in all three complexes (Heddle et al. 1980).

Most of the Guildford Complex has been historically cleared with less than 10% remaining on the Swan Coastal Plain and within the Perth Metropolitan Region (GoWA 2019b), which again is largely consistent with the pre-European vegetation clearing that has taken place within the site. However, it is worthwhile to note that there is no intact remnant vegetation within the area mapped as Guildford Complex.

3.2.2 Vegetation Communities

Six native vegetation communities were described and mapped by AECOM (2020) for the broader Wattle Grove South area. Five vegetation communities (representing three native vegetation and two highly modified or planted) have been mapped consistent with those identified in the AECOM (2020) survey. Areas

not subject to a site survey were extrapolated by JBS&G (2024) (Appendix 3) based on adjacent ecological values, review of aerial imagery and where possible visual assessment from adjoining lots and road reserves.

Three native vegetation communities occur within the Conservation Areas. These communities fall into the broad category of Banksia Woodlands and *Eucalyptus marginata* Woodlands (AECOM 2020). The native vegetation communities within the site and the Conservation Areas are mapped in Figure 5 and presented in Table 3-3.

Table 3-3: Vegetation community descriptions

Description (ACEOM 2020)	Photograph (AECOM 2020)
Remnant native vegetation	
BaEpPf Banksia Woodland *Banksia attenuata*, *Banksia menziesii* and *Eucalyptus todtiana* low open woodland over *Eremaea pauciflora* var. *pauciflora*, *Hibbertia hypericoides* and *Allocasuarina humilis* low shrubland over *Phlebocarya filifolia*, *Mesomelaena pseudostygia* and *Lepidosperma leptostachyum* low sedgeland. Supports the Threatened *Conospermum undulatum* and Priority 3 *Isopogon autumnalis*.	
BmXpEc Banksia Woodland *Banksia menziesii*, *Allocasuarina fraseriana* and *Eucalyptus todtiana* low open woodland over *Xanthorrhoea preissii*, *Eremaea pauciflora* var. *pauciflora* and *Stirlingia latifolia* low open shrubland over *Ehrharta calycina**, *Dasypogon bromeliifolius* and *Anigozanthos manglesii* subsp. *manglesii* mixed grass and forbland.	
EmMpLp *Eucalyptus marginata* Woodland *Eucalyptus marginata* subsp. *marginata* and *Allocasuarina fraseriana* mid open forest over *Mesomelaena pseudostygia* and *Tetraria octandra* low sedgeland with *Lomandra preissii*, *Tricoryne elatior* and *Dampiera linearis* low open forbland.	
Highly modified vegetation	
Planted Planted and maintained gardens Condition considered Completely Degraded	NA
Trees Scattered trees Includes scattered trees (both native and introduced). Condition considered Completely Degraded.	NA

It is worthwhile to note native vegetation on Lots 8 and 9 Brentwood Road was cleared following the surveys undertaken by AECOM (2020) and JBS&G (2024), which mapped the vegetation as BmXpEc and ranged from Degraded to Very Good condition. Figure 5 reflects the recent clearing and illustrates the current and remaining extent of BmXpEc.

Table 3-4 presents the extent of these vegetation communities to be retained in Conservation.

Table 3-4: Vegetation community and extents in Conservation Areas

Vegetation community	Extent within Site	Conservation	Potential Future Conservation	Total area and percentage (Conservation and Potential Future Conservation)
BaEpPf	4.23 ha	3.41 ha	0.74 ha	4.15 ha (98% of BaEpPf area)
BmXpEx	0.28 ha	0.15 ha	0.05 ha	0.20 ha (71% of BmXpEx area)
EmMpLp	0.05 ha	0.05 ha	0.0 ha	0.05 ha (100% of EmMpLp area)
Total	**4.56 ha**	**3.61 ha**	**0.79 ha**	**4.40 ha (96% of total remnant vegetation area)**

3.2.3 Vegetation Condition

Vegetation condition within the site and the Conservation Areas varies from Excellent to Completely Degraded (Figure 6 and Table 3-5). As previously advised, and due to the recently clearing on Lots 8 and 9, the areas provided in the table below will have a minor variation to the areas presented in JBS&G (2024) ecological memo.

Vegetation condition mapped within the site as being in Good or better condition is 3.61 ha, all of which will be retained in Conservation (Figure 6).

Table 3-5: Vegetation condition and extents in Conservation Areas

Vegetation condition	Extent within site	Conservation	Potential Future Conservation	Total area (Conservation and Potential Future Conservation)
Remnant Native Vegetation				
Excellent	3.41 ha	3.41 ha	0.00 ha	3.41 ha
Very Good	0.05 ha	0.05 ha	0.00 ha	0.05 ha
Good	0.15 ha	0.15 ha	0.00 ha	0.15 ha
Degraded	0.13 ha	0.00 ha	0.05 ha	0.05 ha
Completely Degraded	0.82 ha	0.00 ha	0.74 ha	0.74 ha
Total	**4.56 ha**	**3.61 ha**	**0.79 ha**	**4.40 ha**

3.2.4 Floristic Community Types

An FCT analysis was undertaken by Plantecology (2024) (Appendix 4) in accordance with DBCA (2023) Methods for Survey and Identification of Western Australian Threatened Ecological Communities. The FCT assignment used the Gibson et al. (1994) and Keighery et al. (2012) datasets, and assignment was done by minimum dissimilarity between the AECOM and JBS&G plot data and plots from two regional datasets (nearest neighbour) (Plantecology 2024).

The FCT analysis incorporated relevant quadrats from the broader AECOM (2020) study area. Although some of the quadrats themselves were outside of the site and within the wider Wattle Grove area, using these quadrats enabled a better and more robust analysis of FCT. All but one of these quadrats were surveyed by AECOM (2020), with the other quadrat surveyed by JBS&G (2024).

Within the Conservation Areas, the probable FCTs assigned from the analysis undertaken by Plantecology (2024) include:

- FCT 20a *Banksia attenuata* woodlands over species rich dense shrublands State TEC – Critically Endangered (BC Act)
- FCT 20c Shrublands and woodlands of the eastern side of the Swan Coastal Plain State TEC – Critically Endangered (BC Act) and Federal TEC – Endangered (EPBC Act)

Regarding, the remaining patch of vegetation (BmXpEc) mapped within Lot 8, which is 0.05 ha in extent and is in Degraded condition, a targeted survey and FCT analysis of the flora and vegetation within this patch will be undertaken in accordance with DBCA (2023) Methods for Survey and Identification of Western Australian Threatened Ecological Communities, prior to any future subdivision application being lodged over this patch of vegetation to verify if it represents FCT 20c Shrublands and woodlands of the eastern side of the Swan Coastal Plain and therefore, requires retention and rehabilitation in accordance with the Environmental Conditions (Appendix 2).

3.2.5 Threatened Ecological communities

Native vegetation was mapped over 4.56 ha within the site. The FCT analysis undertaken by Plantecology (2024) (Appendix 4) and the Banksia Woodlands Assessment undertaken by JBS&G (2024) (Appendix 3) was used to determine the presence of any conservation-significant ecological communities within the four major vegetation patches (Figure 5) occurring within the site and the Conservation Areas. Three of these include TECs (Patches 1, 2 and 4), and another one (Patch 3) previously included TEC vegetation that has been recently cleared (Figure 7)

- Patch 1, contains:
  - 1.8 ha of Banksia Woodland – BaEpPf across Lots 254 and Lot 2 Victoria Road
  - BaEpPf is assigned as probably being FCT 20a B*anksia attenuata* woodlands over species rich dense shrublands State TEC – Critically Endangered (BC Act)
  - Banksia Woodlands of the Swan Coastal Plain TEC
  - Supports occurrences of threatened flora species *Conospermum undulatum* (Vulnerable) and priority flora *Isopogon autumnalis* (Priority 3).
- Patch 2, contains:
  - 0.35 ha of Banksia Woodland – BaEpPf
  - BaEpPf is assigned as probably being FCT 20a *Banksia attenuata* woodlands over species rich dense shrublands State TEC – Critically Endangered (BC Act)
  - Banksia Woodlands of the Swan Coastal Plain TEC
  - Supports occurrences of threatened flora species *Conospermum undulatum* (Vulnerable) and priority flora *Isopogon autumnalis* (Priority 3).
- Patch 3, previously contained:
  - 0.05 ha of Banksia Woodland – BmXpEc, use to comprise of approximately 0.3 ha of BmXpEc
  - BmXpEc assigned as probably being FCT 20c Shrublands and woodlands of the eastern side of the Swan Coastal Plain State TEC – Critically Endangered (BC Act) and Federal TEC – Endangered (EPBC Act)

- Patch 4, contains:
  - 2.07 ha of Banksia Woodland – BaEpPf
  - BaEpPf is assigned as probably being FCT 20a *Banksia attenuata* woodlands over species rich dense shrublands State TEC – Critically Endangered (BC Act)
  - Banksia Woodlands of the Swan Coastal Plain TEC
  - Supports occurrences of threatened flora species *Conospermum undulatum* (Vulnerable) and priority flora *Isopogon autumnalis* (Priority 3).

3.3 Flora

3.3.1 Conservation Significant Flora

AECOM undertook an ecological spring survey, incorporating flora and vegetation in October 2019 (AECOM 2020). The survey recorded data from twelve quadrats and eight relevés, covering a broader area of the Wattle Grove locality than the site. The result of this survey has been augmented by the further survey work undertaken by JBS&G (2024) as part of the MRS amendment for the site.

AECOM (2020) recorded 165 native vascular flora taxa from the broader survey area and 21 introduced flora taxa, many of which are not expected to occur within the site. This also included two conservation significant flora taxa, concentrated in two localised areas, within the site and Conservation Areas (Figure 8):

- *Conospermum undulatum* (T)
- *Isopogon autumnalis* (P3), previously named *Isopogon drummondii*.

The AECOM field survey was undertaken at an appropriate time to identify conservation significant orchid species if present, however, the survey only gained access to approximately 50% of lots and recognised that there is potential for conservation significant flora taxa to have been missed if present. JBS&G conducted flora and vegetation surveys, incorporating both previously surveyed and unsurveyed lots within the site. JBS&G recorded observations of conservation significant flora from the boundary of Lots 210 and 801. Observations of Lot 210 and Lot 801 noted the presence of *Conospermum undulatum* (T) and *Isopogon autumnalis* (P3).

3.3.2 Introduced Flora

Two Declared Pest plants were identified by AECOM (2020) as occurring within the broader survey area, **Asparagus asparagoides* (bridal creeper) and **Rubus ulmifolius* (blackberry). AECOM (2020) did not include a location for these weed species, so it is not known whether AECOM identified them as occurring within the site. JBS&G (2024) recorded **Asparagus asparagoides* (bridal creeper) on Lot 254 Victoria Road, and also noted that Lot 801 is a significant source of weeds invading remnant vegetation on Lot 210, including but not limited to **Leptospermum laevigatum*. Plantecology (2025) recorded **Gomphocarpus fruticosus* (Narrowleaf cottonbush) on Lot 54 Victoria Road.

3.4 Terrestrial Fauna

3.4.1 Fauna habitats

The AECOM (2020) survey broadly defined and mapped six fauna habitats within the wider area of Wattle Grove South area. Of these, only four of these habitats were mapped within the site, including:

- Banksia Woodlands
- Eucalypt Woodlands
- Scattered Trees

- Planted and Maintained Gardens

These survey results were further confirmed by JBS&Gs surveys undertaken in 2021 and 2022 (JBS&G 2024).

Fauna habitat within the site has been highly modified through historical and ongoing land uses, which have resulted in the clearing of the majority of native vegetation. The small areas of remnant vegetation that remain within the site provide the greatest significant fauna habitat and comprise mostly Banksia Woodlands, which exists in four distinct patches, as well as one very small patch of Eucalyptus Woodland in Very Good condition (Figure 9). The fauna habitat types that have been recorded within the site and the Conservation Areas are presented in Table 3-6.

Table 3-6: Fauna habitat descriptions (AECOM 2020)

Fauna habitat	Description
Banksia Woodland	This habitat generally comprises a low open woodland of Banksia and Eucalyptus over a low open shrubland on loamy, sandy brown soil. The habitat is generally considered high quality due to the presence of Banksia, its complexity and limited disturbance levels. Habitat quality is reduced where areas are significantly degraded due to impacts from clearing and edge effects. Fauna habitat characteristics include: • Dense understorey common • Logs of various sizes are common. • Fine and coarse leaf litter common to abundant • Bare ground occasionally present • Absence of stones and boulders • Large mature trees in occasional abundance (hollows absent). 
	Conservation significant species with potential to utilise habitat: • Generally good quality foraging habitat for Carnaby's cockatoo and Baudin's cockatoo • Low to moderate quality foraging habitat for the Forest Red-tailed black cockatoo • Contains occasional breeding tree for black cockatoos • Habitat for Quenda
Eucalypt Woodland	This habitat typically contains a Eucalypt woodland / open forest over a low shrubland over sandy brown soils. This habitat is variable throughout the survey area though generally contains a Eucalyptus woodland / open forest over a low shrubland over sandy brown soils. This habitat is considered high to moderate (depending on degree of degradation) quality due to the structural complexity and disturbance levels. Significant habitat characteristics include: • presence of large mature eucalypts • dense understorey occasionally present • logs of various sizes in variable abundance • fine and coarse leaf litter common • bare ground occasionally present • absence of stones and boulders • large hollows occasionally present, small hollows common • soils of areas at base of Darling scarp contained pea-gravel. 
	Conservation significant species with potential to utilise habitat:

Fauna habitat	Description

	• Potential foraging, breeding and roosting habitat for:
	  ▪ Forest Red-tailed black cockatoo
	  ▪ Carnaby's cockatoo
	  ▪ Baudin's cockatoo.
	• Habitat for Quenda

Planted and Maintained Gardens	Highly variable habitat including areas of planted and maintained native and introduced vegetation.  The habitat is considered low to moderate quality due to disturbance levels and limited habitat complexity. Significant habitat characteristics include: • mature trees rare • variability of understorey, with areas of dense understorey generally absent • general lack of hollows • bare sandy ground abundant • absence of stones, boulders and rock crevices.

	Conservation significant species with potential to utilise habitat:
	• Potential foraging, breeding and roosting habitat for:
	  ▪ Forest Red-tailed black cockatoo
	  ▪ Carnaby's cockatoo
	  ▪ Baudin's cockatoo.
	• Habitat for Quenda

Scattered Trees	This habitat is varied and contains large mature native and non-native eucalypt trees, as well as other introduced species such as Cape Lilac and Jacaranda. Trees were generally recorded over cleared areas.  The significant fauna habitat characteristics include: • presence of large mature trees • absence of dense understorey • small hollows are common, large hollows are rare • logs of all sizes are rare to occasionally present • coarse and fine litter are present but generally only under trees. • bare sandy ground abundant • absence of stones, boulders and rock crevices.

	Conservation significant species with potential to utilise habitat:
	• Potential foraging, breeding and roosting habitat for:
	  ▪ Forest Red-tailed black cockatoo
	  ▪ Carnaby's cockatoo
	  ▪ Baudin's cockatoo.
	• Marginal habitat for Quenda

Fauna habitat	Description	
Cleared	Generally, consists of areas which have been cleared (e.g. paddocks) and now comprise bare soil and / or weeds (may contain the occasional shrub/ tree), or hardstand areas (e.g. roads). Habitat is considered very low quality. Conservation significant species with potential to utilise habitat: • This habitat may contain the occasional individual foraging tree/shrub for black cockatoos.	

Regarding the clearing that has taken place on Lots 8 and 9 Brentwood Road and the mapping discrepancy identified on Lot 2 Victoria Road, Table 3-8 and Figure 9 reflects the updated fauna habitat areas for Banksia Woodland and Eucalyptus Woodland as a result of this clearing and revision to the mapping.

Table 3-7: Fauna habitats and extents in Conservation Areas

Fauna habitat (vegetation communities)	Extent within Site	Conservation	Potential Future Conservation	Total area and percentage (Conservation and Potential Future Conservation)
Banksia Woodlands (BaEpPf)	4.23 ha	3.41 ha	0.74 ha	4.15 ha (98%)
Banksia Woodlands (BmXpEc)	0.28 ha	0.15 ha	0.05 ha	0.20 ha (71%)
Eucalypt Woodlands (EmMpLp)	0.05 ha	0.05 ha	0.0 ha	0.05 ha (100%)
Total	**4.56 ha**	**3.61 ha**	**0.79 ha**	**4.40 ha (96%)**

3.4.2 Fauna Assemblage

Fifty-one vertebrate fauna species were recorded within the site or in adjacent areas during the AECOM (2020) field survey. This comprised 36 bird, 11 mammal, one amphibian and three reptile species.

3.4.3 Conservation Significant Fauna

Five of the 51 recorded vertebrate fauna species are identified as having some conservation significance, including three birds and one mammal, summarised as follows:

- Forest Red-Tailed black cockatoo *Calyptorhynchus banksii* (listed as Vulnerable under the EPBC Act and the BC Act).
- Carnaby's cockatoo *Zandi latirostris* (listed as Endangered under the EPBC Act and the BC Act).
- Quenda *Isoodon fusciventer* (listed as Priority 4 by DBCA) (refer to Figure 9 for locations of Quenda diggings and scat recorded within the site).
- Rainbow Bee-Eater *Merops ornatus* (listed as Marine under the EPBC Act).

Whilst not observed during the survey, an additional conservation significant fauna species is also considered to have the potential to utilise the habitats within the survey area:

- Baudin's cockatoo *Zandi baudinii* (listed as Endangered under the BC Act and the EPBC Act).

3.4.4 Black Cockatoo Habitat

3.4.4.1 Foraging Habitat

The site contains both native and introduced vegetation, of varying quality, some of which may be suitable for foraging for all three black cockatoo species, as described in Table 3-6. The suitability of this habitat for foraging varies, depending on the type of habitat and its condition.

Phoenix Environmental (2024) utilised the data collected by AECOM (2020) and JBS&G (2024), which included site surveys undertaken by AECOM in 2019 and JBS&G in 2021 and 2022 and determined the foraging habitat value using the BCE (2021) scoring system for all three black cockatoos within the site and the Conservation Areas.

At the time of the surveys undertaken by AECOM (2020) and JBS&G (2024), there were no records of fire and therefore, is unlikely to have impacted forage species coverage scores (Phoenix Environmental 2024).

The BCE (2021) scoring system provides a foraging value score that reflects the significance of vegetation as foraging habitat for black cockatoos and a numerical value that is designed to assess potential impact significance and offset requirements. The foraging value of the vegetation is dependent on the following components:

- Site condition – a score out of six is determined based on the vegetation composition, condition and structure.
- Site context – a score out of three is determined for the context of the site, which is a function of site size, availability of nearby habitat and breeding area, as well as consideration of connectivity to access foraging sites.
- Species stocking rate – a score out of one is determined based on upon the black cockatoo species being either abundant or not-abundant (i.e. a score of 1 is used when the species is reported regularly and/or there is abundant foraging evidence and a score of 0 is used when the species is recorded or reported very infrequently, and there is little or no foraging evidence).

Determining the total score out of 10, which may require moderation for context and species density with respect to the site condition (vegetation) score. Moderation also includes consideration of pine plantations as a special case for foraging value

Site condition is scored out of 6 and is the biggest factor in the overall score. Site condition varied between species of black cockatoo and vegetation communities, with higher scores being attributed to those vegetation communities/habitats with a higher density of foraging species (Phoenix Environmental 2024).

The site context was assigned by Phoenix Environmental (2024) as 3 to all polygons, given:

- Carnaby's cockatoo: local breeding is also known and 32.9% of native vegetation remains within 15 km of the MRS amendment area.
- Baudin's cockatoo: no local breeding is known or likely, but 32.9% of native vegetation remains within 15 km of the MRS amendment area
- Forest Red-tailed black cockatoo: no local breeding is known or likely, but 32.9% of native vegetation remains within 15 km of the MRS amendment area.

The following stocking rates were calculated by Phoenix Environmental as:

- Carnaby's cockatoo: stocking rate = 1 as observed feeding and multiple recent and historic evidence of feeding activity were recorded (i.e. AECOM 2020; DBCA 2023; JBS&G 2024 and here).
- Baudin's cockatoo: stocking rate = 0 as no feeding was directly observed, nor was recent or historical evidence found and desktop records are also absent within 15 km of the MRS amendment area

- Forest Red-tailed black cockatoo: stocking rate = 1 as observed feeding and multiple recent and historic evidence of feeding activity were recorded (i.e. AECOM 2020; DBCA 2023; JBS&G 2024 and here).

The moderation values were applied to parts of the habitat polygons that did not record any known forage species (native or introduced) (Phoenix Environmental 2024).

The resultant foraging habitat scores for all three black cockatoos according to the vegetation communities is presented in Table 3-9. Areas that have been subject to clearing or development have been mapped as 'Cleared', and include the recent clearing on Lots 8 and 9. As a result, the areas provided in the table below will have a minor variation to the areas presented in Phoenix Environmental's (2024) black cockatoo habitat assessment (Appendix 5).

Table 3-8: Black cockatoo foraging habitat value per BCE 2021 scoring method

Vegetation community	Rating*	Carnaby's cockatoo		Baudin's cockatoo		Forest Red-tailed black cockatoo	
		Score	Sum area (ha)	Score	Sum area (ha)	Score	Sum area (ha)
BaEpPf	Low	-	0	2	0.82	3	0.82
	Medium	6	0.82	5	1.34	-	0
	High	8	3.41	7	2.07	8	3.41
BmXpEc	High	-	0	7	0.15 (pre clearing 0.29)	7	0 (pre clearing 0.05)
		8	0.15 (pre clearing 0.29)	-	0	8	0.15 (pre clearing 0.24)
EmMpLp	Low	2	0.08	3	0.08	3	0.08
	High	8	0.05	7	0.05	8	0.05
Trees	Low	2	20.43	2	21.62	2	20.61
		3	5.84	3	4.48	3	6.30
	Medium	5	0.59	5	0.81	-	0
		6	0.05	-	0	-	0
Planted	Low	2	2.80	3	2.80	2	2.80
Cleared	Low	2	91.37 (pre clearing 91.23)	2	91.37 (pre clearing 91.23)	2	91.37 (pre clearing 91.23)
Total area (ha)		**125.59**		**125.59**		**125.59**	

*** Relative Rating**

- Low value habitat (red) is 1 to 3 out of 10
- Medium value habitat (yellow) is 4 to 6 out of 10
- High value habitat (green) is 7 to 10 out of 10

The spatial distribution of the foraging habitat value across the site and the Conservation Areas is shown in Figure 10 (Carnaby's cockatoo), Figure 11 (Forest Red-tailed black cockatoo) and Figure 12 (Baudin's cockatoo).

Based on the density of suitable foraging species, most of the site (ranging from 95.96% for Carnaby's cockatoo to 97.01% for Forest Red-tailed black cockatoo) is comprised of low foraging habitat value for all three Black cockatoos (Table 3-10). The Banksia Woodland (BaEpPf and BmXpEc) and Eucalyptus Woodland (EmMpLp) scored the highest at either 7 or 8 out of 10. There were some discrete areas that were of medium foraging habitat value for Carnaby's cockatoo (located on Lot 801 and Lot 2) and Baudin's cockatoo (located on Lots 84, 504, 803 and 804).

Table 3-9: Foraging habitat value per black cockatoo species in Conservation

Rating	Score	Carnaby's cockatoo			Baudin's cockatoo			Forest Red-tailed black cockatoo		
		Extent in Site	Conservation	Potential Conservation	Extent in Site	Conservation	Potential Conservation	Extent in Site	Conservation	Potential Conservation
Low	2	114.68 ha (91.32%)	-	0.05 ha (0.04%)	113.81 ha (90.63%)	-	0.79 ha (0.63%)	114.78 ha (91.39%)	-	0.05 ha (0.04%)
	3	5.84 ha (4.65%)	-	-	7.36 ha (5.79%)	-	-	7.20 ha (5.73%)		0.74 ha (0.59%)
Subtotal		120.52 ha (95.97%)	-	-	121.17 ha (96.48%)		-	121.97 ha (97.12%)	0.60 ha (0.48%)	-
Medium	5	0.59 ha (0.47%)	-	-	2.15 ha (1.71%)	1.34 ha (1.06%)	-	-	-	-
	6	0.87 ha (0.69%)		0.74 ha (0.59%)	-	-	-	-	-	-
Subtotal		1.46 ha (1.16%)		-	2.15 ha (1.71%)	1.34 ha (1.06%)	-	-	-	-
High	7	-	-	-	2.27 ha (1.81%)	2.27 ha (1.81%)	-	-	-	-
	8	3.61 ha (2.88%)	3.61 ha (2.87%)	-	-	-	-	3.61 ha (2.87%)	3.61 ha (2.87%)	-
Subtotal		3.61 ha (2.88%)	3.61 ha (2.87%)		2.27 ha (1.81%)	2.27 ha (1.81%)	-	3.61 ha (2.87%)	3.61 ha (2.87%)	
Total		125.59 ha (100%)	3.61 ha (2.87%)	0.79 ha (0.63%)	125.59 ha (100%)	3.61 ha (2.87%)	0.79 ha (0.63%)	125.58 ha (100%)	3.61 ha (2.87%)	0.79 ha (0.63%)

Given the results of the habitat assessment, Phoenix Environmental (2024) recommended that all of the high-quality TEC remnant vegetation present within the site is retained to support local breeding, roosting and foraging for Carnaby's cockatoo and Forest Red-tailed black cockatoo as the remaining areas offer little value to those species.

Table 3-10 lists the foraging habitat score for each black cockatoo species and those that will be retained in the Conservation areas. The table highlights that all areas containing high quality foraging habitat for all three black cockatoos will be retained for conservation.

3.4.4.2 Potential Breeding Habitat

Potential nesting trees, in the context of black cockatoos, are defined by DAWE (2022) as native trees of suitable species with a diameter at breast height (DBH) greater than 500 mm (or >300 mm for Salmon Gum and Wandoo). Trees with a DBH greater than 500 mm (or >300 mm for Salmon Gum and Wandoo) are large enough to potentially contain hollows suitable for nesting black cockatoos or have the potential to develop suitable hollows over the next 50 years.

Based on the AECOM (2020) and JBS&G (2024) surveys, and the more recent Phoenix Environmental (2025) survey, a total 158 potential nesting trees have been recorded within the site (Figure 13).

The majority of potential nesting trees are scattered in areas of degraded habitat or cleared land/paddocks and consist of native trees known to support breeding such as Jarrah, Marri, Tuart and Flooded Gums (Phoenix Environmental 2024).

3.4.4.2.1 Tree hollow inspection

As part of Phoenix Environmental (2024) analysis of the black cockatoo data collected from the site surveys by AECOM (2020) and JBS&G (2020), seven potential nesting trees were identified as requiring re-inspection to confirm location and suitability of hollows as nests for black cockatoos (Appendix 5). Phoenix Environmental (2024) inspected the seven potential nesting trees on 19 January 2024 with a GoPro pole camera and recorded tree species, DBH, number of hollows present, hollow heights present, hollow height and orientation, hollow suitability (e.g. size of entrance, condition of outside of the hollow), and evidence of use (Phoenix Environmental 2024). None of the inspected trees are suitable for black cockatoo nesting (Phoenix Environmental 2024).

In order to be suitable for black cockatoos, hollow entrances need to be at least 100 mm in diameter. Hollows in Jarrah tend to be smaller than those found in Marri, consequently black cockatoos, particularly Forest Red-tailed black cockatoos, breed predominantly in Marri, in the Jarrah-Marri forest of the south-west (Whitford 2002; Johnstone et al 2013). On the Swan Coastal Plain most black cockatoo breeding records, particularly for Carnaby's cockatoo, are in Tuart (Johnstone and Kirkby 2011).

Given the semi-urban nature of the local environment and the outcome of the hollow inspection undertaken by Phoenix Environmental (2024), it is unlikely that the site represents breeding habitat for any of the 3 black cockatoo species especially in the absence of confirmed or historic breeding observations and the absence of any trees with suitable hollows.

The site does contain small areas of high-quality foraging habitat, as well as water sources and roosting site in close proximity, and so whilst the site could be considered high quality future breeding habitat, the site comprises semi-rural residential land that has been heavily developed and highly modified (Phoenix Environmental 2024). Subsequently, numerous potential nesting trees have been lost over the past few years due to age and condition and therefore, in the consideration of the current land use, it is considered highly unlikely that the current crop of trees will still be standing in 50 to 100 years, which is when they may begin to develop larger hollows suitable for breeding (Phoenix Environmental 2024).

3.4.4.3 Potential Roosting Habitat

Carnaby's and Baudin's cockatoos roost in or near riparian environments or near other permanent water sources, generally within any tall trees, but particularly Flat-topped Yate, Salmon Gum, Wandoo, Marri, Karri,

Blackbutt, Tuart, introduced Eucalypts and introduced Pines. The Forest Red-tailed black cockatoo prefers the edges of forests for roosting, within any tall trees, but particularly tall Jarrah, Marri, Blackbutt, Tuart and introduced Eucalypt trees (DotEE 2017).

Within 12 km of the MRS amendment area, there are 50 confirmed roosting sites (23 Forest Red-tailed black cockatoo roosting sites, 7 White tailed black cockatoo roosting sites and 20 White-tailed and Forest Red-tailed roosting sites) and 10 unconfirmed roosting sites (Plate 3-5) (Birdlife 2024, as cited in Phoenix Environmental 2024).

Located 250 m east from the MRS amendment area is an unconfirmed roosting site (KALWATR001), which means roosting black cockatoos have been provided but there has been no positive count recorded during any of the Great Cocky Count census (Birdlife 2024, as cited in Phoenix Environmental 2024). The following 2 roosting sites occur to the east and are within 1 km of the MRS amendment area (Phoenix Environmental 2024):

- Confirmed site (KALWATR002) is located 850 m east of the MRS amendment area and is known to support FRTBC roosting of up to 150 individuals (Great Cocky Count Census 2016 2018) (DBCA 2023), with lower numbers recorded in subsequent years (2019 – 23, 2021 – 87, 2022 – 0 and 2023 – 35).
- Unconfirmed site (KALWATR001) is located 250 m east of the MRS amendment area. An unconfirmed black cockatoo roosting site is where roosting has been reported but there has been no positive count recorded during any of the Great Cocky Count census (Birdlife 2024, as cited in Phoenix Environmental 2024).

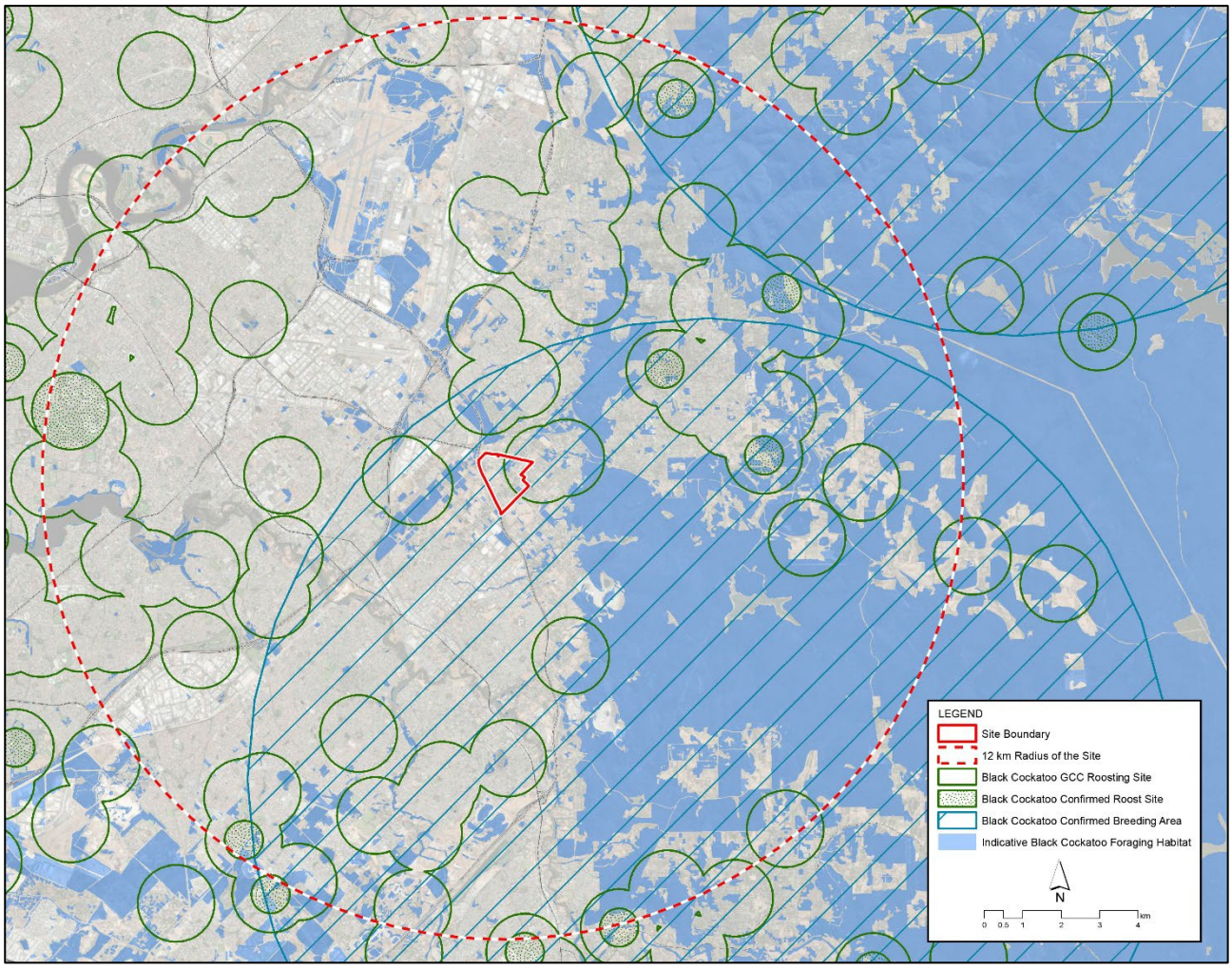


Plate 3-5: Black cockatoo roosting and breeding sites (within 12 km)

The habitat assessment undertaken by AECOM (2020) determined that 29.8 ha of suitable roosting habitat was present, consisting of remnant native vegetation, planted gardens and scattered trees; however, these have been found to be of largely low value (Phoenix Environmental 2024).

Numerous surveys have been undertaken within the site since 2019, as well as numerous sites in close proximity are part of annual black cockatoo monitoring, and to date no roosting sites for black cockatoo species have been identified within the site (Plate 3-5). So, while there may be suitable roosting habitat, it does not appear to be used as such, at least not for the last decade (Phoenix Environmental 2024).

4 Conservation Areas

4.1 Environmental objective

To protect, maintain and enhance the quality and ecological function of the conservation significant ecological communities and flora, and black cockatoo habitat for the long term.

4.2 Environmental values

4.2.1 Threatened Ecological Communities

4.2.1.1 *Banksia attenuata* woodlands over species rich dense shrublands (FCT 20a)

This community occurs on sands at the base of the Darling Scarp between Chittering and Gosnells. It is very species rich and is usually dominated *Banksia attenuata* (occasionally *Eucalyptus marginata*) *Bossiaea eriocarp*a, *Conostephium pendulum*, *Hibbertia huegelii*, *H. hypericoides*, *Petrophile linearis*, *Scaevola repens, Stirlingia latifolia*, *Mesomelaena pseudostygia* and *Alexgeorgea nitens* being common in the understorey. The introduced bulbous weed *Gladiolus caryophyllaceus* is also common in the community (DPaW 2016).

This community is listed as Critically Endangered under the State BC Act, and is listed as sub-community under the Banksia Woodlands of the Swan Coastal Plain ecological community (Section 4.2.1.3), which is listed as Endangered under the Federal EPBC Act.

4.2.1.1.1 Recovery Plan for Banksia attenuata woodlands over species rich dense shrublands (FCT 20a)

The objective of the interim recovery plan is 'to maintain and maintain or improve the overall condition of the *Banksia attenuata* woodlands over species rich dense shrublands in the known locations' (DPaW 2016).

Table 4-1 identifies the relevant recovery actions for FCT 20a that have guided the preparation of this CAMS and future management actions to be implemented through the CAMP for each Conservation Area containing FCT 20a, and to ensure conservation measures proposed will achieve the overall objective of the Recovery Plan and contribute towards increasing the occurrences of FCT 20a within the conservation estate.

Table 4-1: Relevance to the interim recovery plan for FCT 20a

Recovery action (DPaW 2016)	Relevance to site and future conservation
Liaise with stakeholders to implement recovery	As part of the CAMS and subsequent CAMP (to be prepared and implemented at subdivision/development stage), liaison will be undertaken with DBCA and the City of Kalamunda to ensure the management actions will ensure FCT 20a is adequately protected within the Conservation Areas.
Seek to minimise further clearing of the community	Implementation of the Local Structure Plan and the Environmental Conditions (Appendix 2) will result in all occurrences of FCT 20a being retained and protected within the Conservation Areas. Thereby, minimising the further clearing of the community.
Verify occurrences as required	All 3 remaining areas of intact remnant vegetation (in Good or better condition) within the MRS amendment area have been surveyed and the probable FCT 20a has been assigned using DBCA (2024) Methods for survey and identification of Western Australian threatened ecological communities.
Continue to monitor the extent and boundaries of occurrences	Where occurrences of FCT 20a are retained within the Conservation Areas, regular monitoring and annual reporting via the CAMP will be undertaken. Annual reporting will include annual monitoring of condition to ensure the occurrences are being maintained and not declining in condition.

Recovery action (DPaW 2016)	Relevance to site and future conservation
Implement weed control and rehabilitation as required	The CAMP will include and implement weed control measures within the Conservation Area, and in line with the following protocol: 1. Determine which weeds are present and develop a prioritised weed control program 2. Select appropriate herbicides 3. Control invasive weeds by hand removal or spot spraying as the herb layer is an integral part of this plant community and care will be taken to minimise disturbance of native herbs The CAMP will also include a rehabilitation program that will be tailored to increase the extent as well as improve the overall condition of the FCT 20a within the Conservation Areas.
Develop and implement a fire management strategy	The CAMP will include appropriate bushfire management measures to be implemented within the Conservation Areas. Furthermore, site specific Bushfire Management Plans will be required as part of local structure planning, subdivision and/or development.
Implement disease hygiene procedures	The CAMP will establish and implement hygiene procedures to prevent introduction of pathogens within the Conservation Area.
Seek long term protection of the community for conservation	Implementation of the Local Structure Plan and the Environmental Conditions (Appendix 2) will result in all occurrences of FCT 20a being retained and protected within the Conservation Areas. Further, implementation of the CAMP will facilitate their on-ground management and thereby, ensure their conservation for the long term.

4.2.1.2 Shrublands and Woodlands of the Eastern Swan Coastal Plain (FCT 20c)

This community occurs mainly on the transitional soils of the Ridge Hill, on the Swan Coastal Plain adjacent to the Darling Scarp, and extends marginally onto the alluvial clays deposited on the eastern fringe of the Swan Coastal Plain. This community has been recorded between Stratton and Maddington (DBCA 2023).

The flora of this community reflects the transitional landform and soil zone between the Scarp and the Swan Coastal Plain, and comprises a shrubland or woodland of *Banksia attenuata* (slender banksia) and *Banksia menziesii* (firewood banksia), sometimes with *Allocasuarina fraseriana* (western sheoak), over a shrub layer that can include the species *Adenanthos cygnorum* (woolybush), *Hibbertia huegelii*, *Scaevola repens var. repens* (fan flower), *Allocasuarina humilis* (dwarf sheoak), *Bossiaea eriocarpa* (common brown pea), *Hibbertia hypericoides* (yellow buttercups) and *Stirlingia latifolia* (blueboy). A suite of herbs usually occur within this community, including *Conostylis aurea* (golden conostylis), *Trachymene pilosa* (native parsnip), *Lomandra hermaphrodita*, *Burchardia congesta* (milkmaids) and *Patersonia occidentalis* (purple flag), and the sedges *Mesomelaena pseudostygia* (semaphore sedge) and *Lyginia barbata* (DBCA 2023).

This community is listed as Critically Endangered under the State BC Act and Endangered under the Federal EPBC Act.

4.2.1.2.1 Approved Conservation Advice for Shrublands and Woodlands of the eastern Swan Coastal Plain

The objective of this conservation advice is 'to mitigate the risk of extinction (or collapse) of the Shrublands and Woodlands of the eastern Swan Coastal Plain ecological community, and help recover its biodiversity and function' (TSSC 2017).

The advice outlines the following four key approaches to achieving this objective:

- Protect the ecological community to prevent further loss of extent and condition
- Restore the ecological community within its original range by active abatement of threats, regeneration and revegetation, and other conservation initiatives

- Communication – Engage with and support people to increase understanding of the value and function of the ecological community and encourage their efforts in its protection and recovery
- Research and monitoring to improve our understanding of the ecological community and methods for restoration and protection over the long-term.

The above key approaches have guided the preparation of this CAMS and future management actions to be implemented through the CAMP for any Conservation Area containing Shrublands and Woodlands of the eastern Swan Coastal Plain. Thereby, ensuring the management actions proposed will contribute to the long-term protection and restoration of any occurrences of Shrublands and Woodlands of the eastern Swan Coastal Plain within the Conservation Areas.

4.2.1.2.2 Interim Recovery Plan for the Eastern Shrublands and Woodlands (Community type 20C) 2006-2011

The objective of the interim recovery plan is 'To maintain or improve the overall condition of the 'shrublands and woodlands of the eastern side of the Swan Coastal Plain' and reduce the level of threat with the aim of downgrading it from Critically Endangered to Endangered' (DEC 2006).

Table 4-2 identifies the relevant recovery actions for FCT 20c that have guided the preparation of this CAMS and future management actions to be implemented through the CAMP for any Conservation Area containing FCT 20c, and to ensure conservation measures proposed will achieve the overall objective of the Recovery Plan and contribute towards increasing the occurrences of FCT 20c within the conservation estate.

Table 4-2: Relevance to the interim recovery plan for FCT 20c

Recovery action (DPaW 2016)	Relevance to site and future conservation
Liaise with stakeholders to implement interim recovery plan	As part of the CAMS and subsequent CAMP (to be prepared and implemented at subdivision/development stage), liaison will be undertaken with DBCA and the City of Kalamunda to ensure the management actions will ensure FCT 20a is adequately protected within the Conservation Areas.
Monitor the extent and boundaries of the community	Where occurrences of FCT 20c are retained within the Conservation Areas, regular monitoring and annual reporting via the CAMP will be undertaken. Annual reporting will include annual monitoring of condition to ensure the occurrences are being maintained and not declining in condition.
Develop and implement fire management strategy	The CAMP will include appropriate bushfire management measures to be implemented within the Conservation Areas. Furthermore, site specific Bushfire Management Plans will be required as part of local structure planning, subdivision and/or development.
Monitor dieback and determine priority areas for dieback treatment	The CAMP will include the requirement for baseline dieback assessment and mapping to be undertaken within the Conservation Area, to identify priority areas for dieback treatment. If dieback is found to be present, annual reporting will include annual monitoring of dieback within the Conservation Area.
Implement dieback treatments	The CAMP will establish and implement hygiene procedures to prevent introduction of pathogens within the Conservation Areas.
Assess and monitor weed populations	The CAMP will include the requirement to undertake a baseline weed survey and annual weed monitoring as part of the annual reporting requirements for the CAMP.
Implement weed control, replanting and rehabilitation where necessary	The CAMP will include and implement weed control measures within the Conservation Area, and in line with the following protocol: 1. Determine which weeds are present and develop a prioritised weed control program 2. Select appropriate herbicides

Recovery action (DPaW 2016)	Relevance to site and future conservation
	3. Control invasive weeds by hand removal or spot spraying as the herb layer is an integral part of this plant community and care will be taken to minimise disturbance of native herbs If required, the CAMP will also include a revegetation program that will be tailored to increase the extent as well as improve the overall condition of the FCT 20c within the Conservation Areas.
Ensure fences are constructed and maintained.	The CAMP will include the requirement to provide install, monitor and maintain access appropriate fencing around the Conservation Areas.

4.2.1.3 Banksia Woodlands of the Swan Coastal Plain ecological community

The ecological community is a woodland associated with the Swan Coastal Plain of southwest Western Australia, and is largely restricted to the Perth (SWA02) and Dandaragon (SWA01) subregions of the Swan Coastal Plain IBRA bioregion; however, it does also extend into immediately adjacent areas on the Whicher and Darling escarpments (which lie within the HAF01 and JAF02 subregions of the Jarrah Forest IBRA bioregion), to the south and east where pockets of Banksia Woodland may also occur (TSSC 2016).

A key diagnostic feature is a prominent tree layer of Banksia, with scattered eucalypts and other tree species often present among or emerging above the Banksia canopy. The understorey is a species rich mix of sclerophyllous shrubs, graminoids and forbs. The ecological community is characterised by a high endemism and considerable localised variation in species composition across its range (TSSC 2016).

This community is listed as Endangered under the Federal EPBC Act, and at a State level it is listed by DBCA as Priority 3.

4.2.1.3.1 Approved conservation advice for the Banksia Woodlands of the Swan Coastal Plain

The conservation objective of this advice is to 'mitigate the risk of extinction of the Banksia Woodlands of the Swan Coastal Plain ecological community and help recover its biodiversity and function' (TSSC 2016).

The advice outlines three key actions to achieve this conservation objective being:

- Protect the ecological community to prevent further loss of extent and condition.
- Restore the ecological community within its original range by active abatement of threats, revegetation and other conservation initiatives.
- Communicate with and support researchers, land use planners, landholders, land managers, community members, including the Indigenous community, and others to increase understanding of the value and function of the ecological community and encourage their efforts in its protection and recovery.

The above key actions have guided the preparation of this CAMS and future management actions to be implemented through the CAMP for each Conservation Area containing Banksia Woodlands of the Swan Coastal Plain ecological community. Thereby, ensuring the management actions proposed will contribute to the long-term protection and restoration of the Banksia Woodlands of the Swan Coastal Plain TEC within the Conservation Areas.

4.2.2 Conservation Significant Flora

4.2.2.1 *Conospermum undulatum* (T)

Conospermum undulatum (waxy-leaved smokebush) is an erect shrub which grows to 1.5 m height and is characterised by its fibrous, longitudinally fissured stems and wide leaves with wavy margins. It is listed as Vulnerable under the BC Act and EPBC Act and is ranked as Vulnerable (VU) under World Conservation Union (IUCN 1994) Red List criterion B1+2c, with its main threats being listed as further land clearing, poor habitat quality, road and firebreak maintenance, inappropriate fire regimes, weeds, recreational activities and rabbit grazing (DEC 2009). *Conospermum undulatum* is recorded from 25 historical populations, comprising 83 subpopulations. However, only 20 populations currently contain extant plants (DEC 2009). It occurs on sand and sandy clay soils, often over laterite, on flat or gently sloping sites between the Swan and Canning Rivers. A few records are from slightly swampy habitat. Habitat critical to the survival of *Conospermum undulatum* includes the area of occupancy of important populations and areas of similar habitat surrounding important populations (DEC 2009). Important populations of *Conospermum undulatum* are listed in the species' recovery plan.

4.2.2.1.1 Recovery plan for Conospermum undulatum

The objective of the recovery plan is to maintain or improve the conservation status of *Conospermum undulatum* during the term of this plan by abating identified threats to populations (DEC 2009).

Table 4-3 identifies the relevant recovery actions for *Conospermum undulatum* that have guided the preparation of this CAMS and future management actions to be implemented through the CAMP for each Conservation Area containing *Conospermum undulatum*, and to ensure conservation measures proposed will achieve the overall objective of the Recovery Plan and contribute towards improving its conservation status.

Table 4-3: Relevance to the Recovery Plan for *Conospermum undulatum*

Recovery action (DEC 2009)	Relevance to site and future conservation
Monitor populations	Where populations of *Conospermum undulatum* within the Conservation Areas are retained, regular monitoring and annual reporting via the CAMP will record occurrences of the species and whether they are being maintained / improved and are not declining.
Liaise with relevant land managers regarding management of bushland containing *Conospermum undulatum*	As part of the CAMS and subsequent CAMP/s (to be prepared and implemented at subdivision/development stage), liaison will be undertaken with DBCA and the City of Kalamunda to ensure the management actions will ensure the populations of *Conospermum undulatum* are adequately protected within the Conservation Areas.
Fence subpopulations	Fencing the Conservation Area or populations of *Conospermum undulatum* will be included as part of the on-ground management for each Conservation Area, where required.
Undertake weed control	The CAMP will include and implement weed control measures within the Conservation Area, and in line with the following protocol: 1. Determine which weeds are present and develop a prioritised weed control program 2. Select appropriate herbicides 3. Control invasive weeds by hand removal or spot spraying around *Conospermum undulatum* plants when weeds first emerge
Develop and implement a rabbit control strategy	The CAMP will include and implement pest control measures, including rabbit control within the Conservation Area.

Recovery action (DEC 2009)	Relevance to site and future conservation
Assess development applications for lands containing *Conospermum undulatum*	The Environmental Management Framework sets out the future requirements for Local Structure Plan, subdivision and development applications which will ensure DBCA continue to assess future proposals for lands for lands containing *Conospermum undulatum* and participate in environmental impact assessment and statutory planning processes.
Increase area of *Conospermum undulatum* in the conservation estate	Implementation of the Local Structure Plan and the Environmental Conditions (Appendix 2) will result in occurrences of *Conospermum undulatum* being retained and protected within the Conservation Areas. Thereby, leading to the area of *Conospermum undulatum* in the conservation estate being increased.
Conduct further surveys	Past surveys undertaken by AECOM (2020) and JBS&G (2024) have recorded several populations of *Conospermum undulatum* within the site. Flora surveys will be undertaken over areas that have not be previously surveyed.
Develop and implement a fire management strategy	The CAMP will include appropriate bushfire management measures to be implemented within the Conservation Areas. Furthermore, site specific Bushfire Management Plans will be required as part of local structure planning, subdivision and/or development.
Promote awareness	The CAMP will include the requirement for educational signage to be installed providing information on the species and the importance of its conservation, in consultation with DBCA

4.2.2.2 *Isopogon autumnalis* (P3)

Isopogon autumnalis is an erect shrub growing to 1 m height with cream-yellow flowers and mostly terete leaves (Rye and MacFarlane 2019). It is listed as a Priority 3 taxon by DBCA. It is known from a large range extending from the southern Lesueur Sandplains through the Swan Coastal Plain and Dandaragan Plateau to the Northern Jarrah Forrest. It prefers white, grey or yellow sand, often over laterite. It was previously known as *Isopogon drummondii* but was renamed in 2019 due to lack of a type specimen and descriptions being based on cultivated specimens (Rye and MacFarlane 2019). Variants of the taxon with larger leaves were transferred to *Isopogon sphaerocephalus*.

4.2.3 Black cockatoos

4.2.3.1 Carnaby's cockatoo

Carnaby's cockatoo (*Zanda latirostris*) is listed as Endangered under the EPBC Act (Federal) and Endangered under the BC Act (State). The species is endemic to the south-west of Western Australia, extending from the Murchison River to Esperance, and inland to Coorow, Kellerberrin and Lake Cronin. This black cockatoo has a white patch on its cheek, white bands on its tail and a strong curved bill. Carnaby's cockatoo is a seasonal visitor to the Swan Coastal Plain, which provides important foraging and roosting habitat during the non-breeding season.

Carnaby's cockatoo feeds on seeds, nuts and flowers of a variety of native and exotic plants. Feed plants include the various proteaceous species (e.g. Banksia, Grevillea and Hakea), Marri (*Corymbia calophylla*), Jarrah (*Eucalyptus marginata*), and seeds from the cones of Pine (*Pinus* sp.) trees. Cockatoo flocks follow vegetation corridors and actively avoid cleared and open areas when moving between roosting, water and food resources. Habitat fragmentation increases the distances cockatoos need to travel between resources. Proximity of foraging habitat and water has been demonstrated to be critical to support roosting and breeding sites (Le Roux 2017).

Carnaby's cockatoo displays strong pair bonds and nest in the hollows of live or dead mature Eucalypts including Salmon Gum (*Eucalyptus salmonophloia*), York Gum (*Eucalyptus loxophleba* subsp. *loxophleba*), Flooded Gum (*Eucalyptus rudis*), Karri (*Eucalyptus diversicolor*), Wandoo (*Eucalyptus wandoo*), Tuart

(*Eucalyptus gomphocephala*) and Marri (*Corymbia calophylla*), (DSEWPaC 2012). Nest hollows generally range from 2.5-12 m above ground, size of entrance from 23-30 cm and depth of hollows from 1-2.5 m (Johnstone and Storr 1998).

Carnaby's cockatoo has undergone a dramatic decline of approximately 50 percent in the past 45 years, with the main contributing factors the clearing of core breeding habitat in the Wheatbelt, the deterioration of nesting hollows and clearing of foraging habitat.

Breeding habitat for this species occurs in the Wheatbelt, Jarrah Forest and South Coast regions, and the species is expanding its current breeding range with small patches of breeding habitat now being utilised across the Swan Coastal Plain. After breeding, Carnaby's cockatoo disperse to the higher rainfall coastal areas of the south-west of Western Australia to feed in late December to July. Breeding has been recorded from early July to mid-December.

4.2.3.1.1 Recovery plan for Carnaby's cockatoo

The objective of the recovery plan is to stop further decline in the distribution and abundance of Carnaby's cockatoo by protecting the birds throughout their life stages and enhancing habitat critical for survival throughout their breeding and non-breeding range, ensuring that the reproductive capacity of the species remains stable or increases (DPaW 2013).

Table 4-4 identifies the relevant recovery actions for Carnaby's cockatoo that have guided the preparation of this CAMS and future management actions to be implemented through the CAMP for each Conservation Area containing black cockatoo habitat, and to ensure the conservation measures proposed will achieve the overall objective of the Recovery Plan and contribute towards protecting and enhancing habitat critical for their survival.

Table 4-4: Relevance to the recovery plan for Carnaby's cockatoo

Recovery action (DPaW 2013)	Relevance to site and future conservation
Protect and management important habitat	Implementation of the Local Structure Plan and the Environmental Conditions (Appendix 2) will result in: • Medium to high quality foraging habitat for Carnaby's cockatoo (*Zanda latirostris*), Forest Red-tailed black cockatoo (*Calyptorhynchus banksii naso*) and Baudin's cockatoo (*Zanda baudinii*) being retained and protected within the Conservation Areas via the CAMP. • Potential nesting trees being retained and protected within the Conservation Areas via the CAMP Thereby, ensuring future protection and management of their habitat within the Conservation Areas.
Undertake regular monitoring	Regular monitoring and annual reporting will be undertaken via the CAMP. Annual reporting will include annual monitoring of habitat condition to ensure the occurrences are being maintained and not declining in condition.
Manage other impacts	The CAMP will address, monitor and implement management measures to reduce the following potential impacts on black cockatoo habitat within the Conservation areas: • Fauna and pest management • Weed and pathogen control • Bushfire management • Fencing and access control
Engage with broader community	The CAMP will include the requirement for educational signage to be installed providing information on the species and the importance of its conservation, in consultation with DBCA.

4.2.3.2 Forest Red-tailed black cockatoo

The Forest Red-tailed black cockatoo (*Calyptorhynchus banksii naso*) is listed as Vulnerable under the EPBC Act (Federal) and Vulnerable under the BC Act (State). The species is endemic to the south-west humid and semi-humid zones of Western Australia, where it inhabits dense Jarrah, Karri and Marri forests which receive more than 600 mm average annual rainfall (DSEWPaC 2012). It has a pair of black central tail feathers and a bright red, orange or yellow barring on the tail.

This species predominantly feeds in eucalypt forests, preferring Marri (*Corymbia calophylla*) and Jarrah (*Eucalyptus marginata*) seeds, but also feeding on Blackbutt (*Eucalyptus patens*), Albany Blackbutt (*Eucalyptus staeri*), Karri (*Eucalyptus diversicolor*), Sheoak (*Allocasuarina* sp.) and Snottygobble (*Persoonia longifolia*) (Johnstone and Kirkby 2016).

Forest Red-tailed black cockatoo are monogamous and pairs nest in tree hollows from 6.5 to 33 m above ground. Most nests are in very large and very old, mature Marri (Johnstone, Kirkby and Sarti 2013), though they will nest in other Eucalypts such as Tuart (Johnstone and Kirkby 2016). Breeding habitat for this species occurs in the eastern margins of the Jarrah forests of the Wheatbelt, and within the Jarrah Forest regions. The Forest Red-tailed black cockatoo is also expanding its current breeding range with small patches of breeding habitat now being utilised across the Swan Coastal Plain.

4.2.3.2.1 Conservation advice for Forest Red-tailed black cockatoo

The Approved Conservation Advice for Forest Red-tailed black cockatoo identifies various research priorities, regional priority and threat abatement actions to support the recovery of Forest Red-tailed black cockatoo (DEWHA 2009).

The following relevant regional priority actions were identified to be:

- Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary
- Determine and implement ways to manage forests for the conservation of the subspecies.

The above regional priority actions have guided the preparation of the CAMS and future management actions to be implemented through the CAMP for each Conservation Area containing black cockatoo habitat. Thereby, ensuring the management actions proposed will contribute to the long-term conservation of black cockatoo habitat.

It is worthwhile to note that the Recovery Plan for Forest Red-tailed black cockatoo has been revoked and is no longer in effect.

4.2.3.3 Baudin's cockatoo

Baudin's cockatoo (*Zanda baudinii*) is listed as Endangered under the EPBC Act (Federal) and the BC Act (State). The species is distributed throughout the south-western humid and subhumid zones of Western Australia, from the northern Darling Range and adjacent far east of the Swan Coastal Plain (south of the Swan River), south to Bunbury and across to Albany (Johnstone and Storr 1998). It is a large black cockatoo with rectangular white patches in the tail. Males have a pink eye ring, the female a dark eye ring.

Baudin's cockatoo forages primarily in Eucalypt forest, where it feeds on seeds, flowers, nectar and buds from Marri (*Corymbia calophylla*), and seeds of Eucalyptus and proteaceous species (e.g. Banksia and Hakea), as well as orchard fruits and Pines (*Pinus* sp). It also takes insect larvae and insects (including beetle, wasp and moth larvae) from under bark and in wood of live and dead trees, from galls and from flower spikes of Xanthorrhoea and the pith of *Anigozanthos flavidus* (Johnstone and Kirkby 2008).

This black cockatoo primarily nests in tree hollows in live or dead Karri (*Eucalyptus diversicolor*), Marri (*Corymbia calophylla*), Wandoo (*Eucalyptus wandoo*) and Tuart (*Eucalyptus gomphocephala*) (DSEWPaC 2012). Baudin's cockatoo nests in spring in the deep south-west of Western Australia.

4.2.3.3.1 Conservation advice for Baudin's cockatoo

The reason for the conservation assessment and advice was 'to change the listing status of Baudin's cockatoo to Endangered' (TSSC 2018).

The relevant conservation and management priorities are identified to be (TSSC 2018):

- Ensure land managers are aware of the species' occurrence and provide appropriate mitigation measures against habitat clearing
- Undertake habitat restoration by revegetating suitable areas with key tree species
- Fire must be managed to ensure that prevailing fire regimes do not disrupt the life cycle of Baudin's cockatoo, that they support rather than degrade the species habitat, and that they do not promote invasion of exotic species
- Implement best practice and adaptive management actions to reduce the spread of phytopathogens, manage and contain infested areas, and protect non-infested areas across the Baudin's cockatoo distribution
- Monitor the progress of conservation actions, including the effectiveness of management actions and adapt them if necessary to contribute to the species' recovery

The above priority actions have guided the preparation of the CAMS and future management actions to be implemented through the CAMP for each Conservation Area containing black cockatoo habitat. Thereby, ensuring the management actions proposed will contribute to the long-term conservation of black cockatoo habitat.

It is worthwhile to note that the Recovery Plan for Baudin's cockatoo has been revoked and is no longer in effect.

5 Management

5.1 Key threats and management issues

The key threats and management issues to threatened ecological communities, conservation significant flora, and black cockatoo habitat contained in the Conservation Areas are (Figure 14):

- Uncontrolled access within the Conservation Areas may result in vandalism or damage to native vegetation as a result of waste discharge or soil contamination.
- Introduction and/or spread of weed species and pathogens leading to reduced flora species and system diversity.
- Poor management and/or supervision during works associated future urban development may lead to the loss of threatened ecological communities, conservation significant flora, and black cockatoo habitat outside of clearing boundaries.
- Poor management and/or supervision during works associated with future urban development may lead to the loss of habitat for threatened fauna and migratory species.
- Works associated with future urban development have the potential to cause bush fires in the surrounding environment leading to damage or death to local flora, fauna and/or communities.
- Uncontrolled release of waste may result in pollution to the Conservation Areas.

5.2 Management provisions

The following sets out the management provisions that will be used to inform the preparation of the future CAMP for each Conservation Area as urban subdivision or development progresses.

5.2.1 Delineation and access management

Defining and delineating the final boundary of the Conservation Areas is critical to protecting the quality and ecological function of the threatened ecological communities and conservation significant flora, and black cockatoo habitat for the long term. The detrimental consequences of not adequately delineating each Conservation Area can lead to degrading processes such as:

- unapproved clearing
- uncontrolled vehicle and pedestrian access
- increase in the risk of weed and pathogens
- uncontrolled waste and pollution
- vandalism (including arson).

In accordance with the requirements of the Environmental Conditions (Appendix 2), and to guide the preparation and implementation of the CAMP, delineation and access management actions are presented in Table 5-1.

Table 5-1: Delineation and access management actions

Management Action	Target	Timing	Responsibility	Environmental Outcome
Preparation of CAMP				
Confirm final Conservation Area boundary by undertaking studies to confirm presence and extent of significant ecological attributes set out in the Environmental Conditions (Appendix 2). Note: see sections 5.2.2, 5.2.3 and 5.2.6 for further detail on studies to be undertaken.	To ensure final boundary of Conservation Area retains the significant ecological attributes set out in the Environmental Conditions (Appendix 2).	During detailed subdivision design and preparation of each CAMP.	Environmental consultant/ Developer	Will ensure the long-term protection and management of the Conservation Area and its significant ecological attributes.
Define location and type of fencing, gates and signage to be installed around the Conservation Area.	To prevent unauthorised vehicle and pedestrian access to the Conservation Area.	During preparation of CAMP.	Environmental consultant/ Developer	
Potential management provisions to be included CAMP				
Clearly demarcate the boundary of the Conservation Area with star pickets and/or flagging at minimum	To ensure no clearing of vegetation within the Conservation Area.	Prior to clearing commencing within the subdivision / development area	Construction contractor	Will ensure the long-term protection and management of the Conservation Area and prevent its significant ecological attributes being degraded as a result of unapproved clearing and unmitigated vehicle and pedestrian access.
Install and maintain appropriate fencing around the periphery of the Conservation Area and lockable gates at appropriate locations to enable vehicle access when required.	To prevent unauthorised vehicle and pedestrian access to the Conservation Area.	During clearing and post construction until handover	Construction contractor	
Install and maintain signage on periphery fencing detailing access and presence of the Conservation Area.	Increase awareness that the Conservation Area is a restricted access reserve containing significant vegetation and discourage unauthorised access	As periphery fencing is installed during clearing and post construction until handover	Construction contractor	

5.2.2 Threatened ecological communities

To ensure the overall maintenance or improvement of TECs within the Conservation Areas, the following management and recovery actions (where applicable) should be incorporated into each CAMP and implemented as urban subdivision and development progresses:

- Conduct baseline vegetation assessments to confirm, map and assess the current condition and extent of occurrences of TEC/s.
- Liaise with key stakeholders (i.e. DBCA and City of Kalamunda)
- Where appropriate, include a rehabilitation program that is tailored to increase the extent (within degraded areas) as well as maintain and/or enhance (where practicable) the condition of the TEC/s within the Conservation Areas.
- Continue to monitor the extent and boundaries of occurrences of TEC/s.
- Implement weed and pathogen control measures within the Conservation Area
- Develop and implement bushfire management measures
- Develop pest management measures within the Conservation Area.

These actions aim to protect, restore, and enhance the ecological integrity of TECs, which are often highly vulnerable to environmental pressures and the key threats identified in Section 5.1.

In accordance with the requirements of Environmental Conditions (Appendix 2), and to guide the preparation and implementation of the CAMP, TEC management actions are presented in Table 5-2.

Table 5-2: TECs management actions

Management Action	Target	Timing	Responsibility	Environmental Outcome
Preparation of CAMP				
Conduct baseline vegetation assessments to confirm, map and assess the current condition and extent of occurrences of TEC/s	To ensure known occurrences are maintained or improved within the Conservation Area.	During preparation of each CAMP.	Environmental consultant/ Developer	Will ensure the long-term protection, management and rehabilitation (if required) of TECs in the Conservation Areas.
If required, following baseline assessment, include a rehabilitation program that is tailored to increase the extent (within degraded areas) as well as maintain and/or enhance (where practicable) the condition of the TEC/s within the Conservation Areas. Rehabilitation program to include: • completion criteria for: ▪ vegetation condition ▪ flora diversity ▪ weeds, diversity and cover.	To ensure known degraded occurrences of TECs that are in 'degraded' condition are restored to achieve a condition rating of 'good' or better, in accordance with Keighery 1994	During preparation of CAMP.	Environmental consultant/ Revegetation contractor/ Developer	

Management Action	Target	Timing	Responsibility	Environmental Outcome
• revegetation measures (i.e. topsoil and native seed collection, etc) • corrective actions • Timing, monitoring and responsibility.				
Liaise with key stakeholders (i.e. DBCA and City of Kalamunda).	To ensure management actions are appropriate and adequate.	During preparation of CAMP.	Environmental consultant/	
Potential management provisions to be included CAMP				
Install and maintain signage on periphery fencing detailing access and presence of TEC in the Conservation Area	Increase awareness that the Conservation Area is a restricted access reserve containing TECs and discourage unauthorised access	Post construction until handover	Developer	Will ensure the long-term protection and management of the Conservation Area and prevent its significant ecological attributes being degraded as a result of unapproved clearing and unmitigated vehicle and pedestrian access.
Monitor the extent and boundaries of occurrences of TEC/s.	To ensure known occurrences of TECs are maintained or improved within Conservation Areas.	Annually (post construction) and for remaining duration of Management Plan implementation until handover	Environmental consultant/ Developer	
If revegetation is being undertaken, confirm boundary of rehabilitation area.	Prior to revegetation, confirm revegetation location is suitable to reduce risk of stock not establishing or causing disruption to currently present ecosystem.	Prior to revegetation commencing	Revegetation contractor	Will ensure the long-term protection, management and rehabilitation (if required) of TECs in the Conservation Areas.
Implement revegetation measures and monitoring schedule to align with completion criteria.	Completion criteria are achieved within desired timeframe.	Throughout program until handover	Revegetation contractor / Construction contractor	

5.2.3 Threatened flora

To ensure the total number of conservation-significant flora is maintained or increased within a Conservation Area, the following management and recovery actions (where applicable) should be incorporated into each CAMP and implemented as urban subdivision and development progresses:

- Conduct targeted baseline threatened flora surveys within the Conservation Areas
- Liaise with key stakeholders (i.e. DBCA and City of Kalamunda)
- Continue to monitor the extent and of occurrences of conservation significant flora within the Conservation Areas
- Implement weed and pathogen control measures within the Conservation Area
- Develop and implement bushfire management measures
- Develop pest management measures within the Conservation Areas.

In accordance with the requirements of the Environmental Conditions (Appendix 2), and to guide the preparation and implementation of the CAMP, conservation significant flora management actions are presented in Table 5-3.

Table 5-3: Conservation significant flora management actions

Management Action	Target	Timing	Responsibility	Environmental Outcome
Preparation of CAMP				
Conduct targeted baseline threatened flora surveys to record occurrences within the Conservation Area.	To ensure populations of threatened flora are maintained or increased within the Conservation Area.	Prior to preparation of CAMP.	Environmental consultant/ Developer	Will ensure the long-term protection and management of populations of threatened flora in Conservation Areas.
Following baseline threatened flora survey, define appropriate buffers to threatened flora to be established and maintained within the Conservation Area.	To ensure populations of threatened flora are maintained or increased within the Conservation Area.	Prior to subdivision design During preparation of CAMP	Environmental consultant/ Developer	
If required, following baseline assessment, include a rehabilitation program that is tailored to maintain or increase the populations of threatened flora (where practicable) within the Conservation Areas. Rehabilitation program to include: • completion criteria for: ▪ occurrences of threatened flora ▪ weeds, diversity and cover • response actions • Timing, monitoring and responsibility.	To ensure populations of threatened flora are maintained or increased within the Conservation Area.	Prior to subdivision design During preparation of CAMP	Environmental consultant/ Developer	

Management Action	Target	Timing	Responsibility	Environmental Outcome
Liaise with key stakeholders (i.e. DBCA and City of Kalamunda).	To ensure management actions are appropriate and adequate.	During preparation of CAMP.	Environmental consultant/ Developer	
Potential management provisions to be included CAMP				
Install and maintain signage on periphery fencing detailing access and presence of conservation significant flora in the Conservation Area.	Increase awareness that the Conservation Area is a restricted access reserve containing conservation significant flora and discourage unauthorised access	Post construction until handover	Developer	Will ensure the long-term protection and management of populations of threatened flora and prevent species decline as a result of threatening process such as weed and/or pest invasion, unapproved clearing, unmitigated vehicle and pedestrian access.
If required, establish and maintain buffers to threatened flora within the Conservation Area.	To ensure populations of threatened flora are maintained or increased within the Conservation Area.	Prior to clearing Post construction until handover	Environmental consultant/ Developer	
Monitor the populations of threatened flora.	To ensure populations of threatened flora are maintained or increased within the Conservation Area	Annually (post construction) and for remaining duration of Management Plan implementation until handover	Environmental consultant/ Developer	

5.2.4 Waste management

The increased urbanisation of the site is likely to result in increased waste disposal within the Conservation Areas, which can have detrimental impacts on flora and fauna through the introduction of weeds and dieback, contamination of soils and physically endangering native fauna.

To guide the preparation and implementation of the CAMP, conservation significant flora management actions are presented in Table 5-4.

Table 5-4: Waste management actions

Management Action	Target	Timing	Responsibility	Environmental Outcome
Preparation of CAMP				
Conduct inspection to identify presence and type of waste located within the Conservation Area.	To prevent the buildup of waste within the Conservation Area.	Prior to preparation of CAMP.	Environmental consultant/ Developer	Will ensure the long-term protection and management of significant environmental values within the Conservation Area.
Liaise with key stakeholders (i.e. DBCA and City of Kalamunda)	To ensure management actions are appropriate and adequate.	During preparation of CAMP.	Environmental consultant/ Developer	
If required, based on the results of the inspection, develop a waste management program.	To ensure the appropriate removal of waste from the Conservation Area.	During preparation of CAMP	Environmental consultant/ Developer	
Potential management provisions to be included CAMP				
Chemical, hydrocarbon and other hazardous waste material must be stored at minimum 50 m from the boundary of the Conservation Area.	To prevent spills impacting native vegetation and fauna habitat within the Conservation Area.	During clearing and construction	Construction contractor	Implementation of waste management measures to ensure significant ecological values within the Conservation Area are protected in the long term by: • reducing weeds within the Conservation Area • preventing any new weeds and pathogens being introduced into the Conservation Area.
Temporary installation of shade cloth on Conservation Area fencing .	To restrict wind-blown material entering the Conservation Area.	During clearing and construction	Construction contractor	
Portable ablution blocks must be stored at minimum 50 m from the boundary of the Conservation Area.	To prevent spills impacting native vegetation and fauna habitat within the Conservation Area.	During clearing and construction.	Construction contractor	
Undertake a waste removal program within the Conservation Area, following the outcome of baseline inspection and thereafter, following monitoring events.	To prevent the buildup of wase within the Conservation Area.	As required based on the results of monitoring until handover	Developer/ Construction contractor	

5.2.5 Weed and pathogen management

To minimise the potential introduction and spread of weeds and pathogens (i.e. dieback) to vegetation within the Conservation Area, appropriate management measures will developed to inform the preparation of the CAMP and implemented as urban subdivision and development progresses.

In accordance with the requirements of the Environmental Conditions (Appendix 2), and to guide the preparation and implementation of the CAMP, weed and pathogen management actions are presented in Table 5-5.

Table 5-5: Weed and pathogen management actions

Management Action	Target	Timing	Responsibility	Environmental Outcome
Preparation of CAMP				
Conduct baseline weed and pathogen surveys and mapping within the Conservation Areas.	To minimise the spread of existing weed species and pathogens, and the introduction of new weed species and pathogens in the Conservation Area.	Prior to preparation of CAMP.	Environmental consultant/ Developer	Will ensure the long-term protection and management of significant ecological values in the Conservation Area.
If required, based on the results of the baseline weed and pathogen surveys, develop a weed and pathogen control program. Weed and/or pathogen control program to include: • Weed control techniques • Pathogen management and hygiene measures • Completion criteria • Timing, roles and responsibilities.		During preparation of CAMP	Environmental consultant/ Developer	
Liaise with key stakeholders (i.e. DBCA and City of Kalamunda)	To ensure management actions are appropriate and adequate.	During preparation of CAMP	Environmental consultant/ Developer	
Potential management provisions to be included CAMP				
Prior to entering the Conservation Area, all vehicles and machinery are to be free of mud and soil that may have been brought onto site from outside of the subdivision / development area.	To prevent the introduction of new weed species and pathogens into the Conservation Area.	For the duration of the CAMPs implementation until handover	All personnel	Implementation of weed and dieback measures to ensure significant ecological values within the Conservation Area are protected in the long term by: • reducing weeds within the Conservation Area • preventing any new weeds and
Prior to clearing around the periphery of the Conservation Area, all vehicles and machinery are to be free of mud and soil that may have been brought onto site from outside of the subdivision / development area.	To prevent the introduction of new weed species and pathogens into the Conservation Area.	During clearing adjacent to the Conservation Area	All personnel	

Management Action	Target	Timing	Responsibility	Environmental Outcome
If required, undertake weed pathogen control program and appoint experienced contractor to manage weeds within the Conservation Area.	To ensure weed densities do not increase to a level above the maximum target cover.	Annually (post construction) and for remaining duration of Management Plan implementation until handover	Environmental consultant/ Developer	pathogens being introduced into the Conservation Area.
Topsoil from clearing activities to be retained and appropriately stockpiled within the subdivision / development area.	To prevent the introduction of new weed species and pathogens into the Conservation Area.	During clearing and excavation	Construction contractor/ Revegetation contractor	
Any seedlings used as part of revegetation activities are to be free of soil that may contain dieback or weeds (i.e., plants must be supplied by a NIASA accredited nursery).	To prevent the introduction of new weed species and pathogens into the Conservation Area.	During revegetation	Revegetation contractor	

5.2.6 Fauna and pest management

To protect and maintain the significant environmental values within the Conservation Areas, and reduce the impacts of invasive or pest species that threaten endemic fauna survival within the Conservation Areas, the following pest management controls should be incorporated into CAMP and implemented as urban subdivision and development progresses:

- Develop fauna and pest management measures to increase habitat quality and availability within the Conservation Area.
- Develop management measures to enhance black cockatoo habitat within the Conservation Area.
- Reduce access for pest species to Conservation Areas.

To guide the preparation and implementation of the CAMP, fauna and pest management actions are presented in Table 5-6.

Table 5-6: Fauna and pest management actions

Management Action	Target	Timing	Responsibility	Environmental Outcome
Preparation of CAMP				
Conduct baseline fauna habitat and black cockatoo habitat assessment within the Conservation Area.	To ensure overall fauna habitat and black cockatoo habitat is maintained or enhanced within the Conservation Area.	Prior to preparation of CAMP.	Environmental consultant/ Developer	To ensure overall fauna habitat and black cockatoo habitat is maintained or enhanced within the Conservation Area.
Following baseline survey, develop management measures to maintain or enhance black cockatoo habitat within the Conservation Area.	Increase available foraging habitat for black cockatoos.	During preparation of CAMP.	Environmental consultant/ Developer	
Following baseline survey, develop fauna and pest management measures to maintain or enhance habitat quality and availability within the Conservation Area.	To mitigate impacts of herbivory on conservation significant flora and revegetation activities.	During preparation of CAMP.	Environmental consultant/ Developer	To reduce the impacts of feral species on endemic fauna survival.
Liaise with key stakeholders (i.e. DBCA and City of Kalamunda)	To ensure management actions are appropriate and adequate.	During preparation of CAMP.	Environmental consultant/ Developer	To ensure overall fauna habitat and black cockatoo habitat is maintained or enhanced within the Conservation Area.
Potential management provisions to be included CAMP				
Undertake pest fauna control / removal (if required).	To mitigate impacts of herbivory on conservation significant flora and revegetation activities. Reduce/remove pest species present within the Conservation Area.	Post construction until handover	Developer	Will ensure the long-term protection and management of conservation significant flora and prevent species decline as a result of threatening process

Management Action	Target	Timing	Responsibility	Environmental Outcome
Translocation of hollow bearing logs into the Conservation Area.	To increase the availability and quality of native fauna habitat. To ensure populations of conservation significant flora are maintained or increased within the Conservation Area	Post construction	Environmental consultant/ Developer	such as weed and/or pest invasion, unapproved clearing, unmitigated vehicle and pedestrian access.
Revegetation and landscaping within the Conservation Area with suitable endemic native species will be undertaken to provide foraging habitat for black cockatoos.	To maintain or increase available foraging habitat for black cockatoos.	During revegetation until handover	Revegetation consultant/ Landscape consultant	
Install educational signage regarding black cockatoo species ecology and habitat within the Conservation Area.	To reduce impacts of increased human activity within the MRS amendment area on black cockatoos.	Post construction	Developer	
Install and maintain conservation fencing to protect vegetation from herbivory and endemic fauna from feral animals.	To reduce the potential harm of feral animals within the Conservation Area to native flora and fauna.	Post construction until handover	Developer	

5.2.7 Bushfire management

Urban subdivision and development of the site may increase the risk of fire within the Conservation Areas through:

- The operation of equipment and machinery
- Handling and storage of flammable liquids
- Inappropriate storage of waste materials including cigarette butts
- The presence of vegetation stockpiles which can act as fuel sources

To guide the preparation and implementation of the CAMP, fauna and pest management actions are presented in Table 5-7.

Table 5-7: Bushfire management actions

Management Action	Target	Timing	Responsibility	Environmental Outcome
Potential management provisions to be included CAMP				
Store all flammable materials as specified by manufacturer's instruction at minimum 50 m from boundary of the Conservation Area.	To minimise the risk of fire within the Conservation Area.	During clearing and construction	Construction contractor	Ensures maintenance of natural bushfire cycles, promoting species natural regeneration cycles and limiting the destruction of species beyond levels where establishment can occur.
Prohibit vehicle movements within the Conservation Area during increased fire risk or total bans.	To minimise the risk of fire within the Conservation Area.	For the duration of the CAMPs implementation until handover	All personnel	
Vegetation stockpiles to be stored at minimum 50 m from boundary of the Conservation Area.	To minimise the risk of fire within the Conservation Area.	During clearing and construction	All personnel	
Undertake vegetation clearing in line with requirements under the City of Kalamunda Fire Hazard Reduction Notice.	Bushfire risk is not exacerbated with increased housing density requirements.	Ongoing until handover	Construction contractor	Reduces potential risk of bushfire frequency occurring beyond natural cycles.

6 Monitoring and assessment

To guide the preparation of the CAMP, the following monitoring actions have been developed for inclusion within the CAMP to ensure assessment of the effectiveness of the management actions.

Table 6-1: Monitoring actions

Parameter	Timing / frequency	Location	Purpose	Responsibility
Delineation and access management				
Condition of delineation and access infrastructure (i.e. fencing, gates, access tracks, signage, etc.)	• Pre clearing site inspection • Monthly site inspections (during construction • Quarterly site inspection (post construction) and for remainder of Management Plan implementation until handover	Perimeter of Conservation Area, where delineation and access infrastructure has been installed.	To ensure that delineation and access infrastructure is in good condition and there has been no unauthorised access into the Conservation Area	Construction contractor
Threatened ecological communities				
Monitor the extent and boundaries of occurrences of TEC/s.	• Pre clearing site inspection • Annual monitoring (post construction) and for remaining duration of Management Plan implementation until handover	Known occurrences of TEC/s within the Conservation Area.	To ensure known occurrences of TECs are maintained or improved within the Conservation Area.	Environmental consultant/ Developer
If revegetation is required, annual revegetation monitoring to assess: • Weed species and percentage cover • Native species and percentage cover • Evidence of threatening processes (such as herbivory)	• Annually in Spring following initial planting works until handover	Throughout revegetation area	To assess the efficacy of revegetation activities.	Environmental consultant/ Developer
Threatened flora				
Monitor the populations of threatened flora.	• Pre clearing site inspection • Annual monitoring (post construction) and for remaining duration of Management Plan implementation until handover	Known populations of threatened flora within the Conservation Area.	To ensure populations of threatened flora are maintained or increased within the Conservation Area.	Environmental consultant/ Developer
Waste management				
Monitor and assess volume of waste within Conservation Area.	• Pre clearing site inspection • Monthly site inspections (during construction) • Annual monitoring (post construction) and for	Within 30 meters of the perimeter of the Conservation	To minimise volume of waste deposited within the Conservation Area.	Environmental consultant/ Developer

Parameter	Timing / frequency	Location	Purpose	Responsibility
	remaining duration of Management Plan implementation until handover	Area until handover		
Weed and pathogen management				
Monitor and assess pathogen extent (if present) and weed distribution, species and density / cover.	• Pre clearing site inspection • Annual monitoring (post construction) and for remaining duration of Management Plan implementation until handover	Conservation Area	Ensure effective weed and pathogen control is undertaken and that weed densities do not increase above established % cover.	Environmental consultant/ Developer
Fauna and pest management				
Evidence / presence of pests / feral animals and associated damage to native vegetation / fauna / black cockatoo habitat.	• Pre clearing site inspection • Annual monitoring (post construction) and for remaining duration of Management Plan implementation until handover	Conservation area	To determine the presence of pests / feral animals within the Conservation Area and whether damage is occurring to native vegetation or fauna as a result.	Environmental consultant/ Developer
Monitor black cockatoo habitat	• Pre clearing site inspection • Annual monitoring (post construction) and for remaining duration of Management Plan implementation until handover	Black cockatoo habitat within the Conservation Area	To ensure overall fauna habitat and black cockatoo habitat is maintained or enhanced within the Conservation Area.	Environmental consultant/ Developer

7 Response actions

The CAMP will develop appropriate trigger criteria and response actions to be initiated if monitoring indicates the management measures are not successful or effective.

To guide the preparation of the CAMP, the following trigger criteria and response actions have been developed for inclusion within the CAMP; however, given each Conservation Area will have different ecological values, vegetation condition, black cockatoo habitat quality scores, weed/pathogen extent, etc, it is anticipated that the CAMP will develop specific trigger criteria and response actions to be initiated for each Conservation Area.

Table 7-1: Response actions

Parameter	Trigger criteria	Response Action	Responsibility
Delineation and access	Damage has been reporting to delineation infrastructure, including fencing, gates or signage	1. Determine cause of damage 2. Prevent recurrence of damage where possible 3. Take necessary steps to repair damaged infrastructure	Construction contractor/ Developer
	Unauthorised vehicle / personnel reported within the Conservation Area	1. Determine how access was gained and if possible, the likely time of access 2. Implement remedy, which may include repairing damaged infrastructure or the installation of additional signage	Construction contractor/ Developer
Threatened ecological communities	Annual monitoring indicates current extent of TEC trending towards decline in vegetation condition.	1. Determine cause of decline by reviewing degree of infrastructure/development disturbance, site condition, climatic factors and other factors (i.e. fire, storm, insect activity, pests, etc). 2. Undertake preventative measures, which may include a pest animal control program, improving access infrastructure, etc.	Environmental consultant/ Developer
	Clearing of TEC beyond area of the development and within Conservation Area.	1. Stop works (temporary) 2. Record environmental incident 3. Investigate cause 4. Update environmental training of personnel (if appropriate) 5. Undertake remedial / rehabilitation works within impact area.	Environmental consultant/ Revegetation contractor
Revegetation	Annual revegetation monitoring indicates that less than established number of native plant species are represented within the revegetation area	1. Assess likely reason for lower plant species representation 2. Undertake infill planting / seeding with additional species as required. 3. Liaise with DBCA/DWER to agree an alternative approach should this be required.	Environmental consultant/ Revegetation contractor
	Annual revegetation monitoring indicates that native plant species are not achieving established % cover of the revegetation area	1. Determine cause of deficient coverage. 2. Undertake infill planting / seeding as required 3. Liaise with DBCA/DWER to agree an alternative approach should this be required.	Environmental consultant/ Revegetation contractor
	Annual revegetation monitoring indicates herbivory	1. Determine scale and extent of herbivory observed.	Environmental consultant/

Parameter	Trigger criteria	Response Action	Responsibility
	as the primary cause of plant mortality within the revegetation area	2. Undertake preventative measures, which may include the installation of exclusion fencing, tree guards, or the implementation of a pest animal control program.	Revegetation contractor
Threatened flora	Annual monitoring indicates populations of threatened flora is trending towards decline.	1. Determine cause of decline by reviewing degree of infrastructure/development disturbance, site condition, climatic factors and other factors (i.e. fire, storm, insect activity, pests, etc). 2. Undertake preventative measures, which may include a pest animal control program, improving access infrastructure, etc.	Environmental consultant/ Revegetation contractor
	Clearing of threatened flora beyond area of the development and within the Conservation Area.	1. Stop works (temporary) 2. Record environmental incident 3. Investigate cause 4. Update environmental training of personnel (if appropriate) 5. Undertake remedial / rehabilitation works within impact area.	Environmental consultant/ Revegetation contractor
Weed and pathogen management	Identification of a "Declared Pest" weed species within the Conservation Area (e.g. *Zantedeschia aethiopica*)	1. Undertake weed control as required, with the objective of eradicating all identified Declared Pests from the Conservation Area.	Environmental consultant/ Revegetation contractor
	Monitoring indicates that weed densities are over established % cover	1. Develop a weed control program and appoint an experienced contractor to manage weeds within the Conservation Area, with the objective of reducing weed cover to below established % cover.	Environmental consultant/ Revegetation contractor
	Vehicles which have not been inspected for mud and soil access in the Conservation Area.	1. The vehicle must be stopped and inspected for mud and soil. If the vehicle is deemed to be clean it can continue to be used within the Conservation Area. 2. If a build-up of mud and soil is identified, then the vehicle must be removed offsite for cleaning.	Environmental consultant/ Revegetation contractor
Fauna and pests	Evidence of damage by animals (i.e. herbivory) to established % cover of monitoring sites Evidence of feral predators observed within or surrounding the Conservation Area .	1. Investigate cause 2. Undertake intervention or remediation works if required (move bins, fencing, trapping, baiting or hive removal). 3. Monitor success of works.	Environmental consultant/ Developer
Bushfire	Fire incident within the Conservation Area.	1. Investigate cause 2. Consult with local fire authorities in relation to improvements in fire mitigation measures 3. Amend and update figure mitigation measures following consultation 4. Communicate outcomes to all contractors	Construction contractor/ Environmental consultant/ Developer

8 Reporting

A report summarising the results of all monitoring will be prepared annually, for provision to the Project Manager. This monitoring report is also to be submitted to the City of Kalamunda, DBCA, DWER or EPA upon request. The report may be used as evidence of legal compliance or non-compliance and must be correct and auditable. The annual monitoring report will include at minimum:

- Methodology employed during monitoring
- Monitoring results
- Assessment of revegetation against completion criteria
- Details of any response actions implemented
- Recommendations for changes to the CAMP if required.

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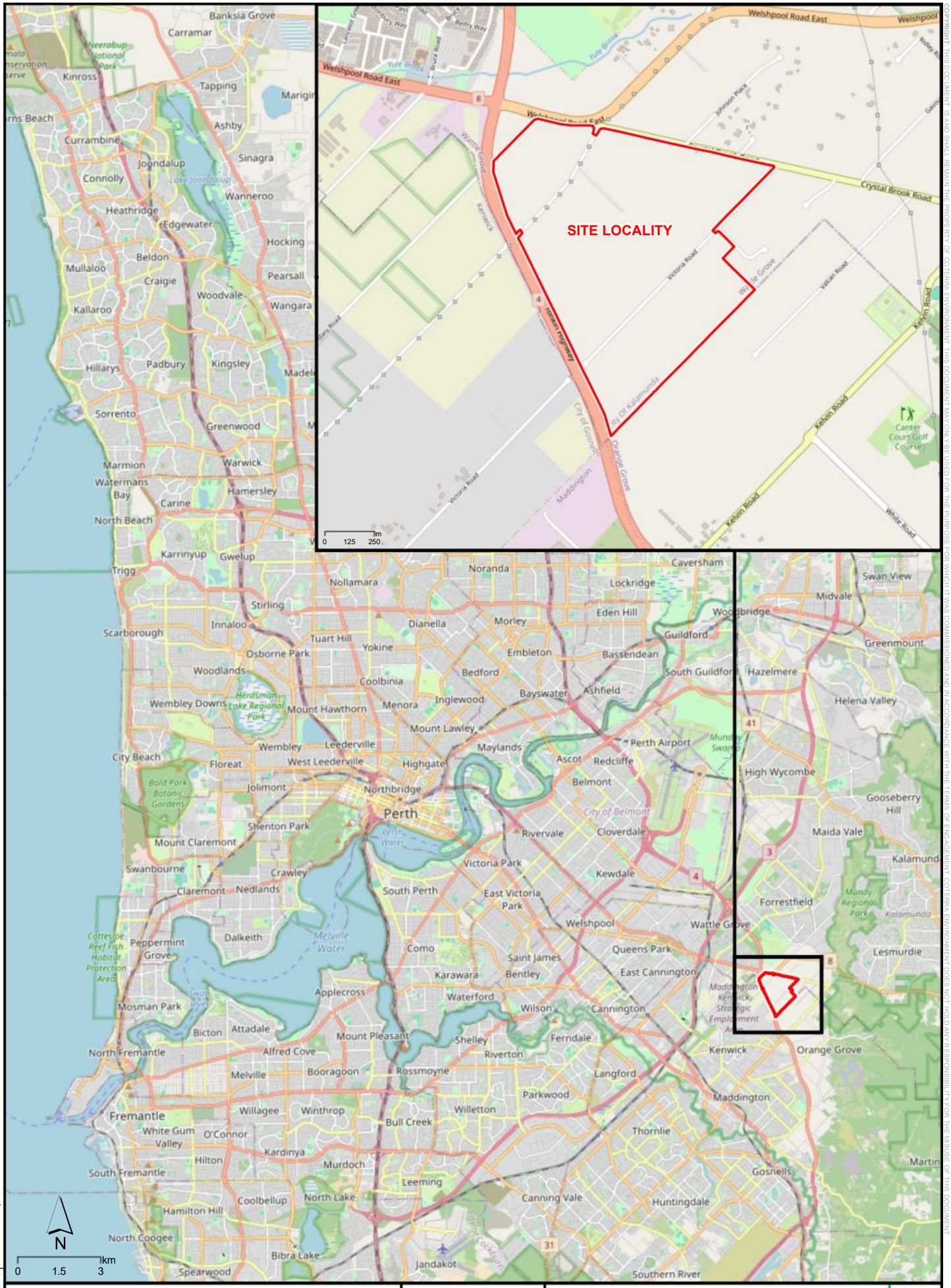
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Figures



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Hesperia
ENVIRONMENTAL ASSESSMENT REPORT
WATTLE GROVE SOUTH LSP

SITE LOCATION

Figure 1

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LEGEND

Local Structure Plan Area

Cadastre

N

0 25 50 100 150 200 m

Scale: 1:6,000 @ A3

GDA2020 MGA Zone 50

Welshpool Rd East

Boundary Rd

Brentwood Rd

Johnson Pl

Philemon Ct

Crystal Brook Rd

Emanuel Ct

Easterbrook Pl

Tonkin Hwy

Victoria Rd

Valcan Rd

Kelvin Rd

Source: Cadastre - Landgate
Orthophoto - NearMaps, 17.03.25

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WATTLE GROVE SOUTH LOCAL STRUCTURE PLAN

AERIAL PHOTOGRAPH

Figure 2

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LEGEND

- Local Structure Plan Area
- Cadastre
- Contour (mAHD)

Geology

- Mgs2: GRAVELLY SILT - strong brown, tough, common pebbles of fine to coarse-grained, subrounded granite, some dolerite and rare sandstone (SS), variable sand content.
- Ms4: SANDY SILY - cream to pale brown alluvium, clayey in part, fine to medium-grained sand, of alluvial origin.
- S8: SAND - white to pale grey at surface, yellow at depth, fine to medium-grained, moderately sorted, subangular to subrounded, minor heavy minerals, of eolian origin.
- S10: SAND - as S8 over sandy clay to clayey sand of the Guildford Formation, of eolian origin.
- S12: SAND - structureless, yellow, fine-grained, subangular and medium to coarse-grained subrounded to rounded quartz, feldspar and heavy minerals common, minor silt and clay, of colluvial origin.

N

0 50 100 200 300 400 m

Scale: 1:7,500 @ A3
GDA2020 MGA Zone 50

Source: Cadastre - Landgate
Orthophoto - NearMaps, 17.03.25
Geology and Topography - DPIRD

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TOPOGRAPHY AND SOILS

Figure 3

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YULE BROOK

Rivervale Wattle Grove Link

Bruce Rd

Brook Rd

Boundary Rd

Brentwood Rd

Tonkin Hwy

Welshpool Rd East

Johnson Pl

Philemon Ct

Crystal Brook Rd

Emanuel Ct

Easterbrook Pl

Victoria Rd

Valcan Rd

Canter Ct

UFI 7793 UFI 13619 UFI 15020 UFI 13619 UFI 15021 UFI 7771 UFI 15257 UFI 8025 UFI 8027 UFI 8026 UFI 15816 UFI 8028 UFI 15814 UFI 15815 UFI 8030 UFI 7775 UFI 14962 UFI 8032 UFI 8031 UFI 8033 UFI 8034 UFI 8035 UFI 14964 UFI 8036 UFI 7795 UFI 15983 UFI 13825 UFI 13825 UFI 15987 UFI 8045 UFI 15984 UFI 15986 UFI 15985 UFI 8046 UFI 8037

LEGEND

- Local Structure Plan Area
- Cadastre
- Major Tributary

Wetland Mapping

- Conservation
- Resource Enhancement
- Multiple Use

N

0 50 100 200 300 400 m

Scale: 1:7,500 @ A3
GDA2020 MGA Zone 50

Source: Cadastre - Landgate
Orthophoto - NearMaps, 17.03.25
Wetlands - DBCA | Hydrography - DWER

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WETLAND MAPPING

Figure 4

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LEGEND

- Local Structure Plan Area
- Cadastre
- Public Open Space – Conservation
- Public Open Space – Potential Conservation

Vegetation Communities

- BaEpPf
- BmXpEc
- EmMpLp
- Trees
- Planted
- Cleared
- BmXpEc Recently Cleared

N

0 37.5 75 150 225 300 m

Scale: 1:6,000 @ A3
GDA2020 MGA Zone 50

Source: Cadastre - Landgate
Orthophoto - NearMaps, 17.03.25

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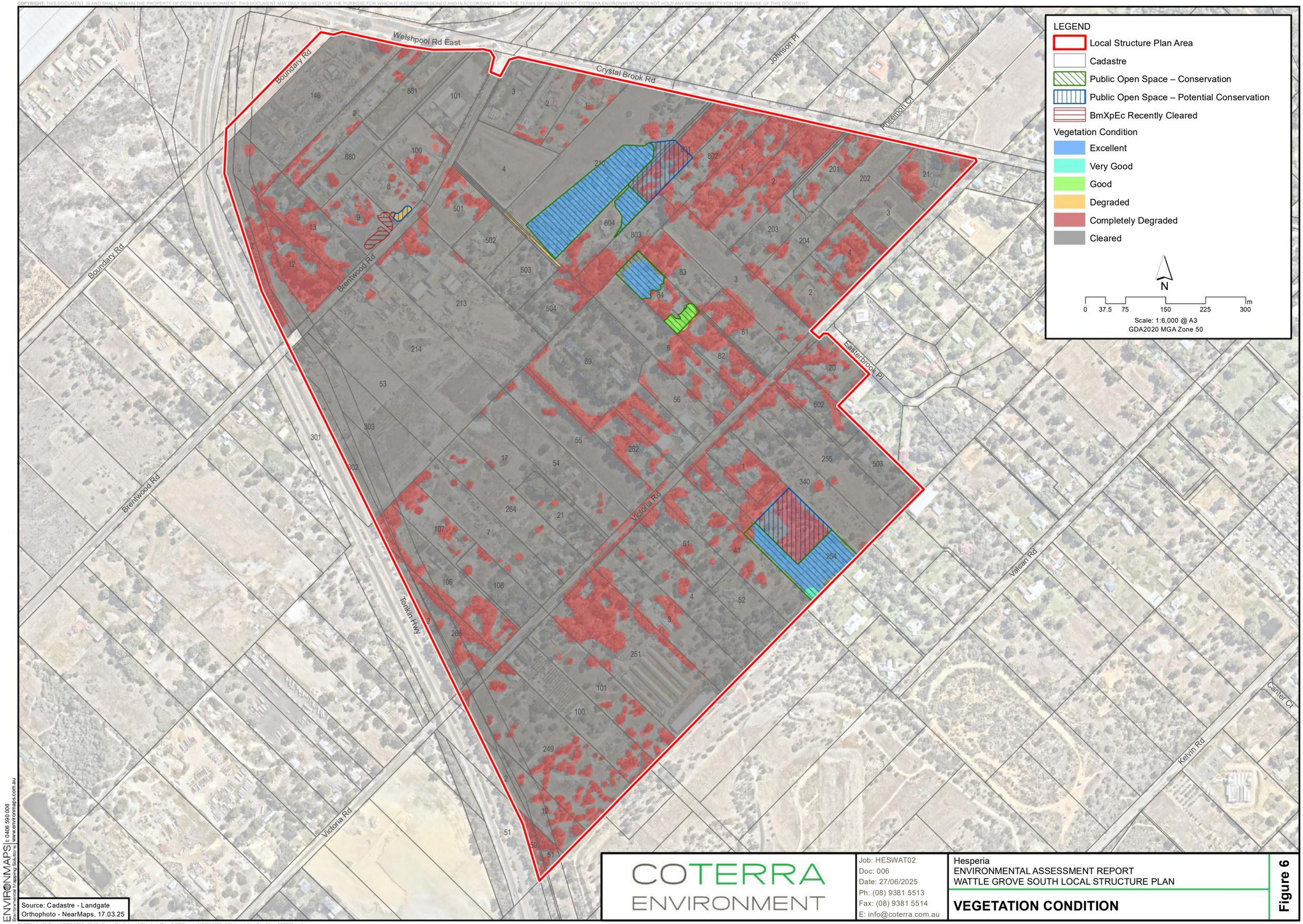
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VEGETATION COMMUNITIES

Figure 5

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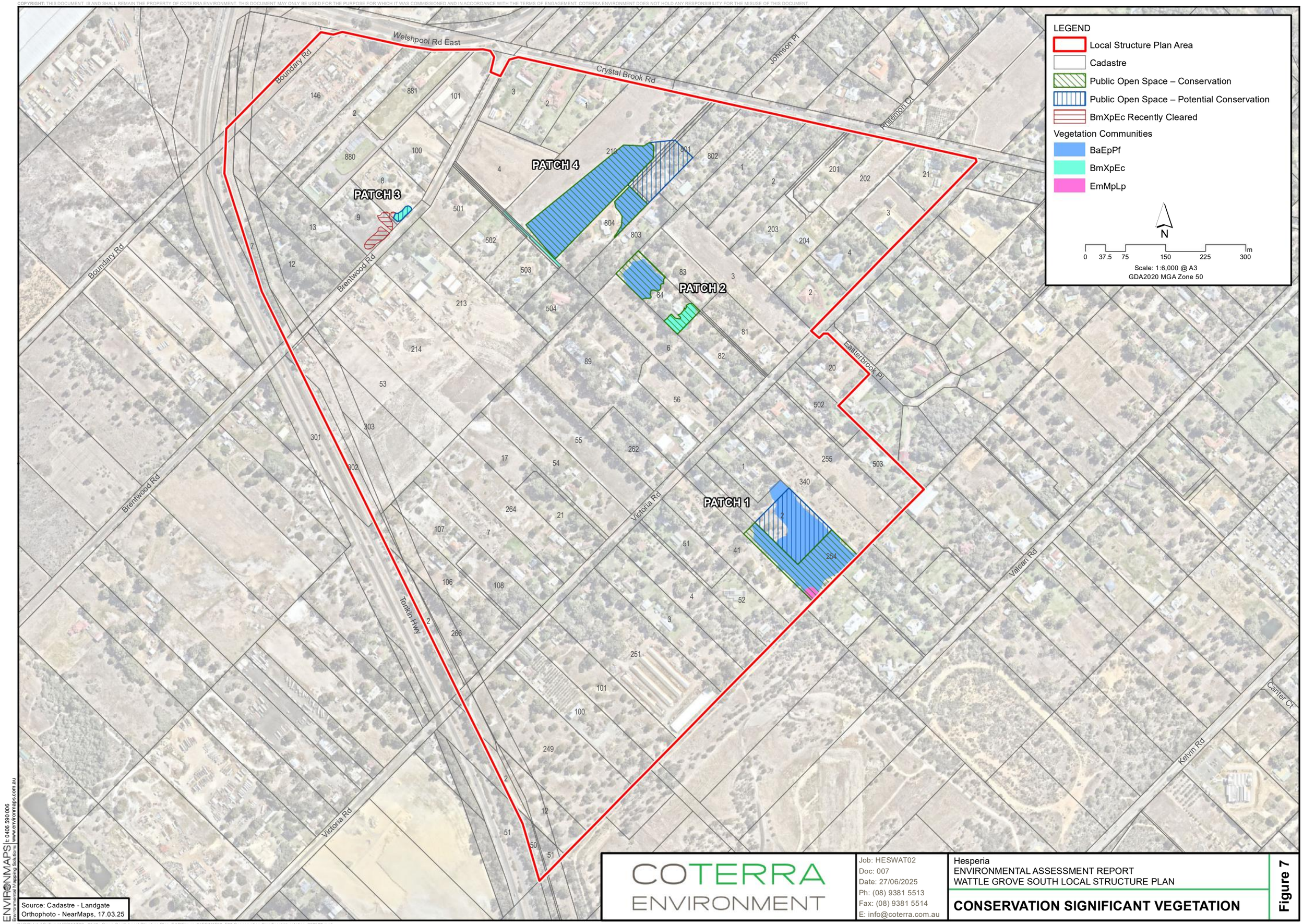
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VEGETATION CONDITION

Figure 6

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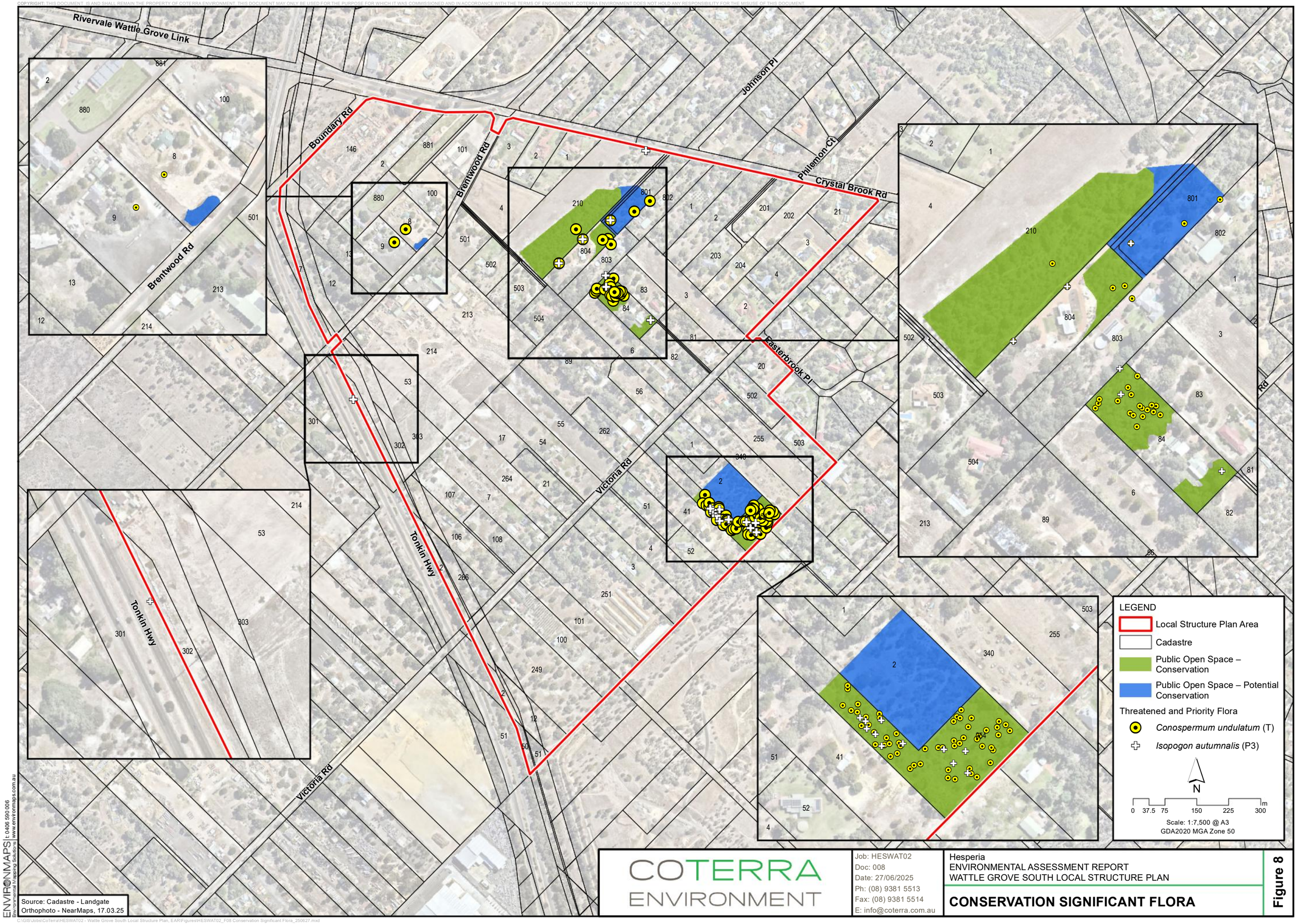
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CONSERVATION SIGNIFICANT VEGETATION

Figure 7

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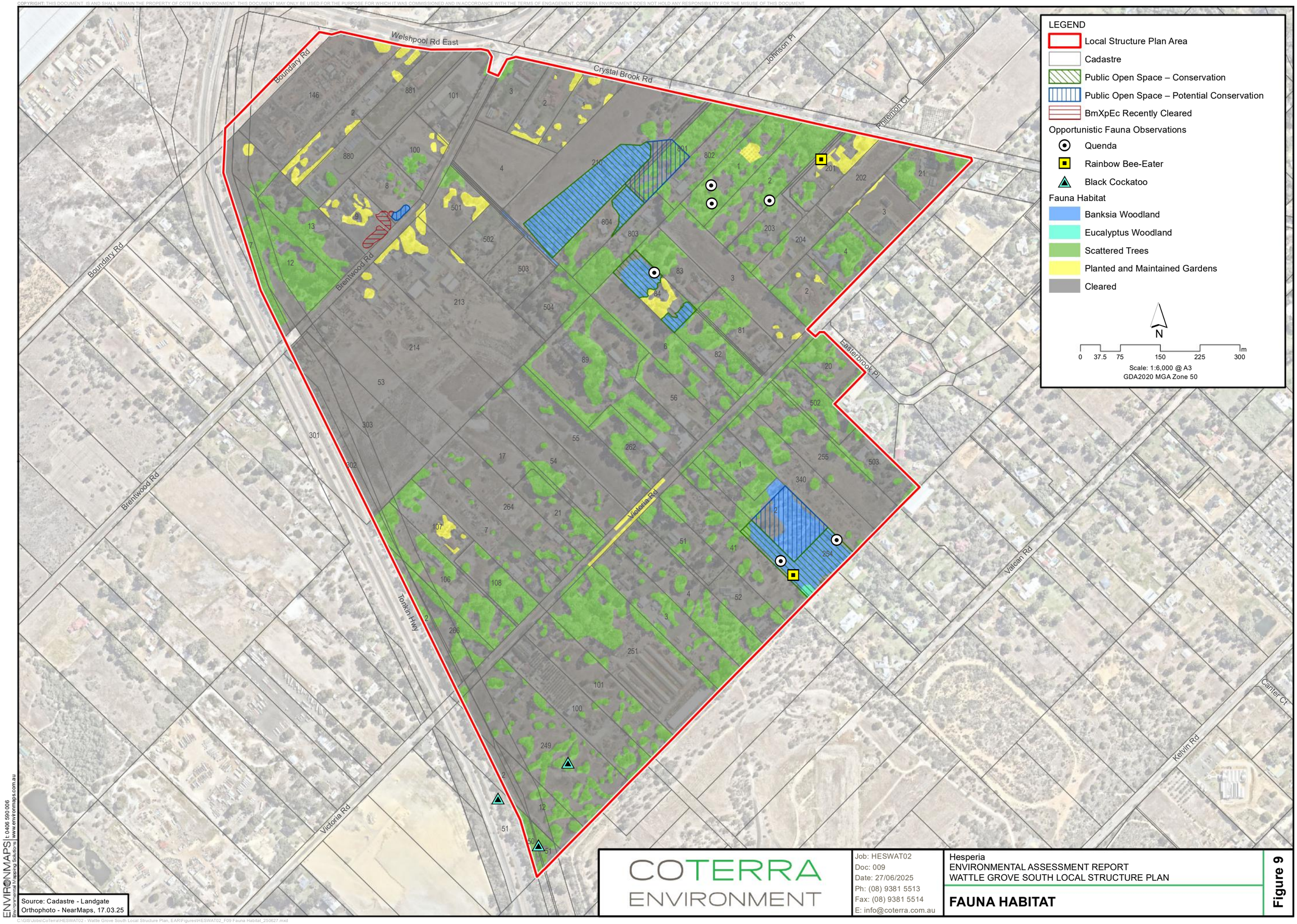
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CONSERVATION SIGNIFICANT FLORA

Figure 8

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FAUNA HABITAT

Figure 9

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LEGEND

- Local Structure Plan Area
- Cadastre
- Public Open Space – Conservation
- Public Open Space – Potential Conservation
- BmXpEc Recently Cleared

Carnaby's Cockatoo Foraging Habitat

- 2
- 3
- 5
- 6
- 8

N

0 37.5 75 150 225 300 m

Scale: 1:6,000 @ A3
GDA2020 MGA Zone 50

Source: Cadastre - Landgate
Orthophoto - NearMaps, 17.03.25

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CARNABY'S COCKATOO FORAGING HABITAT

Figure 10

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LEGEND

- Local Structure Plan Area
- Cadastre
- Public Open Space – Conservation
- Public Open Space – Potential Conservation
- BmXpEc Recently Cleared

Forest Red-tailed Black Cockatoo Foraging Habitat

- 2
- 3
- 7
- 8

N

0 37.5 75 150 225 300 m

Scale: 1:6,000 @ A3
GDA2020 MGA Zone 50

Welshpool Rd East
Crystal Brook Rd
Johnson Pl
Pittemon Ct
Boundary Rd
Brentwood Rd
Easterbrook Pl
Victoria Rd
Tonkin Hwy
Valcan Rd
Canter Ct
Kelvin Rd

Source: Cadastre - Landgate
Orthophoto - NearMaps, 17.03.25

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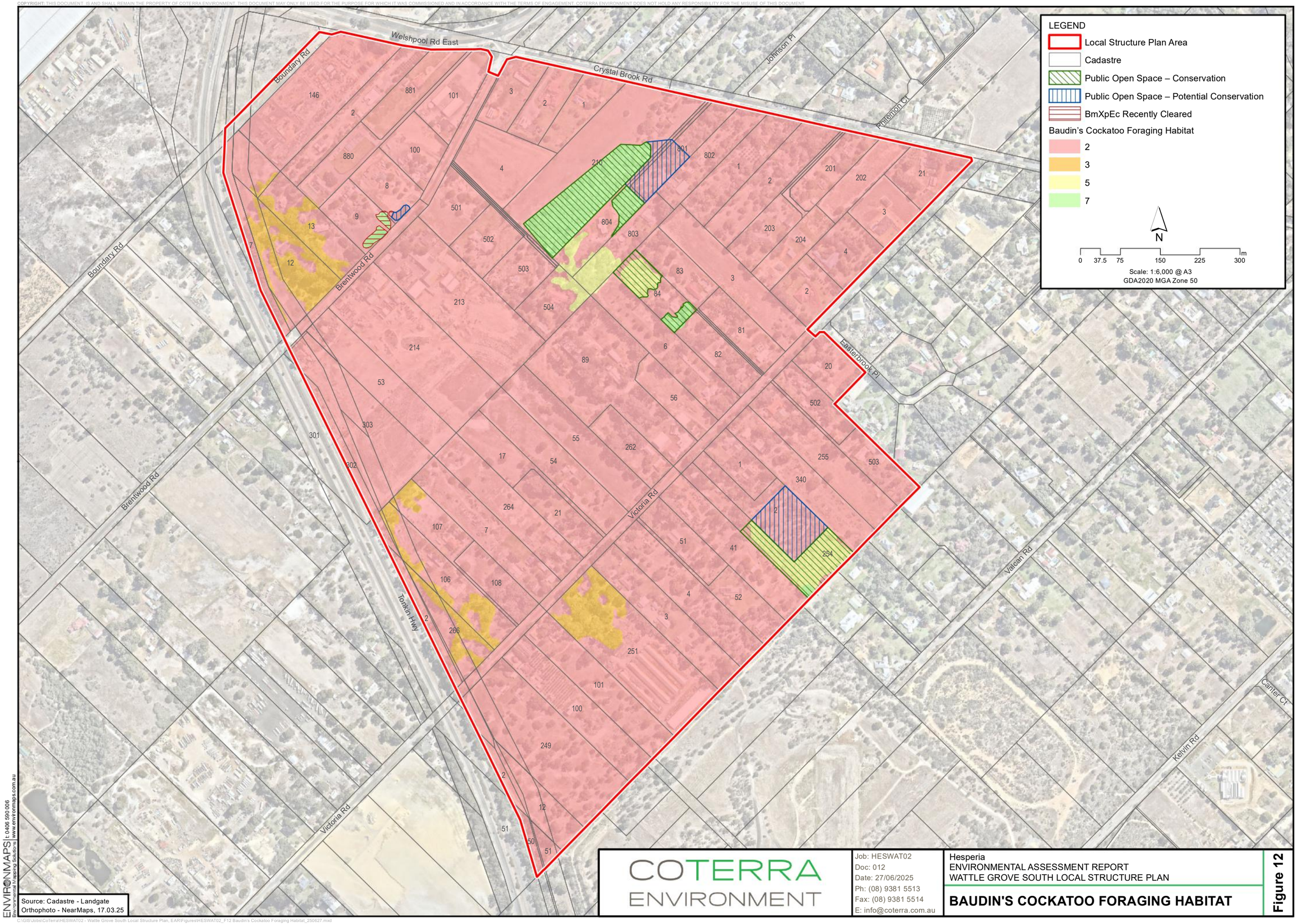
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WATTLE GROVE SOUTH LOCAL STRUCTURE PLAN

FOREST RED-TAILED BLACK COCKATOO FORAGING HABITAT

Figure 11

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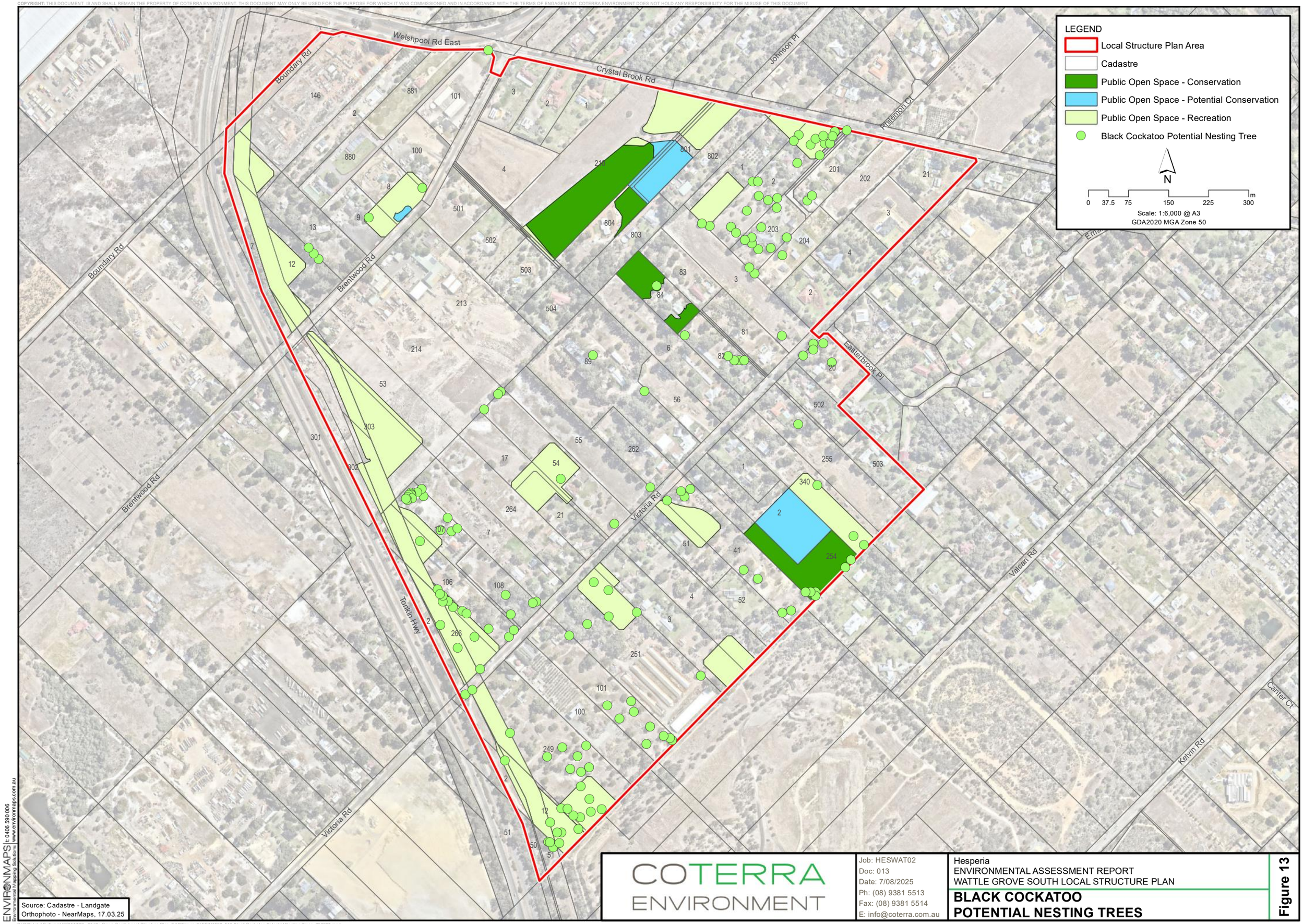
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BAUDIN'S COCKATOO FORAGING HABITAT

Figure 12

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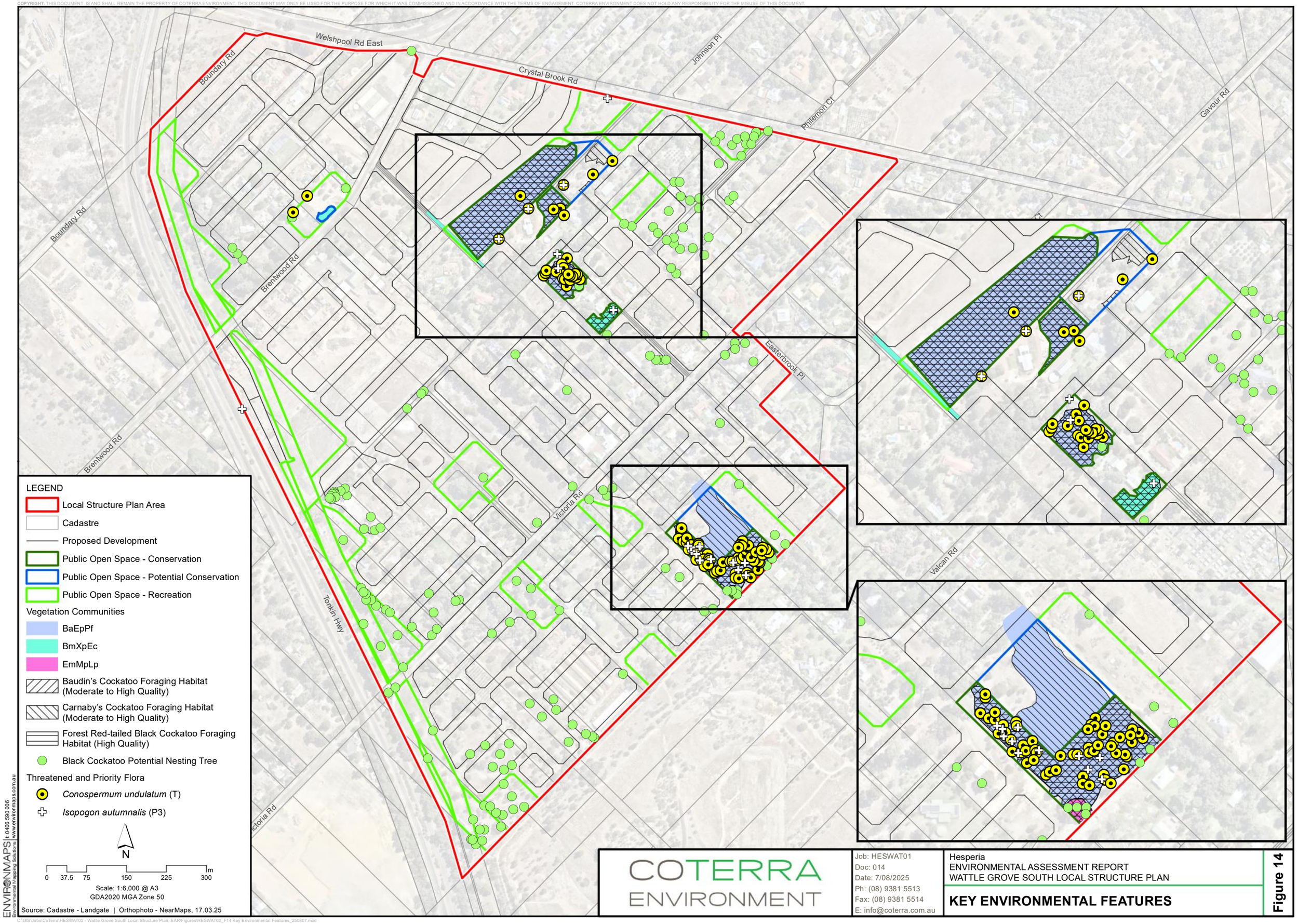
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BLACK COCKATOO POTENTIAL NESTING TREES

Figure 13

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KEY ENVIRONMENTAL FEATURES

Figure 14

Appendix 4 Wetland Assessment (Pentium Water 2024)

PENTIUM WATER

WETLAND ASSESSMENT

Wattle Grove South MRS Amendment 1388/57

Rev 1

15/07/2024



Document Status

Version	Purpose of document	Authorised by	Reviewed by	Review Date
Rev 0	Draft for Review	S.McSweeney	J.Halleen	23/02/2024
Rev 1	Final	S.McSweeney	J.Halleen	15/07/2024

Approval for Issue

Name	Signature	Date
John Halleen		15/07/2024

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Executive Summary

The Western Australian Planning Commission (WAPC) are proposing to rezone approximately 126 hectares (ha) of 'Rural' zoned land for 'Urban' use residential purposes, under the Metropolitan Region Scheme (MRS) Amendment 1388/57. MRS Amendment 1388/57 is located within Wattle Grove, bound by Welshpool Road East and Crystal Brook Road to the north, and Tonkin Highway to the west. The MRS amendment area is located approximately 30 kilometres (km) east of Perth CBD within the City of Kalamunda.

Figure A illustrates the location and the Wattle Grove MRS amendment area.

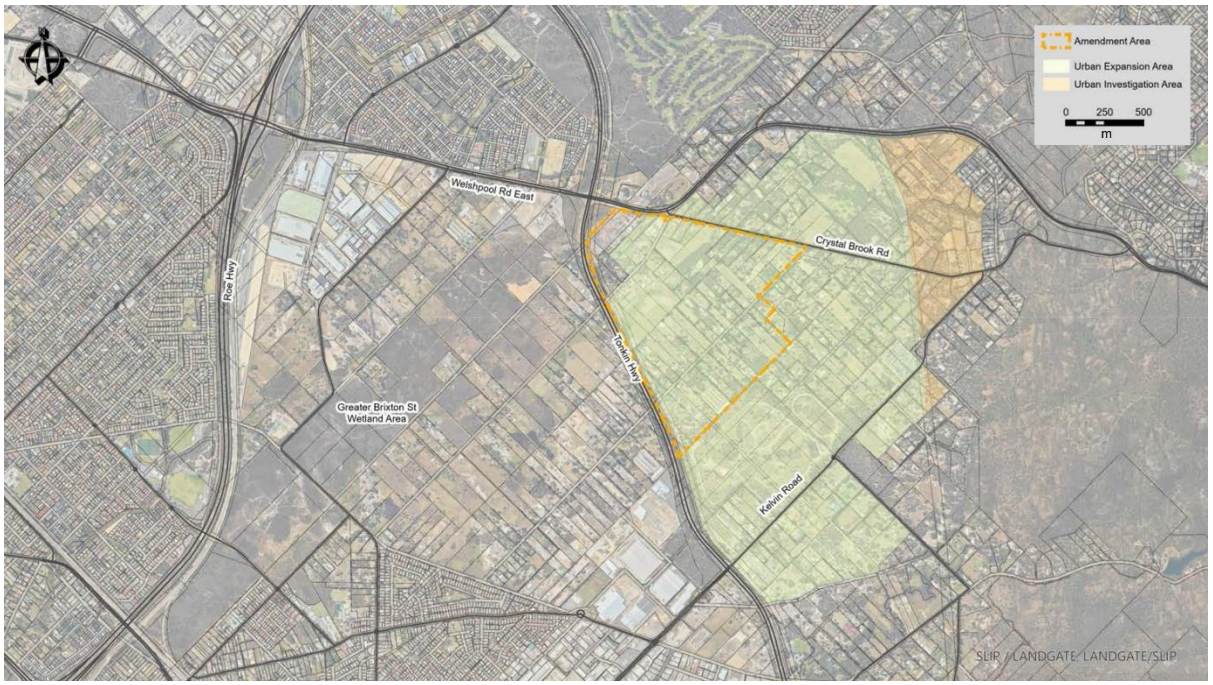


Figure A: Wattle Grove MRS Amendment Area

Wetland Assessment – Scope of Works

The Wattle Grove MRS amendment 1388/57 is subject to a 'formal' assessment by the Environmental Protection Authority (EPA). The EPA's Instruction for Environmental Review No. 2335 for Amendment 1388/57 requires the following scope of works specific to wetlands within and adjacent to the MRS amendment area:

1. Determine the boundaries of wetlands and/or buffer requirements to wetlands within and adjacent to the amendment area proposed to be retained.
2. Boundary and buffer studies should consider the characteristics of hydrology, hydric soils and wetland vegetation, and the water balance of the wetland/wetland dependent vegetation.

Accordingly, the purpose of this wetland report assessment is to address the Environmental Review No. 2335 (Task 11) scope of works.

The wetlands subject to this wetland assessment are shown in Figure B.

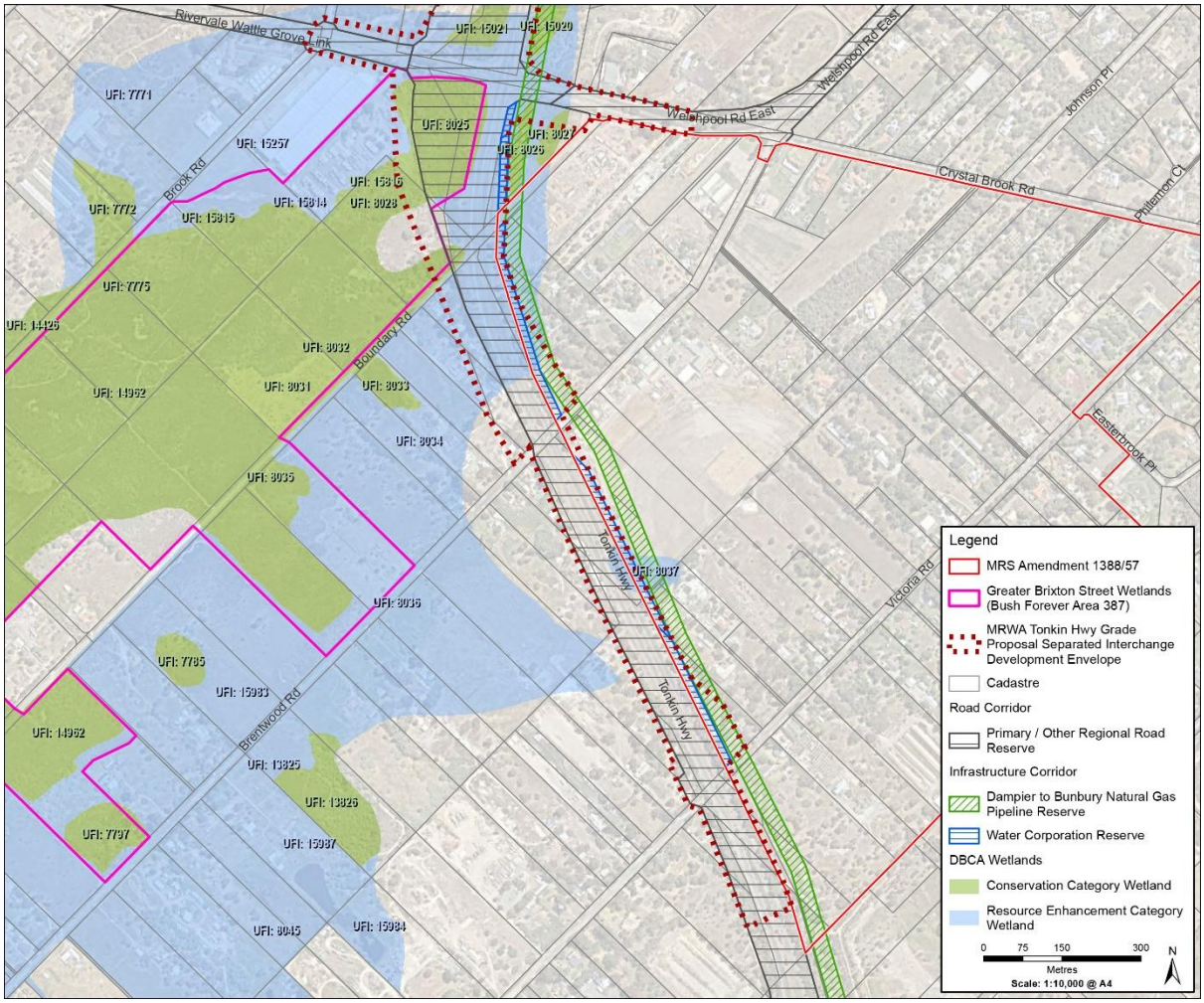


Figure B: Wetlands within the Amendment Area, Lot 501 and the GBSW

The scope of works is specific to the mapped wetlands within the MRS amendment area and the mapped wetlands adjacent to the MRS amendment area The wetlands subject to the scope of works include:

1. Within the MRS amendment area:
    a. Two Resource Enhancement Wetlands (REW) (UFI 8037 & UFI 15257) occurring within the Wattle Grove MRS amendment area within the MRS amendment area.
2. Adjacent to the MRS amendment area. The mapped wetlands adjacent to the MRS amendment area inclusive of:
    a. <u>East of Tonkin Highway</u> - Lot 501:
        i. Two Conservation Category Wetlands (CCW) (UFI 8026 & UFI 8027) and a portion of REW UFI 15257 are mapped within Lot 501. Lot 501 is located adjacent to the MRS amendment northern boundary and the Boundary Road reserve.
    b. <u>West of Tonkin Highway</u> – Greater Brixton Street Wetland (GBSW) & within the eastern portion of Bush Forever Site No. 387:
        i. The GBSW area incorporates numerous Department of Biodiversity, Conservation and Attractions (DBCA) mapped CCW and REW features. The mapped wetlands located in the GBSW within 150 m of the amendment area include, three CCW UFI 8025, UFI 8028, UFI 14962, one REW UFI 5257 and a MUW UFI 8030.

MRS Amendment Area: REWs (UFI 8037 & UFI 15257) Detailed Wetland Assessment Scope of Work

The scope incorporates undertaking an assessment of the environmental values of the two REW inclusive of:

- The wetland assessment adopted the methodology defined within the 'A methodology for the evaluation of wetlands on the Swan Coastal Plain, Western Australia" (DBCA 2017). This assessment included the following scope:
    - Review of the DBCA GWSCP dataset using available regional scale data.
    - Review current and historical land uses.
    - Determine the boundaries of wetlands and/or buffer requirements to wetlands within and adjacent to the MRS amendment area.

Outside of the MRS Amendment Area: Lot 501 & the GBSW Area - Wetland Buffer Scope of Work

- Assessment of the separation buffers in accordance with 'Guideline for the Determination of Wetland Buffer Requirements' (WAPC 2005) of the following mapped wetlands:
- Within Lot 501: Two Conservation Category Wetlands (CCW) (UFI 8026 and UFI 8027) and portion of REW UFI 15257.
- Within the GBSW area: Numerous mapped wetlands located within 150 m of the MRS amendment area.
- The 'Guideline for the Determination of Wetland Buffer Requirements' (WAPC 2005) requires the completion of the following seven steps to determine the wetland separation:
    - Step 1: Acknowledge existence of wetland.
    - Step 2: Identify wetland attributes, wetland management category and establish management objective.
    - Step 3: Define wetland function area.
    - Step 4: Identify threatening processes.
    - Step 5: Identify role of separation.
    - Step 6: Establish separation requirement.
    - Step 7: Apply separation requirement to proposal and assess its ability to achieve management objective.

Conclusion

MRS Amendment Area: REWs (UFI 8037 & UFI 15257)

Currently within the mapped REWs (UFI 8037 & UFI 15257) are the following land uses:

- Tonkin Highway reserve
- Boundary Road reserve
- Water Corporation pipeline and DBNGP easements
- Semi-rural paddocks
- Commercial landscape supply business
- Commercial turf farm.

The wetland areas have been subject to historical construction works and infilling to support the above land uses. The assessment of the REWs UFI 8037 & UFI 15257 values concluded:

- Historical clearing and infilling activities within the mapped two REW areas associated with the construction of the Tonkin Highway, Water Corporation pipeline and DBNGP which is maintained as a cleared easement.
- The two REW's (UFI 8037 and portion of UFI 15257) within the MRS amendment area are in 'Completely Degraded' condition or in the case of REW UFI 8037 within Tonkin Highway reserve, DBNGP easement and the former turf farm has been completed infilled and cleared of all native vegetation.

- The wetland's ecological values are no longer present. There are no groundwater dependent riparian communities present or habitat (or habitat diversity) for aquatic dependent fauna. The mapped wetland contains a commercial turf area and the cleared Water Corporation and DBNGP easements.

In summary, the detailed wetland assessment recommends the two REWs (UFI 8037 and portion of UFI 15257) within the MRS amendment areas are removed from the GWSCP dataset.

Portions of the former mapped REWs (UFI 8037 and portion of UFI 15257) will be incorporated into POS areas and stormwater bioretention basins adjacent to the Water Corporation pipeline and DBNGP easement. The DWMS (Hyd2O 2024) identifies the future Local Structure Plan and subdivision plans will formally integrate the Water Corporation and DBNGP easement into open space, ensuring the pipeline(s) are protected whilst also providing a valuable community asset that provides local amenity.

DBCA is the custodian of the Geomorphic Wetlands of the Swan Coastal Plain (GWSCP) dataset. An application to DBCA to amend GWSCP dataset for the two REWs (UFI 8037 and portion of UFI 15257) removing these two wetlands from the geomorphic wetland database will occur concurrently with the finalisation of a future Local Structure Plan and LWMS.

DBCA provided advice on the environmental values of the wetlands currently mapped in the GWSCP dataset within the MRS amendment area using available regional scale data. The review concluded that the two REW within the MRS amendment area (portion of UFI 15257 within the amendment area and UFI 8037) have values commensurate with a Multiple Use Wetland (MUW).

Outside of the MRS Amendment Area: Lot 501 & the GBSW Area

The Wattle Grove South MRS amendment 1388/57 does not alter:

- Lot 501 existing 'Parks and Recreation' land use and the existing management of Lot 501.
- The GBSW area 'Parks and Recreation' and Bush Forever Site No 387.
- The proposed 'Urban' land use within the amendment area (and proposed future residential development) does not intrude into the two CCWs (UFI 8026 & UFI 8027) or the GBSW area.

<u>Lot 501 - two CCWs (UFI 8026 & UFI 8027) and portion of REW UFI 15257</u>

The two CCWs are located are within Lot 501. Lot 501 is a 1.6 ha triangular landholding bounded by Tonkin Highway to the west, Welshpool Road to the north and Boundary Road to the south. The landholding also contains a portion of REW UFI 15257. Lot 501 is zoned 'Parks & Recreation' under the MRS and is owned and managed by the WAPC.

Land uses within Lot 501 and 50 m of the two CCWs UFI 8026 & UFI 8027 are the following key land uses:

- Welshpool Road and Tonkin Highway reserves.
- DBNGP and Water Corporation easements.
- Boundary Road reserve.
- Landscape supply commercial business.
- Semi-rural lots.

These land uses have resulted in the historical clearing of significant portion of the two CCWs and native vegetation within Lot 501. The construction of the Welshpool Road, Tonkin Highway, Boundary Road and DBNGP resulted in the clearing of native vegetation and the infilling of the mapped wetland areas. Approximately 80% of Lot 501 has been cleared of native vegetation. Lot 501 currently manages the Tonkin Highway reserve, Welshpool Road reserve and the DBNGP easement as cleared open areas.

The two CCWs (UFI 8026 & UFI 8027) and portion of REW UFI 15257 within Lot 501 are in 'Degraded to Completely Degraded' condition as a result of clearing from historical rural land uses and infilling of the wetland areas from the construction of Welshpool Road, Tonkin

Highway and Boundary Road. A commercial landscape supply business and rural landholdings are located immediately south of Boundary Road within the amendment area. In summary, the entire wetland ecological attributes and values of the two CCWs (UFI 8026 & UFI 8027) and the portion of REW UFI 15257 are contained within areas of Lot 501. Specifically, the wetland attributes (i.e., native wetland vegetation or seasonal surface water areas) do not extend outside of Lot 501.

The desktop review site, visit and assessment conclude the existing ecological attributes and values of the two CCWs (UFI 8026 & UFI 8027) and the portion of REW UFI 15257 are aligned with REWs category wetland and/or MUW category wetland.

Boundary Road provides an approximate 20 m permanent infrastructure barrier between the two CCWs within Lot 501 and the commercial landscape supply yard and the semi-rural paddocks within the MRS amendment area.

The wetland assessment concluded the 20 m Boundary Road reserves provides physical separation from the two CCWs (UFI 8026 and UFI 8027) and the portion of REW UFI 15257. The road reserve is managed by the City of Kalamunda and will be maintained in the future.

The conclusion drawn on the status of and the road separation distance is supported by:

- The assessment of the two CCWs (UFI 8026 and UFI 8027) and portion of REW UFI 15257 demonstrate ecological values more aligned with REW category and/or MUW category wetlands. This conclusion was underpinned by the following assessment:
    - Approximately 80% of Lot 501 has been historically cleared of native vegetation and subject to infilling.
    - The historical and current land uses resulting in the establishment of open cleared areas within the mapped wetland areas include:
        - Welshpool Road and Tonkin Highway reserves.
        - DBNGP and Water Corporation easements.
        - Boundary Road reserve.
    - Lot 501 is owned and managed by the WAPC and regularly maintained via slashing and mowing of the open grass and weed areas to uphold the road reserves, Water Corporation and DBNGP easements as cleared open areas.
    - The understorey of the two CCWs (UFI 8026 and UFI 8027) and portion of REW UFI 15257 within Lot 501 is significantly dominated by weed species including *Avena barbata* (wild oats), *Eragrostis curvula* (African lovegrass), *Ehrharta calycina* (perennial veldtgrass) and *Watsonia meriana*.
    - The Boundary Road reserve adjacent to Lot 501 is a fixed City of Kalamunda road asset.
    - The MRS amendment does not alter:
        - The location or the road reserve land use.
        - The Lot 501 “Parks and Recreation” land use.
    - Immediately east of Boundary Road (i.e., approximately 20 m from the mapped wetlands) are private landholdings including a commercial landscape supply yard and cleared semi-rural property and the DBNGP easement. Portions of these landholdings have been extensively filled and cleared of native vegetation. These land uses (i.e., the privately owned commercial and rural land uses) and the DBNGP easement have been in place for over 20 years.

<u>GBSW area</u>

The GBSW is located approximately 75 m amendment area boundary from the mapped eastern boundary (at the closest point) separated by the four lane Tonkin Highway. The separation distance is further extended by approximately 25 m due to the Water Corporation and DBNGP easements located along the length of the amendment area’s western boundary.

At Brentwood Road there is an at level pedestrian crossing of the four lane Tonkin Highway. The distance to the mapped GBSW boundary from the amendment area along Brentwood Road is approximately 700 m. This pedestrian access would be formally closed either as part of MRWA's proposed Tonkin Highway Grade Separated Interchange (which extends the highway from four to six lanes) or through a future subdivision approval.

The separation distance review of the GBSW and the amendment area identified:

- The existing transport infrastructure (Tonkin Highway) and Water Corporation and DBNGP easements which provides a physical separation boundary to the amendment area.
- The Tonkin Highway Grade Separated Interchange Proposal, specifically, if the upgrade of Tonkin Highway is approved (i.e., increased to six lanes) the minimum separation distance to the amendment area would be extended by an additional 30 m.
- The amendment area and any proposed future development works do not intrude into the GBSW area and remain on the eastern side of Tonkin Highway.

The proposed wetland buffer distance to the GBSW area is:

- A minimum 100 m buffer from the GBSW (at the closest point) will be maintained. The Tonkin Highway reserve in combination with the Water Corporation pipeline and DBNGP easements has already established a minimum 100 m physical boundary between the GBSW wetlands and the amendment area at the closest point. If the MRWA Tonkin Highway Grade Separated Interchange Proposal is approved and constructed (creating a six lane highway) the minimum buffer would extend to approximately 130 m.
- Importantly, the vast majority of the proposed future 'Urban' land uses will be located significantly further (i.e., 500 m plus) from the GBSW area.

Table of Contents

Acronym Table xii

1. Summary 1
   1.1. Project background 1
   1.2. Purpose 1
   1.3. Wetlands subject to the wetland assessment report 1
      1.3.1. Relevant Policy and Guidance 2

2. Methodology 4
   2.1. Evaluation of the two REWs (UFI 8037 & UFI 15257) within the amendment area 4
   2.2. Buffer assessment of the wetlands located within Lot 501 adjacent to the amendment area & the GBSW area. 4

3. Environmental Context 6
   3.1. Desktop assessment 6
   3.2. Wetland assessment areas 6
   3.3. Ecological wetland values within the amendment area & Lot 501 6
      3.3.1. Historical land use context 6
      3.3.2. Current land use 7
         3.3.2.1. MRS amendment area & adjacent Lot 501 7
      3.3.3. Historical wetland review – within the amendment area 8
      3.3.4. Historical wetland review – adjacent to the amendment area 13
      3.3.5. Geology 15
         3.3.5.1. Regional Geology 15
         3.3.5.2. Geotechnical Assessment 16
      3.3.6. Hydrology 17
         3.3.6.1. Surface Water 17
         3.3.6.2. Groundwater 18
      3.3.7. Regional vegetation context 18
      3.3.8. Vegetation units 19
         3.3.8.1. REW - UFI 8037 19
         3.3.8.2. REW UFI 15257 20
         3.3.8.3. CCWs UFI 8026 & UFI 8027 and portion of REW UFI 15257 within Lot 501 23
      3.3.9. Vegetation condition 26
         3.3.9.1. REW UFI 8037 & UFI 15257 26
         3.3.9.2. CCWs UFI 8026 & UFI 8027 and portion of REW UFI 15257 within Lot 501 26
      3.3.10. Flora 26
      3.3.11. Threatened and Priority Ecological Communities 27
      3.3.12. Fauna 27
         3.3.12.1. REW UFI 8037 & UFI 15257 28
         3.3.12.2. CCWs UFI 8026 & UFI 8027 and portion of REW UFI 15257 within Lot 501 28
      3.3.13. Social 28
         3.3.13.1. REW UFI 8037 & UFI 15257 28
         3.3.13.2. CCWs UFI 8026 & UFI 8027 and portion of REW UFI 15257 within Lot 501 28
      3.3.14. Cultural 29
   3.4. Summary 30
   3.5. Ecological Wetland Values – GBSW Area 33
      3.5.1. Land use context 33
      3.5.2. Tenure and land management 36
      3.5.3. Regional Geology 38
      3.5.4. Surface Water 38
      3.5.5. Groundwater 39
      3.5.6. Regional Vegetation 39
         3.5.6.1. Key studies and investigations 39

3.5.6.2. Groundwater Dependent Ecosystems 40
3.5.6.3. Flora within the GBSW 40
4. Detailed wetland assessment 42
4.1. Preliminary evaluation of REW UFI 8037 and REW UFI 15257 (within the MRS Amendment area) 42
4.2. Secondary evaluation 43
4.3. Alignment with the DBCA preliminary wetland advice 44
4.4. REWs (UFI 8037 & UFI 15257) review 44
4.4.1. Proposed Management 45
5. Wetland Buffer Assessment 47
5.1. CCWs UFI 8026 & UFI 8027 and portion of REW UFI 15257 within Lot 501 47
5.1.1. Land use review 47
5.1.2. Wetland buffer assessment 49
5.2. Wetlands within the GBSW area 55
5.2.1. Land use review 55
5.2.2. Wetland buffer assessment 56
6. Summary and recommendations 61
6.1. Summary 61
6.2. Evaluation of REW UFI 8037 and REW UFI 15257 61
6.3. Wetland Buffer Assessment 62
6.3.1. CCWs UFI 8026 & UFI 8027 and portion of REW UFI 15257 within Lot 501 62
6.3.2. GBSW area 62
7. References 63

Table of Appendices

Appendix A: 66
Detailed assessment of Resource Enhancement Wetland UFI 8037 66
Appendix B: 78
Detailed assessment of Resource Enhancement Wetland UFI 15257 78

List of Figures

Within the report

Figure A: Wattle Grove MRS Amendment Area iii
Figure B: Wetlands within the amendment area, Lot 501 and the GBSW iv
Figure C: Wattle Grove Amendment Area and the GBSW 1953 aerial photograph 7
Figure D: Regional Geological Mapping 17
Figure E: Yule Brook Sub-Catchment 18
Figure F: REW 8037 and the DBNGP easement 20
Figure G: REW 15257 and the DBNGP and Water Corporation easement 21
Figure H: Vegetation Types 22
Figure I: CCWs UFI 8026 & UFI 8027 and portion of REW UFI 15257 within Lot 501 24
Figure J: Aboriginal Heritage Sites and Wetlands within the Amendment Area 30
Figure K: CCWs (UFI 8026 & UFI 8027) and REW UFI 15257 within Lot 501 48
Figure L: Physical infrastructure separating CCW UFI 14962 and the Amendment Area 56
Figure M: Access Pathways towards the GBSW 60

List of Plates

Plate 1: Planted Eucalyptus camaldulensis (Red River Gum) trees within REW 15257 23
Plate 2: REW 15257 within the amendment area and the cleared Water Corporation and DBNGP easements and the Tonkin Highway road reserve 23
Plate 3: The cleared DBNGP easement bisects CCWs UFI 8026 & UFI 8027 25
Plate 4: Boundary Road reserve and the adjacent landscape supply business 26
Plate 5: Southern portion of REW 15257 within the amendment area 44
Plate 6: CCW UFI 8026 and REW UFI 15257 located within the DBNGP easement 54
Plate 7: CCW UFI 8027 and REW UFI 15257 adjacent to the DBNGP easement 54

List of Tables

Table 1: Environmental Review No. 2335 Inland Waters – wetland specific scoping requirements 1
Table 2: Wetland management categories and management objectives 1
Table 3: DBCA mapped geomorphic wetlands present within and adjacent to the MRS Amendment area 1
Table 4: Policy and guidance relevant to this wetland assessment 2
Table 5: Historical aerial assessment of REW UFI 8037 8
Table 6: Historical aerial assessment of REW UFI 15257 10
Table 7: Historical aerial assessment of two CCWs (UFI 8026 UFI 8027) and portion of REW UFI 15257 within Lot 501 13
Table 8: Regional geological succession within the amendment area and Lot 501 15
Table 9: Summary of the geological map units within the amendment area and Lot 501 ..... **Error! Bookmark not defined.**
Table 10: Superficial Formation Geological Condition (Douglas Partners 2020 & 2022) 16
Table 11: Vegetation complexes of the survey area and percent remaining in the Perth-Peel region (Heddle et al. 1980) 19
Table 12: Summary of significant wetland features and their attributes 31
Table 13: Summary of significant wetland features and their attributes 33
Table 14: Summary of the DBCA mapped wetland features within 75 m to 150 m of the amendment area 33
Table 15: Historical aerial assessment of the GBSW area 34
Table 16: GBSW management reserves & tenure ..... **Error! Bookmark not defined.**
Table 17: Regional geological succession within the GBSW Area 38
Table 18: Threatened and Priority FCTs recorded within GBSW (Emerge Associates 2022) 40
Table 19: Conservation significant flora species within GBSW (Tauss et al. 2019) 41
Table 20: Preliminary evaluation of REW UFI 8037 and REW UFI 15257 42
Table 21: Summarised results of the secondary assessment 43
Table 22: CCWs UFI 8026 & UFI 8027 and wetland buffer assessment 49
Table 23: GBSW buffer assessment 56

Acronym Table

Acronym	Definition
AH Act	*Aboriginal Heritage Act 1972*
ASS	Acid Sulfate Soils
bgl	Below Ground Level
BC Act	*Biodiversity Conservation Act 2016*
CBD	Central Business District
CCW	Conservation Category Wetland
DBCA	Department of Biodiversity, Conservation and Attractions
DBNGP	Dampier to Bunbury Natural Gas Pipeline
DPLH	Department of Planning, Lands and Heritage
DWER	Department of Water and Environmental Regulation
EPA	Environmental Protection Authority
EP Act	*Environmental Protection Act 1986*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
FCT	Floristic Community Type
GBSW	Greater Brixton Street Wetlands
GWSCP	Geomorphic Wetlands of the Swan Coastal Plain
ha	Hectare
km	Kilometres
kL	Kilolitres
LSP	Local Structure Plan
LWMS	Local Water Management Strategy
m	Metres
m AHD	metres Australian Height Datum
MGL	Maximum groundwater level
MKSEA	Maddington Kenwick Strategic Employment Area
MNES	Matters of National Significance
MRS	Metropolitan Region Scheme
MUW	Multiple Use Wetland
POS	Public Open Space
REW	Resource Enhancement Wetland
SCP	Swan Coastal Plain
TEC	Threatened Ecological Community
UFI	Unique Feature Identifier
UWMP	Urban Water Management Plan
WAPC	Western Australian Planning Commission

1. Summary

1.1. Project background

The Wattle Grove South Metropolitan Region Scheme (MRS) amendment 1388/57 proposes to re-zone an area of approximately 126 hectares (ha) of the Wattle Grove landholdings from 'Rural' to 'Urban'. The landholdings subject to the MRS amendment area is bound by Tonkin Highway (west), Welshpool Road East (north), Crystal Brook Road (north), Victoria Road and Easterbrook Road (east) and the rear boundaries of lots fronting Victoria Road (south).

Regionally, Watle Grove is located within the City of Kalamunda approximately 15 kilometre (km) east of Perth Central Business District (CBD).

The location of the Wattle Grove South MRS amendment area is shown in Figure A.

1.2. Purpose

MRS amendment 1388/57 is subject to a 'formal' assessment by the Environmental Protection Authority (EPA). Table 1 defines the EPA's Instruction for Environmental Review No. 2335 for Amendment 1388/57 specific scopes of works for the assessment of wetlands.

Table 1: Environmental Review No. 2335 Inland Waters – wetland specific scoping requirements

Task	Required Work
11.	• Determine the boundaries of wetlands and/or buffer requirements to wetlands within and adjacent to the amendment area proposed to be retained. • Boundary and buffer studies should consider the characteristics of hydrology, hydric soils and wetland vegetation, and the water balance of the wetland/wetland dependent vegetation.

Accordingly, the purpose of this wetland report assessment is to address the Environmental Review No. 2335 (Task 11) scope of works.

1.3. Wetlands subject to the wetland assessment report

Wetlands within the Swan Coastal Plain (SCP) are protected and managed by the management category assigned by the Department of Biodiversity, Conservation and Attractions (DBCA).

The DBCA management categories and their objectives are outlined in Table 2.

Table 2: Wetland management categories and management objectives

Category	Objective
Conservation Category Wetlands (CCW)	To preserve wetland (natural) attributes and functions.
Resource Enhancement Wetlands (REW)	To restore wetlands through maintenance and enhancement of wetland functions and attributes.
Multiple Use Wetlands (MUW)	To use, develop and manage wetlands in the context of water, town, and environmental planning.

Table 3 summaries the wetlands subject to this wetland assessment report inclusive of the numerous mapped wetlands within the GBSW area.

Table 3: DBCA mapped geomorphic wetlands present within and adjacent to the MRS Amendment area.

Unique Feature Identifier (UFI)	Geomorphic classification	Management category	Land tenure details	Total area (ha)
Within the MRS amendment area				
UFI 8037	REW	Sumpland	• Lot 301 – zoned Primary Regional Road. • Lot 302 – zoned 'Rural' (Water Corporation easement).	0.86

Unique Feature Identifier (UFI)	Geomorphic classification	Management category	Land tenure details	Total area (ha)
			• Lot 303 - zoned 'Rural' (turf farm). • Dampier to Bunbury Natural Gas Pipeline (DBNGP) easement (D207286). • Lot 107 – zone 'rural' predominantly cleared small rural landholding. • Lot 106 – zone 'rural' predominantly cleared small rural landholding.	
UFI 15257	REW	Palusplain	• Lots 146, 12 & - zoned 'Rural' predominantly cleared small rural landholdings. • Lot 302 – zoned 'Rural' (Water Corporation easement). • DBNGP easement.	30.33 (2.06 is within the amendment area)
North of the MRS amendment area (within 32 m of the MRS amendment area)				
UFI 8026	CCW	Palusplain	• Lot 501 - zoned 'Parks and Recreation'. • Lot 500 – zoned 'Parks and Recreation' & Water Corporation easement. • DBNGP easement.	0.38
UFI 8027	CCW	Palusplain		0.32
UFI 15257	REW	Palusplain		30.33 (0.52 ha is within Lot 501).
GBSW area (within 150 m of the MRS amendment area)				
8025	CCW	Palusplain	Lot 51 Zoned 'Parks and Recreation' & Bush Forever Site No 387	2.78
8028	CCW	Sumpland	Lot 340 Zoned 'Parks and Recreation' & Bush Forever Site No 387	1.48
8030	Multiple Use	Palusplain	Lot 342 Zoned 'Parks and Recreation' & Bush Forever Site No 387	1.29
14962	CCW	Palusplain	Lot 342 Zoned 'Parks and Recreation' & Bush Forever Site No 387	62.68
15257	REW	Palusplain	Lot 51 Zoned 'Parks and Recreation' & Bush Forever Site No 387	30.33

1.3.1. Relevant Policy and Guidance

The relevant government policy and guidance for inland waters and to specifically address EPA's Instruction for Environmental Review No. 2335 (Task 11) requirements are summarised in Table 4.

Table 4: Policy and guidance relevant to this wetland assessment

Policy and Guidance	Key Aspects

Environmental Factor Guideline: Inland Waters (EPA, 2018).	• Inland Waters identified as a key environmental factor.
	• The MRS amendment for the inland waters assessment considers:
	  ○ The potential environmental impacts, the mitigation hierarchy (direct and indirect impacts).
	  ○ Implications of cumulative impacts.
	  ○ Predicted residual impacts and management approaches.

Policy and Guidance	Key Aspects
A methodology for the evaluation of wetlands on the Swan Coastal Plain, Western Australia (DBCA 2017).	• Assessment of the environmental values of the two REW (UFI 8037 & UFI 15257) which intersect the western boundary of the amendment area.

Guidance Statement 33: Environmental Guidance for Planning and Development	• The guidelines provide an option for a site-specific wetland buffer assessment.
	• A wetland buffer distance was determined for:
	  ○ CCWs (UFI 8026 & 8027) within Lot 501 adjacent to the MRS amendment area.
	  ○ Wetlands within the GBSW area.
	• This assessment considered:
	  ○ The physical characteristics relevant to the wetland, including wetland values and attributes.
	  ○ Surrounding land use(s).
	  ○ The feature being mitigated for or against (threatening process).

Draft - Guideline for Determining of Wetland Buffer Requirements (WAPC 2005).	• Separation buffers is recognised as essential for the achievement and maintenance of the wetland's management objective.
	• The Draft Guideline for Determining of Wetland Buffer Requirements were considered in the buffer assessment for:
	  ○ CCWs (UFI 8026 & 8027) within Lot 501 adjacent to the MRS amendment area.
	  ○ Numerous wetlands within the GBSW area.

Better Urban Water Management (WAPC 2008).	• The Wattle Grove South DWMS (Hyd2O 2024) has been prepared to specifically satisfy the following requirements:
	• Better Urban Water Management (WAPC, 2008).
	  ○ Inland Waters technical investigations defined in the instructions for Environmental Review No. 2335 (EPA 2022).
	  ○ The drainage strategy integrates Water Sensitive Urban Design principles to minimise impact to sensitive water resources and wetlands.

Environmental values and pressures for the Greater Brixton Street Wetlands on the Swan Coastal Plain - Section 16(j) of the *Environmental Protection Act 1986* (EPA 2022).	• The Wattle Grove South Wetland Assessment Report incorporates a wetland buffer assessment to the GBSW. • The EPA's s.16(j) GBSW advice has been incorporated into the assessment of the Inland Waters environmental factor and the ERD.

2. Methodology

2.1. Evaluation of the two REWs (UFI 8037 & UFI 15257) within the amendment area

The scope incorporates undertaking an assessment of the environmental values of the two REW inclusive of:

- The wetland assessment adopted the methodology defined within the 'A methodology for the evaluation of wetlands on the Swan Coastal Plain, Western Australia" (DBCA 2017). This assessment included the following scope:
    - Review of the DBCA GWSCP dataset using available regional scale data.
    - Review current and historical land uses.
    - Determine the boundaries of wetlands and/or buffer requirements to wetlands within and adjacent to the MRS amendment area.

The two REWs (UFI 8037 & UFI 15257) within the amendment area subject to the reclassification assessment are shown in Figure 2.

2.2. Buffer assessment of the wetlands located within Lot 501 adjacent to the amendment area & the GBSW area.

Wetlands, located within 150 m of the amendment area, subject to the buffer assessment include:

1. East of Tonkin Highway - Lot 501:
    a. Two Conservation Category Wetlands (CCW) (UFI 8026 & UFI 8027) and a portion of REW UFI 15257 are mapped within Lot 501. Lot 501 is located adjacent to the MRS amendment northern boundary and the Boundary Road reserve.
2. West of Tonkin Highway – Greater Brixton Street Wetland (GBSW) & within the eastern portion of Bush Forever Site 387:
    a. The GBSW area incorporates numerous Department of Biodiversity, Conservation and Attractions (DBCA) mapped CCW and REW features. The mapped wetlands located in the GBSW within 150 m of the amendment area include, three CCW UFI 8025, UFI 8028, UFI 14962, one REW UFI 5257 and a MUW UFI 8030.

The Wattle Grove South MRS amendment 1388/57 does not alter:

- Lot 501 existing 'Parks and Recreation' land use.
- The GBSW area 'Parks and Recreation' and Bush Forever Site No 387.
- The proposed 'Urban' land use within the amendment area (and proposed future residential development) does not intrude into the two CCWs (UFI 8026 & UFI 8027) or the GBSW area.

In addition, the two CCWs (UFI 8026 & UFI 8027) and the numerous wetlands with the GBSW area are physically separated from the amendment area by key regional infrastructure corridors including:

- Boundary Road reserve.
- Tonkin Highway reserve and Welshpool Road reserve.
- Water Corporation water pipeline easement.
- DBNGP pipeline corridor.

In this context, the purpose of this evaluation is focused on assessing the separation buffers to the two CCWs (UFI 8026 & UFI 8027) and portion of REW UFI 15257 within Lot 501 and the numerous mapped wetlands within the GBSW area located inside 150 m of the amendment area in accordance with Guideline for the Determination of Wetland Buffer Requirements

(WAPC 2005). The guideline requires the completion of the following seven steps to determine the wetland separation:

- Step 1: Acknowledge existence of wetland.
- Step 2: Identify wetland attributes, wetland management category and establish management objective.
- Step 3: Define wetland function area.
- Step 4: Identify threatening processes.
- Step 5: Identify role of separation.
- Step 6: Establish separation requirement.
- Step 7: Apply separation requirement to proposal and assess its ability to achieve management objective.

Figure 2 illustrates the infrastructure corridors located between the amendment area and the two CCWs (UFI 8026 & UFI 8027) and portion of REW UFI 15257 within Lot 501 and the mapped wetlands within the GBSW area.

3. Environmental Context

3.1. Desktop assessment

This Wetland Assessment Report references information from various technical assessments and surveys completed across the amendment areas and within the MRWA Tonkin Highway reserve. The key documents of relevance include:

- Wattle Grove South Ecological Surveys. Unpublished report, prepared for the City of Kalamunda (AECOM 2020).
- Environmental Assessment Report: Various Lots, Wattle Grove. Unpublished report prepared for Burgess Design Group (360 Environmental 2018).
- Tonkin Highway Welshpool Road to Hale Road Vegetation condition assessment (Strategen Environmental 2019).
- Tonkin Highway Grade Separated Interchanges, Hale Road, and Welshpool Road EPBC 2019/8529 Preliminary Documentation (GHD 2021).
- Tonkin Grade Separated Interchanges Biological Survey and Targeted Black Cockatoo Habitat Assessment (Woodman Environmental 2021).
- Report on Preliminary Geotechnical Investigation Proposed Wattle Grove Development Victoria Road, Wattle Grove (Douglas Partners 2022).
- Report on Preliminary Geotechnical Investigation Proposed Wattle Grove Development Precinct 1, Victoria Road, Wattle Grove (Douglas Partners 2020).
- Geophysical Subsurface Investigation at Proposed Land Development Site Wattle Grove (GBG Group 2023).
- District Water Management Strategy (Hyd2O 2024).
- Water Balance Assessment (Emerge Associates 2023).

3.2. Wetland assessment areas

This assessment separates the wetlands spatially into the following areas (Figure B):

1. Wetlands east of Tonkin Highway within Lot 501 which includes:
    a. The amendment area (two REWs UFI 8037 & UFI 15257).
    b. Outside of the amendment area in Lot 501 (two CCWs UFI 8026 & UFI 8027 and a portion of REW UFI 15257).
2. The numerous mapped wetlands located west of Tonkin Highway located in the GBSW within 150 m of the amendment area include, three CCW UFI 8025, UFI 8028, UFI 14962, one REW UFI 5257 and a MUW UFI 8030.

3.3. Ecological wetland values within the amendment area & Lot 501

3.3.1. Historical land use context

A review of historical aerial photography shows the wetland areas within the MRS amendment area, the two CCWs (UFI 8026 & UFI 8027) and numerous wetland areas within the GBSW area have been subject to land clearing to establish semi-rural landholdings.

The earliest available aerial imagery of the Wattle Grove and the GBSW area is from 1953 (Figure C). This aerial illustrates a significant portion of the amendment area was subdivided and cleared for primarily rural land uses including grazing pasture, horse training and market gardens/orchards.

The former Crystal Brook tributary which flowed into the GBSW area via the two CCWs (UFI 8026 & UFI 8027) is visible, traversing the north west portion of the amendment area, linking the two CCWs (UFI 8026 & UFI 8027) before re-joining Yule Brook about 2.2 km within the GBSW area at the location of the Alison Baird Reserve. During this period, deep unlined

open drains were constructed along road reserves and the eastern portion of Boundary Road was constructed clearing a portion of the Crystal Brook tributary.

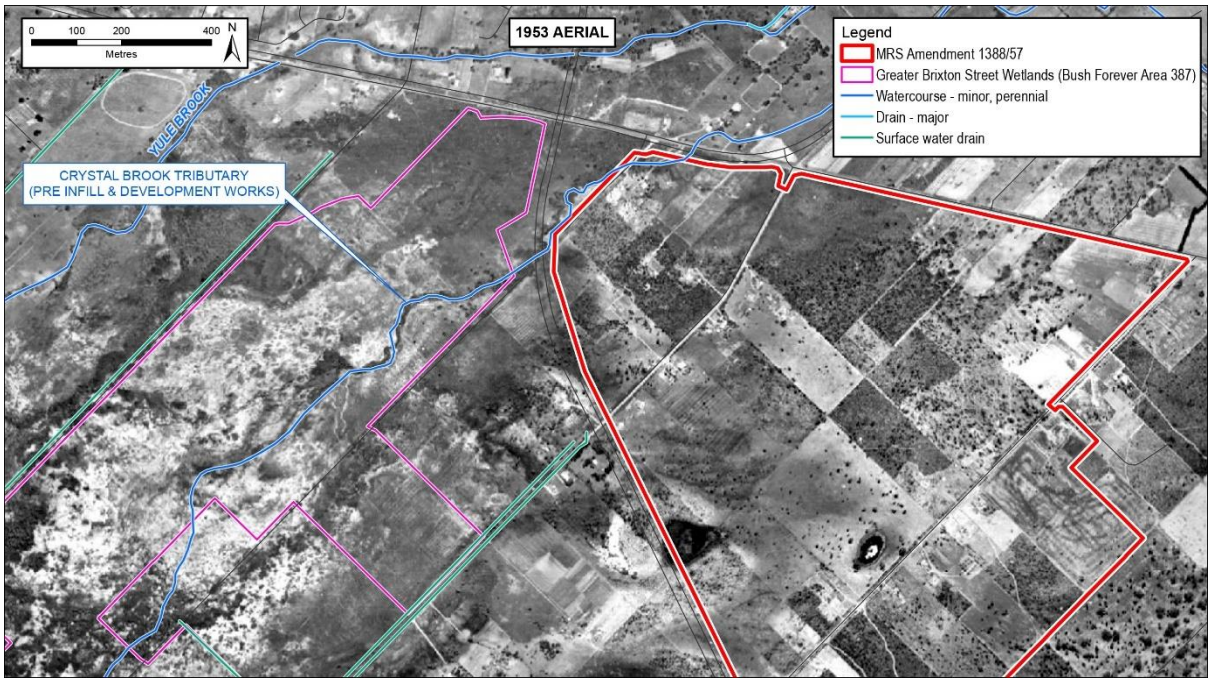


Figure C: Wattle Grove amendment area and the GBSW area (1953 aerial photograph).

The following key development undertaken between 1953 and 1985 amended the regional and local hydrological conditions:

1. Construction of Tonkin Highway, the Boundary Road reserve which bisects:
    a. Crystal Brook
    b. The GBSW area and the amendment area
2. Operational Hartfield Golf Course located in the north-east of Welshpool Road (and approximately 500 m from amendment area) constructed immediately adjacent to Yule Brook.
3. Clearing of vegetation adjacent to Yule Brook and excavation of the brook in areas to function as a drain.
4. Construction unlined open drains both within Brook, Boundary, Brentwood, and Victoria road reserves.
5. Water Corporation pipeline corridor which cleared portions of the two CCWs (UFI 8026 & UFI 8027) and REW (UFI 15257) across Lots 501, 146, 12 and 7.
6. REW (UFI 15257) remnant vegetation within Lots 501, 146, 12 and 7 was cleared to establish commercial land uses (along Boundary Road) and small-scale livestock properties.
7. During the construction of Tonkin Highway REW (UFI 8037) was partially infilled and the landowner of Lot 303 expanded the turf farm across the remaining REW area.
8. Expansion of rural and orchards land uses within the amendment area.
9. Clearing to establish rural lots and commercial business (i.e., poultry farm and laydown areas) within and adjacent to the GBSW area.

3.3.2. Current land use

3.3.2.1. MRS amendment area & adjacent Lot 501

The amendment area and immediately adjacent landholdings comprises numerous land uses including:

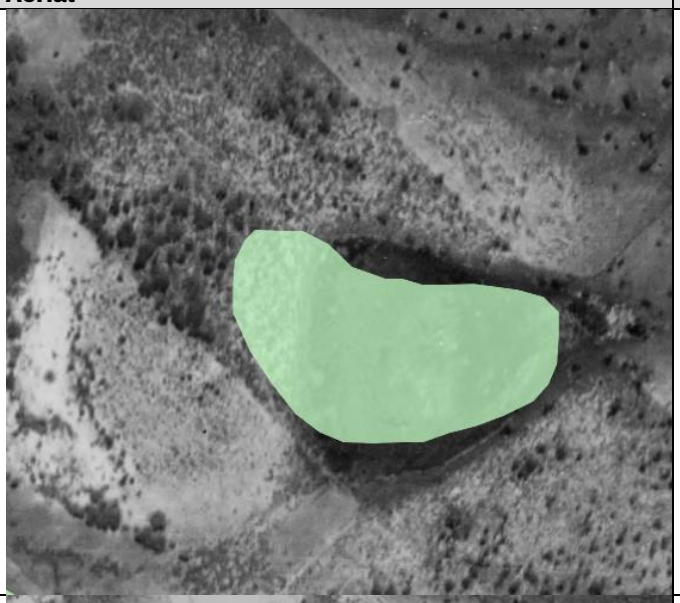
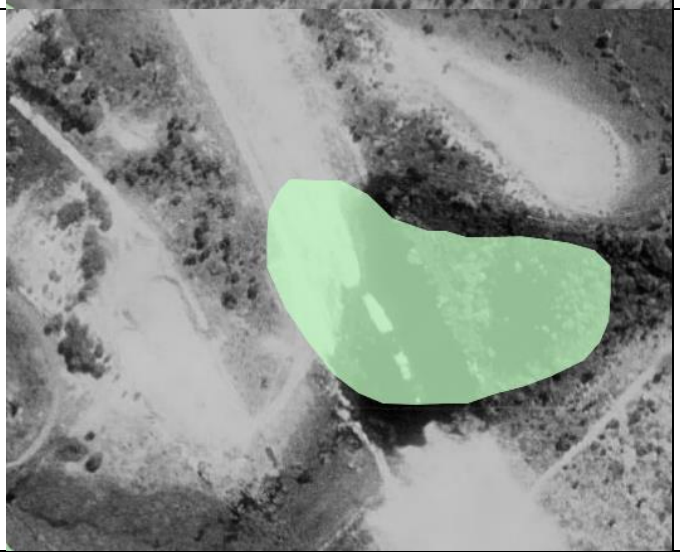
- Commercial landscape supply along Welshpool Road and Boundary Road adjacent to two CCWs (UFI 8026 & UFI 8027) and REW (UFI 15257).
- Residential and semi-rural lots.
- A turf farm within Lots 213, 214, 53 and 303 Brentwood Road the west of the amendment area.

- A former poultry farm within Lot 251 Victoria Road in the south-east portion of the amendment area, which ceased operations approximately ten years ago.
- Water Corporation and DBNGP cleared pipeline easements, which runs parallel to the Tonkin Highway along the amendment area's western boundary.
- Welshpool Road and Tonkin Highway road reserves.

3.3.3. Historical wetland review – within the amendment area

Table 5 outlines the historical aerial assessment of REW UFI 8037 within the amendment area.

Table 5: Historical aerial assessment of REW UFI 8037

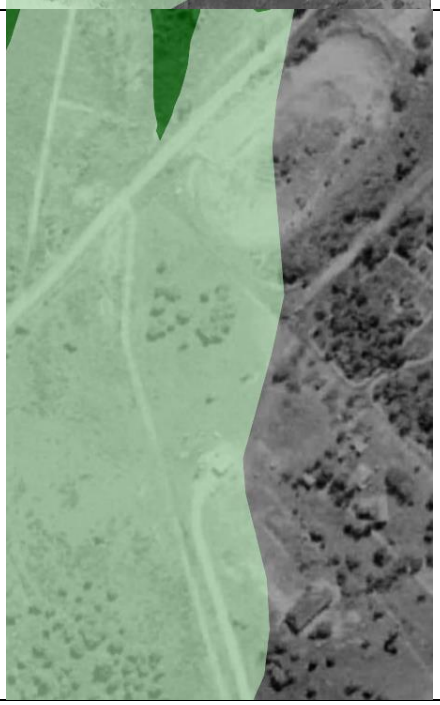
Year	Aerial	Comment
1953		• The earliest aerial of REW UFI 8037. • Intact wetland waterbody. • Clearing and infilling of the REW from landholdings west of the REW.
1974		• Infilling and clearing of the wetland from preloading/ earthworks undertaken for the construction of the Tonkin Highway. • Infilling and clearing of REW UFI 8037 in private landholding. This land clearing was to support rural land use adjacent to the REW.

1981		• Ongoing infilling and works within REW UFI 8037 from the construction Tonkin Highway. • Clearing and infilling from the installation of the Water Corporation's water & the DBNGP pipelines. • Extensive clearing of the REW UFI 8037 area and surrounding landholdings.
2000		• The native vegetation within REW UFI 8037 completely cleared. • Excavation of the wetland to create a water source. • Turf farm is the dominant land use.
2003 to 2023		• Waterbody has been filled with sand to expand the turf farm. • The construction of the turf farm, the Tonkin Highway (via pre-loading) and excavation of the Water Corporation and DBNGP pipeline corridors (~ 15 m in width) involved the removal of clayey/hydric soils. • REW 8037 has been subject to historical impacts including clearing of vegetation and filling works to facilitate the construction of Tonkin Highway, the Water Corporation & DBNGP pipelines, and an operational turf farm. • The wetland's ecological values are no longer present. There are no groundwater dependent riparian communities present or habitat (or habitat diversity) for aquatic dependent fauna.

		• The mapped wetland contains a commercial turf area and the cleared Water Corporation and DBNGP easements.

Table 6 outlines the historical aerial assessment of REW UFI 15257 within the amendment area.

Table 6: Historical aerial assessment of REW UFI 15257

Year	Aerial	Comment
1953		• Extensive land clearing within REW UFI 15257 and adjacent rural landholdings. Significant reduction in riparian vegetation. • Boundary Road reserve which bisects REW UFI 15257 was constructed prior to 1953. • Houses constructed within immediately adjacent to REW UFI 15257.
1979		• Over 90% of the native vegetation within the mapped REW UFI 15257 area has been cleared. • Additional houses (and rural infrastructure) constructed (and infilling) within and immediately adjacent to REW UFI 15257.

1981		• Clearing and infilling within the mapped REW UFI 15257 to support:
		  ○ The construction of Tonkin Highway and excavation of the Water Corporation and DBNGP pipeline corridors (~ 15 m in width).
		  ○ Expansion of the rural lifestyle properties.
		  ○ Clearing and infilling of Lots south of Boundary Road.

1985		• The Water Corporation and the DBNGP pipeline easement adjacent to the Tonkin Highway remain cleared of remnant vegetation. • Over 95% of the mapped REW UFI 15257 within the amendment area has been cleared. • Clearing and earth working the Lots south of Boundary Road for commercial land use. • Planting of non-native trees within the rural paddocks along the Water Corporation and DBNGP easement. • Expansion of rural properties within and adjacent to REW UFI 15257.

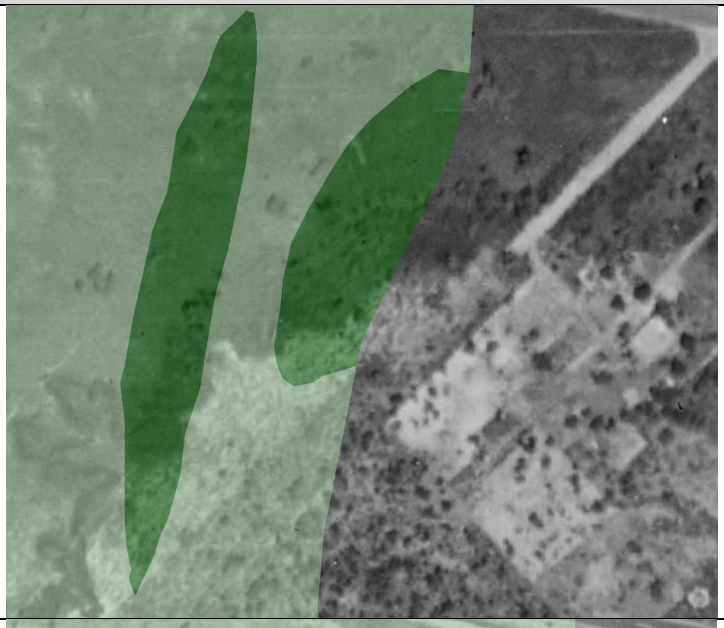
2000		• Commercial landscape/garden supply stockyard established adjacent to the Boundary Road within the mapped wetland boundary. • Additional houses constructed immediately adjacent to REW UFI 15257. • The Water Corporation and DBNGP easement remain cleared of vegetation.

2003 to 2020		• Additional clearing of native vegetation and infilling of the wetland for the following purpose:
		  ○ Expansion of the commercial landscape/garden supply stockyard.
		  ○ Expansion of land uses within the rural properties to include landscaped gardens, swimming pools & tennis court.
		• Maturing of the non-native trees planted in the early 1990s along fence lines.
		• Within and adjacent to the Tonkin Highway reserve, the following vegetation was surveyed and mapped:
		  ○ Planted stands of *Corymbia calophylla* (Marri) and non-native eucalypt Eucalyptus camaldulensis (Red River Gum) over non-native eucalypt *Casuarina cunninghamiana subsp. cunninghamiana*, *Melaleuca preissiana*, *Jacksonia sternbergiana* and *Schinus terebinthifolia over introduced species on various soils and topographical positions (Woodman Environmental 2021).
		• Within the DBNGP easement (open paddock area):
		  ○ Cleared paddocks with *Eucalyptus camaldulensis* (Red River Gum).
		• The vegetation was surveyed as in 'Completed Degraded' condition.

3.3.4. Historical wetland review – adjacent to the amendment area

Table 7 outlines the historical aerial assessment of the two CCWs (UFI 8026 & UFI 8027) and the portion of REW UFI 15257 within Lot 501, located north-west of the amendment area adjacent to Tonkin Highway and Welshpool Road.

Table 7: Historical aerial assessment of two CCWs (UFI 8026 UFI 8027) and portion of REW UFI 15257 within Lot 501

Year	Aerial	Comment
1953		• Wetlands connected to Crystal Brook. • Boundary Road partially constructed and bisects Crystal Brook. • Clearing of native vegetation within the two CCWs (UFI 8026 UFI 8027), REW UFI 15257 within Lot 501 and immediate surroundings. • Portions of the landholdings adjacent south of Boundary Road were cleared.
1965		• Over 80% of the native vegetation within the two CCWs (UFI 8026 UFI 8027) and the portion of the REW UFI 15257, Crystal Brook tributary and immediate surroundings within Lot 501 was cleared. • Boundary Road constructed further westward with formalisation of the Crystal Brook tributary into an open road side drain. • The mapped CCWs are located immediately adjacent to the constructed Boundary Road. • Rural landholdings south of Boundary Road have been cleared of native vegetation.

1985		• Widening of Welshpool Road into Lot 501. • The DBNGP easement is located wholly across CCW UFI 8026. • The construction of the Tonkin Highway and the installation of the water and DBNGP pipeline which involved the removal of clayey/hydric soils. • The two CCW (UFI 8026 UFI 8027) and REW UFI 15257 within Lot 501 demonstrate limited native vegetation re-growth i.e., regular maintenance of the cleared areas. • Landholdings south of Boundary Road were cleared and earth worked and infilled. • Boundary Road terminated at Tonkin Highway.
2000		• Lot 501 is estimated to be 80% cleared of native vegetation. • Lot 501 is subject to regular vegetation maintenance program with a focus on clearing the wetland understorey and the Water Corporation and DBNGP pipeline easement. • Landholdings south of Boundary Road used as commercial landscape/garden supply business.

2003 to 2020		• No significant change to the status of the two CCWs (UFI 8026 UFI 8027) and REW UFI 15257 within Lot 501 not significantly changed. The wetlands areas remain subject to regular maintenance (i.e., mowing of grass/understorey). • Expansion of the commercial landscape supply business south of Boundary Road.

3.3.5. Geology

3.3.5.1. Regional Geology

Regional topographic contour mapping (DPIRD 2019) indicates that the Amendment Area is relatively flat to undulating, with elevation ranging from 21 m Australian Height Datum (AHD) in the west of the amendment area to 35 m AHD in the east. The amendment area is located between Yule Brook Main Drain (approximately 200 m to the north and north-west) and Bickley Brook Main Drain (approximately 1.8 km to the south).

A summary of the regional geological succession is provided in Table 8.

Table 8: Regional geological succession within the amendment area and Lot 501

Stratigraphy	Lithology
Amendment Area (and UI and UE areas)	
Superficial Formations	
Bassendean Sand	Sand, minor silt and clay.
Guildford Formation	Alluvial sand and clay with shallow-marine and estuarine lenses.
Yoganup Formation	Sand with minor clay.
Osborne Formation: • Kardinya Shale Member. • Henley Sandstone Member.	Siltstone and shale, minor sandstone / claystone.

The superficial formations underlying the amendment area comprise of the Yoganup Formation with areas of overlying Bassendean Sand (to the east, central and southern areas), and the Guildford Formation (west and north-west). The non-continuous Guildford Formation interfingers with the Bassendean Sand and is close to the surface in areas along the north western and western boundary within the amendment area. The Leederville Formation intersect the superficial formations approximately 30 m below ground level (bgl).

Table 9 provides a summary of the geological map units within the amendment area and immediate surrounds including Lot 501.

Table 9: Summary of the geological map units within the amendment area and Lot 501

Map Unit	Description	Equivalent Unit on Geological Maps
S_8	• Sand – white to pale grey at surface, yellow at depth, fine to medium-grained, moderately sorted, subangular to subrounded, minor heavy minerals, of eolian origin.	Bassendean Sand (Qpb).
S_{10}	• Sand – S8 (sand) over sandy clay to clayey sandy of the Guildford Formation, of eolian origin.	Thin Bassendean Sand over Guildford Formation (Qpb/Qpa).
S_{12}	• Sand – structureless, yellow, fine-grained, subangular, and medium to coarse grained subrounded to rounded quartz, feldspar and heavy minerals common, minor silt and clay, of colluvial origin.	Yoganup Formation (Qpr).
Mgs_2	• Gravelly silt – strong brown, tough, common pebbles of fine to coarse-grained, sub-rounded granite, some dolerite and rare sandstone (SS), variable sand content.	Colluvium (Qc).
Ms_4	• Sandy silt – cream to pale brown, angular to rounded sand, low cohesion, of alluvial origin.	Alluvium (Qha).
Cs	• Sandy clay – white/grey to brown, fine to coarse-grained, subangular to rounded sand, clay of moderate plasticity gravel and silt layers near scarp.	Guildford Clay (Qpa).

3.3.5.2. Geotechnical Assessment

Two geotechnical investigations in October 2020 and November 2022 were undertaken within the amendment area. The geotechnical investigations included (Douglas Partners 2020 & 2022):

- Excavation of 27 test pits.
- Perth sand penetrometer (PSP) testing adjacent to each test pit location.
- Installation of 2 groundwater monitoring bores.
- Infiltration testing at seven locations.

Table 10 summarises the geotechnical assessment (Douglas Partners 2020 & 2022) and the alignment with the regional geological units and aquifer.

Table 10: Superficial Formation Geological Condition (Douglas Partners 2020 & 2022)

Formation	Stratigraphy	Thickness	Lithology	Aquifer
Superficial	Topsoil / Bassendean Sand	0.1 m to 0.15 m.	Dark grey-brown and grey-brown, sandy topsoil with silt and roots.	Superficial aquifer
	Bassendean Sand	0.5 m and test pit termination depths of 2.5 m.	**SAND SP:** loose to dense, fine to medium grained, light grey and light yellow brown.	
	Yoganup Formation	Below Bassendean Sand and from 0.8 m depth.	**SAND SP-SM:** medium dense to dense, light brown and yellow-brown sand, with low plasticity to non-plastic fines content of between approximately 5% to 12%, underlying topsoil or surficial fill at some test locations. Fines content typically increases with depth.	
		Between 0.1 m and 1.6 m extending to depths of between 0.6 m and termination depths of up to 2.5 m in some locations.	**SAND/Clayey SAND SP-SC/SC:** yellow-brown sand with clay/clayey sand (approximately 12% and greater content of low plasticity fines).	



		Between 0.6 m and 1.5 m extending to termination depths of up to 2.5 m in some locations.	**Clayey SAND SC:** yellow-brown low plasticity clayey sand was encountered.	

Figure D illustrates the regional geology and geological investigations within the amendment area and the GBSW area.

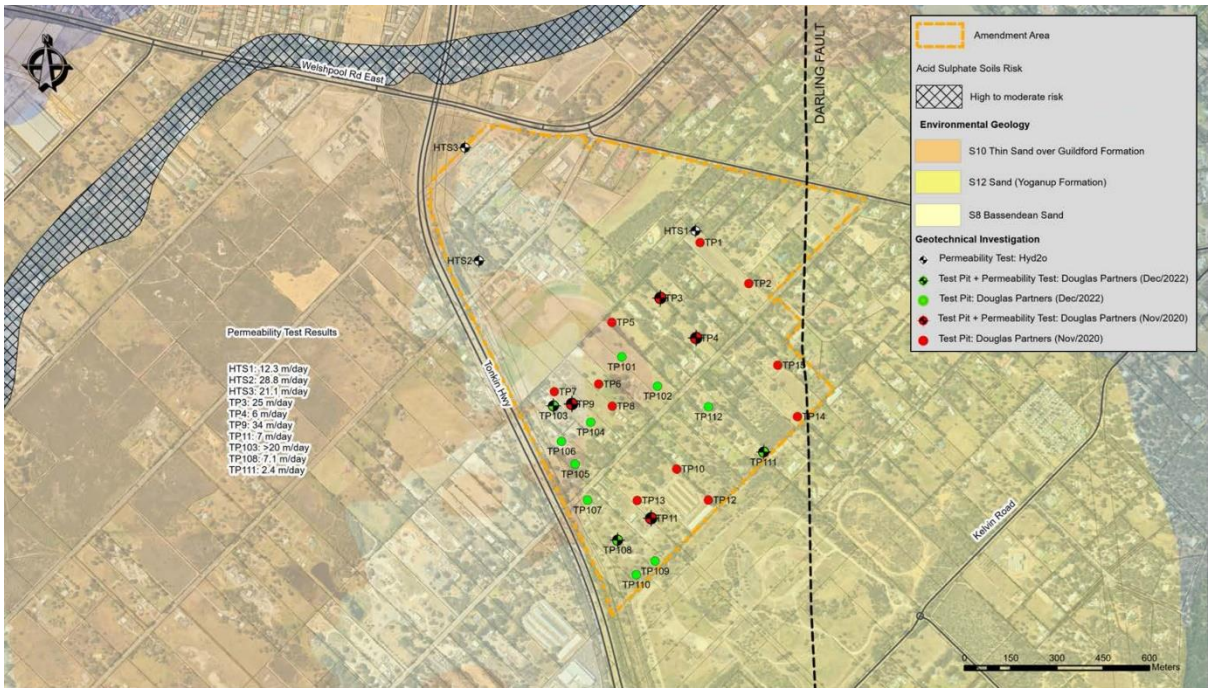


Figure D: Regional Geological Mapping

3.3.6. Hydrology

3.3.6.1. Surface Water

The amendment area is situated within the Yule Brook sub-catchment (Figure E) which forms the northern most section of the larger Swan Avon Canning River Catchment. The Yule Brook (and its major tributaries, Woodlupine Brook and Crystal Brook) has a total catchment area of 56 km^2, most of which is highly modified and includes urban uses such as light to medium industry and high-density residential developments, as well as agricultural uses such as horticulture and poultry farming (Hyd2o 2023).

The amendment area represents approximately 2% of the total Yule Brook catchment area and 15% of the GBSW area sub-catchment. However, the surface water contribution towards the GBSW amendment area is estimated to be 7.8% (much less than 15%) due to its sandy soils (enables infiltration of surface water) and deep groundwater table (Hyd2o 2023).

Crystal Brook once traversed through the amendment area into the GBSW area. However, in the early 1950's, the brook was diverted (via an excavated drain) north of the amendment area into the Yule Brook. The Crystal Brook tributary within the north western portion of the amendment area was historically cleared and filled to support the following developments:

- Rural and commercial land uses.
- Construction of Welshpool Road.
- Construction of Tonkin Highway.
- Construction of Boundary Road and associated open road side drains.

Remnants of the Crystal Brook creek line within the north-eastern portion of the GBSW area, adjacent to Tonkin Highway remains intact. Surface water from the north-western portion of the amendment area conveyed via the Boundary Road culvert, beneath the Tonkin Highway, follows for the first approximately 500 m the Crystal Brook tributary alignment.

The Crystal Brook tributary within the GBSW area is not contiguous and has been subject to land clearing and rural land uses.

In larger stormwater events, surface water is intercepted by the open road side drain adjacent to Boundary Road.

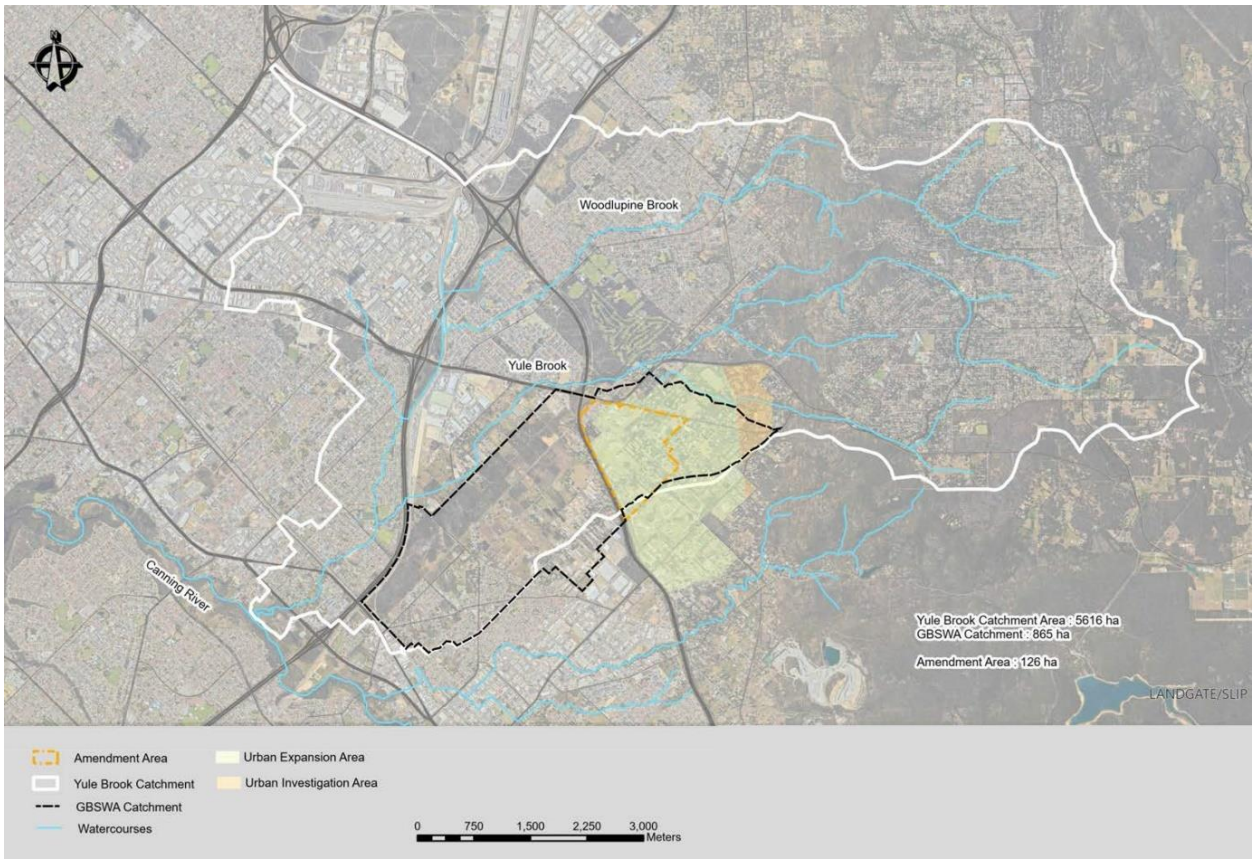


Figure E: Yule Brook Sub-Catchment (Hyd2o, 2024a)

3.3.6.2. Groundwater

The DWER regional mapping in the area extends over the amendment area is but is limited is local accuracy by the distance of the closest DWER bores to the site, which is over 5 km to the west, with no bores to the north, east and south. More detailed site-specific investigations were therefore undertaken to provide local mapping of groundwater levels and flow directions.

The detailed site specific investigations across the amendment area, and within the GBSW area, encompasses 23 bores and a further three regional DWER bores. The groundwater data determined the contours ranged from approximately 16 m AHD in the north eastern to approximately 19 mAHD on the western boundary at the amendment area.

Groundwater flow generally ranges from north west to south east across the amendment area (Hyd2o 2023). The regional groundwater depth was found to range from 5 m to 20 m below the natural ground surface (Hyd2o 2023).

3.3.7. Regional vegetation context

Heddle *et al.* (1980) regional vegetation complex mapping, used to assess pre-European vegetation, identified the amendment area and Lot 501 as straddling three vegetation complexes, specifically, the Forrestfield, Southern River, and Guildford Complex.

These complexes align with three major landforms, Foothills (Ridge Hill Shelf) in the east of the survey area, the Pinjarra Plain, and a combination of Bassendean Dunes and Pinjarra Plain. The three vegetation complexes are described in Table 11.

Table 11: Vegetation complexes of the survey area and percent remaining in the Perth-Peel region (Heddle et al. 1980)

Complex	Description	% Remaining
Forrestfield Complex	Vegetation ranges from open forest of *Corymbia calophylla – Eucalyptus wandoo* – E. *marginata* to open forest of *E. marginata – C. calophylla – A. fraseriana – Banksia* spp. With fringing woodland of *E. rudis* in the gullies that dissect this landform.	10.3%
Southern River	Open woodland of Marri-Jarrah-banksia on the elevated areas and a fringing woodland of *Eucalyptus rudis -Melaleuca rhaphiophylla* along the streams.	16.8%
Guildford Complex	A mixture of open forest to tall open forest of *C. calophylla – E. wandoo – E. marginata* and woodland of *E. wandoo* (with rare occurrences of *E. lane-poolei*). Minor components include *E. rudis – M. rhaphiophylla*.	5.87%

3.3.8. Vegetation units

The wetland vegetation assessment(s) is underpinned by:

1. Wattle Grove South Ecological Surveys. Detailed vegetation and flora surveys were completed in October 2019 (AECOM 2020).
2. Biological Survey and Targeted Black Cockatoo Habitat Assessment for the Tonkin Grade Separated Interchanges. Flora and vegetation field survey completed between August to December 2019 and March 2020 (Woodman Environmental 2021).

3.3.8.1. REW - UFI 8037

The wetland vegetation within REW UFI 8037 was historically cleared in the early 1980's to accommodate the construction of the Tonkin Highway, the Water Corporation water pipeline and the DBNGP. In the early 2000's the landowner extended the turf farm across the mapped REW area.

There is no native vegetation within the turf farm (Lot 303), the Water Corporation water pipeline and DBNGP easements (Lot 302) and the Tonkin Highway road reserve (Lot 301). The remnant vegetation is 0.08 ha area within Lots 107 and Lot 106. This remnant vegetation consists of scattered trees (primarily Red River Gums) in a cleared rural paddock.

The 2023 aerial photograph, shown in Figure F, illustrates the status of REW 8037 within the turf farm and the Tonkin Highway reserve.

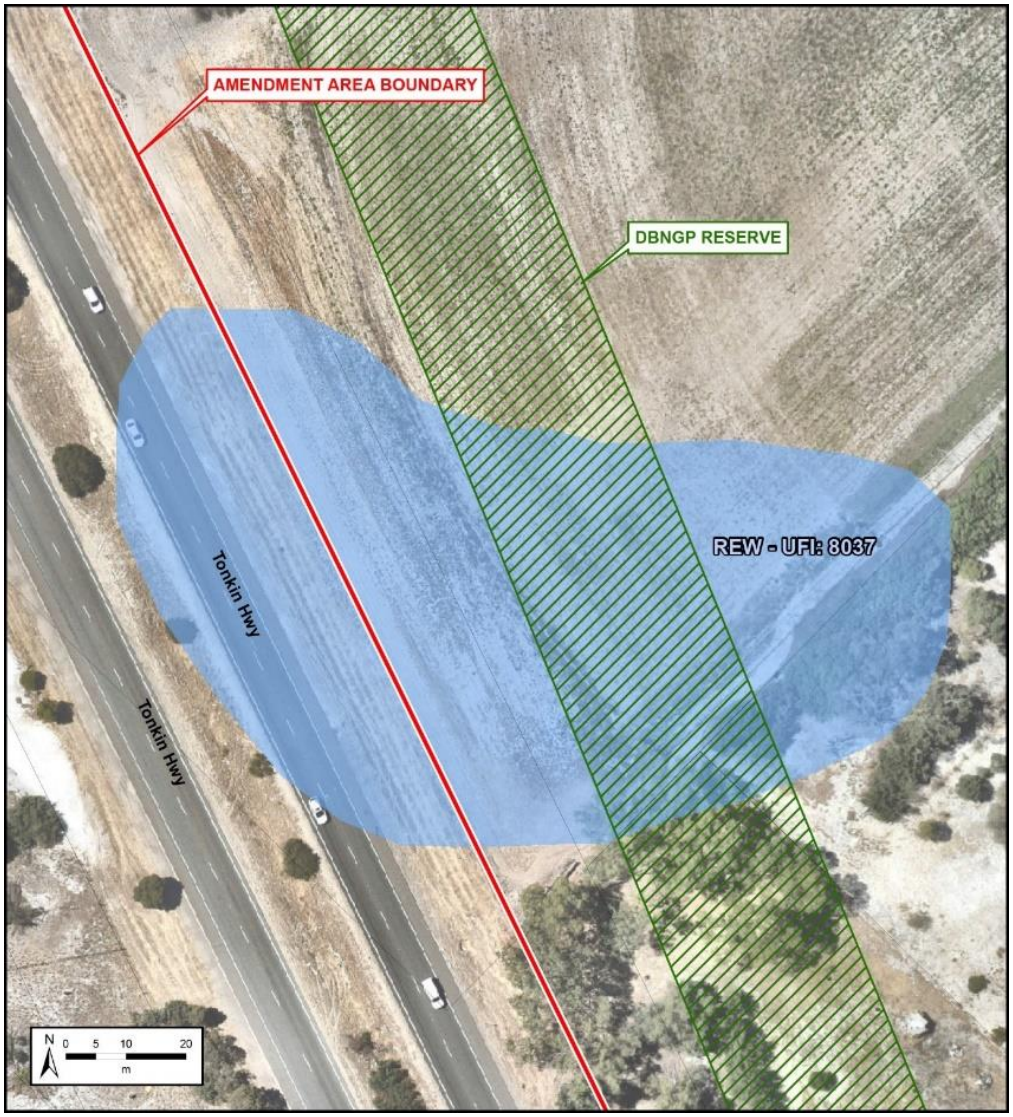


Figure F: REW 8037 and the DBNGP easement.

3.3.8.2. REW UFI 15257

In 1985 over 90% of the remnant native vegetation within REW UFI 15257 has been historically cleared. The historical clearing of the vegetation within REW UFI 15257 was a direct result of establishing rural livestock paddocks and dwellings, construction of Tonkin Highway and the Water Corporation pipeline and the DBNGP.

Currently within the mapped REW (UFI 15257) are the following land uses:

- Tonkin Highway reserve
- Boundary Road reserve
- Water Corporation and DBNGP pipeline easements
- Semi-rural paddocks
- Commercial landscape supply business

REW UFI 15257 with the existing land uses is shown in Figure G.

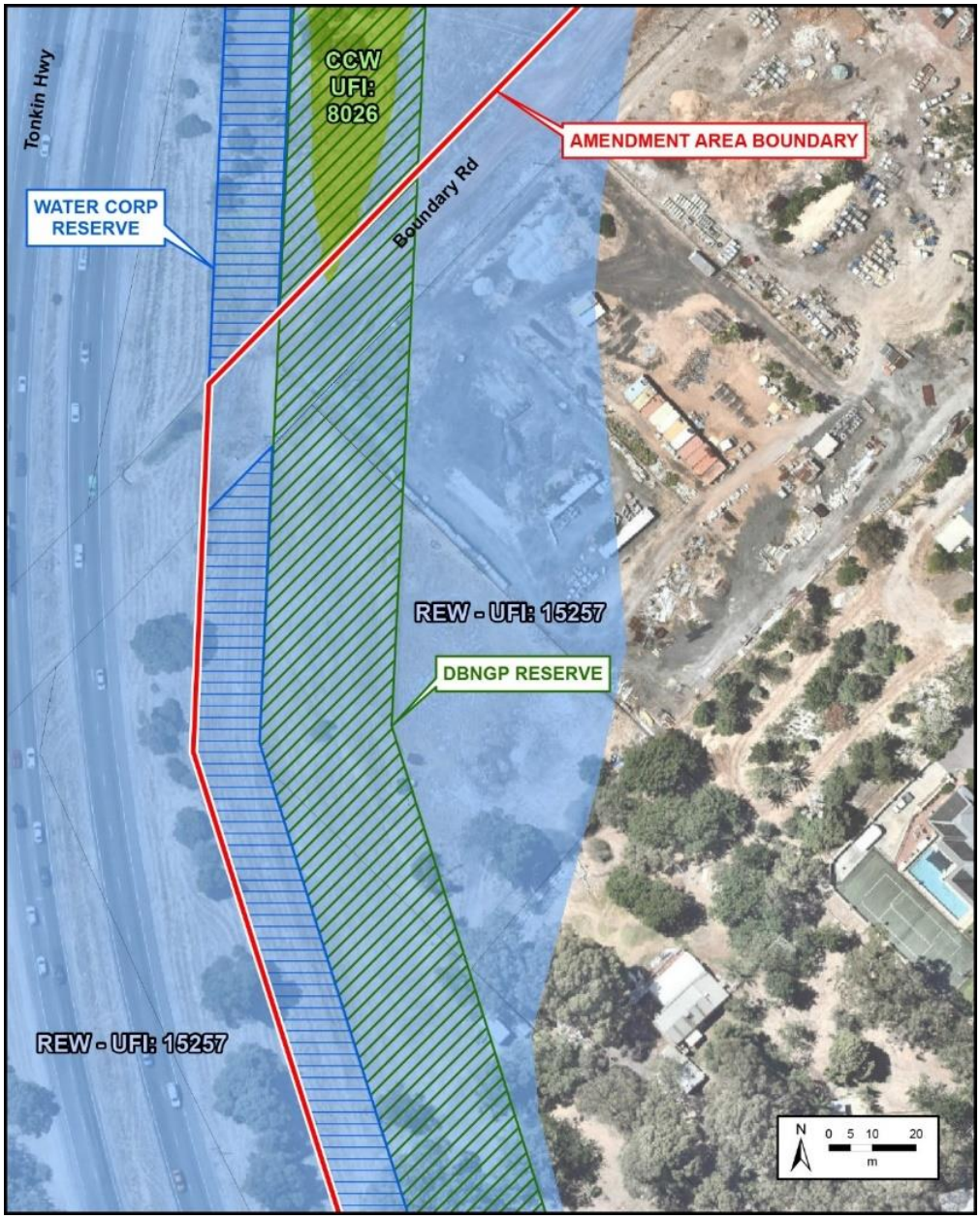


Figure G: REW 15257 and the DBNGP and Water Corporation easement

Between 1985 and 1995 the landowner(s) planted eucalyptus trees along fence lines adjacent to the cleared Water Corporation and the DBNGP pipeline easements. Additionally, MRWA planted trees within the Tonkin Highway road reserve.

The ecological/botanical surveys undertaken by AECOM and Woodman Environmental between 2019 to 2020 identified for the portion of REW UFI 15257 that is within the amendment area as:

- Within and adjacent to the Tonkin Highway reserve:
    - Planted stands of *Corymbia calophylla* (Marri) and non-native eucalypt *Eucalyptus camaldulensis* (Red River Gum) over non-native eucalypt *Casuarina cunninghamiana* subsp. *cunninghamiana*, *Melaleuca preissiana*, *Jacksonia sternbergiana* and **Schinus terebinthifolia* over introduced species on various soils and topographical positions (Woodman Environmental 2021).
- Within the DBNGP easement:
    - Cleared paddocks with *Eucalyptus camaldulensis* (Red River Gum).
    - 'Scattered trees' and open paddock areas with no native understorey (AECOM 2020).

Figure H outlines the vegetation unit mapping (Woodman Environmental 2021).



Figure H: Vegetation Types (Woodman Environmental 2021).

The site visit identified the planted Red River Gums as the dominant tree species along the DBNGP easement boundary (Plate 1).



Plate 1: Planted *Eucalyptus camaldulensis* (Red River Gum) trees within REW 15257

Plate 2 shows the open paddock and Water Corporation and DBNGP easements are.



Plate 2: REW 15257 within the amendment area and the cleared Water Corporation and DBNGP easements and the Tonkin Highway road reserve.

3.3.8.3. CCWs UFI 8026 & UFI 8027 and portion of REW UFI 15257 within Lot 501

The two CCWs are located are within Lot 501. Lot 501 is a 1.6 ha triangular landholding bounded by Tonkin Highway to the west, Welshpool Road to the north and Boundary Road to the south. The landholding also contains a portion of REW UFI 15257.

The two CCWs and the portion of REW UFI 15257 within Lot 501 have been historically disturbed from the construction of the adjacent roads and the installation of the Water Corporation pipeline and the DBNGP.

Within 50 m of the two CCWs UFI 8026 & UFI 8027 are the following key land uses:

1. Welshpool Road and Tonkin Highway.
2. Boundary Road
3. Landscape supply commercial business.
4. Rural lots.

The land uses within Lot 501 (inclusive of the two CCWs and the portion of REW UFI 15257) including the Tonkin Highway, Welshpool Road and Boundary Road reserves, Water Corporation pipeline/DBNGP easements has resulted in the historical clearing of significant portion of the native vegetation within Lot 501.

Immediately adjacent to the adjacent to Lot 501 (including the two CCWs and the portion of REW UFI 15257) within the amendment area are the following land uses, Boundary Road reserve, commercial landscaping business and cleared rural lots. There is no remnant native vegetation within 70 m of the two CCWs.

Figure I illustrated the existing the status of the two CCWs within Lot 501 and the adjacent Tonkin Highway (west), Welshpool Road (north), Boundary Road (south) and the commercial landscape business (south).

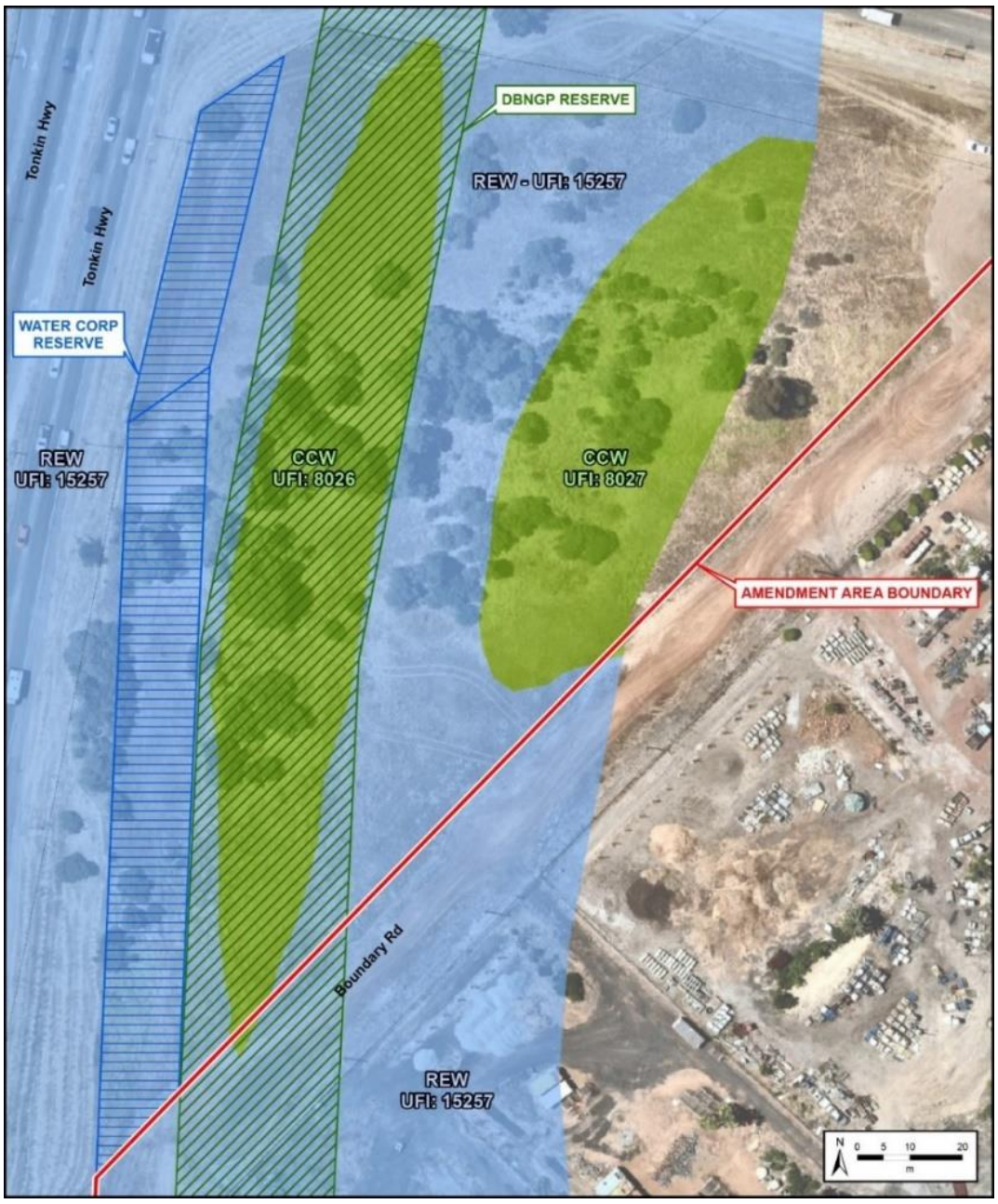


Figure I: CCWs UFI 8026 & UFI 8027 and portion of REW UFI 15257 within Lot 501.

Boundary Road is a City of Kalamunda local road asset. The MRS amendment does not alter the Boundary Road reservation and/or its current location or the City's management of the road reservation.

The Water Corporation and DBNGP easements and the two CCWs (UFI 8026 & UFI 8027) and portion of REW 15257 within Lot 501 are illustrated in Plate 3.



Plate 3: The cleared DBNGP easement bisects CCWs UFI 8026 & UFI 8027

Woodman Environmental (2021) vegetation survey identified the following vegetation units within primarily the mapped CCWs areas within Lot 501:

- Mid open woodland of *Corymbia calophylla* over low woodland of mixed species dominated by *Eucalyptus rudis*, *Melaleuca rhaphiophylla* and *Melaleuca preissiana* over tall sparse shrubland of mixed species dominated by *Acacia saligna* over mid sparse shrubland of *Acacia pulchella* over mid tussock grassland of mixed species dominated by **Avena barbata*, * *Eragrostis curvula* and **Ehrharta calycina* over **Watsonia meriana* on grey and brown sandy loam and clay loam on plains, flats, and drainage lines.
- Individual or stands of *Corymbia calophylla* over introduced species including **Avena barbata*, **Bromus diandrus* and **Ehrharta calycina* on various soils and topographical positions.

The mapped vegetation units within Lot 501 are illustrated in Figure 4.

Boundary Road reserve and the adjacent landscape supply business and the two CCWs within Lot 501 is shown in Plate 4.



Plate 4: Boundary Road reserve and the adjacent landscape supply business

3.3.9. Vegetation condition

3.3.9.1. REW UFI 8037 & UFI 15257

The AECOM survey of portions two REWs (UFI 8037 & UFI 15257) and the two CCWs (UFI 8026 & UFI 8027) identified as being significantly altered areas because of historical clearing and construction of key infrastructure corridors (Tonkin Highway reserve, Water Corporation pipeline and the DBNGP easement). Consequently, the vegetation condition was rated as 'Completely Degraded'.

Weeds are prevalent throughout the wetlands, due to the high level of historical land clearing and disturbance associated with historical and existing land uses.

3.3.9.2. CCWs UFI 8026 & UFI 8027 and portion of REW UFI 15257 within Lot 501

Woodman Environmental survey of Lot 501 inclusive of the two CCWs (UFI 8026 & UFI 8027) and REW UFI 15257 rated the vegetation as being in a 'Degraded' Condition with the REW UFI 15257 rated in 'Completely Degraded' condition.

3.3.10. Flora

Database research identified the potential for *Banksia mimica* (T) to be within 500 m of two REWs (UFI 8037 UFI and 15257) with a known population 3 recorded in 2000 on properties south east of Crystal Brook Road and Brentwood Road. All properties in this vicinity have been cleared and no native vegetation remains (AECOM 2020). B. mimica was not recorded during the AECOM (2020) and Woodman Environmental (2021) surveys field survey.

The AECOM (2020) and Woodman Environmental (2021) surveys assessed portions of the amendment area (including portions of REWs (UFI 8037 UFI and 15257) and CCWs (UFI 8026 & UFI 8027)) and the Tonkin Highway road reserve for the flora species including:

- Flora identified as a Threatened (T) or Priority (P) species (formally listed significant taxa – includes taxa listed under both State and Commonwealth legislation and classified as Priority by DBCA).
- Locally endemic or associated with a restricted habitat type (e.g., surface water or GDEs).
- New species or species with anomalous features that indicate a potential new species.
- Representative of the range of a species (particularly at the extremes of range, recently discovered range extensions, or isolated outliers of the main range).
- Unusual species, including restricted subspecies, varieties or naturally occurring hybrids.
- Relictual status, being representative of taxonomic groups that no longer occur widely in the broader landscape.

The AECOM (2020) and Woodman Environmental (2021) surveys did not identify any conservation significant flora was recorded within or adjacent to:

- The portions of UFI 8037 and UFI 15257 that intersect the amendment area.
- Lot 501 inclusive of the two CCWs (UFI 8026 & UFI 8027) and REW UFI 15257.

The closest significant flora recorded was approximately 1 km south and south-west of REW UFI 8037. The significant flora species include (Woodman Environmental 2021):

1. *Conospermum undulatum* (T)
2. *Johnsonia pubescens* subsp. *cygnorum* (P2)
3. *Verticordia lindleyi* subsp. *lindleyi* (P4)

3.3.11. Threatened and Priority Ecological Communities

Database searches undertaken by AECOM (2020) and Woodman Environmental (2021) identified 14 conservation significant ecological communities that occurred in proximity of the amendment area. The AECOM (2020) and Woodman Environmental (2021) confirmed no Threatened Ecological Communities (TEC), listed under the *Biodiversity Conservation Act 2016* (BC Act) and/or *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) occur within the REW areas (UFI 8037 and UFI 15257) and Lot 501 inclusive of the two CCWs (UFI 8026 & UFI 8027).

The wetland areas (REWs (UFI 8037 and UFI 15257) and the two CCWs (UFI 8026 & UFI 8027)) been subject to historical clearing and rural land uses, and therefore do not contain Threatened or Priority Ecological Communities.

The closest TECs located within the GBSW area (100 m to 1 km to the west) include:

- SCP3a - *Corymbia calophylla -Kingia australis* woodlands on heavy soils, Swan Coastal Plain (WA); *Corymbia calophylla - Kingia australis* woodlands on heavy soils of the Swan Coastal Plain (Commonwealth.
- SCP3b - *Corymbia calophylla - Eucalyptus marginata* woodlands on sandy clay soils of the southern Swan Coastal Plain
- SCP10a - Shrublands on dry clay flats (WA); Clay Pans of the Swan Coastal Plain (Commonwealth).

Within the amendment area the following TEC has been recorded approximately 500 m – 1 km east of REWs (UFI 8037 and UFI 15257):

- SCP20a - *Banksia attenuata* woodlands over species rich dense shrublands (WA); Banksia Woodlands of the Swan Coastal Plain (Commonwealth).

3.3.12. Fauna

Conservation significant fauna searches were conducted using a 10 km buffer in NatureMap and the EPBC Protected Matters Search Tool (PMST) to identify fauna species potentially occurring in the amendment area.

The database search indicated 38 fauna taxa of conservation significance have the potential to occur within the amendment area. A total of 14 species are listed as Threatened under both the BC Act and EPBC Act. However, the two REWs (UFI 8037 UFI & 15257) which intersect the amendment area are predominantly or entirely cleared of native vegetation for the following land uses, Tonkin Highway, rural livestock paddocks, commercial landscaping supply business, and a turf farm, and therefore there is no intact wetland habitat areas.

An assessment of the likelihood for each species to occur was undertaken, based on the habitat types with the amendment area using desktop information (i.e., Naturemap) and AECOM (2020) and Woodman Environmental (2021) detailed vegetation and flora surveys.

The results of the assessment determined the following conservation significant fauna species may potentially use the planted vegetation/remnant vegetation within REWs (UFI 8037 & UFI 15257) and the two CCWs (UFI 8026 & UFI 8027):

- *Calyptorhynchus banksii naso* (Forest red-tailed black cockatoo) which is listed as 'vulnerable' under the EPBC Act and the BC Act.

- *Zanda latirostris* (Carnaby's cockatoo) which is listed as 'endangered' under the EPBC Act and the BC Act.
- *Zanda baudinii* (Baudin's cockatoo) which is listed as 'endangered' under the EPBC Act and the BC Act.
- *Isoodon obesulus fusciventer* (Quenda) – Priority 4 (BC Act).

3.3.12.1. REW UFI 8037 & UFI 15257

The REWs (UFI 8037 & UFI 15257) comprise planted mature trees, predominantly *Eucalyptus camaldulensis* (Red River Gum), cleared livestock pastures or turf farm therefore providing limited fauna habitat. Sightings of Quenda were recorded in several lots across the amendment area, however due to the lack of any understorey/riparian vegetation, it is unlikely the infilled REWs areas (UFI 8037 and UFI 15257) provide suitable habitat for ground dwelling fauna, such as Quenda.

The mature stands of *Eucalyptus camaldulensis* (Red River Gum) have the potential to provide secondary low value foraging and roosting habitat for the threatened Forest red-tailed black cockatoo species.

3.3.12.2. CCWs UFI 8026 & UFI 8027 and portion of REW UFI 15257 within Lot 501

The Water Corporation pipeline and DBNGP corridors which dissect the two CCWs (UFI 8026 & UFI 8027) and REW UFI 15257 are maintained as cleared easements. The existing weeds and grass understorey is regularly slashed which limits any native vegetation re-growth.

The *Corymbia calophylla* trees within the two CCWs (UFI 8026 & UFI 8027) and the portion of REW (UFI 15257) within Lot 501 has the potential to provide foraging and roosting habitat to Carnaby's cockatoo and Forest red-tailed black cockatoos. The limited native vegetation areas within small wetland areas (bisected by infrastructure corridors) could provide habitat areas for frogs and reptiles.

3.3.13. Social

3.3.13.1. REW UFI 8037 & UFI 15257

The REWs UFI 8037 and UFI 15257 have been subject to significant alteration due to historical clearing to facilitate livestock paddocks, rural residential and turf farm purposes, and the construction of infrastructure, including Tonkin Highway reserve, Water Corporation pipeline and the DBNGP easements. The Water Corporation and DBNGP easements are maintained as cleared grassed areas which is regularly slashed.

The portion of REWs UFI 8037 and UFI 15257 within the amendment area are located within private landholdings, infrastructure easement and therefore are not available to the public for recreational purposes and provides no public visual amenity.

The portion of the REWs UFI 8037 and UFI 15257 (inclusive of the planted mature trees (predominantly *Eucalyptus camaldulensis*) will be incorporated into POS areas and stormwater bioretention basins adjacent to the Water Corporation and DBNGP pipeline easement. The DWMS (Hyd2O 2024) identifies the future Local Structure Plan and subdivision plans will formally integrate the Water Corporation and DBNGP easement into open space, ensuring the pipeline is protected whilst also providing a valuable community asset that provides local amenity.

3.3.13.2. CCWs UFI 8026 & UFI 8027 and portion of REW UFI 15257 within Lot 501

The two CCWs (UFI 8026 & UFI 8027) like the REWs (UFI 8037 & UFI 15257), have been subject to historical anthropogenic impacts including the construction of Tonkin Highway, Welshpool Road, and Boundary Road. The wetlands were further disturbed from the installation of the Water Corporation pipeline and the DBNGP. The Water Corporation and the DBNGP easements are maintained as cleared grassed areas which is regularly slashed.

Lot 501 inclusive of the wetland areas are subject to regular maintenance (slashing).

Boundary Road provides an approximate 20 m permanent infrastructure barrier between the two CCWs within Lot 501 and the commercial landscape supply yard and the semi-rural paddocks within the MRS amendment area.

The two CCWs (UFI 8026 & UFI 8027) are outside of the amendment area located adjacent to the approximate 20 m Boundary Road reserve and is therefore not subject to any land use change.

3.3.14. Cultural

A search of the Department of Planning, Lands and Heritage (DPLH) – Aboriginal Heritage Places mapping tool (DPLH 2024) concluded that the amendment area intersects one registered heritage site: Brentwood Road Swamp (Site ID 4343). Wetland UFI 8037 also intersects this heritage site.

Figure J illustrates the location of the Brentwood Road Swamp (Site ID 4343).

The Brentwood Road Swamp was recorded in 1973 and is listed on the Register of Aboriginal Sites as an artefact scatter with an unreliable location. However, this mapped registered site (and its immediate surroundings) have been subject to historical disturbance including the construction of Tonkin Highway, Water Corporation water pipeline, the DBNGP and a commercial turf farm.

The Brentwood Road Swamp (Site ID 4343) is a heavily disturbed and altered environment. A cultural heritage survey completed with the Traditional Owner elders in 2021 identified no cultural material within the amendment area (Horizon Heritage 2021).

A search of the State Heritage Office InHerit search tool did not identify any European cultural heritage places within or adjacent to the Amendment Area (SHO 2021).

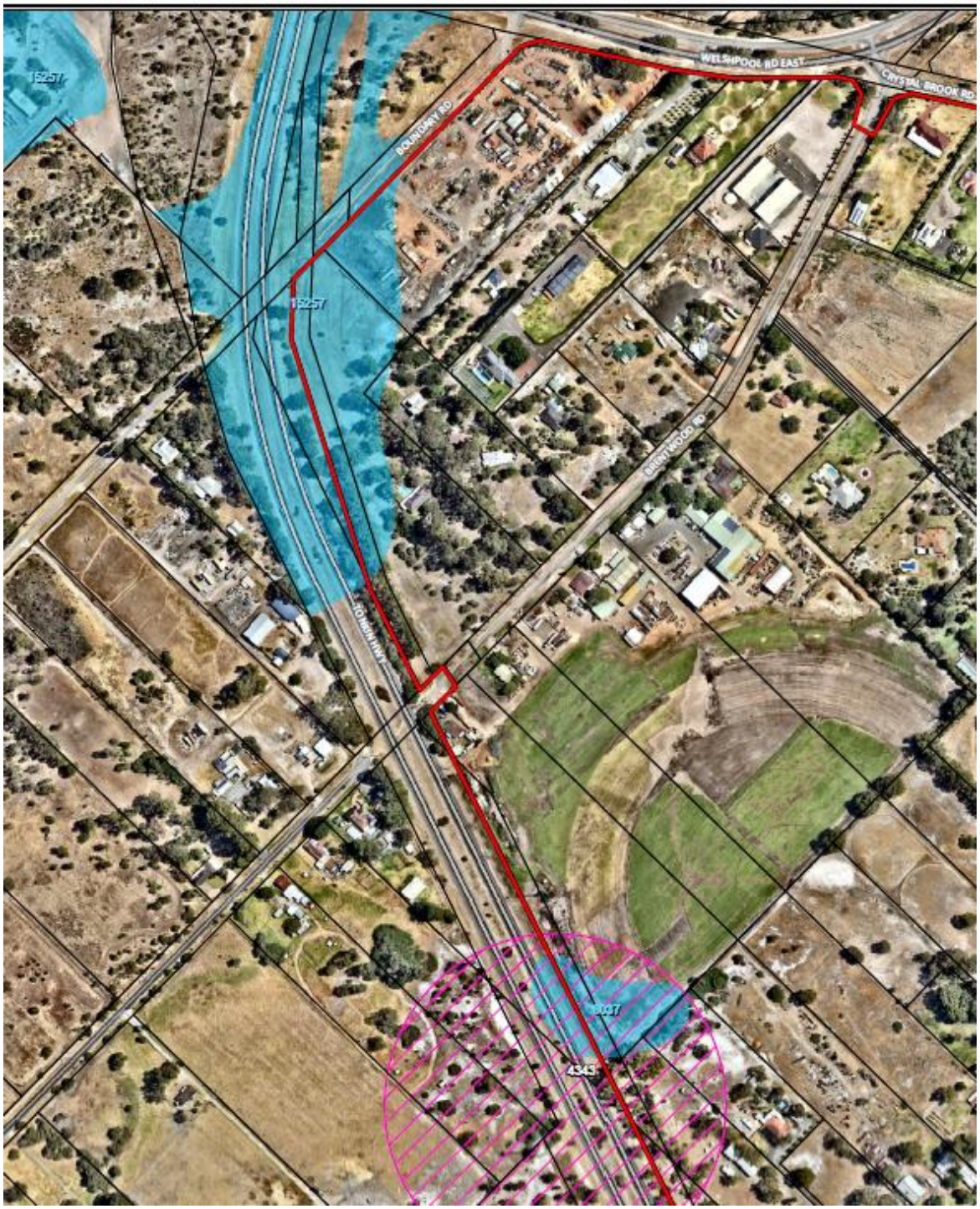


Figure J: Aboriginal Heritage Sites and Wetlands within the Amendment Area

3.4. Summary

Significant wetlands within and adjacent to the amendment area are defined as follows:

- The REWs within the amendment area (UFI 8037 & UFI 15257)
- The two CCWs (UFI 8026 & UFI 8027) and portion of REW (UFI 15257) within Lot 501.

The location and extent of the mapped wetlands within and adjacent to the MRS amendment area is shown in Figure B.

The values of each wetland feature documented as part of the wetland assessment are summarised in Table 12.

Table 12: Summary of significant wetland features and their attributes

Wetland Attribute	Wetlands within the amendment area		Wetlands within Lot 501		
Wetland	**REW UFI 8037**	**REW UFI 15257**	**CCW UFI 8026**	**CCW UFI 8027**	**REW UFI 15257**
Area	0.86 ha.	30.33 ha (approximately 2.06 ha is within the amendment area).	0.38 ha.	0.32 ha.	30.33 (0.52 ha is within Lot 501).
Geomorphology	Bassendean Sand over sandy clay to clayey sand of the Guildford Formation.		Bassendean Sand over sandy clay to clayey sand of the Guildford Formation.		
Hydrology	Sumpland	Palusplain	Palusplain	Palusplain	Palusplain
Vegetation unit	• Over 90% of the mapped REW has no native vegetation. Native vegetation was historically cleared, and the wetland infilled to establish the rural land uses and then subsequently, for the establishment of a turf farm, construction of Tonkin Highway and Water Corporation and DBNGP easements. • The vegetation present is scattered trees approximately 0.08 ha at the periphery of the REW in Lots 106 and 107.	• Within the Tonkin Highway reserve and Water Corporation easement: ○ Stands of *Corymbia calophylla* (Marri) and non-native eucalypt *Eucalyptus camaldulensis* (Red River Gum) over non-native eucalypt *Casuarina cunninghamiana* subsp. *cunninghamiana, Melaleuca preissiana, Jacksonia sternbergiana* and **Schinus terebinthifolia* over introduced species. • Within the DBNGP easement: ○ Cleared paddocks with *Eucalyptus camaldulensis* (Red River Gum).	• 80% of Lot 501 has been historically cleared of native vegetation. The remnant vegetation community consists of non-continuous patches of: ○ Mid open woodland of *Corymbia calophylla* over low woodland of mixed species dominated by *Eucalyptus rudis, Melaleuca rhaphiophylla* and *Melaleuca preissiana* over tall sparse shrubland of mixed species dominated by *Acacia saligna* over mid sparse shrubland of *Acacia pulchella* over mid tussock grassland of mixed species dominated by **Avena barbata*, * *Eragrostis curvula* and **Ehrharta calycina* over **Watsonia meriana* on grey and brown sandy loam and clay loam on plains, flats, and drainage lines. ○ Individual or stands of *Corymbia calophylla* over introduced species including **Avena barbata*, **Bromus diandrus* and **Ehrharta calycina* on various soils and topographical positions (mostly with REW UFI 15257).		

Vegetation condition	Vegetation is predominately cleared and is surveyed in a 'Completely Degraded' condition.	Vegetation is predominately cleared and is surveyed in a 'Completely Degraded' condition.	Vegetation is surveyed in a 'Degraded to Completely Degraded' condition.
TEC	No State & Commonwealth listed TECs were surveyed / observed.	No State & Commonwealth listed TECs were surveyed / observed.	No State & Commonwealth listed TECs were surveyed / observed.
Conservation Significant flora	No conservation significant flora present.		No conservation significant flora present.
Conservation Significant fauna	• Lack of dense understorey for Quenda. • Limited foraging/roosting/breeding trees for the threatened black cockatoo species within the planted stands of *Eucalyptus camaldulensis* (Red River Gum).		• The limited native vegetation, in particular the *Corymbia calophylla* (Mari) trees within the two CCWs (UFI 8026 and UFI 8027) has the potential to provide foraging and roosting habitat to the threatened Carnaby's cockatoo and Forest red-tailed black cockatoo species. • Former Crystal Brook tributary and two CCW wetland areas provides habitat for frogs and reptiles.
Heritage sites	The wetland is located within one heritage site: Brentwood Road Swamp (Site ID 4343). This heritage site has historically been high disturbed from the construction of Tonkin Highway, Water Corporation and DBNGP pipelines and the turf farm.	The wetland is not within an identified as an Aboriginal Heritage Place.	The CCWs and portion of REW UFI are not within an identified as an Aboriginal Heritage Place.

3.5. Ecological Wetland Values – GBSW Area

The GBSW comprises a complex of significant wetlands, including areas of seasonally waterlogged flats (palusplain) and seasonally inundated basins (sumplands). Table 13 outlines the DBCA mapped geomorphic wetland features within the GBSW area.

Table 13: Summary of significant wetland features and their attributes

Wetland category	UFI No.	Total Area
CCW	7637, 7646, 7653, 7747, 7748, 7775, 7797, 8025, 8028, 8031, 8032, 8035, 13129, 13131, 13365, 14962, 15255, 15815, 15816.	Approximately 150.1 ha
REW	8036, 15257, 15814, 15983	Approximately 10 ha
MUW	7740, 7744, 7746, 8030, 14964, 15254, 15724	Approximately 6.5 ha

The nearest DBCA mapped geomorphic wetland features within the GBSW area to the amendment area outlined in Table 14.

Table 14: Summary of the DBCA mapped wetland features within 75 m to 150 m of the amendment area.

UFI No.	Geomorphic classification	Management category	Land tenure details	Total area (ha)
GBSW area (within 75 m to 150 m of the MRS amendment area)				
8025	CCW	Palusplain	Lot 51 Zoned 'Parks and Recreation'	2.78
8028	CCW	Sumpland	Lot 340 Zoned 'Parks and Recreation'	1.48
8030	Multiple Use	Palusplain	Lot 342 Zoned 'Parks and Recreation'	1.29
14962	CCW	Palusplain	Lot 342 Zoned 'Parks and Recreation'	62.68
15257	REW	Palusplain	Lot 51 Zoned 'Parks and Recreation'	30.33

3.5.1. Land use context

The GBSW area and associated buffer supports a variety of existing conservation, rural, drainage and road corridor land uses, including:

- Bush Forever Ste 387.
- Rural-residential lots and dwellings.
- Equine and small-scale livestock properties.
- Light commercial and machinery lay down areas.
- Waste and recycled material storage and stockpiling.
- The construction of road side drainage swales along Brook Road, Boundary Road, and Brentwood Road.

Under the MRS, the GBSW (inclusive of the DBCA mapped wetlands) are reserved for 'Parks and Recreation' or 'Public Purposes'. Designated Bush Forever Site 387 covers an area of 176 ha across the GBSW area. Brook Road and Boundary Road frame, to the north and south, the majority of the GBSW area.

Figure 1 illustrates the GBSW area and Bush Forever Site 387 boundary.

Historical development of the surrounding landholdings to the GBSW resulted in the construction of open road side drainage lines, which still exist. Both Brook Road and Boundary Road contain constructed roadside swales, which capture and direct surface water runoff as well as intersected groundwater flows.

Table 15 outlines the historical aerial assessment of the numerous wetlands within the GBSW area.

Table 15: Historical aerial assessment of the GBSW area

Year	Aerial	Comment
1953		• Localised pre-earthworks/infilling associated with the construction of rural land uses. • Crystal Brook linked the two CCWs (UFI 8026 UFI 8027) remains partially intact within the eastern wetlands in the GBSW area. • The Crystal Brook tributary was a key conveyance pathway for seasonal surface water flows.
1974		• The Crystal Brook tributary was disrupted by the construction of Boundary Road and the excavation of open road side drains.

1981		• The construction of Tonkin Highway and the formalisation of open drains and culverts adjacent to the highway. • Commercial and rural lifestyle development within and adjacent to the GBSW area. • Clearing of vegetation south of Boundary Road and along Brook Road.
1995		• Consolidation of commercial land uses along Brook Road north of the GBSW area. This has resulted in localised infilling and clearing of wetland vegetation. • Expansion of rural land uses along Boundary Road and the north-west portion of Brook Road resulting in significant clearing of native vegetation within the eastern portion of the GBSW area. • Upgrade of Brook Road and Boundary Road.

2020		• Surface water flows is primarily via the open drains along Boundary Road and Brook Road. • A portion of the surface water flow conveyed via the Boundary Road culvert, follows the original Crystal Brook tributary alignment for the first approximately 500 m. • The Crystal Brook tributary with the GBSW area is no longer contiguous and has been subject to historical land clearing. • Evidence of re-growth of native vegetation within the GBSW post-acquisition and inclusion of the landholdings into Bush Forever Site 387.

3.5.2. Tenure and land management

The management of the GBSW area is not uniform. It incorporates a non-continuous A-Class Reserve area, Bush Forever Sites No. 387 and No. 422, State Government agencies (i.e., DBCA and the Western Australian Planning Commission (WAPC)), University of Western Australia (UWA) and private landholdings.

A summary of the GBSW management areas, summary of the environmental land assets and the land manager are outlined in Table 16.

Table 16: GBSW management reserves & tenure

Reserve / Management Areas	Summary of environmental values	Land Manager	Distance to Amendment Area
Within Bush Forever Site No. 387			

A Class Reserve / GBSW	• Non-contiguous reserve consisting of Brixton Block, Wanaping Block and separate landholdings, Alison Baird Reserve, private and government owned landholdings.
	• TECs identified include:
	  ○ FCT 3a - Corymbia calophylla - Kingia australis woodlands on heavy soils of the Swan Coastal Plain.
	  ○ FCT 7, FCT 8, FCT 9, FCT 10a - Clay pans of the Swan Coastal Plain.
	  ○ FCT 21c - Low lying Banksia attenuata woodlands or shrublands.
	  ○ FCT 23a - Banksia Woodlands of the Swan Coastal Plain IBRA Region.
	• Guildford Vegetation Complex is the dominant vegetation complex (Heddle et al. 1990). Only 5.1% of Guildford complex remains on the Swan Coastal Plain.
		DBCA	100 m – 200 m

	• DBCA's Threatened and Priority Fauna and Atlas of Living Australia databases identified 319 vertebrate species have the potential to occur in the GBSW area (EPA 2022).		
State Government owned	• Multiple mapped CCWs & REWs. • Historical clearing & intact vegetation areas.	WAPC	400 m – 1,000 m
Private landholdings	• Private landholdings (not including UWA landholding). • Industrial land use & rural lifestyle.	Various private landowners	200 m

Alison Baird Reserve - 35 ha area.	• CCW areas – including clay pans which are listed as Wetlands of National Significance.
	• Over 650 native taxa from 80 families and characterised 13 vegetation communities (Tauss et al. 2019).
	• Alison Baird Reserve is recognised as the most floristically biodiverse area with an extensive number of endemic species including Spider net grevillea, Swamp starflower and the *Pyramid mulla mulla* (Tauss et al. 2019; Tauss and Weston 2010).
	• EPBC Act listed:
	  ○ FCT 3a - Corymbia calophylla - Kingia australis woodlands on heavy soils of the Swan Coastal Plain.
	  ○ FCT 7, FCT 8, FCT 9, FCT 10a - Clay pans of the Swan Coastal Plain.
	  ○ FCT 21c - Low lying Banksia attenuata woodlands or shrublands.
	  ○ FCT 23a - Banksia Woodlands of the Swan Coastal Plain IBRA Region.
	• Sumpland CCW areas with areas of Melaleuca woodlands over shrubland heath.
	• Endangered Ecological Community *Corymbia calophylla — Kingia australis* woodlands on heavy soils of the Swan Coastal Plain).
	• Threatened or priority fauna habitat including:
	  ○ Carnaby's black cockatoo
	  ○ Forest red-tailed black cockatoo
	  ○ Chuditch
	  ○ Southern brown bandicoot
		UWA	1,500 m

Wanaping Block - 38 ha area.		DBCA	2,200 m
Brixton Block - 21 ha area.		DBCA / Friends of Brixton Street Wetland	2,900 m
GBSW Areas outside of Bush Forever Site No. 387			
Private landholdings / High School	• Mix of wetland types (CCWs, REWs, MUW) and areas with intact native vegetation and cleared areas. • Semi-rural properties within the western portion of the GBSW area. • Industrial development within the western portion of the GBSW area adjacent to Roe Highway. • High school area	• Rehoboth Christian College • Various private landowners	600 m - 2,900 m

3.5.3. Regional Geology

The unique wetlands and associated ecology of the GBSW area are underpinned by a distinct hydrogeology (alluvial Pinjarra Plain characterised by soils of the Guildford Formation) which established a relatively flat landscape, which supports surface water flows and channels that can lead to waterlogging and the formation of seasonal wetlands.

Table 17 outlines the regional geology within the GBSW area.

Table 17: Regional geological succession within the GBSW Area

Stratigraphy	Lithology
GBSW area	
Superficial Formations	
Bassendean Sand	Sand, minor silt and clay.
Guildford Formation	Alluvial sand and clay with shallow-marine and estuarine lenses.
Osborne Formation: • Kardinya Shale Member • Henley Sandstone Member	Siltstone and shale, minor sandstone / claystone.

The Guildford Formation clay layers form a complex sequence of clay lenses that is laterally and vertically varied. The clay layers demonstrate high resistivity which restrict the flow of water.

The regional geological map units within the GBSW area are Guildford Formation with Bassendean Dunes and Bassendean. Dunes/Pinjarra Plain (Churchward and McArthur 1980).

The Geological Survey of Western Australia, (Environmental Geology Series Armadale Part Sheets 2033 I & 2133 IV (Jordan 1986)), indicates the GBSW area is underlain by white clay of the Guildford Formation and is comprises:

- **Sand (S8):** white to pale grey at surface, yellow at depth, fine to medium-grained, moderately sorted, subangular to subrounded, minor heavy minerals, of eolian origin.
- **Clayey sand (SC):** silty in part, pale grey-brown, medium to coarse, poorly sorted, sub-angular to rounded, frequent heavy minerals, rare feldspar, of alluvial origin.
- **Sand (S10):** white to pale grey at surface, yellow at depth, fine to medium-grained, moderately well sorted, subangular to subrounded quartz, of eolian origin, over other units.
- **Sand (S12):** structureless, yellow, fine-grained, subangular, and medium to coarse-grained subrounded to rounded quartz, feldspar and heavy minerals common, minor silt and clay, of colluvial origin.
- **Sandy silt (Ms4):** cream to pale brown alluvium, clayey in part, fine to medium-grained sand, of alluvial origin.
- **Sandy clay (Cs):** white, grey to brown, fine to coarse-grained, subangular to rounded sand, clay of moderate plasticity gravel and silt layers near scarp.

Geotechnical investigations undertaken for the Maddington Kenwick Strategic Employment Area (MKSEA) Precincts 2 and 3B indicate soil characteristics generally comprised of topsoil or fill to depths ranging from 0.1 m to 1.2 m, overlying sand, clayey, silty, or gravelly materials. The clayey and sandy materials encountered include stiff to hard clay or clayey sand/sandy clay (Emerge 2023b).

3.5.4. Surface Water

The GBSW area located within the western portion of the Yule Brook catchment (Figure E). Two main surface watercourses dissect the catchment Woodlupine Brook and Yule Brook. The Yule Brook catchment has been highly altered by a range of urban uses such as light to medium industry, residential developments, and agricultural production (DWER 2019). Both the Woodlupine Brook and Yule Brook watercourses ultimately and discharge to the Canning River south-west of the GBSW area.

GBSW area is situated on the Pinjarra Plain landform, which is characterised by impermeable soil layers often resulting in expressions of perched groundwater. This landform significantly affects the flow of water, specifically (Emerge Associates 2023b):

- The majority of surface water runoff flows into surface water channels, including natural waterways (i.e., Yule Brook) and extensive network of constructed, open, and unlined drains, occurring along roads.
- Surface water is maintained as perched groundwater due to the impermeable clay layers rather than infiltrating downwards into underlying regional aquifers. The perched groundwater can move laterally through the catchment, until it intersects a drain or more permeable soil layers enabling deeper groundwater recharge.
- The primary water outputs would comprise evapotranspiration and surface water export via Yule Brook, into the Canning River.

The construction of roads, open road side drains and stormwater pipes within the GBSW area resulted in an efficient conveyance of stormwater towards the Yule Brook and the Canning River. This outcome changed the historical hydrological flows patterns within areas of the GBSW with less surface water available to traverse the wetland (and associated flora and water dependent vegetation communities) areas (Tauss et al. 2019).

3.5.5. Groundwater

The GBSW area comprise a complex series of regionally and nationally significant wetlands, including areas of seasonally waterlogged flats (palusplain) and seasonally inundated basins (sumplands). The GBSW comprises native vegetation, which is highly biodiverse, supporting at least 611 native plant taxa, threatened and priority flora, threatened ecological communities, and habitat for threatened and priority fauna.

Consequently, vegetation within these wetlands is expected to be sustained by direct rainfall and localised perched groundwater, and not from incoming surface water flows or a deeper permanent aquifer. A shallow perched aquifer occurs between the Guildford Formation and the overlying sand and sandy clay associated with the Bassendean Sand unit (Bourke 2017). Wetlands within the GBSW rely almost solely on rainfall to fill due to the underlying clay-dominated soils of the Guildford formation, which are waterlogged through winter and form deep pools in clay depressions (DBCA 2018).

In the context of this assessment, wetland value is considered to include the potential for the wetland to support any of the following attributes:

- Flora or fauna species listed as threatened under the EPBC Act or BC Act.
- Species listed by DBCA as Priority 1, 2, 3, or 4.
- TECs or Priority Ecological Communities (PECs) as listed under the EPBC Act.
- GDEs.

3.5.6. Regional Vegetation

The regional vegetation complex mapping (Heddle et al. 1980) illustrates the GBSW area occurs within the Guildford complex. This vegetation complex has been subject to significant historical land clearing since European settlement, resulting in approximately 5.1% of its original extent currently remaining.

3.5.6.1. Key studies and investigations

A range of parties have undertaken vegetation and flora surveys and reporting across the GBSW area. The key studies which underpin the assessment of the GBSW flora and vegetation include:

- Vegetation, Flora, and Conservation Values of Lot 106 Wanaping Road, Kenwick in the Greater Brixton St Wetlands (Keighery and Tauss 2008).
- Flora, Vegetation and Wetlands of MKSEA (Tauss and Weston 2010).
- Environmental Review City of Gosnells Town Planning Scheme No. 6 Amendments 166 and 169 (Emerge Associates, 2023c).
- The Greater Brixton Street Wetlands Management Guidelines, Natural History and Research (Marshall, 2000).

The Floristic Community Types (FCTs) and associated threatened and priority ecological communities which occur within the GBSW area and are considered groundwater dependent are defined in Table 18 (Emerge Associates 2023c).

Table 18: Threatened and Priority FCTs recorded within GBSW (Emerge Associates 2023c)

FCT	Dominant water balance process	Ecological water requirements
FCT 3a - *Corymbia calophylla - Kingia australis* woodlands on heavy soils of the Swan Coastal Plain.	• The community requires a relatively shallow (approximately 0.5 to 3 m) depth to groundwater, and occurrences can become inundated in the wetter months due to rainfall and surface flows (DoEE 2017).	• The *Corymbia calophylla – Kingia australis* woodlands on heavy soils of the Swan Coastal Plain TEC occurs on flat landforms which are saturated due to an underlying impervious soil layer (such as a claypan or hardpan) which acts as a barrier to drainage of water through the soil, causing waterlogging.
FCT 7, FCT 8, FCT 9, FCT 10a - Clay pans of the Swan Coastal Plain.	• The TEC is reliant on the local catchment sustaining poorly drained flats, i.e., fresh surface water pooling over a confining layer (Emerge Associates 2023c).	• The Clay pans of the Swan Coastal Plain TEC occurs when a clay substrate forms an impermeable layer close to the surface and impedes water movement vertically enabling water to collect on the surface. The TEC relies on rainfall and/or local surface flow to fill the clay pan landform and are less likely to be influenced by groundwater (DSEWPaC 2012).
FCT 21c - Low lying *Banksia attenuata* woodlands or shrublands. FCT 21c. FCT 23a - Banksia Woodlands of the Swan Coastal Plain IBRA Region.	• This community is largely restricted to the uplands on the Bassendean system, consisting of low dunes and interwoven wetlands. • Muchea limestone and other palusplain vegetation types that access water at depth, albeit potential shallow depth) (Emerge Associates 2023c).	• The community occurs within wetland and/or heavy soils associated with the eastern side of the Swan Coastal Plain (DoEE 2017). • The Shrublands and woodlands on Muchea limestone TEC occurs on palusplain soils locally mapped as Muchea Limestone comprising limestone, clay, and sand. The community can occur as a wetland or terrestrial environment that accesses groundwater at depth with sustained saturation which allows plants to access stored water. • These vegetation units are reliant on water predominantly from the rainfall and surface water flows which saturates the perched aquifer.

3.5.6.2. Groundwater Dependent Ecosystems

The GBSW area is located within the Mungala consanguineous wetland suite as identified by Hill et al. (1996). The Mungala consanguineous suite is characterised by its location in the transition between Bassendean Dunes and Pinjarra Plain and contains approximately 25,979 ha of wetlands, of which approximately 12.6% comprises CCWs (Emerge Associates 2023c).

All the vegetation units / ecosystems across the GBSW area (including upland Banksia and *Corymbia* (marri) woodlands) are considered groundwater-dependent by Tauss et al. (2019).

The GBSW vegetation and flora communities depend significantly on the seasonal rainfall and associated surface water flows which seasonally fills and waterlogs the impermeable clay layers forming a perched groundwater layer.

3.5.6.3. Flora within the GBSW

Flora and vegetation studies of the GBSW area have recorded 611 native plant taxa. The conservation significant flora species recorded by Tauss et al. (2019) within the GBSW area are outlined in Table 19.

Table 19: Conservation significant flora species within GBSW (Tauss et al. 2019)

Species	Level of Significance	
	State	Commonwealth EPBC Act
Grevillea thelemanniana	Threatened	Critically Endangered
Ptilotus pyramidatus	Threatened	Critically Endangered
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	Threatened	Critically Endangered
Andersonia gracilis	Threatened	Endangered
Austrostipa bronwenae	Threatened	Endangered
Calytrix breviseta subsp. Breviseta	Threatened	Endangered
Diuris purdiei	Threatened	Endangered
Eremophila glabra subsp. Chlorella	Threatened	Endangered
Lepidosperma rostratum	Threatened	Endangered
Conospermum undulatum	Threatened	Endangered
Eleocharis keigheryi	Threatened	Endangered
Calandrinia sp. Piawaning (A.C. Beauglehole 12257)	Priority 1	
Schoenus sp. Beaufort (G.J. Keighery 6291)	Priority 1	
Comesperma griffinii	Priority 2	
Comesperma rhadinocarpum	Priority 2	
Diuris brevis	Priority 2	
Isotropis cuneifolia subsp. glabra	Priority 2	
Lepyrodia curvescens	Priority 2	
Schoenus loliaceus	Priority 2	
Byblis gigantea	Priority 3	
Chamaescilla gibsonii	Priority 3	
Cyathochaeta teretifolia	Priority 3	
Eryngium pinnatifidum subsp. palustre (G.J. Keighery 13459)	Priority 3	
Eryngium subdecumbens (G.J. Keighery 5390)	Priority 3	
Isopogon drummondii	Priority 3	
Myriophyllum echinatum	Priority 3	
Schoenus benthamii	Priority 3	
Schoenus capillifolius	Priority 3	
Schoenus pennisetis	Priority 3	
Schoenus sp. Waroona (G.J. Keighery 12235)	Priority 3	
Stylidium aceratum	Priority 3	
Stylidium longitubum	Priority 3	
Aponogeton hexatepalus	Priority 4	
Drosera occidentalis	Priority 4	
Hydrocotyle lemnoides	Priority 4	
Ornduffia submersa	Priority 4	
Schoenus natans	Priority 4	
Verticordia lindleyi subsp. lindleyi	Priority 4	

4. Detailed wetland assessment

4.1. Preliminary evaluation of REW UFI 8037 and REW UFI 15257 (within the MRS Amendment area)

The results of the desktop and field assessments as outlined in Section 3 were used to complete the preliminary and secondary evaluations as appropriate, in accordance with the "A methodology for the evaluation of wetlands on the SCP, Western Australia" (DBCA 2017).

The preliminary evaluation identifies whether the wetland(s) or wetland portion is of high conservation value i.e. is listed under international or national lists or registers as significant (e.g. Ramsar listed), or the wetland is spatially dominated by vegetation in good or better condition and supports additional high conservation values such as threatened species or communities (DBCA 2017).

Table 20 presents a summary of the desktop review for the two REWs (UFI 8037 & UFI 15257) within the amendment area.

Table 20: Preliminary evaluation of REW UFI 8037 and REW UFI 15257

No.	Criteria	REW UFI 8037	REW UFI 15257
		Y/N	Y/N
1.	The wetland is currently recognised as internationally or nationally significant for its natural values. Lists/registers include: • The Ramsar Convention on Wetlands. • State Government endorsed candidate sites for the Ramsar. • Convention on Wetlands. • Directory of Important Wetlands in Australia National Heritage List or equivalent.	N	N
2.	The wetland is spatially dominated by vegetation in a good or better condition using the vegetation condition scale outlined in Appendix B and is identified as significant for its natural values under one or more of the following: • Conservation Reserves for Western Australia Systems 1, 2, 3, 5. • Conservation Reserves for Western Australia, The Darling System – System 6. • A Systematic Overview of Environmental Values of the Wetlands, Rivers, and Estuaries of the Busselton – Walpole Region. • The Environmental Significance of Wetlands in the Perth to Bunbury Region Bush Forever, Swan Bioplan (including Peel Regionally Significant Natural Areas) or equivalent.	N	N
3.	The wetland supports a breeding, roosting, or refuge site or a critical feeding site for populations of fauna listed by the Australian Government (for example, EPBC Act, migratory bird agreements such as JAMBA, CAMBA and RoKAMBA) or the State (for example, threatened and specially protected fauna listed under the BC Act).	N	N
4.	The wetland is spatially dominated by vegetation in a good or better condition using the vegetation condition scale outlined in Appendix B and supports one or more of the following: • An occurrence of a TEC. • A confirmed occurrence of a priority 1 or priority 2 ecological community. • A confirmed occurrence of a declared rare (threatened) flora species.	N	N
5.	Equal to or greater than 90% of the wetland supports vegetation in a 'good or better' condition using the vegetation condition scale outlined in Appendix B of DBCA guidelines (2017a).	N	N
6.	The wetland is spatially dominated by vegetation in a 'good or better' condition using the vegetation condition scale outlined in Appendix B and is known to support internationally, nationally, or state-wide scientific values including geo-heritage and geo-conservation.	N	N

7.	The wetland is spatially dominated by vegetation in a good or better condition using the vegetation condition scale outlined in Appendix B and meets one of the following: • ≤ 10% of wetlands of the same type are assigned Conservation management category within the Swan Coastal Plain (by area).	N	N
Confirmed Conservation Category Wetland?		N	N
Secondary Evaluation required?		Y	Y

Following the evaluation process, if the wetland(s) is assigned to the "Conservation Management Category" through the preliminary evaluation, no further evaluation is required. If the wetland does not meet any of the preliminary evaluation criteria a secondary evaluation is triggered.

The desktop review and preliminary evaluation of the two REWs (UFI 8037 & UFI 15257) against the wetland specific criteria concluded these two wetlands are not consistent with "Conservation Management Category" criteria. In accordance with DBCA's evaluation methodology a secondary assessment was required.

4.2. Secondary evaluation

The secondary evaluation using the results of the detailed investigations assesses the wetland(s) against a series of criteria related to wetland geomorphology, wetland processes, linkages, habitats, flora, fauna, cultural, scientific, and educational values. The outcomes are tallied with cumulative scores for high (H), intermediate (I) and low (L) values totalled.

Management categories are assigned based on whether the wetland has predominantly high values (assigned 'conservation'), intermediate values (assigned 'resource enhancement') or low values (assigned 'multiple use').

Table 21 presents the results of the secondary evaluation of REWs UFI 8037 & UFI 15257.

Table 21: Summarised results of the secondary assessment

Attributes / Functions / Values	**Scores**		
	High	**Intermediate**	**Low**
UFI 8037			
Geomorphology	I		I
Wetland processes			II
Linkages			I
Habitats			I
Flora	I		III
Fauna	I		I
Cultural	I	I	
Scientific and educational			
Total score	4	1	9
Defining attributes / functions / values	Geomorphology, flora, fauna and cultural		
Applicable management category	Multiple Use category		
UFI 15257			
Geomorphology	III		I
Wetland processes			II
Linkages		I	
Habitats			I
Flora	I	I	II
Fauna	I		I
Cultural			I
Scientific and educational			
Total score	5	2	8
Defining attributes / functions / values	Geomorphology, flora, and fauna		
Applicable management category	Multiple Use category		

The detailed secondary evaluation criteria recorded for each attribute/function/value for REWs UFI 8037 & UFI 15257 are provided in Appendix A and Appendix B.



Plate 5: Southern portion of REW 15257 within the amendment area

4.3. Alignment with the DBCA preliminary wetland advice

DBCA's 2021 advice specific to the wetlands and the GBSW area within the amendment area outlined within the MRS Amendment Request - Wattle Grove South (WAPC 2021), comprised:

1. The REW (UFI 15257) partially intersects the site, but that this area has been significantly modified during the construction of Tonkin Highway and the DBNGP.
2. REW (UFI 8037) has been cleared and filled and no longer exists.
3. The DBCA and DWER have recently undertaken a review of the environmental values of the wetlands currently mapped in the GWSCP dataset using available regional scale data. While this dataset is unpublished, the result of the mapping indicates that the two REW within the amendment area (UFI 15257 & UFI 8037) have values commensurate with a MUW.
4. The proposed development will reduce impacts on the wetlands within the GBSW (located to the west Tonkin Highway) by improving water quality and reducing the nutrient levels exported from the amendment area.

The conclusions from the detailed assessment of the REWs (UFI 8037 & UFI 15257) environmental values and the requirements for retention were consistent with DBCA's review that "REWs UFI 15257 & UFI 8037 have values commensurate with a MUW".

4.4. REWs (UFI 8037 & UFI 15257) review

The MRS Amendment Request - Wattle Grove South (WAPC, 2021) incorporates the following DBCA's advice specific to the wetlands within the amendment area:

- The REW (UFI 15257) partially intersects the site, but that this area has been significantly modified during the construction of Tonkin Highway and the DBNGP. The original wetland area was historically cleared pre-1950 (initially establish rural landholdings) and contains no surface water body and no fauna habitat for aquatic dependent fauna species.
- REW (UFI 8037) has been cleared and filled and no longer exists. The wetland has been historically infilled and contains no surface water body and no fauna habitat for aquatic dependent fauna species.

- The DBCA and DWER have recently undertaken a review of the environmental values of the wetlands currently mapped in the GWSCP dataset using available regional scale data. While this dataset is unpublished, the result of the mapping indicates the two REW within the amendment area (UFI 15257 & UFI 8037) have values commensurate with a MUW.

The assessment of the REWs UFI 8037 and portion of UFI 15257 values concluded:

- The wetland values are representative of MUW category wetland, in alignment with the wetland advice provided by DBCA i.e., the wetlands are in 'Completely Degraded' condition or have been completely infilled.
- REW 8037 has been subject to historical impacts including clearing of native vegetation and infilling works to facilitate the construction of Tonkin Highway, the Water Corporation pipeline and DBNGP, and a commercial turf farm.
- The wetland's ecological values (or GDEs) are no longer present. There are no groundwater dependent riparian communities present or habitat (or habitat diversity) or aquatic dependent fauna. The mapped wetland contains a commercial turf area and the cleared Water Corporation and DBNGP easements.
- Currently within the mapped portion of REW (UFI 15257) in the MRS amendment area are the following land uses:
    - Tonkin Highway reserve
    - Boundary Road reserve
    - Water Corporation pipeline and DBNGP easements
    - Semi-rural paddocks
    - Commercial landscape supply business
- The REW (UFI 15257) wetland area has been subject to historical infrastructure construction works and infilling to support the above land uses and infrastructure.
- Within and adjacent to the Tonkin Highway reserve, the following vegetation was surveyed and mapped:
    - Planted stands of *Corymbia calophylla* (Marri) and non-native eucalypt *Eucalyptus camaldulensis* (Red River Gum) over non-native eucalypt *Casuarina cunninghamiana* subsp. *cunninghamiana*, *Melaleuca preissiana*, *Jacksonia sternbergiana* and **Schinus terebinthifolia* over introduced species on various soils and topographical positions (Woodman Environmental 2021).
- Along the boundary of the Water Corporation / DBNGP easement (maintained as an open paddock area):
    - Planted *Eucalyptus camaldulensis* (Red River Gum).
- There is no seasonal surface water present within REW UFI 15257 (within the MRS amendment area) or fauna habitat for aquatic dependent fauna species. The vegetation was surveyed as in 'Completed Degraded' condition.

It is recommended for the two REWs (UFI 8037 and portion of UFI 15257) within the MRS amendment areas are removed from the GWSCP dataset. DBCA is the custodian of the GWSCP dataset. An application to DBCA to amend GWSCP dataset for the two REWs (UFI 8037 and portion of UFI 15257) removing these two wetlands from the geomorphic wetland database will occur concurrently with the finalisation of a future Local Structure Plan and LWMS.

4.4.1. Proposed Management

Portions of the former mapped REWs (UFI 8037 and portion of UFI 15257) will be incorporated into POS areas and stormwater bioretention basins adjacent to the Water Corporation pipeline and DBNGP easement. The DWMS (Hyd2O 2024) identifies the future Local Structure Plan and subdivision plans will formally integrate the Water Corporation pipeline and DBNGP easement into open space, ensuring the pipeline(s) are protected whilst also providing a valuable community asset that provides local amenity.

In large storm events (for example a 100 year storm event) stormwater contained in stormwater basins will overtop and infiltrate across POS areas including the Water Corporation/DBNGP easement. This is in alignment with the existing (or pre-development) stormwater flow patterns.

The DPLH Aboriginal Heritage Places mapping tool (DPLH 2024a) identified the MRS amendment area intersects one registered heritage site:

- Brentwood Road Swamp (Site ID 4343). REW (UFI 8037) intersects a portion of this heritage site.

A cultural heritage survey completed with the Traditional Owner elders in 2021 concluded (Horizon Heritage 2021):

- The Brentwood Road Swamp (Site ID 4343) is a heavily disturbed and altered environment.
- No cultural material was observed/recorded within the MRS amendment area.

This section of the MRS amendment area is adjacent or within the Water Corporation/DBNGP easement. Activities within the DBNGP easement is restricted and generally prohibits any construction works. Accordingly, the Water Corporation and DBNGP easement will form POS areas. Stormwater bioretention basin would be located adjacent (but outside of) the POS / easement area. All future works within proximity of Brentwood Road Swamp (Site ID 4343) will be undertaken in consultation with the Traditional Owner group.

The planted mature trees (include Red River Gums and Marri trees) aligning the easement boundaries will be managed within POS area.

5. Wetland Buffer Assessment

The buffer assessment was applied to the mapped wetlands within approximately 150 m of the amendment area. The following wetlands are located within 150 m of the amendment area:

1. Two CCWs (UFI 8026 & UFI 8027) are located are within Lot 501. Lot 501 a 1.6 ha triangular landholding bounded by Tonkin Highway to the west, Welshpool Road to the north and Boundary Road to the south. The landholding also contains a 0.52 ha portion of REW UFI 15257.
2. GBSW area which incorporates numerous DBCA mapped CCW and REW features. The mapped wetlands within 150 m of the amendment area include, three CCW UFI 8025, UFI 8028, UFI 14962, one REW UFI 5257 and a MUW UFI 8030.

The Wattle Grove South MRS amendment 1388/57 does not alter the existing land uses outside of the amendment area. Specifically, the proposed 'Urban' land use within the amendment area does not intrude into Lot 501 or the GBSW area.

Figure B illustrates the location of the two CCWs (UFI 8026 & UFI 8027) and portion of REW UFI 15257 within Lot 501 and the numerous mapped wetlands within the GBSW area.

5.1. CCWs UFI 8026 & UFI 8027 and portion of REW UFI 15257 within Lot 501

5.1.1. Land use review

The wetland assessment identified there is currently no separation buffer from the two CCWs (UFI 8026 & UFI 8027) and portion of REW UFI 15257 within Lot 501. The mapped wetland and associated buffer area has been subject to historical anthropogenic impacts, specifically, the existing infrastructure corridors, which both frame and intrude into the mapped wetlands areas and immediate surrounds within Lot 501. Key infrastructure located immediately adjacent to or within the mapped wetland areas within Lot 501 include:

- Boundary Road reserve.
- Tonkin Highway reserve and Welshpool Road reserve.
- Water Corporation water pipeline easement.
- DBNGP easement.

The existing infrastructure corridors are fixed and operational. These structures essentially frame and contain the limited wetland environmental and ecological values to entirely within Lot 501 without the application of any additional buffers to surrounding land uses i.e., landscape supply yard, Welshpool Road and Tonkin Highway. Importantly, the wetland buffer assessment identified:

- The wetland/ecological values associated with the mapped CCWs (UFI 8026 & UFI 8027) and REW UFI 15257 do not extend outside of Lot 501.
- The MRS amendment does not alter the existing WAPC land management practices including regular mowing and slashing of the wetland areas to maintain the road reserves/Water Corporation and DBNGP as cleared areas.

The Boundary Road reserves separate Lot 501 (inclusive of the two CCWs and a portion of REW UFI 15257) from the adjacent commercial (landscape supply business) and rural lots. The mapped CCWs (and portion of REW UFI 15257) are located at the southern border of the Boundary Road reserve. The MRS amendment does not alter the Boundary Road reservation and/or its current location. However, as the majority of Boundary Road is unsealed, the future key infrastructure work adjacent to Lot 501 will be to seal (i.e., asphalt surfacing) Boundary Road and install footpaths within the road reserve.

CCW UFI 8026 is located wholly within the DBNGP easement.

There is no native vegetation in the amendment area within 70 m of the two CCWs (UFI 8026 & UFI 8027) the landholdings Immediately south of Boundary Road has been historically

cleared and is currently used for commercial landscape supply business, rural lots, and the Water Corporation water pipeline and DBNGP easements.

Lot 501 is owned by the WAPC. The landholding is regularly maintained via slashing and mowing of the open grass and weed areas to uphold the road reserves, Water Corporation and DBNGP easements as cleared open areas.

The desktop review site, visit and assessment conclude the existing ecological attributes and values of the two CCWs (UFI 8026 & UFI 8027) and the portion of REW UFI 15257 are aligned with REWs category wetland and/or MUW category wetland.

Figure K illustrates the status of Lot 501 (which includes the two CCWs and portion of REW UFI 15257), inclusive of the adjacent land uses, the Tonkin Highway, Welshpool Road, the Boundary Road reserve, and the Water Corporation and DBNGP easements.

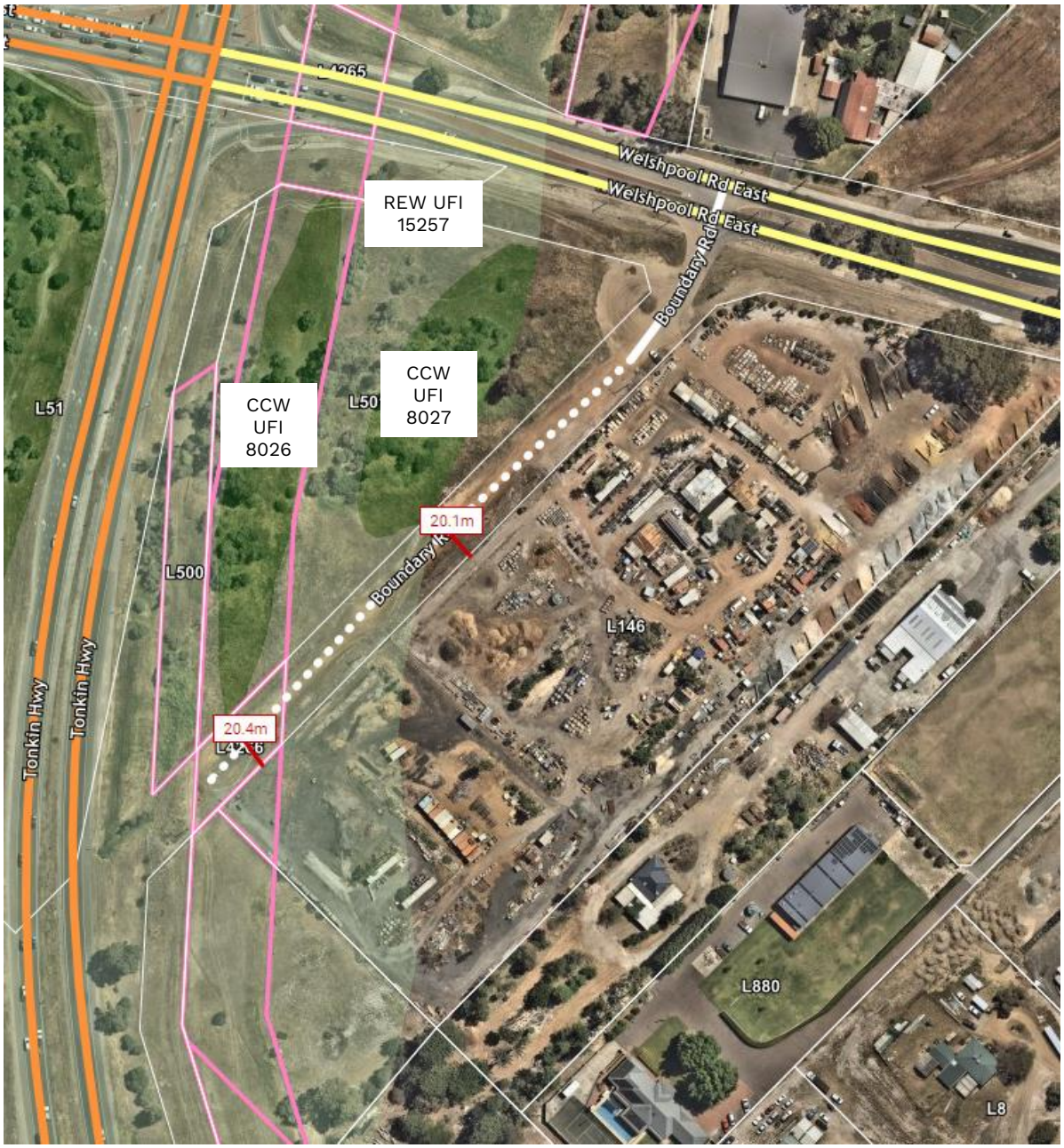


Figure K: CCWs (UFI 8026 & UFI 8027) and REW UFI 15257 within Lot 501.

5.1.2. Wetland buffer assessment

The wetland buffer assessment of the two CCWs (UFI 8026 & UFI 8027) within Lot 501 is summarised in Table 22.

Table 22: CCWs UFI 8026 & UFI 8027 and wetland buffer assessment

Wetland buffer assessment step	Assessment
Step 1 - Wetland existence	• The DBCA wetland mapping identifies the two CCWs (UFI 8026 & UFI 8027) and a portion of REW UFI 15257 within Lot 501 as 'Palusplain'. • Lot 501 is owned and managed by the WAPC and regularly maintained via slashing and mowing of the open grass and weed areas to uphold the road reserves, Water Corporation and DBNGP easements as cleared open areas. • The existence of the two CCWs and one REW is confirmed.

Step 2 – Wetland attributes	• The two CCWs are narrow and small in area (UFI 8026 is 0.38 ha in area & CCW UFI 8027 0.32 ha). The REW UFI 15257 is 0.52 ha in area.
	• The two wetlands (UFI 8026 & UFI 8027) and REW UFI 15257 have been significantly modified because of:
	  ○ Construction of Tonkin Highway Welshpool Road and Boundary Road.
	  ○ The Water Corporation pipeline and the DBNGP easement which are maintained as cleared open areas.
	• Woodman Environmental survey of the two CCWs (UFI 8026 & UFI 8027) and the portion of REW UFI 15257 within Lot 501 rated the vegetation as being in a 'Degraded to Completely Degraded' condition.
	• The key environmental attributes for the two wetlands (UFI 8026 & UFI 8027) are:
	  ○ The two CCWs and the REW are located within a portion of the former Crystal Brook tributary.
	  ○ CCW UFI 8026 is 0.38 ha in area. The native vegetation area is approximately 0.28 ha. CCW UFI 8026 is wholly within the DBNGP easement.
	  ○ CCW UFI 8027 is 0.32 ha in area. The native vegetation area is approximately 0.25 ha.
	  ○ No TECs or priority flora are present.
	  ○ The *Corymbia calophylla* trees within the two CCWs has the potential to provide limited foraging and roosting habitat to the threatened Carnaby's cockatoo and Forest red-tailed black cockatoo species.
	  ○ The limited native vegetation areas within the two CCW wetland areas could provide habitat areas for frogs and reptiles.

Step 3 – Wetland function	• **Vegetation**
	  ○ Woodman Environmental (2021) vegetation survey identified the following vegetation units:
	  ▪ Mid open woodland of *Corymbia calophylla* over low woodland of mixed species dominated by *Eucalyptus rudis, Melaleuca rhaphiophylla* and *Melaleuca preissiana* over tall sparse shrubland of mixed species dominated by *Acacia saligna* over mid sparse shrubland of *Acacia pulchella* over mid tussock grassland of mixed species dominated by **Avena barbata*, **Eragrostis curvula* and **Ehrharta calycina* over **Watsonia meriana* on grey and brown sandy loam and clay loam on plains, flats, and drainage lines.
	  ▪ Individual or stands of *Corymbia calophylla* over introduced species including **Avena barbata*, **Bromus diandrus* and **Ehrharta calycina* on various soils and topographical positions (mostly within the REW area).
	  ○ No State & Commonwealth listed TECs were surveyed / observed.
	  ○ No conservation significant flora was surveyed / observed.
	• **Geology/Hydric Soils**
	  ○ Bassendean Sand over sandy clay to clayey sand of the Guildford Formation.

	○ Geotechnical investigations within the vicinity of Lot 501 identified the geology as sandy clay to clayey sandy of the Guildford Formation. • **Hydrology** ○ There are no existing bioretention swales managing / treating surface water from the surrounding catchment entering Lot 501. ○ Remnants of the Crystal Brook creek line within the north-eastern portion of the GBSW area, adjacent to Tonkin Highway remains intact. Surface water from the north-western portion of the amendment area conveyed via the Boundary Road culvert, beneath the Tonkin Highway, follows for the first approximately 500 m the Crystal Brook tributary alignment. ○ The groundwater depth ranges from 4 m to 20 m bgl. Groundwater flow generally ranges from north west to south east across the amendment area (Hyd2o 2023).
Step 4 – Threatening processes	• Threats identified to the two CCWs (UFI 8026 & UFI 8027) and the portion of REW UFI 15257 within Lot 501 from the future 'Urban' land use located south of Boundary Road include: ○ Changes to hydrology - alteration to surface water levels and flows. ○ Changes to hydrology - reduced water quality. ○ Groundwater rise through higher recharge. ○ Managing drainage from the amendment area to the Boundary Road culvert. ○ Unauthorised pedestrian access has the potential to impact significant wetlands, watercourses and vegetation through trampling or taking of vegetation, litter accumulation and disturbance of fauna. ○ Introduction or spread of weeds. ○ Introduction or spread of disease (Phytophthora dieback). ○ Increase of feral animals.
Step 5 – Role of the separation	• The proposed development was determined to have the potential to provide the following threatening processes: ○ Alteration to the existing surface water flow regime. ○ Surface water quality. • The DWMSs propose a range of groundwater and stormwater management strategies that will protect and sustain the existing hydrology of the wetlands, and vegetation, with respect to water quality. The DWMS sets out the following management strategies (Hyd2O 2024): ○ Treating stormwater runoff within the amendment areas prior to entering Lot 501 and the two CCWs. ○ Use of reticulated sewerage systems. ○ Implementation of the DWMS and the proposed groundwater and stormwater management strategies and design requirements will ensure the pre-development hydrology of the two CCWs and vegetation is maintained, such that the potential impacts are unlikely to occur. • Unauthorised public access: ○ Lot 501 is peripheral to the majority of the amendment area. It is located at the north-western boundary of the amendment area, wedged between Welshpool Road, Tonkin Highway and Boundary Road. The existing road infrastructure provide a physical barrier to Lot 501. ○ The amendment area does not propose to install any paths within Lot 501. ○ Public access can be managed through the installation of a footpath along Boundary Road reserve adjacent to Lot 501. • Spread of weeds: ○ Weeds species dominate Lot 501 understorey including *Avena barbata*, *Eragrostis curvula*, *Ehrharta calycina* and *Watsonia meriana*. No works are proposed within Lot 501. The landowner (the WAPC) of Lot 501 currently manages weeds through regular slashing/mowing inclusive of the mapped CCW areas. ○ The weed species are already highly prevalent within the amendment area and Lot 501. Future development activities within

	the amendment area will not result in the intensification of weeds. The implementation of the proposed scheme amendment, through subdivision, development and supporting infrastructure works provides an opportunity to remove the majority of weeds (and associated weed seed bank within the topsoil) through the clearing of weed dominated areas as part of future bulk earthworks. ○ Future environmental retention areas and stormwater drainage swales/basins will be the focus of the weed management measures. ○ The risk of weeds from the amendment area during the construction phase will be addressed in a Construction Environmental Management Plan (CEMP). The CEMP will address: ▪ Hygiene management (weeds and Phytophthora dieback). ▪ Hydrocarbon spill management. ▪ Sediment and erosion control actions. ▪ Dust management. ▪ Monitoring program (parameters to be monitored, methodology and frequency). ▪ Reporting. ▪ Corrective actions. • Introduction or spread of disease (*Phytophthora* dieback): ○ The threat from *Phytophthora* dieback would be addressed through the implementation of hygiene protocols to mitigate the risk of dieback spread, through the implementation of the CEMP during construction. • Feral animals: ○ Currently, there are no active feral animal controls within Lot 501. The key feral animals threat is primarily from cats. Under the City of Kalamunda Keeping and Control of Cat Local Law 2023, cats are prohibited in the City's Parks and Reserves. Lot 501 containing the two CCWs is zoned 'Parks and Recreation' could be added to the City's registered prohibited. Cats observed within Lot 501 can be trapped and removed by the City. ○ All cats over six-months must be microchipped, sterilised, and registered with the City of Kalamunda. Cat registrations must register with the City of Kalamunda.
Buffer	• Summary: ○ The assessment of the two CCWs (UFI 8026 & UFI 8027) and portion of REW UFI 15257 within Lot 501 concluded the wetlands are highly modified due to: ▪ Historical clearing and construction of infrastructure corridors. ▪ The regular maintenance program to keep the Water Corporation and DBNGP easements and the Tonkin Highway / Welshpool Road reserves cleared. ○ Boundary Road provides a physical barrier to the amendment area and is located immediately adjacent to the two CCWs and the portion of REW UFI 15257 within Lot 501. ○ There is no native vegetation (or wetland environmental values) south of Boundary Road in the amendment area. The landholdings south of the mapped CCWs has been cleared of vegetation and is used as a landscape supply yard. ○ The buffer assessment of the two CCWs (UFI 8026 & UFI 8027) and the portion of REW UFI 15257 within Lot 501 considered: ▪ The existing management practices undertaken within Lot 501. ▪ The Boundary Road reserve. ▪ Minimising the threats from the MRS amendment (i.e., future 'Urban' development). ○ The desktop review site, site investigation and assessment conclude the existing ecological attributes and values of the two CCWs (UFI 8026 & UFI 8027) and the portion of REW UFI 15257 are aligned with REWs category wetland and/or MUW category wetland.

	• **Wetland buffer:**
	  ○ The wetland assessment identified there is currently no separation buffer from the two CCWs (UFI 8026 & UFI 8027) and portion of REW UFI 15257 within Lot 501.
	  ○ The mapped wetland and associated buffer area has been subject to historical anthropogenic impacts, specifically, the existing infrastructure corridors, which both frame and intrude into the mapped wetlands areas and immediate surrounds within Lot 501. Key infrastructure located immediately adjacent to or within the mapped wetland areas within Lot 501 include:
	  ▪ Boundary Road reserve.
	  ▪ Tonkin Highway reserve and Welshpool Road reserve.
	  ▪ Water Corporation water pipeline easement.
	  ▪ DBNGP easement.
	  ○ The existing infrastructure corridors are fixed and operational. These structures essentially frame and contain the limited wetland environmental and ecological values to entirely within Lot 501 without the application of any additional buffers to surrounding land uses i.e., landscape supply yard, Welshpool Road and Tonkin Highway. Importantly, assessment identified:
	  ▪ The wetland/ecological values associated with the mapped CCWs (UFI 8026 & UFI 8027) and REW UFI 15257 do not extend outside of Lot 501.
	  ○ The wetland assessment concluded the existing 20 m Boundary Road reserves provides an existing physical separation from the two CCWs (UFI 8026 and UFI 8027) and the portion of REW UFI 15257.
	  ○ The road reserve is managed by the City of Kalamunda and will be maintained in the future.
	  ○ The conclusion drawn on the status of and the road separation distance is supported by:
	  ▪ The assessment of the two CCWs (UFI 8026 and UFI 8027) and portion of REW UFI 15257 demonstrate ecological values more aligned with REW category and/or MUW category wetlands.
	  ▪ The values of the two CCWs (UFI 8026 and UFI 8027) and portion of REW UFI 15257 are contained wholly within Lot 501.
	  ▪ This conclusion was underpinned by the following assessment:
	  • Approximately 80% of Lot 501 has been historically cleared of native vegetation and subject to infilling.
	  • The historical and current land uses resulting in the establishment of open cleared areas within the mapped wetland areas include:
	  ○ Welshpool Road and Tonkin Highway reserves.
	  ○ DBNGP and Water Corporation easements.
	  ○ Boundary Road reserve.
	  • Lot 501 is owned and managed by the WAPC and regularly maintained via slashing and mowing of the open grass and weed areas to uphold the road reserves, Water Corporation and DBNGP easements as cleared open areas.
	  • The understorey of the two CCWs (UFI 8026 and UFI 8027) and portion of REW UFI 15257 within Lot 501 is significantly dominated by weed species including *Avena barbata* (wild oats), *Eragrostis curvula* (African lovegrass), *Ehrharta calycina* (perennial veldtgrass) and *Watsonia meriana*.
	  • The two CCWs (UFI 8026 and UFI 8027) and portion of REW UFI 15257 are in a 'Degraded to Completely Degraded' condition.
	  ○ The MRS amendment does not alter:

	▪ The location or the Boundary Road reserve land use. ▪ The Lot 501 "Parks and Recreation" land use. ○ Immediately south of Boundary Road (i.e., approximately 20 m from the mapped wetlands) are private landholdings including a commercial landscape supply yard and cleared semi-rural property and the DBNGP easement. Portions of these landholdings have been extensively filled and cleared of native vegetation. These land uses (i.e., the privately owned commercial and rural land uses) and the DBNGP easement have been in place for over 20 years. ○ The two CCWs (UFI 8026 & UFI 8027) and portion of REW UFI 15257 have limited ecological attributes which are entirely contained within Lot 501 and do not extend into the Boundary Road reserve or the MRS amendment.
Step 7 – Wetland management	• The site review and wetland assessment conclude the existing ecological attributes and values of the two CCWs (UFI 8026 & UFI 8027) and the portion of REW (UFI 15257) within Lot 501 are aligned with REWs category wetland and/or MUW category wetland. • Boundary Road provides an approximate 20 m permanent infrastructure barrier between the two CCWs within Lot 501 and the commercial landscape supply yard and the semi-rural paddocks within the MRS amendment area. • Lot 501 is owned and managed by the WAPC as a 'Parks and Recreation' reserve. Lot 501 is located outside of the MRS amendment area. The Wattle Grove South MRS amendment does not: ○ Alter the existing 'Parks and Recreation' land use zoning within Lot 501. ○ Alter the City of Kalamunda's Boundary Road reserve land use. • Noting Lot 501 is outside of the MRS amendment boundary, the management of the two CCWs (UFI 8026 & UFI 8027 and portion of REW UFI 15257) will incorporate the following: ○ Formal Boundary Road as a hard infrastructure barrier to the wetlands from future 'Urban' land uses. ○ Formalising a footpath on the southern side of Boundary Road (i.e., adjacent to the proposed future 'Urban' land uses area or the current commercial landscaping yard). ○ Install contemporary drainage basins adjacent to Boundary Road (within the amendment area) with the objective of improving surface water quality and maintaining existing flow rates from the amendment area via the Boundary Road culvert. ○ The proposed formalising of Boundary Road, footpath, and drainage basin areas (within the amendment area) will be defined and managed in accordance with the following sequential planning stages: ▪ Wattle Grove South LSP – which incorporates LWMS and landscape masterplan. ▪ Subdivision approval – subdivision condition requirements will require: • UWMP. • Detailed landscape plan which incorporates the drainage basins/swales. • Detailed engineering drainage design. • No impacts or loss of the wetland's foreshore functions, vegetation or other water dependent ecosystems are expected to the wetlands within Lot 501. Lot 501 is not subject to the MRS Amendment 1388/57 and will be managed in accordance with the landowner's (WAPC) existing management practices. • The WAPC as the landowner of Lot 501 (or MRWA as the proponent for the Tonkin Highway Grade Separated Interchanges proposal which intersections a portion of Lot 501) may seek to formally engage with DBCA for the purpose of amending the GWSCP dataset (specifically the category

	status of the two CCWs (UFI 8026 & UFI 8027) and the portion of REW (UFI 15257)) within Lot 501.

Plates 6 and 7 illustrate the existing weeds/grassed area within and surrounding the two CCWs areas and the DBNGP easement.



Plate 6: CCW UFI 8026 and REW UFI 15257 located within the DBNGP easement.



Plate 7: CCW UFI 8027 and REW UFI 15257 adjacent to the DBNGP easement.

5.2. Wetlands within the GBSW area

5.2.1. Land use review

The following existing infrastructure corridors form a physical barrier between the GBSW area (inclusive of the GBSW numerous mapped wetlands) and the amendment area. The infrastructure corridors include:

- Tonkin Highway reserve (which is proposed to increase to six lanes).
- Water Corporation water pipeline easement.
- DBNGP pipeline easement.

The closest wetland (CCW UFI 14962) within the GBSW area (and the Tonkin Highway reserve) is situated approximately 75 m to the west of the amendment area, separated by the four-lane Tonkin Highway. Note the mapped CCW (UFI 14962) extends into the Tonkin Highway reserve. The measurement was taken from the CCW (UFI 14962) from within the highway reserve. If the upgrade of Tonkin Highway is approved (i.e., increased to six lanes) the separation distance to the amendment area would be further extended by an approximate 30 m.

Within the amendment area, immediately adjacent to the Tonkin Highway is the Water Corporation and DBNGP pipeline easements. The *Dampier to Bunbury Pipeline Act 1997* excludes development within the easement. These easements further extend the separation distance from the proposed future residential development, within the amendment area to the closest wetland within the GBSW area to approximately 105 m.

The significant portion of the Wattle Grove amendment area is located significantly further than 100 m south-east of the GBSW area.

Figure L illustrates the locations of the closest mapped wetland to the amendment area and the Water Corporation and DBNGP easements.

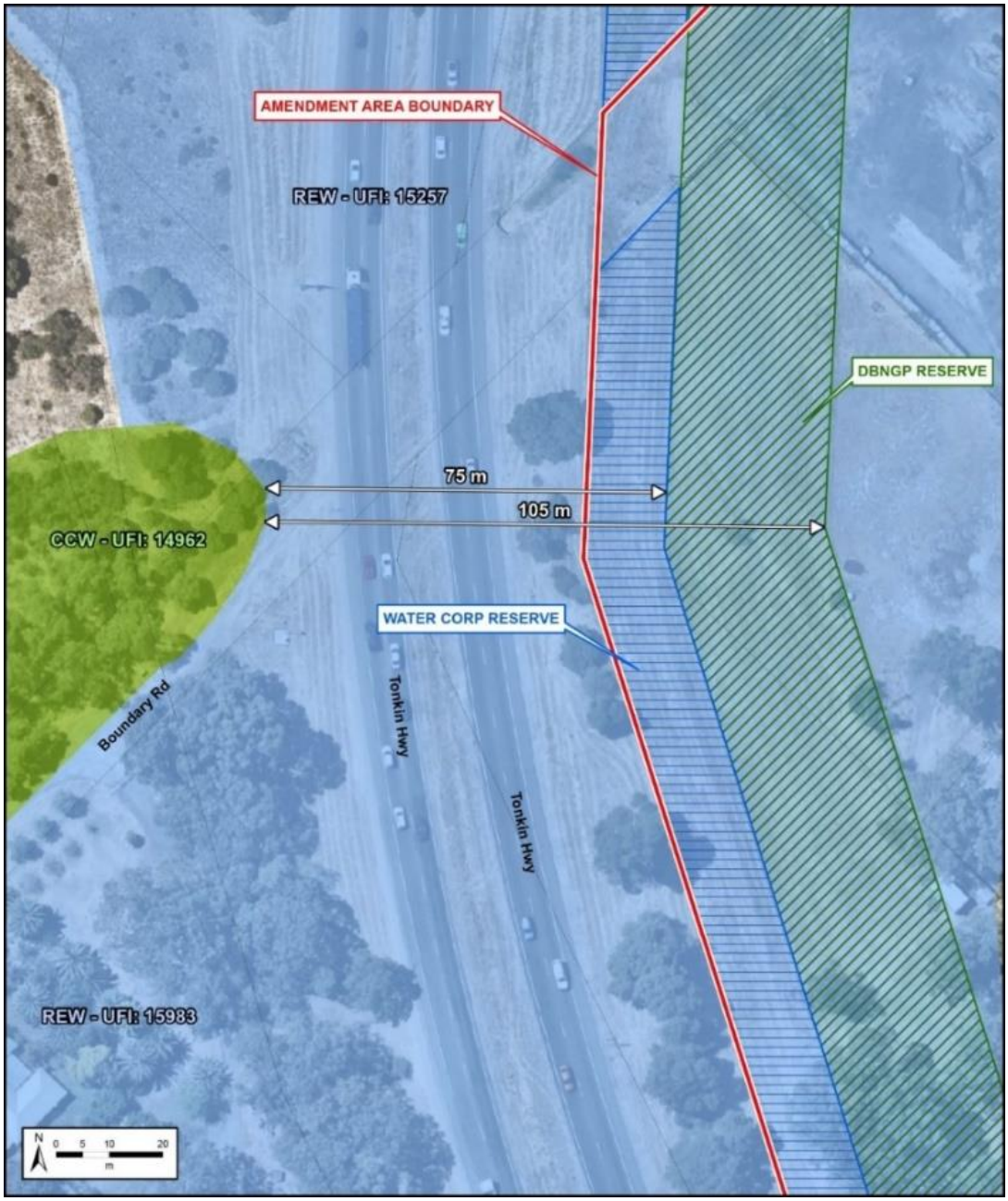


Figure L: Physical infrastructure separating CCW UFI 14962 and the Amendment Area.

5.2.2. Wetland buffer assessment

The wetland buffer assessment of the numerous mapped CCW and REW features within the GBSW (primarily inside 150 m of the amendment area) is summarised in Table 23.

Table 23: GBSW buffer assessment

Wetland buffer assessment step	Assessment
Step 1 - Wetland existence	• The GBSW are a Nationally Important Wetland which comprises a complex of significant wetlands, including areas of seasonally waterlogged flats (palusplain) and seasonally inundated basins (sumplands) and cover 176 ha. • The mapped wetlands within 150 m of the amendment area include, three CCW UFI 8025, UFI 8028, UFI 14962, one REW UFI 5257 and a MUW UFI 8030.
Step 2 – Wetland attributes	• Overarching GBSW area

	○ Non-contiguous reserve consisting of Brixton Block, Wanping Block and separate landholdings, Alison Baird Reserve, private and government owned landholdings. ○ TECs identified include: ▪ FCT 3a - *Corymbia calophylla - Kingia australis* woodlands on heavy soils of the Swan Coastal Plain. ▪ FCT 7, FCT 8, FCT 9, FCT 10a - Clay pans of the Swan Coastal Plain. ▪ FCT 21c - Low lying *Banksia attenuata* woodlands or shrublands. ▪ FCT 23a - Banksia Woodlands of the Swan Coastal Plain IBRA Region. ▪ Guildford Vegetation Complex is the dominant vegetation complex (Heddle et al. 1990). Only 5.1% of Guildford complex remains on the Swan Coastal Plain. ○ DBCA's Threatened and Priority Fauna and Atlas of Living Australia databases identified 319 vertebrate species have the potential to occur in the GBSW area (EPA 2022). • CCW UFI 8025, UFI 8028, UFI 14962 ○ The GBSW mapped wetlands within 150 m of the amendment area (including CCW UFI 8025, UFI 8028, UFI 14962) are mapped as: ▪ Mixed shrublands on seasonally waterlogged or inundated flats or edges of depressions. ▪ Water filled depressions, may be clay based (claypans) or humus rich or combinations of both. ▪ The vegetation condition ranges from 'Good' to 'Completely Degraded' (Emerge 2023c).
Step 3 – Wetland function	• Vegetation ○ The vast majority of the GBSW comprises native vegetation, which is highly biodiverse, supporting at least 611 native plant taxa, threatened and priority flora, threatened ecological communities, and habitat for threatened and priority fauna. • Geology/Hydric Soils ○ The Guildford Formation clay layers form a complex sequence of clay lenses that is laterally and vertically varied. Cemented clay layers are common within a few metres of the surface of the GBSW area. It is these clay layers that underpin the base of the claypans (Lane and Evans 2019). • Hydrology ○ The primary water input is rainfall; however, some inflows occur from upstream catchments. ○ The GBSW rely primarily on rainfall to fill due to the underlying clay-dominated soils of the Guildford formation, which are waterlogged through winter and form deep pools in clay depressions (DBCA 2018). ○ Perched groundwater moves laterally until it intersects drainage lines or is utilised via evapotranspiration.
Step 4 – Threatening processes	• Threats identified to the GBSW mapped wetlands within 150 m of the amendment from the future 'Urban' land use include: ○ Changes to hydrology - alteration to surface water levels and flows. ○ Changes to hydrology - reduced water quality. ○ Managing drainage from the amendment area to the Boundary Road culvert. ○ Unauthorised pedestrian access has the potential to impact significant wetlands, watercourses and vegetation through trampling or taking of vegetation, bank erosion, litter accumulation and disturbance of fauna. ○ Introduction or spread of weeds. ○ Introduction or spread of disease (*Phytophthora* dieback). ○ Increase of feral animals.
Step 5 – Role of the separation	• The proposed development was determined to have the potential to provide the following threatening processes: ○ Alteration to the existing surface water flow regime. ○ Surface water quality.

	• The DWMS propose a range of groundwater and stormwater management strategies that will protect and sustain the existing hydrology of the wetlands, and vegetation, with respect to water quality. The DWMS sets out the following management strategies (Hyd2O 2024):
	  ○ Treating stormwater runoff within the amendment areas prior to entering Lot 501 which is then directed via the Boundary Road culvert towards the GBSW area.
	  ○ Use of reticulated sewerage systems.
	  ○ Implementation of the DWMS and the proposed groundwater and stormwater management strategies and design requirements will ensure the pre-development hydrological flows towards the GBSW is maintained (Hyd2O 2024).
	• Unauthorised public access:
	  ○ Access to the GBSW is not considered a significant threat for the following reasons:
	  ▪ Tonkin Highway (four lanes) provides a physical barrier to the GBSW area. The highway is proposed to be widened to six lanes, providing additional physical separation distance to the GBSW area.
	  ▪ There is no direct pedestrian access to the GBSW area.
	  ▪ A pedestrian footpath exists across Tonkin Highway at Brentwood Road. The majority of the GBSW area is between Boundary Road and Brook Road which is approximately 700 m to the north. The closest portion of the GBSW area along Brentwood Road is approximately 550 m west of Tonkin Highway. This portion of the GBSW is adjacent to rural lots and dog training/kennels. The Brentwood Road pedestrian crossing is proposed to be closed as part of the MRWA Tonkin Highway upgrade.
	  ▪ The other alternative access routes into the GBSW area are via Welshpool Road and then Brook Road (approximately 1.3 km) or via Crystal Brook Road, Kelvin Road and then Bickley Road (approximately 6.7 km).
	  ▪ Figure M illustrates the existing access pathway/roads towards the GBSW area.
	• Spread of weeds:
	  ○ Weeds species within Lot 501 which is located adjacent to the Boundary Road culvert includes *Avena barbata*, *Eragrostis curvula*, *Ehrharta calycina* and *Watsonia meriana*. The Lot 501 landowner (the WAPC) currently manages weeds through regular slashing/mowing inclusive of the CCW areas.
	  ○ The weed species are already highly prevalent within the amendment area and Lot 501. Future development activities within the amendment area will not result in the intensification of weeds. The implementation of the proposed scheme amendment, through subdivision, development and supporting infrastructure works provides an opportunity to remove the majority of weeds (and associated weed seed bank within the topsoil) through the clearing of weed dominated areas as part of future bulk earthworks.
	  ○ Future environmental retention areas and stormwater drainage swales/basins will be the focus of weed management measures.
	  ○ The risk of weeds from the amendment area during the construction phase will be addressed in a CEMP. The CEMP will address:
	  ▪ Hygiene management (weeds and *Phytophthora* dieback).
	  ▪ Hydrocarbon spill management.
	  ▪ Sediment and erosion control actions.
	  ▪ Dust management.
	  ▪ Monitoring program (parameters to be monitored, methodology and frequency).
	  ▪ Reporting.
	  ▪ Corrective actions.
	• Introduction or spread of disease (*Phytophthora* dieback):
	  ○ The threat from *Phytophthora* dieback would be addressed through the implementation of hygiene protocols to mitigate the risk of

	dieback spread, through the implementation of CEMP during construction.
	• Feral animals:
	  ○ The key feral animals threat is primarily from cats and foxes. Under the City of Kalamunda Keeping and Control of Cat Local Law 2023, cats are prohibited in the City's Parks and Reserves.
	  ○ All cats over six-months must be microchipped, sterilised, and registered with the City of Kalamunda and/or the City of Gosnells.
	  ○ The City of Gosnells also provides cat trapping services and requires all cats to be registered.

Buffer	• Summary:
	  ○ The buffer assessment to the numerous DBCA mapped CCW and REW features within the GBSW and specifically the mapped wetlands within 150 m of the amendment area include, three CCW UFI 8025, UFI 8028, UFI 14962, one REW UFI 5257 and a MUW UFI 8030 considered:
	  ▪ The existing transport infrastructure (Tonkin Highway) and Water Corporation and DBNGP easements which provides a physical separation boundary to the amendment area.
	  ▪ MRWA's proposed upgrade to Tonkin Highway. If the upgrade of Tonkin Highway is approved (i.e., increased to six lanes) the minimum separation distance to the amendment area would be extended by a further 30 m.
	  ▪ The amendment area and any proposed future development works do not intrude into the GBSW area and remain on the eastern side of Tonkin Highway.
	• Wetland buffer:
	  ○ The four lane Tonkin Highway reserve in combination with the Water Corporation and DBNGP pipeline easements establishes a minimum 100 m physical boundary between the GBSW wetlands and the amendment area at the closest point. If the Tonkin Highway upgrade is approved and constructed the minimum buffer would extend to approximately 130 m.
	  ○ In acknowledgement of the Tonkin Highway reserve and the adjacent Water Corporation and DBNGP pipeline easements the proposed buffer distance to the future residential development will remain a minimum 100 m from the GBSW.
	  ○ The threats to the wetlands within the GBSW from future residential development can be managed within this proposed buffer.

Step 7 – Wetland management	• The proposed wetland buffer distance to the GBSW area is: • A minimum 100 m buffer from the GBSW (at the closest point) will be maintained. The Tonkin Highway reserve in combination with the Water Corporation and DBNGP pipeline easements has already established a minimum 100 m physical boundary between the GBSW wetlands and the amendment area at the closest point. • If the MRWA Tonkin Highway Grade Separated Interchange Proposal is approved and constructed (creating a six lane highway) the minimum buffer would extend to approximately 130 m. Noting the vast majority of the proposed future 'Urban' land uses will be located significantly further (i.e., 500 m plus) from the GBSW.

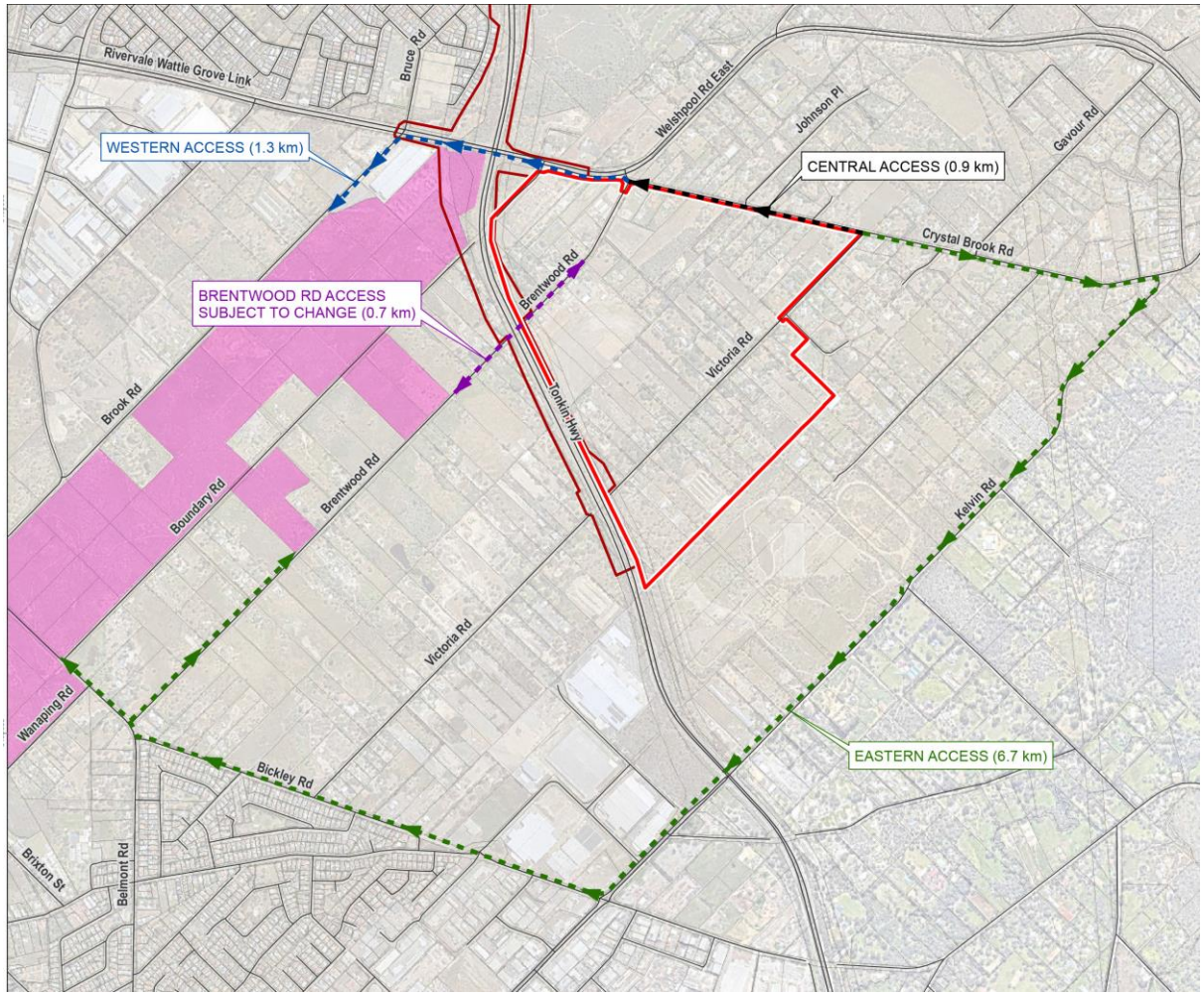


Figure M: Access Pathways towards the GBSW

6. Summary and recommendations

6.1. Summary

Based on the results of the wetland assessment, the following conclusions and recommendations are provided:

1. Overall, since 1953, the wetlands within the amendment area and the adjacent Lot 501 have been subject to significant historical anthropogenic impacts, resulting in the clearing of native vegetation and the infilling of the mapped wetland areas. For example, the historical clearing and infilling of wetland areas to establish rural landholdings and the construction of key infrastructure corridors including:
    a. Welshpool Road, Tonkin Highway and Boundary Road.
    b. Water Corporation and DBNGP pipeline easements
2. The detailed wetland assessment recommends the removal of UFI 8037 and portion of UFI 15257 within the MRS amendment area from the GWSCP dataset. This recommendation is reflective of the historical land uses and the 'Completely Degraded' ecological condition of the two wetlands. Specifically, historical anthropogenic impacts including the construction of the Tonkin Highway, Water Corporation and DBNGP pipelines and adjacent land uses including commercial turf farm and rural lots resulted in the clearing and infilling of the wetlands.
3. The advice received from DBCA acknowledges the two REWs (UFI 8037 & UFI 15257) have values commensurate with a MUW category wetland.
4. The evaluation and assessment of the wetlands in Lot 501 concluded the existing ecological attributes and values of the two CCWs (UFI 8026 & UFI 8027) and the portion of REW (UFI 15257) are aligned with REWs category wetland and/or MUW category wetland.
5. The specific evaluation and assessment of the two CCWs and the portion of REW UFI 15257 within Lot 501 determined the wetlands are in a 'Degraded to Completely Degraded' condition, specifically REW UFI 15257.
6. The wetland assessment identified there is currently no separation buffer from the two CCWs (UFI 8026 & UFI 8027) and portion of REW UFI 15257 within Lot 501. The existing infrastructure corridors (Boundary Road, Tonkin Highway and Welshpool Road) framing Lot 501 are fixed and operational. These structures essentially frame and contain the limited wetland environmental and ecological values to entirely within Lot 501 without the application of any additional buffers to surrounding land uses i.e., landscape supply yard, Welshpool Road and Tonkin Highway. Importantly, assessment identified:
    a. The wetland/ecological values associated with the mapped CCWs (UFI 8026 & UFI 8027) and REW UFI 15257 do not extend outside of Lot 501.
    b. The MRS amendment does not alter the existing WAPC land management practices including regular mowing and slashing of the wetland areas to maintain the road reserves/Water Corporation and DBNGP as cleared areas.
7. The two CCWs (UFI 8026 & UFI 8027) and the numerous wetlands with the GBSW area are physically separated from the amendment area by key regional infrastructure corridors including:
    a. Boundary Road reserve.
    b. Tonkin Highway reserve and Welshpool Road reserve.
    c. Water Corporation water pipeline easement.
    d. DBNGP easement.

6.2. Evaluation of REW UFI 8037 and REW UFI 15257

The DBCA acknowledges that the wetland spatial information provided in their Geomorphic Wetlands of the Swan Coastal Plain dataset is not 100% accurate. A modification to the dataset can be requested if it is considered that the management category or boundary of a wetland is incorrect or has been altered.

The assessment of the REWs UFI 8037 and portion of UFI 15257 values concluded:

- Removal of REW (UFI 8037) which totals 0.86 ha from the DBCA GWSCP dataset.

- Removal of the portion of REW (UFI 15257) which totals approximately 2.06 ha (within the MRS amendment area) from the DBCA GWSCP dataset.
- The removal of UFI 8037 and portion of UFI 15257 within the MRS amendment area from the GWSCP dataset is reflective of the historical land uses and the 'Completely Degraded' ecological condition of the two wetlands. Specifically, historical anthropogenic impacts including the construction of the Tonkin Highway, Water Corporation pipeline and DBNGP and adjacent land uses including commercial turf farm and rural lots resulted in the clearing and infilling of the wetlands.
- An application to DBCA to amend the GWSCP dataset for the two REWs (UFI 8037 and portion of UFI 15257) will be undertaken concurrently with the finalising of the Local Structure Plan and the LWMS.
- Portions of the two former wetland areas will be incorporated into POS areas and stormwater bioretention basins.
- It is not expected there will be any measurable impacts to the 'Completely Degraded' REWs UFI 8037 and portion of UFI 15257 within the MRS amendment area. The existing trees planted within the portion of UFI 15257 within MRS amendment area (mostly located within the Water Corporation / DBBGP easement boundary) will be retained and integrated in POS areas and stormwater bioretention basins.

6.3. Wetland Buffer Assessment

6.3.1. CCWs UFI 8026 & UFI 8027 and portion of REW UFI 15257 within Lot 501

The assessment of the CCWs (UFI 8026 & UFI 8027 and portion of REW UFI 15257 within Lot 501) demonstrate ecological values aligned with REW category and/or MUW category wetlands. This assessment considered the Lot 501 wetlands could justify a downgrading of their wetland management categories.

The WAPC as the landowner of Lot 501 (or MRWA as the proponent for the Tonkin Highway Grade Separated Interchanges proposal which intersections a portion of Lot 501) may seek to formally engage with DBCA for the purpose of amending the GWSCP dataset (specifically the category status of the two CCWs (UFI 8026 & UFI 8027) and the portion of REW (UFI 15257)) within Lot 501.

The wetland assessment concluded the existing 20 m Boundary Road reserves provides an existing physical separation from the two CCWs (UFI 8026 and UFI 8027) and the portion of REW UFI 15257.

6.3.2. GBSW area

The buffer assessment acknowledged the existence of the Tonkin Highway reserve, the Water Corporation pipeline and the DBNGP easements. This establishes a physical separation barrier of a minimum 100 m from any proposed future development within the amendment area to the GBSW area.

In consideration of potential threats to the mapped wetlands within the GBSW area, because of the proposed 'Urban' land use change:

1. There will be no change to hydrological regimes that would result in impacts to groundwater dependent vegetation within the GBSW area, specifically, no changes to the existing surface water volumes flowing towards the GBSW area.
2. Treatment of surface water in vegetated drainage swales/basins within the amendment areas prior to discharging into Lot 501 and the Boundary Road culvert.
3. The pre-development surface water flow volumes will be maintained into Lot 501.
4. Controlling public access through the installation of footpaths and closure of the Brentwood Road cross over across Tonkin Highway.

The buffer assessment recommended maintaining the minimum 100 m separation buffer (inclusive of the existing Tonkin Highway reserve and the Water Corporation pipeline and DBNGP easements) will be established to the future 'Urban' development within the amendment area at the closet point. If the Tonkin Highway upgrade is approved and constructed the minimum buffer would extend to approximately 130 m.

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Appendix A: Detailed assessment of Resource Enhancement Wetland UFI 8037

Detailed assessment of Resource Enhancement Wetland UFI 8037

Assessment element		Details	
Wetland location / Lot details		• Lot 301 – zoned Primary Regional Road. • Lot 302 – zoned 'Rural' (Water Corporation easement). • Lot 303 - zoned 'Rural' (turf farm). • Dampier to Bunbury Natural Gas Pipeline (DBNGP) easement (D207286). • Lot 107 – zone 'Rural' predominantly cleared small rural landholding. • Lot 106 – zone 'Rural' predominantly cleared small rural landholding.	
Wetland details			
Name		Palusplain: seasonally waterlogged flat.	
UFI		8037.	
Area		0.86 hectares.	
Preliminary desktop questions			
Land uses		**International, national, or regional significance**	
Current ownership	Mixed: Private (turf farm), Main Roads WA.	Conservation significance	No.
Current land use	Mixed: Turf farm, Water Corporation easement, DBNGP easement and Tonkin Highway reserve.	Ramsar	No.
Past land use	Rural.	Conservation reserve (system 6)	No.
Surrounding land use	Tonkin Highway, rural lots.	Bush Forever	No.
Existing management	Unknown.	Conservation estate	No.
Fire history/regime	No known fires in past 10 years.	Other	No.
Scientific value			
Scientific, geo-heritage or geo-conservation values		No.	
Fauna			
Threatened fauna		• Forest red-tailed black cockatoo (*Calyptorhynchus banksii naso*) VU. • Carnaby's cockatoo (*Calyptorhynchus latirostris*) EN. • Baudin's cockatoo (*Calyptorhynchus baudinii*) – Vu. • Quenda (*Isoodon fusciventer*) Priority 4 (P4).	
Source		DBCA threatened fauna database records within 1 km of the REW UFI 8037.	
Threatened Ecological Communities related to fauna		No.	
Flora			
Vegetation condition		Completed degraded.	
Is the wetland vegetation predominantly in good condition?		No.	
Vegetation complex (Heddle et al., 1980)		Guildford complex.	
% remaining vegetation complex:		5.87%.	
Threatened ecological communities		No.	

Representatives			
% area wetlands in same suite assigned Conservation mgt category		1.5.	
% area wetlands with same classification and suite assigned Conservation mgt category		1.3.	
Is the wetland rare:		No.	
Site assessment questions			
Geomorphology		**Wetland Processes**	
Geomorphic unit	Bassendean Sand over sandy clay to clayey sand of the Guildford Formation.	Wetland salinity.	Unknown.
Can all areas of the wetland be visited?	No. Turf farm was not accessible – observations made from adjacent areas and aerial photographs.	Groundwater dependence.	• Over 90% of the mapped REW has no native vegetation during the construction of the Tonkin Highway, rural land use/turf farm and the installation of the Water Corporation pipeline and the DBNGP. • The native vegetation present is limited to a 0/08 ha area of scattered trees within a rural paddock.
		Surface water present.	No.
Slope	Minimal.	Artificial drainage features.	No drains present. Evidence of infilling of the wetland body.
		Wetland processes occurring.	Potential infiltration into the superficial aquifer.
Describe any human induced alterations	Fill, excavation, alienation on boundaries, structural control.	Alteration of processes.	Highly altered. Current and historical land uses have disrupted natural hydrology and the native vegetation.
% geomorphology altered	>90%	Impact of alteration of processes.	Wetland natural attributes highly altered.
		Is the wetland part of a hydrological linkage?	No.
		Is the wetland part of an ecological linkage?	No
Habitats			
Is the wetland important for maintaining genetic and ecological diversity?		No.	
Does the wetland support/likely to support fauna at vulnerable life stages?		No.	
Fauna habitats present		The REW UFI 8037 was historically cleared for initially rural land use and subsequently the construction of Tonkin Highway, and the installation of the Water Corporation pipeline and the DBNGP and the turf farm.	
Fauna observed		No.	

Comments on habitat diversity	Native vegetation highly disturbed with over 90% of the mapped REW area in a cleared state.
Flora	
Significant flora species	• No Priority (or significant) Flora was recorded during the site flora and vegetation survey (AECOM 2020 & Woodman Environmental 2021).
Vegetation unit description(s)	• Cleared turf farm/Tonkin Highway reserve and Water Corporation and DBNGP easements. • Open paddocks with *Eucalyptus camaldulensis* (Red River Gum).
% of wetland boundary surrounded by land dominated by native vegetation	<90%
Compare wetland flora diversity	Very low.
Evidence of disturbance in last 24 months	No significant additional disturbance since 2008.
Fauna	
Evidence of native fauna species.	Nil.
Does the wetland function/potentially function as refuge.	Unlikely.
Potential fauna habitat utilisation; feeding/breeding/roosting/movement.	Predominantly disturbed turf farm and Tonkin Highway reserve.
Fauna diversity compared to similar wetlands.	Very low to none.
Cultural	
Is the wetland identified on national, state, regional or local heritage list	No.
Is the wetland identified for Aboriginal heritage value	• The wetland is within one heritage site: Brentwood Road Swamp (Site ID 4343), which was recorded in 1973 and listed on the Register for Aboriginal Sites as an artefact scatter with an unreliable location. • The substantial disturbance and the significant historical development (i.e., Tonkin Highway, DBNGP installation and the turf farm) it is unlikely the heritage values persist. • A site assessment was undertaken by Horizon Heritage Management (2021) to verify the location of the registered heritage site. This assessment concluded the Brentwood Road Swamp (Site ID 4343) is a heavily disturbed and altered environment with no cultural material evident during the site verification assessment nor through Traditional Owner visit to the site in December 2022 (Horizon Heritage 2021).
Are there any identified important social values	No.
Identify passive and active recreational use	No.
Education and scientific	
Is there an educational institution known to use wetland for educational purposes?	No.
Is there potential for wetland to be used in the future for educational purposes?	No.

DBCA methodology secondary wetland evaluation criteria - UFI 8037

Attributes/ functions/ values	General criteria	Criteria	Possible score	Assigned score	Comments
Geomorphology					
1	Representativeness	≤ 20% of wetlands of the same type are assigned Conservation on the Swan Coastal Plain by area.	H	-	40.1% of Sumpland wetlands on the Swan Coastal Plain are classified as 'Conservation' category.
2		≤ 20% of wetlands in the same consanguineous suite are assigned Conservation by area.	H	H	12.6% of wetlands in the Mungala consanguineous suite are classified as 'Conservation' category.
3		≤ 20% of wetlands of the same type in the same consanguineous suite are assigned Conservation by area.	H	-	29.3% of Sumpland wetlands in the Mungala consanguineous suite are classified as 'Conservation' category (by area).
4		The wetland is outstanding in some geomorphic aspect, for example size, origin, height relative to sea level, depth, age.	H	-	
5	Naturalness	Alteration to the wetland's geomorphology by % area:		L	The wetlands geomorphology has been significantly altered and infilled through historical rural land use and development of adjacent infrastructure, including Tonkin Highway and the Water Corporation pipeline and DBNGP. The wetland is in a 'Completely Degraded' condition and contains no remnant native vegetation or fauna habitat.
		< 25% altered	H		
		25-75% altered	I		
		> 75% altered.	L		
6	Scarcity	The wetland exhibits unusual geomorphology or unusual internal geomorphic features compared to other wetlands of the same type in the consanguineous suite.	H	-	
7		The wetland is the best example of its type in its consanguineous suite.	H	-	There are examples of more intact wetland areas within the Swan Coastal Plain, including adjacent Greater Brixton Street Wetlands.
Wetland processes					
8	Representativeness	The wetland is an important component of the natural hydrological cycle providing natural functions (e.g. flood protection, recharge/discharge, hydrological storage, support for groundwater dependent ecosystems).	H	L	

Attributes/ functions/ values	General criteria	Criteria	Possible score	Assigned score	Comments
		The wetland's vegetation, geomorphology, hydrology, or sediments are modified; however, the wetland is still a component of the hydrological cycle providing natural and artificial functions (e.g. flood remediation, recharge/discharge, hydrological storage, support for groundwater dependent ecosystems).	I		
		The wetland's vegetation, geomorphology, hydrology, or sediments are modified to the extent that the wetlands hydrological functions are artificial such as storage, or the wetland has been disconnected from the natural hydrological cycle and no longer provides natural attributes and functions.	L		
9		The wetland supports a representative process (e.g. wetland process typical of the wetland's hydrological setting, sediment accretionary process typical of the wetland's geomorphic setting or hydrochemical process typical of the wetland's geological setting).	H	-	
10	Naturalness	The wetland is not subject to altered wetland processes or, is subject to altered wetland processes and the wetland's natural attributes and functions are maintained.	H	L	
		The wetland is subject to altered wetland processes and the wetland's natural attributes and functions have been changed; however, they have the potential to be rehabilitated.	I		
		The wetland is subject to altered wetland processes to the extent that the wetland no longer supports natural attributes and functions.	L		
11	Scarcity	The wetland exhibits unusual processes compared to other wetlands of the same type in the consanguineous suite.	H	-	

Attributes/ functions/ values	General criteria	Criteria	Possible score	Assigned score	Comments
Linkages					
12	Representativeness	The wetland is a hydrological link in a larger or more complex and intact system.	H	-	
13	Naturalness	The wetland is part of a continuous ecological linkage or wildlife corridor, or a regionally significant ecological linkage or wildlife corridor connecting bushland or wetland areas.	H	L	The wetland is not within a mapped ecological linkage or directly linked to areas of intact native vegetation. It is located within 500 m of 'Conservation Category Wetlands' (GBSW), however, it is separated by Tonkin Highway reserve and surrounding rural/residential areas.
		The wetland is part of a fragmented ecological linkage or wildlife corridor.	I		
		The wetland is disturbed and isolated, surrounded by either a built or highly disturbed environment with no nearby native vegetation or waterways to support an intact or fragmented ecological linkage or wildlife corridor.	L		
14	Scarcity	The wetland has unusual hydrological, hydrogeological, hydrochemical, or ecological linkages with adjacent wetlands or bushland	H	-	
Habitats					
15	Representativeness	The wetland is isolated from other undisturbed wetlands or bushland and as a result, maintains important ecological or genetic fauna or flora diversity within its consanguineous suite domain.	H	-	A conservation category wetland is located within 400 m of the wetland which appears undisturbed (also within the Jandakot consanguineous suite)
16		The wetland contains evidence of surface water or groundwater expression that is vital for maintaining regionally significant populations of native aquatic or terrestrial flora or fauna.	H	-	There are no significant water bodies that exist within the area. The wetland has been historically infilled as a result of anthropogenic impacts including the establishment of rural paddocks, the construction of Tonkin Highway and Water Corporation pipeline/ DBNGP which resulted in the infilling and clearing of the mapped wetland area.
		The wetland contains evidence of surface water or groundwater expression that is important for maintaining populations of native aquatic or terrestrial flora or fauna.	I		
17		The wetland provides a nursery for native fauna populations or maintains fauna	H	-	

Attributes/ functions/ values	General criteria	Criteria	Possible score	Assigned score	Comments
		populations at a vulnerable stage of their life cycle.			
18	Naturalness	The wetland supports habitats that are unaltered, or the wetland has been altered and its natural habitats are maintained.	H	L	
		The wetland supports habitats that are altered; however, the habitats are still identifiable and have the potential to naturally regenerate or be rehabilitated after weed control, if required.	I		
		The wetland is altered and as a result is no longer supporting natural habitats which can be rehabilitated.	L		
19	Scarcity	The wetland supports habitats that are unusual compared to other wetlands of the same type on the Swan Coastal Plain.	H	-	
Flora					
20	Representativeness	The wetland's current diversity of native flora is similar to what would be expected in an unaltered state.	H	L	The wetland has been subject to degrading processes. The area is predominately cleared, with a small portion containing scattered trees. The native vegetation is entirely cleared, and the wetland infilled.
		The wetland supports a reduced diversity of native flora due to human induced disturbances.	I		
		The wetland supports a significantly reduced diversity of native flora species due to human induced disturbances.	L		
21		The wetland is identified in a vegetation complex (Heddle et al. 1980) which is represented by:		H	The wetland is mapped within the Pinjarra 968 vegetation association, of which 6.61% is remaining of its pre-European extent on the Swan Coastal Plain. However, the majority of
		≤ 30% of the pre-European extent	H		

Attributes/ functions/ values	General criteria	Criteria	Possible score	Assigned score	Comments
		30-50% of the pre-European extent.	I		Pinjarra vegetation association has been historically cleared, including with the wetland area. Subsequently, there is no remnant native vegetation within the wetland.
22	Naturalness	Using the vegetation condition scale outlined in Appendix B, the wetland's vegetation condition by area is:		L	The wetland lacks remnant vegetation and is predominately cleared or in 'Completely Degraded' condition.
		≥ 75% Good, Very Good, Excellent or Pristine	H		
		25-75% Good, Very Good, Excellent or Pristine	I		
		< 25% Good, Very Good, Excellent or Pristine.	L		
23		The wetland or ≥ 50% of the wetland boundary is surrounded by land dominated by remnant native vegetation.	H	L	The amendment area is predominately cleared as a result of historical clearing and associated 'Rural' land uses. Most of the vegetation surrounding the mapped wetland area is in a 'Completely Degraded' condition. The vegetated areas mostly consist of scattered planted trees (i.e., Red River Gum trees). The is two small patches (0.38 ha UFI 8026 & 0.32 UFI 8027) of remnant native vegetation associated with the mapped 'Conservation Category Wetlands' located 500 m from UFI 8037.
		The wetland or 10-50% of the wetland boundary is surrounded by land dominated by remnant native vegetation.	I		
		The wetland or < 10% of the wetland boundary is surrounded by land dominated by remnant native vegetation.	L		
24	Scarcity	The wetland supports an occurrence of declared rare, priority 1, priority 2, priority 3 or priority 4 flora, or an occurrence of three or more significant flora taxa.	H	-	
25		The wetland is likely to support declared rare, priority 1, priority 2, priority 3 or priority 4 flora; however, the occurrence cannot be located, or its habitat has been altered and is no longer in a natural state.	I	-	

Attributes/ functions/ values	General criteria	Criteria	Possible score	Assigned score	Comments
26		The wetland supports an occurrence of a threatened ecological community, priority 1 or priority 2 ecological community.	H	-	
27		The wetland supports an occurrence of a priority 3 or priority 4 ecological community.	I	-	
Fauna					
28	Representativeness	The wetland is an ecological refuge for regionally significant fauna species or fauna assemblages.	H	-	
		The wetland has the potential to be an ecological refuge but is disturbed and its attributes and functions require rehabilitation.	I		
29		The wetland supports a permanent or seasonal feeding, breeding, roosting, or watering site for regionally significant native fauna.	H	-	
		The wetland supports a permanent or seasonal feeding, breeding, roosting, or watering site for regional or local fauna but only in association with other surrounding natural areas.	I		
30	Naturalness	The wetland's current diversity of native fauna is similar to what would be expected in an unaltered state, or the wetland supports diverse fauna compared to other wetlands of the same type.	H	L	The wetland area and associated native vegetation have been infilled and cleared. There is minimal to no fauna habitat such as Quenda and the three threatened black cockatoo species. Within the Water Corporation / DBNGP cleared easement there are planted red river gum trees. The red river gum trees, are not preferred breeding or nesting trees for the three threatened black cockatoo species.
		The wetland supports a reduced diversity of fauna compared to other wetlands of the same type.	I		
		The wetland supports limited attributes and functions for fauna populations due to human induced disturbances.	L		
31	Scarcity	The wetland is likely to support a breeding, roosting, refuge or feeding site for populations of fauna listed by the Australian Government (e.g. EPBC Act 1999, JAMBA, CAMBA, RoKAMBA Agreements) or the State	H	H	The planted red river gums provide low quality Carnaby's, Baudin's, and Forest Red-tailed black Cockatoo foraging habitat trees.

Attributes/ functions/ values	General criteria	Criteria	Possible score	Assigned score	Comments
		(e.g. threatened or specially protected fauna listed under the Wildlife Conservation Act 1950).			
32		The wetland supports a breeding, roosting, refuge or feeding site for priority 1, priority 2, priority 3 or priority 4 fauna.	H	-	
33		The wetland supports an occurrence of a threatened ecological community, priority 1 or priority 2 ecological community.	H	-	
34		The wetland supports an occurrence of a priority 3 or priority 4 ecological community or a breeding, roosting, refuge or feeding site for significant fauna.	I	-	
Cultural					
35	Representativeness	The wetland or its immediate surrounds is identified for its natural values on a national or State heritage list or the wetland supports other known regional heritage values.	H	-	The wetland is not identified on the State Heritage Register.
36		The wetland or its immediate surrounds is identified for its natural values on a municipal heritage list or the wetland supports other known local heritage values.	I	-	The wetland is not identified on the Municipal Heritage list.
37		The wetland or its immediate surrounds is identified on a national, State or local list or register for its Aboriginal cultural value.	H	H	The wetland is within one heritage site: Brentwood Road Swamp (Site ID 4343).
38		The wetland is important to the local community for its natural values.	H	-	The wetland has been substantially cleared and developed, and as such is not considered important to the community based on its natural values.
39		The wetland is or has the potential to be a site for public or private based recreation.	I	-	The wetland has been substantially developed including the construction of Tonkin Highway, and the installation of the DBNGP and a Turf farm, and, as such, cannot be utilised for public or private recreation.
40		The wetland is the subject of a recognised ecological restoration / rehabilitation project by a community group, landowner or land manager that aims to improve the	H	I	• The wetland is within one heritage site: Brentwood Road Swamp (Site ID 4343), which was recorded in 1973 and listed on

Attributes/ functions/ values	General criteria	Criteria	Possible score	Assigned score	Comments
		wetland's natural, heritage, cultural or social values.			the Register for Aboriginal Sites as an artefact scatter with an unreliable location. The substantial disturbance and the significant historical development (i.e., Tonkin Highway, DBNGP installation and the turf farm) it is unlikely the heritage values persist. • A site assessment was undertaken by Horizon Heritage Management (2021) to verify the location of the registered heritage site. • A reliable location for the site will be determined following DPLH consideration of the results of the site assessment. The site is a registered Aboriginal heritage site and as such is afforded protection under the AH Act.
		The wetland is likely to support heritage, cultural or social values; however, the values cannot be confirmed, or the values have been disturbed and are no longer as important or significant.	I		
		The wetland did support heritage, cultural or social values; however, these have been significantly disturbed and are no longer important or the values have been removed.	L		
Scientific and Educational					
41	Representativeness	The wetland supports known important teaching or research characteristics and for this reason is an existing or potential education or research site. Note: the wetland must still support the relevant teaching or research characteristics.	H	-	The wetland is located on predominately private property, comprising a Turf Farm and rural residential land use, as well as Tonkin Highway in the west and the DBNGP. The wetland is therefore highly disturbed and unlikely to be of interest in studying for ecological or hydrological purposes.
		The wetland has the potential to be used as a study or research site.	I		
42		The wetland supports known scientific, geo-heritage or geo-conservation values.	H	-	

Appendix B: Detailed assessment of Resource Enhancement Wetland UFI 15257

Detailed assessment of Resource Enhancement Wetland UFI 15257

Assessment element		Details	
Wetland location / Lot details		• Lots 501, 146, 12 & 7 - zoned 'Rural' predominantly cleared small rural landholdings. • Lot 302 – zoned 'Rural' (Water Corporation easement). • Dampier to Bunbury Natural Gas Pipeline (DBNGP) easement (D207286).	
Wetland details			
Name		Palusplain: seasonally waterlogged flat.	
UFI		15257.	
Area		30.33 hectares (approximately 2.06 ha area is within the amendment area).	
Preliminary desktop questions			
Land uses		**International, national, or regional significance**	
Current ownership	Mixed: Private (rural landholdings), Main Roads WA.	Conservation significance	No.
Current land use	Mixed: Small rural lots, Water Corporation easement, DBNGP easement and Tonkin Highway reserve.	Ramsar	No.
Past land use	Rural.	Conservation reserve (system 6)	No.
Surrounding land use	Tonkin Highway, rural lots.	Bush Forever	No.
Existing management	Unknown.	Conservation estate	No.
Fire history/regime	No known fires in past 10 years.	Other	No.
Scientific value			
Scientific, geo-heritage or geo-conservation values		• No.	
Fauna			
Threatened fauna		• Forest red-tailed black cockatoo (*Calyptorhynchus banksii naso*) VU. • Carnaby's cockatoo (*Calyptorhynchus latirostris*) EN. • Baudin's cockatoo (*Calyptorhynchus baudinii*) – Vu. • Quenda (*Isoodon fusciventer*) Priority 4 (P4).	
Source		DBCA threatened fauna database records within 1 km of the REW UFI 15257.	
Threatened Ecological Communities related to fauna		No.	
Flora			
Vegetation condition		Completed Degraded.	
Is the wetland vegetation predominantly in good condition?		No.	
Vegetation complex (Heddle et al., 1980)		Southern River & Guildford Complex.	
% remaining vegetation complex:		• Southern River - 16.8% • Guildford Complex - 5.87%.	
Threatened ecological communities		No.	
Representatives			

% area wetlands in same suite assigned Conservation mgt category		1.5.	
% area wetlands with same classification and suite assigned Conservation mgt category		1.3.	
Is the wetland rare:		No.	
Site assessment questions			
Geomorphology		**Wetland Processes**	
Geomorphic unit	Bassendean Sand over sandy clay to clayey sand of the Guildford Formation.	Wetland salinity.	Unknown.
Can all areas of the wetland be visited?	Yes.	Groundwater dependence.	Approximately 90% of the mapped REW UFI 15257 has no native vegetation.
		Surface water present.	No.
Slope	Minimal.	Artificial drainage features.	No drains present.
		Wetland processes occurring.	Potential infiltration into the superficial aquifer.
Describe any human induced alterations	Fill, excavation, alienation on boundaries, structural control.	Alteration of processes.	Highly altered. Current and historical land uses have disrupted natural hydrology and the native vegetation.
% geomorphology altered	>90%	Impact of alteration of processes.	Wetland natural attributes highly altered.
		Is the wetland part of a hydrological linkage?	No.
		Is the wetland part of an ecological linkage?	No
Habitats			
Is the wetland important for maintaining genetic and ecological diversity?		No.	
Does the wetland support/likely to support fauna at vulnerable life stages?		No.	
Fauna habitats present		The REW UFI 15257 was historically cleared for initially rural land use and subsequently the construction of Tonkin Highway and the installation of the Water Corporation pipeline and the DBNGP. Water Corporation and the DBNGP easements are maintained as cleared paddocks with planted trees along the fence line.	
Fauna observed		No.	
Comments on habitat diversity		Native vegetation highly disturbed with 90% of the mapped REW area has been historically cleared. The cleared areas are maintained as open paddocks.	
Flora			
Significant flora species		No Priority (or significant) Flora was recorded during the site flora and vegetation survey (AECOM 2020 & Woodman Environmental 2021).	
Vegetation unit description(s)		• Within the Tonkin Highway reserve and Water Corporation easement:	

	○ Stands of *Corymbia calophylla* (Marri) and non-native eucalypt *Eucalyptus camaldulensis* (Red River Gum) over non-native eucalypt *Casuarina cunninghamiana* subsp. *cunninghamiana, Melaleuca preissiana, Jacksonia sternbergiana* and **Schinus terebinthifolia* over introduced species. • Cleared paddocks with *Eucalyptus camaldulensis* (Red River Gum).
% of wetland boundary surrounded by land dominated by native vegetation	<90%
Compare wetland flora diversity	Very low.
Evidence of disturbance in last 24 months	No significant additional disturbance since 2008.
Fauna	
Evidence of native fauna species.	Nil.
Does the wetland function/potentially function as refuge.	Unlikely.
Potential fauna habitat utilisation; feeding/breeding/roosting/movement.	• Planted trees existing within a historically disturbed rural landholdings and infrastructure corridor(s) (Tonkin Highway reserve, Water Corporation pipeline & DBNGP easements) with no native understorey. • The easements are maintained as open paddock areas with planted trees along the fenced boundary.
Fauna diversity compared to similar wetlands.	Very low to none.
Cultural	
Is the wetland identified on national, state, regional or local heritage list	No.
Is the wetland identified for Aboriginal heritage value	No heritage sites within REW UFI 15257.
Are there any identified important social values	No.
Identify passive and active recreational use	No.
Education and scientific	
Is there an educational institution known to use wetland for educational purposes?	No.
Is there potential for wetland to be used in the future for educational purposes?	No.

DBCA methodology secondary wetland evaluation criteria - 15257

Attributes/ functions/ values	General criteria	Criteria	Possible score	Assigned score	Comments
Geomorphology					
1	Representativeness	≤ 20% of wetlands of the same type are assigned Conservation on the Swan Coastal Plain by area.	H	H	3.8% of Palusplain wetlands on the Swan Coastal Plain are classified as 'Conservation' category.
2		≤ 20% of wetlands in the same consanguineous suite are assigned Conservation by area.	H	H	12.6% of wetlands in the Mungala consanguineous suite are classified as 'Conservation' category.
3		≤ 20% of wetlands of the same type in the same consanguineous suite are assigned Conservation by area.	H	H	4.1% of Palusplain wetlands in the Mungala consanguineous suite are classified as 'Conservation' category (by area).
4		The wetland is outstanding in some geomorphic aspect, for example size, origin, height relative to sea level, depth, age.	H	-	
5	Naturalness	Alteration to the wetland's geomorphology by % area:		L	The wetlands geomorphology has been significantly altered through historical rural land use and development of adjacent infrastructure, including the infilling of the wetland area to establish the Tonkin Highway and the Water Corporation pipeline / DBNGP. The wetland is in a 'Completely Degraded' condition and contains no remnant native vegetation or fauna habitat.
		< 25% altered	H		
		25-75% altered	I		
		> 75% altered.	L		
6	Scarcity	The wetland exhibits unusual geomorphology or unusual internal geomorphic features compared to other wetlands of the same type in the consanguineous suite.	H	-	
7		The wetland is the best example of its type in its consanguineous suite.	H	-	
Wetland processes					
8	Representativeness	The wetland is an important component of the natural hydrological cycle providing natural functions (e.g. flood protection, recharge/discharge, hydrological storage, support for groundwater dependent ecosystems).	H	L	

Attributes/ functions/ values	General criteria	Criteria	Possible score	Assigned score	Comments
		The wetland's vegetation, geomorphology, hydrology, or sediments are modified; however, the wetland is still a component of the hydrological cycle providing natural and artificial functions (e.g. flood remediation, recharge/discharge, hydrological storage, support for groundwater dependent ecosystems).	I		
		The wetland's vegetation, geomorphology, hydrology, or sediments are modified to the extent that the wetlands hydrological functions are artificial such as storage, or the wetland has been disconnected from the natural hydrological cycle and no longer provides natural attributes and functions.	L		
9		The wetland supports a representative process (e.g. wetland process typical of the wetland's hydrological setting, sediment accretionary process typical of the wetland's geomorphic setting or hydrochemical process typical of the wetland's geological setting).	H	-	
10	Naturalness	The wetland is not subject to altered wetland processes or, is subject to altered wetland processes and the wetland's natural attributes and functions are maintained.	H	L	
		The wetland is subject to altered wetland processes and the wetland's natural attributes and functions have been changed; however, they have the potential to be rehabilitated.	I		
		The wetland is subject to altered wetland processes to the extent that the wetland no longer supports natural attributes and functions.	L		
11	Scarcity	The wetland exhibits unusual processes compared to other wetlands of the same type in the consanguineous suite.	H	-	

Attributes/ functions/ values	General criteria	Criteria	Possible score	Assigned score	Comments
Linkages					
12	Representativeness	The wetland is a hydrological link in a larger or more complex and intact system.	H	-	
13	Naturalness	The wetland is part of a continuous ecological linkage or wildlife corridor, or a regionally significant ecological linkage or wildlife corridor connecting bushland or wetland areas.	H	I	The wetland forms part of a larger network, as it is adjacent to the GBSW. However, the surrounding land use has been subject to substantial clearing and degradation, including construction of Tonkin Highway, Water Corporation pipeline and the DBNGP, resulting in fragmentation of the wetland.
		The wetland is part of a fragmented ecological linkage or wildlife corridor.	I		
		The wetland is disturbed and isolated, surrounded by either a built or highly disturbed environment with no nearby native vegetation or waterways to support an intact or fragmented ecological linkage or wildlife corridor.	L		
14	Scarcity	The wetland has unusual hydrological, hydrogeological, hydrochemical or ecological linkages with adjacent wetlands or bushland	H	-	
Habitats					
15	Representativeness	The wetland is isolated from other undisturbed wetlands or bushland and as a result, maintains important ecological or genetic fauna or flora diversity within its consanguineous suite domain.	H	-	The wetland does not maintain important ecological or genetic fauna or flora diversity.
16		The wetland contains evidence of surface water or groundwater expression that is vital for maintaining regionally significant populations of native aquatic or terrestrial flora or fauna.	H	-	There is no evidence of surface water or groundwater features that may be important for maintaining aquatic or terrestrial flora or fauna.
		The wetland contains evidence of surface water or groundwater expression that is important for maintaining populations of native aquatic or terrestrial flora or fauna.	I		
17		The wetland provides a nursery for native fauna populations or maintains fauna	H	-	The wetland is not considered to provide a nursery for fauna given the lack of native vegetation and habitat values.

Attributes/ functions/ values	General criteria	Criteria	Possible score	Assigned score	Comments
		populations at a vulnerable stage of their life cycle.			
18	Naturalness	The wetland supports habitats that are unaltered, or the wetland has been altered and its natural habitats are maintained.	H	L	Given the substantial level of disturbance and development already having occurred, the wetland is not considered to support natural habitats that can be rehabilitated.
		The wetland supports habitats that are altered; however, the habitats are still identifiable and have the potential to naturally regenerate or be rehabilitated after weed control, if required.	I		
		The wetland is altered and as a result is no longer supporting natural habitats which can be rehabilitated.	L		
19	Scarcity	The wetland supports habitats that are unusual compared to other wetlands of the same type on the Swan Coastal Plain.	H	-	
Flora					
20	Representativeness	The wetland's current diversity of native flora is similar to what would be expected in an unaltered state.	H	L	
		The wetland supports a reduced diversity of native flora due to human induced disturbances.	I		
		The wetland supports a significantly reduced diversity of native flora species due to human induced disturbances.	L		
21		The wetland is identified in a vegetation complex (Heddle et al. 1980) which is represented by:		H	The wetland is mapped within the Pinjarra 968 vegetation association, of which 6.61% is remaining of its pre-European extent on the Swan Coastal Plain. However, the majority of Pinjarra vegetation association has been historically cleared, including with the wetland area. Subsequently, there is no remnant native vegetation within the wetland.
		≤ 30% of the pre-European extent	H		
		30-50% of the pre-European extent.	I		
22	Naturalness	Using the vegetation condition scale outlined in Appendix B, the wetland's vegetation condition by area is:		L	The wetland is predominately cleared in a 'Completely Degraded' condition.
		≥ 75% Good, Very Good, Excellent or Pristine	H		

Attributes/ functions/ values	General criteria	Criteria	Possible score	Assigned score	Comments
		25-75% Good, Very Good, Excellent or Pristine	I		
		< 25% Good, Very Good, Excellent or Pristine.	L		
23		The wetland or ≥ 50% of the wetland boundary is surrounded by land dominated by remnant native vegetation.	H	I	The wetland within the amendment area is highly disturbed due to surrounding land uses. A portion of the wetland outside of the amendment area is surrounded by native vegetation within the GBSW.
		The wetland or 10-50% of the wetland boundary is surrounded by land dominated by remnant native vegetation.	I		
		The wetland or < 10% of the wetland boundary is surrounded by land dominated by remnant native vegetation.	L		
24	Scarcity	The wetland supports an occurrence of declared rare, priority 1, priority 2, priority 3 or priority 4 flora, or an occurrence of three or more significant flora taxa.	H	-	There is no evidence of the wetland supporting the occurrence of any Threatened or Priority flora.
25		The wetland is likely to support declared rare, priority 1, priority 2, priority 3 or priority 4 flora; however, the occurrence cannot be located, or its habitat has been altered and is no longer in a natural state.	I	-	
26		The wetland supports an occurrence of a threatened ecological community, priority 1 or priority 2 ecological community.	H	-	
27		The wetland supports an occurrence of a priority 3 or priority 4 ecological community.	I	-	
Fauna					
28	Representativeness	The wetland is an ecological refuge for regionally significant fauna species or fauna assemblages.	H	-	The wetland is highly disturbed and comprises predominately private rural land uses, with a lack of remnant vegetation providing fauna habitat.
		The wetland has the potential to be an ecological refuge but is disturbed and its attributes and functions require rehabilitation.	I		
29		The wetland supports a permanent or seasonal feeding, breeding, roosting or	H	-	

Attributes/ functions/ values	General criteria	Criteria	Possible score	Assigned score	Comments
		watering site for regionally significant native fauna.			
		The wetland supports a permanent or seasonal feeding, breeding, roosting or watering site for regional or local fauna but only in association with other surrounding natural areas.	I		
30	Naturalness	The wetland's current diversity of native fauna is similar to what would be expected in an unaltered state, or the wetland supports diverse fauna compared to other wetlands of the same type.	H	L	
		The wetland supports a reduced diversity of fauna compared to other wetlands of the same type.	I		
		The wetland supports limited attributes and functions for fauna populations due to human induced disturbances.	L		
31	Scarcity	The wetland is likely to support a breeding, roosting, refuge or feeding site for populations of fauna listed by the Australian Government (e.g. EPBC Act 1999, JAMBA, CAMBA, RoKAMBA Agreements) or the State (e.g. threatened or specially protected fauna listed under the Wildlife Conservation Act 1950).	H	H	The wetland supports a small portion of low quality Carnaby's, Baudin's, and Forest red-tailed black Cockatoo foraging habitat, specifically planted river gum trees.
32		The wetland supports a breeding, roosting, refuge or feeding site for priority 1, priority 2, priority 3 or priority 4 fauna.	H	-	
33		The wetland supports an occurrence of a threatened ecological community, priority 1 or priority 2 ecological community.	H	-	
34		The wetland supports an occurrence of a priority 3 or priority 4 ecological community or a breeding, roosting, refuge or feeding site for significant fauna.	I	-	
Cultural					

Attributes/ functions/ values	General criteria	Criteria	Possible score	Assigned score	Comments
35	Representativeness	The wetland or its immediate surrounds is identified for its natural values on a national or State heritage list or the wetland supports other known regional heritage values.	H	-	The wetland is not identified on the State Heritage Register.
36		The wetland or its immediate surrounds is identified for its natural values on a municipal heritage list, or the wetland supports other known local heritage values.	I	-	The wetland is not identified on the Municipal Heritage list.
37		The wetland or its immediate surrounds is identified on a national, State, or local list or register for its Aboriginal cultural value.	H	-	The wetland is not identified as an Aboriginal Heritage Place.
38		The wetland is important to the local community for its natural values.	H	-	The wetland has been substantially cleared and developed, and as such is not considered important to the community based on its natural values.
39		The wetland is or has the potential to be a site for public or private based recreation.	I	-	The wetland has been substantially developed and, as such, cannot be utilised for public or private recreation.
40		The wetland is the subject of a recognised ecological restoration / rehabilitation project by a community group, landowner or land manager that aims to improve the wetland's natural, heritage, cultural or social values.	H	L	It is possible that the wetland once supported heritage, cultural or social values however given the substantial disturbance and development present, it is unlikely that these values persist.
		The wetland is likely to support heritage, cultural or social values; however, the values cannot be confirmed, or the values have been disturbed and are no longer as important or significant.	I		
		The wetland did support heritage, cultural or social values; however, these have been significantly disturbed and are no longer important or the values have been removed.	L		
Scientific and Educational					
41	Representativeness	The wetland supports known important teaching or research characteristics and for this reason is an existing or potential	H	-	

Attributes/ functions/ values	General criteria	Criteria	Possible score	Assigned score	Comments
		education or research site. Note: the wetland must still support the relevant teaching or research characteristics.			
		The wetland has the potential to be used as a study or research site.	I		
42		The wetland supports known scientific, geo-heritage or geo-conservation values.	H	-	

Appendix 5 Ecological Memo (JBS&G 2024)

Wattle Grove South MRS Amendment Area Ecological Survey Effort

Hesperia Property Pty Ltd for Western Australian Planning Commission

Technical Memo

JBS&G 60309 | 157,603

19 February 2024

JBS&G

We acknowledge the Traditional Custodians of Country throughout Australia and their connections to land, sea and community.

We pay respect to Elders past and present and in the spirit of reconciliation, we commit to working together for our shared future.



Caring for Country The Journey of JBS&G
Artist: Patrick Caruso, Eastern Arrernte

Table of Contents

Table of Contents i

1. Purpose and Scope 3

1.1 Survey overview 4

2. Desktop Assessments 7

2.1.1 Conservation Significant Flora 7

2.1.2 Threatened and Priority Ecological Communities 9

2.1.3 Conservation Significant Fauna 11

3. Field Survey Results and Discussion 13

3.1 Flora and Vegetation 13

3.1.1 Vegetation Communities 13

3.1.2 Vegetation Condition 14

3.1.3 Floristic Community Type Analysis 17

3.1.4 Threatened and Priority Ecological Communities 20

3.1.5 Conservation Significant Flora 22

3.2 Fauna 24

3.2.1 Terrestrial Fauna Habitat 24

3.2.2 Terrestrial Fauna Occurrence 31

3.2.3 Conservation Significant Terrestrial Fauna 32

4. Adequacy of Flora and Vegetation Surveys 34

4.1 Key Flora and Vegetation Survey Guideline Requirements 34

4.2 Flora and Vegetation survey adequacy assessment 34

4.2.1 Survey 1: Wattle Grove South Ecological Surveys AECOM (2020) 34

4.2.2 Survey 2: Targeted Flora, Habitat and Supplementary Flora & Vegetation surveys JBS&G 2021 and 2022 35

5. Adequacy of Fauna Surveys 38

5.1 Key Fauna survey guideline requirements 38

5.2 Fauna survey adequacy assessment 38

6. Conclusions 39

7. References 40

8. Limitations 42

Appendix A 360 Environmental (2018) Environmental Assessment Report 43

Appendix B AECOM (2020) Wattle Grove South Ecological Surveys Report 44

Appendix C Quadrat and relevé data sheets 45

Appendix D Floristic Community Type Analysis 2023 (PATN results) 46

Appendix E Banksia Woodlands of the Swan Coastal Plain Assessment 47

Appendix F Reconnaissance Flora and Vegetation Assessment 48

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List of Tables

Table 2-1: Threatened and Priority flora potentially occurring within 5 km of MRS amendment area 7
Table 2-2 Threatened and Priority Ecological Communities identified in the desktop assessment 10
Table 2-3: Threatened and Priority Fauna potentially occurring within 10 km of the MRS amendment area. 12
Table 3-1: Vegetation Community Descriptions 13
Table 3-2: Vegetation Communities 14
Table 3-3: Vegetation Condition within the Amendment Area 14
Table 3-4 Inferred FCTs for Remnant Native Vegetation within the MRS Amendment Area 18
Table 3-5: Fauna Habitats Recorded within the MRS amendment area 25
Table 3-6: Fauna Species Observed During Field Surveys 31
Table 4-1 Flora and vegetation guidance requirements (EPA 2016a) 34
Table 4-2 AECOM (2020) potential limitations and constraints 34
Table 4-3: Targeted Flora and Supplementary Flora & Vegetation surveys JBS&G (2021 & 2022) – limitations and constraints. 36
Table 5-1 Fauna guidance requirements (EPA 2020) 38

List of Figures

Figure 1-1 MRS Amendment Area 5
Figure 1-2: Lots surveyed by AECOM and JBS&G within MRS amendment area 6
Figure 3-1: Vegetation Communities within the MRS amendment area 15
Figure 3-2: Vegetation condition within MRS amendment area 16
Figure 3-3: Conservation Significant Ecological Communities within the Amendment Area 21
Figure 3-4: Fauna habitat 30

1. Purpose and Scope

This memorandum provides a summary of the ecological survey effort undertaken for the Metropolitan Region Scheme (MRS) Amendment 1388/57 – Wattle Grove South.

The Western Australian Planning Commission (WAPC) is proposing to rezone approximately 126 ha of 'Rural' zoned land to 'Urban' under the MRS. The MRS amendment area is located within Wattle Grove, bound by Welshpool Road East and Crystal Brook Road to the north, and Tonkin Highway to the west. The MRS amendment area is approximately 30 km east of the Perth Central Business District (CBD) and is located within the City of Kalamunda. The MRS amendment area covers a total of 126 ha and is comprised of 77 lots.

This memo provides an overview of the following flora, vegetation and fauna surveys and assessments that have been undertaken within the MRS amendment area:

- 360 Environmental (2018) – desktop assessment (Appendix A);
- AECOM (2020) – desktop and detailed field surveys (Appendix B); and
- JBS&G – various surveys in 2021 and 2022 (Appendices C to F).

These surveys and assessments are intended to inform the environmental impact assessment of MRS Amendment 1388/57 and will inform the environmental management framework that will be further referenced in the Environmental Review Document.

1.1 Survey overview

The majority of the MRS amendment area (Figure 1-1) has been previously surveyed by AECOM (2020) as part of the City of Kalamunda's preparation of a concept plan for the wider Crystal Brook (Wattle Grove South) investigation area. Additional targeted survey work was undertaken by JBS&G between 2021 and 2022 to provide supplementary ecological data for the MRS amendment area not covered by previous survey effort or to provide further targeted surveys. The majority of the MRS amendment area, being 69 of the 77 lots (representing approximately 92% by area), has been subject to some form of ecological assessment. Thirteen of the lots were surveyed based on observations made from the fence line of road and adjacent lots and detailed aerial photography. Eight privately owned lots were unable to be surveyed due to limited access.

The fauna, flora and vegetation survey effort within the MRS amendment area is summarised below and depicted in Figure 1-2.

Summary of ecological survey within the MRS amendment area

360 Environmental (2018) and AECOM (2020) have previously undertaken desktop assessments of the MRS amendment area as part of a consideration of the broader Wattle Grove (South) locality. AECOM (2020) also conducted site survey's and assessment for flora, vegetation and fauna.

Five further supplementary surveys of the MRS amendment area were completed by JBS&G during 2021 and 2022:

- Tree survey (February 2021): Habitat tree survey of various lots and the Victoria Road reserve.
- Targeted flora survey (August 2021): *Drakea elastica* on Lot 254 Victoria Road;
- Supplementary vegetation and flora assessment (October 2021): Various lots;
- Reconnaissance vegetation and flora assessment (January 2022) (Appendix F): Various lots, including from lot boundaries; and
- Further reconnaissance vegetation and flora assessment of targeted lots (October 2022).

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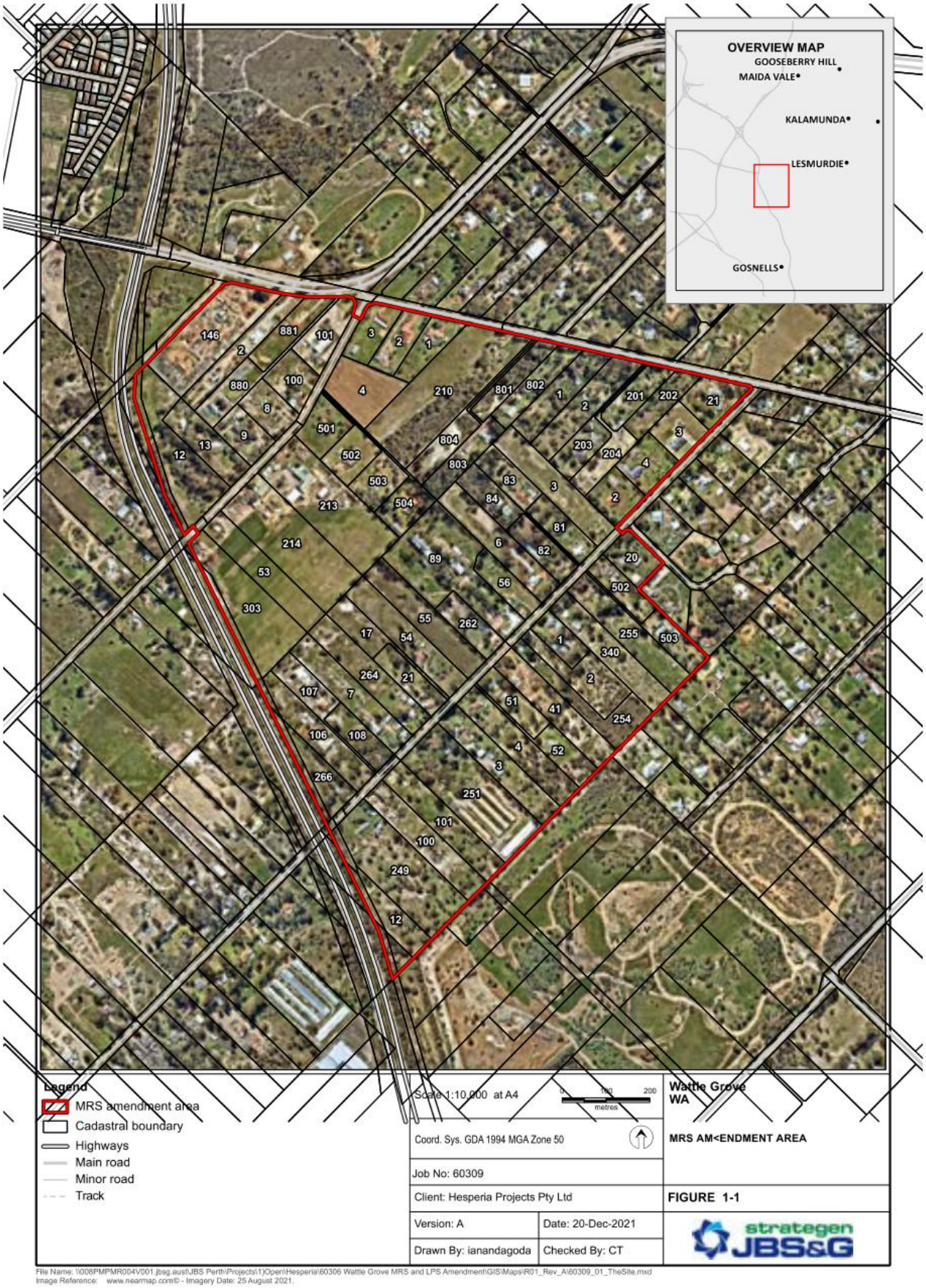


Figure 1-1 MRS Amendment Area

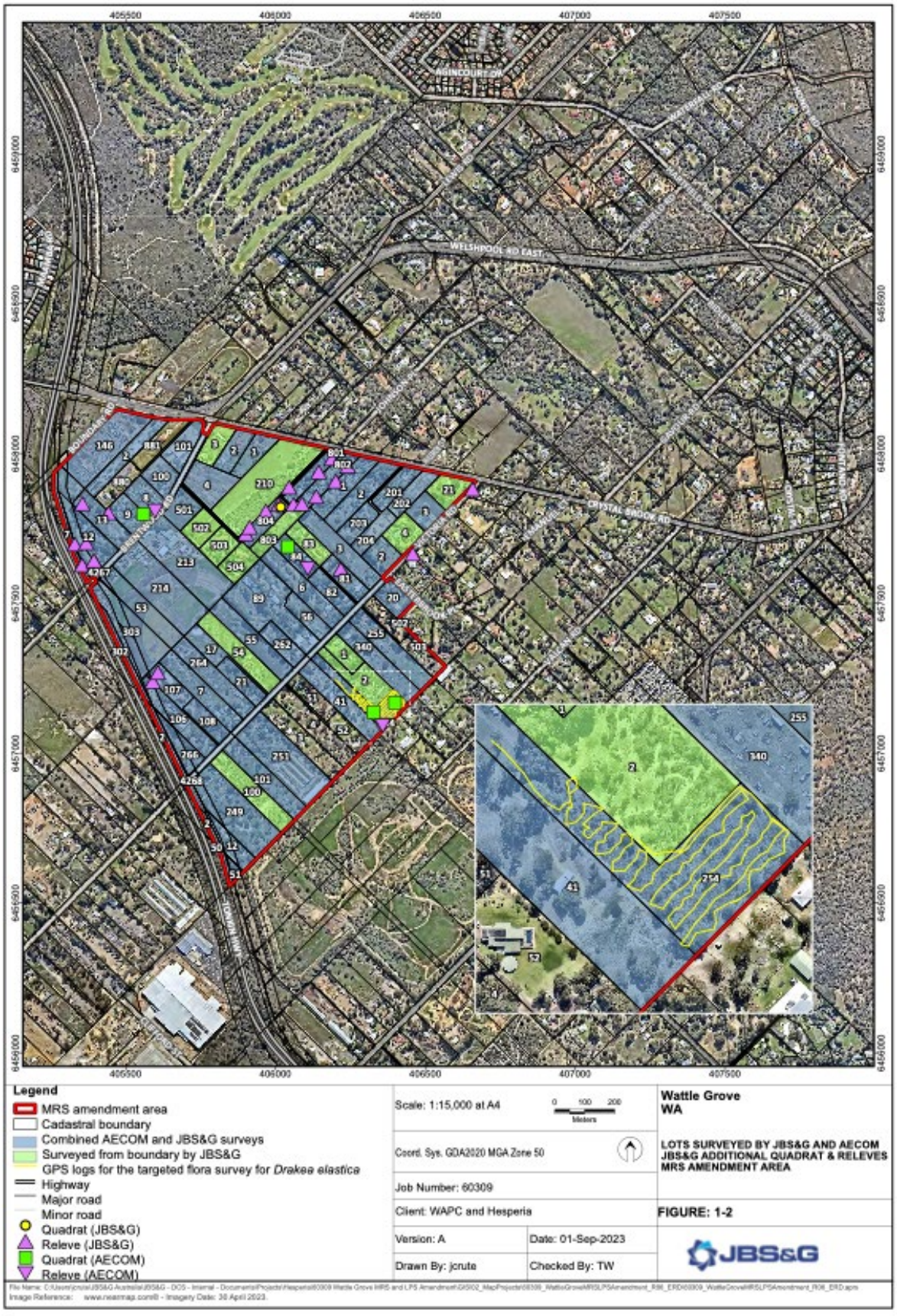


Figure 1-2: Lots surveyed by AECOM and JBS&G within MRS amendment area

2. Desktop Assessments

2.1.1 Conservation Significant Flora

360 Environmental (2018) and AECOM (2020) undertook desktop assessments for the Wattle Grove (South) locality. Further desktop assessments were undertaken in September 2023 by JBS&G to verify the validity of the previous searches, with new database requests submitted to the Department of Biodiversity, Conservation and Attractions (DBCA) for both the Threatened and Priority Flora Database and the Western Australian Herbarium Database. A total of 83 flora taxa of conservation significance were identified by the searches, with 60 potentially occurring within a 5 km buffer of the MRS amendment area. A 10 km buffer was requested; however, DBCA determined that a 5 km buffer was appropriate for the MRS amendment area, based on the number of records available in the general area and the range of local species, and that this flexibility caters for complexity, ensuring meaningful results.

The potential for these plants to occur within the site was assessed and based on general habitat requirements and distribution. Twenty Threatened and 61 Priority flora species were considered to have the potential to occur within the site (Table 2-1). The JBS&G 2023 database search results are presented in Table 2-1.

Further, two conservation significant flora taxa were identified by AECOM (2020) to have been historically recorded within the site:

- *Conospermum undulatum* (T) – listed under the Federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the State *Biodiversity Conservation Act 2016* (BC Act)
- *Isopogon autumnalis* (P3), previously named *Isopogon drummondii* – listed under the Department of Biodiversity Conservation and Attraction's (DBCAs) Priority flora lists

Table 2-1: Threatened and Priority flora potentially occurring within 5 km of MRS amendment area

Species (Common name (if applicable))	Conservation status		Potential to occur (based on desktop assessment)
	EPBC Act	BC Act	
Grevillea thelemanniana (Spider Net Grevillea)	Critically Endangered	Critically Endangered	Possible
Ptilotus pyramidatus	Critically Endangered	Critically Endangered	Unknown
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	Critically Endangered	Critically Endangered	Likely
Caladenia huegelii (Grand Spider Orchid)	Endangered	Critically Endangered	Unknown
Drakaea elastica (Glossy-leaved Hammer Orchid)	Endangered	Critically Endangered	Likely
Calytrix breviseta subsp. Breviseta	Endangered	Critically Endangered	Likely
Thelymitra magnifica (Crystal Brook Star Orchid)	-	Critically Endangered	Likely
Andersonia gracilis	Endangered	Vulnerable	Possible
Austrostipa bronwenae	Endangered	Endangered	Likely
Banksia mimica (Summer Honeypot)	Endangered	Vulnerable	Possible
Darwinia apiculata (Scarp Darwinia)	Endangered	Endangered	Possible
Diuris purdiei (Purdie's Donkey Orchid)	Endangered	Endangered	Unknown
Eremophila glabra subsp. Chlorella	Endangered	Endangered	Likely
Macarthuria keigheryi	Endangered	Endangered	Possible
Lepidosperma rostratum	Endangered	Endangered	Likely
Thelymitra stellata (Star Orchid)	Endangered	Endangered	Likely
Acacia anomala (Grass Wattle)	Vulnerable	Vulnerable	Possible

Species (Common name (if applicable))	Conservation status		Potential to occur (based on desktop assessment)
	EPBC Act	BC Act	
Acacia aphylla (Leafless Rock Wattle)	Vulnerable	Vulnerable	Possible
Anthocercis gracilis (Slender Tailflower)	Vulnerable	Vulnerable	Possible
Conospermum undulatum	Vulnerable	Vulnerable	Confirmed
Eleocharis keigheryi	Vulnerable	Vulnerable	Possible
Morelotia australiensis		Vulnerable	Unlikely
Goodenia arthrotricha	Endangered	Endangered	Possible
Grevillea curviloba	Endangered	Endangered	Possible
Diuris drummondii (Tall Donkey Orchid)	Vulnerable	Threatened	Unlikely
Schoenus sp. Beaufort (G.J. Keighery 6291)	-	P1	Possible
Boronia humifusa	-	P1	Possible
Lepyrodia curvescens	-	P2	Possible
Schoenus loliaceus	-	P2	Possible
Comesperma griffinii	-	P2	Likely
Platysace ramosissima	-	P3	Possible
Schoenus benthamii	-	P3	Possible
Schoenus capillifolius	-	P3	Possible
Schoenus pennisetis	-	P3	Possible
Schoenus sp. Waroona (G.J. Keighery 12235)	-	P3	Possible
Stylidium aceratum	-	P3	Possible
Styphelia filifolia	-	P3	Unknown
Thysanotus anceps	-	P3	Possible
Isopogon autumnalis (Previously *Isopogon drummondii)*	-	P3	Confirmed
Isotropis cuneifolia subsp. *Glabra*	-	P3	Possible
Allocasuarina grevilleoides	-	P3	Possible
Jacksonia gracillima	-	P3	Possible
Lasiopetalum glutinosum subsp. *Glutinosum*	-	P3	Unlikely
Meionectes tenuifolia	-	P3	Possible
Myriophyllum echinatum	-	P3	Possible
Babingtonia urbana (Coastal Plain Babingtonia)	-	P3	Unlikely
Banksia pteridifolia subsp. *Vernalis*	-	P3	Unlikely
Byblis gigantea (Rainbow Plant)	-	P3	Unlikely
Chamaescilla gibsonii	-	P3	Possible
Comesperma rhadinocarpum (Slender-fruited Comesperma)	-	P3	Unknown
Asteridea gracilis	-	P3	Possible
Beaufortia purpurea (Purple Beaufortia)	-	P3	Possible
Eryngium pinnatifidum subsp. Palustre (G.J. Keighery 13459)	-	P3	Likely
Carex tereticaulis	-	P3	Possible
Eryngium sp. Subdecumbens (G.J. Keighery 5390)	-	P3	Likely
Haemodorum loratum	-	P3	Likely
Halgania corymbosa	-	P3	Possible
Acacia horridula	-	P3	Likely
Schoenus natans (Floating Bog-rush)	-	P4	Possible
Lasiopetalum bracteatum	-	P4	Likely
Cyanicula ixioides subsp. *Ixioides*	-	P4	Unknown

Species (Common name (if applicable))	Conservation status		Potential to occur (based on desktop assessment)
	EPBC Act	BC Act	
Senecio leucoglossus	-	P4	Possible
Stylidium longitubum (Jumping Jacks)	-	P4	Possible
Stylidium striatum (Fan-leaved Triggerplant)	-	P4	Possible
Verticordia lindleyi subsp. *Lindleyi*	-	P4	Likely
Ornduffia submersa	-	P4	Unknown
Acacia oncinophylla subsp. *Patulifolia*	-	P4	Likely
Drosera occidentalis (Western Sundew)	-	P4	Unknown
Calothamnus accedens	-	P4	Possible
Aponogeton hexatepalus	-	P4	Possible
Bolboschoenus fluviatilis	-	P3	Unlikely
Calandrinia uncinella	-	P1	Possible
Calectasia grandiflora	-	P2	Possible
Commersonia sp. Lesmurdie (A.A. Mitchell 11429)	-	P2	Unlikely
Cyanothamnus tenuis	-	P4	Unlikely
Diuris brevis	-	P2	Possible
Hydrocotyle lemnoides	-	P4	Possible
Johnsonia pubescens subsp. Cygnorum	-	P2	Possible
Pimelea rara	-	P4	Unlikely
Pithocarpa corymbulosa	-	P3	Unlikely
Rytidosperma racemosum var. racemosum	-	P2	Possible
Thysanotus cymosus	-	P3	Unlikely

2.1.2 Threatened and Priority Ecological Communities

The BC Act defines an ecological community as a naturally occurring assemblage of organisms that occurs in a particular habitat. In most instances on the Swan Coastal Plain, an ecological community has been determined based on their floristic community type (FCT) and some Commonwealth listed Threatened Ecological Communities (TECs) may correspond with more than one FCT at a State level.

The number of TECs and Priority Ecological Communities (PECs) identified as potentially occurring within the MRS amendment area reflects the unique landforms that occur in a highly fragmented environment at the base of the Darling Scarp. This area is influenced by the Scarp and the Swan Coastal Plain and supports a mix of Banksia and Eucalyptus woodlands, Heath shrublands and wetlands.

The 2023 desktop assessment identified 6 TECs listed under the EPBC Act and 11 TECs listed under the BC Act and 3 PECs listed by the DBCA as having a likely or greater chance of occurrence in the MRS amendment area (See Table 2-2). Of these, the Commonwealth-listed Banksia Woodlands of the Swan Coastal Plain TEC (which is listed as Priority 3 by the DBCA) and 2 State-listed TECs have been identified as occurring in discrete areas within the MRS amendment area.

Table 2-2 Threatened and Priority Ecological Communities identified in the desktop assessment

Community	Conservation Code		Presence in the MRS amendment area
	State (WA)	EPBC Act (Cth)	
Banksia Woodlands of the Swan Coastal Plain Incorporating the State listed TECs and PECs:	P3	E	Present (See section 3.1.4)
• *Banksia attenuata* woodlands over species rich dense shrublands (FCT/SCP 20a) • *Banksia attenuata* and/or *Eucalyptus marginata* woodlands of the eastern side of the Swan Coastal Plain (FCT/SCP 20b) • Low lying *Banksia attenuata* woodlands or shrublands (FCT/SCP 21c)	CR CR P3		• Present (See section 3.1.4) • Present (See section 3.1.4) • Absent
SCP20c Shrublands and Woodlands of the Eastern Swan Coastal Plain (FCT20c)	CR	E	Absent
Clay Pans of the Swan Coastal Plain Incorporating the State listed TECs: • Herb rich saline shrublands in clay pans (FCT/SCP 07) • Herb rich shrublands in clay pans (FCT/SCP 08) • Shrublands on dry clay flats. (FCT/SCP 10a)	 EN EN EN	CE	Absent • Absent • Absent • Absent
SCP 3a *Corymbia calophylla – Kingia australis* Woodlands on Heavy Soils of the Swan Coastal Plain (FCT/SCP 3a)	CR	E	Absent
SCP3b *Corymbia calophylla – Eucalyptus marginata* Woodlands on Sandy Clay Soils of the southern Swan Coastal Plain (FCT/SCP 3b)	EN	-	Absent
SCP3c *Corymbia calophylla – Xanthorrhoea preissii* Woodlands and Shrublands, Swan Coastal Plain (FCT/SCP 3c)	EN	E	Absent
Central Northern Darling Scarp Granite Shrubland Community	P4	-	Absent
SCP02 Southern Wet Shrublands, Swan Coastal Plain (FCT/SCP 02)	CR	-	Absent
Muchea Limestone – Shrublands and Woodlands on Muchea Limestone of the Swan Coastal Plain	EN	E	Absent

Conservation Codes	**State (WA)**	**Federal**
Endangered	EN	E
Critically Endangered	CR	CE
Vulnerable	VU	V
Priority (rated in order of significance from 1 to 4)	P	*Not applicable*

2.1.3 Conservation Significant Fauna

Conservation significant fauna database searches were conducted using a 10 km buffer surrounding the MRS amendment area using the EPBC Act Protected Matters Search Tool (PMST) and the DBCA Threatened, Specially Protected, and Priority Fauna database by AECOM (2020) and JBS&G in 2022. An additional database search was conducted in September 2023 by JBS&G to verify the validity of the previous searches.

The 2023 desktop assessment identified a total of 33 fauna taxa of conservation significance as potentially occurring within a 10 km buffer of the MRS amendment area (Table **2**-**3**). The majority of these taxa are associated with wetland (and other discrete) habitats that are within a 10km radius but do not occur within the MRS amendment area. The EPBC Protected Matters Search identified five fauna species listed as Marine under the EPBC Act which only pertains to Commonwealth Land.

As such, of the 33 conservation significant fauna taxa identified in the desktop assessment, up to 7 species are considered to have the potential to occur based on presence of suitable habitat within the MRS amendment area, including 3 species (black cockatoo) listed under both the BC and EPBC Act. The likelihood for each species to occur within the MRS amendment area is provided in Table **2**-**3**.

As the site is predominantly cleared of native vegetation and used for rural purposes, the site does not provide large areas of intact or connected habitat. The surrounding environment (external to the MRS amendment area) is also predominantly cleared and consists of rural land uses containing limited native vegetation. Large areas of intact vegetation are located east of the site, within the Lesmurdie Falls National Park, which is considered to provide higher quality fauna habitat. The Greater Brixton Street Wetlands, located to the west of the site and physically separated by Tonkin Highway, also provides higher quality fauna habitat. There are some discrete areas of good (and better) quality remnant vegetation and scattered trees located within the MRS amendment area. An assessment of the likelihood for each species to occur included consideration of the habitat types within the MRS amendment area.

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Table 2-3: Threatened and Priority Fauna potentially occurring within 10 km of the MRS amendment area

Scientific Name	Common Name	Conservation Status		Likelihood of occurrence within the MRS Amendment Area
		State (WA)	Federal	
Leioproctus douglasiellus	a short-tongued bee	EN	CR	Unlikely
Neopasiphae simplicior	a short-tongued bee	EN	CR	Unlikely
Glossurocolletes bilobatus	a short-tongued bee (southwest)	P2		Possible
Zanda baudinii	Baudin's cockatoo	EN	EN	Possible
Neelaps calonotos	black-striped snake, black-striped burrowing snake	P3		Unlikely
Oxyura australis	blue-billed duck	P4		Unlikely
Zanda latirostris	Carnaby's cockatoo	EN	EN	Likely
Westralunio carteri	Carter's freshwater mussel	VU	VU	Unlikely
Hydroprogne caspia	Caspian tern	MI	MI	Unlikely
Australotomurus morbidus	cemetery springtail, Guildford springtail	P3		Unlikely
Dasyurus geoffroii	chuditch, western quoll	VU	VU	Unlikely
Tringa nebularia	common greenshank	MI	MI	Unlikely
Actitis hypoleucos	common sandpiper	MI	MI	Unlikely
Thalasseus bergii	crested tern	MI	MI	Unlikely
Calyptorhynchus banksii naso	forest red-tailed black cockatoo	VU	VU	Likely
Plegadis falcinellus	glossy ibis	MI	MI	Unlikely
Kawanaphila pachomai	grey vernal katydid (southwest)	P1		Unlikely
Tringa stagnatilis	marsh sandpiper, Little greenshank	MI	MI	Unlikely
Myrmecobius fasciatus	numbat, walpurti	EN	EN	Unlikely
Pandion haliaetus	osprey	MI	MI	Unlikely
Falco peregrinus	peregrine falcon	OS		Unlikely
Lerista lineata	Perth slider, lined skink	P3		Unlikely
Isoodon fusciventer	quenda, southwestern brown bandicoot	P4		Likely
Setonix brachyurus	quokka	VU	VU	Unlikely
Acanthophis antarcticus	southern death adder	P3		Unlikely
Phascogale tapoatafa wambenger	south-western brush-tailed phascogale, wambenger	CD		Unknown
Idiosoma sigillatum	Swan Coastal Plain shield-backed trapdoor spider	P3		Possible
Hydromys chrysogaster	water-rat, rakali	P4		Unlikely
Notamacropus irma	western brush wallaby	P4		Unlikely
Platycercus icterotis xanthogenys	western rosella (inland)	P4		Possible
Pseudemydura umbrina	western swamp tortoise	CR	CR	Unlikely
Tringa glareola	wood sandpiper	MI	MI	Unlikely
Bettongia penicillata ogilbyi	woylie, brush-tailed bettong	CR	EN	Unlikely

Conservation Codes	**State (WA)**	**Federal**
Endangered	EN	E
Critically Endangered	CR	CE
Vulnerable	VU	V
Priority (rated in order of significance from 1 to 4)	P	*Not applicable*

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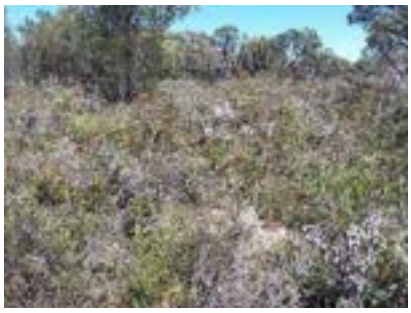
3. Field Survey Results and Discussion

3.1 Flora and Vegetation

3.1.1 Vegetation Communities

Six native vegetation communities were described and mapped by AECOM (2020) for the broader Wattle Grove South area. Of these, three occur within the MRS amendment area. These communities fall into two broad categories of Banksia Woodland and *E. marginata* Woodland (AECOM 2020). Vegetation descriptions for those communities present in the MRS amendment area are provided in Table 3-1 and shown Figure 3-1. The delineation of vegetation communities was supported by cluster analysis of floristic data. The cluster outcomes as identified using AECOMs quadrat and relevé data (Q09, Q06, Q13, R12, R14 and R05) (AECOM 2020) and the single quadrat data collected by JBS&G in 2022 (S01) are provided below. The quadrat and relevé data sheets are provided in Appendix C.

Table 3-1: Vegetation Community Descriptions

Description	Additional Details	Photograph
BmXpEc **Banksia Woodland** *Banksia menziesii, Allocasuarina fraseriana* and *Eucalyptus todtiana* low open woodland over *Xanthorrhoea preissii*, *Eremaea pauciflora* var. *pauciflora* and *Stirlingia latifolia* low open shrubland over *Ehrharta calycina**, *Dasypogon bromeliifolius* and *Anigozanthos manglesii* subsp. *manglesii* mixed grass and forbland (AECOM 2020). Represents Federal TEC Banksia Woodlands of the SCP and WA TEC *B. attenuata* and/or *E. marginata* woodlands of the eastern SCP (SCP20b) (AECOM 2020).	Survey effort: Q09 (AECOM quadrat) R12 (AECOM relevé) R14 (AECOM relevé) Species richness: 80 native and 12 weed species (AECOM 2020).	 Source: AECOM 2020
BaEpPf **Banksia Woodland** *Banksia attenuata*, *Banksia menziesii* and *Eucalyptus todtiana* low open woodland over *Eremaea pauciflora* var. *pauciflora*, *Hibbertia hypericoides* and *Allocasuarina humilis* low shrubland over *Phlebocarya filifolia*, *Mesomelaena pseudostygia* and *Lepidosperma leptostachyum* low sedgeland (AECOM 2020). Represents Federal TEC Banksia Woodlands of the SCP. One patch also represents the WA TEC *Banksia attenuata* woodlands over species rich dense shrublands (SCP20a). Supports the Threatened *Conospermum undulatum* and Priority 3 *Isopogon drummondii* (AECOM 2020).	Survey effort: Q6 (AECOM quadrat) Q13 (AECOM quadrat) S01 (JBS&G relevé) Species richness: 88 native and 7 weed species.	 Source: AECOM 2020
EmMpLp ***E. marginata* Woodland** *Eucalyptus marginata* subsp. *marginata* and *Allocasuarina fraseriana* mid open forest over *Mesomelaena pseudostygia* and *Tetraria octandra* low sedgeland with *Lomandra preissii*, *Tricoryne elatior* and *Dampiera linearis* low open forbland (AECOM 2020). Larger patch of this community surveyed in wider Wattle Grove South survey area (but outside of MRS amendment area) represents WA TEC *B. attenuata* and/or *E. marginata* woodlands of the eastern SCP (SCP20b) (AECOM 2020).	Survey effort: R05 (AECOM relevé)	 Source: AECOM 2020
Significantly Altered Includes planted, gardens, scattered trees (both native and introduced). Condition considered Completely Degraded.	N/A	N/A

Of the mapped vegetation communities, three represent remnant native vegetation while the remaining two represent highly modified or planted vegetation communities. Areas previously subject to clearing or development have been identified as 'Cleared'. Areas not subject to a site assessment have been extrapolated based on adjacent environmental values, review of aerial imagery and where possible, visual assessment from adjoining lots and road reserves. The area each vegetation community occupies within the site is provided in Table 3.3.

Table 3-2: Vegetation Communities

Vegetation Community	Area (ha)	Percentage Total (%)
Remnant Native Vegetation		
BaEpPf	4.23	3.37
BmXpEc	0.42	0.34
EmMpLp	0.13	0.10
Total Remnant Native Vegetation	**4.70**	**3.73**
Highly Modified Vegetation		
Planted	2.80	2.23
Scattered Trees	26.90	21.42
Other		
Cleared	91.10	72.54
Grand Total	**125.58**	**100**

3.1.2 Vegetation Condition

Vegetation condition within the MRS amendment area varied from 'Excellent' to 'Completely Degraded' and is described in Table 3-3 and shown in Figure 3-2. The condition map reflects the current land use which comprises numerous landholdings and contains a mixture of land uses including residential and rural living, composite business along Welshpool and Brentwood Roads and horticulture (including turf farm). The turf farm located across Lots 303, 53, 214 and 213, south of Brentwood Road, has discontinued operations in the last 6 months. There is a former poultry farm located at Lot 251 within the south-east portion of the site, that ceased operations over a decade ago. The Dampier to Bunbury natural gas pipeline (DBNGP) also runs along the western edge of the site adjacent to Tonkin Highway. The majority of rural residences comprise cleared paddocks, grasslands (lawn) and maintained gardens.

Table 3-3: Vegetation Condition within the Amendment Area

Vegetation Condition	Area (ha)	Percentage Total (%)
Excellent	3.41	2.71
Very Good	0.1	0.08
Good	0.24	0.19
Degraded	0.13	0.10
Completely Degraded	24.95	19.87
Cleared	96.74	77.04
Total	**125.58**	**100**



Figure 3-1: Vegetation Communities within the MRS amendment area



Figure 3-2: Vegetation condition within MRS amendment area

3.1.3 Floristic Community Type Analysis

An FCT analysis was undertaken by JBS&G ecologists in accordance with the EPA Technical Guidance – *Flora and Vegetation Surveys for Environmental Impact Assessment* (2020), utilising the Keighery et al. (2020) Swan Coastal Plain (SCP) dataset, compiled with the site survey datasets.

This analysis incorporated all of the quadrats from the broader AECOM (2020) study area that were placed within the vegetation communities observed within the MRS amendment area. Although some of the quadrats themselves were outside of the study area, using these quadrats enabled a better and more robust FCT analysis. All but one of these quadrats were surveyed by AECOM in 2019, with the other quadrat surveyed by JBS&G in 2021. The JBS&G quadrat was located in vegetation that has become degraded due to adjacent clearing; however, the information from this quadrat is still valuable as it represents a larger patch of vegetation nearby that could not be directly accessed for survey purposes. The locations of these quadrats are shown in Figure 1-2. The FCTs inferred from the analysis include:

- FCT/SCP 20a *B. attenuata* woodlands over species rich dense shrublands
- FCT/SCP 23a central *B. attenuata -B. menziesii* woodlands
- Potential for FCT/SCP 20b *Banksia attenuata — Eucalyptus marginata* woodlands of the eastern side of the Swan Coastal Plain

The FCT analysis results were used to inform the TEC and PEC assessment discussed in Section 3.1.4 (Appendix D). Details for each quadrat, with the highest percentage in similarity to the SCP quadrats, and the inferred FCT conclusions are presented in Table 3-4.

The MRS amendment area occurs at the confluence of three major landforms; the Foothills (Ridge Hill Shelf) (east), the Pinjarra Plain, and a combination of Bassendean Dunes and Pinjarra Plain. Because of this, one of the inferred FCTs remain slightly cryptic as it is unclear what landform they would represent at this scale. Furthermore, low similarity was observed across all quadrats analysed, suggesting poor comparability to the SCP data. A number of factors would influence this, such as position of survey area along the base of the Darling Scarp – species present may not be typical of that landform due to the proximity of the scarp, single quadrat sampling event, drying climate; and isolation of native vegetation patches and existing disturbances (AECOM 2020).

The areas of remnant native vegetation within the MRS amendment area are small and range in size from 0.05 to 2.07 ha. Given these small areas, it is believed that the sampling undertaken is representative of the vegetation communities present at each occurrence. Through single site insertion of the quadrat results from the vegetation surveys undertaken against the Keighery (2020) Swan Coastal Plain (SCP) dataset, it was found that definitive flora community types could be attributed to the native vegetation for the majority of the MRS amendment area, and therefore, it is considered that the small number of quadrats sampled provides sufficient information on the vegetation communities present within accessible properties present in the MRS amendment area.

Table 3-4 Inferred FCTs for Remnant Native Vegetation within the MRS Amendment Area

Vegetation unit	Total area within MRS amendment area (ha)	Quadrat *(# of species)*	Inside MRS area?	FCTs based on similarity	Dendro-gram FCTs	Inferred FCT
BaEpPf **Banksia Woodland** *Banksia attenuata, Banksia menziesii* and *Eucalyptus todtiana* low open woodland over *Eremaea pauciflora* var. *pauciflora*, *Hibbertia hypericoides* and *Allocasuarina humilis* low shrubland over *Phlebocarya filifolia, Mesomelaena pseudostygia* and *Lepidosperma leptostachyum* low sedgeland.	**4.233**	4 *(62)*	No	20b (Site: Rush02) 0.37% 20a (Site: hart01) 0.37% 20a (Site: activ01) 0.34% 20a (Site: APBF-2) 0.34% 20a (Site: m5303) 0.34%	20a, 20c, 20b.	TEC *Banksia attenuata* woodlands over species rich dense shrublands (FCT/SCP 20a). However, there may be an ecotone and/or some overlap with 20b, 20c, 23a and/or 23b. The soil and landform units correspond to those of 20a; all of these quadrats include *Isopogon autumnalis*, which is a taxa useful in distinguishing FCT/SCP 20a from all of the eastern southern Swan Coastal Plain FCT/SCPs (3a, 3b, 3c, 20b, 20c) The quadrats sampled contained 12 out of the 19 typical species identified by Gibson et al (1994), and 10 out of the 12 identified as 'common' for this FCT by DPAW (2016): *Banksia attenuata, Bossiaea eriocarpa, Hibbertia huegelii*, *Hibbertia hypericoides, Petrophile linearis*, *Scaevola repens, Stirlingia latifolia, Mesomelaena pseudostygia, and Alexgeorgea nitens.* Two of the quadrats also contain *Daviesia nudiflora* which can be useful in differentiating 20a from 20b and 20c.
		6 *(52)*	**Yes**	20c (Site: talb8) 0.43% 23b (Site: ELE03) 0.43% 23a (Site: Perth06) 0.42% 23a (Site: Kens01) 0.42%	20a, 20c, 20b.	
		13 *(57)*	**Yes**	S09 (Site: BNR18) 0.42% 23b (Site: ELE28) 0.42% 23a (Site: perth08) 0.4% 23a (Site: Tele01) 0.39% 20a (Site: activ01) 0.39%	20a, 20c, 20b.	
		JBSG01 *(50)*	**Yes**	23a (Site: Tele01) 0.44% 20a (Site: activ03) 0.44% 21a (Site: card7) 0.43% 20a (Site: KOON-1) 0.43%	21a, 21b, 21c.	
BmXpEc **Banksia Woodland** *Banksia menziesii, Allocasuarina fraseriana* and *Eucalyptus todtiana* low open woodland over *Xanthorrhoea preissii, Eremaea pauciflora* var. *pauciflora* and *Stirlingia latifolia* low open shrubland over **Ehrharta calycina*, *Dasypogon bromeliifolius* and *Anigozanthos manglesii*	**0.424**	**9** *(38)*	**Yes**	23a (Site: perth04) 0.45% 23a (Site: Kens01) 0.44% 23a (Site: Tele01) 0.43% 23a (Site: perth08) 0.42% 20a (Site: activ03) 0.41%	20b, 20a, 20c.	May be Banksia attenuata – B. menziesii woodlands (FCT/SCP 23a), however there is some similarity with other FCT/SCPs such as 20a and 20b, and there are some species present (*Cyathochaeta avenacea*, *Dasypogon bromeliifolius*, and *Morelotia octandra* (previously *Tetraria octandra*), which imply lower-lying landforms and heavier soils than are typical for this FCT.
		18 *(41)*	No	28 (Site: wire01) 0.40% 23a (Site: perth08) 0.40% 20a (Site: activ03) 0.38% 23a (Site: Tele01) 0.38%	21a, 23a, 4, 21c	
		19 *(45)*	No	20a (Site: activ03) 0.41% 20b (Site: Rush02) 0.4% 23a (Site: Tele01) 0.38% 23a (Site: Kens01) 0.38%	20a, 20c, 20b.	

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Vegetation unit	Total area within MRS amendment area (ha)	Quadrat *(# of species)*	Inside MRS area?	FCTs based on similarity	Dendro-gram FCTs	Inferred FCT
subsp. *manglesii* mixed grass and forbland.						
EmMpLp **E. marginata Woodland** *Eucalyptus marginata* subsp. *marginata* and *Allocasuarina fraseriana* mid open forest over *Mesomelaena pseudostygia* and *Tetraria octandra* low sedgeland with *Lomandra preissii*, *Tricoryne* elatior and *Dampiera linearis* low open forbland.	0.13	20 *(44)*	No	23a (Site: perth04) 0.35 % 23a (Site: perth08) 0.34% 23a (Site: bibra01) 0.33% 20a (Site: activ03) 0.33% 20b (Site: card5) 0.33%	21a, 21c, 23a, 4	Inconclusive; may be TEC *Banksia attenuata — Eucalyptus marginata* woodlands of the eastern side of the Swan Coastal Plain (FCT/SCP 20b), as per AECOM (2020) conclusions. FCT/SCP 20b is known from pre-European vegetation complexes at the base of the Darling Scarp and largely on the Forrestfield unit (Ridge Hill Shelf), Guildford unit (Pinjarra Plain), and Southern River Unit, which aligns with the surveyed location, however it is primarily known to occur between Byford and Yarloop, both of which are considerably south of this location. According to DBCA (2023), this FCT differs from FCT/SCP 20a and 20c in the presence of understorey species that can include *Grevillea pilulifera*, *Babingtonia camphorosmae*, *Hibbertia vaginata*, *Caladenia flava, Hakea stenocarpa and Conostylis setosa*: None of the abovementioned species were recorded in this quadrat, however this does not definitively indicate that it is not FCT/SCP 20b. FCT/SCP 20b is also characterised by and the general absence of *Alexgeorgea nitens* - a common component of FCT/SCP 20a –not observed in this quadrat.

3.1.4 Threatened and Priority Ecological Communities

Native vegetation was mapped over 4.70 ha within the survey area. Conservation-significant ecological communities occur within four major vegetation patches (Figure 3.3) (Appendix E). Two of these include TECs, and another one may include very small and heavily degraded patches of another TEC (pending verification). The four patches are:

- Patch 1: Contained within Lot 254 is 1.8 ha of BaEpPf which is inferred as being FCT/SCP 20a (refer to Table 3-4), which is a State-listed TEC (Critically Endangered). Whilst FCT/SCP 20a is not a Commonwealth-listed TEC, 0.99 ha is in excellent condition (contains AECOM quadrats 6 and 4), and meets the condition threshold requirement for the Commonwealth-listed Banksia Woodlands of the Swan Coastal Plain TEC. Located adjacent on Lot 2 is 0.82 ha of BaEpPf which is mapped as completely degraded and is not included as part of the Commonwealth-listed Banksia Woodlands of the Swan Coastal Plain TEC. Also, a small (0.05 ha) area of the Eucalyptus woodland which may be FCT/SCP 20b TEC (contains AECOM quadrat 5), in very good condition. Patch 1 also supports occurrences of threatened flora species *Conospermum undulatum* (Vulnerable) and priority flora *Isopogon autumnalis* (Priority 3).

- Patch 2: Contained within Lot 84 is 0.35 ha of BaEpPf which is inferred as being FCT/SCP 20a (contains AECOM quadrat 13) and 0.14 ha of BmXpEc which is inferred as being FCT/SCP 23a; however there is some similarity with other FCT/SCPs such as 20a and 20b (refer to Table 3-4) (contains AECOM relève 12). FCT/SCP 20a is a State-listed TEC (Critically Endangered) and whilst this patch represents two discreet areas that are different vegetation communities and inferred FCTs they are broadly defined as Banksia Woodland. Furthermore, due to the connection of canopies of trees these two areas are considered representative of the same patch. Whilst the area falls outside the required 0.5 ha by a minute amount the precautionary principle has been applied and therefore, the patch meets the threshold requirements for the Commonwealth listed Banksia Woodlands of the Swan Coastal Plain TEC. Patch 2 also supports occurrences of threatened flora species *Conospermum undulatum* (Vulnerable) and priority flora *Isopogon autumnalis* (Priority 3).

- Patch 3: Contains approximately 0.3 ha of BmXpEc which is inferred as being FCT/SCP 23a (refer to Table 3-4) (contains AECOM quadrat 9 and relève 8), which is not a State-listed TEC and whilst it is broadly considered to be Banksia Woodlands, this patch is not considered to be representative of the Commonwealth-listed Banksia Woodlands of the Swan Coastal Plain TEC due to its degradation and patch size.

- Patch 4: a total of 2.07 ha of BaEpPf which is inferred as being FCT/SCP 20a (refer to Table 3-4) (contains JBS&G quadrat S01), which is a State-listed TEC, and given it is in excellent condition it meets the condition threshold requirement for the Commonwealth-listed Banksia Woodlands of the Swan Coastal Plain TEC. Patch 4 also supports occurrences of threatened flora species *Conospermum undulatum* (Vulnerable) and priority flora *Isopogon autumnalis* (Priority 3).

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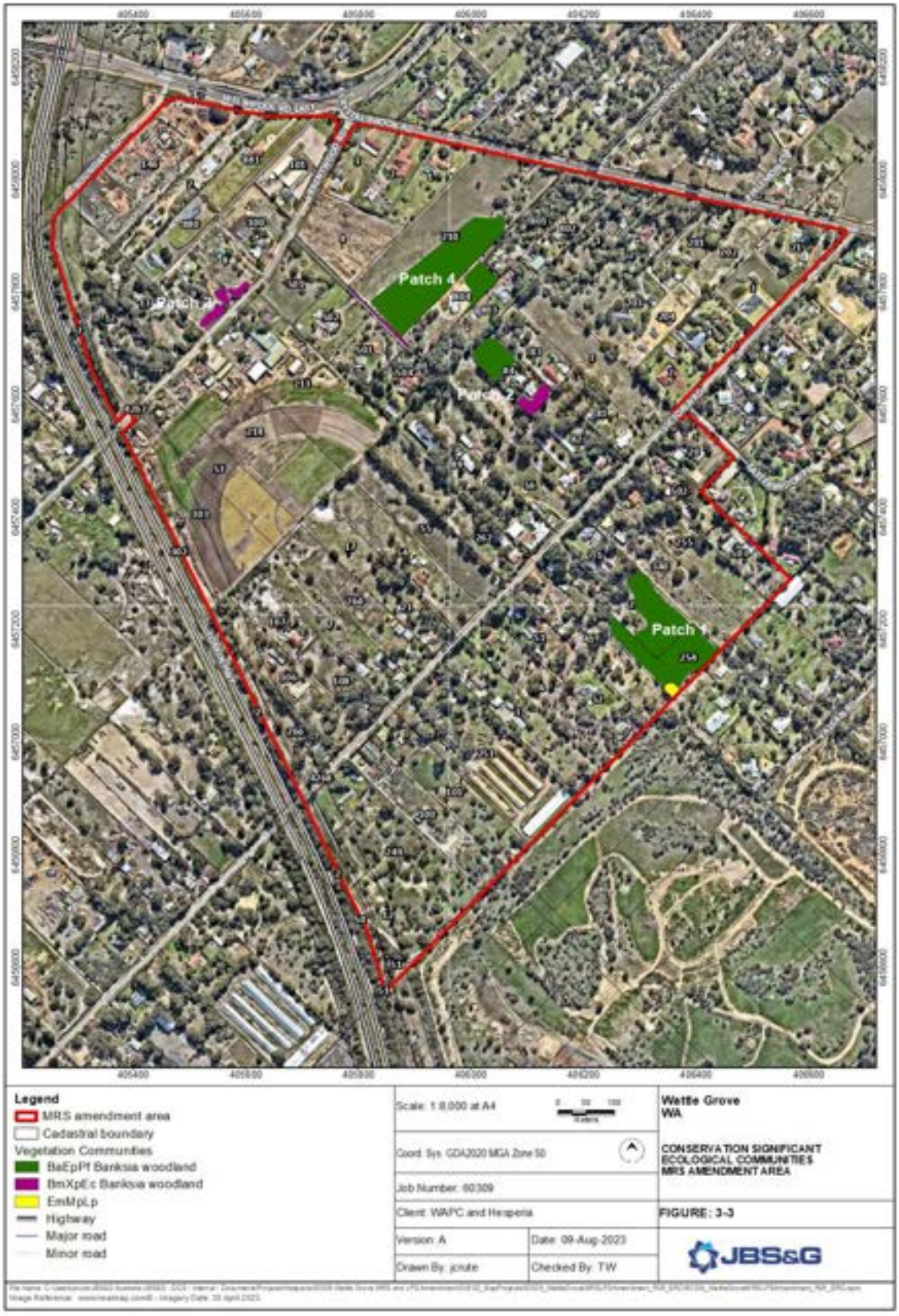


Figure 3-3: Conservation Significant Ecological Communities within the Amendment Area

3.1.5 Conservation Significant Flora

AECOM undertook an ecological spring survey, incorporating flora and vegetation in October 2019 (AECOM 2020). The survey recorded data from twelve quadrats and eight relevés, covering a broader area of the Wattle Grove locality. The result of this survey has been augmented by the further survey work by JBS&G. It is considered that the MRS amendment area has been adequately surveyed and values appropriately assessed.

AECOM (2020) recorded two conservation significant flora taxa, concentrated in two localised areas, within the MRS amendment area (Appendix B).

- *Conospermum undulatum* (T)
- *Isopogon autumnalis* (P3), previously named *Isopogon drummondii*.

The AECOM field survey was undertaken at an appropriate time to identify conservation significant orchid species if present. JBS&G conducted flora and vegetation surveys in October 2021 and August and October 2022, incorporating both previously surveyed and unsurveyed lots within the MRS amendment area.

In addition, flora surveys conducted by JBS&G in January 2022 recorded observations of conservation significant flora from the boundary of Lots 210 and 801. Observations of Lot 210 and Lot 801 noted the presence of *Conospermum undulatum* (T) and *Isopogon autumnalis* (P3).

Conospermum undulatum (waxy-leaved smokebush) is an erect shrub which grows to 1.5 m height and is characterised by its fibrous, longitudinally fissured stems and wide leaves with wavy margins. It is listed as Vulnerable under the BC Act and EPBC Act and is ranked as Vulnerable (VU) under World Conservation Union (IUCN 1994) Red List criterion B1+2c, with its main threats being listed as further land clearing, poor habitat quality, road and firebreak maintenance, inappropriate fire regimes, weeds, recreational activities and rabbit grazing (DEC 2009). *Conospermum undulatum* is recorded from 25 historical populations, comprising 83 subpopulations. However, only 20 populations currently contain extant plants (DEC 2009). It occurs on sand and sandy clay soils, often over laterite, on flat or gently sloping sites between the Swan and Canning Rivers. A few records are from slightly swampy habitat. Habitat critical to the survival of *Conospermum undulatum* includes the area of occupancy of important populations and areas of similar habitat surrounding important populations (DEC 2009). Important populations of *Conospermum undulatum* are listed in the species' recovery plan.

Isopogon autumnalis is an erect shrub growing to 1 m height with cream-yellow flowers and mostly terete leaves (Rye and MacFarlane 2019). It is listed as a Priority 3 taxon by DBCA. It is known from a large range extending from the southern Lesueur Sandplains through the Swan Coastal Plain and Dandaragan Plateau to the Northern Jarrah Forrest. It prefers white, grey or yellow sand, often over laterite. It was previously known as *Isopogon drummondii* but was renamed in 2019 due to lack of a type specimen and descriptions being based on cultivated specimens (Rye and MacFarlane 2019). Variants of the taxon with larger leaves were transferred to *Isopogon sphaerocephalus*.

Two additional conservation significant flora species, *Banksia mimica* and *Lasiopetalum glutinosum* subsp. *glutinosum,* were identified in the 2018 desktop assessment through DBCA records (360 Environmental 2018). *Banksia mimica* was previously recorded southeast of the Crystal Brook Road and Brentwood Road junction. All properties in this vicinity have since been cleared for residential development, and no native vegetation remains. *Banksia mimica* was not recorded during the field survey (AECOM 2020) or by JBS&G during subsequent site surveys.

Records of *Lasiopetalum glutinosum* within the site are associated with Paganoni Swamp, approximately 60 km southwest of the site (360 Environmental, 2018)). The occurrence of *Lasiopetalum glutinosum* within the site is therefore considered a result of mapping inaccuracies. AECOM determined that the species is unlikely to occur within the site, given it is associated with lateritic outcrops on the Darling Scarp. AECOM (2020) did not identify *Lasiopetalum glutinosum* during the survey or JBS&G during subsequent site surveys.

Targeted flora survey – *Drakea elastica*

On 25 August 2021 an experienced JBS&G ecologist visited Lot 254 Victoria Road, Wattle Grove to undertake a targeted flora survey for conservation significant species. Vegetation at Lot 254 is an open to sparse *Banksia* woodland over closed, medium-low shrubland. As previously discussed, the vegetation (BaEpPf) within Lot 254 has been inferred as FCT/SCP 20a *Banksia attenuata* woodlands over species rich dense shrublands.

The survey primarily targeted the Threatened (T) orchid species *Drakaea elastica*. a small, tuberous orchid, whose distinctive leaves appear at ground level in late winter. Remnant native vegetation within the lot was traversed at 10 m intervals and the ground was observed for *Drakea elastica* leaves. The survey tracks were recorded on a Garmin™ GPS (Figure 1.2).

No *Drakaea elastica* were identified by this survey, though one other conservation significant taxa, *Conospermum undulatum* (T), previously identified from Lot 254, was observed in abundance. *Isopogon autumnalis* (P3), previously named *Isopogon drummondii*, was also seen in abundance. *Conospermum undulatum* (T) was also visible, flowering, in the adjacent Lot 2.

Vegetation within the remnant was in Very Good to Excellent condition, but with significant invasive weed species at the edges. Significant weed taxa observed during the *D. elastica* survey included **Acacia iteaphylla* (Flinders Range wattle), **Leptospermum laevigatum* (Victorian tea tree), **Cytisus proliferus* (tree lucerne), **Eragrostis curvula* (African love grass), **Ehrharta longifolia* (annual veldt grass) and **Asparagus asparagoides* (bridal creeper).

Understory vegetation was dense and leaf litter at the site had built up to around 20 cm depth, mostly obscuring the ground, and resulting in high fuel loadings that may present a fire hazard. This also resulted in a low level of detectability for *Drakea elastica*, though in such circumstances, it was unlikely to be present as any individuals would not receive sufficient light.

3.2 Fauna

3.2.1 Terrestrial Fauna Habitat

A terrestrial fauna survey was undertaken by AECOM in October 2019 (Appendix B), which primarily focused on mapping fauna habitats and assessing their potential to be utilised by conservation significant fauna species within the wider Wattle Grove area. Fauna habitats were assessed for specific habitat components, including consideration of structural diversity and refuge opportunities for fauna. The survey covered a broader area than the site, and six broadly defined habitats were mapped in the survey area, with only three of these habitats mapped within the MRS amendment area. Further surveys undertaken by JBS&G have corroborated the findings of the AECOM surveys within the MRS amendment area.

Fauna habitats within the MRS amendment area has been severely compromised through historic and ongoing land uses, which have resulted in the clearing of the majority of native vegetation, and degradation of the little remnant native vegetation through ongoing rural land uses. The remnant vegetation provides the greatest significant of fauna habitat, comprising Banksia Woodland and Eucalyptus Woodland, which exist in four distinct patches (Figure 3.3). Eucalyptus Woodland was mapped as Completely Degraded and Very Good, where Banksia Woodland was mapped as completely Degraded to Excellent.

The habitat types of 'Planted and Maintained Gardens' and 'Scattered Trees' are both highly disturbed and highly degraded. These habitat types contain a mixture of native and non-native eucalypt trees, as well as other introduced species such as Cape Lilac and Jacaranda. The main distinction between the two habitat types is the understorey; understorey is not present in the Scattered Trees habitat and is variable in the Planted and Maintained Gardens habitat. These habitat types, whilst highly degraded, retain some value for species of conservation significance, namely black cockatoos. These habitat types may be utilised as breeding, roosting and/or foraging habitat by the Forest Red-tailed Black Cockatoo, Carnaby's Cockatoo and Baudin's Cockatoo.

The majority of the MRS amendment area lacks any natural attributes and is now only utilised by generally common and widespread fauna species with non-specific requirements which allow them to persist in disturbed to highly disturbed habitats. As a result, the fauna diversity is well below levels present prior to historical disturbances having occurred. Due to these factors, most of the MRS amendment area has very little conservation significance to fauna in general.

The terrestrial fauna habitat is described in Table 3-5 and Figure 3-4.

Table 3-5: Fauna Habitats Recorded within the MRS amendment area

Fauna Habitat	Description	Conservation Significant Species with Potential to Utilise Habitat	Area within MRS amendment area	Representative Photo
Banksia Woodland	This habitat generally comprised a low open woodland of Banksia and Eucalyptus over a low open shrubland on loamy, sandy brown soil (AECOM 2020). The habitat is generally considered high quality due to presence of Banksia, its complexity and limited disturbance levels. Habitat quality is reduced where areas are significantly degraded due to impacts from clearing and edge effects (AECOM 2020). Significant habitat characteristics include (AECOM 2020): • dense understorey common • logs of various sizes are common • fine and course leaf litter common to abundant • bare ground occasionally present absence of stones and boulders • Large mature trees in rare to occasional abundance • Large hollows generally absent, small hollows common.	• Generally good quality foraging habitat for Carnaby's Cockatoo and Baudin's Cockatoo (AECOM 2020) • Low to moderate quality foraging habitat for the Forest Red-tailed Black Cockatoo (AECOM) • Contains occasional breeding tree for black cockatoos (AECOM 2020) • Habitat for Quenda (AECOM 2020).	4.66 ha	 Source: AECOM 2020

Fauna Habitat	Description	Conservation Significant Species with Potential to Utilise Habitat	Area within MRS amendment area	Representative Photo
Eucalyptus Woodland	This habitat is variable throughout the survey area though generally contains a Eucalyptus woodland / open forest over a low shrubland over sandy brown soils (AECOM 2020). This habitat is considered high to moderate (depending on degree of degradation) quality due to the structural complexity and disturbance levels (AECOM 2020). Significant habitat characteristics include (AECOM 2020): • presence of large mature eucalypts • dense understorey occasionally present • logs of various sizes in variable abundance • fine and course leaf litter common • bare ground occasionally present • absence of stones and boulders • large hollows occasionally present, small hollows common • soils of areas at base of Darling scarp contained pea-gravel	• Potential foraging, breeding and roosting habitat for (AECOM 2020): ○ Forest Red-tailed Black Cockatoo ○ Carnaby's Cockatoo ○ Baudin's Cockatoo • Habitat for Quenda (AECOM 2020)	0.13 ha	 Source: AECOM 2020  Source: AECOM 2020

Fauna Habitat	Description	Conservation Significant Species with Potential to Utilise Habitat	Area within MRS amendment area	Representative Photo
Planted and Maintained Gardens	Highly variable habitat including areas of planted and maintained native and introduced vegetation (AECOM 2020). The habitat is considered low to moderate quality due to disturbance levels and limited habitat complexity (AECOM 2020). Significant habitat characteristics include (AECOM 2020): • mature trees rare • variability of understorey, with areas of dense understorey generally absent • general lack of hollows • bare sandy ground abundant • absence of stones, boulders and rock crevices.	• Predominantly foraging habitat, but also occasionally potential breeding and roosting habitat for (AECOM 2020): ○ Forest Red-tailed Black Cockatoo ○ Carnaby's Cockatoo ○ Baudin's Cockatoo • Habitat for Quenda (AECOM 2020).	2.80 ha	 Source: AECOM 2020
Scattered Trees	This habitat is varied and contains large mature native and non-native eucalypt trees, as well as other introduced species such as Cape Lilac and Jacaranda. Trees were generally recorded over cleared areas. (AECOM 2020) The significant fauna habitat characteristics include (AECOM 2020): • presence of large mature trees • absence of dense understorey • small hollows are common, large hollows are rare • logs of all sizes are rare to occasionally present	• Potential foraging, breeding and roosting habitat for (AECOM 2020): ○ Forest Red-tailed Black Cockatoo ○ Carnaby's Cockatoo ○ Baudin's Cockatoo • Marginal habitat for Quenda (AECOM 2020).	26.90	 Source: AECOM 2020

Fauna Habitat	Description	Conservation Significant Species with Potential to Utilise Habitat	Area within MRS amendment area	Representative Photo
	• course and fine litter are present but generally only under trees. • bare sandy ground abundant • absence of stones, boulders and rock crevices.			 Source: AECOM 2020  Source: AECOM 2020

Fauna Habitat	Description	Conservation Significant Species with Potential to Utilise Habitat	Area within MRS amendment area	Representative Photo
Cleared Ground	Generally consists of areas which have been cleared (e.g. paddocks) and now comprise bare soil and / or weeds (may contain the occasional shrub/ tree), or hardstand areas (e.g. roads). Habitat is considered very low quality.	This habitat may contain the occasional individual foraging tree/ shrub for black cockatoos.	91.10 ha	



Figure 3-4: Fauna habitat

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3.2.2 Terrestrial Fauna Occurrence

Fifty-one vertebrate fauna species were recorded within the MRS amendment area and in adjacent areas during the AECOM and JBS&G field surveys. This comprised 36 bird, 11 mammal, one amphibian and three reptile species. The species observed during field surveys are presented in Table 3-6.

Table 3-6: Fauna Species Observed During Field Surveys

Species	Common Name	Status	Observations
Birds			
Anas superciliosa	Pacific Black Duck	Native	Observed in artificial ponds
Anthochaera carunculata	Red Wattlebird	Native	Commonly seen and heard throughout survey area
Cacatua roseicapilla roseicapilla	Galah	Native	Observed multiple times during survey
Cacatua sanguinea	Western Corella	Native	Small flock observed in trees
Cacomantis flabelliformis	Fan-tailed Cuckoo	Native	Heard in trees in paddock
Calyptorhynchus banksii	Forest Red-tailed Black Cockatoo	Native	Two birds observed foraging in Marri tree, multiple birds seen flying over area, multiple observations of foraging evidence
Chenonetta jubata	Australia Wood Duck	Native	Observed multiple times during survey
Chrysococcyx basalis	Horsfield's Bronze Cuckoo	Native	Heard multiple times
Colluricincla harmonica	Grey Shrike thrush	Native	Heard in Flooded Gums adjacent drainage line
Corvus coronoides	Australian Raven	Native	Commonly seen and heard throughout survey
Cracticus tibicen	Australian Magpie	Native	Commonly seen and heard throughout survey
Cracticus torquatus	Grey Butcherbird	Native	Observed flying through maintained gardens
Dace/a novaeguineae	Laughing Kookaburra	Naturalised exotic	Commonly seen and heard throughout survey area
Dromaius novaehollandiae	Emu	Native	Individual observed in an enclosure
Petrochelidon nigricans	Tree Martin	Native	Flock of 10 birds observed flying in survey area
Gerygone fusca	Western Gerygone	Native	Seen in survey area
Grallina cyanoleuca	Magpie Lark	Native	Commonly seen and heard throughout Survey
Gavicalis virescens	Singing Honeyeater	Native	Common throughout survey area
Malurus splendens	Splendid Fairywren	Native	Seen and heard twice in survey area
Merops ornatus	Rainbow Bee-Eater	Native	Multiple observations recorded throughout survey area
Ocyphaps lophotes	Crested Pigeon	Native	Observed several times
Pardalotus striatus	Striated Pardalote	Native	Commonly seen and heard throughout survey area
Pavo cristatus	Common Peafowl	Introduced	Heard several times
Phaps chalcoptera	Common Bronzewing	Native	Observed several times in survey area
Phylidonyris niger	White-cheeked Honeyeater	Native	Observed multiple times in survey area
Phylidonyris novaehollandiae	New Holland Honeyeater	Native	Commonly seen and heard throughout survey
Platycercus spurius	Red-capped Parrot	Native	Observed individuals and foraging evidence multiple times
Platycercus zonarius	Australian Ringneck	Native	Commonly seen and heard throughout survey area
Rhipidura leucophrys	Willie Wagtail	Native	Commonly seen and heard throughout survey area
Spilopelia senegalensis senegalensis	Laughing Turtle Dove	Introduced	Seen and heard multiple times in trees and flying over survey area
Taeniopygia guttata	Zebra Finch	Native	Two finches observed in Jarrah tree
Threskiornis moluccus	Australian White Ibis	Native	Observed multiple times during survey
Todiramphus sanctus	Sacred Kingfisher	Native	Individual in tree in maintained garden
Zanda latirostris	Carnaby's Cockatoo	Native	Foraging evidence observed
Zosterops lateralis	Silver-eye	Native	Observed twice in survey area, flying through trees and in banksia woodland
Mammals			

Species	Common Name	Status	Observations
Canis familiaris	Dog	Introduced	Common throughout survey area
Capra hircus	Goat	Introduced	Observed in paddock
Equus asinus	Donkey	Introduced	Observed in field
Equus cabal/us	Horse	Introduced	Horses observed in multiple paddocks in survey area
Felis catus	Cat	Introduced	Seen once during survey
Isoodon fusciventer	Quenda	Native	Observed directly and indirectly (conical digging and scat) several times in survey area
Lama glama	Llama	Introduced	Observed in field
Macropus fuliginosus	Western Grey Kangaroo	Native	Observed directly and indirectly several times in survey area
Oryctolagus cuniculus	Rabbit	Introduced	Observed directly and indirectly several times in survey area
Ovis aries	Sheep	Introduced	Observed in paddock
Vulpes vulpes	Red Fox	Introduced	Multiple scats recorded
Amphibians			
Crinia glauerti	Clicking Froglet	Native	Multiple
Reptiles			
Cryptoblepharus buchananii	Buchanan's Snake- Eyed Skink	Native	Seen multiple times on trees throughout survey area
Pogona minor minor	Western Bearded Dragon	Native	Observed in survey area
Tiliqua rugosa rugosa	Bobtail	Native	Observed twice during survey

3.2.3 Conservation Significant Terrestrial Fauna

Four of the 51 recorded vertebrate fauna species are identified as having some conservation significance, including three birds and one mammal, summarised as follows:

- Forest Red-Tailed Black Cockatoo *Calyptorhynchus banksii* (listed as Vulnerable under the EPBC Act and the BC Act).
- Carnaby's Cockatoo *Zanda latirostris* (listed as Endangered under the EPBC Act and the BC Act).
- Quenda *Isoodon fusciventer* (listed as Priority 4 by DBCA). Refer to Plate 3 for photographs of Quenda diggings and scat recorded within the survey area.
- Rainbow Bee-Eater *Merops ornatus* (listed as Marine under the EPBC Act). Species listed as Marine under the EPBC Act are only considered significant in Commonwealth land and as the MRS amendment area does not contain Commonwealth land, these species will not be further discussed within the report.

Based on the desktop assessment and the field survey, an additional conservation significant fauna species is also considered to have the potential to utilise the habitats within the survey area:

- Baudin's Cockatoo *Zandi baudinii* - listed as Vulnerable under the BC Act and the EPBC Act.

Black Cockatoo Survey

Targeted Black Cockatoo surveys were conducted to identify potential breeding, roosting and foraging habitat for the three threatened black cockatoo species that occur in WA, as all three species have the potential to utilise the habitats present in the MRS Amendment Area:

- Carnaby's Cockatoo *Zanda latirostris* (Endangered under both EPBC and BC Acts);
- Baudin's Cockatoo *Zanda baudinii* (Endangered under both EPBC and BC Acts); and
- Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso* (Vulnerable under both EPBC and BC Acts).

The AECOM and JBS&G surveys were undertaken in accordance with the DSEWPaC (2012), the draft DotEE (2017) and the DAWE (2022) referral guidelines for all three black cockatoos, as were relevant at that time. These survey's will inform future habitat assessment and reporting.

Quenda

The quenda (*Isoodon obesulus*) is a medium-sized ground dwelling marsupial of the bandicoot and bilby family (Marsupialia: Peramelemorphia) and is endemic to the south-west of Western Australia. This species is identified as a Priority 4 species at a state level under the BC Act, however it is not listed as threatened under either State or Commonwealth legislation. Like many small-to-medium sized Australian marsupials, quenda have suffered a drastic population decline post European settlement and it is estimated that their historical range distribution has contracted by approximately 40% (Abbott 2008). The Priority 4 listing means that this species is categorised as "Rare, Near Threatened and other species in need of monitoring".

The species is found in forest, woodland, heath and shrub communities, and preferred habitat usually consists of a combination of sandy soils and dense heathy vegetation. Quenda are known to inhabit urban backyards, urban parklands, bush fragments, and conservation reserves, even where no predator control programs occur (Bryant, Kobryn, Hardy, & Fleming, 2017; Howard *et al.,* 2014; Valentine *et al.*, 2013). However, they prefer dense, understory vegetation and are found in both open forest, and dense vegetation near swamps and watercourses (Valentine *et al.,* 2013). They are currently found in an arc along the Swan Coastal Plain with some sightings near Geraldton in the North extending past Cape Naturaliste and Cape Leeuwin to the south, through to Albany and Esperance in the southeast.

The habitat types of Cleared and Scattered trees do not provide favourable habitat for quenda, as they lack the dense understorey vegetation and cover that the species prefers. The preferred Quenda habitat, primarily the Banksia Woodland, will be retained in Conservation areas to ensure the species can continue to occupy the MRS amendment area. Quenda are not considered to be conservation significant in the context of the proposed MRS amendment area due to the Priority 4 listing and limited suitable habitat.

Rainbow Bee-eater

Whilst the Rainbow Bee-eater has historically been listed as a migratory species of conservation significance, it, has since been removed from the EPBC migratory species list. Currently, the Rainbow Bee-eater is only listed under the EPBC Act as "Marine", and therefore are only considered conservation significant in Commonwealth marine environments. In addition, the Rainbow Bee-eater is currently considered to be a low priority for management, although population size and trends have not been quantified, the population size is assumed to be reasonably large and there is little documented evidence of population declines (DAWE, 2021). Subsequently, this species is not considered to be conservation significant in the context of the proposed MRS amendment area.

4. Adequacy of Flora and Vegetation Surveys

4.1 Key Flora and Vegetation Survey Guideline Requirements

The flora and vegetation surveys considered in this memo were conducted in accordance with the EPA's (2016a) Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment as outlined in Table 4-1.

Table 4-1 Flora and vegetation guidance requirements (EPA 2016a)

Survey Aspect	Overview of guideline requirement
Survey Timing	The recommended survey timing for surveys on the swan coastal plain is spring (September, October, November)
Survey Effort	A detailed survey should include assessment of quadrats, multiple sampling periods and targeted surveys where appropriate
	A minimum of three quadrats should be sampled in each vegetation unit, with additional quadrats proportional to the size of the vegetation. To clarify vegetation unit boundaries, additional quadrats can be deployed.

4.2 Flora and Vegetation survey adequacy assessment

4.2.1 Survey 1: Wattle Grove South Ecological Surveys AECOM (2020)

An assessment of the accuracy and validity of the AECOM (2020) ecological survey against the EPA's Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment (2016a) has been undertaken. This technical guidance provides a range of potential limitations and constraints that may affect the thoroughness of a field survey and the conclusions reached. Results of this assessment are provided below in Table 4-2. In summary, the survey was predominately constrained by access restrictions within the survey area, however it is considered to provide an adequate level of survey for lots accessed for the purposes of the MRS amendment.

Table 4-2 AECOM (2020) potential limitations and constraints

Potential limitation	Impact on assessment	Comment
Availability of contextual information at a regional and local scale	**Not a constraint**	The survey was undertaken on the Swan Coastal Plain which has been well studied and documented with ample literature available. Furthermore, two desktop assessments were undertaken of the site in question (360 Environmental 2018; AECOM 2020) which informed the field survey methodology.
Competency / experience of the team carrying out the survey, including experience in the bioregion surveyed	**Not a constraint**	Competency and experience of field personnel is presented within Section 4.2 of the report. The field survey was undertaken by Floora de Wit, an ecologist with 13 years of experience undertaking flora and vegetation assessments on the Swan Coastal Plain. Her qualifications include: • Bachelor of Science (Environmental Biology); and • Postgraduate Diploma (Environmental Management and Impact Assessment).
Completeness and further work which might be needed (i.e., was the relevant survey area fully surveyed).	**Potential constraint**	Floristic data was collected from 4 non-permanent quadrats and 3 relève's within the MRS amendment area. Data collected included the presence of plant species, their cover abundance, structural composition of vegetation, physical environment, and presence / absence of disturbance.
Was the appropriate area fully surveyed (effort and extent)	**Not a constraint.**	Floristic data was collected from 4 non-permanent quadrats and 3 relève's across the MRS amendment area. Quadrats were 10x10 m in size. Vegetation type and vegetation condition was mapped across the entirety of the survey area.
Access restrictions within the survey area	**Constraint**	Access to undertake the flora assessment was not provided for a number of private lots within the project area. Of the 77 private

Potential limitation	Impact on assessment	Comment
		properties within the MRS amendment area, 52 (67%) were available for surveying.
Survey timing, rainfall, season of survey	**Potential constraint**	The survey was undertaken in October 2019 following a period of below average rainfall in the preceding months. A total of six flora species of conservation significance were determined likely to be present within the study area based on a desktop assessment. Of these species, the following three would not be flowering during the time in which the survey was undertaken: • *Banksia mimica* – December to February • *Haemodorum loratum* – November • *Isopogon drummondii* – February to June
Disturbance that may have affected the results of the survey such as fire, flood or clearing	**Not a constraint.**	Vegetation within the study area is highly fragmented as a result of clearing for rural and residential purposes. Additionally, degrading processes that are currently active within the site include: • edge effects; • weed incursion; and • a drying climate.

4.2.2 Survey 2: Targeted Flora, Habitat and Supplementary Flora & Vegetation surveys JBS&G 2021 and 2022

Five further flora and vegetation surveys have been completed of the MRS amendment area by JBS&G as follows:

- Tree survey (February 2021): Habitat tree survey of various lots and the Victoria Road reserve.
- Targeted flora survey (August 2021): 1,500 m meandering survey at 10 m intervals throughout approximately 1.65ha.
- Supplementary spring vegetation and flora assessment (October 2021): Various lots, including 1 quadrat, and numerous relève and observation points.
- Reconnaissance vegetation and flora assessment (January 2022) (Appendix F): Various lots, including relève and observation points.
- Further reconnaissance vegetation and flora assessment of targeted lots (October 2022): Various lots, including relève and observation points.

The supplementary surveys in 2021 included a targeted flora survey in late winter for Drakea elastica on Lot 254 Victoria Road and spring survey in October for Lots 12 and 13 Brentwood Road, Lots 81, 106 and 107 Victoria Road and Lots 210 and 804 Crystal Brook Road. One quadrat and one relève were surveyed in the areas of vegetation on each of these previously unsurveyed lots, with the exception of Lot 210, as access to this lot was still not granted at the time.

In lieu of this limited access, the surveying botanists made observations of Lot 210 from the fence line shared with the adjacent Lot 804. The observations were adequate to enable vegetation type and condition mapping to be extrapolated for Lot 210, using the Keighery scale (1994), which is consistent with the mapping completed for all other lots surveyed within the MRS amendment area.

In January 2022, JBS&G undertook a reconnaissance flora and vegetation assessment which included observations from the boundary of several other previously unsurveyed lots where access had still not been granted. This survey included Lots 21, 801, 802 and 803 Crystal Brook Road and Lot 4 (No.36) Victoria Road. Vegetation type and condition were assessed based on visual observations made from the fence line of adjacent lots.

In October 2022, JBS&G undertook a further reconnaissance flora and vegetation assessment, to provide further gap analysis. Data from multiple relève's and observation points was collected across Lots 1, 54 and 83 Victoria Road, Lots 502, 503 and 504 Brentwood Road and Lot 3 Crystal Brook Road.

As such, the majority of the MRS amendment area (~92%) has been subject to an ecological assessment. Survey effort has focused on areas of remnant native vegetation, based on aerial imagery assessments undertaken as part of desktop surveys. All areas of intact remnant native vegetation identified in the desktop assessments has been subject to some form of field survey.

Table 4-3 displays the evaluation of the Targeted Flora survey, supplementary vegetation and flora assessment, and reconnaissance vegetation and flora assessment from lot boundaries undertaken by JBS&G in 2021 and 2022, against a range of potential limitations that may have had effect on that assessment. Based on this evaluation, the assessment has not been subject to constraints that would affect the thoroughness of the assessment and the conclusions reached. It is considered that these surveys provide an adequate level of survey to meet EPA guidance for the purposes of the MRS Amendment.

Table 4-3: Targeted Flora and Supplementary Flora & Vegetation surveys JBS&G (2021 & 2022) – limitations and constraints.

Potential limitation	Impact on assessment	Comment
Availability of contextual information at a regional and local scale	**Not a constraint**	The survey was undertaken on the Swan Coastal Plain which has been well studied and documented with ample literature available. Furthermore, desktop assessments were undertaken of the site in question which informed the field survey methodology
Competency / experience of the team carrying out the survey, including experience in the bioregion surveyed	**Not a constraint**	The field surveys were undertaken by: Rachael Pratt, senior ecologist with over 20 years of experience undertaking flora and vegetation assessments on the Swan Coastal Plain). Richard Lloyd, principal ecologist with over 20 years of experience.
Completeness and further work which might be needed (i.e., was the relevant survey area fully surveyed).	**Not a constraint.**	Floristic data was collected from 1 non-permanent quadrat, and numerous relève's and observation points across the site. A targeted survey was undertaken in August 2021, comprising 1500 m of meandering survey at 10 m intervals throughout approximately 1.65 ha at Lot 254 Victoria Road. Data collected included the presence of plant species, their cover abundance, structural composition of vegetation, physical environment, and presence / absence of disturbance.
Was the appropriate area fully surveyed (effort and extent)	**Not a constraint.**	Floristic data was collected from 1 non-permanent quadrat, and various relève's and observation points across the site. Quadrats were 10x10 m in size. Vegetation type and vegetation condition was mapped across the entirety of the survey area.
Access restrictions within the survey area	**Potential constraint.**	Access to undertake the targeted flora and supplementary flora and vegetation surveys was not provided for all of the previously surveyed and 8 previously non surveyed lots, and a further 13 lots were surveyed from the boundary of the property.
Survey timing, rainfall, season of survey	**Potential constraint**	Flora and vegetation surveys were undertaken on 25 August 2021, 7 October 2021, 24 January 2022, 22 August 2022 and 6 October 2022. A total of six flora species of conservation significance were determined likely to be present within the study area based on a desktop assessment. Of these species, two would not be flowering during the time in which the survey was undertaken. These include: • *Haemodorum loratum* – November • *Isopogon drummondii* – February to June

Potential limitation	Impact on assessment	Comment
Disturbance that may have affected the results of the survey such as fire, flood or clearing	**Not a constraint.**	Vegetation within the study area is highly fragmented as a result of clearing for rural and residential purposes. Additionally, degrading processes that are currently active within the site include: • edge effects • weed incursion • a drying climate.

5. Adequacy of Fauna Surveys

5.1 Key Fauna survey guideline requirements

The fauna surveys considered in this memo were conducted in accordance with key survey requirements prescribed by EPA's (2020) Technical Guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment as outlined in Table 5-1.

Table 5-1 Fauna guidance requirements (EPA 2020)

Survey Aspect	Overview of guideline requirement
Survey Timing	The recommended survey timing for surveys on the swan coastal plain is generally September for December.
Survey Effort	Surveys for EIA should use primary techniques to develop species inventories. Supplementary techniques can then be used to build on and refine results as necessary. Primary techniques include but are not limited to Pit Traps, Funnel Traps, Aluminium box traps, cage traps, spotlighting and head torching, observation – bird surveys, opportunistic observations, searching for tracks and signs, acoustic surveys – audible calls and ultrasonic calls, and camera traps

5.2 Fauna survey adequacy assessment

The majority of the site has been subject to an ecological or Black Cockatoo Habitat Assessment.

AECOM (2020) conducted a Level 1 fauna survey in accordance with Technical Guidance – Terrestrial Fauna Surveys (EPA 2016b) and Technical Guidance – Sampling Methods for Terrestrial Vertebrate Fauna (EPA 2016c). The fauna survey was conducted by AECOM's Ecologist in conjunction with the detailed flora and vegetation survey. Conducting the two surveys concurrently enabled consistent and clear mapping of the fauna habitats and vegetation communities. The Level 1 fauna survey primarily focused on mapping of fauna habitat and assessing this habitat for potential utilisation by conservation significant fauna species. Fauna habitats were assessed for specific habitat components, including consideration of structural diversity and refuge opportunities for fauna.

Records of all observed fauna and birds, species identified from distinctive calls and details of indirect evidence such as scats, tracks and diggings were documented. Particular attention was given to searching for conservation significant species identified in the desktop assessment as having potential to occur in the area. All observations were made between daylight hours of 0700 and 1700.

A targeted black cockatoo survey was conducted in conjunction with the Level 1 fauna survey and detailed flora and vegetation survey by AECOM Ecologists and Botanist. This survey was conducted over multiple mobilisations due to site accessibility, including 9 and 10 September 2019; 1 to 4, and the 8 October 2019; 18 and 21 November. JBS&G conducted a further tree survey over various lots within the MRS amendment area in February 2021 to supplement the habitat survey data.

6. Conclusions

The significant ecological findings from the assessment of the MRS amendment area are outlined below:

- Timings for the surveys undertaken for the Proposal were considered adequate based on EPA guidance, i.e. a primary survey and targeted survey undertaken during the spring season. The surveys were undertaken across multiple years with effort focused on areas of remnant native vegetation.
- The survey effort undertaken within the MRS amendment area is considered appropriate based on EPA's (2016a) guidance:
    - The area of greatest impact and habitat loss, areas of native vegetation and Banksia Woodlands, have been extensively surveyed over multiple years and seasons.
    - The MRS amendment areas has been surveyed with sufficient detail to characterise the receiving environment and to assess the vegetation condition, with targeted surveys undertaken to identify flora of conservation significance. In particular, the presence of TECs and a PEC within the MRS amendment area has been identified and FCT analysis undertaken.
    - An adequate number of quadrats have been undertaken within vegetation units (with the exception of vegetation unit EmMplp due to the small area of this unit located in Lot 254 Victoria Road) i.e. a minimum of three quadrats have been sampled in each vegetation unit. Information on flora and vegetation has been provided in a report that aligns with the requirements of the EPA (2016a). Desktop reviews and interrogation of recommended spatial data and existing ecological survey reports has been completed, with this information used to guide survey planning, with specific reference to determining the presence or absence of flora or ecological communities of conservation significance.
- Surveys over the Amendment Area meet the requirements for a detailed survey. Targeted searches for flora of conservation were completed. Information on survey effort and the location of quadrats is provided in all Appendix C as required by EPA (2016a) guidance.

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8. Limitations

Scope of services

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Appendix A 360 Environmental (2018) Environmental Assessment Report

360 environmental

Various Lots, Wattle Grove

Environmental Assessment Report

Prepared for:
Burgess Design Group

April 2018

people • planet • professional

Document Reference	Revision	Prepared by	Reviewed by	Admin Review	Submitted to Client	
					Copies	Date
2188AB	1 INTERNAL DRAFT	CM	KC	-	1x electronic	12/03/18
2188AB	2 CLIENT DRAFT	CM	-	NL	1x electronic	13/03/18
2188AB	3 CLIENT FINAL	CM	KC	NL	1x electronic	24/04/18

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Table of Contents

1 Introduction 1
1.1 Background 1
1.2 Environmental Assessment Objectives 1
1.3 Scope of Works 1
2 Key Environmental Legislation and Policies 3
2.1 Commonwealth Legislation 3
2.2 State Legislation 3
3 Planning Context 9
4 Site Environmental Features 11
4.1 Climate 11
4.2 Topography 11
4.3 Regional Geology and Soils 11
4.4 Hydrogeology 12
4.5 Contamination 13
4.6 Reserves and Conservation Areas 14
4.7 Flora and Vegetation 15
4.8 Fauna 23
4.9 Heritage 25
4.10 Site History 26
4.11 Surrounding Land Uses 27
4.12 Industrial Separation Distances 27
5 Potential Site Environmental Constraints 29
5.1 Wetlands and Wetland Buffers 29
5.2 Watercourse and Foreshore Areas 30
5.3 Declared Rare Flora 31
5.4 Threatened Ecological Communities 31
5.5 Water Management 31
5.6 Industrial Separation Buffers 32
6 Summary 33
6.1 Outcome and Key Findings of Assessment 33
7 Limitations 35
8 References 36

List of Tables

Table 1. Key State Legislation 3
Table 2. Relevant Standards, Guidelines and Policies 6
Table 3. Wetland Categories and Management Objectives (WAPC 2005) 13
Table 4. Contaminated Sites Within the Vicinity of the Site (DWER 2017b) 14
Table 5. Remnant Vegetation Statistics (Government of Western Australia 2016) 16
Table 6. Likelihood Assessment of Conservation Significant Fauna Species Occurring Within the Site (DEE 2017; DBCA 2017a; b) 18
Table 7. Introduced Flora Recorded in the Survey Area. 21
Table 8. Likelihood Assessment of Conservation Significant Fauna Occurring Within the Site (DEE 2017) (DBCA 2017a;d) 23
Table 9. Aboriginal Heritage Sites Within or in the Vicinity of the Site (DPLH 2017) 25

List of Figures

Figure 1. Site Location 40
Figure 2.Topography 41
Figure 3. Geology and Soils 42
Figure 4. Surface Hydrology 43
Figure 5. Contamination 44
Figure 6. Conservation Areas 45
Figure 7. Broad Vegetation Types 46
Figure 8. Declared Rare Flora 47
Figure 9. Threatened and Priority Ecological Communities 48
Figure 10. Heritage 49
Figure 11a. Historical Aerial (1953) 50
Figure 11b. Historical Aerial (1965) 51
Figure 11c. Historical Aerial (1974) 52
Figure 11d. Historical Aerial (1985) 53
Figure 11e. Historical Aerial (1995) 54
Figure 11f. Historical Aerial (2000) 55
Figure 11g. Historical Aerial (2010) 56

Figure 11h. Historical Aerial (2017) 57
Figure 12. Groundwater WIN Bores..... 58
Figure 13. Land Use Opportunities and Constraints..... 59
Figure 14. Environmental Opportunities and Constraints 60

List of Appendices

Appendix A EPBC Protected Matters Report
Appendix B DBCA Naturemap Report
Appendix C WIN Groundwater Bores

1 Introduction

1.1 Background

360 Environmental Pty Ltd was commissioned by Burgess Design Group Pty Ltd on behalf of the City of Kalamunda to prepare an environmental assessment report (EAR) for various lots bound by Tonkin Highway, Kelvin Road, Welshpool Road East, Fontano Road, Judith Road and Crystal Brook Road in Wattle Grove ('the site').

The purpose of this EAR is to inform a feasibility study on the future rezoning of the site from 'Rural' to 'Urban' under the Metropolitan Region Scheme (MRS).

The site is approximately 325 ha in size and is located approximately 14.75 km southeast of Perth's Central Business District (CBD). The site is situated within the City of Kalamunda local government area and is zoned 'Special Rural' and 'Rural Composite' under the City's Local Planning Scheme No. 3 (LPS 3).

1.2 Environmental Assessment Objectives

This Environmental Assessment Report (EAR) provides an overview of the general environmental features of the Site and includes an overview of the Site's remaining biological and social environment including wetlands, Aboriginal and non-Aboriginal Heritage sites, regional soil types, hydrology, geomorphology, flora, vegetation and fauna, planning context and social environment as determined through a review of existing information.

1.3 Scope of Works

The scope of works for this study is as follows:

- Literature review of relevant environmental and planning documents;
- Desktop review of geology, regional surface hydrology and groundwater information using databases and digital mapping information;
- Preliminary acid sulfate soils (ASS) assessment, including review of ASS risk mapping and local soil types;
- Desktop site assessment of contamination and review of historical and current land uses;
- Detailed desktop assessment of flora, vegetation, fauna from searches of the Department of Biodiversity, Conservation and Attractions' (DBCAs) Threatened and Priority searches, NatureMap and the Commonwealth's Protected Matters Search Tool;
- Review of mapped conservation areas;

- Desktop heritage (Aboriginal and non-Aboriginal) assessment;
- Identification of other environmental issues associated with proposed rezoning; and
- Formulation of a report detailing the above.

2 Key Environmental Legislation and Policies

2.1 Commonwealth Legislation

2.1.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the central piece of environmental legislation which protects Matters of National Environmental Significant (MNES) and broadly, to conserve Australia's biodiversity. If a proposed action is likely to have a significant impact on any MNES, a referral to the Commonwealth Department of the Environment and Energy (DEE) is required.

2.2 State Legislation

2.2.1 Environmental Protection Act 1986

The *Environmental Protection Act 1986* (EP Act) is the key legislative tool for environmental protection in Western Australia. It is administered by the Environmental Protection Authority (EPA) and the Minister for Environment. Under Part IV of the EP Act, the EPA undertakes environmental impact assessment of proposals and schemes to provide advice on environmental acceptability of developments. The environment impact assessment process provides an orderly and systematic evaluation of a proposal and its potential impact on the environment. A critical component of the assessment is the consideration of ways in which the implemented proposal could avoid or reduce any potential impact on the environment.

2.2.2 Relevant Legislation and Regulations

All future rezoning and development will be required to comply with the requirements of other relevant state legislation and regulations. Table 1 provides a summary of the key state legislation and regulations relevant to the proposed residential development.

Table 1. Key State Legislation

Key Legislation	Responsible Government Agency	Aspect
Aboriginal Heritage Act 1972	Department of Planning, Lands and Heritage	Archaeological and ethnographic heritage
Aboriginal Heritage Regulations 1974	Department of Planning, Lands and Heritage	Archaeological and ethnographic heritage

KEY LEGISLATION	RESPONSIBLE GOVERNMENT AGENCY	ASPECT
Agricultural and Related Resources Protection Act 1976	Department of Primary Industries and Regional Development	Weeds and feral animals
Biosecurity and Agriculture Management Act 2007	Department of Primary Industries and Regional Development	Weeds / pests / diseases
Bush Fires Act 1954	Department of Fires and Emergency Services	Bush fire control
Conservation and Land Management Act 1984	Department of Biodiversity Conservation and Attractions Department of Agriculture	Flora and fauna / habitat / weeds / pests / diseases
Conservation and Land Management Regulations 2002	Department of Biodiversity Conservation and Attractions Department of Agriculture	Flora and fauna / habitat / weeds / pests / diseases
Contaminated Sites Act 2003	Department of Water and Environmental Regulation	Management of contaminated soils and water
Environmental Protection Act 1986	Environmental Protection Authority Department of Water and Environmental Regulation	Part IV – Environmental Impact Assessment Part V – Works Approvals and Licences
Environmental Protection (Clearing of Native Vegetation) Regulations 2004	Department of Water and Environmental Regulation	Clearing of native vegetation
Planning and Development Act 2005	Department of Planning, Lands and Heritage	Structure planning and subdivision approval
Rights in Water and Irrigation Act 1914	Department of Water and Environmental Regulation	Governs management of the use, service and health of water and watercourses (including beds and banks). Water licensing is required in all proclaimed areas and for all artesian groundwater wells throughout the state.

KEY LEGISLATION	RESPONSIBLE GOVERNMENT AGENCY	ASPECT
Wildlife Conservation Act 1950	Department of Biodiversity Conservation and Attractions	Wildlife conservation and protection

2.2.3 Relevant Standards, Guidelines and Policies

Future development is subject to compliance with applicable standards, guidelines and policies developed by the State's regulators to assist proponents in understanding the minimum requirements for environmental protection. The following table details the key standards, guidelines and State Planning Policies relevant to future residential development of the site (Table 2).

Table 2. Relevant Standards, Guidelines and Policies

DOCUMENT	DESCRIPTION
EPA Policies and Guidance	
Statement of Environmental Principles, Factors and Objectives (EPA 2016a)	This statement communicates the EPA considers the object and principles of the EP Act, uses environmental factors and objectives to organise and systemise environmental impact assessment, taking a holistic view of the environment and considering significance of a proposal.
Environmental Factor Guideline – Flora and Vegetation (EPA 2016b)	Provides guidance to protect flora and vegetation so that biological diversity and ecological integrity are maintained.
Environmental Factor Guideline – Terrestrial Environmental Quality (EPA 2016c)	Provides guidance with the objective to maintain the quality of land and soils so that environmental values are protected.
Environmental Factor Guideline – Terrestrial Fauna (EPA 2016d)	Provides guidance with the objective to protect terrestrial fauna so that biological diversity and ecological integrity at maintained.
Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016e)	Provides technical guidance to ensure adequate flora and vegetation data of an appropriate standard are obtained and used in environmental impact assessment.
Technical Guidance – Terrestrial Fauna Surveys (EPA 2004)	Provides technical on the direction and information on general standards and protocols for terrestrial fauna surveys for environmental impact assessment.
Guidance Statement No. 3: *Separation Distances between Industrial and Sensitive Land Uses* (EPA 2005)	Provides guidance on the generic separation (buffer) distances between Industrial and Sensitive land uses to avoid conflicts between these land uses.
Guidance Statement No. 6: *Rehabilitation of Terrestrial Ecosystems* (EPA 2006)	Provides guidance to ensure the return of biodiversity in rehabilitated areas by increasing the quality, uniformity, and efficiency of standards and processes for rehabilitation of native vegetation in Western Australia and to allow more effective monitoring and auditing of outcomes.
Guidance Statement No. 33: *Environmental Guidance for Planning and Development* (EPA	Provides information and advice to assist land use planning and development processes to protect, conserve and enhance the environment.

DOCUMENT	DESCRIPTION
2008)	Describes the processes the EPA may apply under the EP Act to land use planning and development in Western Australia, and the environmental impact assessment process applied by the EPA to schemes.
Guidance Statement No. 41: *Aboriginal Heritage Assessment* (EPA 2004b)	Provides guidance on the EPA's position on the assessment of Aboriginal heritage and information that the EPA will consider when assessing proposals where Aboriginal heritage is a relevant environmental factor.
Guidance Statement No. 56: *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004d)	Provides guidance and information on the EPA's expected standards and protocols for terrestrial flora and vegetation surveys to environmental consultants and proponents.
WA Environmental Offsets Policy (EPA 2011)	Seeks to protect and conserve environmental and biodiversity values for present and future generations. The policy ensures that economic and social development may occur while supporting long term environmental and conservation values.
EPA Bulletins	
Environmental Protection Bulletin No. 1: *Environmental Offsets* (EPA 2014b)	Clarifies how the EPA will consider offsets through the environmental impact assessment process.
State Planning Policies	
State Planning Policy 2.8: *Bushland Policy for the Perth Metropolitan Region* (WAPC 2010)	Provide policy and implementation framework that will ensure bushland protection and management issues in the Perth Metropolitan Region are appropriately addressed and integrated with broader land use planning and decision making. Ensure the long-term protection of biodiversity and associated environmental values.
State Planning Policy 2.9: *Water Resources* (WAPC 2006)	Provides clarification and additional guidance to planning decision-makers for consideration of water resources identified as having significant economic, social, cultural or environmental values.
State Planning Policy 3.7: *Planning in Bushfire Prone Areas* (WAPC 2015)	Provides guidance on the implementation of effective risk-based land use planning and development to preserve life and reduce the impact of bushfire on property and

DOCUMENT	DESCRIPTION
	infrastructure.
Road and Rail Transport Noise and Freight Considerations in Land Use Planning (WAPC 2009)	Provides guidance to promote a system in which sustainable land use and transport are mutually compatible.
Department of Water and Environmental Regulation (DWER) Guidelines	
Assessment and management of contaminated sites Guideline (DER 2014)	Provides guidance on the assessment and management of contaminated sites in Western Australian within legislative framework of the Contaminated Sites Act 2003 and the Contaminated Sites Regulations 2006.
Identification and investigation of acid sulfate soils and acidic landscapes (DER 2013)	Provides guidance to assist with the identification, assessment and management of acid sulfate soils in Western Australia.

3 Planning Context

3.1.1 Shire of Kalamunda Local Planning Scheme No. 3

Under the City of Kalamunda's LPS 3, the site is zoned 'Special Rural' or 'Rural Composite'.

3.1.2 Draft Perth and Peel @3.5 Million Sub-regional Planning Framework

The draft Perth and Peel @ 3.5 million suite of strategic land use planning documents aim to accommodate 3.5 million people by the year 2050. The WAPC identified part of the Site as 'Urban Expansion' in the draft Metropolitan Perth and Peel Sub-regional Planning Framework (WAPC 2015).

3.1.3 Draft Perth and Peel Green Growth Plan for 3.5 million

In response to the draft Perth and Peel Sub-Regional Frameworks, the draft Perth and Peel Green Growth Plan for 3.5 million (draft GGP) has been prepared. The draft Green Growth Plan proposes to secure upfront Commonwealth environmental approvals and streamline State environmental approvals for development required to support growth to 3.5 million people. The Plan also aims to provide protection of bushland, rivers, wildlife and wetlands through implementation of a strategic conservation plan (DPC 2016).

The site has been identified under the draft GGP as having areas identified within the:

- Urban class of action area; or
- Rural Residential class of action area; or
- Area not within the Urban, Industrial or Rural Residential classes of action (DCP 2016).

The site has also been identified as having areas mapped as Broad and Specific Commitments and Values under the draft GGP (DCP 2016).

The draft Broad Commitments and Values relate to seeking an overall conservation outcome where further work is needed to determine when intervention is required to reach an outcome. Draft Broad Commitments and Values include the following environmental aspects (DoP 2017):

- Threatened fauna habitat;
- Vegetation complexes of more than 10 % and less than 30 % remaining;
- Negotiated planning solution and rural complementary Bush Forever areas with three classes of action mapped;

- Resource Enhancement Wetlands with remnant vegetation and a 50 m buffer; and
- Conservation Category Wetlands 50 m buffer.

The draft Specific commitments relate to draft commitments for protecting a specific occurrence of an environmental value, including (DPC 2016):

- Threatened flora;
- Threatened Ecological Communities;
- Conservation Category Wetlands;
- Vegetation complexes with less than 10 % remaining;
- Bush Forever areas within three classes of action mapped (excluding those within the 'rural complementary' or 'negotiated planning solution' categories); and
- Short-tongued Bee *(Leioproctus douglasiellus*) distribution.

Some areas within the site have known existing approvals where the draft commitments do not apply (while such approvals remain valid). These approvals include Part IV or V Division 2 of the *Environmental Protection Act 1986* or under subdivision approval; or for matters of national environmental significance under Part 9 of the EPBC Act.

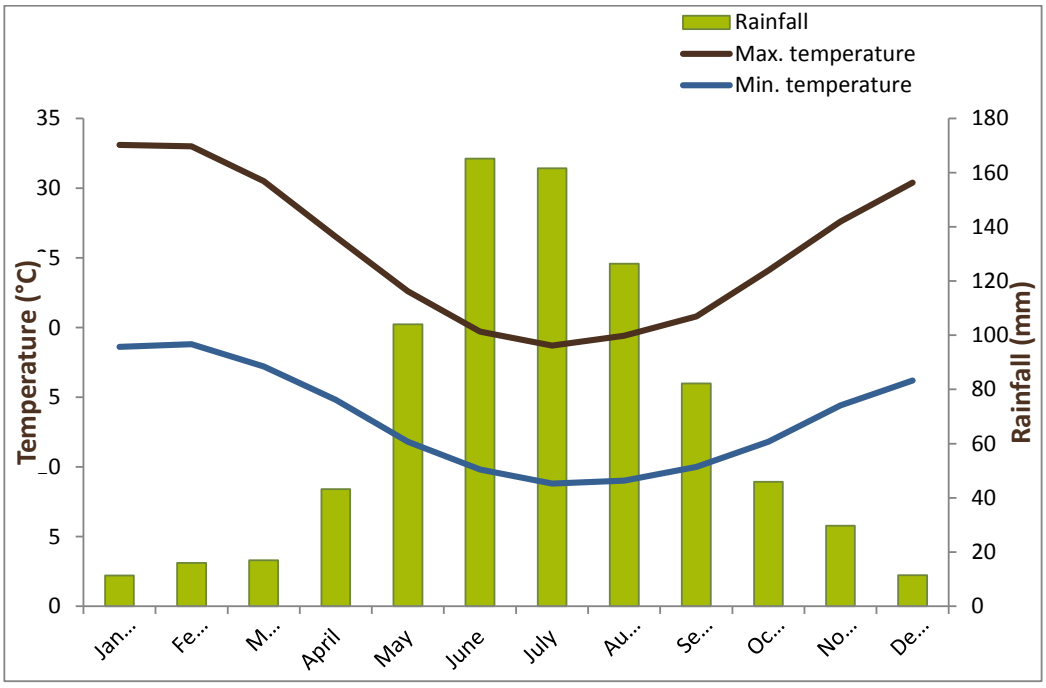
3.1.4 City of Kalamunda Local Biodiversity Strategy

The City of Kalamunda's Local Biodiversity Strategy has been developed in anticipation of future urban development encroaching into natural assets. The Strategy aims to strategically plan natural area protection to ensure biodiversity conservation is incorporated into decision making processes. The Strategy focusses on protection of natural areas containing endemic species or ecological communities that are described as having high biodiversity values (Local Natural Areas (LNAs)). LNAs are natural areas outside of management by the DBCA and Bush Forever Sites, where Local Government Authorities can exercise the most control. The site does not contain any LNAs (Shire of Kalamunda 2008).

4 Site Environmental Features

4.1 Climate

The Site is within a warm Mediterranean climate with warm summers and cool winters. Weather data was collected between 1961 and 2017 from the Gosnells City Station (#009106) located approximately 5.7 km southeast from the Site. The annual mean maximum temperature is 25.5 ºC and the annual mean minimum temperature is 13.4 ºC. The annual mean rainfall was recorded at 820.3 mm (BoM 2017) (Graph 1).



Graph 1: Climate Statistics for 1961 and 2017 Gosnells City Station (BoM 2017)

4.2 Topography

The elevation across the site ranges from 21 m Australian Height Datum (AHD) to 79 m AHD, falling from the east to the west (Figure 2) (DoW 2010).

4.3 Regional Geology and Soils

Surface geology profile mapping at 1: 250 000 indicates the geology of the Site is typically basal conglomerate overlain by dune quartz with heavy mineral concentrations associated with the Kwinana Group and the Yoganup Formation, and alluvial sand and clay with shallow-marine and estuarine lenses and local basal conglomerate associated with the Guildford formation (GSWA 2008):

Soil Landscapes and Land Systems mapping has identified the Site is within the following land systems (DAFWA 2012):

- **Pinjarra System:** Poorly drained coastal plain with variable alluvial and Aeolian sands; and
- **Forrestfield System:** Duplex sandy gravels, pale deep sands and grey deep sandy duplexes.

The (then) Department of Agriculture and Food (DAFWA) Soil Subsystems mapping indicates the Site is within the following soil subsystems (DAFWA 2008):

- Pinjarra Gf3 Phase: Level to very gently sloping plain. Poorly drained mottled yellow earths with loamy topsoil;
- Pinjarra Gf6 Phase: Seasonally inundated swamps with very poorly drained uniform non-cracking clays;
- Pinjarra Gf7 Phase: Minor rises with deep rapidly drained brownish, siliceous or bleached sands underlain by mottled yellow clay;
- Forrestfield (D Range) F1 Phase: Foot and low slopes (<10%) with deep rapidly drained siliceous yellow brown sands, and pale or bleached sands with yellow-brown subsoil;
- Forrestfield (D Range) F2 Phase: Well drained foot and low slopes. Gravelly yellow or brown duplex soils with sandy topsoil;
- Forrestfield F4 Phase: Incised stream channels within gentle slopes with deep acidic yellow duplex soils and sandy alluvial gradational brown earths; and
- Forrestfield (D Range) F8 Phase: Slopes 3-15%. Moderately well drained gravelly duplex soils with sandy loam to loam topsoil.

4.4 Hydrogeology

4.4.1 Groundwater

Data from the Perth Groundwater Map indicates the groundwater table ranges between 12 m Australian Height Datum (AHD) and 17 m AHD. Groundwater flows from east to west (DWER 2017a).

The Site is not within a Public Drinking Water Source Area (DWER 2017a).

4.4.2 Surface Water

Yule Brook, a major tributary, exists 55 m to the north of the site, separated by Welshpool Road East (Figure 4) (DoW 2012a).

An un-named minor non-perennial watercourse traverses the northern portion of the site connecting to Yule Brook in the northeast. In addition, another minor perennial

watercourse traverses along the boundary in the south-western corner of the site (DoW 2012a)

The site also contains three constructed earth dams and two perennial lakes. A constructed minor drain extends south of Crystal Brook Road to a constructed dam (Figure 4) (DoW 2012a).

The site is not within a mapped 100 Year ARI Floodplain Area (DoW 2015).

4.4.3 Wetlands

A wetland is defined in Schedule 5 of the *Environmental Protection Act 1986* as a 'an area of seasonally, intermittently or permanently waterlogged or inundated land, whether natural or otherwise, and includes a lake, swamp, marsh, spring, dampland, tidal flat or estuary' (Hill *et al.* 1996).

Desktop mapping has identified that small portions along the western boundary of the Site (along Tonkin Highway) are mapped as Conservation Category (CCW) and Resource Enhancement wetlands (Figure 4) (DPaW 2017).

Wetland categories and their management objectives are described within Table 3 below:

Table 3. Wetland Categories and Management Objectives (WAPC 2005)

CATEGORY	CATEGORY DESCRIPTION	MANAGEMENT OBJECTIVES
Conservation Category	High conservation and ecological value	To preserve the wetlands (natural) attributes and functions
Resource Enhancement	Moderate natural and human use attributes that can be restored or enhanced	To restore wetlands through maintenance and enhancement of wetland functions and attributes
Multiple Use	Little remaining important wetland attributes, functions and ecological value	To use, develop and manage wetlands in the context of water, town and environmental planning

4.5 Contamination

4.5.1 Acid Sulfate Soils

Desktop mapping has identified the entire Site as having 'Moderate to Low' risk of acid sulfate soils (ASS) risk within 3 m of natural soil surface and 'High to Moderate' risk beyond 3 m (DER 2014) (Figure 5).

4.5.2 Contaminated Sites

Under the *Contaminated Sites Act 2003*, contaminated sites must be reported to the DWER, investigated and, if necessary, remediated.

Review of DWER's Contaminated Sites Database has identified there are no registered contaminated sites within the Site, however, there are four contaminated sites within a 1 km radius (DWER 2017b) (Table 4) (Figure 5):

Table 4. Contaminated Sites Within the Vicinity of the Site (DWER 2017b)

Lot	Nature and Extent of Contamination	Status	Distance from site (km)
Lot 804 on Plan 59983, Kenwick	Fragments of asbestos containing material (ACM) are present within the soils at the Site	Contaminated – Restricted Us	0.41
Lot 9005 on Plan 40777, Maddington	Landfill gases have been identified along the eastern boundary and the southwest corner of the Site. Hydrocarbon-impacted groundwater was identified across the majority of the Site. Asbestos impacted fill was identified beneath the landfill capping layer across a majority of the Site.	Contaminated – Restricted Use	1.61
Lot 7, Former Caltex Service Station, Welshpool Rd, Wattle Grove.	Surface and subsurface soils are impacted with hydrocarbons. Groundwater beneath the Source and Affected Sites is impacted with hydrocarbons.	Contaminated – remediation required	0.90
Lot 566 Orchard Road, Maddington	Hydrocarbons (such as from petrel or diesel) are present in groundwater beneath the south-western portion of the Site.	Remediated for Restricted Use	1.40

4.6 Reserves and Conservation Areas

Desktop mapping has identified that the Site is not within any conservation areas. However, there are a number of conservation areas abutting the site and within a 2 km radius (Figure 6). Five Bush Forever sites (ID: 50, 51, 53, 320 and 387) exist within 2 km of the site to the north, south and west (DoP 2014).

Several lots outside of the site boundary have been identified as DBCA Managed Lands that are managed and vested under the Conservation and Land Management Act 1984 (CALM Act) (DPaW 2016) (Figure 6).

4.6.1 Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESAs) are identified and protected under the *Environmental Protection (Environmentally Sensitive Areas) Notice 2005*. Under the Notice, it is an offence to kill or destroy vegetation within an ESA without a Native Vegetation Clearing Permit (NVCP).

A number of Environmentally Sensitive Areas (ESAs) impinge the site (Figure 6) (DER 2014b). DWER's online Clearing Permit System has identified that the ESAs across the Site refer to the presence of the following; Declared Rare Flora (DRF) or a Threatened Ecological Community (DWER 2017c).

Cross referencing data obtained from DBCA's Threatened and Priority Flora database and the TEC/PEC database search, these ESA's refer to the location of the following two DRF and the area of vegetation within 50 m of the DRF location:

- Wavy Smoke-bush (*Conospermum undulatum*); and
- Summer Honeypot (*Banksia mimica*).

4.7 Flora and Vegetation

4.7.1 Bioregion

The Site is located within the Swan Coastal Plain and the Jarrah Forest bioregions of the Interim Biogeographic Regionalisation of Australia (IBRA).

The Swan Coastal Plain Perth subregion (SWA02) is a low lying coastal plain composed of colluvial and Aeolian sands, alluvial river flats and coastal limestone rising to duricrusted Mesozoic sediments in the east. Outwash plains are extensive only in the south, while a complex series of seasonal wetlands and swamps extends from north to south. Vegetation comprises heath and/or Tuart woodlands on limestone, Banksia and Jarrah- Banksia woodlands on Quaternary marine dunes of various ages, Marri on colluvial and alluvial soils, *Casuarina obesa* on out-wash plains, and paperbark (*Melaleuca spp*.) in wetland areas (Mitchell *et al*. 2002).

The Northern Jarrah Forest subregion (JF1) incorporates the area east of the Darling Scarp, overlying Archaean granite and metamorphic rocks of an average elevation of 300 m, capped by an extensive lateritic duricrust, dissected by later drainage and broken by occasional granite hills. In the east, the laterite becomes deeply dissected until it compresses isolated remnants. Rainfall is from 1300 mm on the scarp to approximately 700 mm in the east and north. Vegetation comprises Jarrah – Marri forest in the west with Bullich and Blackbutt in the valleys grading to Wandoo and Marri woodlands in the east with Powder bark on breakaways. There are extensive but localised sand sheets

with *Banksia* low woodlands. Heath is found on granite rocks and as a common understorey of forests and woodlands in the north and east. 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 (Williams *et al.* 2001).

4.7.2 Broad Vegetation Types

Vegetation mapping of the Swan Coastal Plain subregion of WA was completed on a broad scale (1:250,000) by Beard (1980). These vegetation units were re-assessed by Shepherd et al. (2001) to account for clearing in the intensive land use zone, dividing some larger vegetation units into smaller units.

The Site is within three vegetation units described below (Shepherd *et al. 2001*) (Figure 7):

- **Pinjarra 3:** Medium forest; Jarrah – Marri;
- **West Darling 4:** Medium woodland; Marri and Wandoo; and
- **Pinjarra 968:** Medium woodland; Jarrah, Marri and Wandoo.

Remnant vegetation statistics of the IBRA region and the above vegetation association is detailed in Table 5.

Table 5. Remnant Vegetation Statistics (Government of Western Australia 2016)

	Pre–European (ha)	Current Extent (ha)	% Remaining	% Remaining in DBCA reserves
IBRA Region Swan Coastal Plain	1,501,221.93	578,432.17	38.53	37.85
IBRA Region Jarrah Forest	4,506,660.26	2,416,018.14	53.61	69.17
State wide				
Beard Veg Assoc No. 3	2,661,405.06	1,806,812.23	67.89	81.22
Beard Veg Assoc No. 4	1,054,279.89	293,367.54	27.83	22.78
Beard Veg Assoc No. 968	296,877.84	95,642.43	32.22	57.30
In IBRA Sub-region SWA02				
Beard Veg Assoc No. 3	16,754.96	2,798.11	16.70	12.66
Beard Veg Assoc No. 4	13,107.83	1,903.81	14.52	13.36

	Pre–European (ha)	Current Extent (ha)	% Remaining	% Remaining in DBCA reserves
Beard Veg Assoc No. 968	136,188.20	8,967.05	6.58	21.83
In IBRA Sub-region JF01				
Beard Veg Assoc No. 3	908,099.69	723,075.06	79.63	83.87
Beard Veg Assoc No. 4	614,200.81	198,940.05	32.39	30.36
Beard Veg Assoc No. 968	72,007.43	53,204.08	73.89	60.30
Local Government Authority – City of Kalamunda				
Beard Veg Assoc No. 3	26,414.55	21,061.60	79.73	89.46
Beard Veg Assoc No. 4	2,882.29	2,046.48	71.00	58.89
Beard Veg Assoc No. 968	663.60	95.65	14.41	1.25

The biodiversity conservation goals are based on the national targets for biodiversity conservation as set out in *The National Objectives and Targets for Biodiversity Conservation 2001 – 2005,* which aim to:

- Prevent clearing of ecological communities with **less than 30%** of the original extent remaining;
- Recover ecological communities with **less than 10%** of the original extent remaining; and
- Protect threatened species and ecological communities.

The State Government acknowledges that 30% representation of the original extent of each vegetation type is regarded as the threshold level below which species loss appears to accelerate exponentially at an ecosystem level, and 10% representation of the original extent of each vegetation type is regarded as the level representing 'endangered' (WAPC 2011). Based on the figures provided above for representation across the State, all vegetation types, except **West Darling 4** are above the 30% target. Within the City of Kalamunda, all vegetation types except **Pinjarra 968** are above the 30% target. However, it is important to note that in comparison, there is a small proportion of **Pinjarra 968** within the City of Kalamunda's boundary.

Vegetation complexes of the Southwest botanical district have been mapped by Heddle *et al*. (1980). Four vegetation complexes exist across the site which relates to the underlying soil profile (Figure 7):

- **Guildford Complex:** Open forest to tall open forest and woodland;
- **Southern River Complex:** Open woodland;
- **Forrestfield Complex:** Open forest and fringing woodland; and
- **Darling Scarp Complex:** Low open woodland to lichens.

4.7.3 Declared, Rare and Priority Flora

Database searches were undertaken to identify the conservation significant flora species occurring or potentially occurring within a 5 km radius of the site. The searches included the DEE's Protected Matters Search Tool (PMST), DBCA's NatureMap database and DBCA's Threatened and Priority Flora database request (DEE 2017; DBCA 2017a; DBCA 2017b).

Review of the database searches identified 75 conservation significant flora species as potentially occurring within the site and a likelihood assessment of the species was undertaken (Table 6) (Figure 8).

Table 6. Likelihood Assessment of Conservation Significant Fauna Species Occurring Within the Site (DEE 2017; DBCA 2017a; b)

Taxon	Conservation Status		Likelihood of Occurrence in Site
	EPBC	DBCA	
Calectasia cyanea	Critically Endangered	Threatened	Possible
Grevillea thelemanniana subsp. thelemanniana	Critically Endangered	Threatened	Possible
Ptilotus pyramidatus	Critically Endangered	Threatened	Unknown
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	Critically Endangered	Threatened	Likely
Andersonia gracilis	Endangered	Threatened	Possible
Austrostipa bronwenae	Endangered	Threatened	Likely
Banksia mimica	Endangered	Threatened	Unknown
Caladenia huegelii	Endangered	Threatened	Unknown
Calytrix breviseta subsp. breviseta	Endangered	Threatened	Likely
Chamelaucium sp. Gingin	Endangered	Threatened	Possible
Darwinia apiculata	Endangered	Threatened	Possible
Diuris drummondii	Endangered	Threatened	Unknown
Diuris purdiei	Endangered	Threatened	Unknown
Drakaea elastica	Endangered	Threatened	Likely
Eremophila glabra subsp. chlorella	Endangered	Threatened	Likely
Eucaluptus x balanites	Endangered	Threatened	Likely
Grevilea curviloba subsp. incurva	Endangered	Threatened	Likely
Lasiopetalum pterocarpum	Endangered	Threatened	Possible

TAXON	CONSERVATION STATUS		LIKELIHOOD OF OCCURRENCE IN SITE
	EPBC	DBCA	
Lepidosperma rostratum	Endangered	Threatened	Likely
Macarthuria keigheryi	Endangered	Threatened	Possible
Thelymitra stellata	Endangered	Threatened	Likely
Acacia anomala	Vulnerable	Threatened	Possible
Acacia aphylla	Vulnerable	Threatened	Possible
Conospermum undulatum	Vulnerable	Threatened	Likely
Diuris micrantha	Vulnerable	Threatened	Possible
Drakaea micrantha	Vulnerable	Threatened	Unknown
Eleocharis keigheryi	Vulnerable	Threatened	Possible
Amanita quenda	-	Priority 1	Possible
Calandrinia sp. Piawaning	-	Priority 1	Likely
Schoenus sp. Beaufort (G.J. Keighery 6291)	-	Priority 1	Possible
Thelymitra magnifica	-	Priority 1	Likely
Comesperma griffinii	-	Priority 2	Likely
Comesperma rhadinocarpum	-	Priority 2	Unknown
Isotropis cuneifolia subsp. glabra	-	Priority 2	Possible
Lepyrodia curvescens	-	Priority 2	Possible
Melaleuca viminalis	-	Priority 2	Possible
Schoenus loliaceus	-	Priority 2	Possible
Acacia horridula	-	Priority 3	Likely
Amanita wadjukiorum	-	Priority 3	Likely
Babingtonia urbana	-	Priority 3	Unlikely
Banksia pteridifolia subsp. vernalis	-	Priority 3	Unlikely
Byblis gigantea	-	Priority 3	Unlikely
Chamaescilla gibsonii	-	Priority 3	Possible
Eryngium pinnatifidum subsp. Palustre (G.J. Keighery 13459)	-	Priority 3	Likely
Eryngium sp. Subdecumbens (G.J. Keighery 5390)	-	Priority 3	Likely
Haemodorum loratum	-	Priority 3	Likely
Isopogon drummondii	-	Priority 3	Possible
Lasiopetalum glutinosum subsp. glutinosum	-	Priority 3	Likely
Meionectes tenuifolia	-	Priority 3	Possible
Myriophyllum echinatum	-	Priority 3	Possible
Pithocarpa corymbulosa	-	Priority 3	Possible
Platysace ramosissima	-	Priority 3	Possible

Taxon	Conservation Status		Likelihood of occurrence in site
	EPBC	DBCA	
Schoenus benthamii	-	Priority 3	Possible
Schoenus capillifolius	-	Priority 3	Possible
Schoenus pennisetis	-	Priority 3	Possible
Stylidium aceratum	-	Priority 3	Possible
Stylidium periscelianthum	-	Priority 3	Possible
Styphelia filifolia	-	Priority 3	Unknown
Thysanotus anceps	-	Priority 3	Possible
Acacia oncinophylla subsp. patulifolia	-	Priority 4	Likely
Aponogeton hexatepalus	-	Priority 4	Likely
Boronia tenuis	-	Priority 4	Unlikely
Centrolepis caespitosa	-	Priority 4	Unknown
Cyanicula ixioides subsp. ixioides	-	Priority 4	Unknown
Drosera occidentalis subsp. occidentalis	-	Priority 4	Unknown
Hibbertia montana	-	Priority 4	Possible
Hydrocotyle lemnoides	-	Priority 4	Likely
Lasiopetalum bracteatum	-	Priority 4	Likely
Ornduffia submersa	-	Priority 4	Unknown
Pimelea rara	-	Priority 4	Possible
Schoenus natans	-	Priority 4	Possible
Senecio leucoglossus	-	Priority 4	Possible
Stylidium longitubum	-	Priority 4	Possible
Stylidium striatum	-	Priority 4	Possible
Verticordia lindleyi subsp. lindleyi	-	Priority 4	Likely

24 flora species were considered Likely to occur due to the presence of suitable habitat and close proximity to previous records. 35 species were considered Possible and four considered Unlikely to occur within the site. 12 species had an unknown likelihood of occurrence due to the lack of available data.

Several occurrences of the following five DRF species have been identified as occurring within or close to the boundary of the site based on the DBCA Threatened Priority Flora database search (DBCA 2017a) (Figure 8):

- *Conospermum undulatum;*
- *Isopogon drummondii;*
- *Banksia mimica;*
- *Lasiopetalum glutinosum subsp. glutinosum;* and

- *Thelymitra magnifica.*

Given the above, site specific flora and vegetation surveys will be required to confirm the presence of DRF within the site.

4.7.4 Threatened and Priority Ecological Communities

Desktop searches of the DBCA's Threatened and Priority Ecological Communities dataset identified several TECs or TEC buffers occurring within and surrounding the site. The dataset provided by the DBCA has generic buffers of 200 m or 500 m surrounding the TECs or PECs (DBCA 2017c) (Figure 9):

- Banksia Dominated Woodlands of the Swan Coastal Plain;
- SCP20a - *Banksia attenuata* woodlands over species rich dense shrublands;
- SCP3a -*Eucalypt calophylla – Kingia australis* woodlands on heavy soils, Swan Coastal Plain;
- SCP3b - *Eucalyptus calophylla – eucalyptus marginata* woodlands on sandy clay soils of the southern Swan Coastal Plain;
- Shrublands and woodlands on Muchea Limestone;
- Herb rich shrublands in clay pans;
- SCP10a - Shrublands on dry clay flats; and
- Central Granite Shrublands Community.

Given the above, site specific flora and vegetation surveys will be required to identify the presence of TECs or PECs within the site.

4.7.5 Weeds

A desktop search of the EPBC PMST has identified a total of 19 introduced species that may occur within a 5 km radius of the Site (Table 7) (DEE 2017).

Of these 19 weed species, nine are Declared under the *Biosecurity and Agriculture Management Act 2007* (BAM Act) and 15 are listed as Weeds of National Significance (WONS).

Table 7. Introduced Flora Recorded in the Survey Area.

TAXON	(COMMON NAME)	DECLARED BAM ACT	WONS
**Anredera cordifolia*	Madeira Vine	-	Yes
**Asparagus asparagoides*	Bridal Creeper	s22(2) C3	Yes
**Brachiaria mutica*	Para Grass	-	-
**Cenchrus ciliaris*	Buffel-grass	-	-
**Chrysanthemoides monilifera*	Bitou Bush	s12 C2	Yes

TAXON	(COMMON NAME)	DECLARED BAM ACT	WONS
**Chrysanthemoides monilifera subsp. monilifera*	Boneseed	s12 C2	Yes
**Eichhornia crassipes*	Water Hyacinth	s12 C2	Yes
**Genista linifolia*	Flax-leaved Broom	-	Yes
**Genista monspessulana*	Cape Broom	-	Yes
**Genista sp. X Genista monspessulana*	Broom	-	Yes
**Lantana camara*	White Sage	s22(2) C3	Yes
**Lycium ferocissimum*	African Boxthorn	-	Yes
**Olea europaea*	Olive	-	-
**Pinus radiata*	Pine	-	-
**Rubus fruticosus aggregate*	Blackberry	-	Yes
**Sagittaria platyphylla*	Slender Arrowhead	s22(2) C3	Yes
**Salix spp. except S. babylonica, S.x calodendron & S. x reichardtii*	Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow	s12 C1	Yes
**Salvinia molesta*	Giant Salvinia	s12 C1	Yes
**Tamarix aphylla*	Athel Pine	s22(2) C3	Yes

*The (then) Department of Agriculture and Food WA (DAFWA) maintains a list of Declared Plants for Western Australia under the Biosecurity and Agriculture Management Act 2007 (BAM Act). If a plant is declared for the whole of the State or for particular Local Government Areas, all landholders are obliged to comply with the relevant species-specific control measures.

*The DAFWA maintains a list of Declared Plants for Western Australia under the BAM Act. If a plant is declared for the whole of the State or for particular Local Government Areas, all landholders are obliged to comply with the relevant species-specific control measures.

[1]Declared Pest - s22(2)

Declared pests must satisfy any applicable import requirements when imported, and may be subject to an import permit if they are potential carriers of high-risk organisms. They may also be subject to control and keeping requirements once within Western Australia.

Under the BAM Act, all declared pests are placed in one of three categories, namely C1 (exclusion), C2 (eradication) or C3 (management).

C1 category (Exclusion) - Pests will be assigned to this category if they are not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.

C2 category (Eradication) – Pests will be assigned to this category if they are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.

C3 category (Management) – Pests will be assigned to this category if they are established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest (DAFWA 2017).

4.8 Fauna

4.8.1 Threatened and Priority Fauna

Conservation significant fauna potentially occurring within a 5 km radius of the Site were determined through desktop searches using DEE's PMST, DBCA's NatureMap search tool and DBCA's Threatened and Priority Fauna databases.

A number of species returned in the databases were historical records of locally extinct species (e.g. Malleefowl) and these have been omitted from further discussion.

A likelihood assessment was undertaken to determine the likelihood of these species occurring within the Site based on suitable habitat present and the species known distribution based on the following criteria:

The Likelihood of each species is based on the following criteria:

- Recorded: Recorded during the field survey or site reconnaissance;
- Likely: Suitable habitat is present in the Survey Area and the Survey Area is in the species' known distribution;
- Possible: Limited or no suitable habitat is present in Survey Area, but is nearby. The species has good dispersal abilities and is known from the general area; and
- Unlikely: No suitable habitat is present in Survey Area but is nearby, the species has poor dispersal abilities, but is known from the general area; or suitable habitat is present, however, the Survey Area is outside of the species' known distribution.

Table 8. Likelihood Assessment of Conservation Significant Fauna Occurring Within the Site (DEE 2017) (DBCA 2017a;d)

Species	Conservation Status		Likelihood of Occurrence
	DBCA	EPBC	
Australasian Bittern (*Botaurus poiciloptilus*)	Threatened	Endangered	Unlikely
Brush-tailed Bettong (*Bettongia penicillata ogilbyi*)	Threatened	Critically Endangered	Unlikely
Eastern Curlew (*Numenius madagascariensis*)	Threatened	Critically Endangered	Unlikely
Curlew Sandpiper (*Calidris ferruginea*)	Threatened	Critically Endangered	Unlikely
Australian Painted Snipe (*Rostratula australis*)	Threatened	Endangered	Possible
Western Ringtail Possum (*Pseudocheirus occidentalis*)	Threatened	Vulnerable	Unlikely
Quokka (*Setonix brachyurus*)	Threatened	Vulnerable	Unlikely

Species	Conservation Status		Likelihood of Occurrence
	DBCA	EPBC	
Baudin's Cockatoo (*Calyptorhynchus baudinii*)	Threatened	Vulnerable	Possible
Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*)	Threatened	Vulnerable	Likely
Carnaby's Cockatoo (*Calyptorhynchus latirostris*)	Threatened	Endangered	Likely
Chuditch (*Dasyurus geoffroii*)	Threatened	Vulnerable	Unlikely
Short-tongued Bee (*Leioproctus douglasiellus*)	Threatened	Critically Endangered	Unlikely
Western Swamp Tortoise (*Pseudemydura umbrina*)	Threatened	Critically Endangered	Unlikely
South Western Phascogale (*Phascogale tapoatafa wambenger*)	Conservation Dependent Fauna	-	Unknown
Great Egret (*Ardea modesta*)	International Agreement	Marine	Possible
Rainbow Bee-eater (*Merops ornatus*)	International Agreement	Marine	Possible
Wood Sandpiper (*Tringa glareola*)	International Agreement	Marine/Migratory	Possible
Common Sandpiper (*Tringa hypoleucos*)	International Agreement	Marine/Migratory	Possible
Common Greenshank (*Tringa nebularia*)	International Agreement	Marine/Migratory	Possible
Marsh Sandpiper (*Tringa stagnatilis*)	International Agreement	Marine/Migratory	Possible
Peregrine Falcon (*Falco peregrinus*)	Other Specially Protected Fauna	-	Unlikely
Western Swamp Tortoise (*Pseudemydura umbrina*)	Threatened	-	Unlikely
Scorpionfly (*Austromerope poultoni*)	Priority 2	-	Unknown
A short-tongued bee (*Leioproctus bilobatus*)	Priority 2	-	Unknown
Southern Death Adder (*Acanthophis antarcticus*)	Priority 3	-	Unlikely
Black Striped Snake (*Neelaps colonotos*)	Priority 3	-	Possible
Water-rat (*Hydromys chrysogaster*)	Priority 4	-	Possible
Southern Brown Bandicoot (*Isoodon obesulus fusciventer*)	Priority 4	-	Likely
Western Brush Wallaby (*Macropus irma)*	Priority 4	-	Possible
Blue billed Duck	Priority 4	-	Unlikely

Species	Conservation Status		Likelihood of Occurrence
	DBCA	EPBC	
(*Oxyura australis*)			

Due to the site being mostly cleared of native vegetation and used for rural purposes, it is not likely that the site would offer large areas of valuable intact habitat. The surrounding environment is also representative of clearing and rural land uses containing limited vegetation to the north, west and south of the site. Large areas of intact vegetation area located to the east of the site and therefore, may provide better fauna habitat than the site itself.

Some fauna species may utilise the minor watercourse that traverses the site which appears to have intact vegetation along the foreshore area and within remaining patches. However, fauna are more likely to utilise surrounding larger areas of intact vegetation to the east.

4.9 Heritage

4.9.1 Aboriginal Heritage

In Western Australia, the *Aboriginal Heritage Act 1972* protects places and objects customarily used by or traditional to the original habitants of Australia or their descendants. A register of such places and objects are maintained under the Act, however, all sites are protected under the Act whether they are registered or not (DPLH 2017).

A desktop search has identified two Registered Aboriginal Heritage Sites and one Lodged Aboriginal Heritage Site intersecting the Site and three Registered sites located within 1 km of the site (Table 9; Figure 10) (DPLH 2017).

Table 9. Aboriginal Heritage Sites Within or in the Vicinity of the Site (DPLH 2017)

Number	Site Name	Type	Status	Distance from site (m)
4343	Brentwood Road Swamp	Artefacts / Scatter	Registered	0
4342	Brentwood Road Quarry	Artefacts / Scatter, Quarry	Registered	0
4341	Brentwood Road NW	Artefacts / Scatter	Lodged	0
3264	White Road, Orange Grove	Artefacts/Scatter, Skeletal Material/Burial	Registered	679

NUMBER	SITE NAME	TYPE	STATUS	DISTANCE FROM SITE (M)
3631	Yule Brook A & B	Artefacts/Scatter	Registered	420
3773	Welshpool Reserve	Camp	Registered	275

4.9.2 European Heritage

A desktop search of the State Heritage Office has identified there are no State Heritage Sites within the Site or within a 2 km radius of the Site (SHO 2017). No World Heritage or National Heritage places are located within a 5 km radius of the Site (DEE 2017).

The Site does contain one Shire of Kalamunda Municipal Heritage place, Mrs Wright's Home (former) located at 150 Crystal Brook Road, Wattle Grove. This site is not registered under State Legislation. However, it is graded as Category 4 which states 'Photographically record prior to major development or demolition. Recognise and interpret the site if possible' (SHO 2017) (Figure 10).

The Site contains one heritage site listed as 'Other Heritage Sites', White's home & store located at 80 Crystal Brook Road, Wattle Grove. The site is currently a single storey residence and there are no other details regarding this Site with the State Heritage Office (SHO 2017) (Figure 10).

4.10 Site History

4.10.1 Historical Aerial Imagery

Review of historical aerial imagery was undertaken to identify and assess land use and development changes within the area over time. The earliest available aerial of the site was taken in 1953 and more recent aerial images (from approximately 10 year intervals up to present) were viewed (Figures 11a-h).

The review of historical aerial imagery has identified substantial clearing of majority of vegetation within the site and surrounding areas occurred prior to 1953 and subdivided for rural land uses including market gardens, agricultural/animal grazing and pastures. Portions in the south-west of the site were identified as wet during this time. Some patches of remnant vegetation remained until prior to 1974. It appears potential sand extraction activities were undertaken in the northern and south-eastern portions of the site and adjacent areas which expanded between 1953 and 1974.

Further clearing of remnant native vegetation occurred by 1974 and some rural residential dwellings were constructed. It appears some vegetation regrowth or planting has occurred prior to 1974. Development and rural land uses replaced the sand extraction areas by 1985. During this time, further rural residential development occurred

within the site and surrounding areas. Majority of the clearing within the site occurred by 1995 and some regeneration and plantation occurred between 1995 and 2010.

Urban residential developments began between 2010 and 2017 to the north, north-west and north-east of the site boundary.

4.10.2 WIN Groundwater Bore Database Search

A search of the (then) Department of Water (DoW)'s WIN Groundwater bore database has identified 51 bores within the site boundary (Figure 12) (DoW 2017). These operational statuses and current owners of these bores are unknown. Information on each WIN bore's ID, purpose, status, drill depth, drill date and owner are provided in Appendix C.

4.11 Surrounding Land Uses

The Lesmurdie Reserve exists to the east of the site. Pockets of residential developments exist to the north, west, south-west and east of the site beyond the rural areas. The Hartfield Country Club Golf Course is located 236 m to the north. An industrial and commercial precinct is located to the south-west of the site in Kenwick.

4.12 Industrial Separation Distances

Under the EPA's *Guidance Statement No. 3: Separation Distances between Industrial and Sensitive Land Uses,* all new industries, infrastructure and estates in the vicinity of proposed/existing sensitive land uses, and vice versa, require a suitable separation distance. Sensitive land uses are defined by the EPA as; residential developments, hospitals, hotels, motels, hostels, caravan parks, schools, nursing homes, child care facilities, institutions, shopping centres (EPA 2005). This Guidance Statement outlines the generic buffer distances between sensitive and industrial land uses in the absence of site-specific technical investigations (EPA 2005).

4.12.1 Kennels

Three kennels exist to the west of the site (Figure 13). The EPA's Guidance Statement No. 3 provides a generic buffer distance of 500 m from sensitive land uses within rural zones and a 1000 m buffer in or nearby urban areas in the absence of site specific investigations (EPA 2005). Kennels have associated odour and noise impacts. It is to be noted that separation distances are not required to other industrial land uses under GS3.

Proposed zoning of the site to Urban will require a generic 1000 m buffer distance between the existing kennels and future residential and sensitive land use developments. A buffer of 1000 m from all three kennels will impinge the western portion of the site (Figure 13). Site specific noise and odour modelling would be required to determine a more appropriate buffer distance in negotiation with the City of Kalamunda.

Lots 24, 25, 26 and 36 Welshpool Road East, Wattle Grove have been identified as having an additional use under the LPS 3 for dog kennels. Despite provision within the Scheme, it does not appear the lots are currently used for dog kennels. Current uses of these lots include a garden centre and veterinary hospital.

4.12.2 Poultry Farms

One poultry farm exists within the southern portion of the site (Poultry Farm 1) and two poultry farm exists to the south and west of the site (Poultry Farm 2 and 3 respectively) (Figure 13). Under GS3, the generic buffer distance for Poultry Farms ranges from 300 m – 1000 m (EPA 2005). Under the City of Kalamunda's LSP, a 300 m buffer is mapped from Poultry Farm 1 and 3. Under the City of Gosnell's Town Planning Scheme No. 6 (TSP 6) a buffer of 500 m has been applied to Poultry Farm 2 (Figure 13). Buffers of Poultry Farm 1 and 2 impact the developable potential of the site for sensitive land uses, however, industrial development are unaffected by poultry farm buffers.

4.12.3 Turf Farms

One turf farm is located within the south-western portion of the site (Figure 13). Under GS3, a generic buffer distance of 500 m from turf farm is applicable from sensitive land uses or developments. This buffer distance only impinges the site south of Crystal Brook Road (Figure 13). Industrial development to the south of Crystal Brook Road is unlikely to be affected by the turf farm buffer.

5 Potential Site Environmental Constraints

The potential key environmental issues associated with the existing development include:

- Wetlands and wetland buffers;
- Watercourse and Foreshore Areas;
- Declared Rare Flora;
- Threatened Ecological Communities;
- Water Management; and
- Industrial separation buffers.

5.1 Wetlands and Wetland Buffers

Under the Western Australian Planning Commission's *Guideline for the Determination of Wetland Buffer Requirements* (2005), the consideration of wetlands is required during a change in land use or a proposed development in the immediate vicinity of a wetland where the future land use is likely to conflict with the established wetland management objectives. Under the guidelines, an appropriate buffer distance should be identified to achieve an acceptable planning outcome. Buffer distances determined based on the wetland's category and no development is permitted within buffers (WAPC 2005).

As the site contains and is within the vicinity of wetlands, there is the potential for their associated buffers to impinge on the south-western portion of the site and decrease the developable potential of the site. A minimum buffer distance of 50 m from a CCW and a 30 – 50 m buffer from REWs is generally applicable. Figure 14 identifies the worst case scenario of the area of land onsite that may be impinged by wetland buffers of 50 m. This would equate to approximately 8.44 ha of land within the site to be sterilised from future development.

However, the REW's located within the site appear to have been historically cleared of most vegetation. Reclassification of the REWs to MUWs may be possible and this would remove this wetland area as a constraint to future development (approximately 8.44 ha). Development within MUWs is generally permissible as they have little remaining ecological wetland attributes and function, provided adequate depth to groundwater is established as part of future development.

A CCW located south of the Tonkin Highway and Welshpool Road East intersection, at worst case, would have a minimum 50 m buffer applicable (see Figure 14). However, as the area within the site and within a potential 50 m buffer has already been cleared, developed and is separated by a road reserve, it is considered unlikely that a buffer would be required.

5.1.1 Further Investigations and Management Requirements

The vegetation of the mapped wetlands within the site and the applicable buffers is representative of previous land uses and historical clearing. It is likely that these areas would include patches of non-endemic species and plantings. Ground surveys would be required to assess the vegetation within the site to determine the impacts of mapped wetlands and associated buffers to future urban development.

A Wetland and Wetland Buffer Management Plan (WWBMP) will be required for the lots located within or adjacent to wetlands at the local structure planning or subdivision stage.

5.2 Watercourse and Foreshore Areas

The minor non-perennial stream watercourse that traverses the northern portion of the site is likely to require a defined foreshore area due to the vegetation along the watercourse in accordance with DoW's Operational Policy 4.3: *Identifying and establishing waterways foreshore areas* (2012). Development within the foreshore area of a watercourse is generally not permitted and therefore has the potential to reduce the developable potential of the site.

There are no standard foreshore widths and should be determined in discussion with DWER and other relevant agencies. Generally, the foreshore area can be defined as the furthest extent of riparian vegetation and other associated riverine landforms and functions. Figure 14 identifies a potential foreshore area; however, groundtruthing is required through survey work to identify watercourses, and determine foreshore areas and watercourse buffer zones. Watercourses, foreshore areas and watercourse buffer zones require protection through the creation of easements for drainage and water management purposes, specify approved and un-approved land uses and activities within the zones and providing Watercourse and Foreshore Management Plans detailing these.

5.2.1 Further Investigations and Management Requirements

As part of future structure planning, identification of watercourses and foreshore area, will be undertaken as part of a biophysical assessment. The biophysical assessment will be undertaken in accordance with the (then) Department of Water's (DoW's) *Operational Policy 4.3: Identifying and establishing waterways foreshore areas* (2012) and the (then) Water and Rivers Commission policy *Determining Foreshore Reserves* (2001).

To ensure these watercourses and their associated foreshore area and buffer zone is appropriately protected and managed, the following will be required as part of future development:

- The creation of easements for the purpose of drainage and water management;
- Specifying approved or unapproved activities within the buffer zone; and

- Preparation of a Watercourse and Foreshore Management Plan at the local structure planning or subdivision stage.

5.3 Declared Rare Flora

Several occurrences of the Wavy Smoke Bush (*Conospermum undulatum*) and the Summer Honeypot (*Banksia mimica*) have been identified as occurring within the site based on DBCA database searches. These species and the vegetation within 50 m of the DRF are protected under the EPBC Act.

The occurrences of both these DRFs throughout the site are considered a potential constraint to development as the DRF and vegetation within 50 m of the flora are protected under the EPBC Act (Figure 14).

5.3.1 Further Investigations and Management Requirements

It is likely a Flora and Vegetation survey would be required to confirm the presence and locations of these DRF species to inform future rezoning and structure planning. In addition, an EPBC referral would likely be required at structure planning stage to address potential impacts associated with urban development near DRFs.

A Flora and Vegetation Management Plan may be required at the subdivision stage.

5.4 Threatened Ecological Communities

Portions within the site have been mapped by DBCA as the Banksia Woodlands of the Swan Coastal Plain TEC, *Eucalyptus calophylla-Kingia australis* woodlands and Shrublands and Woodlands on Muchea Limestone listed as Endangered under the EPBC Act (Figure 9). However, the DBCA's mapping is based on the Commonwealth's 'likely to occur' areas and represents broad scale vegetation units that are most likely to contain the ecological communities.

5.4.1 Further Investigations and Management Requirements

Site specific flora and vegetation surveys will be required to identify the presence of TECs or PEC, which will inform the structure planning stage. Depending on the potential impacts, the presence of TECs within the site may require the project to be referred to the DEE under the EPBC Act for an assessment of potential impacts associated with urban development within or nearby TECs.

A Flora and Vegetation Management Plan may be required at the subdivision stage for the protection of identified TECs or PECs.

5.5 Water Management

The Site has a few tributaries which traverse the site and there are small portions of CCW and REW along the western boundary of the site. It should be noted that development proposals within 200 m of the boundary of a CCW or REW should be

referred to DBCA for advice where the quality or volume of water flowing into the wetland may be affected by a development.

5.5.1 Further Investigations and Management Requirements

A District Water Management Strategy (DWMS) will be required to support any future MRS Amendment. The purpose this document will be to provide a coordinating framework that guides the key requirements for water sensitive urban design. It will also demonstrate that Site can support urban and/or industrial development and best practice urban water management.

A groundwater monitoring program will also be required prior to the development of a Local Water Management Strategy at the local structure planning stage.

5.6 Industrial Separation Buffers

The presence of prescribed premises, including poultry farms, kennels and a turf farm, within and adjacent to the site has the potential to impact on the type of future land uses within the site (should these premises remain in operation).

The three surrounding kennels, poultry farms and turf farm buffers impinge on the site. However, the buffers are only applicable for sensitive land uses. Majority of the land use buffers impinge across the southern half of the site (south of Crystal Brook Road) which would identify this portion to be potentially used for future industrial development (Figure 13).

5.6.1 Further Investigations and Management Requirements

The portion of the site to the north of Crystal Brook Road is impinged by fewer buffers and may have a better potential for residential development (Figure 13). However, site specific odour and noise modelling would need to be undertaken to identify opportunities with reduced buffers from surrounding land uses. In addition, management and mitigation measures may be required to support urban residential development in this area.

6 Summary

6.1 Outcome and Key Findings of Assessment

The site is currently used for rural land uses and has been historically cleared of majority of native vegetation. A desktop review of the environmental aspects of the site has determined the following are relevant:

- **Wetlands and Wetland Buffers:** As the site is mapped as containing and within the vicinity of geomorphic wetlands, there is the potential for their associated buffers to impinge on the south-western portion of the site. A buffer distance of 30 – 50 m is generally imposed on REWs and a minimum 50 m buffer is generally imposed on CCWs. However, as the vegetation within the mapped wetlands and the corresponding buffers does not appear to be intact and has been subject to clearing, it is likely that smaller buffer distances from the wetlands could be negotiated. Alternatively, there is a potential opportunity to reclassify the wetlands within and surrounding the site to increase the developable potential of the site. Site specific surveys would be required to assess the vegetation remaining and the condition of the wetlands. A Wetland and Wetland Buffer Management Plan may be required at subdivision.
- **Watercourse and Foreshore Area:** The minor non-perennial watercourse that traverses through the northern portion of the site would likely require a biophysical assessment to identify the extent of the foreshore area. The extent of the foreshore area would impact on the developable potential of the surrounding area. A Watercourse and Foreshore Management Plan may be required at the structure planning or subdivision stage. Additionally, the creation of easements for the foreshore and buffer area for the purpose of drainage and water management, as well as specifying the approved and unapproved activities within the buffer zone will provide further protection and management.
- **Declared Rare Flora:** There are several historical occurrences of DRF within the site. The species and the vegetation within 50 m of the occurrence are protected under Federal legislation. Flora and vegetation surveys would be required to confirm the presence or absence of these DRF species which would provide a better indication of the land available for development. A Flora and Vegetation Management Plan may be required at the subdivision stage.
- **Threatened Ecological Communities:** The site is mapped as having several TECs and associated buffers across the site. These mapped TECs are based on the DEE's likelihood of TEC occurrences and are not based on actual recorded data. These TECs appear to correspond with patches of possible remnant vegetation which is likely to be associated with the Banksia Woodlands TEC, *Eucalyptus*

calophylla-Kingia australis woodlands and Shrublands TEC and Woodlands on Muchea Limestone TEC. Flora and vegetation surveys of these patches of vegetation would be required to determine the presence or absence of these TECs. Should these TECs be identified as occurring within the site, clearing or potential impacts to the TECs will require approval from the DEE and the DWER. A Flora and Vegetation Management Plan may be required at the subdivision stage.

- **Water Management:** There are several tributaries which traverse the site, as well as wetland located along the western boundary of the site. A DWMS will be required as part of any future rezoning under the MRS, as well as groundwater monitoring to inform the LWMS at the local structure planning stage.
- **Land Use Buffers:** The site is constrained by generic or imposed buffers on prescribed premises (Poultry farms, turf farm and kennels). The opportunities for land development within the site is recommended to be split into two land uses, the area to the south of Crystal Brook Road would be more suitable for continued rural uses or industrial development. While the area to the north of Crystal Brook Road has the potential to be developed to urban residential - should the generic buffers be reduced. Site specific studies and modelling would be required to determine appropriate buffers from the surrounding.

7 Limitations

This report is produced strictly in accordance with the scope of services set out in the contract or otherwise agreed in accordance with the contract. 360 Environmental makes no representations or warranties in relation to the nature and quality of soil and water other than the visual observation and analytical data in this report.

In the preparation of this report, 360 Environmental has relied upon documents, information, data and analyses ("client's information") provided by the client and other individuals and entities. In most cases where client's information has been relied upon, such reliance has been indicated in this report. Unless expressly set out in this report, 360 Environmental has not verified that the client's information is accurate, exhaustive or current and the validity and accuracy of any aspect of the report including, or based upon, any part of the client's information is contingent upon the accuracy, exhaustiveness and currency of the client's information. 360 Environmental shall not be liable to the client or any other person in connection with any invalid or inaccurate aspect of this report where that invalidity or inaccuracy arose because the client's information was not accurate, exhaustive and current or arose because of any information or condition that was concealed, withheld, misrepresented, or otherwise not fully disclosed or available to 360 Environmental.

Aspects of this report, including the opinions, conclusions and recommendations it contains, are based on the results of the investigation, sampling and testing set out in the contract and otherwise in accordance with normal practices and standards. The investigation, sampling and testing are designed to produce results that represent a reasonable interpretation of the general conditions of the site that is the subject of this report. However, due to the characteristics of the site, including natural variations in site conditions, the results of the investigation, sampling and testing may not accurately represent the actual state of the whole site at all points.

It is important to recognise that site conditions, including the extent and concentration of contaminants, can change with time. This is particularly relevant if this report, including the data, opinions, conclusions and recommendations it contains, are to be used a considerable time after it was prepared. In these circumstances, further investigation of the site may be necessary.

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FIGURES



Legend

Site Location (325 ha)

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- LOCALITY MAP SOURCED LANDGATE 2017
- AERIAL PHOTOGRAPHY SOURCED LANDGATE 2017
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Metres

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LOCALITY MAP



PROJECT ID	DATE
2118	6/03/2018

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
SL	CM	KC	1

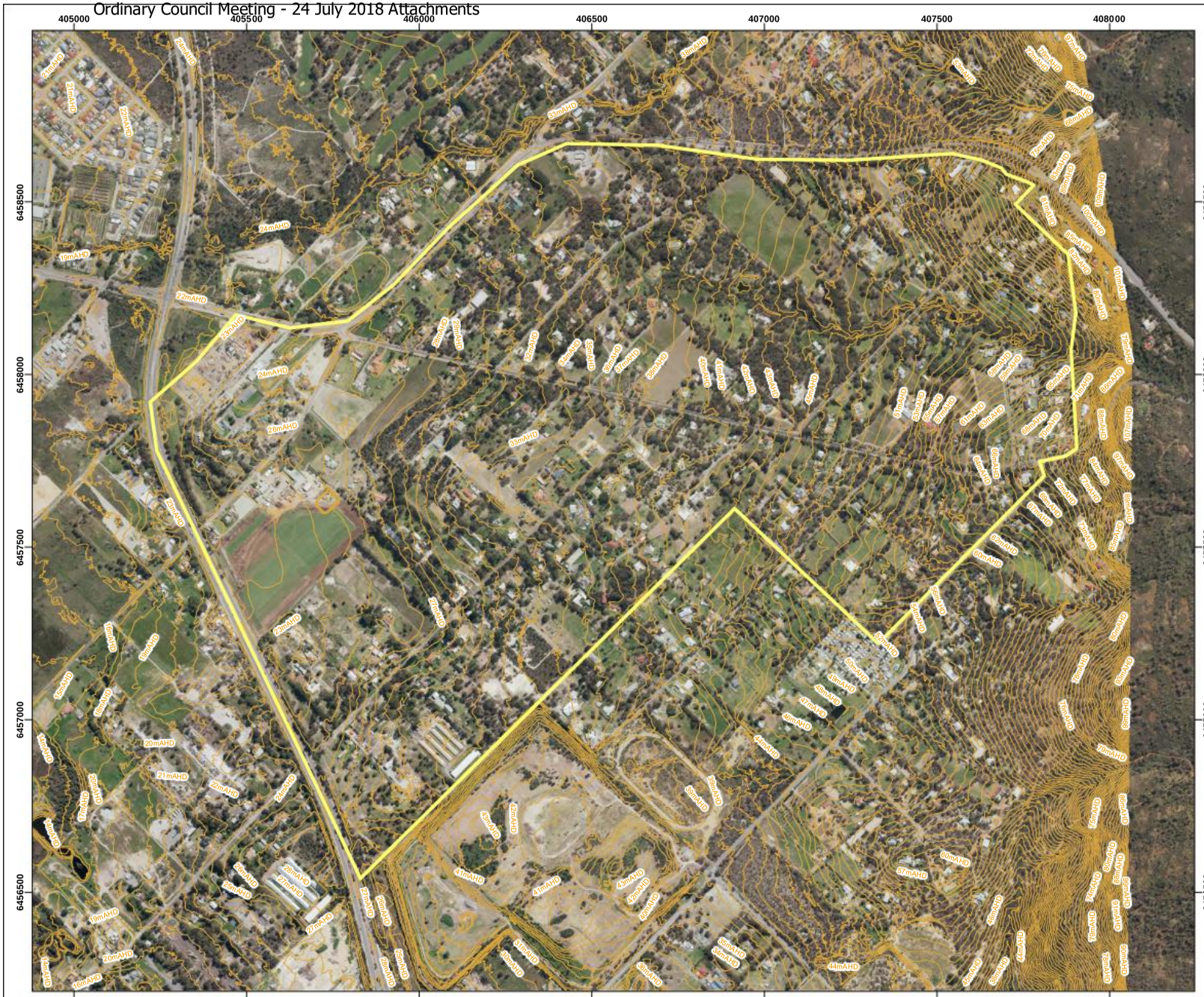
Burgess Design Group
Various Lots, Wattle Grove

Environmental Assessment Report

Figure 1
Site Location

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K:\Projects\9.0 APP\2118 Wattle Grove MRS Amend EAR\Figures\2118 F1 Site Location.mxd



Legend

- Site Location
- Topographical Contours 1m

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- ELEVATION SOURCED DOW 2012
- LOCALITY MAP SOURCED LANDGATE 2017
- AERIAL PHOTOGRAPHY SOURCED LANDGATE 2017
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Metres
1:15,000 @ A4

LOCALITY MAP



PROJECT ID	DATE
2118	6/03/2018

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
SL	CM	KC	1

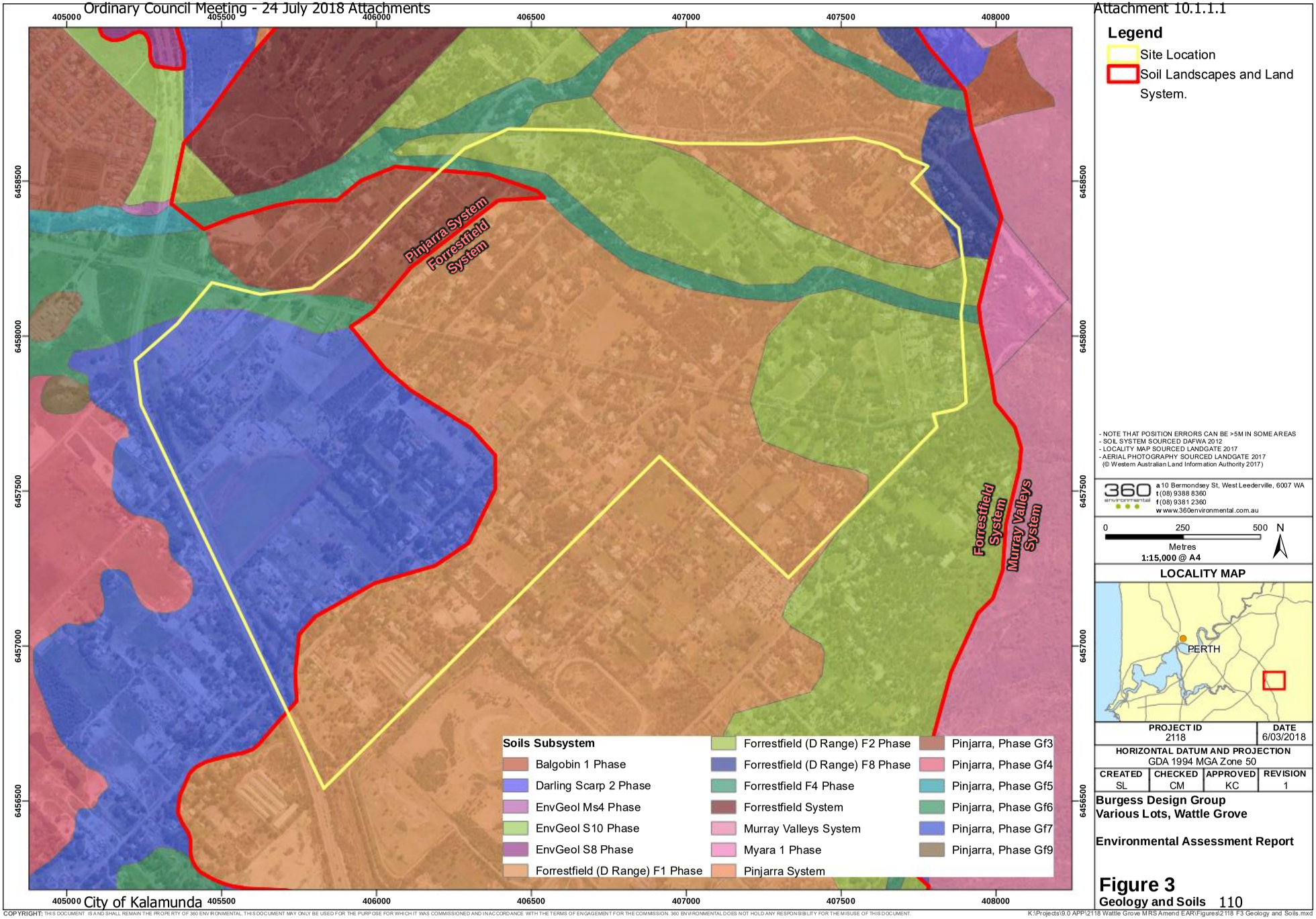
Burgess Design Group
Various Lots, Wattle Grove

Environmental Assessment Report

Figure 2
Topography 109

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K:\Projects\9.0 APP\2118 Wattle Grove MRS Amend EAR\Figures\2118 F2 Topography.mxd



Legend

- Site Location
- Soil Landscapes and Land System.

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- SOIL SYSTEM SOURCED DAFWA 2012
- LOCALITY MAP SOURCED LANDGATE 2017
- AERIAL PHOTOGRAPHY SOURCED LANDGATE 2017
(© Western Australian Land Information Authority 2017)

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GDA 1994 MGA Zone 50

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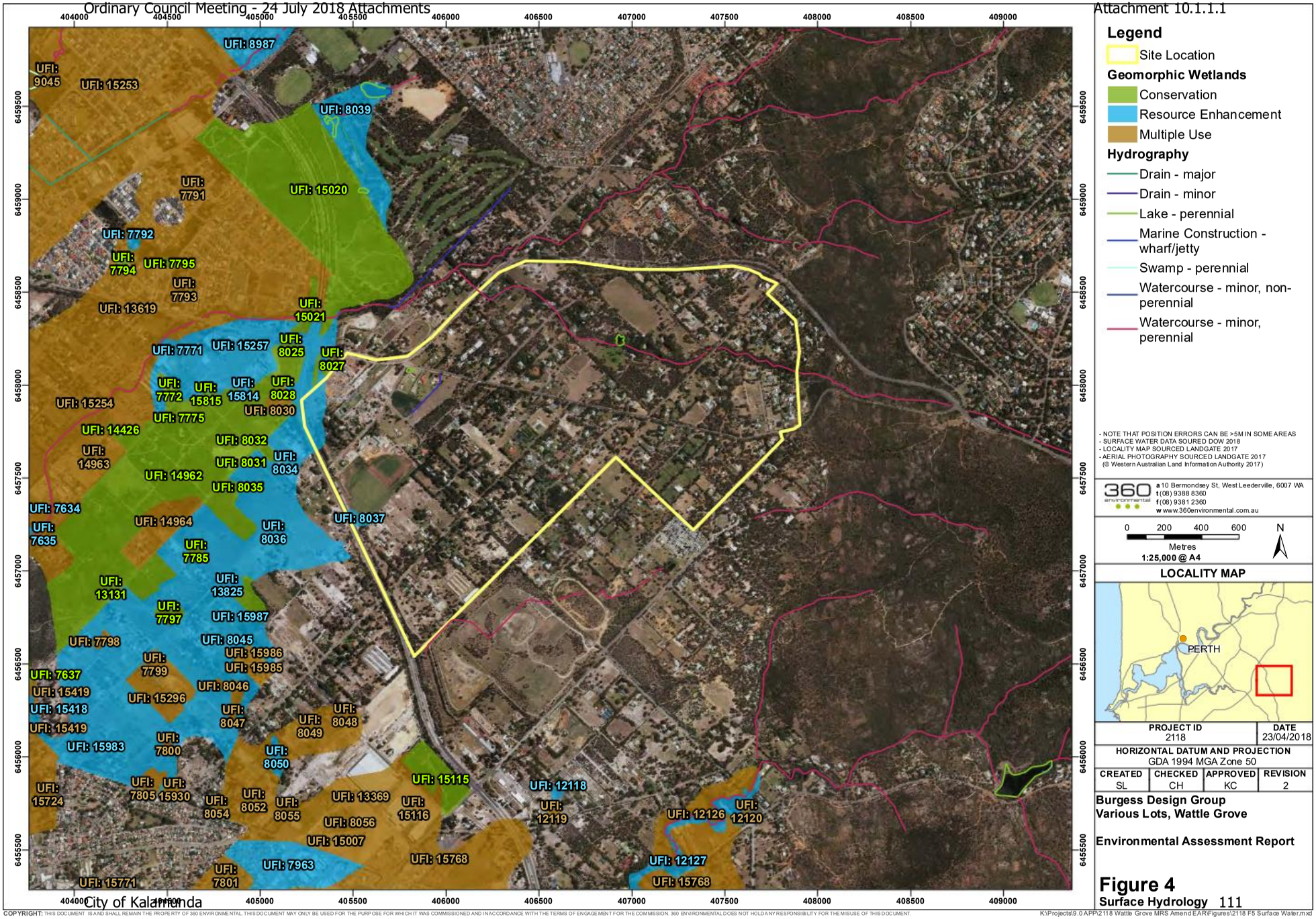
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Environmental Assessment Report

Figure 3
Geology and Soils

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Legend

- Site Location

Geomorphic Wetlands

- Conservation
- Resource Enhancement
- Multiple Use

Hydrography

- Drain - major
- Drain - minor
- Lake - perennial
- Marine Construction - wharf/jetty
- Swamp - perennial
- Watercourse - minor, non-perennial
- Watercourse - minor, perennial

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- SURFACE WATER DATA SOURED DOW 2018
- LOCALITY MAP SOURCED LANDGATE 2017
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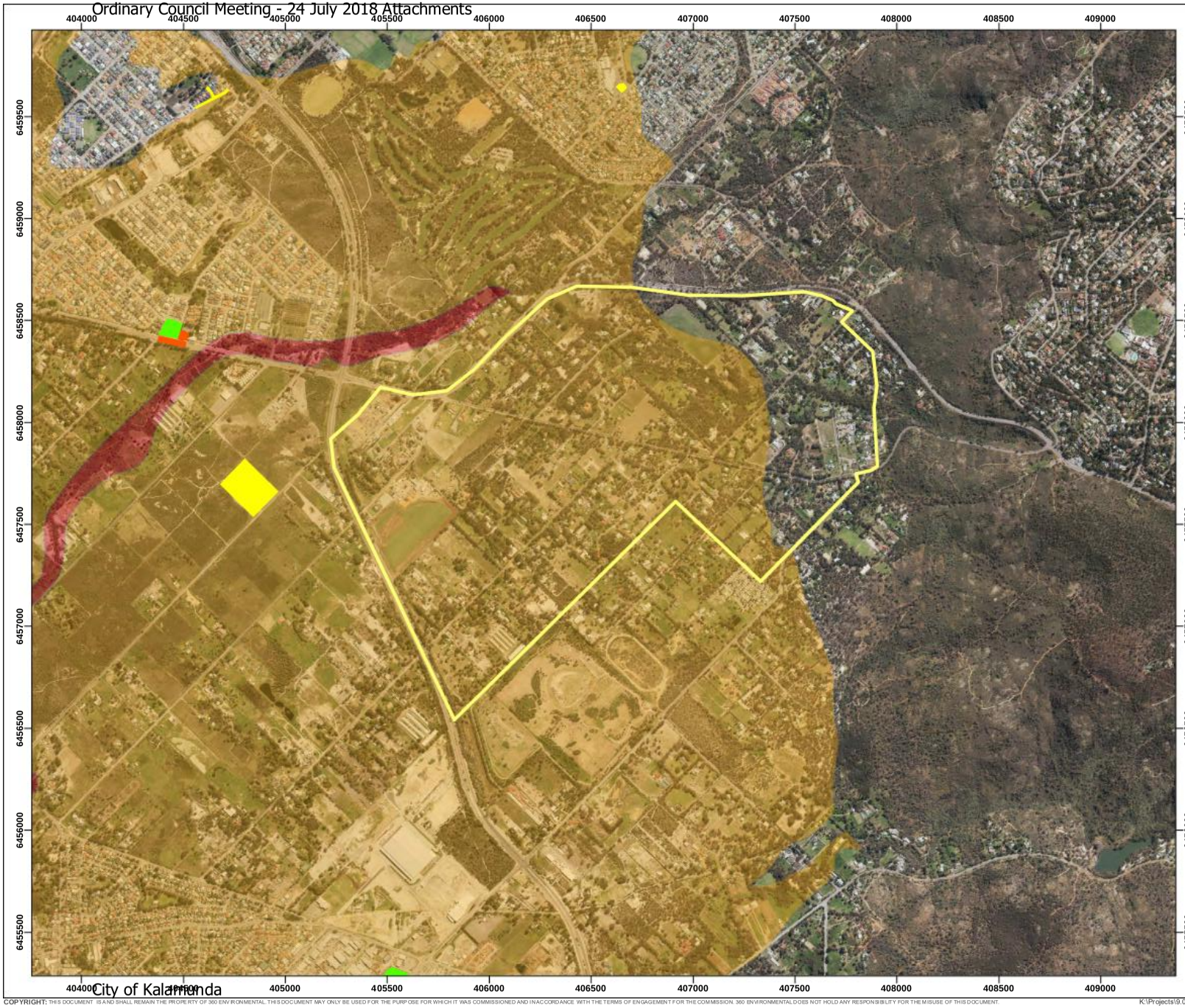
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Figure 4
Surface Hydrology

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Legend

Site Location

Contaminated Sites

- Remediated for Restricted Use
- Contaminated: Restricted Use
- Contaminated: Remediation Required

Acid Sulfate Soils

- High to Moderate risk
- Moderate to Low risk

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- ASS AND CONTAMINATED SITES SOURCED DWER 2018
- LOCALITY MAP SOURCED LANDGATE 2017
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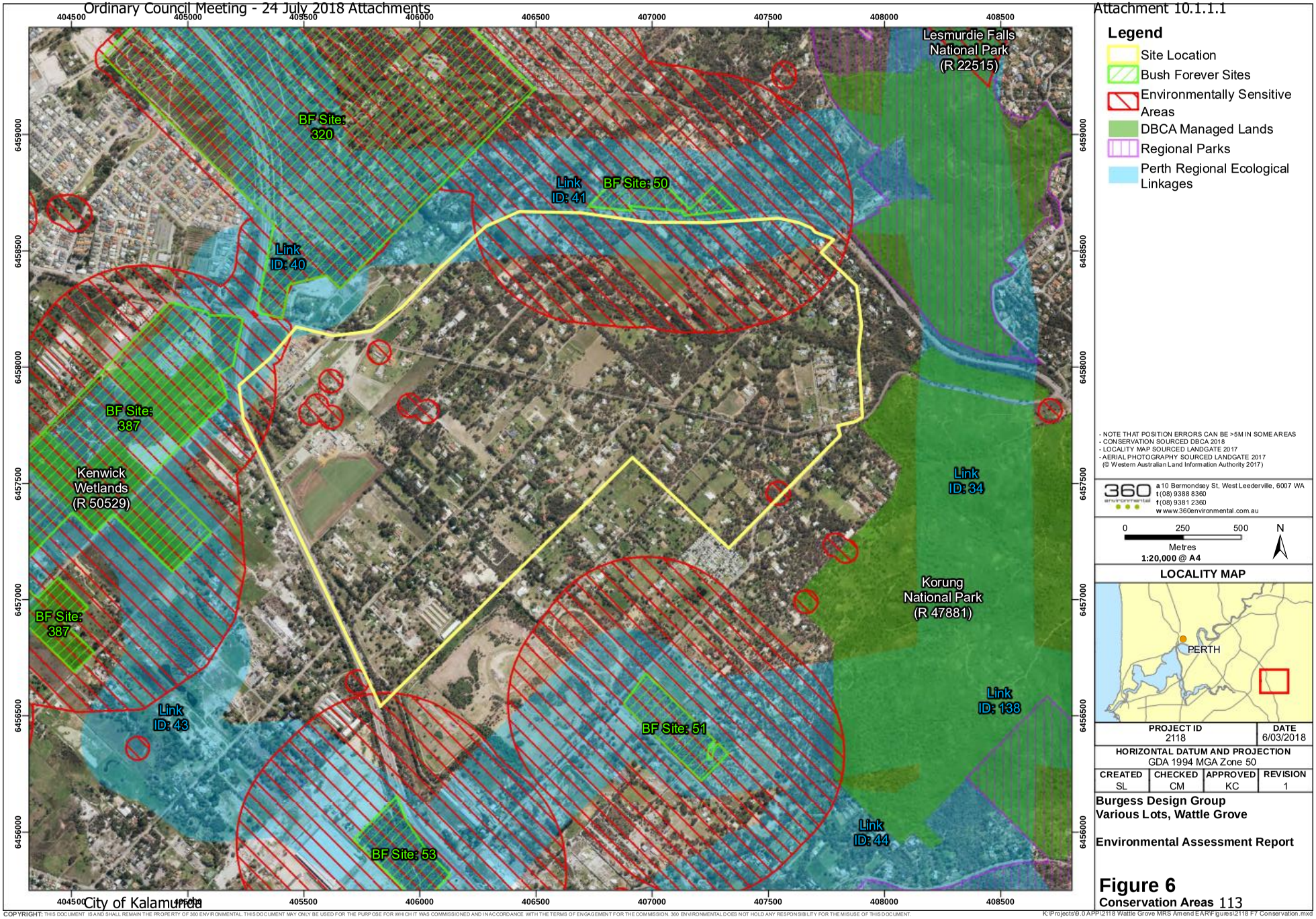
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Figure 5
Contamination

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Legend

- Site Location
- Bush Forever Sites
- Environmentally Sensitive Areas
- DBCA Managed Lands
- Regional Parks
- Perth Regional Ecological Linkages

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- CONSERVATION SOURCED DBCA 2018
- LOCALITY MAP SOURCED LANDGATE 2017
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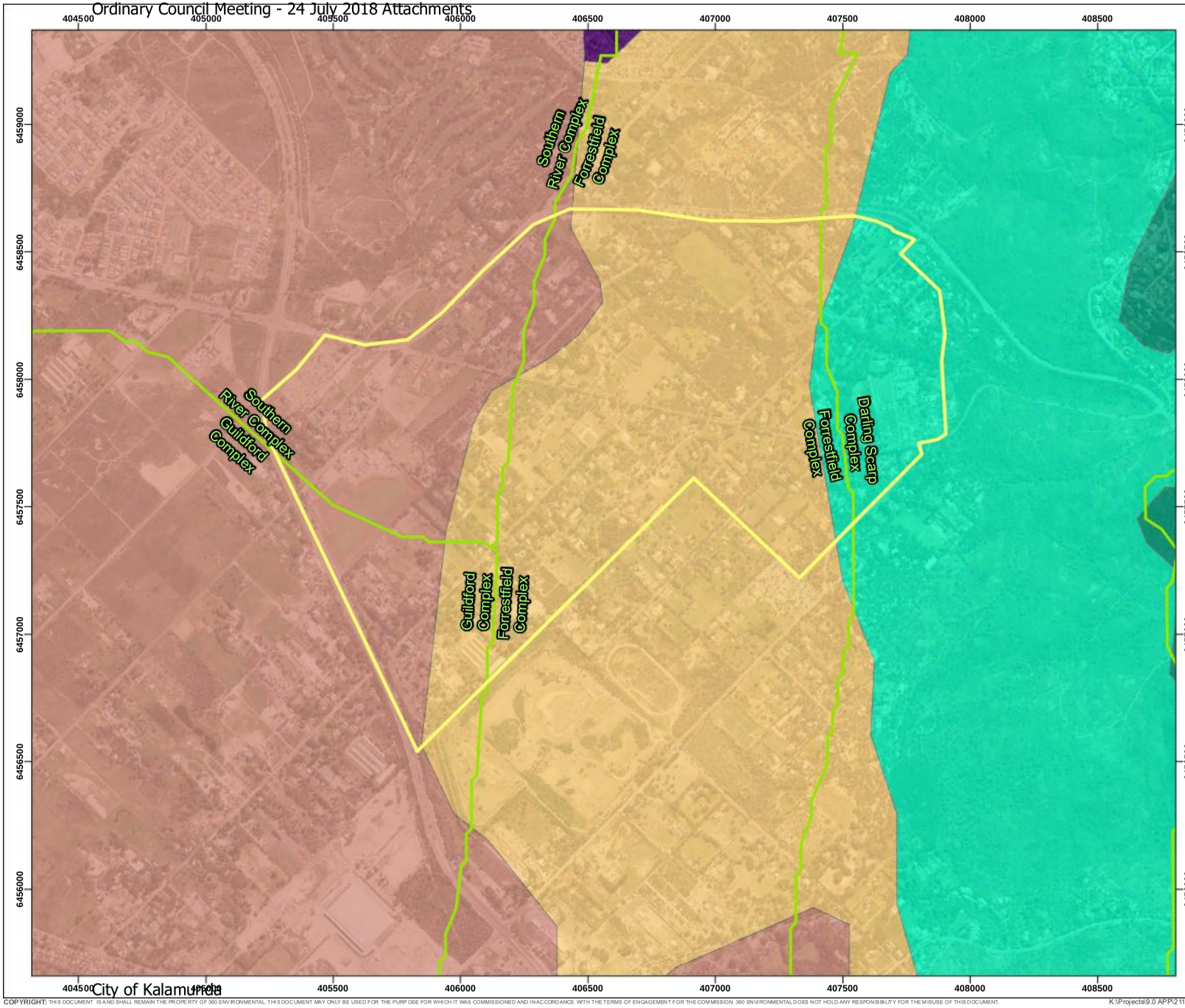
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Figure 6
Conservation Areas 113

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Legend

- Site Location
- Heddle Vegetation Complexes

Pre European Vegetation Types

- BASSENDEAN_1009
- PINJARRA_3
- PINJARRA_968
- WEST DARLING_3
- WEST DARLING_4

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- CONSERVATION SOURCED DBCA 2018
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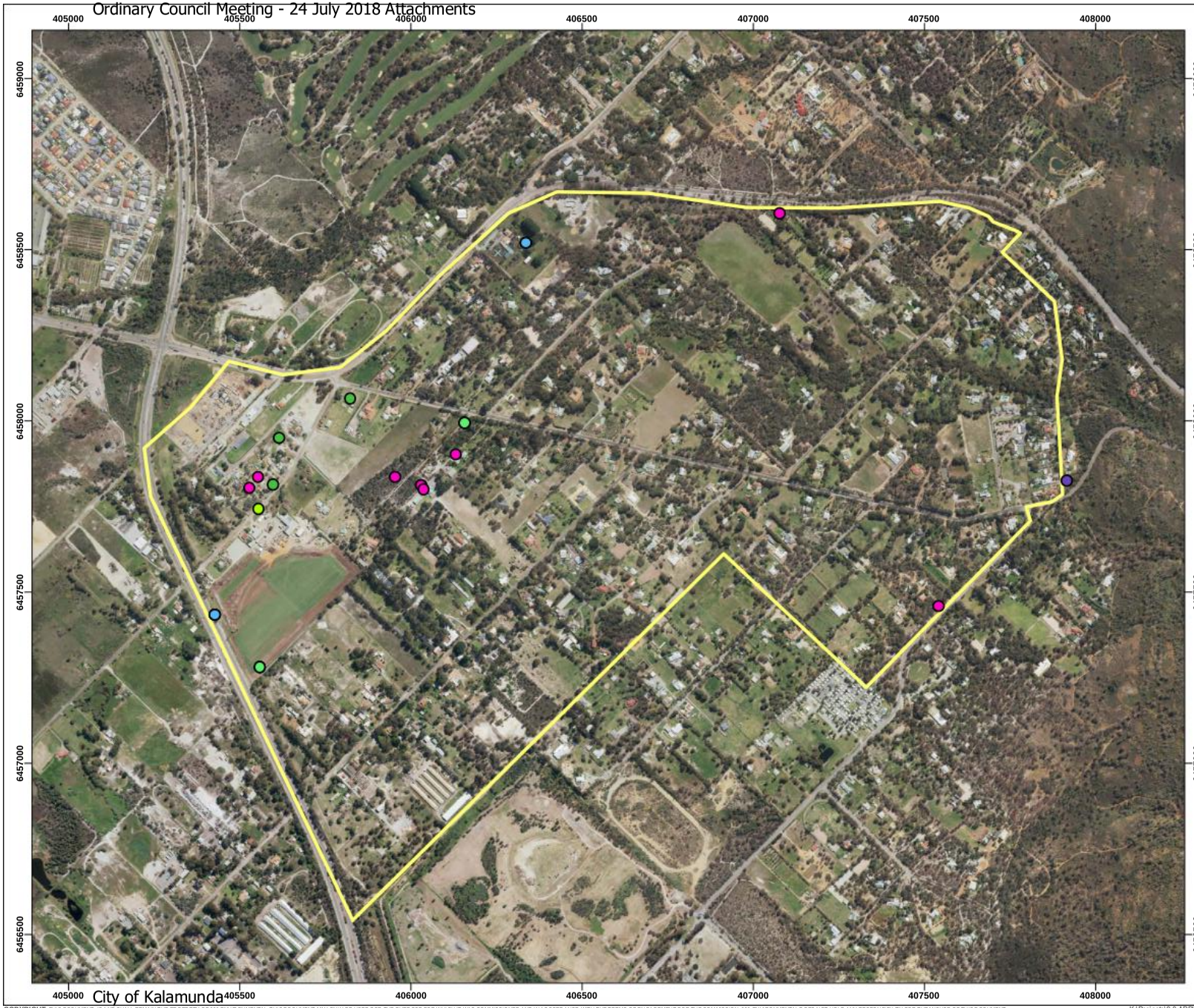
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Figure 7
Broad Vegetation Types

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Legend

- *Banksia mimica*
- *Conospermum undulatum*
- *Isopogon drummondii*
- *Lasiopetalum glutinosum* subsp. *glutinosum*
- *Thelymitra magnifica*

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- FLORA SOURCED DBCA 2018
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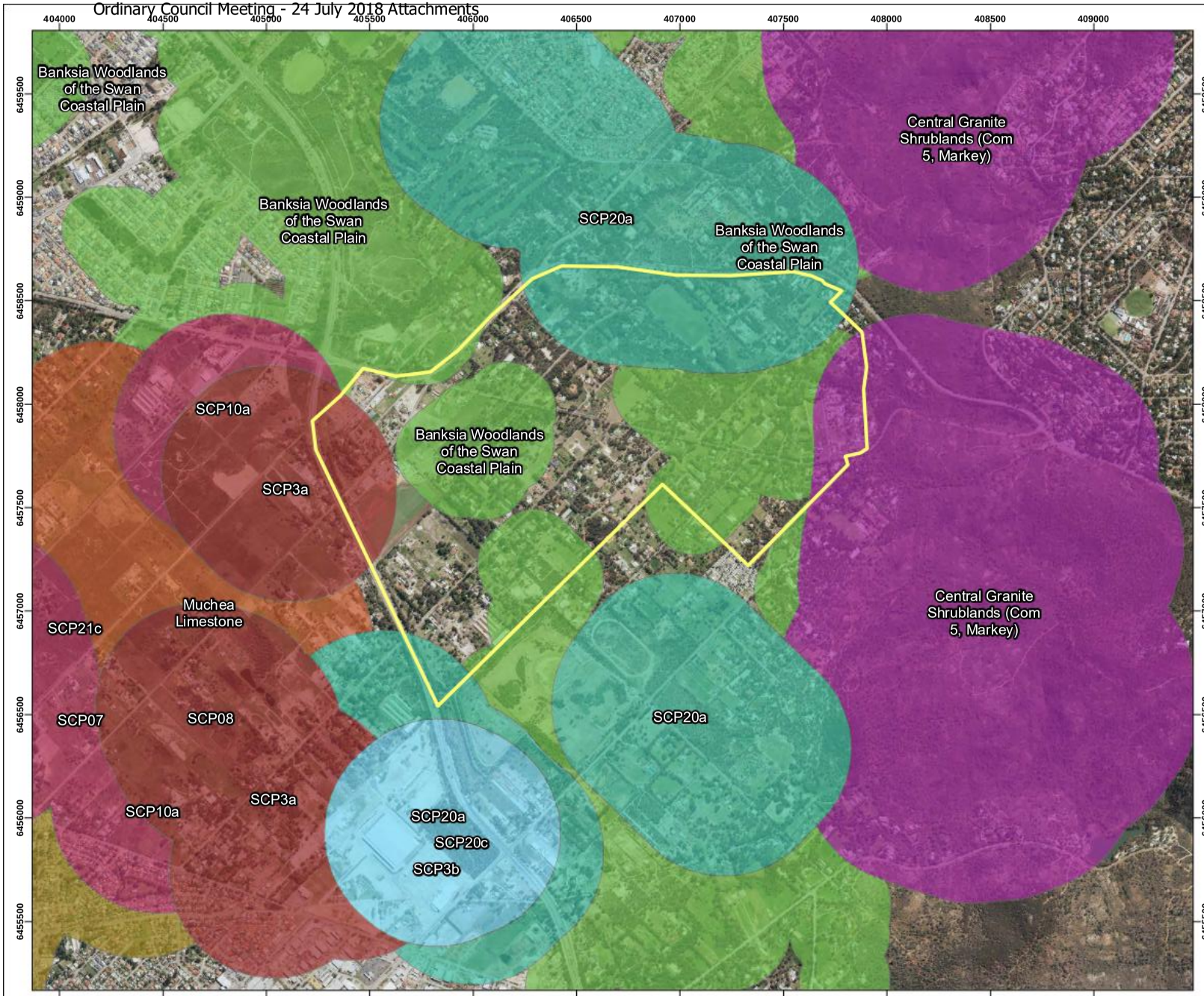
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Figure 8
Declared Rare Flora 115

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Legend

- Site Location

TECs and PECs

- Banksia Woodlands of the Swan Coastal Plain
- Central Granite Shrublands (Com 5, Markey)
- Muchea Limestone
- SCP07
- SCP08
- SCP10a
- SCP20a
- SCP20c
- SCP21c
- SCP3a
- SCP3b

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- HERITAGE SOURCED DAA AND SHO 2018
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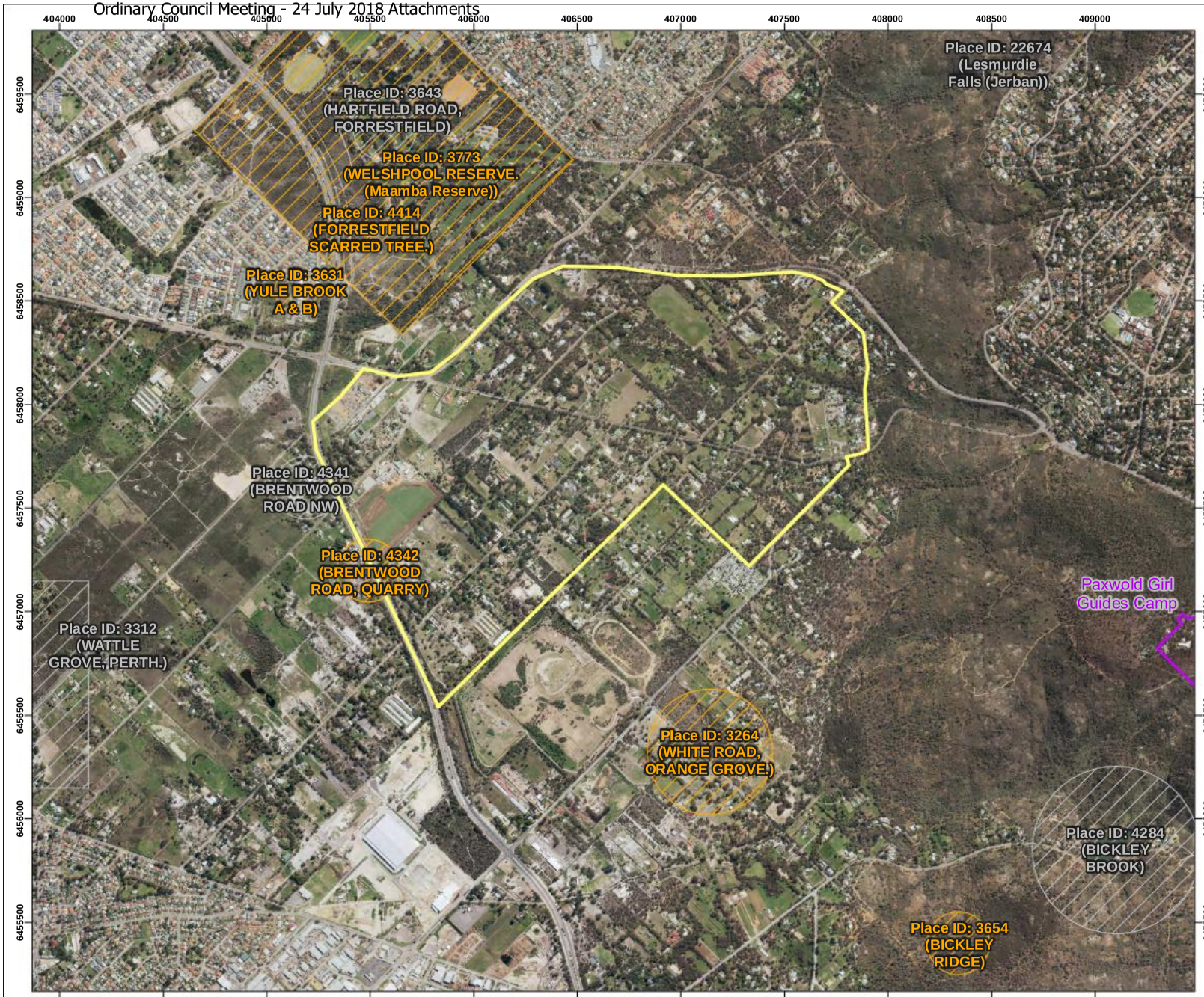
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Figure 9
Threatened and Priority Ecological Communities

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Legend

- Site Location
- State Heritage Office Registered Sites
- Aboriginal Heritage Sites - Registered
- Aboriginal Heritage Sites - Lodged

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- HERITAGE SOURCE D DAA AND SHO 2018
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Figure 10
Heritage

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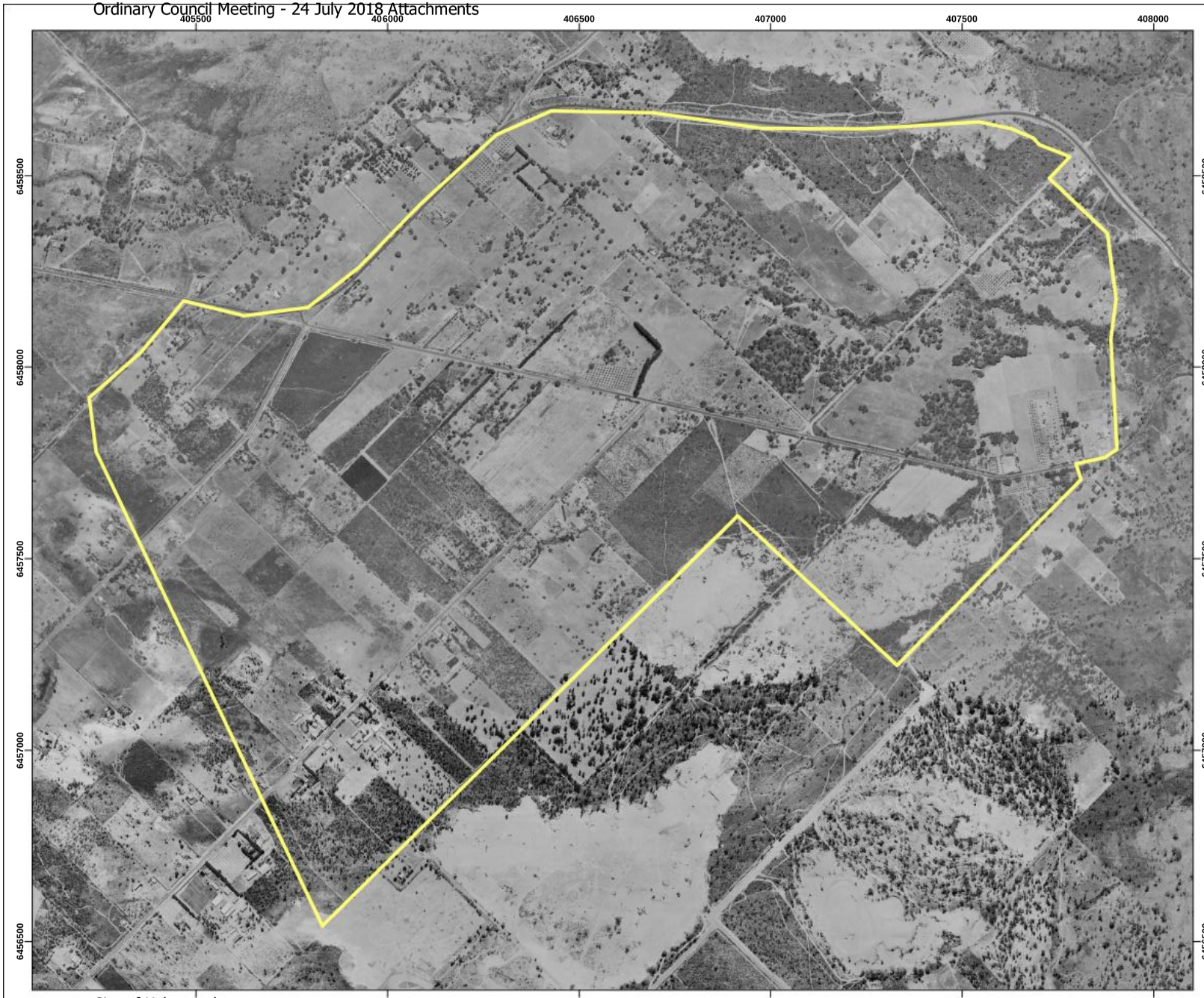
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Figure 11a
Historical Aerial - 1953

City of Kalamunda

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Site Location

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Figure 11b
Historical Aerial - 1965

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Figure 11c
Historical Aerial -1974

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Figure 11d
Historical Aerial -1985

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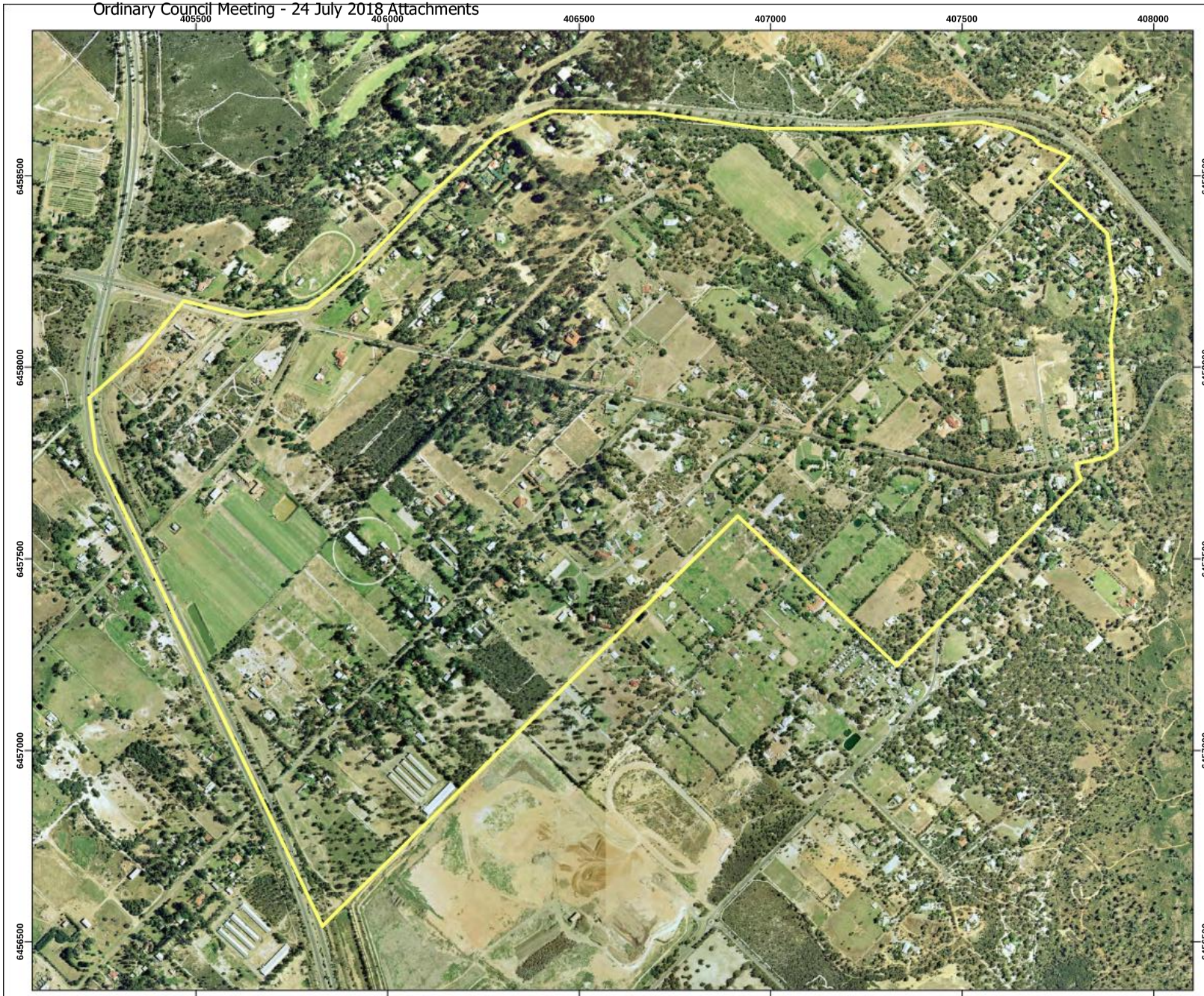
Figure 11e

Historical Aerial - 1995

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Figure 11f
Historical Aerial - 2001

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Figure 11g
Historical Aerial - 2017

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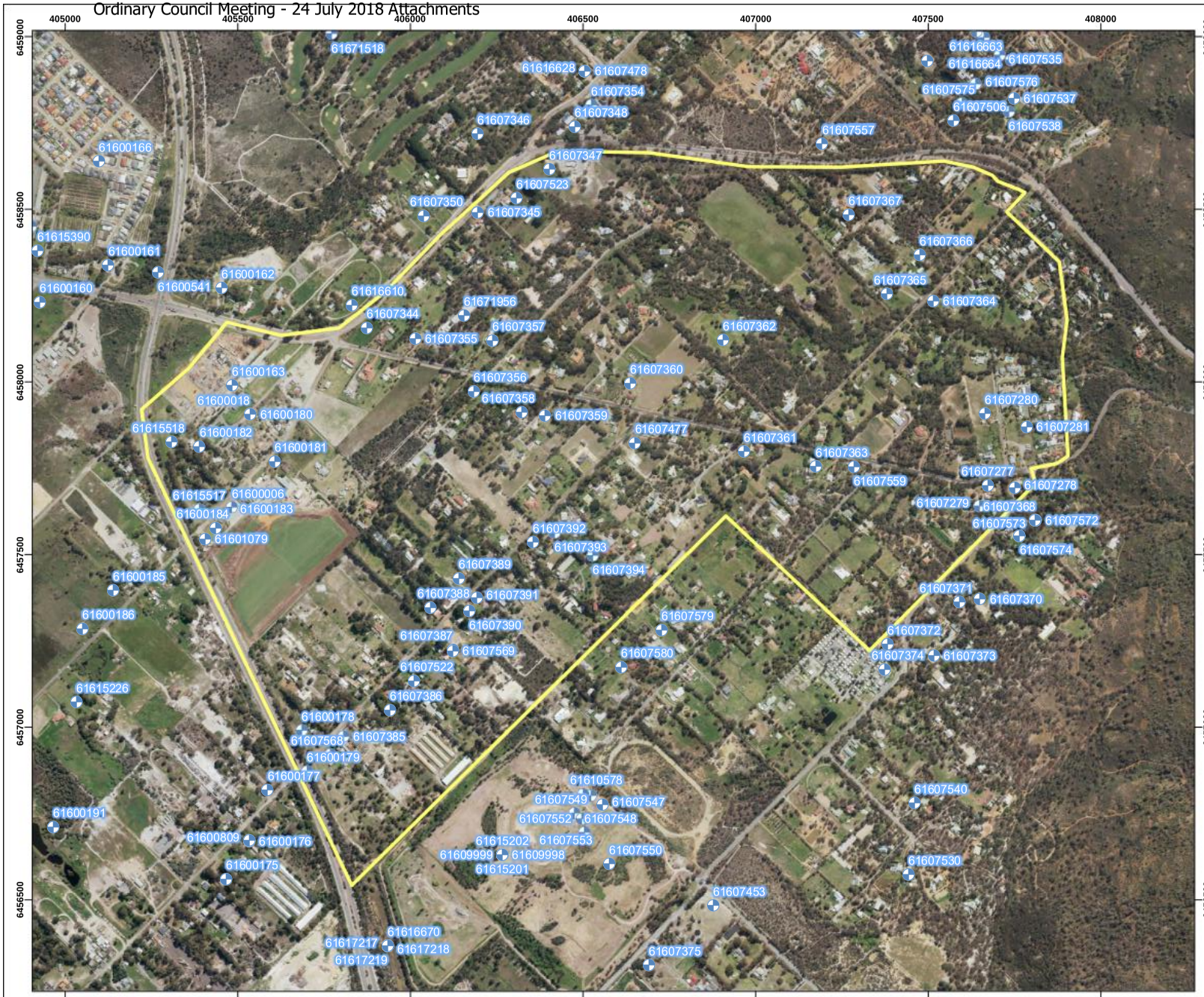
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Figure 11h
Historical Aerials 2017

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Legend

- Site Location
- WIN Groundwater Bores

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- WIN BORES SOURCED DOW 2018
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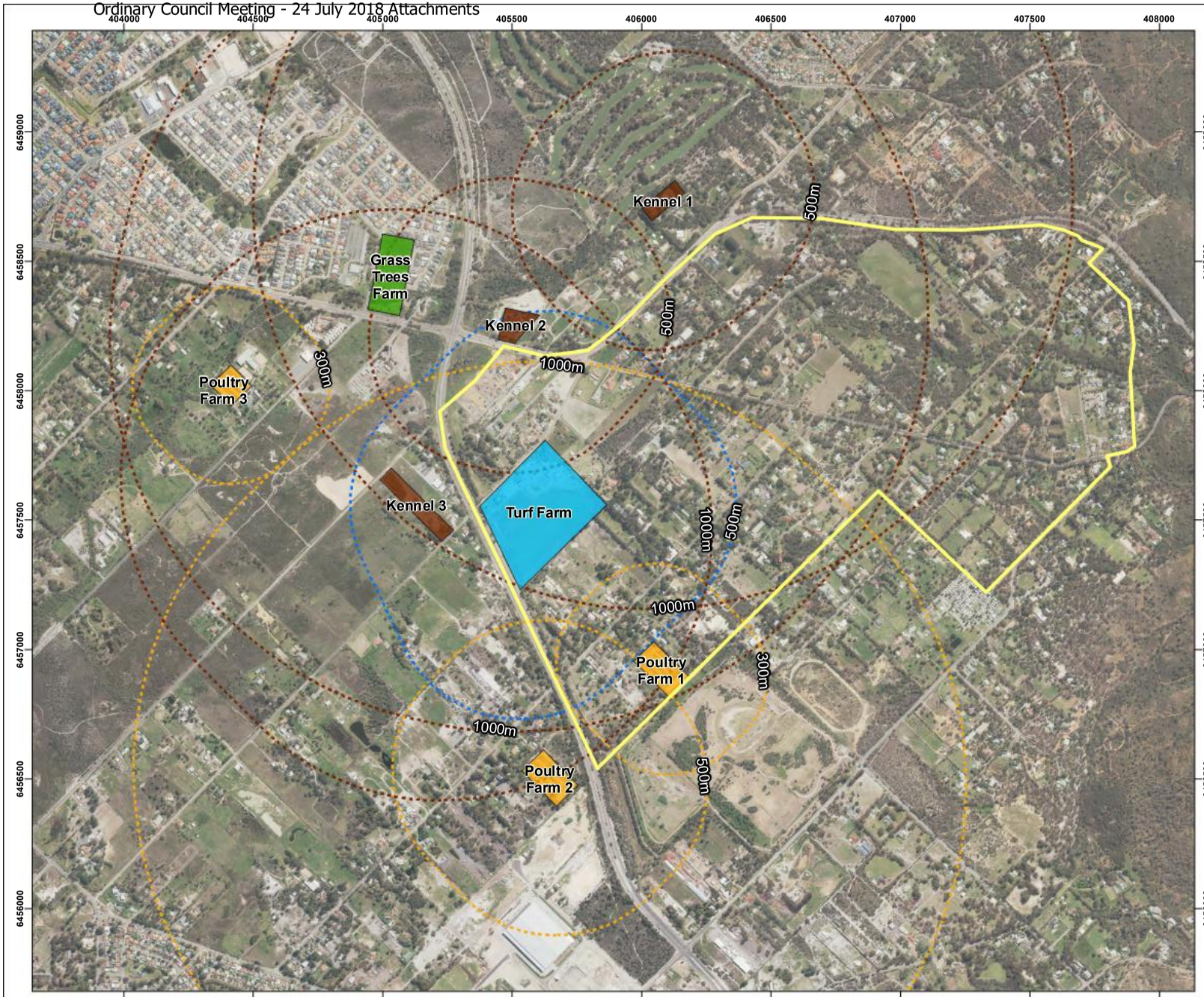
Burgess Design Group
Various Lots, Wattle Grove

Environmental Assessment Report

Figure 12
WIN Groundwater Bores

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Legend

- Site Boundary
- Grass Trees Farm
- Kennels
- Poultry Farms
- Turf Farm

Land Use Buffers

- Kennel
- Poultry Farm
- Turf Farm

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- LOCALITY MAP SOURCED LANDGATE 2017
- AERIAL PHOTOGRAPHY SOURCED LANDGATE 2017
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LOCALITY MAP



PROJECT ID	DATE
2118	12/03/2018

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

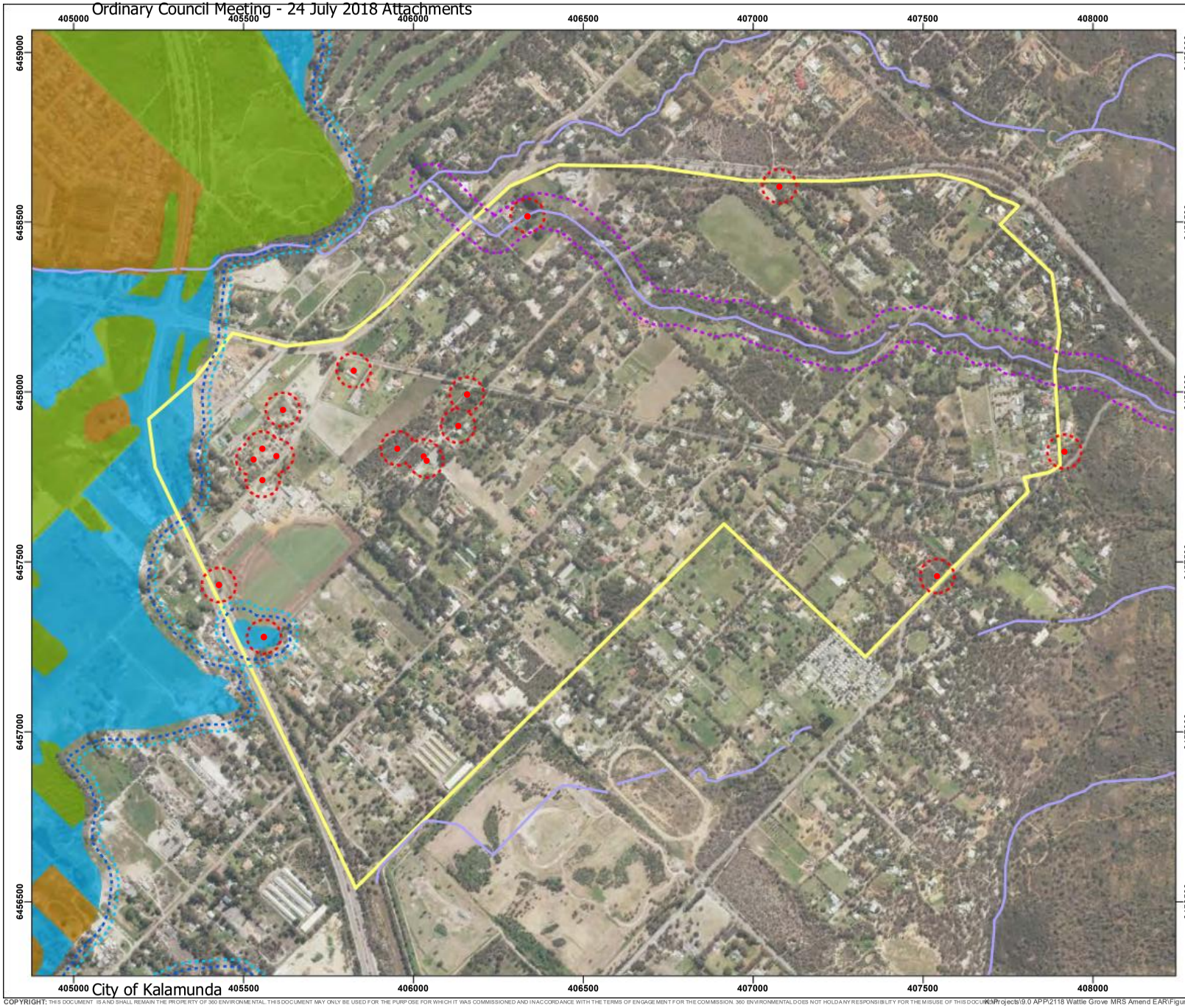
CREATED	CHECKED	APPROVED	REVISION
SL	CM	KC	1

Burgess Design Group
Various Lots, Wattle Grove

Environmental Assessment Report

Figure 13
Land Use Opportunities and Constraints

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K:\Projects\9.0 APP\2118 Wattle Grove MRS Amend EAR\Figures\2118 FX Environmental Opportunities and Constraints.mxd



Legend

- Site Boundary
- Declared Rare Flora
- Declared Rare Flora 50m Buffer
- Watercourse - minor, perennial
- Potential Foreshore Area

Geomorphic Wetlands

- Conservation
- Resource Enhancement
- Multiple Use
- Not Assessed

Wetland Buffers

- 30m Buffer
- 50m Buffer

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- LOCALITY MAP SOURCED LANDGATE 2017
- AERIAL PHOTOGRAPHY SOURCED LANDGATE 2017
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LOCALITY MAP



PROJECT ID	DATE
2118	23/04/2018

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
SL	CH	KC	2

Burgess Design Group
Various Lots, Wattle Grove

Environmental Assessment Report

Figure 14
Environmental Opportunities and Constraints

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APPENDIX A

EPBC Protected Matters Report

Australian Government
Department of the Environment and Energy

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: 25/10/17 19:14:08

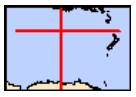
Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates
Buffer: 5.0Km



Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	3
Listed Threatened Species:	38
Listed Migratory Species:	9

Other Matters Protected by the EPBC Act

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

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

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

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	15
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

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

State and Territory Reserves:	7
Regional Forest Agreements:	1
Invasive Species:	43
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

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

Name	Status	Type of Presence
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Community likely to occur within area
Clay Pans of the Swan Coastal Plain	Critically Endangered	Community likely to occur within area
Corymbia calophylla - Kingia australis woodlands on heavy soils of the Swan Coastal Plain	Endangered	Community known to occur within area

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
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat known to occur within area
Calyptorhynchus baudinii Baudin's Cockatoo, Long-billed Black-Cockatoo [769]	Vulnerable	Roosting known to occur within area
Calyptorhynchus latirostris Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat known to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Insects		
Leioproctus douglasiellus a short-tongued bee [66756]	Critically Endangered	Species or species habitat known to occur within area
Mammals		

Name	Status	Type of Presence
Bettongia penicillata Brush-tailed Bettong, Woylie [213]	Endangered	Species or species habitat may occur within area
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat known to occur within area
Pseudocheirus occidentalis Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Vulnerable	Species or species habitat may occur within area
Setonix brachyurus Quokka [229]	Vulnerable	Species or species habitat likely to occur within area
Plants		
Acacia anomala Grass Wattle, Chittering Grass Wattle [8153]	Vulnerable	Species or species habitat known to occur within area
Andersonia gracilis Slender Andersonia [14470]	Endangered	Species or species habitat known to occur within area
Anthocercis gracilis Slender Tailflower [11103]	Vulnerable	Species or species habitat likely to occur within area
Banksia mimica Summer Honeypot [82765]	Endangered	Species or species habitat likely to occur within area
Caladenia huegelii King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat likely to occur within area
Calytrix breviseta subsp. breviseta Swamp Starflower [23879]	Endangered	Species or species habitat known to occur within area
Chamelaucium sp. Gingin (N.G.Marchant 6) Gingin Wax [88881]	Endangered	Species or species habitat may occur within area
Conospermum undulatum Wavy-leaved Smokebush [24435]	Vulnerable	Species or species habitat likely to occur within area
Darwinia apiculata Scarp Darwinia [8763]	Endangered	Species or species habitat likely to occur within area
Diuris drummondii Tall Donkey Orchid [4365]	Vulnerable	Species or species habitat likely to occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat likely to occur within area
Diuris purdiei Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat known to occur within area
Drakaea elastica Glossy-leafed Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid [16753]	Endangered	Species or species habitat likely to occur within area
Drakaea micrantha Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
Eleocharis keigheryi Keighery's Eleocharis [64893]	Vulnerable	Species or species habitat known to occur within area
Eucalyptus x balanites Cadda Road Mallee, Cadda Mallee [87816]	Endangered	Species or species habitat may occur within area
Grevillea curviloba subsp. incurva Narrow curved-leaf Grevillea [64909]	Endangered	Species or species habitat likely to occur within area
Lasiopetalum pterocarpum Wing-fruited Lasiopetalum [64922]	Endangered	Species or species habitat may occur within area
Lepidosperma rostratum Beaked Lepidosperma [14152]	Endangered	Species or species habitat likely to occur within area
Macarthuria keigheryi Keighery's Macarthuria [64930]	Endangered	Species or species habitat likely to occur within area
Ptilotus pyramidatus Pyramid Mulla-mulla [18216]	Critically Endangered	Species or species habitat known to occur within area
Synaphea sp. Fairbridge Farm (D. Papenfus 696) Selena's Synaphea [82881]	Critically Endangered	Species or species habitat known to occur within area
Synaphea stenoloba Dwellingup Synaphea [66311]	Endangered	Species or species habitat may occur within area
Thelymitra dedmaniarum Cinnamon Sun Orchid [65105]	Endangered	Species or species habitat likely to occur within area
Thelymitra stellata Star Sun-orchid [7060]	Endangered	Species or species habitat known to occur within area

Listed Migratory Species [Resource Information]

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

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -

Listed Marine Species [Resource Information]

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

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
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 known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		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

Name	Threatened	Type of Presence
		area
Motacilla cinerea		
Grey Wagtail [642]		Species or species habitat may occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus		
Osprey [952]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato)		
Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Thinornis rubricollis		
Hooded Plover [59510]		Species or species habitat may occur within area
Tringa nebularia		
Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Kenwick Wetlands	WA
Korung	WA
Lesmurdie Falls	WA
Unnamed WA23076	WA
Unnamed WA24657	WA
Unnamed WA29815	WA
Unnamed WA37997	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 Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis		
Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos		
Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis		
European Goldfinch [403]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Funambulus pennantii Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		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
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and		Species or species

Name	Status	Type of Presence
Sterile Pussy Willow [68497]		habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area
Ramphotyphlops braminus Flowerpot Blind Snake, Brahminy Blind Snake, Cacing Besi [1258]		Species or species habitat likely to occur within area

Nationally Important Wetlands [Resource Information]

Name	State
Brixton Street Swamps	WA

Caveat

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

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

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

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

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

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

- migratory and
- marine

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

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

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

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

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

Coordinates

-32.00957 116.00676

Acknowledgements

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

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

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

Please feel free to provide feedback via the Contact Us page.

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Canberra ACT 2601 Australia
+61 2 6274 1111

APPENDIX B

DBCA Naturemap Report

NatureMap Species Report

Created By Guest user on 26/10/2017

Current Names Only Yes
Core Datasets Only Yes
Method 'By Circle'
Centre 116° 00' 26" E,32° 00' 41" S
Buffer 5km
Group By Kingdom

Kingdom	Species	Records
Animalia	395	9190
Fungi	23	45
Plantae	1063	3808
Protozoa	4	5
TOTAL	**1485**	**13048**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Animalia					
1.	24260	*Acanthiza apicalis (Broad-tailed Thornbill, Inland Thornbill)*			
2.	24261	*Acanthiza chrysorrhoa (Yellow-rumped Thornbill)*			
3.	24262	*Acanthiza inornata (Western Thornbill)*			
4.	24265	*Acanthiza uropygialis (Chestnut-rumped Thornbill)*			
5.	25242	*Acanthophis antarcticus (Southern Death Adder)*		P3	
6.	24560	*Acanthorhynchus superciliosus (Western Spinebill)*			
7.	25535	*Accipiter cirrocephalus (Collared Sparrowhawk)*			
8.	25536	*Accipiter fasciatus (Brown Goshawk)*			
9.	24282	*Accipiter fasciatus subsp. fasciatus (Brown Goshawk)*			
10.	42368	*Acritoscincus trilineatus (Western Three-lined Skink)*			
11.	25755	*Acrocephalus australis (Australian Reed Warbler)*			
12.	41323	*Actitis hypoleucos (Common Sandpiper)*		IA	
13.		*Agraptocorixa parvipunctata*			
14.		*Ainudrilus nharna*			
15.		*Alboa worooa*			
16.		*Allodessus bistrigatus*			
17.		*Alona affinis*			
18.		*Alona cf. guttata*			
19.		*Alona rigidicaudis*			
20.		*Alona setigera*			
21.		*Alonella clathratula*			
22.		*Aname mainae*			
23.		*Aname tepperi*			
24.	24312	*Anas gracilis (Grey Teal)*			
25.	24313	*Anas platyrhynchos (Mallard)*			
26.	24315	*Anas rhynchotis (Australasian Shoveler)*			
27.	24316	*Anas superciliosa (Pacific Black Duck)*			
28.	47414	*Anhinga novaehollandiae (Australasian Darter)*			
29.		*Anisops thienemanni*			
30.		*Anopheles annulipes s.l.*			
31.		*Anser anser*			
32.	25241	*Antaresia stimsoni subsp. stimsoni (Stimson's Python)*			
33.	24561	*Anthochaera carunculata (Red Wattlebird)*			
34.	24562	*Anthochaera lunulata (Western Little Wattlebird)*			
35.	24991	*Aprasia repens (Sand-plain Worm-lizard)*			
36.		*Apsectrotanypus nr maculosa*			
37.	24285	*Aquila audax (Wedge-tailed Eagle)*			
38.		*Arachnura higginsi*			
39.		*Araneus cyphoxis*			
40.		*Araneus eburnus*			
41.	41324	*Ardea modesta (great egret, white egret)*		IA	
42.	24340	*Ardea novaehollandiae (White-faced Heron)*			
43.	24341	*Ardea pacifica (White-necked Heron)*			

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44.		*Arrenurus (Micruracarus) sp. 1 (SAP)*			
45.	25566	*Artamus cinereus (Black-faced Woodswallow)*			
46.	24353	*Artamus cyanopterus (Dusky Woodswallow)*			
47.		*Artoria linnaei*			
48.		*Artoriopsis joergi*			
49.		*Austracantha minax*			
50.		*Austrolestes analis*			
51.		*Austrolestes io*			
52.	24318	*Aythya australis (Hardhead)*			
53.		*Backobourkia heroine*			
54.		*Ballarra longipalpus*			
55.		*Barnardius zonarius*			
56.		*Bennelongia sp.*			
57.		*Berosus approximans*			
58.		*Berosus australiae*			
59.	24162	*Bettongia penicillata subsp. ogilbyi (Woylie, Brush-tailed Bettong)*		T	
60.		*Bezzia sp.*			
61.		*Bezzia sp. 2 (SAP)*			
62.	24319	*Biziura lobata (Musk Duck)*			
63.		*Boeckella bispinosa*			
64.		*Brachionus quadridentatus*			
65.	42381	*Brachyurophis semifasciatus (Southern Shovel-nosed Snake)*			
66.	25713	*Cacatua galerita (Sulphur-crested Cockatoo)*			
67.	25714	*Cacatua pastinator (Western Long-billed Corella)*			
68.	25715	*Cacatua roseicapilla (Galah)*			
69.	25716	*Cacatua sanguinea (Little Corella)*			
70.	24729	*Cacatua tenuirostris (Eastern Long-billed Corella)*	Y		
71.	25598	*Cacomantis flabelliformis (Fan-tailed Cuckoo)*			
72.	42307	*Cacomantis pallidus (Pallid Cuckoo)*			
73.	25717	*Calyptorhynchus banksii (Red-tailed Black-Cockatoo)*			
74.	24731	*Calyptorhynchus banksii subsp. naso (Forest Red-tailed Black-Cockatoo)*		T	
75.	24733	*Calyptorhynchus baudinii (Baudin's Cockatoo (long-billed black-cockatoo), Baudin's Cockatoo)*		T	
76.	24734	*Calyptorhynchus latirostris (Carnaby's Cockatoo (short-billed black-cockatoo), Carnaby's Cockatoo)*		T	
77.	48400	*Calyptorhynchus sp. (white-tailed black cockatoo)*		T	
78.		*Candonocypris novaezelandiae*			
79.		*Ceinidae sp.*			
80.		*Cephalodella gibba*			
81.		*Ceratopogonidae sp.*			
82.		*Cercophonius granulosus*			
83.		*Cercophonius sulcatus*			
84.		*Ceriodaphnia sp.*			
85.	24186	*Chalinolobus gouldii (Gould's Wattled Bat)*			
86.		*Chaoboridae sp.*			
87.	43380	*Chelodina colliei (South-western Snake-necked Turtle)*			
88.	24321	*Chenonetta jubata (Australian Wood Duck, Wood Duck)*			
89.	33939	*Cherax cainii (Marron)*			
90.		*Cherax destructor*			
91.		*Cherax quinquecarinatus*			
92.		*Chironominae sp.*			
93.	24980	*Christinus marmoratus (Marbled Gecko)*			
94.		*Chroicocephalus novaehollandiae*			
95.		*Chydorus sp.*			
96.	24288	*Circus approximans (Swamp Harrier)*			
97.		*Coenagrionidae sp.*			
98.	25675	*Colluricincla harmonica (Grey Shrike-thrush)*			
99.	24399	*Columba livia (Domestic Pigeon)*	Y		
100.	24361	*Coracina maxima (Ground Cuckoo-shrike)*			
101.	25568	*Coracina novaehollandiae (Black-faced Cuckoo-shrike)*			
102.	24363	*Coracina novaehollandiae subsp. subpallida (Black-faced Cuckoo-shrike)*			
103.		*Corixidae sp.*			
104.		*Cormocephalus aurantiipes*			
105.		*Cormocephalus rubriceps*			
106.		*Cormocephalus strigosus*			
107.	25592	*Corvus coronoides (Australian Raven)*			
108.	24417	*Corvus coronoides subsp. perplexus (Australian Raven)*			
109.		*Corynoneura sp. (V49) (SAP)*			
110.	24420	*Cracticus nigrogularis (Pied Butcherbird)*			
111.	25595	*Cracticus tibicen (Australian Magpie)*			

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112.	24422	*Cracticus tibicen subsp. dorsalis (White-backed Magpie)*			
113.	25596	*Cracticus torquatus (Grey Butcherbird)*			
114.		*Cricotopus 'brevicornis'*			
115.	25398	*Crinia georgiana (Quacking Frog)*			
116.	25399	*Crinia glauerti (Clicking Frog)*			
117.	25400	*Crinia insignifera (Squelching Froglet)*			
118.	25401	*Crinia pseudinsignifera (Bleating Froglet)*			
119.	30893	*Cryptoblepharus buchananii*			
120.		*Cryptochironomus griseidorsum*			
121.	24883	*Ctenophorus ornatus (Ornate Crevice-Dragon)*			
122.	25027	*Ctenotus australis*			
123.	25039	*Ctenotus fallens*			
124.		*Culex (Culex) annulirostris*			
125.		*Culicoides sp.*			
126.	24322	*Cygnus atratus (Black Swan)*			
127.		*Cypretta sp.*			
128.		*Cyprinotus cingalensis*			
129.	30901	*Dacelo novaeguineae (Laughing Kookaburra)*	Y		
130.	25673	*Daphoenositta chrysoptera (Varied Sittella)*			
131.	24092	*Dasyurus geoffroii (Chuditch, Western Quoll)*		T	
132.		*Delena cancerides*			
133.	25766	*Delma fraseri (Fraser's Legless Lizard)*			
134.	24999	*Delma grayii*			
135.	25296	*Demansia psammophis subsp. reticulata (Yellow-faced Whipsnake)*			
136.		*Diaphanosoma sp.*			
137.	25607	*Dicaeum hirundinaceum (Mistletoebird)*			
138.		*Dingosa serrata*			
139.		*Dinocambala ingens*			
140.	24939	*Diplodactylus polyophthalmus*			
141.		*Diptera sp.*			
142.		*Dolichopodidae sp.*			
143.		*Dunhevedia crassa*			
144.		*Dytiscidae sp.*			
145.	25096	*Egernia kingii (King's Skink)*			
146.		*Egretta novaehollandiae*			
147.		*Elanus axillaris*			
148.	47937	*Elseyornis melanops (Black-fronted Dotterel)*			
149.		*Eolophus roseicapillus*			
150.	24652	*Eopsaltria georgiana (White-breasted Robin)*			
151.		*Ephydridae sp.*			
152.		*Eriophora biapicata*			
153.	24379	*Erythrogonys cinctus (Red-kneed Dotterel)*			
154.		*Euchlanis sp.*			
155.		*Eupograpta kottae*			
156.		*Eylais sp.*			
157.	25621	*Falco berigora (Brown Falcon)*			
158.	25622	*Falco cenchroides (Australian Kestrel, Nankeen Kestrel)*			
159.	24472	*Falco cenchroides subsp. cenchroides (Australian Kestrel, Nankeen Kestrel)*			
160.	25623	*Falco longipennis (Australian Hobby)*			
161.	25624	*Falco peregrinus (Peregrine Falcon)*		S	
162.	24041	*Felis catus (Cat)*	Y		
163.	25727	*Fulica atra (Eurasian Coot)*			
164.	24761	*Fulica atra subsp. australis (Eurasian Coot)*			
165.	30916	*Funambulus pennanti (Indian Palm Squirrel)*	Y		
166.	34028	*Galaxias occidentalis (Western Minnow)*			
167.	25729	*Gallinula tenebrosa (Dusky Moorhen)*			
168.	24763	*Gallinula tenebrosa subsp. tenebrosa (Dusky Moorhen)*			
169.	25730	*Gallirallus philippensis (Buff-banded Rail)*			
170.	24765	*Gallirallus philippensis subsp. mellori (Buff-banded Rail)*			
171.		*Gallus gallus*			
172.	25530	*Gerygone fusca (Western Gerygone)*			
173.	24271	*Gerygone fusca subsp. fusca (Western Gerygone)*			
174.		*Glacidorbidae sp.*			Y
175.	47962	*Glyciphila melanops (Tawny-crowned Honeyeater)*			
176.		*Glyptophysa sp*			
177.	24443	*Grallina cyanoleuca (Magpie-lark)*			
178.		*Gripopterygidae sp.*			
179.	24295	*Haliastur sphenurus (Whistling Kite)*			
180.		*Haliplus gibbus*			
181.		*Hebridae sp.*			

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182.	25409	*Heleioporus barycragus (Hooting Frog)*			
183.	25410	*Heleioporus eyrei (Moaning Frog)*			
184.		*Hemianax papuensis*			
185.		*Hemicordulia tau*			
186.		*Hemicorduliidae sp.*			
187.	25115	*Hemiergis initialis subsp. initialis*			
188.	25119	*Hemiergis quadrilineata*			
189.	24961	*Heteronotia binoei (Bynoe's Gecko)*			
190.	47965	*Hieraaetus morphnoides (Little Eagle)*			
191.	25734	*Himantopus himantopus (Black-winged Stilt)*			
192.	24491	*Hirundo neoxena (Welcome Swallow)*			
193.		*Holasteron perth*			
194.	24215	*Hydromys chrysogaster (Water-rat, Rakali)*		P4	
195.		*Hydrophilidae sp.*			
196.		*Idiommata blackwalli*			
197.		*Ilyocryptus sp.*			
198.		*Ilyodromus sp.*			
199.		*Isidorella sp.*			
200.	25478	*Isoodon obesulus (Southern Brown Bandicoot)*		P4	
201.	24153	*Isoodon obesulus subsp. fusciventer (Quenda, Southern Brown Bandicoot)*		P4	
202.		*Isopeda leishmanni*			
203.		*Isopedella cana*			
204.		*Lacrimicypris "drummondi" n.sp. (SAP)*			
205.		*Latonopsis brehmi*			
206.		*Latrodectus hasseltii*			
207.		*Leberis aenigmatosa*			
208.	33981	*Leioproctus bilobatus (short-tongued bee)*		P2	
209.	33983	*Leioproctus douglasiellus (short-tongued bee)*		T	
210.		*Leptoceridae sp.*			
211.	25131	*Lerista distinguenda*			
212.	25133	*Lerista elegans*			
213.	25005	*Lialis burtonis*			
214.		*Libellulidae sp.*			
215.	25661	*Lichmera indistincta (Brown Honeyeater)*			
216.	24582	*Lichmera indistincta subsp. indistincta (Brown Honeyeater)*			
217.		*Limbodessus shuckhardi*			
218.		*Limnadia sp.*			
219.		*Limnochares australica*			
220.		*Limnophyes vestitus (V41)*			
221.	25378	*Litoria adelaidensis (Slender Tree Frog)*			
222.	25388	*Litoria moorei (Motorbike Frog)*			
223.		*Longepi woodman*			
224.		*Lophoictinia isura*			
225.		*Lycidas chlorophthalmus*			
226.		*Lycosa leuckartii*			
227.		*Lynceus sp.*			
228.	24132	*Macropus fuliginosus (Western Grey Kangaroo)*			
229.	24133	*Macropus irma (Western Brush Wallaby)*		P4	
230.		*Macrothrix sp.*			
231.	24326	*Malacorhynchus membranaceus (Pink-eared Duck)*			
232.	25650	*Malurus elegans (Red-winged Fairy-wren)*			
233.	24551	*Malurus pulcherrimus (Blue-breasted Fairy-wren)*			
234.	25654	*Malurus splendens (Splendid Fairy-wren)*			
235.	24552	*Malurus splendens subsp. splendens (Splendid Fairy-wren)*			
236.	24583	*Manorina flavigula (Yellow-throated Miner)*			
237.		*Maraura macracantha (formerly Alona macrocantha)*			
238.		*Masasteron maini*			
239.	25758	*Megalurus gramineus (Little Grassbird)*			
240.		*Megaporus sp.*			
241.	25663	*Melithreptus brevirostris (Brown-headed Honeyeater)*			
242.	24587	*Melithreptus chloropsis (Western White-naped Honeyeater)*			
243.	25184	*Menetia greyii*			
244.	24598	*Merops ornatus (Rainbow Bee-eater)*		IA	
245.		*Mesocyclops brooksi*			
246.		*Microcarbo melanoleucos*			
247.		*Microcyclops varicans*			
248.		*Microvelia sp.*			
249.		*Missulena granulosa*			
250.		*Missulena occatoria*			
251.		*Mitzoruga insularis*			

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252.		*Monohelea sp. 1 (SAP)*			
253.		*Monohelea sp. 2 (SAP)*			
254.	25240	*Morelia spilota subsp. imbricata (Carpet Python)*			
255.	24223	*Mus musculus (House Mouse)*	Y		
256.		*Myandra bicincta*			
257.	25420	*Myobatrachus gouldii (Turtle Frog)*			
258.		*Nannoperca vittata*			
259.	25248	*Neelaps bimaculatus (Black-naped Snake)*			
260.	25249	*Neelaps calonotos (Black-striped Snake, black-striped burrowing snake)*		P3	
261.		*Nematoda sp.*			
262.	25686	*Neochmia temporalis (Red-browed Finch)*	Y		
263.	24738	*Neophema elegans (Elegant Parrot)*			
264.	24739	*Neophema petrophila (Rock Parrot)*			
265.		*Nicodamus mainae*			
266.	25747	*Ninox connivens (Barking Owl)*			
267.	25252	*Notechis scutatus (Tiger Snake)*			
268.		*Notiasemus glauerti*			
269.		*Notonectidae sp.*			
270.	25564	*Nycticorax caledonicus (Rufous Night Heron)*			
271.	24194	*Nyctophilus geoffroyi (Lesser Long-eared Bat)*			
272.		*Occiperipatoides gilesii*			
273.	24407	*Ocyphaps lophotes (Crested Pigeon)*			
274.		*Oligochaeta sp.*			
275.		*Ommatoiulus moreletii*			
276.		*Onychohydrus sp.*			
277.		*Oribatida sp.*			
278.		*Orthocladiinae sp.*			
279.		*Orthocladiinae sp. C = V44 Gymnometriocnemus (SAP)*			
280.		*Oxyopes gracilipes*			
281.	24328	*Oxyura australis (Blue-billed Duck)*		P4	
282.	25680	*Pachycephala rufiventris (Rufous Whistler)*			
283.	24624	*Pachycephala rufiventris subsp. rufiventris (Rufous Whistler)*			
284.		*Palaemonidae sp.*			
285.		*Paramerina levidensis*			
286.		*Paramphisopus palustris*			
287.	25253	*Parasuta gouldii*			
288.	25681	*Pardalotus punctatus (Spotted Pardalote)*			
289.	25682	*Pardalotus striatus (Striated Pardalote)*			
290.	24628	*Pardalotus striatus subsp. murchisoni (Striated Pardalote)*			
291.	24648	*Pelecanus conspicillatus (Australian Pelican)*			
292.	48060	*Petrochelidon ariel (Fairy Martin)*			
293.	48061	*Petrochelidon nigricans (Tree Martin)*			
294.	48066	*Petroica boodang (Scarlet Robin)*			
295.	24659	*Petroica goodenovii (Red-capped Robin)*			
296.	25697	*Phalacrocorax carbo (Great Cormorant)*			
297.	25698	*Phalacrocorax melanoleucos (Little Pied Cormorant)*			
298.	24667	*Phalacrocorax sulcirostris (Little Black Cormorant)*			
299.	25699	*Phalacrocorax varius (Pied Cormorant)*			
300.	24409	*Phaps chalcoptera (Common Bronzewing)*			
301.	48070	*Phascogale tapoatafa subsp. wambenger (South-western Brush-tailed Phascogale, Wambenger)*		T	
302.		*Phreatoicidae sp.*			
303.		*Phryganoporus gausapatus subsp. occidentalis*			Y
304.	48071	*Phylidonyris niger (White-cheeked Honeyeater)*			
305.	24596	*Phylidonyris novaehollandiae (New Holland Honeyeater)*			
306.		*Physidae sp.*			
307.		*Planicirclus alticarinatus*			
308.		*Planorbidae sp.*			
309.	24841	*Platalea flavipes (Yellow-billed Spoonbill)*			
310.	24842	*Platalea regia (Royal Spoonbill)*			
311.	25720	*Platycercus icterotis (Western Rosella)*			
312.	24745	*Platycercus icterotis subsp. icterotis (Western Rosella)*			
313.	25721	*Platycercus zonarius (Australian Ringneck, Ring-necked Parrot)*			
314.	24751	*Platycercus zonarius subsp. zonarius (Port Lincoln Parrot)*			
315.	25007	*Pletholax gracilis subsp. gracilis (Keeled Legless Lizard)*			
316.	25703	*Podargus strigoides (Tawny Frogmouth)*			
317.	24679	*Podargus strigoides subsp. brachypterus (Tawny Frogmouth)*			
318.	25510	*Pogona minor (Dwarf Bearded Dragon)*			
319.	24907	*Pogona minor subsp. minor (Dwarf Bearded Dragon)*			
320.	24681	*Poliocephalus poliocephalus (Hoary-headed Grebe)*			

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321.		*Poltys laciniosus*			
322.		*Polygonarea repanda*			Y
323.	25731	*Porphyrio porphyrio (Purple Swamphen)*			
324.	24767	*Porphyrio porphyrio subsp. bellus (Purple Swamphen)*			
325.	24771	*Porzana tabuensis (Spotless Crake)*			
326.		*Procladius paludicola*			
327.		*Procladius sp. (normal claws)*			
328.	25261	*Pseudechis australis (Mulga Snake)*			
329.	25345	*Pseudemydura umbrina (Western Swamp Tortoise, Western Swamp Turtle)*		T	
330.	25259	*Pseudonaja affinis subsp. affinis (Dugite)*			
331.	25433	*Pseudophryne guentheri (Crawling Toadlet)*			
332.	25710	*Pterodroma macroptera (Great-winged Petrel)*			
333.	24173	*Pteropus scapulatus (Little Red Flying-fox)*			
334.		*Purpureicephalus spurius*			
335.	24245	*Rattus rattus (Black Rat)*	Y		
336.		*Raveniella cirrata*			
337.		*Raveniella peckorum*			
338.		*Rhantus suturalis*			
339.	48096	*Rhipidura albiscapa (Grey Fantail)*			
340.	25614	*Rhipidura leucophrys (Willie Wagtail)*			
341.	24199	*Scotorepens balstoni (Inland Broad-nosed Bat)*			
342.	25534	*Sericornis frontalis (White-browed Scrubwren)*			
343.		*Simocephalus elizabethae*			
344.		*Simuliidae sp.*			
345.	30948	*Smicrornis brevirostris (Weebill)*			
346.		*Spencerhydrus sp.*			Y
347.	24645	*Stagonopleura oculata (Red-eared Firetail)*			
348.		*Steatoda grossa*			
349.		*Sternopriscus sp.*			
350.	25655	*Stipiturus malachurus (Southern Emu-wren)*			
351.		*Storena formosa*			
352.	24426	*Strepera versicolor subsp. plumbea (Grey Currawong)*			
353.	25589	*Streptopelia chinensis (Spotted Turtle-Dove)*	Y		
354.	25590	*Streptopelia senegalensis (Laughing Turtle-Dove)*	Y		
355.	24943	*Strophurus spinigerus subsp. inornatus*			
356.	24942	*Strophurus spinigerus subsp. spinigerus*			
357.		*Supunna funerea*			
358.		*Tabanidae sp.*			
359.	25705	*Tachybaptus novaehollandiae (Australasian Grebe, Black-throated Grebe)*			
360.	24682	*Tachybaptus novaehollandiae subsp. novaehollandiae (Australasian Grebe, Black-throated Grebe)*			
361.	24331	*Tadorna tadornoides (Australian Shelduck, Mountain Duck)*			
362.		*Tanypodinae sp.*			
363.		*Tanytarsus fuscithorax*			
364.	24167	*Tarsipes rostratus (Honey Possum, Noolbenger)*			
365.		*Tasmanicosa leuckartii*			
366.		*Testudinella patina*			
367.	24845	*Threskiornis spinicollis (Straw-necked Ibis)*			
368.	25519	*Tiliqua rugosa*			
369.	25204	*Tiliqua rugosa subsp. aspera*			
370.	25207	*Tiliqua rugosa subsp. rugosa*			
371.		*Tipulidae sp.*			
372.	25549	*Todiramphus sanctus (Sacred Kingfisher)*			
373.	24309	*Todiramphus sanctus subsp. sanctus (Sacred Kingfisher)*			
374.	48141	*Tribonyx ventralis (Black-tailed Native-hen)*			
375.		*Trichocerca similis*			
376.	25723	*Trichoglossus haematodus (Rainbow Lorikeet)*			
377.	24755	*Trichoglossus haematodus subsp. moluccanus (Rainbow Lorikeet)*	Y		
378.	24806	*Tringa glareola (Wood Sandpiper)*		IA	
379.	24808	*Tringa nebularia (Common Greenshank, greenshank)*		IA	
380.		*Triplectides australis*			
381.		*Turbellaria sp.*			
382.	48147	*Turnix varius (Painted Button-quail)*			
383.	24852	*Tyto alba subsp. delicatula (Barn Owl)*			
384.	24983	*Underwoodisaurus milii (Barking Gecko)*			
385.		*Urodacus novaehollandiae*			
386.		*Urodacus planimanus*			
387.	25218	*Varanus gouldii (Bungarra or Sand Monitor)*			
388.	25225	*Varanus rosenbergi (Heath Monitor)*			
389.	25526	*Varanus tristis (Racehorse Monitor)*			

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390.		*Venator immansueta*			
391.		*Venatrix arenaris*			
392.		*Venatrix pullastra*			
393.	24206	*Vespadelus regulus (Southern Forest Bat)*			
394.	34113	*Westralunio carteri (Carter's Freshwater Mussel)*		T	
395.	25765	*Zosterops lateralis (Grey-breasted White-eye, Silvereye)*			
Fungi					
396.	45014	*Amanita quenda*		P1	
397.	43542	*Amanita wadjukiorum*		P3	
398.	38757	*Amanita xanthocephala*			
399.		*Boletus sp.*			
400.	38774	*Cortinarius archeri*			
401.		*Cortinarius sublargus*			Y
402.		*Dermocybe clelandii*			
403.	38784	*Descomyces albus*			
404.	27748	*Flavoparmelia rutidota*			
405.		*Fomitopsis lilacinogilva*			
406.		*Gymnopilus purpuratus*			
407.		*Hygrocybe astatogala*			Y
408.	38800	*Labyrinthomyces varius*			
409.		*Lactarius clarkeae*			
410.	38804	*Lactarius eucalypti*			
411.		*Phytophthora cinnamomi*			
412.	38825	*Pluteus pauperculus*			
413.	38836	*Russula erumpens*			
414.		*Scleroderma cepa*			
415.		*Tubaria rufofulva*			
416.	45896	*Ustilago bromivora*			
417.	45902	*Ustilago nuda*			
418.	45906	*Ustilago tepperi*			
Plantae					
419.	19708	*Abutilon grandifolium*	Y		
420.	15429	*Acacia alata var. alata*			
421.	3219	*Acacia anomala (Grass Wattle)*		T	
422.	3220	*Acacia aphylla (Leafless Rock Wattle)*		T	
423.	15466	*Acacia applanata*			
424.	3233	*Acacia barbinervis*			
425.	3294	*Acacia dentifera*			
426.	11926	*Acacia drewiana subsp. drewiana*			
427.	3373	*Acacia horridula*		P3	
428.	3374	*Acacia huegelii*			
429.	3382	*Acacia incrassata*			
430.	3409	*Acacia lasiocarpa (Panjang)*			
431.	11611	*Acacia lasiocarpa var. lasiocarpa*			
432.	3454	*Acacia nervosa (Rib Wattle)*			
433.	3464	*Acacia obovata*			
434.	14131	*Acacia oncinophylla subsp. patulifolia*		P4	
435.	17860	*Acacia podalyriifolia*	Y		
436.	3502	*Acacia pulchella (Prickly Moses)*			
437.	15481	*Acacia pulchella var. glaberrima*			
438.	15483	*Acacia pulchella var. pulchella*			
439.	30033	*Acacia saligna subsp. lindleyi*			
440.	3541	*Acacia sessilis*			
441.	3557	*Acacia stenoptera (Narrow Winged Wattle)*			
442.	3574	*Acacia teretifolia*			
443.	3602	*Acacia willdenowiana (Grass Wattle)*			
444.	1205	*Acanthocarpus canaliculatus*			
445.	7811	*Acanthospermum hispidum (Starburr)*	Y		
446.	6205	*Actinotus leucocephalus (Flannel Flower)*			
447.	14970	*Adenanthos barbiger*			
448.	1775	*Adenanthos cygnorum (Common Woollybush)*			
449.	11837	*Adenanthos cygnorum subsp. cygnorum (Common Woollybush)*			
450.	18396	*Aeonium haworthii*	Y		
451.	1505	*Agave americana (Century Plant)*	Y		
452.	5316	*Agonis flexuosa (Peppermint, Wonil)*			
453.	179	*Agrostis gigantea (Redtop Bent)*	Y		
454.	23474	*Agrostocrinum hirsutum*			
455.	1261	*Agrostocrinum scabrum (Blue Grass Lily)*			
456.	23501	*Agrostocrinum scabrum subsp. scabrum*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
457.	184	*Aira caryophyllea (Silvery Hairgrass)*	Y		
458.	185	*Aira cupaniana (Silvery Hairgrass)*	Y		
459.	1056	*Alexgeorgea nitens*			
460.	1374	*Allium ampeloprasum*	Y		
461.	1728	*Allocasuarina fraseriana (Sheoak, Kondil)*			
462.	1732	*Allocasuarina humilis (Dwarf Sheoak)*			
463.	1734	*Allocasuarina microstachya*			
464.	2648	*Alternanthera denticulata (Lesser Joyweed)*			
465.	7820	*Ambrosia artemisiifolia (Annual Ragweed, Bitterweed, Hay-feverweed, Hog-weed)*	Y		
466.	7821	*Ambrosia psilostachya (Perennial Ragweed)*	Y		
467.	13380	*Amphibromus nervosus*			
468.	197	*Amphipogon debilis*			
469.	199	*Amphipogon strictus (Greybeard Grass)*			
470.	200	*Amphipogon turbinatus*			
471.	1058	*Anarthria gracilis*			
472.	1059	*Anarthria humilis*			
473.	1060	*Anarthria laevis*			
474.	6300	*Andersonia aristata (Rice Flower)*			
475.	6309	*Andersonia gracilis*		T	
476.	6312	*Andersonia involucrata*			
477.	6314	*Andersonia lehmanniana*			
478.	11471	*Andersonia lehmanniana subsp. lehmanniana*			
479.	7833	*Angianthus preissianus*			
480.	1406	*Anigozanthos bicolor (Little Kangaroo Paw)*			
481.	11470	*Anigozanthos bicolor subsp. bicolor*			
482.	1409	*Anigozanthos humilis (Catspaw)*			
483.	11434	*Anigozanthos humilis subsp. humilis*			
484.	1411	*Anigozanthos manglesii (Mangles Kangaroo Paw, Kurulbrang)*			
485.	11261	*Anigozanthos manglesii subsp. manglesii*			
486.	1416	*Anigozanthos viridis (Green Kangaroo Paw, Kurulbardang)*			
487.	11566	*Anigozanthos viridis subsp. viridis*			
488.	6946	*Anthocercis gracilis (Slender Tailflower)*		T	
489.	12724	*Anthotium junciforme*			
490.	202	*Anthoxanthum odoratum (Sweet Vernal Grass)*	Y		
491.	3686	*Aotus cordifolia*			
492.	1116	*Aphelia brizula*			
493.	1117	*Aphelia cyperoides*			
494.	1118	*Aphelia drummondii*			
495.	43548	*Aphelia sp. Albany (B.G. Briggs 596)*			
496.	141	*Aponogeton hexatepalus (Stalked Water Ribbons)*		P4	
497.	32314	*Archidium rehmannii*			
498.	7838	*Arctotheca calendula (Cape Weed, African Marigold)*	Y		
499.	1264	*Arnocrinum preissii*			
500.	28288	*Artemisia arborescens (Silver Wormwood)*	Y		
501.	1364	*Asphodelus fistulosus (Onion Weed)*	Y		
502.	20350	*Astartea affinis (West-coast Astartea)*			
503.	20283	*Astartea scoparia (Common Astartea)*			
504.		*Asterella drummondii*			
505.	6323	*Astroloma ciliatum (Candle Cranberry)*			
506.	6327	*Astroloma foliosum (Candle Cranberry)*			
507.	6334	*Astroloma pallidum (Kick Bush)*			
508.	6337	*Astroloma stomarrhena (Red Swamp Cranberry)*			
509.	38480	*Austrostipa bronwenae*		T	
510.	17233	*Austrostipa campylachne*			
511.	17234	*Austrostipa compressa*			
512.	17241	*Austrostipa hemipogon*			
513.	17245	*Austrostipa mollis*			
514.	17254	*Austrostipa tenuifolia*			
515.	17257	*Austrostipa variabilis*			
516.	231	*Avellinia michelii*	Y		
517.	233	*Avena barbata (Bearded Oat)*	Y		
518.	20013	*Axonopus fissifolius*	Y		
519.	18279	*Babiana angustifolia*	Y		
520.	36441	*Babingtonia camphorosmae (Camphor Myrtle)*			
521.	45403	*Babingtonia pelloeae (Pelloe's Babingtonia)*			
522.	45402	*Babingtonia urbana (Coastal Plain Babingtonia)*		P3	
523.	1382	*Baeometra uniflora*	Y		
524.	32682	*Banksia armata var. armata*			
525.	1800	*Banksia attenuata (Slender Banksia, Piara)*			
526.	32580	*Banksia dallanneyi var. dallanneyi*			

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527.	32577	*Banksia dallanneyi var. mellicula*			
528.	1819	*Banksia grandis (Bull Banksia, Pulgarla)*			
529.	1822	*Banksia ilicifolia (Holly-leaved Banksia)*			
530.	1823	*Banksia incana*			
531.	33399	*Banksia incana var. incana*			
532.	1834	*Banksia menziesii (Firewood Banksia)*			
533.	32211	*Banksia mimica (Summer Honeypot)*		T	
534.	32202	*Banksia nivea (Honeypot Dryandra, Pudjarn)*			
535.	32138	*Banksia pteridifolia subsp. vernalis*		P3	
536.	32080	*Banksia sessilis var. sessilis*			
537.	1852	*Banksia telmatiaea (Swamp Fox Banksia)*			
538.	32031	*Banksia vestita (Summer Dryandra)*			
539.	1855	*Banksia victoriae (Woolly Orange Banksia)*			
540.	32315	*Barbula calycina*			
541.	32321	*Bartramia breutelii*			
542.	32323	*Bartramia pseudostricta*			
543.	15037	*Bartsia trixago*	Y		
544.	740	*Baumea arthrophylla*			
545.	743	*Baumea juncea (Bare Twigrush)*			
546.	747	*Baumea rubiginosa*			
547.	5387	*Beaufortia macrostemon (Darling Range Beaufortia)*			
548.	5393	*Beaufortia squarrosa (Sand Beaufortia, Sand Bottlebrush, Puno)*			
549.	4413	*Boronia crenulata (Aniseed Boronia)*			
550.	16636	*Boronia crenulata subsp. viminea*			
551.	11503	*Boronia crenulata var. crenulata*			
552.	4414	*Boronia cymosa (Granite Boronia)*			
553.	4432	*Boronia ovata*			
554.	4438	*Boronia ramosa*			
555.	11381	*Boronia ramosa subsp. anethifolia*			
556.	11564	*Boronia ramosa subsp. ramosa*			
557.	4444	*Boronia tenuis (Blue Boronia)*		P4	
558.	1272	*Borya scirpoidea*			
559.	1273	*Borya sphaerocephala (Pincushions)*			
560.	3710	*Bossiaea eriocarpa (Common Brown Pea)*			
561.	3714	*Bossiaea ornata (Broad Leaved Brown Pea)*			
562.	7867	*Brachyscome bellidioides*			
563.	3000	*Brassica tournefortii (Mediterranean Turnip)*	Y		
564.	244	*Briza maxima (Blowfly Grass)*	Y		
565.	245	*Briza minor (Shivery Grass)*	Y		
566.	249	*Bromus diandrus (Great Brome)*	Y		
567.	250	*Bromus hordeaceus (Soft Brome)*	Y		
568.	1366	*Bulbine semibarbata (Leek Lily)*			
569.	1383	*Burchardia bairdiae*			
570.	12770	*Burchardia congesta*			
571.	1385	*Burchardia multiflora (Dwarf Burchardia)*			
572.	3178	*Byblis gigantea (Rainbow Plant)*		P3	
573.	1276	*Caesia micrantha (Pale Grass Lily)*			
574.	1277	*Caesia occidentalis*			
575.	15330	*Caladenia arenicola*			
576.	44900	*Caladenia denticulata subsp. rubella*			
577.	1590	*Caladenia ferruginea (Rusty Spider Orchid)*			
578.	1592	*Caladenia flava (Cowslip Orchid)*			
579.	15348	*Caladenia flava subsp. flava*			
580.	13859	*Caladenia longicauda subsp. clivicola*			
581.	15365	*Caladenia longicauda subsp. longicauda*			
582.	17760	*Caladenia nobilis*			
583.	15503	*Caladenia paludosa*			
584.	2854	*Calandrinia granulifera (Pygmy Purslane)*			
585.	2856	*Calandrinia liniflora (Parakeelya)*			
586.	20096	*Calandrinia sp. Piawaning (A.C. Beauglehole 12257)*		P1	
587.	1213	*Calectasia cyanea (Blue Tinsel Lily)*		T	
588.	1214	*Calectasia grandiflora (Blue Tinsel Lily)*			
589.	19309	*Calectasia narragara*			
590.	4717	*Callitriche stagnalis (Common Starwort)*	Y		
591.	36520	*Callitris acuminata (Dwarf Cypress)*			
592.	36600	*Callitris pyramidalis (Swamp Cypress)*			
593.	5411	*Calothamnus hirsutus*			
594.	5426	*Calothamnus quadrifidus (One-sided Bottlebrush, Kwowdjard)*			
595.	35816	*Calothamnus quadrifidus subsp. quadrifidus*			
596.	5428	*Calothamnus rupestris (Mouse Ears)*			

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597.	5431	*Calothamnus torulosus*			
598.	5437	*Calytrix acutifolia*			
599.	5439	*Calytrix angulata (Yellow Starflower)*			
600.	5441	*Calytrix aurea*			
601.	13653	*Calytrix breviseta subsp. breviseta*		T	
602.	5458	*Calytrix flavescens (Summer Starflower)*			
603.	5460	*Calytrix fraseri (Pink Summer Calytrix)*			
604.	5461	*Calytrix glutinosa*			
605.	5485	*Calytrix variabilis*			
606.	19713	*Campsis radicans*	Y		
607.	32461	*Campylopus bicolor var. bicolor*			
608.	32338	*Campylopus introflexus*	Y		
609.	11351	*Cassytha aurea var. hirta*			
610.	2951	*Cassytha flava (Dodder Laurel)*			
611.	2952	*Cassytha glabella (Tangled Dodder Laurel)*			
612.	11501	*Cassytha glabella forma casuarinae*			
613.	2956	*Cassytha pomiformis (Dodder Laurel)*			
614.	2957	*Cassytha racemosa (Dodder Laurel)*			
615.	11242	*Cassytha racemosa forma pilosa*			
616.	11799	*Cassytha racemosa forma racemosa*			
617.	760	*Caustis dioica*			
618.	6539	*Centaurium erythraea (Common Centaury)*	Y		
619.	7918	*Centipeda cunninghamii (Common Sneezewood, Gukwonderuk, Old Man Weed)*			
620.		*Centratherum punctatum*			
621.	1121	*Centrolepis aristata (Pointed Centrolepis)*			
622.	1123	*Centrolepis caespitosa*		P4	
623.	1125	*Centrolepis drummondiana*			
624.	1129	*Centrolepis glabra (Smooth Centrolepis)*			
625.	1131	*Centrolepis inconspicua*			
626.	43642	*Centrolepis sp. Kalannie (B.J. Lepschi et al. BJL 3517)*			
627.	17685	*Chaetanthus aristatus*			
628.	1280	*Chamaescilla corymbosa (Blue Squill)*			
629.	11299	*Chamaescilla corymbosa var. corymbosa*			
630.	19338	*Chamaescilla gibsonii*		P3	
631.	8788	*Chamaescilla versicolor*			
632.	1513	*Chasmanthe floribunda (African Cornflag)*	Y		
633.	31	*Cheilanthes austrotenuifolia*			
634.	3169	*Cheiranthera preissiana*			
635.	17706	*Chordifex sinuosus*			
636.	763	*Chorizandra enodis (Black Bristlerush)*			
637.	764	*Chorizandra multiarticulata*			
638.	3753	*Chorizema dicksonii (Yellow-eyed Flame Pea)*			
639.	11900	*Chrysanthemoides monilifera subsp. monilifera*	Y		
640.	6543	*Cicendia filiformis (Slender Cicendia)*	Y		
641.	7370	*Citrullus lanatus (Pie Melon)*	Y		
642.	2929	*Clematis pubescens (Common Clematis)*			
643.	32999	*Colocasia esculenta var. esculenta*	Y		
644.	4550	*Comesperma calymega (Blue-spike Milkwort)*			
645.	4551	*Comesperma ciliatum*			
646.	14663	*Comesperma griffinii*		P2	
647.	4560	*Comesperma rhadinocarpum (Slender-fruited Comesperma)*		P2	
648.	4564	*Comesperma virgatum (Milkwort)*			
649.	40864	*Commersonia cygnorum*			
650.	15607	*Conospermum acerosum subsp. acerosum*			
651.	15041	*Conospermum canaliculatum*			
652.	16853	*Conospermum capitatum subsp. glabratum*			
653.	1875	*Conospermum huegelii (Slender Smokebush)*			
654.	1882	*Conospermum stoechadis (Common Smokebush)*			
655.	1885	*Conospermum triplinervium (Tree Smokebush)*			
656.	13999	*Conospermum undulatum*		T	
657.	6347	*Conostephium minus (Pink-tipped Pearl flower)*			
658.	6348	*Conostephium pendulum (Pearl Flower)*			
659.	6349	*Conostephium preissii*			
660.	11826	*Conostylis aculeata subsp. aculeata*			
661.	12109	*Conostylis aculeata subsp. preissii*			
662.	1420	*Conostylis androstemma (Trumpets)*			
663.	1423	*Conostylis aurea (Golden Conostylis)*			
664.	1429	*Conostylis caricina*			
665.	12035	*Conostylis caricina subsp. caricina*			
666.	1434	*Conostylis festucacea*			

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667.	11695	*Conostylis festucacea subsp. festucacea*			
668.	1436	*Conostylis juncea*			
669.	1437	*Conostylis latens*			
670.	11388	*Conostylis pauciflora subsp. euryrhipis*		P4	
671.	1454	*Conostylis setigera (Bristly Cottonhead)*			
672.	11597	*Conostylis setigera subsp. setigera*			
673.	1455	*Conostylis setosa (White Cottonhead)*			
674.	5502	*Conothamnus trinervis*			
675.	20074	*Conyza sumatrensis*	Y		
676.	48259	*Cortaderia selloana subsp. selloana*	Y		
677.	17104	*Corymbia calophylla (Marri)*			
678.	7945	*Cotula coronopifolia (Waterbuttons)*	Y		
679.	13354	*Craspedia variabilis*			
680.	17701	*Crassula closiana*			
681.	3137	*Crassula colorata (Dense Stonecrop)*			
682.	11563	*Crassula colorata var. colorata*			
683.	3138	*Crassula decumbens (Rufous Stonecrop)*			
684.	3142	*Crassula natans*	Y		
685.	18397	*Crassula tetragona subsp. robusta*	Y		
686.	29054	*Crepis foetida subsp. foetida (Stinking Hawksbeard)*	Y		
687.	35838	*Cristonia biloba subsp. biloba*			
688.	13470	*Cryptandra arbutiflora var. arbutiflora*			
689.	4809	*Cryptandra pungens*			
690.	11021	*Cuscuta planiflora*	Y		
691.	15114	*Cyanicula gemmata*			
692.	15404	*Cyanicula sericea*			
693.	51	*Cyathea cooperi*	Y		
694.	768	*Cyathochaeta avenacea*			
695.	769	*Cyathochaeta clandestina*			
696.	17618	*Cyathochaeta equitans*			
697.	40661	*Cycnogeton lineare*			
698.	283	*Cynodon dactylon (Couch)*	Y		
699.	285	*Cynosurus echinatus (Rough Dogstail)*	Y		
700.	783	*Cyperus congestus (Dense Flat-sedge)*	Y		
701.	18198	*Cyperus papyrus*	Y		
702.	815	*Cyperus tenellus (Tiny Flatsedge)*	Y		
703.	816	*Cyperus tenuiflorus (Scaly Sedge)*	Y		
704.	17692	*Cytogonidium leptocarpoides*			
705.	7420	*Dampiera alata (Winged-stem Dampiera)*			
706.	7428	*Dampiera coronata (Wedge-leaved Dampiera)*			
707.	7454	*Dampiera linearis (Common Dampiera)*			
708.	7462	*Dampiera pedunculata*			
709.	5505	*Darwinia apiculata (Scarp Darwinia)*		T	
710.	5508	*Darwinia citriodora (Lemon-scented Darwinia)*			
711.	18193	*Darwinia thymoides subsp. thymoides*			
712.	1218	*Dasypogon bromeliifolius (Pineapple Bush)*			
713.	1220	*Dasypogon obliquifolius*			
714.	6218	*Daucus glochidiatus (Australian Carrot)*			
715.	3793	*Daviesia angulata*			
716.	3799	*Daviesia cordata (Bookleaf)*			
717.	3805	*Daviesia decurrens (Prickly Bitter-pea)*			
718.	19747	*Daviesia decurrens subsp. decurrens*			
719.	18560	*Daviesia divaricata subsp. divaricata*			
720.	3815	*Daviesia horrida (Prickly Bitter-pea)*			
721.	3824	*Daviesia nudiflora*			
722.	3832	*Daviesia physodes*			
723.	3834	*Daviesia polyphylla*			
724.	3839	*Daviesia rhombifolia*			
725.	3845	*Daviesia triflora*			
726.	17336	*Dennstaedtia davallioides*	Y		Y
727.	17663	*Desmocladus asper*			
728.	17691	*Desmocladus fasciculatus*			
729.	11636	*Dianella revoluta var. divaricata*			
730.	1287	*Dichopogon capillipes*			
731.	32345	*Didymodon australasiae*			
732.	17838	*Dielsia stenostachya*			
733.	311	*Digitaria ciliaris (Summer Grass)*	Y		
734.	316	*Digitaria longiflora*			
735.	320	*Digitaria sanguinalis (Crab Grass)*	Y		
736.	1509	*Dioscorea hastifolia (Warrine, Wararn)*			

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737.	18589	*Diplopeltis huegelii subsp. lehmannii*			
738.	3867	*Dipogon lignosus (Dolichos Pea)*	Y		
739.	19649	*Disa bracteata*	Y		
740.	32347	*Ditrichum difficile*			
741.	7961	*Dittrichia graveolens (Stinkwort)*	Y		
742.	12943	*Diuris brumalis*			
743.	11049	*Diuris corymbosa*			
744.	1634	*Diuris laxiflora (Bee Orchid)*			
745.	1637	*Diuris purdiei (Purdie's Donkey Orchid)*		T	
746.	4757	*Dodonaea ceratocarpa*			
747.	15406	*Drakaea gracilis*			
748.	3095	*Drosera erythrorhiza (Red Ink Sundew)*			
749.	13211	*Drosera erythrorhiza subsp. collina*			
750.	3097	*Drosera gigantea (Giant Sundew)*			
751.	15453	*Drosera gigantea subsp. gigantea*			
752.	3098	*Drosera glanduligera (Pimpernel Sundew)*			
753.	13195	*Drosera helodes*			
754.	3101	*Drosera heterophylla (Swamp Rainbow)*			
755.	13197	*Drosera hyperostigma*			
756.	3106	*Drosera macrantha (Bridal Rainbow)*			
757.	14298	*Drosera macrantha subsp. macrantha*			
758.	3109	*Drosera menziesii (Pink Rainbow)*			
759.	11853	*Drosera menziesii subsp. menziesii*			
760.	13216	*Drosera menziesii subsp. penicillaris*			
761.	3110	*Drosera microphylla (Golden Rainbow)*			
762.	3115	*Drosera occidentalis (Western Sundew)*			
763.	13191	*Drosera occidentalis subsp. occidentalis*		P4	
764.	3118	*Drosera pallida (Pale Rainbow)*			
765.	3123	*Drosera platystigma (Black-eyed Sundew)*			
766.	3125	*Drosera pycnoblasta (Pearly Sundew)*			
767.	8911	*Drosera rosulata*			
768.	3131	*Drosera stolonifera (Leafy Sundew)*			
769.	3135	*Drosera zonaria (Painted Sundew)*			
770.	33500	*Dysphania ambrosioides (Mexican Tea)*	Y		
771.	7374	*Ecballium elaterium (Squirting Cucumber)*	Y		
772.	32351	*Eccremidium pulchellum*			
773.	328	*Echinochloa colona (Awnless Barnyard Grass)*	Y		
774.	11105	*Echinochloa crus-galli*	Y		
775.	329	*Echinochloa crus-pavonis (South American Barnyard Grass)*	Y		
776.	16093	*Echinochloa esculenta*	Y		
777.	8450	*Eclipta prostrata*	Y		
778.	347	*Ehrharta calycina (Perennial Veldt Grass)*	Y		
779.	349	*Ehrharta longiflora (Annual Veldt Grass)*	Y		
780.	5187	*Elatine gratioloides (Waterwort)*			
781.	822	*Eleocharis acuta (Common Spikerush)*			
782.	17605	*Eleocharis keigheryi*		T	
783.	352	*Eleusine coracan (Indian Millet)*	Y		
784.	353	*Eleusine indica (Crowsfoot Grass)*	Y		
785.	1644	*Elythranthera emarginata (Pink Enamel Orchid)*			
786.	32353	*Entosthodon apophysatus*			
787.	32354	*Entosthodon productus*			
788.	374	*Eragrostis cilianensis (Stinkgrass)*	Y		
789.	376	*Eragrostis curvula (African Lovegrass)*	Y		
790.	379	*Eragrostis elongata (Clustered Lovegrass)*			
791.		*Eragrostis sp.*			
792.	5540	*Eremaea fimbriata*			
793.	5541	*Eremaea pauciflora*			
794.	14103	*Eremaea pauciflora var. calyptra*			
795.	14104	*Eremaea pauciflora var. pauciflora*			
796.	17150	*Eremophila glabra subsp. chlorella*		T	
797.	15414	*Eriochilus helonomos*			
798.	6219	*Eryngium pinnatifidum (Blue Devils)*			
799.	41801	*Eryngium pinnatifidum subsp. Palustre (G.J. Keighery 13459)*		P3	
800.	15446	*Eryngium pinnatifidum subsp. pinnatifidum*			
801.	41810	*Eryngium sp. Subdecumbens (G.J. Keighery 5390)*		P3	
802.	18299	*Erythrina x sykesii*	Y		
803.	5580	*Eucalyptus camaldulensis (River Gum, Yabalinyba)*			
804.	5708	*Eucalyptus marginata (Jarrah, Djara)*			
805.	13547	*Eucalyptus marginata subsp. marginata (Jarrah)*			
806.	13548	*Eucalyptus marginata subsp. thalassica (Blue-leaved Jarrah)*			

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807.	5763	*Eucalyptus rudis (Flooded Gum, Kulurda)*			
808.	5797	*Eucalyptus wandoo (Wandoo, Wondu)*			
809.	12906	*Eucalyptus wandoo subsp. wandoo*			
810.	3872	*Euchilopsis linearis (Swamp Pea)*			
811.	3880	*Eutaxia virgata*			
812.	32367	*Fissidens megalotis*			
813.	32368	*Fissidens taylorii*			
814.	32469	*Fissidens taylorii var. taylorii*			
815.		*Fossombronia altilamellosa*			
816.	2969	*Fumaria capreolata (Whiteflower Fumitory)*	Y		
817.	31532	*Fumaria muralis subsp. muralis*	Y		
818.		*Fumaria sp.*			
819.	32370	*Funaria hygrometrica*			
820.	900	*Gahnia aristata*			
821.	907	*Gahnia trifida (Coast Saw-sedge)*			
822.	7321	*Galium divaricatum*	Y		
823.	3887	*Gastrolobium acutum*			
824.	20475	*Gastrolobium capitatum*			
825.	20483	*Gastrolobium linearifolium*			
826.	3912	*Gastrolobium oxylobioides (Champion Bay Poison)*			
827.	3923	*Gastrolobium spathulatum (Poison Bush)*			
828.	16311	*Gazania linearis*	Y		
829.	32374	*Gemmabryum cheelii*			
830.	32375	*Gemmabryum chrysoneuron*			
831.	32379	*Gemmabryum inaequale*			
832.	32380	*Gemmabryum pachythecum*			
833.	32381	*Gemmabryum preissianum*			
834.	32383	*Gemmabryum sullivanii*			
835.	3936	*Genista linifolia (Flaxleaf Broom)*	Y		
836.	32384	*Gigaspermum repens*			
837.	18298	*Gladiolus carneus*	Y		
838.	1520	*Gladiolus caryophyllaceus (Wild Gladiolus)*	Y		
839.	6143	*Glischrocaryon aureum (Common Popflower)*			
840.	6587	*Gomphocarpus fruticosus (Narrowleaf Cottonbush)*	Y		
841.	11051	*Gomphocarpus physocarpus*	Y		
842.	10909	*Gompholobium confertum*			
843.	3950	*Gompholobium knightianum*			
844.	3951	*Gompholobium marginatum*			
845.	3954	*Gompholobium polymorphum*			
846.	3955	*Gompholobium preissii*			
847.	3956	*Gompholobium shuttleworthii*			
848.	3957	*Gompholobium tomentosum (Hairy Yellow Pea)*			
849.	6149	*Gonocarpus cordiger*			
850.	6159	*Gonocarpus nodulosus*			
851.	6160	*Gonocarpus paniculatus*			
852.	6161	*Gonocarpus pithyoides*			
853.	29362	*Goodenia coerulea*			
854.	12520	*Goodenia fasciculata*			
855.	7517	*Goodenia incana (Hoary Goodenia)*			
856.	12551	*Goodenia micrantha*			
857.	7538	*Goodenia pulchella*			
858.	19286	*Goodenia pulchella subsp. Coastal Plain A (M. Hislop 634)*			
859.	19284	*Goodenia pulchella subsp. Coastal Plain B (L.W. Sage 2336)*			
860.	14282	*Gratiola pubescens*			
861.	1964	*Grevillea bipinnatifida (Fuchsia Grevillea)*			
862.	19628	*Grevillea bipinnatifida subsp. bipinnatifida*			
863.	1997	*Grevillea endlicheriana (Spindly Grevillea)*			
864.	13450	*Grevillea manglesii subsp. manglesii*			
865.	2066	*Grevillea pilulifera (Woolly-flowered Grevillea)*			
866.	15839	*Grevillea preissii subsp. preissii*			
867.	2080	*Grevillea quercifolia (Oak-leaf Grevillea)*			
868.	2101	*Grevillea synapheae (Catkin Grevillea)*			
869.	2107	*Grevillea thelemanniana (Spider Net Grevillea)*			
870.	2122	*Grevillea wilsonii (Native Fuchsia)*			
871.	1465	*Haemodorum discolor*			
872.	1468	*Haemodorum laxum*			
873.	1469	*Haemodorum loratum*		P3	
874.	1472	*Haemodorum simplex*			
875.	1474	*Haemodorum sparsiflorum*			
876.	2128	*Hakea amplexicaulis (Prickly Hakea)*			

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877.	2136	*Hakea candolleana*			
878.	2137	*Hakea ceratophylla (Horned Leaf Hakea)*			
879.	2143	*Hakea conchifolia (Shell-leaved Hakea)*			
880.	2152	*Hakea cyclocarpa (Ramshorn)*			
881.	2158	*Hakea erinacea (Hedge-hog Hakea)*			
882.	2166	*Hakea incrassata (Marble Hakea)*			
883.	2175	*Hakea lissocarpha (Honey Bush)*			
884.	2185	*Hakea myrtoides (Myrtle Hakea)*			
885.	2197	*Hakea prostrata (Harsh Hakea)*			
886.	2203	*Hakea ruscifolia (Candle Hakea)*			
887.	31793	*Hakea sp. Eastern coastal plain (G.J. Keighery 8014)*			
888.	2206	*Hakea stenocarpa (Narrow-fruited Hakea)*			
889.	2212	*Hakea sulcata (Furrowed Hakea)*			
890.	2214	*Hakea trifurcata (Two-leaf Hakea)*			
891.	2215	*Hakea undulata (Wavy-leaved Hakea)*			
892.	2216	*Hakea varia (Variable-leaved Hakea)*			
893.	3961	*Hardenbergia comptoniana (Native Wisteria)*			
894.	3016	*Heliophila pusilla*	Y		
895.	6838	*Hemiandra linearis (Speckled Snakebush)*			
896.	6839	*Hemiandra pungens (Snakebush)*			
897.	6856	*Hemigenia incana (Silky Hemigenia)*			
898.	41020	*Hemiphora bartlingii (Woolly Dragon)*			
899.	1526	*Hesperantha falcata*	Y		
900.	5108	*Hibbertia acerosa (Needle Leaved Guinea Flower)*			
901.	5112	*Hibbertia aurea*			
902.	5114	*Hibbertia commutata*			
903.	19778	*Hibbertia glomerata subsp. darlingensis*			
904.	5134	*Hibbertia huegelii*			
905.	5135	*Hibbertia hypericoides (Yellow Buttercups)*			
906.	45534	*Hibbertia hypericoides subsp. hypericoides*			
907.	5146	*Hibbertia montana*		P4	
908.	5148	*Hibbertia mylnei*			
909.	5152	*Hibbertia ovata*			
910.	5155	*Hibbertia pilosa (Hairy Guinea Flower)*			
911.	5162	*Hibbertia racemosa (Stalked Guinea Flower)*			
912.	5169	*Hibbertia serrata (Serrate Leaved Guinea Flower)*			
913.		*Hibbertia sp.*			
914.	5171	*Hibbertia spicata*			
915.	11481	*Hibbertia spicata subsp. spicata*			
916.	48381	*Hibbertia striata*			
917.	444	*Holcus lanatus (Yorkshire Fog)*	Y		
918.	6222	*Homalosciadium homalocarpum*			
919.	451	*Hordeum vulgare (Barley)*	Y		
920.	3964	*Hovea chorizemifolia (Holly-leaved Hovea)*			
921.	3966	*Hovea pungens (Devil's Pins, Puyenak)*			
922.	3968	*Hovea trisperma (Common Hovea)*			
923.	12859	*Hovea trisperma var. trisperma*			
924.	18296	*Humulus lupulus*	Y		
925.	12741	*Hyalosperma cotula*			
926.	5216	*Hybanthus calycinus (Wild Violet)*			
927.	6223	*Hydrocotyle alata*			
928.	6226	*Hydrocotyle callicarpa (Small Pennywort)*			
929.	6229	*Hydrocotyle diantha*			
930.	6233	*Hydrocotyle lemnoides (Aquatic Pennywort)*		P4	
931.	452	*Hyparrhenia hirta (Tambookie Grass)*	Y		
932.	5817	*Hypocalymma angustifolium (White Myrtle, Kudjid)*			
933.	35070	*Hypocalymma angustifolium subsp. Swan Coastal Plain (G.J. Keighery 16777)*			
934.	5825	*Hypocalymma robustum (Swan River Myrtle)*			
935.	8086	*Hypochaeris glabra (Smooth Catsear)*	Y		
936.	1070	*Hypolaena exsulca*			
937.	17841	*Hypolaena pubescens*			
938.	910	*Isolepis cernua (Nodding Club-rush)*			
939.	20199	*Isolepis cernua var. cernua*			
940.	20200	*Isolepis cernua var. setiformis*			
941.	912	*Isolepis cyperoides*			
942.	14540	*Isolepis hystrix*	Y		
943.	917	*Isolepis marginata (Coarse Club-rush)*			
944.	919	*Isolepis oldfieldiana*			
945.	2221	*Isopogon asper*			
946.	29775	*Isopogon drummondii*		P3	

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947.	2229	*Isopogon dubius (Pincushion Coneflower)*			
948.	2237	*Isopogon sphaerocephalus (Drumstick Isopogon)*			
949.	7396	*Isotoma hypocrateriformis (Woodbridge Poison)*			
950.	7398	*Isotoma pusilla (Small Isotome)*			
951.	3992	*Isotropis cuneifolia (Granny Bonnets)*			
952.	16317	*Isotropis cuneifolia subsp. glabra*		P2	
953.	1533	*Ixia paniculata*	Y		
954.	1534	*Ixia polystachya (Variable Ixia)*	Y		
955.	3997	*Jacksonia alata*			
956.	3998	*Jacksonia angulata*			
957.	4010	*Jacksonia floribunda (Holly Pea)*			
958.	4012	*Jacksonia furcellata (Grey Stinkwood)*			
959.	4018	*Jacksonia lehmannii*			
960.	4025	*Jacksonia restioides*			
961.	4029	*Jacksonia sternbergiana (Stinkwood, Kapur)*			
962.	1298	*Johnsonia pubescens (Pipe Lily)*			
963.	19632	*Johnsonia pubescens subsp. pubescens*			
964.	1177	*Juncus articulatus (Jointed Rush)*	Y		
965.	1180	*Juncus capitatus (Capitate Rush)*	Y		
966.	1188	*Juncus pallidus (Pale Rush)*			
967.	4037	*Kennedia coccinea (Coral Vine)*			
968.	4044	*Kennedia prostrata (Scarlet Runner)*			
969.	4045	*Kennedia stirlingii (Bushy Kennedia)*			
970.	1221	*Kingia australis (Kingia, Pulonok)*			
971.	5832	*Kunzea ericifolia (Spearwood, Pondil)*			
972.	15498	*Kunzea glabrescens (Spearwood)*			
973.	5835	*Kunzea micrantha*			
974.	17461	*Kunzea micrantha subsp. micrantha*			
975.	3669	*Labichea punctata (Lance-leaved Cassia)*			
976.	20019	*Lachnagrostis filiformis*			
977.	19955	*Lachnagrostis plebeia*			
978.	29046	*Lactuca serriola forma serriola*	Y		
979.	2249	*Lambertia multiflora (Many-flowered Honeysuckle)*			
980.	14083	*Lambertia multiflora var. darlingensis*			
981.	28342	*Landoltia punctata (Thin Duckweed)*			
982.	5025	*Lasiopetalum bracteatum (Helena Velvet Bush)*		P4	
983.	45081	*Lasiopetalum glutinosum subsp. glutinosum*		P3	
984.	4047	*Lathyrus tingitanus (Tangier Pea)*	Y		
985.	4959	*Lawrencia squamata*			
986.	1307	*Laxmannia ramosa (Branching Lily)*			
987.	11911	*Laxmannia ramosa subsp. ramosa*			
988.	11464	*Laxmannia sessiliflora subsp. australis*			
989.	1309	*Laxmannia squarrosa*			
990.	7568	*Lechenaultia biloba (Blue Leschenaultia)*			
991.	1051	*Lemna disperma (Duckweed)*			
992.	925	*Lepidosperma angustatum*			
993.	42741	*Lepidosperma apricola*			
994.	936	*Lepidosperma leptostachyum*			
995.	937	*Lepidosperma longitudinale (Pithy Sword-sedge)*			
996.	940	*Lepidosperma pubisquameum*			
997.	942	*Lepidosperma rostratum*		T	
998.	944	*Lepidosperma scabrum*			
999.		*Lepidosperma sp.*			
1000.	29150	*Lepidosperma sp. Margaret River (B.J. Lepschi 1841)*			
1001.	16284	*Lepidosperma sp. P1 small head (M.D. Tindale 166A)*			
1002.	949	*Lepidosperma tuberculatum*			
1003.	118	*Lepilaena australis (Austral Water Mat)*			
1004.	1653	*Leporella fimbriata (Hare Orchid)*			
1005.	1077	*Leptocarpus canus (Hoary Twine-rush)*			
1006.	1078	*Leptocarpus coangustatus*			
1007.	46375	*Leptocarpus decipiens*			
1008.	1080	*Leptocarpus scariosus*			
1009.	2342	*Leptomeria cunninghamii*			
1010.	5850	*Leptospermum laevigatum (Coast Teatree)*	Y		
1011.	19241	*Lepyrodia curvescens*		P2	
1012.	1085	*Lepyrodia glauca*			
1013.	1088	*Lepyrodia macra (Large Scale Rush)*			
1014.	1090	*Lepyrodia muirii*			
1015.	6367	*Leucopogon capitellatus*			
1016.	6374	*Leucopogon conostephioides*			

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1017.	6397	*Leucopogon glaucifolius*			
1018.	6427	*Leucopogon parviflorus (Coast Beard-heath)*			
1019.	6434	*Leucopogon polymorphus*			
1020.	6436	*Leucopogon propinquus*			
1021.	6439	*Leucopogon pulchellus (Beard-heath)*			
1022.	14637	*Leucopogon sp. Coujinup (M.A. Burgman 1085)*			
1023.	6444	*Leucopogon sprengelioides*			
1024.	6445	*Leucopogon squarrosus*			
1025.	40803	*Leucopogon squarrosus subsp. squarrosus*			
1026.	6447	*Leucopogon strictus*			
1027.	7676	*Levenhookia pusilla (Midget Stylewort)*			
1028.	7677	*Levenhookia stipitata (Common Stylewort)*			
1029.	4363	*Linum trigynum (French Flax)*	Y		
1030.	36160	*Liparophyllum capitatum*			
1031.	7406	*Lobelia rhombifolia (Tufted Lobelia)*			
1032.	7407	*Lobelia rhytidosperma (Wrinkled-seeded Lobelia)*			
1033.	475	*Lolium multiflorum (Italian Ryegrass)*	Y		
1034.	11073	*Lolium x hybridum*	Y		
1035.	1223	*Lomandra caespitosa (Tufted Mat Rush)*			
1036.	1228	*Lomandra hermaphrodita*			
1037.	1229	*Lomandra integra*			
1038.	1232	*Lomandra micrantha (Small-flower Mat-rush)*			
1039.	14542	*Lomandra micrantha subsp. micrantha*			
1040.	1234	*Lomandra nigricans*			
1041.	1236	*Lomandra odora (Tiered Matrush)*			
1042.	1239	*Lomandra preissii*			
1043.	1240	*Lomandra purpurea (Purple Mat Rush)*			
1044.	1243	*Lomandra sericea (Silky Mat Rush)*			
1045.	1245	*Lomandra spartea*			
1046.	1246	*Lomandra suaveolens*			
1047.	7365	*Lonicera japonica (Japanese Honeysuckle)*	Y		
1048.	8564	*Lotus subbiflorus*	Y		
1049.	4063	*Lotus uliginosus (Greater Lotus)*	Y		
1050.	4067	*Lupinus luteus (Yellow Lupin)*	Y		
1051.	1097	*Lyginia barbata*			
1052.	18049	*Lyginia imberbis*			
1053.	36375	*Lysimachia arvensis (Pimpernel)*	Y		
1054.	36373	*Lysimachia minima*	Y		
1055.	6456	*Lysinema ciliatum (Curry Flower)*			
1056.	34736	*Lysinema pentapetalum*			
1057.	5281	*Lythrum hyssopifolia (Lesser Loosestrife)*	Y		
1058.	2839	*Macarthuria australis*			
1059.	17106	*Macarthuria keigheryi*		T	
1060.	85	*Macrozamia riedlei (Zamia, Djiridji)*			
1061.	17636	*Marianthus coeruleopunctatus (Blue-spotted Marianthus)*			
1062.	4079	*Medicago polymorpha (Burr Medic)*	Y		
1063.	4080	*Medicago sativa (Alfalfa)*	Y		
1064.	33638	*Meionectes tenuifolia*		P3	
1065.	37580	*Melaleuca acutifolia*			
1066.	36296	*Melaleuca armillaris subsp. armillaris*	Y		
1067.	5881	*Melaleuca brevifolia*			
1068.	13273	*Melaleuca incana subsp. incana*			
1069.	5926	*Melaleuca lateritia (Robin Redbreast Bush)*			
1070.	5932	*Melaleuca leucadendra*			
1071.	20297	*Melaleuca osullivanii*			
1072.	18394	*Melaleuca parviceps*			
1073.	5958	*Melaleuca radula (Graceful Honeymyrtle)*			
1074.	5959	*Melaleuca rhaphiophylla (Swamp Paperbark)*			
1075.	5961	*Melaleuca scabra (Rough Honeymyrtle, Wurru Bush)*			
1076.	5983	*Melaleuca trichophylla*			
1077.	37683	*Melaleuca viminalis*		P2	
1078.	5987	*Melaleuca viminea (Mohan)*			
1079.	4516	*Melia azedarach (White Cedar)*			
1080.	14985	*Melinis repens*	Y		
1081.	953	*Mesomelaena graciliceps*			
1082.	955	*Mesomelaena pseudostygia*			
1083.	957	*Mesomelaena tetragona (Semaphore Sedge)*			
1084.	485	*Microlaena stipoides (Weeping Grass)*			
1085.	15419	*Microtis media subsp. media*			
1086.	8106	*Millotia tenuifolia (Soft Millotia)*			

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1087.	14344	*Millotia tenuifolia var. tenuifolia (Soft Millotia)*			
1088.	4097	*Mirbelia ramulosa*			
1089.	4100	*Mirbelia spinosa*			
1090.	7410	*Monopsis debilis*	Y		
1091.	37440	*Monopsis debilis var. depressa*	Y		
1092.	4662	*Monotaxis grandiflora (Diamond of the Desert)*			
1093.	19585	*Monotaxis grandiflora var. grandiflora*			
1094.	19179	*Moraea flaccida (One-leaf Cape Tulip)*	Y		
1095.	19178	*Moraea lewisiae*	Y		
1096.	19438	*Moraea ochroleuca*	Y		
1097.	14187	*Myriocephalus occidentalis*			
1098.	6189	*Myriophyllum crispatum*			
1099.	6193	*Myriophyllum echinatum*		P3	
1100.	44496	*Narcissus tazetta subsp. italicus*	Y		
1101.	492	*Neurachne alopecuroidea (Foxtail Mulga Grass)*			
1102.	1381	*Nothoscordum gracile*	Y		
1103.	2401	*Nuytsia floribunda (Christmas Tree, Mudja)*			
1104.	6138	*Oenothera drummondii (Beach Evening Primrose)*	Y		
1105.	20052	*Oenothera jamesii*	Y		
1106.	16347	*Oenothera laciniata*	Y		
1107.	6140	*Oenothera mollissima*	Y		
1108.	14292	*Oenothera stricta subsp. stricta*	Y		
1109.	2365	*Olax benthamiana*			
1110.	2367	*Olax scalariformis*			
1111.	8127	*Olearia axillaris (Coastal Daisybush)*			
1112.	8143	*Olearia paucidentata (Autumn Scrub Daisy)*			
1113.	18254	*Opercularia apiciflora*			
1114.	18255	*Opercularia vaginata (Dog Weed)*			
1115.	5227	*Opuntia stricta (Common Prickly Pear)*	Y		
1116.	46207	*Opuntia tomentosa*	Y		
1117.	36200	*Ornduffia submersa*		P4	
1118.	4113	*Ornithopus compressus (Yellow Serradella)*	Y		
1119.	7122	*Orobanche minor (Lesser Broomrape)*	Y		
1120.	11749	*Orthrosanthus laxus var. laxus (Morning Iris)*			
1121.	168	*Ottelia ovalifolia (Swamp Lily)*			
1122.	14531	*Ottelia ovalifolia subsp. ovalifolia*			
1123.	4348	*Oxalis caprina*	Y		
1124.	4349	*Oxalis corniculata (Yellow Wood Sorrel)*	Y		
1125.	4352	*Oxalis glabra*	Y		
1126.	4355	*Oxalis perennans*			
1127.	4356	*Oxalis pes-caprae (Soursob)*	Y		
1128.	4358	*Oxalis purpurea (Largeflower Wood Sorrel)*	Y		
1129.	20101	*Paragonis grandiflora*			
1130.	7089	*Parentucellia latifolia (Common Bartsia)*	Y		
1131.	7090	*Parentucellia viscosa (Sticky Bartsia)*	Y		
1132.	527	*Paspalum dilatatum*	Y		
1133.	528	*Paspalum distichum (Water Couch)*	Y		
1134.	5225	*Passiflora filamentosa*	Y		
1135.	1542	*Patersonia babianoides*			
1136.	1546	*Patersonia juncea (Rush Leaved Patersonia)*			
1137.	1550	*Patersonia occidentalis (Purple Flag, Koma)*			
1138.	1551	*Patersonia pygmaea (Pygmy Patersonia)*			
1139.	43765	*Pauridia glabella var. glabella*			
1140.	43761	*Pauridia occidentalis var. occidentalis*			
1141.	43762	*Pauridia occidentalis var. quadriloba*			
1142.	10828	*Pavonia hastata*	Y		
1143.	40424	*Pentameris airoides subsp. airoides*	Y		
1144.	40422	*Pentameris pallida*	Y		
1145.	6245	*Pentapeltis peltigera*			
1146.	16477	*Pericalymma ellipticum var. ellipticum*			
1147.	16478	*Pericalymma ellipticum var. floridum*			
1148.	13911	*Persicaria decipiens*			
1149.	2255	*Persoonia angustiflora*			
1150.	2262	*Persoonia elliptica (Spreading Snottygobble)*			
1151.	2273	*Persoonia saccata (Snottygobble)*			
1152.	2284	*Petrophile biloba (Granite Petrophile)*			
1153.	20391	*Petrophile juncifolia*			
1154.	2299	*Petrophile linearis (Pixie Mops)*			
1155.	2301	*Petrophile macrostachya*			
1156.	2308	*Petrophile seminuda*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1157.	2312	*Petrophile striata*			
1158.	19825	*Petrorhagia dubia*	Y		
1159.	547	*Phalaris angusta*	Y		
1160.	551	*Phalaris minor (Lesser Canary Grass)*	Y		
1161.	552	*Phalaris paradoxa (Paradoxa Grass)*	Y		
1162.	20460	*Pheladenia deformis*			
1163.	32409	*Philonotis australiensis*			
1164.	18529	*Philotheca spicata (Pepper and Salt)*			
1165.	1172	*Philydrella drummondii*			
1166.	1173	*Philydrella pygmaea (Butterfly Flowers)*			
1167.	14306	*Philydrella pygmaea subsp. pygmaea*			
1168.	1478	*Phlebocarya ciliata*			
1169.	1479	*Phlebocarya filifolia*			
1170.	16825	*Phyllangium divergens*			
1171.	4675	*Phyllanthus calycinus (False Boronia)*			
1172.	17794	*Phyllanthus tenellus*	Y		
1173.	4	*Phylloglossum drummondii (Pigmy Clubmoss)*			
1174.	6983	*Physalis peruviana (Cape Gooseberry)*	Y		
1175.	2408	*Pilostyles hamiltonii*			
1176.	78	*Pilularia novae-hollandiae (Austral Pillwort)*			
1177.	5231	*Pimelea angustifolia (Narrow-leaved Pimelea)*			
1178.	5238	*Pimelea ciliata (White Banjine)*			
1179.	11928	*Pimelea ciliata subsp. ciliata*			
1180.	11404	*Pimelea imbricata var. major*			
1181.	11402	*Pimelea imbricata var. piligera*			
1182.	5260	*Pimelea rara (Summer Pimelea)*		P4	
1183.	12041	*Pimelea suaveolens subsp. suaveolens*			
1184.	5268	*Pimelea sulphurea (Yellow Banjine)*			
1185.	8163	*Pithocarpa corymbulosa (Corymbose Pithocarpa)*		P3	
1186.	8165	*Pithocarpa pulchella (Beautiful Pithocarpa)*			
1187.	18352	*Pithocarpa pulchella var. melanostigma*			
1188.	7303	*Plantago lanceolata (Ribwort Plantain)*	Y		
1189.	6253	*Platysace filiformis*			
1190.	6255	*Platysace juncea*			
1191.	11132	*Platysace ramosissima*		P3	
1192.	32478	*Pleuridium nervosum var. nervosum*			
1193.	571	*Poa annua (Winter Grass)*	Y		
1194.	573	*Poa drummondiana (Knotted Poa)*			
1195.	8175	*Podolepis gracilis (Slender Podolepis)*			
1196.	8177	*Podolepis lessonii*			
1197.	8182	*Podotheca angustifolia (Sticky Longheads)*			
1198.	8183	*Podotheca chrysantha (Yellow Podotheca)*			
1199.	8188	*Pogonolepis stricta*			
1200.	8395	*Polygala myrtifolia (Myrtleleaf Milkwort)*	Y		
1201.	4578	*Polygala virgata*	Y		
1202.	2416	*Polygonum arenastrum (Sand Wireweed)*	Y		
1203.	2419	*Polygonum aviculare (Wireweed)*	Y		
1204.	582	*Polypogon monspeliensis (Annual Beardgrass)*	Y		
1205.	583	*Polypogon tenellus*			
1206.	4691	*Poranthera microphylla (Small Poranthera)*			
1207.	2884	*Portulaca oleracea (Purslane, Wakati)*			
1208.	1670	*Prasophyllum drummondii (Swamp Leek Orchid)*			
1209.	1672	*Prasophyllum fimbria (Fringed Leek Orchid)*			
1210.	1674	*Prasophyllum giganteum (Bronze Leek Orchid)*			
1211.	16688	*Prasophyllum gracile*			
1212.	1680	*Prasophyllum parvifolium (Autumn Leek Orchid)*			
1213.	10853	*Prasophyllum plumiforme*			
1214.	17211	*Prunus cerasifera*	Y		
1215.	4155	*Psoralea pinnata (African Scurfpea)*	Y		
1216.	13255	*Pterochaeta paniculata*			
1217.	1686	*Pterostylis barbata (Bird Orchid)*			
1218.	12217	*Pterostylis sanguinea*			
1219.	1698	*Pterostylis vittata (Banded Greenhood)*			
1220.	2716	*Ptilotus declinatus (Curved Mulla Mulla)*			
1221.	2720	*Ptilotus esquamatus*			
1222.	2742	*Ptilotus manglesii (Pom Poms, Mulamula)*			
1223.	2753	*Ptilotus pyramidatus*		T	Y
1224.	4172	*Pultenaea ericifolia*			
1225.	16367	*Pyrorchis nigricans (Red beaks, Elephants ears)*			
1226.	8195	*Quinetia urvillei*			

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1227.	13312	*Rhodanthe pyrethrum*			
1228.		*Riccia multifida*			
1229.	6020	*Rinzia crassifolia (Darling Range Rinzia)*			
1230.	17020	*Robinia pseudoacacia*	Y		
1231.	14485	*Romulea flava var. minor*	Y		
1232.	1556	*Romulea rosea (Guildford Grass)*	Y		
1233.	11151	*Rostraria pumila*	Y		
1234.	44608	*Rosulabryum billarderii*			
1235.	20506	*Rubus anglocandicans*	Y		
1236.	2432	*Rumex conglomeratus (Clustered Dock)*	Y		
1237.	40431	*Rytidosperma acerosum*			
1238.	40425	*Rytidosperma caespitosum*			
1239.	79	*Salvinia molesta (Salvinia)*	Y		
1240.	6483	*Samolus junceus*			
1241.	2356	*Santalum acuminatum (Quandong, Warnga)*			
1242.	7368	*Scabiosa atropurpurea (Purple Pincushion)*	Y		
1243.	7602	*Scaevola calliptera*			
1244.	7613	*Scaevola glandulifera (Viscid Hand-flower)*			
1245.	7619	*Scaevola lanceolata (Long-leaved Scaevola)*			
1246.	7635	*Scaevola pilosa (Hairy Fan-flower)*			
1247.	7636	*Scaevola platyphylla (Broad-leaved Fanflower)*			
1248.	13182	*Scaevola repens var. repens*			
1249.	32432	*Schizymenium bryoides*			
1250.	6263	*Schoenolaena juncea*			
1251.	971	*Schoenus andrewsii*			
1252.	974	*Schoenus benthamii*		P3	
1253.	975	*Schoenus bifidus*			
1254.	978	*Schoenus brevisetis*			
1255.	979	*Schoenus caespititius*			
1256.	980	*Schoenus capillifolius*		P3	
1257.	984	*Schoenus curvifolius*			
1258.	985	*Schoenus discifer*			
1259.	986	*Schoenus efoliatus*			
1260.	987	*Schoenus elegans*			
1261.	991	*Schoenus grammatophyllus*			
1262.	994	*Schoenus humilis*			
1263.	996	*Schoenus laevigatus*			
1264.	998	*Schoenus latitans*			
1265.	999	*Schoenus loliaceus*		P2	
1266.	1002	*Schoenus nanus (Tiny Bog Rush)*			
1267.	1003	*Schoenus natans (Floating Bog-rush)*		P4	
1268.	1006	*Schoenus odontocarpus*			
1269.	1007	*Schoenus pedicellatus*			
1270.	1008	*Schoenus pennisetis*		P3	
1271.	1009	*Schoenus pleiostemoneus*			
1272.	17614	*Schoenus plumosus*			
1273.	1011	*Schoenus rigens*			
1274.	1013	*Schoenus sculptus (Gimlet Bog-rush)*			
1275.	16280	*Schoenus sp. Beaufort (G.J. Keighery 6291)*		P1	
1276.	17731	*Schoenus sp. Waroona (G.J. Keighery 12235)*		P3	
1277.	1017	*Schoenus subbulbosus*			
1278.	1018	*Schoenus subfascicularis*			
1279.	1019	*Schoenus subflavus (Yellow Bog-rush)*			
1280.	1026	*Schoenus unispiculatus*			
1281.	17409	*Schoenus variicellae*			
1282.	6033	*Scholtzia involucrata (Spiked Scholtzia)*			
1283.	6	*Selaginella gracillima (Tiny Clubmoss)*			
1284.	32433	*Sematophyllum homomallum*			
1285.	8203	*Senecio diaschides*			
1286.	8212	*Senecio leucoglossus*		P4	
1287.	20663	*Senecio multicaulis subsp. multicaulis*			
1288.	609	*Setaria palmifolia (Palm Grass)*	Y		
1289.	19453	*Setaria parviflora*	Y		
1290.	2909	*Silene gallica (French Catchfly)*	Y		
1291.	8225	*Siloxerus humifusus (Procumbent Siloxerus)*			
1292.	14583	*Siloxerus multiflorus*			
1293.	8231	*Sonchus oleraceus (Common Sowthistle)*	Y		
1294.	617	*Sorghum halepense (Johnson Grass)*	Y		
1295.	1312	*Sowerbaea laxiflora (Purple Tassels)*			
1296.	1558	*Sparaxis bulbifera*	Y		

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1297.	4205	*Sphaerolobium linophyllum*			
1298.	4206	*Sphaerolobium macranthum*			
1299.	4207	*Sphaerolobium medium*			
1300.	635	*Sporobolus virginicus (Marine Couch)*			
1301.	4716	*Stachystemon vermicularis*			
1302.	4733	*Stackhousia monogyna*			
1303.	9070	*Stackhousia pubescens (Downy Stackhousia)*			
1304.	13475	*Stenanthemum humile*			
1305.	19403	*Stenopetalum gracile*			
1306.	2316	*Stirlingia latifolia (Blueboy)*			
1307.	2317	*Stirlingia simplex*			
1308.	18564	*Stylidium aceratum*		P3	
1309.	7681	*Stylidium affine (Queen Triggerplant)*			
1310.	7684	*Stylidium amoenum (Lovely Triggerplant)*			
1311.	30278	*Stylidium androsaceum*			
1312.	25831	*Stylidium araeophyllum (Stilt Walker)*			
1313.	7692	*Stylidium breviscapum (Boomerang Triggerplant)*			
1314.	7693	*Stylidium brunonianum (Pink Fountain Triggerplant)*			
1315.	7694	*Stylidium bulbiferum (Circus Triggerplant)*			
1316.	7696	*Stylidium calcaratum (Book Triggerplant)*			
1317.	7698	*Stylidium caricifolium (Milkmaids)*			
1318.	7702	*Stylidium ciliatum (Golden Triggerplant)*			
1319.	7712	*Stylidium despectum (Dwarf Triggerplant)*			
1320.	7713	*Stylidium dichotomum (Pins-and-needles)*			
1321.	7716	*Stylidium diuroides (Donkey Triggerplant)*			
1322.	7717	*Stylidium divaricatum (Daddy-long-legs)*			
1323.	7721	*Stylidium emarginatum (Biddy-four-legs)*			
1324.	19251	*Stylidium eriopodum*			
1325.	7734	*Stylidium guttatum (Dotted Triggerplant)*			
1326.	7736	*Stylidium hispidum (White Butterfly Triggerplant)*			
1327.	7742	*Stylidium inundatum (Hundreds and Thousands)*			
1328.	7745	*Stylidium junceum (Reed Triggerplant)*			
1329.	7756	*Stylidium longitubum (Jumping Jacks)*		P4	
1330.	7768	*Stylidium obtusatum (Pinafore Triggerplant)*			
1331.	7771	*Stylidium periscelianthum (Pantaloon Triggerplant)*		P3	
1332.	7772	*Stylidium perpusillum (Tiny Triggerplant)*			
1333.	7773	*Stylidium petiolare (Horn Triggerplant)*			
1334.	7774	*Stylidium piliferum (Common Butterfly Triggerplant)*			
1335.	7782	*Stylidium pulchellum (Thumbelina Triggerplant)*			
1336.	7783	*Stylidium pycnostachyum (Downy Triggerplant)*			
1337.	33106	*Stylidium recurvum*			
1338.	7785	*Stylidium repens (Matted Triggerplant)*			
1339.	7790	*Stylidium roseoalatum (Pink-wing Triggerplant)*			
1340.	25806	*Stylidium scariosum*			
1341.	7798	*Stylidium schoenoides (Cow Kicks)*			
1342.	7803	*Stylidium striatum (Fan-leaved Triggerplant)*		P4	
1343.	45594	*Stylidium tenue subsp. majusculum (Showy Fountain Triggerplant)*			
1344.	23511	*Stylidium thesioides (Delicate Triggerplant)*			
1345.	7806	*Stylidium utricularioides (Pink Fan Triggerplant)*			
1346.	40947	*Stylidium xanthellum*			
1347.	1260	*Stypandra glauca (Blind Grass)*			
1348.	48297	*Styphelia filifolia*		P3	
1349.	6476	*Styphelia tenuiflora (Common Pinheath)*			
1350.	2321	*Synaphea acutiloba (Granite Synaphea)*			
1351.	2323	*Synaphea gracillima*			
1352.	2324	*Synaphea petiolaris (Synaphea)*			
1353.	16864	*Synaphea petiolaris subsp. petiolaris*			
1354.	2325	*Synaphea pinnata (Helena Synaphea)*			
1355.	18590	*Synaphea sp. Fairbridge Farm (D. Papenfus 696)*		T	
1356.	2329	*Synaphea spinulosa*			
1357.	15532	*Synaphea spinulosa subsp. spinulosa*			
1358.	32438	*Syntrichia pagorum*			
1359.	20135	*Taxandria linearifolia*			
1360.	4251	*Templetonia drummondii*			
1361.	4256	*Templetonia retusa (Cockies Tongues)*			
1362.	32441	*Tetrapterum cylindricum*			
1363.	1034	*Tetraria capillaris (Hair Sedge)*			
1364.	1036	*Tetraria octandra*			
1365.	667	*Tetrarrhena laevis (Forest Ricegrass)*			
1366.	4535	*Tetratheca hirsuta (Black Eyed Susan)*			

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1367.	48342	*Tetratheca hirsuta subsp. hirsuta*			
1368.	4537	*Tetratheca nuda*			
1369.	4544	*Tetratheca setigera*			
1370.	1701	*Thelymitra antennifera (Vanilla Orchid)*			
1371.	10856	*Thelymitra benthamiana (Leopard Orchid)*			
1372.	1705	*Thelymitra crinita (Blue Lady Orchid)*			
1373.	1707	*Thelymitra flexuosa (Twisted Sun Orchid)*			
1374.	11053	*Thelymitra macrophylla*			
1375.	20729	*Thelymitra magnifica (Crystal Brook Star Orchid)*		P1	
1376.	1715	*Thelymitra spiralis (Curlylocks)*			
1377.	10862	*Thelymitra stellata (Star Orchid)*		T	
1378.	1718	*Thelymitra villosa (Custard Orchid)*			
1379.	20731	*Thelymitra vulgaris*			
1380.	673	*Themeda triandra*			
1381.	5080	*Thomasia foliosa*			
1382.	5084	*Thomasia grandiflora (Large Flowered Thomasia)*			
1383.	5087	*Thomasia macrocarpa (Large Fruited Thomasia)*			
1384.	1317	*Thysanotus anceps*		P3	
1385.	1318	*Thysanotus arbuscula*			
1386.	1319	*Thysanotus arenarius*			
1387.	1328	*Thysanotus dichotomus (Branching Fringe Lily)*			
1388.	1338	*Thysanotus manglesianus (Fringed Lily)*			
1389.	1339	*Thysanotus multiflorus (Many-flowered Fringe Lily)*			
1390.	1343	*Thysanotus patersonii*			
1391.	46055	*Thysanotus sp. Coastal plain (N.H. Brittan 66/63)*			
1392.	1351	*Thysanotus sparteus*			
1393.	1354	*Thysanotus tenellus*			
1394.	1357	*Thysanotus thyrsoideus*			
1395.	1358	*Thysanotus triandrus*			
1396.	8248	*Tolpis barbata (Yellow Hawkweed)*	Y		
1397.		*Tortula recurvata*			
1398.	6280	*Trachymene pilosa (Native Parsnip)*			
1399.	17684	*Tremulina tremula*			
1400.	11112	*Tribolium uniolae*	Y		
1401.	1481	*Tribonanthes australis*			
1402.	1482	*Tribonanthes brachypetala*			
1403.	1483	*Tribonanthes longipetala*			
1404.	1485	*Tribonanthes violacea*			
1405.	4383	*Tribulus terrestris (Caltrop)*	Y		
1406.	8251	*Trichocline spathulata (Native Gerbera)*			
1407.	1361	*Tricoryne elatior (Yellow Autumn Lily)*			
1408.	1362	*Tricoryne humilis*			
1409.	1363	*Tricoryne tenella*			
1410.	43207	*Tricostularia exsul*			
1411.	17145	*Trifolium angustifolium var. angustifolium*	Y		
1412.	4291	*Trifolium arvense (Hare's Foot Clover)*	Y		
1413.	17542	*Trifolium arvense var. arvense*	Y		
1414.	4292	*Trifolium campestre (Hop Clover)*	Y		
1415.	4295	*Trifolium dubium (Suckling Clover)*	Y		
1416.	4298	*Trifolium hirtum (Rose Clover)*	Y		
1417.	17788	*Trifolium pratense var. sativum*	Y		
1418.	15509	*Trifolium tomentosum var. tomentosum*	Y		
1419.	33676	*Triglochin calcitrapa*			
1420.	146	*Triglochin minutissima*			
1421.	147	*Triglochin mucronata*			
1422.	148	*Triglochin muelleri*			
1423.	18587	*Triglochin nana*			
1424.	150	*Triglochin stowardii*			
1425.	151	*Triglochin striata*			
1426.	4737	*Tripterococcus brunonis (Winged Stackhousia)*			
1427.	1139	*Trithuria bibracteata*			
1428.	1141	*Trithuria submersa*			
1429.	38401	*Tritonia gladiolaris (Lined Tritonia)*	Y		
1430.	13479	*Trymalium ledifolium var. rosmarinifolium*			
1431.	33418	*Trymalium odoratissimum subsp. odoratissimum*			
1432.	8255	*Ursinia anthemoides (Ursinia)*	Y		
1433.	38388	*Ursinia anthemoides subsp. anthemoides*	Y		
1434.	7138	*Utricularia inaequalis*			
1435.	7148	*Utricularia multifida*			
1436.	7153	*Utricularia tenella*			

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1437.	17868	*Vallisneria nana*			
1438.	7665	*Velleia trinervis*			
1439.	8257	*Vellereophyton dealbatum (White Cudweed)*	Y		
1440.	6070	*Verticordia acerosa*			
1441.	15431	*Verticordia acerosa var. acerosa*			
1442.	12388	*Verticordia acerosa var. preissii*			
1443.	6076	*Verticordia densiflora (Compacted Featherflower)*			
1444.	15432	*Verticordia densiflora var. densiflora*			
1445.	6088	*Verticordia huegelii (Variegated Featherflower)*			
1446.	15433	*Verticordia huegelii var. huegelii*			
1447.	15434	*Verticordia insignis subsp. insignis*			
1448.	14714	*Verticordia lindleyi subsp. lindleyi*		P4	
1449.	6107	*Verticordia pennigera*			
1450.	6110	*Verticordia plumosa (Plumed Featherflower)*			
1451.	12449	*Verticordia plumosa var. brachyphylla*			
1452.	15618	*Verticordia plumosa var. plumosa*			
1453.	4322	*Vicia sativa (Common Vetch)*	Y		
1454.	12070	*Vicia sativa subsp. sativa*	Y		
1455.	4325	*Viminaria juncea (Swishbush, Koweda)*			
1456.	6575	*Vinca major (Blue Periwinkle)*	Y		
1457.	17042	*Vitis vinifera*	Y		
1458.	722	*Vulpia bromoides (Squirrel Tail Fescue)*	Y		
1459.	11018	*Vulpia muralis*	Y		
1460.	724	*Vulpia myuros (Rat's Tail Fescue)*	Y		
1461.	7384	*Wahlenbergia capensis (Cape Bluebell)*	Y		
1462.	7389	*Wahlenbergia preissii*			
1463.	13103	*Watsonia borbonica*	Y		
1464.	1566	*Watsonia marginata*	Y		
1465.	18108	*Watsonia meriana var. bulbillifera*	Y		
1466.	18118	*Watsonia meriana var. meriana*	Y		
1467.	1569	*Watsonia versfeldii*	Y		
1468.	32456	*Weissia rutilans*			
1469.	12072	*Wurmbea dioica subsp. alba*			
1470.	1401	*Wurmbea pygmaea*			
1471.	1249	*Xanthorrhoea acanthostachya*			
1472.	1251	*Xanthorrhoea brunonis*			
1473.	14544	*Xanthorrhoea brunonis subsp. brunonis*			
1474.	1252	*Xanthorrhoea drummondii*			
1475.	1253	*Xanthorrhoea gracilis (Graceful Grass Tree, Mimidi)*			
1476.	1256	*Xanthorrhoea preissii (Grass tree, Palga)*			
1477.	6283	*Xanthosia atkinsoniana*			
1478.	6284	*Xanthosia candida*			
1479.	6289	*Xanthosia huegelii*			
1480.	44861	*Xerochrysum macranthum*			
1481.	2331	*Xylomelum occidentale (Woody Pear, Djandin)*			
Protozoa					
1482.	38969	*Arcyria minuta*			
1483.	38976	*Badhamia foliicola*			
1484.	39030	*Enerthenema papillatum*			
1485.	39097	*Trichia decipiens*			

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 wholely 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.

APPENDIX C

WIN Groundwater Bores

WIN Bore ID	Owner	Current Purpose	Status	Drill Date	Drill Depth (m below ground level)
61600006	No Current Owner	-	Unknown	01-01-1900 - Unknown	9.14
61600018	No Current Owner	-	Unknown	01-01-1900 - Unknown	9.75
61600163	No Current Owner	-	Unknown	01-01-1900 - Unknown	3.35
61600178	No Current Owner	-	Unknown	01-01-1900 - Unknown	2.74
61600179	No Current Owner	Garden Irrigation	Unknown	01-01-1900 - Unknown	4.57
61600180	No Current Owner	-	Unknown	01-01-1900 - Unknown	5.18
61600181	No Current Owner	Garden Irrigation	Unknown	01-01-1900 - Unknown	4.88
61600182	No Current Owner	Livestock; Garden Irrigation	Unknown	30-06-1958 - Known year	8.23
61600183	No Current Owner	Garden Irrigation; Livestock	Unknown	01-01-1900 - Unknown	24.38
61600184	No Current Owner	-	Unknown	01-01-1900 - Unknown	2.74
61601079	No Current Owner	Irrigation	Unknown	19-06-1998 - Known day	63.00
61607277	No Current Owner	-	Unknown	01-01-1900 - Unknown	10.67
61607278	No Current Owner	-	Unknown	30-06-1950 - Known year	31.09
61607279	No Current Owner	Domestic/Household	Unknown	30-06-1955 - Known year	34.14
61607280	No Current Owner	-	Unknown	30-06-1962 - Known year	40.23
61607281	No Current Owner	-	Unknown	30-06-1962 - Known year	31.09
61607344	No Current Owner	Garden Irrigation	Unknown	01-01-1900 - Unknown	8.84
61607345	No Current Owner	-	Unknown	01-01-1900 - Unknown	11.58
61607347	No Current Owner	Garden Irrigation	Unknown	01-01-1900 - Unknown	8.53
61607355	No Current Owner	-	Unknown	01-01-1900 - Unknown	12.50
61607356	No Current Owner	Garden Irrigation	Unknown	01-01-1900 - Unknown	13.72
61607357	No Current Owner	-	Unknown	01-01-1900 - Unknown	6.10
61607358	No Current Owner	Garden Irrigation	Unknown	01-01-1900 - Unknown	11.58
61607359	No Current Owner	-	Unknown	30-06-1961 - Known year	27.13

WIN Bore ID	Owner	Current Purpose	Status	Drill Date	Drill Depth (m below ground level)
61607360	No Current Owner	-	Unknown	30-06-1961 - Known year	22.25
61607361	No Current Owner	Domestic/Household; Garden Irrigation	Unknown	01-01-1900 - Unknown	25.91
61607362	No Current Owner	Domestic/Household; Garden Irrigation	Unknown	01-01-1900 - Unknown	-
61607363	No Current Owner	Livestock; Garden Irrigation	Unknown	30-06-1962 - Known year	33.83
61607364	No Current Owner	Garden Irrigation	Unknown	01-01-1900 - Unknown	36.58
61607365	No Current Owner	Garden Irrigation	Unknown	30-06-1962 - Known year	34.75
61607366	No Current Owner	Orchard	Unknown	30-06-1958 - Known year	33.53
61607367	No Current Owner	Garden Irrigation	Unknown	01-01-1900 - Unknown	36.58
61607385	No Current Owner	-	Unknown	01-01-1900 - Unknown	3.05
61607386	No Current Owner	-	Unknown	30-06-1970 - Known year	30.48
61607387	No Current Owner	Garden Irrigation	Unknown	01-01-1900 - Unknown	7.92
61607388	No Current Owner	Garden Irrigation	Unknown	30-06-1962 - Known year	13.41
61607389	No Current Owner	Orchard	Unknown	30-06-1971 - Known year	22.86
61607390	No Current Owner	Garden Irrigation	Unknown	30-06-1950 - Known year	6.10
61607391	No Current Owner	Garden Irrigation; Livestock	Unknown	01-01-1900 - Unknown	-
61607392	No Current Owner	Garden Irrigation	Unknown	01-01-1900 - Unknown	-
61607393	No Current Owner	Garden Irrigation	Unknown	01-01-1900 - Unknown	15.24
61607394	No Current Owner	-	Unknown	30-06-1962 - Known year	28.04
61607477	No Current Owner	-	Unknown	15-12-1977 - Known day	30.48
61607522	No Current Owner	Irrigation	Unknown	15-02-1978 - Known day	21.03
61607523	No Current Owner	-	Unknown	30-01-1979 - Known day	25.00
61607559	No Current Owner	-	Unknown	04-05-1989 - Known day	26.00
61607568	No Current Owner	Garden Irrigation	Unknown	01-01-1900 - Unknown	6.00
61607569	No Current Owner	Garden Irrigation	Unknown	30-06-1990 - Known year	24.38

WIN Bore ID	Owner	Current Purpose	Status	Drill Date	Drill Depth (m below ground level)
61615517	No Current Owner	-	Unknown	08-11-1991 - Known day	-
61615518	No Current Owner	-	Unknown	08-11-1991 - Known day	-
61671956	No Current Owner	-	Unknown	Unknown	-

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Appendix B AECOM (2020) Wattle Grove South Ecological Surveys Report.

AECOM Imagine it. Delivered.

City of Kalamunda
28-Feb-2020

Wattle Grove South Ecological Surveys



Wattle Grove South Ecological Surveys

Client: City of Kalamunda

ABN: 60 741 095 678

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Quality Information

Document Wattle Grove South Ecological Surveys

Ref 60527304

Date 28-Feb-2020

Prepared by Floora de Wit & Jared Leigh

Reviewed by Linda Kirchner

Revision History

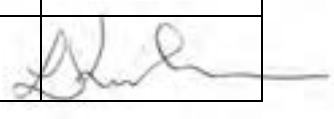
Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
A	24-Jan-2020	Draft for Internal Review	Linda Kirchner Associate Director - Environment	
B	24-Jan-2020	Draft for Client Review	Linda Kirchner Associate Director - Environment	
0	13-Feb-2020	Final Submission (Client Review)	Linda Kirchner Associate Director - Environment	
1	21-Feb-2020	Final Submission (additional Client comments)	Linda Kirchner Associate Director - Environment	
2	28-Feb-2020	Final Submission	Linda Kirchner Associate Director - Environment	

Table of Contents

Executive Summary i
1.0 Introduction 1
1.1 Background 1
1.2 Location 1
1.3 Objectives 1
2.0 Existing Environment 3
2.1 Climate 3
2.1 IBRA Regions 3
2.2 Vegetation 4
2.3 Environmentally Sensitive Areas and Conservation Estates 5
2.4 Wetlands 5
3.0 Legislative Framework 6
3.1 Overview 6
3.2 *Environment Protection and Biodiversity Conservation Act 1999* 7
3.2.1 Matters of National Environmental Significance 7
3.2.2 Flora and fauna 7
3.2.3 Vegetation Communities 7
3.3 Western Australian Legislation 8
3.3.1 Flora and Fauna 8
3.3.2 Vegetation Communities 9
3.3.3 Biosecurity and Agriculture Management Act 2007 10
3.3.4 *Environmental Protection Act 1986* (and Clearing Regulations) 11
4.0 Methodology 12
4.1 Desktop Assessment 12
4.2 Flora and Vegetation Assessment 13
4.2.1 Vegetation mapping 13
4.2.2 Floristic Community Type Analysis 14
4.2.3 Banksia Woodlands TEC Verification 14
4.3 Level 1 Fauna Survey 15
4.4 Targeted Black Cockatoo Survey 16
4.5 Environmental Values Assessment 20
4.6 Survey Limitations 21
5.0 Desktop Assessment Results 25
5.1 Threatened and Priority Ecological Communities 25
5.2 Conservation Significant Flora 29
5.3 Conservation Significant Fauna 32
6.0 Field Survey Results and Discussion 34
6.1 Vegetation 34
6.1.1 Floristic Community Type Analysis 34
6.1.2 Threatened and Priority Ecological Communities 35
6.1.3 Vegetation Communities 39
6.1.4 Vegetation Condition 52
6.2 Flora 62
6.2.1 Threatened and Priority Flora 62
6.2.2 Inventory of Flora Species 65
6.3 Fauna 65
6.3.2 Fauna Habitat 69
6.3.3 Fauna Habitat Linkages 69
6.4 Black Cockatoos 86
6.4.1 Ecology 86
6.4.2 Breeding 87
6.4.3 Roosting 87
6.4.4 Foraging habitat 88
6.5 Environmental Values Assessment 96
7.0 Conclusions 99
8.0 References 100

Appendix A
Desktop Results A

Appendix B
Banksia Woodlands of the SCP Assessment B

Appendix C
Flora Species by Family by Community Matrix C

Appendix D
Flora Quadrat Data D

Appendix E
Black Cockatoo Breeding Tree Data E

Appendix F
Black Cockatoo Foraging Habitat Assessments F

List of Figures

Figure 1 Wattle Grove South 2
Figure 2 Rainfall Data From Perth Airport Weather Station (9021) (BOM, 2019) 3
Figure 3 Survey Area 24
Figure 4 Desktop results for Communities and Flora 31
Figure 5 Threatened Ecological Communities 38
Figure 6 Dendrogram Showing Community Groups in Colours (pink = EmCaFa, blue = EmMpLp, green = EmPcAh, orange = BmXpEc, yellow = BaEpPf) 39
Figure 7 Vegetation Communities 43
Figure 8 Vegetation Condition 53
Figure 9 Threatened and Priority Flora 64
Figure 10 Fauna Habitats 77
Figure 11 Black Cockatoo breeding habitat trees 92
Figure 12 Carnaby's Cockatoo foraging habitat 93
Figure 13 Forest Red-tailed Black Cockatoo foraging habitat 94
Figure 14 Baudin's Cockatoo foraging habitat 95
Figure 15 Environmental values assessment 97

Executive Summary

AECOM Australia Pty Ltd (AECOM) was engaged by City of Kalamunda (the City) to conduct ecological assessments for the Wattle Grove South Project. The ecological assessments included a detailed flora and vegetation assessment, a level 1 fauna assessment and a Black Cockatoo assessment.

The desktop assessment was completed to identify the flora, fauna and communities of conservation significance that may occur in the Wattle Grove South area. The results identified 14 communities, 51 flora species and 26 fauna species of conservation significance that may occur in the survey area. The high number of communities and flora species reflects the unique landforms of the eastern Swan Coastal Plain including claypan wetlands, gravel substrates and influences from the Darling Scarp.

Field surveys commenced following stakeholder consultation (led by the City) to obtain permission to access private properties. Properties where access was granted were defined as the survey area within the Wattle Grove South area. The field surveys were conducted across six days and included all roadside/public access areas and 94 private properties. Most properties supported a mix of native and planted trees and landscaped gardens. These properties were represented by observation points and black cockatoo breeding and foraging assessments. Areas of native vegetation were traversed on foot and subject to detailed surveys including flora quadrats, targeted flora surveys, fauna habitat surveys and black cockatoo assessments.

Key outcomes of the ecological surveys are presented below:

- Banksia Woodlands of the Swan Coastal Plain (*Environment Protection and Biodiversity Conservation Act 1999* [EPBC Act] Endangered) was mapped in three patches extending across 2.41 ha within the survey area.
- Three WA Threatened Ecological Communities (TECs) and one WA Priority Ecological Community (PEC) were identified across 4.55 ha, including WA TEC *B. attenuata* over species rich dense shrublands (SCP20a); WA TEC *B. attenuata* and/or *E. marginata* woodlands of the Eastern SCP (SCP20b); WA TEC *Corymbia calophylla – Eucalyptus marginata* woodlands on sandy clay soils of the southern SCP (SCP3b); and WA PEC Banksia dominated woodlands of the SCP.
- *Conospermum undulatum* (EPBC Act Vulnerable, WA Vulnerable) was recorded on two properties comprising 95 individuals. *Isopogon drummondii* (WA P3) populations were recorded at the same two locations comprising 160 individuals.
- Three fauna species of conservation significance were recorded including the Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii* (EPBC Act and BC Act Vulnerable), Carnaby's Cockatoo *Calyptorhynchus latirostris* (EPBC Act and BC Act Endangered) and the Quenda *Isoodon fusciventer* (WA P4).
- A total of 730 breeding and potential breeding trees were recorded including 17 trees with one or more hollows considered suitable for breeding black cockatoos (27 hollows in total).
- Foraging habitat quality was mapped for Carnaby's Cockatoo, Baudin's Cockatoo *Calyptorhynchus baudinii* and the Forest Red-tailed Black Cockatoo. This included 41.14 ha of Very High and High Quality foraging habitat for Carnaby's Cockatoo and Baudin's Cockatoo, and 33.52 ha of Very High and High Quality foraging habitat for the Forest Red-tailed Black Cockatoo.

The ecological assessments were successfully completed for the Wattle Grove South Project. Obtaining access to all private properties was a significant limitation with 94 properties accessible from approximately 262 properties. It is likely that the other properties that were not surveyed have significant environmental value.

1.0 Introduction

1.1 Background

The Western Australian Planning Commission (WAPC) adopted the North-East Sub-Regional Planning Framework (the Framework) in March 2018. This plan identifies Wattle Grove South as Urban Expansion, with an eastern portion identified as Urban Investigation. The City of Kalamunda's (the City) 2010 Local Planning Strategy identified the whole area as an investigation area. The City is preparing Concept Plans for the area to investigate the most appropriate land use and development outcomes for the area. The Council may decide to proceed with further detailed planning in order to support the preferred development approach determined during concept planning.

In September 2017, the City appointed consultants to undertake the Wattle Grove South Feasibility Study. This study investigated the potential opportunities and constraints of Wattle Grove South, which outlined the key considerations for future planning and recommended appropriate future land uses. During this process the environmental desktop review identified a number of Threatened flora, fauna habitat and Environmentally Sensitive Areas (ESAs) within and/or adjacent to Wattle Grove South.

In order to finalise the concept plans and to support any future detailed planning, detailed information regarding the environmental values within the area is required. This will ensure that any conservation significant factors are accounted for and environmental assets are understood and managed appropriately. AECOM Australia Pty Ltd (AECOM) was engaged by the City to conduct ecological assessments for Wattle Grove South.

1.2 Location

Wattle Grove South is located within the south-eastern portion of the suburb Wattle Grove in Western Australia. It is bounded by Welshpool Road East (north), Tonkin Highway (west) and Kelvin Road, Judith Road, Fontano Road and the City's border with the City of Gosnells (east), shown in Figure 1. Wattle Grove South incorporates 340 ha of land comprising private and council land with 262 properties defined by cadastral boundaries.

1.3 Objectives

The objective of the ecological assessments was to define the environmental values within the survey area to inform Concept Plans and future detailed planning for Wattle Grove South. Specifically, the Project included:

- a desktop assessment to identify significant flora, vegetation and fauna that potentially occur in the area
- a detailed flora and vegetation assessment in accordance with relevant standards and technical guides, including targeted flora and vegetation community surveys
- a Level 1 fauna assessment in accordance with relevant standards and technical guides
- a targeted black cockatoo assessment.
- a Environmental Area Assessment

This technical report presents the methods, results and retention area assessment.

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PROJECT ID 60611889 CREATED BY KW APPROVED BY FDW LAST MODIFIED 24 JAN 2020 AECOM www.aecom.com	LEGEND Wattle Grove South Area Suburb Boundary	**Wattle Grove South Area**
N DATUM GDA 1994 MGA Zone 50 1:20,000 (when printed at A4) 0 100 200 300 400 Metres Data sources: Base Data: (c) Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010),Geoscience Australia, Streetpro		**CITY OF KALAMUNDA** *WATTLE GROVE SOUTH ECOLOGICAL SURVEYS* **Figure** 1

Map Document: \\AUPER1FP001\Projects\606X\60611889\900_CAD_GIS\920_GIS\02_MXDs\20200124_ReportFigures\G60611889_Fig1_WattleGroveSouthArea_A4P_v1.mxd (WyattK2)

A4 size

2.0 Existing Environment

2.1 Climate

The climate of the Perth Metropolitan Region is described as Warm Mediterranean (Mitchell et al 2002). A Mediterranean climate is characterised by warm to hot dry summers and mild to cool wet winters. The Mediterranean climate in Australia is a result of the Indian Ocean High, a high pressure cell that shifts towards the poles in summer and the equator in winter, playing a major role in the formation of the deserts of Western Australia, and the Mediterranean climate of southwest and south-central Australia. Precipitation occurs during winter months, with the possibility of some summer storms.

The closest meteorological station to the survey area with comprehensive data is Perth Airport (Station 009021), which is located 6 km northwest of the survey area. Perth Airport meteorological station is maintained by the Bureau of Meteorology (BoM) and commenced recording in 1944.

Perth Airport has experienced an average annual rainfall of 762 mm, with the majority of rainfall occurring between May and September. In the twelve months preceding the survey rainfall was below average for most months, except for June which was slightly above average (Figure 2). The months with the greatest decline (<40mm) include May, July and September with an overall reduction in annual rainfall. No significant evidence of this was noted in the field, however some orchid species and other ephemeral species may have been missing due to lower rainfall. Furthermore, an earlier start to the Spring season in 2019 may have influenced the presence of ephemeral species.

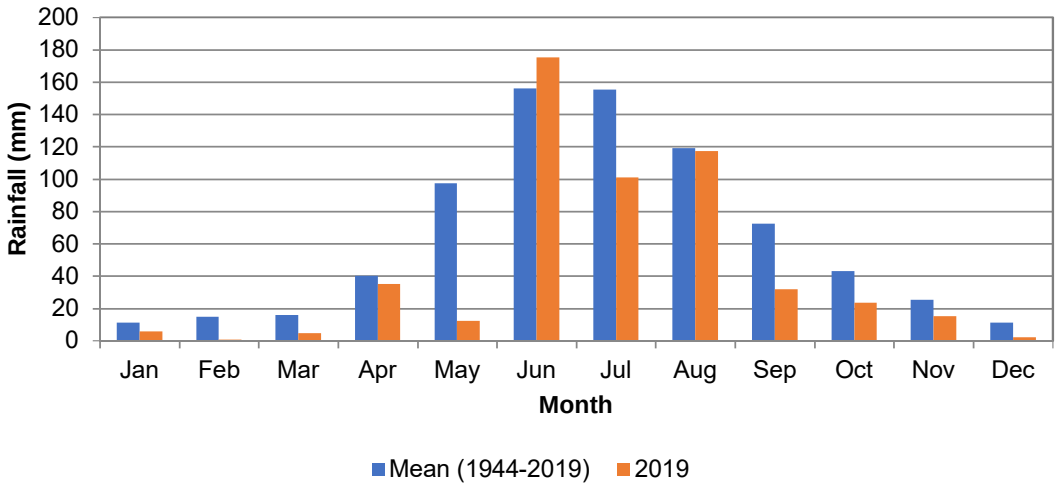


Figure 2 Rainfall Data From Perth Airport Weather Station (9021) (BOM, 2019)

2.1 IBRA Regions

The survey area is located on the Swan Coastal Plain bioregion described in CALM (2002), including Perth and the outer suburbs (excluding the Hills suburbs). The Swan Coastal Plain consists of the Dandaragan Plateau and the Perth Coastal Plain and is comprised of a narrow belt less than 30 km wide of Aeolian, alluvial and colluvial deposits of Holocene or Pleistocene age incorporating a complex series of seasonal fresh water wetlands, alluvial river flats, coastal limestone and several offshore islands. Younger sandy areas and limestone are dominated by heath and/or Tuart woodlands, while *Banksia* and *Jarrah-Banksia* woodlands are found on the older dune systems.

The Swan Coastal Plain subregion, described by Mitchell *et al.* (2002), is a low-lying coastal plain covered with woodlands dominated by *Banksia* or Tuart on sandy soils, *Casuarina obesa* on outwash plains, and paperbark in swampy areas. The area includes a complex series of seasonal wetlands and includes Rottnest, Carnac and Garden Islands. Land use is predominantly cultivation, conservation, urban and rural residential. The area contains a number of rare features including Holocene dunes and wetlands and a large number of threatened species and ecological communities.

2.2 Vegetation

There are three Beard (1981) vegetation associations mapped within the survey area comprising of Jarrah, Marri and/or Wandoo woodlands (Table 1). Of these Association 968 is below the applicable 10% threshold as set by EPA (2015).

Table 1 Pre-European vegetation associations of the survey area (Beard, 1979) and percent remaining (Govt. of WA, 2018)

Association	Description	Percent Remaining
3	Medium Jarrah and Marri forest	18.13
4	Medium woodland; Marri and Wandoo	18.89
968	Medium woodland; Jarrah, Marri and Wandoo	6.56

Heddle *et al.* (1980) completed vegetation complex mapping which used to assess the extent of pre-European vegetation. The survey area is situated on the border of three vegetation complexes, including the Forrestfield, Southern River, and Guildford complex. These complexes align with three major landforms, Foothills (Ridge Hill Shelf) in the east of the survey area, the Pinjarra Plain, and a combination of Bassendean Dunes and Pinjarra Plain. The Guildford Complex is currently below the 10% threshold. These three are described in Table 2.

Table 2 Vegetation complexes of the survey area (Heddle *et al.* 1980) and percent remaining in the Perth-Peel region (EPA, 2015)

Complex	Description	Percent Remaining
Forrestfield complex	Vegetation ranges from open forest of *Corymbia calophylla – Eucalyptus wandoo – E. marginata* to open forest of *E. marginata – C. calophylla – A. fraseriana – Banksia* spp. With fringing woodland of *E. rudis* in the gullies that dissect this landform	10.3
Southern River	Open woodland of Marri-Jarrah-banksia on the elevated areas and a fringing woodland of Eucalyptus rudis-Melaleuca rhaphiophylla along the streams.	16.8
Guildford complex	A mixture of open forest to tall open forest of *C. calophylla – E. wandoo – E. marginata* and woodland of *E. wandoo* (with rare occurrences of *E. lane-poolei*). Minor components include *E. rudis – M. rhaphiophylla*.	5.87

2.3 Environmentally Sensitive Areas and Conservation Estates

Environmentally Sensitive Areas (ESAs) are areas that have been identified for protection due to their environmental significance as outlined in the Western Australian Environmental Protection (Environmentally Sensitive Areas) Notice 2005, which was gazetted on 8 April 2005.

Exceptions offered for clearing under Regulation 5 of the Environmental Protection (Clearing of Native Vegetation) Regulations 2004 do not apply within ESAs. ESAs are gazetted due to supporting environmental values of State or Commonwealth importance and, in this situation, include:

- Declared World Heritage properties (EPBC Act)
- areas included on the Register of the National Estate
- defined wetlands and associated buffers
- vegetation within 50 m of rare flora
- TECs.

Several ESAs occur within Wattle Grove South. One of these represents a TEC listed under the EPBC Act which is also captured in Bush Forever site 51. This bush block is located outside the survey area. The others are likely to represent locations (current and old) of Threatened flora populations and TECs. There are no Bush Forever sites within Wattle Grove South and no conservation estates within or directly adjacent to the survey area.

2.4 Wetlands

The locations of wetlands have been determined using the Geomorphic Wetlands of the Swan Coastal Plain dataset adapted from *Hill et al* (1996). The dataset displays the location, boundary, geomorphic classification (wetland type) and management category of wetlands of the Swan Coastal Plain.

Two unnamed resource enhancement wetlands are located within the survey area including sumpland UFI 8037 and palusplain UFI 15257. Both wetlands have been almost entirely or entirely cleared.

3.0 Legislative Framework

3.1 Overview

Table 3 summarises the key legislation governing the protection and management of Western Australia's conservation significant species and communities, which are further discussed below.

Table 3 Relevant legislation, regulations and guidance

Legislation	Purpose
Commonwealth of Australia	
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	Provides for the protection of the environment and the conservation of biodiversity.
EPBC Act Referral Guidelines for Three Threatened Black Cockatoo Species.	To assist in determining whether an action needs to be referred to the Australian Government. Also provides guidance on black cockatoo survey methodology.
EPBC Act Draft Referral Guidelines, 2017	These draft guidelines are intended to assist proponents in determining whether an action needs to be referred to the Australian Government. Definitions of habitat are provided as are criteria used to judge significant impact for these black cockatoo species.
Western Australia	
Biodiversity Conservation Act 2016 (BC Act)	Provides for the conservation and protection of Western Australia's biodiversity and biodiversity components.
Environmental Protection Act 1986 (EP Act)	Preventing, controlling and abating environmental harm and conserving, preserving, protecting, enhancing and managing the environment.
Biosecurity and Agriculture Management Act 2007 (BAM Act)	Provides for the management, control and prevention of certain plants and animals, and for the protection of agriculture and related resources generally.
EPA Technical Guidance – Terrestrial Fauna Surveys, 2016	Provides guidance on the standard of survey required to assist in collecting the appropriate data for decision-making associated with the protection of Western Australia's terrestrial fauna.
EPA Technical Guidance – flora and vegetation Surveys for Environmental Impact Assessment, 2016	Provides guidance to ensure adequate flora and vegetation data of an appropriate standard are obtained and used in EIA.

3.2 *Environment Protection and Biodiversity Conservation Act 1999*

3.2.1 Matters of National Environmental Significance

Matters of national environmental significance include:

- listed threatened species and ecological communities
- migratory species protected under international agreements
- Ramsar wetlands of international importance
- the Commonwealth marine environment
- world Heritage properties
- national Heritage places
- Great Barrier Reef Marine Park
- a water resource, in relation to coal seam gas development and large coal mining development
- nuclear actions.

If an action is likely to have a significant impact on a MNES this action must be referred to the Minister for the Environment for a decision on whether assessment and approval is required under the EPBC Act.

3.2.2 Flora and fauna

The EPBC Act is the main piece of Federal legislation protecting biodiversity in Australia. Species at risk of extinction are recognised at a Commonwealth level and are categorised in one of six categories as outlined in Table 4, with an additional category for other specially protected fauna.

Table 4 Categories of species listed under Schedule 179 of the EPBC Act

Code	Conservation Category
Ex	Extinct Taxa
ExW	Extinct in the Wild
CE	Critically Endangered
E	Endangered
V	Vulnerable
CD	Conservation Dependent
OS	Other specially protected fauna

3.2.3 Vegetation Communities

Communities can be classified as Threatened Ecological Communities (TECs) under the EPBC Act. The EPBC Act protects Australia's ecological communities by providing for:

- identification and listing of ecological communities as threatened
- development of conservation advice and recovery plans for listed ecological communities
- recognition of key threatening processes
- reduction of the impact of these processes through threat abatement plans.

Categories of federally listed TECs are described in Table 5.

Table 5 Categories of TECs that are listed under the EPBC Act

Code	Conservation Category
CE	Critically Endangered If, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future.
E	Endangered If, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future.
V	Vulnerable If, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future.

3.3 Western Australian Legislation

3.3.1 Flora and Fauna

Threatened flora are plants which have been assessed as being at risk of extinction (DPaW, 2019). Under the BC Act, the Minister for the Environment may declare species of flora to be protected if they are considered to be in danger of extinction, rare or otherwise in need of special protection (WAH, 1998).

Plants and animals that are considered Threatened and need to be specially protected because they are under identifiable threat of extinction are listed under the BC Act. These categories are defined in Table 6.

Table 6 Conservation codes for flora and fauna listed under the *Biodiversity Conservation Act 2016* (Jan 2019)

Code	Conservation Category
CR	**Critically Endangered Species** Threatened species considered to be facing an extremely high risk of extinction in the wild in the immediate future.
EN	**Endangered Species** Threatened species considered to be facing a very high risk of extinction in the wild in the near future.
VU	**Vulnerable Species** Threatened species considered to be facing a high risk of extinction in the wild in the medium-term future.
EX	**Extinct Species** Species where there is no reasonable doubt that the last member of species has died.
MI	**Migratory species** Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth. Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the *Convention on the Conservation of Migratory Species of Wild Animals* (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals, that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species.
CD	**Species of special conservation interest (conservation dependent fauna)** Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened.
OS	**Other specially protected species** Fauna otherwise in need of special protection to ensure their conservation.

Species that have not yet been adequately surveyed to warrant being listed under the BC Act, or are otherwise data deficient, are added to a Priority Lists under Priorities 1, 2 or 3 by the State Minister for Environment. Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. Categories and definitions of Priority Flora and Fauna species are provided in Table 7.

Table 7 Conservation codes for WA flora and fauna listed by DBCA and endorsed by the Minister for Environment

Code	Conservation Category
P1	**Priority One – Poorly Known Species** Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.
P2	**Priority Two – Poorly Known Species** Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.
P3	**Priority Three – Poorly Known Species** Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.
P4	**Priority Four – Rare, Near Threatened and other species in need of monitoring** a. Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands. b. Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent. Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

3.3.2 Vegetation Communities

Threatened Ecological Communities (TECs) are naturally occurring biological assemblages that occur in a particular type of habitat and that may be subject to processes that threaten to destroy or significantly modify the assemblage across its range. TECs are listed by both state and commonwealth legislation.

Vegetation communities in Western Australia are described as TECs if they have been endorsed by the Western Australian Minister for Environment following recommendations made by the Threatened Species Scientific Committee. Categories of TECs are defined in Table 8.

Department of Biodiversity, Conservation and Attractions (DBCA) maintains a database of state listed TECs which is available for online searches via their website. Possible TECs that do not meet survey criteria or are not adequately defined are listed as Priority Ecological Communities (PECs) under Priorities 1, 2 and 3. Ecological communities that are adequately known and are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. Conservation dependent communities are classified as Priority 5. PECs are endorsed by the Minister for Environment and are described in Table 9.

DBCA requires that all Priority and Threatened ecological communities are considered during environmental impact assessments and clearing permit applications.

There is currently no formal protection afforded to TECs or PECs listed at the state level.

Table 8 Conservation codes for State listed ecological communities

Conservation Code	Category
PD	Presumed Totally Destroyed
CR	Critically Endangered
EN	Endangered
VU	Vulnerable

Table 9 Conservation categories for Priority Ecological Communities

Code	Conservation Category
P1	Priority One: poorly-known ecological communities
P2	Priority Two: poorly-known ecological communities
P3	Priority Three: poorly known ecological communities
P4	Priority Four: ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list.
P5	Priority Five: conservation dependent ecological communities

3.3.3 Biosecurity and Agriculture Management Act 2007

Biosecurity is the management of the risk of animal and plant pests and diseases entering, emerging, establishing or spreading in WA to protect the economy, environment and community. Biosecurity is managed under the BAM Act which came into effect 1 May 2013. Exotic animals and plants can become an invasive species if they can establish in new areas where local conditions are favourable for their growth. Each organism listed under the BAM Act comes with certain legal / import requirements:

- Declared Pest, Prohibited - s12. Prohibited organisms are declared pests by virtue of section 22(1), and may only be imported and kept subject to permits.
- Permitted - s11. Permitted organisms may be subject to an import permit if they are potential carriers of high-risk organisms.
- Declared Pest - s22(2). Declared pests may be subject to an import permit if they are potential carriers of high-risk organisms, and may also be subject to control and keeping requirements once within Western Australia.
- Permitted, Requires Permit - r73. Regulation 73 permitted organisms may only be imported subject to an import permit.

Declared pests can be assigned to a C1, C2 or C3 control category under the Biosecurity and Agriculture Management Regulations 2013:

- C1 Exclusion - Organisms which should be excluded from part or all of Western Australia.
- C2 Eradication - Organisms which should be eradicated from part or all of Western Australia.
- C3 Management - Organisms that should have some form of management applied that will alleviate the harmful impact of the organism, reduce the numbers or distribution of the organism or prevent or contain the spread of the organism.
- Unassigned - Declared pests that are recognised as having a harmful impact under certain circumstances, where their subsequent control requirements are determined by a Plan or other legislative arrangements under the BAM Act.

3.3.4 *Environmental Protection Act 1986* (and Clearing Regulations)

Section 38 (Part IV) of the EP Act provides that any person may refer a significant proposal (one that is likely to have a significant effect on the environment) to the EPA. The EP Act also states that where the environmental impact of a proposal can be adequately assessed and managed through other legislative mechanisms the proposal is unlikely to require formal environmental impact assessment.

If a proposal is not formally assessed by the EPA under Part IV of the EP Act, a Part V native Vegetation Clearing Permit may be required. Under Section 51C of the EP Act, clearing of native vegetation without a Native Vegetation Clearing Permit is an offence unless an exemption applies. Exemptions offered for clearing under Regulation 5 of the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* do not apply within Environmentally Sensitive Areas (ESA).

4.0 Methodology

4.1 Desktop Assessment

The desktop assessment involved gathering background information for the local area. Desktop database searches were requested from the following government databases (including a 10 km buffer from the survey area boundary):

- Department of Biodiversity Conservation and Attractions (DBCA) threatened and priority flora, fauna and communities database
- WA Herbarium (WAH) records
- Atlas of Living Australia (AoLA)
- NatureMap
- EPBC Act Protected Matters search.

All flora, fauna and communities of conservation significance identified in the desktop assessment were assessed for their likelihood of occurrence within the survey area (Table 10). Available literature was consulted to describe the existing environment and define broad vegetation types. References included Beard (1981) vegetation mapping, the Biodiversity Audit of Western Australia (CALM 2002), and Heddle *et al.* (1980) vegetation complex mapping.

Table 10 Categories of likelihood of occurrence for species and communities

Likelihood	Flora	Fauna	Communities
Likely to occur	Habitat is present in the Survey area and the species has been recorded in close proximity to the survey area.	Survey area is within the known distribution of the species, habitat is present in the survey area and the species has been recorded in close proximity to the survey area.	Known occurrences of the community in close proximity to the survey area. Vegetation looks the same within the known occurrence and Survey area based on aerial imagery. Geographic location is similar to the survey area.
May occur	Habitat may be present and/or the species has been recorded in close proximity to the survey area.	Survey area is within the known distribution of the species, marginal habitat may be present and/or the species has been recorded in close proximity to the survey area.	Known occurrence of the community in the local area, and/or vegetation looks the same within known occurrence and Survey area based on aerial imagery. Geographic location is similar to the survey area.
Unlikely to occur	No suitable habitat is present and the species has not been recorded in close proximity to the survey area.	Survey area is outside the known distribution for the species, or no suitable habitat is present and the species has not been recorded in close proximity to the survey area.	Known occurrence of the community in close proximity to the survey area however geographic location does not occur in survey area.

4.2 Flora and Vegetation Assessment

A detailed flora and vegetation survey was undertaken by Floora de Wit (collection permit FB62000137). Floora de Wit has 13 years' experience undertaking flora and vegetation assessments on the Swan Coastal Plain. Floora completed a Bachelor of Science in Environmental Biology (Environmental Restoration) and completed a Postgraduate Diploma in Environmental Management and Impact Assessment.

A field survey was undertaken on 1 to 4, 8, 18 and 21 October 2019 and included all properties where access was allowed (see Figure 3). Floristic data was collected from 12 non-permanent quadrats and 8 relevés. Quadrats were used in native vegetation in Good or better condition while degraded patches were recorded as relevés.

Quadrats were 10x10 metres (m) defined by a measuring tape. Data collected from quadrats included the presence of plant species, their cover abundance, structural composition of vegetation, physical environment, and presence/absence of disturbance. Each Site was given a unique site number, and the following parameters recorded:

- date
- location using hand-held GPS (accuracy of 5 m)
- sample site type (quadrat/relevé and size)
- photograph (northwest corner)
- soil details (type, colour, moisture)
- landform
- vegetation condition using the Keighery (1994) scale and description of disturbance
- fire history
- comprehensive species list
- estimated height
- estimated percentage cover (for trees both percentage within quadrat and within community was recorded to enable better description of vegetation community).

Any species unable to be identified in the field were collected for identification in AECOM's in-house herbarium and the specimens and taxonomic references and keys at the Western Australian Herbarium (WAH). Naming of species followed the convention of the WAH.

4.2.1 Vegetation mapping

Vegetation communities were described and mapped based on changes in dominant species composition and landform. Quadrat data was analysed using cluster analysis to determine their floristic similarity and support vegetation community delineation. Vegetation community descriptions were based on the National Vegetation Information System (NVIS) framework (Commonwealth of Australia, 2003).

Vegetation condition was determined using the Keighery (1994) condition scale (Table 11). The scale is based on disturbance (e.g. grazing, erosion), degree of alteration to community and habitat structure and site ecology.

Table 11 Bushland condition ratings (Keighery, 1994)

Descriptor	Explanation
Pristine	Pristine or nearly so, no obvious signs of disturbance
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 of vegetation structure caused by very 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

4.2.2 Floristic Community Type Analysis

The Keighery (2012) SCP dataset was used for the FCT analysis. The survey data was reconciled with this dataset and all species coded using the three first letters of the genus and species, reducing infra-specific names. All nomenclature of species followed the WA Plant Census.

The program PC Ord was used to undertake the Bray Curtis distance measure. The Bray Curtis dissimilarity measure was used to quantify the compositional dissimilarity between the quadrats based on presence absence data. Subtracting the results from 1 gives the similarity index, also known as the Bray Curtis index. This method is easily interpretable and provides meaningful results. A sense check was completed incorporating appropriate geology, soils, landscape and the description provided in the Gibson *et al.* (1994) reference material and Bush Forever (Government of WA, 2000).

4.2.3 Banksia Woodlands TEC Verification

All patches of native vegetation were assessed to determine the presence of the Banksia Woodlands TEC. Patches are defined as a discreet and mostly continuous area of the ecological community. All native vegetation in Good or better condition were considered for an assessment against the key diagnostic criteria for the TEC.

A preliminary review of Banksia species present was undertaken. Patches that were clearly not associated with Banksia Woodlands, e.g. had no Banksia overstorey species were excluded for further consideration. This is in line with the Approved Conservation Advice key diagnostic criteria which defines the requirement of at least one of the following Banksia species: *B. attenuata, B. menziesii B. prionotes* or *B. ilicifolia*. Their omission was further supported by a review of vegetation condition and FCT analysis results.

The native vegetation has been separated into five patches:

- Patch 1 = quadrats 4 and 6
- Patch 2 = quadrats 12 and 13
- Patch 3 = quadrats 18 and 19
- Patch 4 = relevé 08 and quadrat 09
- Patch 5 = relevé 14.

For each patch the key diagnostic characteristics, condition, size and relevant contextual information was considered. The key diagnostic characteristics summarise the main features that characterise the Banksia Woodland. The condition categories are applied to identify the varying quality of patches, usually as a result of degradation, and ensure that patches of high quality are considered a Matter of National Significance (MNES). The condition of the patch was informed by species richness of quadrat data compared to available datasets, most notably the Keighery *et al.* (2012) SCP dataset and weed cover. The condition of the patch and size thresholds are then used to determine whether the quality of the patch is suitable to meet MNES standards.

4.3 Level 1 Fauna Survey

A Level 1 fauna survey was conducted in accordance with Technical Guidance – Terrestrial Fauna Surveys (EPA, 2016b) and Technical Guidance – Sampling Methods for Terrestrial Vertebrate Fauna (EPA, 2016c). The fauna survey was conducted by Ecologist Jared Leigh, in conjunction with the detailed flora and vegetation survey. Conducting the two surveys concurrently enabled consistent and clear mapping of the fauna habitats and vegetation communities.

The Level 1 fauna survey primarily focused on mapping of fauna habitat and assessing this habitat for potential utilisation by conservation significant fauna species. Fauna habitats were assessed for specific habitat components, including consideration of structural diversity and refuge opportunities for fauna. The fauna habitat assessments included:

- Location
- General habitat description
- Habitat condition and disturbance types
- Dominant / characteristic flora species and vegetation layers
- Presence and abundance of:
    - large mature trees
    - small and large hollows
    - varying sizes of fallen logs
    - course and fine litter
    - decorticating bark
    - bare ground
    - grass
    - varying sizes of stones and boulders
    - rock crevices
    - soil cracks
    - cryptogramic crust
    - vines
    - dense shrubs
    - water bodies etc.
- Presence of fauna and secondary signs (e.g. scats, digging, tracks, burrows, egg shell, bones, feathers etc.)
- Connectivity of habitat.

In addition to the habitat mapping, records of all observed fauna and birds identified from distinctive calls, details of indirect evidence such as scats, tracks and diggings were documented. Particular attention was given to searching for conservation significant species identified in the desktop assessment as having the potential to occur in the area. All observations were made between daylight hours of 0700 and 1700.

The taxonomy and nomenclature of all vertebrate species is consistent with the Western Australian Museum's (2019) Checklist of Vertebrates of Western Australia.

4.4 Targeted Black Cockatoo Survey

A targeted black cockatoo survey was conducted in conjunction with the Level 1 fauna survey and detailed flora and vegetation survey by Ecologists Jared Leigh and Cassandra House, and Botanist Floora de Wit. This survey was conducted over multiple mobilisations due to site accessibility, including 9 and 10 September 2019; 1 to 4, 8 October 2019; 18 and 21 November.

The targeted black cockatoo survey was conducted to identify potential breeding, roosting and foraging habitat for the three threatened black cockatoo species that occur in WA, as all three species have the potential to utilise the habitats of the survey area. These are Carnaby's Cockatoo *Calyptorhynchus latirostris* (Endangered under the EPBC Act and under the BC Act), Baudin's Cockatoo *Calyptorhynchus baudinii* (Endangered under the EPBC Act and under the BC Act) and the Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso* (Vulnerable under the EPBC Act and under the BC Act). Refer to Section 5.2.2 for further information on these species. The survey was undertaken in accordance with the DSEWPaC (2012), also utilising the draft DotEE (2017) Referral Guidelines.

4.4.1.1 Breeding Habitat

The black cockatoo breeding habitat assessment focussed on quantifying breeding and potential breeding trees within the survey area. "Potential breeding trees" are generally considered to be hollow-forming eucalypt trees with a Diameter at Breast Height (DBH) >500 mm with "breeding trees" containing potentially suitable hollows. Details collected for each tree included:

- location
- tree species
- DBH
- number of potentially suitable hollows.
- hollow details – including dimensions, height from ground, direction, type of hollow, evidence of use etc.

4.4.1.2 Roosting Habitat

Carnaby's and Baudin's Cockatoos roost in or near riparian environments or near other permanent water sources, generally within any tall trees, but particularly Flat-topped Yate, Salmon Gum, Wandoo, Marri, Karri, Blackbutt, Tuart, introduced eucalypts and introduced pines. The Forest Red-tailed Black Cockatoo prefers the edges of forests for roosting, within any tall trees, but particularly tall Jarrah, Marri, Blackbutt, Tuart and introduced eucalypt trees (DotEE, 2017). Potential roosting trees were searched for and assessed during the field survey.

4.4.1.3 Foraging Habitat

The quality of foraging habitat not only reflects the availability of food sources, but also the proximity to reliable water sources, connectivity to other suitable habitat, presence of breeding habita, and proximity to confirmed roost and breeding sites (amongst others). These parameters were utilised by the DotEE (2017) to produce a draft quality of foraging habitat scoring system (Table 13). This scoring system was amended slightly to incorporate additional habitats and utilised to assess potential foraging habitat throughout the survey area.

The scoring tool is used by initially defining the quality of the overall habitat present (i.e. Very High Quality, High Quality, Quality and Low Quality) and then adding or subtracting points from this depending on the ecological values of the habitat (i.e. proximity to water, proximity to a known roost site, evidence of foraging material etc.). This determines an overall quantitative rating. These scores were then used as representative scores for that unit.

Table 12 defines the levels of foraging habitat quality used during the assessment.

Table 12 Black cockatoo foraging assessment scoring

Score	Foraging Quality
1 – 3	Low Quality
4 – 6	Quality
7 – 8	High Quality
>8	Very High Quality

Table 13 Foraging habitat quality scoring tool for the three Western Australian black Cockatoo species

	Carnaby's Cockatoo	Baudin's Cockatoo	Forest Red-tailed Black Cockatoo
10	Foraging habitat that is being managed for black cockatoos, including successful rehabilitation and/or has some level of protection from clearing.	Foraging habitat that is being managed for black cockatoos, including successful rehabilitation and/or has some level of protection from clearing.	Foraging habitat that is being managed for black cockatoos, including successful rehabilitation and/or has some level of protection from clearing.
7	Native shrubland, kwongan heathland and woodland dominated by proteaceous plant species such as *Banksia* species (including *Dryandra* species) *Hakea* species and *Grevillea* species as well as eucalypt woodland and forest that contains foraging species. Does not include orchards, canola, or areas under RFA	Eucalyptus woodlands and forest of suitable foraging species and proteaceous woodland and heath, particularly Marri. Does not include orchards or areas under RFA	Jarrah and Marri woodlands and forest, and edges of Karri forests, including Wandoo and Blackbutt, within the range of the subspecies. Does not include areas under RFA.
5	Pine plantation, introduced eucalypts and areas of native vegetation that are not dominated by foraging species but contain more than the occasional plant	Pine plantation, introduced eucalypts and areas of native vegetation that are not dominated by foraging species but contain more than the occasional plant	Introduced eucalypts as well as the introduced Cape lilac (*Melia acedarach*), an areas of native vegetation that are not dominated by foraging species but contain more than the occasional plant
1	Individual foraging plants or small stand of foraging plants (≤2 ha)	Individual foraging plants or small stand of foraging plants (≤2 ha)	Individual foraging plants or small stand of foraging plants (≤2 ha)
Additions: Context adjustor – attributes improving habitat quality			
+3	Is within the Swan Coastal Plain	Is within known foraging area	Jarrah and/or Marri shows good recruitment
+3	Contains trees with suitable nest hollows		
+2	Primarily comprises Marri	Primarily contains Marri	Primarily contains Marri and/or Jarrah
+2	Contains trees with potential to be used for breeding (DBH ≥500 mm or ≥300 mm for Salmon Gum and Wandoo)		
+1	Is used for roosting		

	Carnaby's Cockatoo	Baudin's Cockatoo	Forest Red-tailed Black Cockatoo
Subtractions: Context adjustor – attributes reducing habitat quality			
-2	No clear evidence of foraging debris		
-2	No other foraging habitat within 6 km		
-1	Is >12 km from known breeding location		
-1	Is >12 km from known roosting location		
-1	Is >2 km from watering point		
-1	Disease present (e.g. *Phytophthora cinnamomi* or Marri canker)		

Notes: Scoring tool sourced from DotEE (2017) and amended slightly by AECOM

4.5 Environmental Values Assessment

The Environmental Values Assessment (EVA) included consideration of the Ecology survey outcomes and the inclusion of areas outside the ecology survey boundary for which a series of assumptions were made. The three categories used for the EVA are defined in Table 14.

Table 14 Categories for the environmental values assessment

Category	Values
High	• Good connectivity and/or suitable size for maintaining ecological integrity • BC foraging and/or breeding trees • All populations of *C. undulatum* that were recorded during the survey • Incorporates all TECs with the exception of two patches that are <0.2 ha which are captured as Medium • Includes 90% of areas mapped as "native vegetation" with exception of areas <0.2 ha with poor connectivity.
Medium	• Connects high value areas to adjacent high value areas or as 'stepping stone' • Includes BC foraging and/or breeding • May include native vegetation (understorey) species
Low	• Mostly cleared open areas or stands of trees over grassland • Includes planted gardens and hardscape

A significant limitation of the assessment is the proportion of areas not able to be assessed during the field survey. Assumptions for these areas were made based on aerial imagery and some on-ground observations. It is possible that areas not surveyed include 'high' value areas that were not captured in the EVA.

4.6 Survey Limitations

Limitations of the Flora and Vegetation, Level 1 fauna and targeted black cockatoo surveys are discussed in Table 15.

Wattle Grove South includes 262 private properties. Of these, 94 landowners granted access permission to facilitate the field surveys. The ecological surveys are therefore restricted to public access areas and these 94 properties.

Table 15 Limitations of the Ecological Surveys

Limitation	Flora and Vegetation Survey	Targeted Black Cockatoo Survey	Level 1 Fauna Survey
Availability of contextual information on the region	**Nil** Sufficient resources for the Swan Coastal Plain (SCP) were available to provide contextual information including Beard (1981), Heddle *et al.* (1980) vegetation mapping, Perth @ 3.5 million (Government of WA, 2015) and the Gibson *et al.* (1994) and Keighery *et al.* (2012) swan coastal plain datasets.	**Minor** Sufficient contextual information is generally available on the SCP and survey area. Some of the resources utilised to inform the black cockatoo survey include the DBCA database, DotEE (2017), Birdlife (2018) and DSEWPaC (2012), though not all layers within these resources are updated regularly.	**Nil** Sufficient contextual information is available on the SCP and survey area. Some of the resources utilised to inform the level 1 fauna survey include the DBCA database, Naturemap, EPBC Act PMST, AoLA, as well as several field guides and other publications.
Competency/experience of consultant conducting survey	**Nil** The flora and vegetation assessment was led by Floora de Wit who has more than 10 years' experience conducting surveys of similar scope.	**Nil** Floora has more than 10 years of experience with ecological surveys, and over six years' experience conducting targeted black cockatoo surveys. Jared is an ecologist with over 16 years' experience in the environmental industry and over three years' experience conducting targeted black cockatoo surveys.	**Nil** Jared is an ecologist with over 16 years' experience in the environmental industry who has conducted multiple Level 1 fauna surveys on the SCP.

Limitation	Flora and Vegetation Survey	Targeted Black Cockatoo Survey	Level 1 Fauna Survey
Proportion of flora/fauna identified, recorded and/or collected (based on sampling, timing and intensity)	**Moderate** The survey area comprised of mostly landscaped gardens, houses/development, and paddocks with remnant native trees (stand-alone and in patches). Native tree crowns were not readily identified using aerial imagery so vegetation mapping relied on field observations. Best effort was made to accurately identify and map all stands of native trees. The vegetation map was done to a scale where all crowns of native trees were captured.	**Minor** The objective of the targeted black cockatoo survey is not necessarily to record black cockatoos within the survey area, but to map the habitat present. However, both Carnaby's Cockatoo and the Forest Red-tailed Black Cockatoo were recorded through either direct sightings or indirect (foraging) evidence. Foraging evidence can be searched for at any time of year, and can remain on the ground for up to two years (DotEE, 2017). Tree hollow presence and suitability for utilisation by black cockatoos cannot always be assessed adequately at ground level, and hence the Precautionary Principle is utilised where appropriate.	**Minor** Information gained for a Level 1 fauna survey was sufficient for those areas surveyed. Fauna were observed (through direct or indirect evidence) during daylight hours (0700 and 1700hrs) and all habitats were assessed. Nocturnal species were only predominantly observed through indirect evidence.
Completion (is further work needed)	**Moderate to High** Flora and vegetation values were adequately assessed on properties where access was granted. These properties are considered 'complete' for the survey. However, surveying the remainder of the survey area is required to gain a full understanding of the environmental values present.	**Moderate to High** Potentially suitable hollows could be assessed further by utilising elevated work platforms (EWPs) or specialist tree climbers, however this is probably not required at this stage and the objectives of the targeted black cockatoo survey were met**.** Black cockatoo values were adequately assessed on properties where access was granted. These properties are considered 'complete' for the survey. However, surveying the remainder of the survey area is required to gain a full understanding of the environmental values present.	**Moderate to High** The objectives of the level 1 fauna survey were met and no further work is required for those properties that are considered 'complete.' However, surveying the remainder of the survey area is required to gain a full understanding of the environmental values present.

Limitation	Flora and Vegetation Survey	Targeted Black Cockatoo Survey	Level 1 Fauna Survey
Remoteness and/or access problems	**High** Property access was denied for approximately 50% of the survey area (see Figure 3). This report presents the results of properties visited and no access limitations are associated with these properties. This data gap represents a significant limitation for informing the Retention Area Assessment as several properties were noted to support large areas of native vegetation.	**High** The owners of numerous properties have denied access for the survey and as such these properties have been removed from the assessment. The lack of data for these properties may however pose a limitation to the overall understanding of environmental values within the survey area outlined by the City. The objectives of the targeted black cockatoo survey were met for areas that were accessed.	**High** The owners of numerous properties have denied access for the survey and as such these properties have been removed from the assessment. The lack of data for these properties may however pose a limitation to the overall understanding of environmental values within the survey area outlined by the City. The objectives of the level 1 fauna assessment were met for areas that were accessed.
Timing, weather, season, cycle	**Nil** Rainfall was below average in the months preceding the survey. No significant limitations were identified relating to timing, weather, season or cycle.	**Nil** No limitations were identified relating to timing, weather, season or cycle. Foraging evidence can be searched for at any time of year and can remain on the ground for up to two years (DotEE, 2017).	**Nil** The survey was conducted during a period of reasonable weather in Spring. Although it was limited to one seasonal survey period during one year, and predominantly during daylight hours, this does not significantly impact a Level 1 fauna survey.
Disturbances (e.g. fire flood, accidental human intervention) which affected results of the survey	**Nil** The survey area represents a fragmented near-rural landscape that includes maintained gardens, grazed paddocks, hardscape, and native vegetation. Best effort was made to access all patches of native vegetation all of which were subject to degrading processes (edge effects, weeds, drying climate).	**Nil** The targeted black cockatoo survey was not disrupted or impacted.	**Nil** The Level 1 fauna survey was not disrupted or impacted.

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DATUM GDA 1994 MGA Zone 50
0 100 200 300 400
Metres

Data sources:

Base Data: (c) Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010),Geoscience Australia, Streetpro

LEGEND
Wattle Grove South Area
Survey Area

Survey Area

CITY OF KALAMUNDA

WATTLE GROVE SOUTH ECOLOGICAL SURVEYS

Figure
3

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A4 size

5.0 Desktop Assessment Results

5.1 Threatened and Priority Ecological Communities

The database searches identified 14 conservation significant communities that may occur in the survey area. These results include six TECs that are listed under the EPBC Act. At the State-level TECs and PECs are determined by Floristic Community Type (FCTs) therefore some federally listed TECs represent one or more TEC/PEC at a State level.

The number of TECs and PECs identified reflect the unique landforms in a highly fragmented environment that occur at the base of the Darling Scarp. This area is influenced by the Scarp and the Swan Coastal Plain and supports a mix of Banksia and Eucalypt woodlands, Heath shrublands and wetlands.

The 14 significant communities are described in Table 16 including their State and Federal conservation status and the relationship of State listed communities to Federal listings. TECs and PECs are mapped in Figure 4.

Table 16 Threatened Ecological Communities identified in the desktop assessment

Community Name and Description	Cons. Status		Likelihood
	State	EPBC	
Banksia Woodlands of the Swan Coastal Plain The Banksia Woodlands TEC (TSSC, 2017) incorporates woodland of *Banksia* species with scattered Eucalypts and other tree species over a species rich mix of sclerophyllous shrubs, graminoids, and forbs. The community shows high endemism and considerable local variation in species composition across its range. It is restricted to the southwest of WA on the Swan Coastal Plain. It occurs mainly on deep Bassendean and Spearwood sands or occasionally on Quindalup sands. The TEC is identified using the key diagnostic features, condition thresholds and consideration of other environmental factors as described in the approved conservation advice. The community is associated with several State-listed TECs and PECs. Those relevant for this project include:	Various	E	Known/buffer overlaps
• *Banksia attenuata* woodlands over species rich dense shrublands (FCT20a)	EN		Known/buffer overlaps
• *Banksia attenuata* and/or *Eucalypt marginata* woodlands of the eastern side of the Swan Coastal Plain (SCP20b)	EN		Likely
• Low lying *Banksia attenuata* woodlands or shrublands (SCP21c)	P3		May
• Banksia dominated woodlands of the Swan Coastal Plain	P3		Likely
SCP20c Shrublands and Woodlands of the Eastern Swan Coastal Plain (FCT20c) Described in the approved conservation advice (DotEE, 2017b), this TEC is restricted to the eastern side of the SCP in the foothills of the Darling Scarp. It reflects the transitional landform and soil zone between the Scarp and SCP. It is known from approximately 130 ha at Talbot Road Bushland, Bushmead Rifle Range, Great Eastern Highway bypass/Roe Highway intersection, Farrall Road, and Clifford St/Tonkin Highway intersection. Critical habitat for this TEC includes: • Known occurrences • Areas within 200 m of known occurrences on sandy to gravelly soils on eastern SCP and foothills of Darling Scarp • Remnant vegetation that surrounds or links several occurrences. This TEC is identified through FCT analysis. It is recommended that outcomes would be verified by DBCA experts.	CR	E	Likely

Community Name and Description	Cons. Status		Likelihood
	State	EPBC	
Clay Pans of the Swan Coastal Plain This TEC occurs where clay soils form an impermeable layer close to the surface where wetlands form that rely solely on rainfall to fill in winter and dry in summer (DSEWPaC, 2012b). The community is a shrubland (sometimes a low open woodland) over geophytes, herbs and sedges in the wetter parts of the site. The TEC is associated with several Ramsar sites including Brixton Street Wetlands, Ellen Brook Swamps System and Forrestdale Lake Nature Reserve. The identification of this TEC relies on FCT analysis and a consideration of characteristics unique to this TEC including hydrological functions. Associated State-listed TECs include:		CE	Known/buffer overlaps
• Herb rich saline shrublands in clay pans (SCP07)	VU		Unlikely
• Herb rich shrublands in clay pans (SCP08)	VU		Known/buffer overlaps
• Shrublands on dry clay flats. (SCP10a)	EN		Unlikely
SCP 3a *Corymbia calophylla – Kingia australis* Woodlands on Heavy Soils of the Swan Coastal Plain (FCT3a) Described in DotEE (2017a) approved conservation advice, this TEC is located on heavy soils of the eastern SCP between Ruabon and Guildford. The floristic composition varies with water regime which is typically within 3 m of the natural ground surface therefore communities are likely to be heavily reliant on groundwater. Critical habitat for this TEC includes heavy soils, fresh superficial groundwater, and/or surface water that helps sustain flora species in these wetland communities, and the catchment for this groundwater and surface water. All areas meeting the description of the ecological community are habitat areas critical to its survival (i.e. no condition thresholds apply).	CR	E	Known/buffer overlaps
SCP3b *Corymbia calophylla – Eucalyptus marginata* Woodlands on Sandy Clay Soils of the southern Swan Coastal Plain (FCT3b) Occurs on alluvial soils near the Peel-Harvey estuary and on better drained sites on the eastern side of the plain with vegetation dominated by both *C. calophylla* and *E. marginata* (Gibson *et al.*, 1994). Common understorey species include *Bossiaea eriocarpa and Conostylis juncea*.	VU		May

Community Name and Description	Cons. Status		Likelihood
	State	EPBC	
SCP3c *Corymbia calophylla – Xanthorrhoea preissii* Woodlands and Shrublands, Swan Coastal Plain (FCT3c) Located on heavy soils of the eastern side of the Swan Coastal Plain between Bullsbrook and Capel. Dominant trees include *C. calophylla, E. wandoo* and shrubs *Xanthorrhoea preissii, Acacia pulchella, Banksia dallanneyi, Gompholobium marginatum* and *Hypocalymma angustifolium* and herbs *Burchardia congesta, Cyathochaeta avenacea* and *Neurachne alopecuroidea*.	CR	E	Likely
Central Northern Darling Scarp Granite Shrubland Community This PEC is described as shrublands and heath on deeper loams and red earths on fragmented granite/quartzite. Heath species typically consist of the taller shrubs Xanthorrhoea acanthostachya and Allocasuarina humilis over smaller proteaceous and myrtaceous shrubs, namely Melaleuca aff. scabra , Baeckea camphorosmae and to a lesser extent, the proteaceous shrubs Dryandra armata, Hakea incrassata and Hakea undulata . Located in central region of the Northern Darling Scarp near Perth.	P4		Unlikely
SCP02 Southern Wet Shrublands, Swan Coastal Plain (FCT02) Shrublands or open low woodlands identified by Gibson in the Busselton area but is now also known to occur at Perth Airport. The community occurs on seasonally inundated sandy clay soils that support diverse shrubs including *Kingia australis, Eutaxia virgata* and *Calothamnus lateralis*.	EN		Unlikely
Muchea Limestone – Shrublands and Woodlands on Muchea Limestone of the Swan Coastal Plain Occurs on heavy soils on eastern side of the plain. Occurrences include wetland and well-drained habitats and a variety of landforms. Its presence is defined by limestone-influenced substrates. Soils and flora species are influenced by the type of limestone substrate.	EN	E	Unlikely

5.2 Conservation Significant Flora

A total of 51 flora species of conservation significance were identified in the desktop study. This included 32 species listed as threatened under the EPBC Act and 19 species listed by DBCA as Priority species. It should be noted that 22 of the 32 threatened species were identified in the Protected Matters Search with no known records from the vicinity of the survey area. The majority of these were considered unlikely to occur.

Four flora species are known to occur within the survey area, including two threatened species *Banksia mimica* and *Conospermum undulatum* and two Priority species *Isopogon drummondii* (Priority 3) and *Lasiopetalum glutinosum* subsp. *glutinosum* (Priority 3).

Further investigation determined that *L. glutinosum* subsp. *glutinosum* is unlikely to occur in the survey area as it is associated with lateritic outcrops on the Darling Scarp.

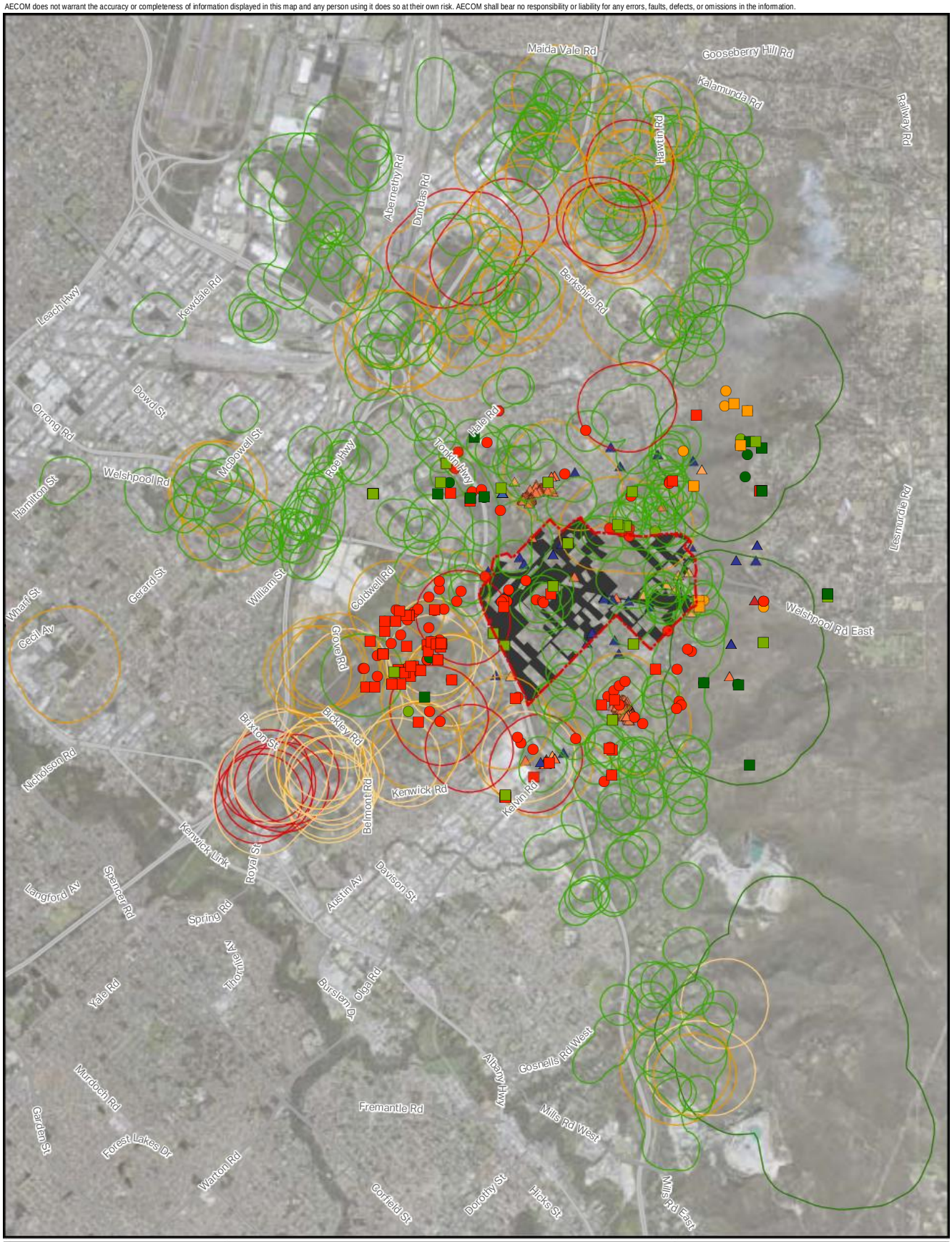
Two flora species are considered likely to occur including *Haemodorum loratum* (Priority 3) and *Verticordia lindleyi* subsp. *lindleyi* (Priority 4). An additional 12 species may occur based on habitat and proximity of known records. The fragmented and mostly cleared private residences within the survey area and lack of wetland habitat as led to the exclusion of many species as being likely to occur.

Table 17 Threatened and Priority Flora that are likely to, or known to occur within the survey area

Species	Cons. Code[1]		Habitat[2]	Count Date	Likelihood of Occurrence
	EPBC	WA			
Banksia mimica	E	VU	Flat to gentle slopes on grey sand in open woodlands. DBCA population 3 occurs within the survey area where it occurs in mixed low heath with a *Banksia attenuata/B. menziesii* open-low woodland overstorey. It is associated with species such as *Adenanthos cygnorum, Eucalyptus todtiana, Nuytsia floribunda, Jacksonia floribunda, Xanthorrhoea preissii, Banksia chamaephyton, Hakea conchifolia* and *Stirlingia latifolia*	2000	Known. DBCA population 3 recorded in 2000 on properties southeast of Crystal Brook Road and Brentwood Road.
Conospermum undulatum	V	VU	Grows on sand and sandy clay soils, often over laterite, on flat or gently sloping sites between the Swan and Canning Rivers. The species is known from *Banksia* and jarrah/marri woodland, with a few records from slightly swampy habitat	2011	Known. Population no. 11 occurs within the survey area.
Haemodorum loratum		P3	Grey or yellow sand and gravel.	2004	Likely. Suitable habitat and record in close proximity to survey area.
Isopogon drummondii		P3	No information available on WAH (1998-). Database results describe flats on grey brown sand with or without gravel in Banksia woodlands.	2013	Known. Numerous records in vicinity of survey area.
Lasiopetalum glutinosum subsp. *glutinosum*		P3	No information available on WAH (1998-). One record nearby recorded on sandplain with Darling Scarp outwash in Banksia/Jarrah woodland.	2008	Known. No suitable habitat in survey area. Records on Darling Scarp.
Verticordia lindleyi subsp. *lindleyi*		P4	Grows in white to grey and yellow sand, often with or over clay and gravel, usually low-lying and winter-wet (George, 2002). Frequently in association with a few other verticordias in heath, shrubland and open woodland (George, 2002). Records from 1990 and 1994.		Likely. Suitable habitat present, several records in close proximity.

1. Conservation codes are outlined in Section 3.0
2. Sourced from Florabase (WAH, 1998-) and DotEE (2019) unless otherwise referenced

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PROJECT ID 60611889 CREATED BY KW APPROVED BY FDW LAST MODIFIED 24 JAN 2020 AECOM www.aecom.com	LEGEND Wattle Grove South Project Area WAHerb Threatened Priority 1 Priority 3 Priority 4	Threatened and Priority Flora Database Threatened Priority 1 Priority 3 Priority 4	TEC / PEC Critically Endangered Endangered Vulnerable Priority 3 Priority 4	Desktop Threatened Fauna Critically Endangered Endangered Vulnerable Priority 3 Priority 4	**Desktop Flora and Fauna Results** **CITY OF KALAMUNDA** *WATTLE GROVE SOUTH ECOLOGICAL SURVEYS*
N 1:60,000 (when printed at A4) DATUM GDA 1994 MGA Zone 50 0 500 1,000 Metres Data sources: Base Data: (c) Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010),Geoscience Australia, Streetpro					**Figure** 4

Map Document: \\AUPER1FP001\Projects\606X\60611889\900_CAD_GIS\920_GIS\02_MXDs\20200124_ReportFigures\G60611889_Fig4_DesktopFloraFauna_A4P_v1.mxd (WyattK2)

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5.3 Conservation Significant Fauna

The NatureMap search identified a total of 192 vertebrate and invertebrate fauna species that have been recorded within the survey and surrounding area. This included seven amphibian, 108 bird, one fish, 31 invertebrate, 14 mammal and 31 reptile species. A review of species habitat was undertaken at which time 26 conservation significant fauna species may occur within the survey area. The likelihood assessment concluded that:

- three species are ‘likely to occur’
- two species ‘may occur’
- 21 species are ‘unlikely to occur’.

The five species considered as ‘likely to occur’ and ‘may occur’ in the survey area include three bird, one invertebrate and one mammal species. Table 18 identifies these species and provides relevant ecological information. The conservation significant categories as defined by DBCA, the BC Act and the EPBC Act are defined in Section 3. The comprehensive desktop results are presented in Appendix A.

The EPBC Protected Matters Search identified five fauna species listed as Marine under the EPBC Act. These were omitted as they only pertain to Commonwealth Land.

Table 18 Conservation significant fauna species that are Likely to Occur or May Occur in the survey area

Scientific Name	Common Name	Conservation Status		Ecology
		WA	EPBC Act	
Calyptorhynchus banksii naso	Forest Red-tailed Black Cockatoo	VU	V	Requires tree hollows to nest and breed, occurs in forests of Karri *Eucalyptus diversicolor*, Jarrah *E. marginata* and Marri *Corymbia calophylla*, with flocks moving out onto the Swan Coastal Plain in search of food from exotic trees such as White Cedar (Johnstone *et al.*, 2010). Foraging habitat for the species consists of Jarrah and Marri woodlands and forest throughout its range. Has become more common in the Metropolitan area in the past few years.
Calyptorhynchus baudinii	Baudin's Cockatoo	EN	E	Habitat critical to the survival of this species includes forests of Karri, Jarrah and Marri, in areas of 600 mm average rainfall per year. Individuals typically move north through the Perth region from March to May and south through the Perth region from August to October. This species ranges north to Gidgegannup and Hoddy Well and west to the Eastern Strip of the Swan Coastal Plain including West Midland in the north, heading south through Armadale, Byford and south and towards the coast until Lake Clifton where it continues to hug the coastline to east of Albany (Johnstone *et al.,* 2010). Breeding has been recorded to the south-west of the area bounded by Leschenault, Collie and Albany (DSEWPaC, 2012), with the most northerly record at Lowden, near Donnybrook (Johnstone & Storr, 1998). Breeding has also been recorded at Serpentine (hills area), and east to Kojonup and near Albany (Johnstone & Kirkby, 2008).
Calyptorhynchus latirostris	Carnaby's Cockatoo	EN	E	The species nests in hollows in eucalypts, particularly Salmon Gum *Eucalyptus salmonophloia* and Wandoo *E. Wandoo*, but nests have been found in other eucalypts including York Gum *E. loxophleba*, Flooded Gum *E. rudis*, Tuart *E. gomphocephala* and Marri *Corymbia calophylla* (Johnstone *et al.*, 2010). Breeding success is largely dependent on suitable feeding habitat adjacent to the nest site to provide the necessary food for the survival of the chick (Johnstone *et al.*, 2010). Diet consists of an array of Proteaceous and *Eucalyptus* species.
Isoodon fusciventer	Quenda	P4	-	The Quenda exists only in a fragmented distribution to its former range in southern south western and eastern Australia. It is found in forest, woodland, heath and shrub communities in these regions. Preferred habitat usually consists of a combination of sandy soils and dense heathy vegetation (Van Dyck & Strahan, 2008).
Westralunio carteri	Carter's Freshwater Mussel	VU	V	The only reasonably large bivalve in freshwaters of south-west Western Australia. Occurs in greatest abundance in slower flowing waters with stable sediments that are soft enough for burrowing. Salinity tolerance is quite low (>3 g /L is lethal) (TSSC, 2018).

6.0 Field Survey Results and Discussion

6.1 Vegetation

6.1.1 Floristic Community Type Analysis

A total of 11 quadrats were subject to the statistical analysis to infer the FCT for these quadrats and associated vegetation patches. Five FCTs were inferred, including:

- FCT3b *C. calophylla-E. marginata* woodlands on sandy clay soils (WA TEC)
- FCT20a *B. attenuata* over species rich dense shrublands (EPBC TEC, WA TEC)
- FCT20b eastern *B. attenuata* and/or *E. marginata* woodlands (partial EPBC TEC, WA TEC)
- FCT21a central *B. attenuata-E. marginata* woodlands (partial EPBC TEC)
- FCT23a central *B. attenuata-B. menziesii* woodlands (partial EPBC TEC)

The FCT analysis results were used to inform the TEC and PEC assessment discussed in the following Section. Details for each quadrat, the top three to four similar SCP quadrats, and inferred FCT conclusions are presented in Table 19.

The survey area extends across three major landforms; the Foothills (Ridge Hill Shelf) (east), the Pinjarra Plain, and a combination of Bassendean Dunes and Pinjarra Plain. Because of this, some of the inferred FCTs remain slightly cryptic as it is unclear what landform they would represent at this scale. Furthermore, low similarity was observed across all quadrats analysed, suggesting poor comparability to the SCP data. A number of factors would influence this, such as:

- position of survey area along the base of the Darling Scarp. It crosses three major landforms and species present may not be typical of that landform due to the proximity of the scarp.
- single quadrat sampling event
- drying climate
- isolation native vegetation patches and existing disturbances.

Table 19 Inferred FCT for Wattle Grove quadrats

Quadrat	Quadrat, % similarity, FCT	Inferred FCT
01	ACTON-1, 31%, 1a Hart01, 31%, 20a Sams01 31%, 28	None of these FCTs align with quadrat data. FCT cannot be inferred.
04	Rush 02, 46%, 20b Hart01, 43%, 20a APBF-2, 40%, 20a	FCT20a *B. attenuata* over species rich dense shrublands is a good fit. High diversity with 61 species/quadrat.
06	Activ03, 47%, 20a Bushm01, 45%, 20a Hart01, 45%, 20a Talb8, 45%, 20a	FCT20a *B. attenuata* over species rich dense shrublands is a good fit. High diversity with 46 species/quadrat. Some edge effects have degraded condition.
07	BURNRD02, 26%, 3b 5C01, 23%, S18 Serp04, 23%, 3b Yarl03, 23%, 3b	FCT3b *C. calophylla-E. marginata* woodlands on sandy clay soils is a good fit. TEC description suggests 'southern SCP' only however Gibson *et al.* (1994) includes better drained sites on eastern side of plain.
09	Kens01, 44%, 23a Perth04, 43%, 23a Perth08, 43%, 23a Tele01, 43%, 23a	FCT23a central *B. attenuata-B. menziesii* woodlands is a good fit.

Quadrat	Quadrat, % similarity, FCT	Inferred FCT
10	Yarl03, 39%, 3b BURNRD02, 37%, 3b KOOLJ-5, 32%, 3b Sunday02, 32%, 21a	FCT3b *C. calophylla-E. marginata* woodlands on sandy clay soils is a good fit. TEC description suggests 'southern SCP' only however Gibson *et al.* (1994) includes better drained sites on eastern side of plain.
11	AMBRAL-1, 38%, 1b Yarl01, 37%, 3c BURNRD02, 35%, 3b R116703, 35%, 1b Waro 02, 35%, 3b	FCT3b *C. calophylla-E. marginata* woodlands on sandy clay soils is a good fit. FCT1b is restricted to southern SCP.
13	Activ03, 44%, 20a BNR18, 41%, S09 Card2, 41%, 20b ELE28, 41%, 23b KOON-1, 41%, 20a KOON-2, 41%, 20a	Does not meet description of FCT20a or 23b. Could be S09 *Banksia attenuata* woodlands over dense low shrubs however its geographical location aligns better with FCT20b eastern *B. attenuata* and/or *E. marginata* woodlands may also be accurate.
15	KING-2, 30%, 28 Cavs11, 30%, 21a Star01, 29%, 24 WOODV-2, 29%, 28	Poor alignment with FCT28 and 24 as they pertain to Spearwood dunes dominated by *Banksia* overstorey. Vegetation represented by Q15 is representative of *E. marginata* woodland therefore may be aligned with FCT21a central *B. attenuata-E. marginata* woodlands.
18	Perth08, 42%, 23a Wire01, 42%, 28 Activ03, 40%, 20a	Similar to Q19, likely to represent FCT20b as it aligns with geographical location, key species, and species richness.
19	Activ03, 42%, 20a Rush02, 42%, 20b KING-2, 38%, 28 Tele01, 38%, 23a	Could represent FCT20a or 20b with presence of key species and correct landform (Ridge Hill Shelf). The lower species richness indicates FCT20b eastern *B. attenuata* and/or *E. marginata* woodlands.
20	Activ03, 37%, 20a Perth04, 36%, 23a	Does not align with 20a or 23a. Is a better fit with FCT20b eastern *B. attenuata* and/or *E. marginata* woodlands. Confirmation from DBCA would be required however as a precaution we have determined this area to be the State listed TEC.

6.1.2 Threatened and Priority Ecological Communities

Native vegetation was mapped for 7.41 ha within the 168 ha survey area. Of this area, 4.55 ha is considered a TEC or PEC. This reflects the condition of vegetation and the size of the patch.

Four conservation significant communities were recorded and mapped, all of which are either wholly or partially under one federally listed TEC:

- EPBC TEC Banksia Woodlands of the SCP
- WA TEC FCT20a *B. attenuata* over species rich dense shrublands (SCP20a)
- WA TEC FCT20b *B. attenuata* and/or *E. marginata* woodlands of the Eastern SCP (SCP20b)
- WA TEC *Corymbia calophylla – Eucalyptus marginata* woodlands on sandy clay soils of the southern SCP (SCP3b)
- WA PEC Banksia dominated woodlands of the SCP.

These communities are described in detail below.

Banksia Woodlands of the Swan Coastal Plain – EPBC Endangered

The presence of the EPBC Act-listed Banksia Woodlands of the Swan Coastal Plain has been confirmed. Native vegetation within the survey area was grouped into patches as defined in the Approved Conservation Advice. Each patch was assessed separately.

Five patches were defined:

- Patch 1 = quadrats 4 and 6
- Patch 2 = quadrats 12 and 13
- Patch 3 = quadrats 18 and 19
- Patch 4 = relevé 08 and quadrat 09
- Patch 5 = relevé 14

Of these, patches 1, 2 and 3 met all criteria to be considered the EPBC TEC Banksia Woodlands of the SCP. The vegetation within these patches was often co-dominated by a mix of *Banksia attenuata, Banksia menziesii, Allocasuarina fraseriana* and *Eucalyptus marginata* subsp. *marginata*. The vegetation varied from 'Good' to 'Excellent' condition. Patch 1 and 2 also support EPBC threatened flora species *Conospermum undulatum*.

The three patches of Banksia Woodlands TEC represent three State listed communities, discussed separately. The total area of native vegetation representing this TEC is 2.41 ha. A detailed assessment of each of these patches is provided in Appendix B.

FCT20a *B. attenuata* over species rich dense shrublands (SCP20a) – WA TEC Endangered

The identification of this TEC was supported by FCT analysis of two quadrats (04 and 06). This area was notably species rich with an average of 53.5 species/quadrat. This TEC is isolated to one location, represented by vegetation community BaEpPf extending for 0.94 ha.

This TEC was identified in the desktop assessment as known to occur in Wattle Grove and coincides with Patch 1 of the Banksia Woodlands TEC.

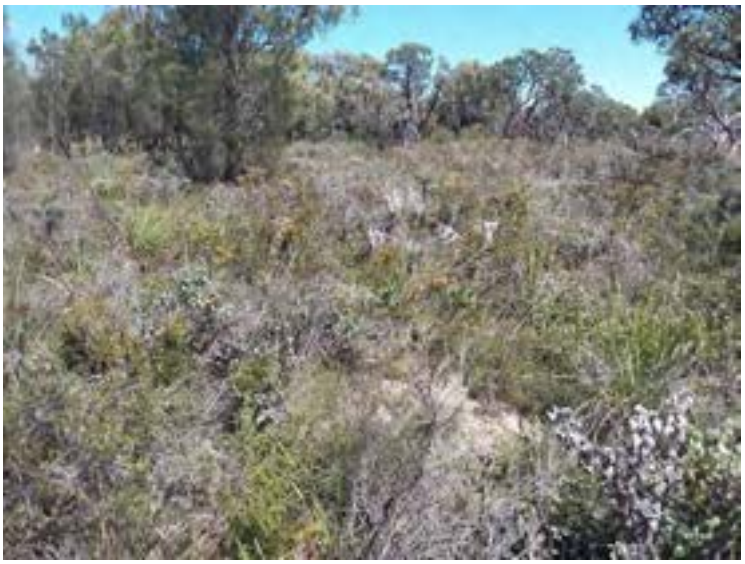


Plate 1 Photograph representative of FCT20a

FCT20b *B. attenuata* and/or *E. marginata* woodlands of the Eastern SCP (SCP20b) – WA TEC Endangered

This TEC has been tentatively mapped at two locations that correspond with Patch 2 and 3 of the Banksia Woodlands TEC. The low confidence mapping is a result of poor clarity from the FCT analysis (low similarity). Verification from DBCA is advisable.

This TEC is represented by three vegetation communities in the survey area including EmMpLp, BaEpPf and BmXpEc and is mapped across 1.80 ha.

***Corymbia calophylla – Eucalyptus marginata* woodlands on sandy clay soils of the southern SCP (SCP3b) – WA TEC Vulnerable**

This TEC was identified following FCT analysis for three quadrats (07, 10 and 11). Further confirmation from DBCA would be required to verify the presence of this TEC. FCT3b is more commonly known from the Peel-Harvey estuary further south, but has been recorded on 'better drained sites on the eastern side of the plain' (Gibson *et al.*, 1994). This TEC is represented by vegetation communities EmPcAh and EmLpFa extending for 1.71 ha.

A precautionary approach has been adopted, where liaison with DBCA may help facilitate a better understanding of the TECs present as this TEC is generally associated with areas further south.

Banksia dominated woodlands of the SCP – WA P3 PEC

This PEC was recorded at one location which coincides with Patch 2 of the EPBC TEC Banksia Woodlands of the SCP. This TEC is not associated with a specific FCT therefore has been assumed to refer to all occurrences of the federal TEC listing. This PEC extends for 0.15 ha.

Tuart Woodlands of the SCP – EPBC TEC, WA P3 PEC

E. gomphocephala trees were observed in the survey area, however all trees were recorded in Completely Degraded areas devoid of native understorey species. For this reason, these patches were excluded for consideration as the EPBC TEC Tuart Woodlands of the SCP.

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LEGEND

- Wattle Grove South Area
- Survey Area
- EPBC TEC *Banksia* Woodlands of the Swan Coastal Plains
- WA TEC *C. calophylla-E. marginata* Woodlands on Sandy Clay Soils (FCT3b)
- WA TEC *Banksia attenuata* Woodland over Species Rich Dense Shrublands
- WA PEC *Banksia* dominated woodlands of the SCP
- Tentative WA TEC *Banksia attenuata* and/or *Eucalyptus marginata* Woodlands of the Eastern Side of the Swan Coastal Plain (SCP20b)
- Not a TEC

Conservation Significant Vegetation

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WATTLE GROVE SOUTH ECOLOGICAL SURVEYS

Figure

5

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6.1.3 Vegetation Communities

Six native vegetation communities were described and mapped. These communities fall into three broad categories including Banksia Woodlands, Eucalypt Woodlands and Riparian Vegetation.

Vegetation descriptions are presented in Table 20 and mapped in Figure 7.

The delineation of vegetation communities was supported by cluster analysis of floristic data. The cluster outcomes are presented below.

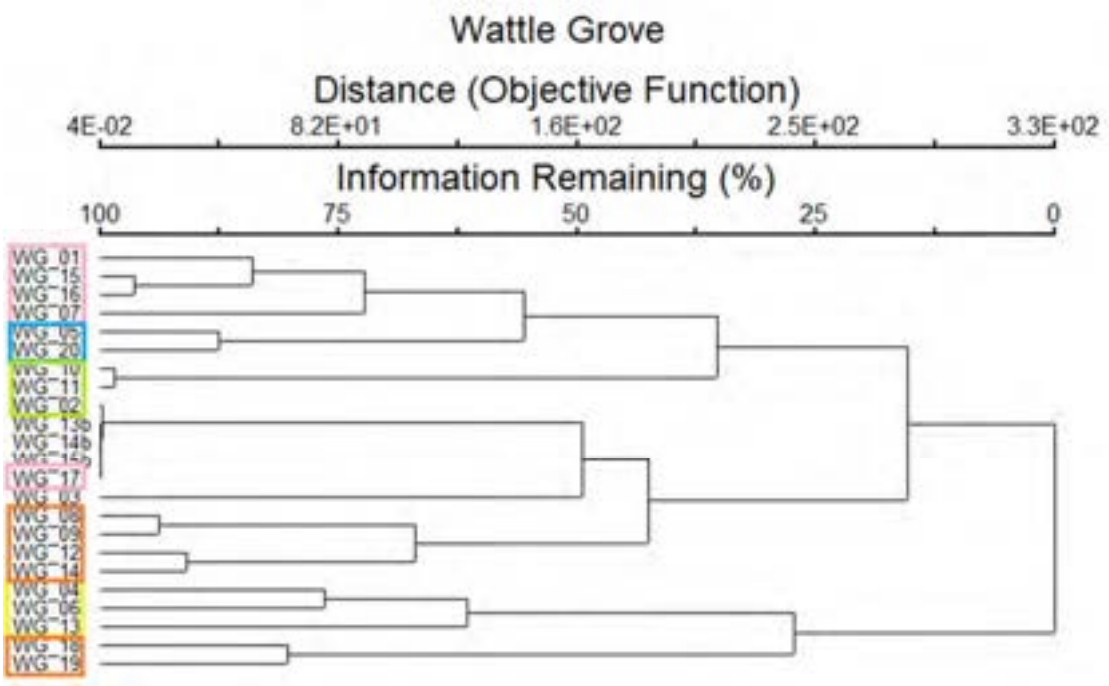


Figure 6 Dendrogram Showing Community Groups in Colours (pink = EmCaFa, blue = EmMpLp, green = EmPcAh, orange = BmXpEc, yellow = BaEpPf)

Table 20 Vegetation community descriptions including mapping code and photographs

Community Description	Additional Details	Photograph
EmCaFa ***E. marginata* Woodland** *Eucalyptus marginata* subsp. *marginata* and *Allocasuarina fraseriana* low woodland over *Cyathochaeta avenacea, Mesomelaena tetragona* and *Daviesia decurrens* subsp. *decurrens* mixed sedge and shrubland over **Freesia alba* x *leichtlinii*, *Lomandra preissii* and *Stylidium brunonianum* low forbland. Numerous strata present in understorey including forbs, sedges, rushes and shrubs. Other dominant species include *Tripterococcus brunonis, Neurachne alopecuroidea, Xanthorrhoea preissii, Labichea punctata* and *Hakea undulata.* Represents WA TEC *C. calophylla-E. marginata* woodlands on sandy clay soils.	Survey effort: Q01, Q07, Q15, R16 Species richness: 76 native and 12 weed species Area: 0.78 ha	
EmMpLp ***E. marginata* Woodland** *Eucalyptus marginata* subsp. *marginata* and *Allocasuarina fraseriana* mid open forest over *Mesomelaena pseudostygia* and *Tetraria octandra* low sedgeland with *Lomandra preissii, Tricoryne elatior* and *Dampiera linearis* low open forbland. Larger patch of this community represents WA TEC *B. attenuata* and/or *E. marginata* woodlands of the eastern SCP (SCP20b).	Survey effort: R05, Q20 Species richness: 42 native and 9 weed species Area: 0.48 ha	

Community Description	Additional Details	Photograph
EmPcAh ***E. marginata* Woodland** *Eucalyptus marginata* subsp. *marginata* and *Corymbia calophylla* mid open forest over *Phyllanthus calycinus*, *Xanthorrhoea preissii* and *Xanthorrhoea gracilis* low shrubland with *Agrostocrinum hirsutum*, *Lomandra sonderi* and *Thysanotus patersonii* low open forbland. Represents WA TEC *C. calophylla-E. marginata* woodlands on sandy clay soils	Survey effort: R02, Q10, Q11 Species richness: 47 native and 9 weed species Area: 1.61 ha	
CcHaEc **Riparian Vegetation** *Corymbia calophylla* mid open woodland over *Spyridium globulosum, Hypocalymma angustifolium* and *Acacia pulchel*la var. *pulchella* tall to low shrubland over **Ehrharta calycina, *Avena barbata* and **Briza minor* low grassland. Represents riparian vegetation associated with a minor water course.	Survey effort: 03 Species richness: 12 native and 5 weed species Area: 0.23 ha	

Community Description	Additional Details	Photograph
BaEpPf **Banksia Woodland** *Banksia attenuata, Banksia menziesii* and *Eucalyptus todtiana* low open woodland over *Eremaea pauciflora* var. *pauciflora*, *Hibbertia hypericoides* and *Allocasuarina humilis* low shrubland over *Phlebocarya filifolia, Mesomelaena pseudostygia* and *Lepidosperma leptostachyum* low sedgeland. Represents EPBC TEC Banksia Woodlands of the SCP. One patch also represents the WA TEC *Banksia attenuata* woodlands over species rich dense shrublands (SCP20a). Supports the Threatened *Conospermum undulatum* and Priority 3 *Isopogon drummondii.*	Survey effort: Q04, Q06, Q13 Species richness: 88 native and 7 weed species Area: 1.55 ha	
BmXpEc **Banksia Woodland** *Banksia menziesii, Allocasuarina fraseriana* and *Eucalyptus todtiana* low open woodland over Xanthorrhoea preissii, Eremaea pauciflora var. pauciflora and Stirlingia latifolia low open shrubland over *Ehrharta calycina, Dasypogon bromeliifolius and Anigozanthos manglesii subsp. manglesii mixed grass and forbland. Represents EPBC TEC Banksia Woodlands of the SCP and WA TEC eastern *B. attenuata* and/or *E. marginata* woodlands (SCP20b).	Survey effort: R08, Q09, R12, R14, Q18, Q19 Species richness: 80 native and 12 weed species Area: 1.92 ha	
Significantly Altered Includes planted, gardens, scattered trees (both native and introduced). Condition considered Completely Degraded.	Area: 56.56 ha	

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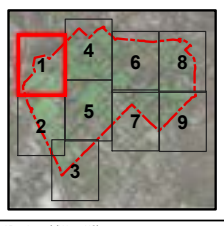
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0 25 50 75 100
Metres

Data sources:

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LEGEND
- Wattle Grove South Area
- Survey Area
- Quadrat
- Relevé
- Vegetation Communities
- BmXpEc
- Trees
- Planted
- Cleared
- Hardstand



Vegetation Communities

CITY OF KALAMUNDA

WATTLE GROVE SOUTH ECOLOGICAL SURVEYS

Figure
7.1

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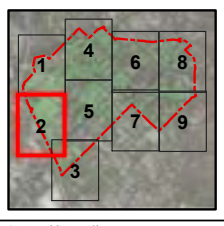
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LEGEND
- Wattle Grove South Area
- Survey Area
- Quadrat
- Relevé

Vegetation Communities
- BmXpEc
- Trees
- Planted
- Cleared
- Hardstand



Vegetation Communities

CITY OF KALAMUNDA

WATTLE GROVE SOUTH ECOLOGICAL SURVEYS

Figure
7.2

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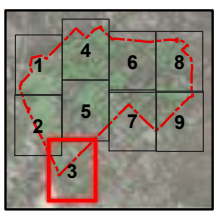
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LEGEND

- Wattle Grove South Area
- Survey Area
- Quadrat
- Relevé

Vegetation Communities

- BaEpPf
- EmMpLp
- Trees
- Planted
- Cleared
- Hardstand



Vegetation Communities

CITY OF KALAMUNDA

WATTLE GROVE SOUTH ECOLOGICAL SURVEYS

Figure

7.3

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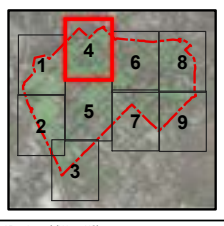
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LEGEND
Wattle Grove South Area
Survey Area
Relevé
Vegetation Communities
CcHaEc
Trees
Planted
Cleared
Hardstand



Vegetation Communities

CITY OF KALAMUNDA

WATTLE GROVE SOUTH ECOLOGICAL SURVEYS

Figure
7.4

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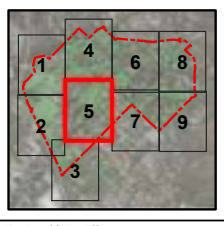
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LEGEND

- Wattle Grove South Area
- Survey Area
- Quadrat
- Relevé

Vegetation Communities

- BaEpPf
- BmXpEc
- EmLpFa
- EmMpLp
- Trees
- Planted
- Cleared
- Hardstand



Vegetation Communities

CITY OF KALAMUNDA

WATTLE GROVE SOUTH ECOLOGICAL SURVEYS

Figure

7.5

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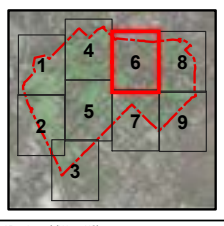
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LEGEND

- Wattle Grove South Area
- Survey Area
- Relevé

Vegetation Communities

- BmXpEc
- EmPcAh
- Trees
- Planted
- Cleared
- Hardstand



Vegetation Communities

CITY OF KALAMUNDA

WATTLE GROVE SOUTH ECOLOGICAL SURVEYS

Figure

7.6

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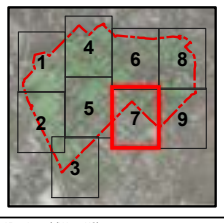
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LEGEND

- Wattle Grove South Area
- Survey Area
- Quadrat
- Relevé

Vegetation Communities

- BaEpPf
- EmCaFa
- EmLpFa
- EmPcAh
- Trees
- Planted
- Cleared
- Hardstand



Vegetation Communities

CITY OF KALAMUNDA

WATTLE GROVE SOUTH ECOLOGICAL SURVEYS

Figure
7.7

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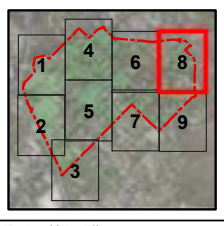
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LEGEND

- Wattle Grove South Area
- Survey Area
- Quadrat
- Relevé

Vegetation Communities

- BmXpEc
- EmCaFa
- EmLpFa
- EmMpLp
- EmPcAh
- Trees
- Planted
- Cleared
- Hardstand



Vegetation Communities

CITY OF KALAMUNDA

WATTLE GROVE SOUTH ECOLOGICAL SURVEYS

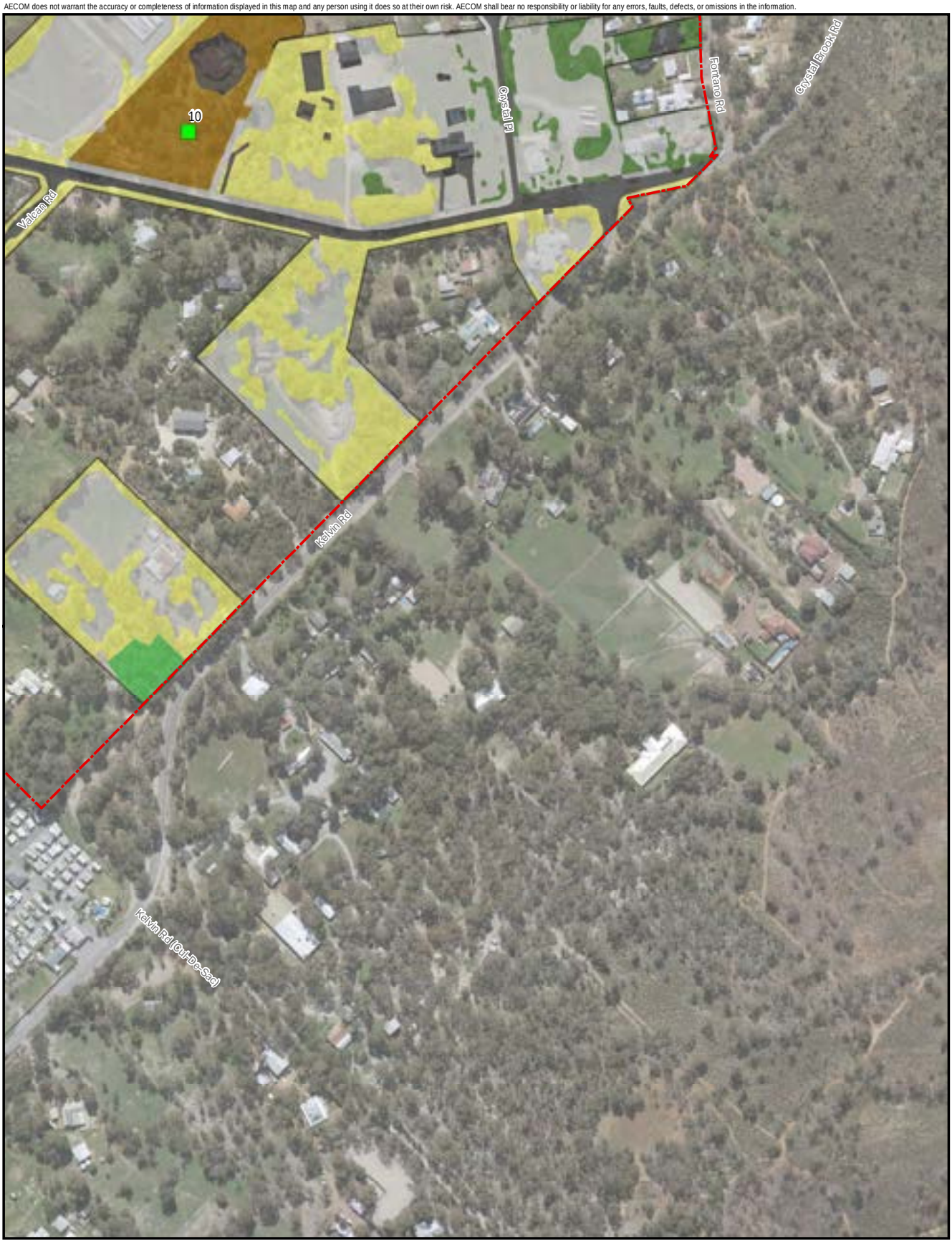
Figure

7.8

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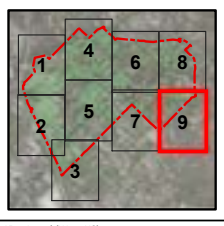
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LEGEND
- Wattle Grove South Area
- Survey Area
- Quadrat

Vegetation Communities
- EmCaFa
- EmPcAh
- Trees
- Planted
- Cleared
- Hardstand



Vegetation Communities

CITY OF KALAMUNDA

WATTLE GROVE SOUTH ECOLOGICAL SURVEYS

Figure
7.9

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A4 size

6.1.4 Vegetation Condition

Vegetation condition within the Survey area varied from 'Excellent' to 'Completely Degraded', shown in Figure 8. The condition map reflects the current land use (private estate). Majority of residences comprise cleared grasslands (lawn) and maintained gardens. Condition extent is presented in Table 21.

Table 21 Vegetation condition

Condition Rating	Area (ha)	Percentage of Survey area (%)
Excellent	2.24	20
Very Good	2.22	76
Good	1.45	1
Degraded	1.59	1
Completely Degraded	127.39	1
Cleared	33.07	1
Total	167.97	100

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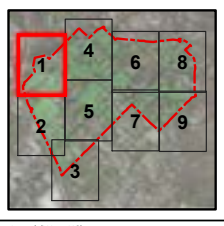
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LEGEND
- Wattle Grove South Area
- Survey Area

Vegetation Condition
- Very Good
- Good
- Degraded
- Completely Degraded
- Cleared



Vegetation Condition

CITY OF KALAMUNDA

WATTLE GROVE SOUTH ECOLOGICAL SURVEYS

Figure
8.1

Map Document: \\AUPER1FP001\Projects\606X\60611889\900_CAD_GIS\920_GIS\02_MXDs\20200124_ReportFigures\G60611889_Fig8_VegCondition_A4P_v1.mxd (WyattK2)

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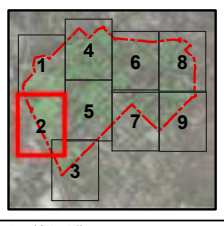
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Metres

Data sources:

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LEGEND
- Wattle Grove South Area
- Survey Area

Vegetation Condition
- Very Good
- Good
- Degraded
- Completely Degraded
- Cleared



Vegetation Condition

CITY OF KALAMUNDA

WATTLE GROVE SOUTH ECOLOGICAL SURVEYS

Figure
8.2

Map Document: \\AUPER1FP001\Projects\606X\60611889\900_CAD_GIS\920_GIS\02_MXDs\20200124_ReportFigures\G60611889_Fig8_VegCondition_A4P_v1.mxd (WyattK2)

A4 size

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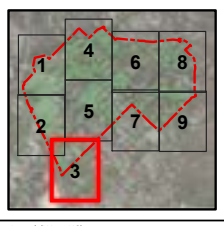
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Metres

Data sources:

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LEGEND
- Wattle Grove South Area
- Survey Area

Vegetation Condition
- Excellent
- Very Good
- Completely Degraded
- Cleared



Vegetation Condition

CITY OF KALAMUNDA

WATTLE GROVE SOUTH ECOLOGICAL SURVEYS

Figure
8.3

Map Document: \\AUPER1FP001\Projects\606X\60611889\900_CAD_GIS\920_GIS\02_MXDs\20200124_ReportFigures\G60611889_Fig8_VegCondition_A4P_v1.mxd (WyattK2)

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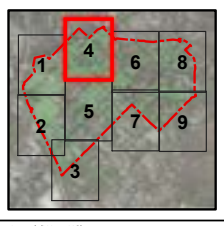
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Metres

Data sources:

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LEGEND
- Wattle Grove South Area
- Survey Area

Vegetation Condition
- Degraded
- Completely Degraded
- Cleared



Vegetation Condition

CITY OF KALAMUNDA

WATTLE GROVE SOUTH ECOLOGICAL SURVEYS

Figure
8.4

Map Document: \\AUPER1FP001\Projects\606X\60611889\900_CAD_GIS\920_GIS\02_MXDs\20200124_ReportFigures\G60611889_Fig8_VegCondition_A4P_v1.mxd (WyattK2)

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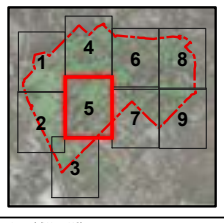
DATUM GDA 1994 MGA Zone 50
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Metres

Data sources:

Base Data: (c) Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010).Geoscience Australia, Streetpro

LEGEND
- Wattle Grove South Area
- Survey Area

Vegetation Condition
- Excellent
- Very Good
- Good
- Degraded
- Completely Degraded
- Cleared



Vegetation Condition

CITY OF KALAMUNDA

WATTLE GROVE SOUTH ECOLOGICAL SURVEYS

Figure
8.5

Map Document: \\AUPER1FP001\Projects\606X\60611889\900_CAD_GIS\920_GIS\02_MXDs\20200124_ReportFigures\G60611889_Fig8_VegCondition_A4P_v1.mxd (WyattK2)

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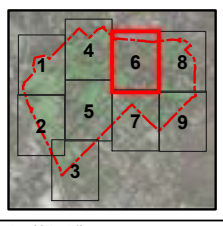
DATUM GDA 1994 MGA Zone 50
0 25 50 75 100
Metres

Data sources:

Base Data: (c) Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010),Geoscience Australia, Streetpro

LEGEND
- Wattle Grove South Area
- Survey Area

Vegetation Condition
- Good
- Degraded
- Completely Degraded
- Cleared



Vegetation Condition

CITY OF KALAMUNDA

WATTLE GROVE SOUTH ECOLOGICAL SURVEYS

Figure
8.6

Map Document: \\AUPER1FP001\Projects\606X\60611889\900_CAD_GIS\920_GIS\02_MXDs\20200124_ReportFigures\G60611889_Fig8_VegCondition_A4P_v1.mxd (WyattK2)

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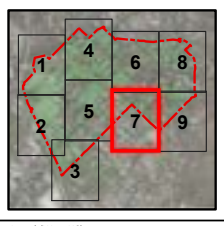
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Metres

Data sources:

Base Data: (c) Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010),Geoscience Australia, Streetpro

LEGEND
- Wattle Grove South Area
- Survey Area

Vegetation Condition
- Excellent
- Very Good
- Degraded
- Completely Degraded
- Cleared



Vegetation Condition

CITY OF KALAMUNDA

WATTLE GROVE SOUTH ECOLOGICAL SURVEYS

Figure
8.7

Map Document: \\AUPER1FP001\Projects\606X\60611889\900_CAD_GIS\920_GIS\02_MXDs\20200124_ReportFigures\G60611889_Fig8_VegCondition_A4P_v1.mxd (WyattK2)

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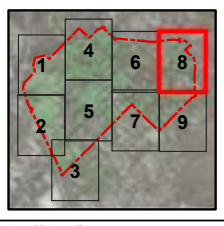
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Metres

Data sources:

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LEGEND
- Wattle Grove South Area
- Survey Area

Vegetation Condition
- Excellent
- Very Good
- Good
- Degraded
- Completely Degraded
- Cleared



Vegetation Condition

CITY OF KALAMUNDA

WATTLE GROVE SOUTH ECOLOGICAL SURVEYS

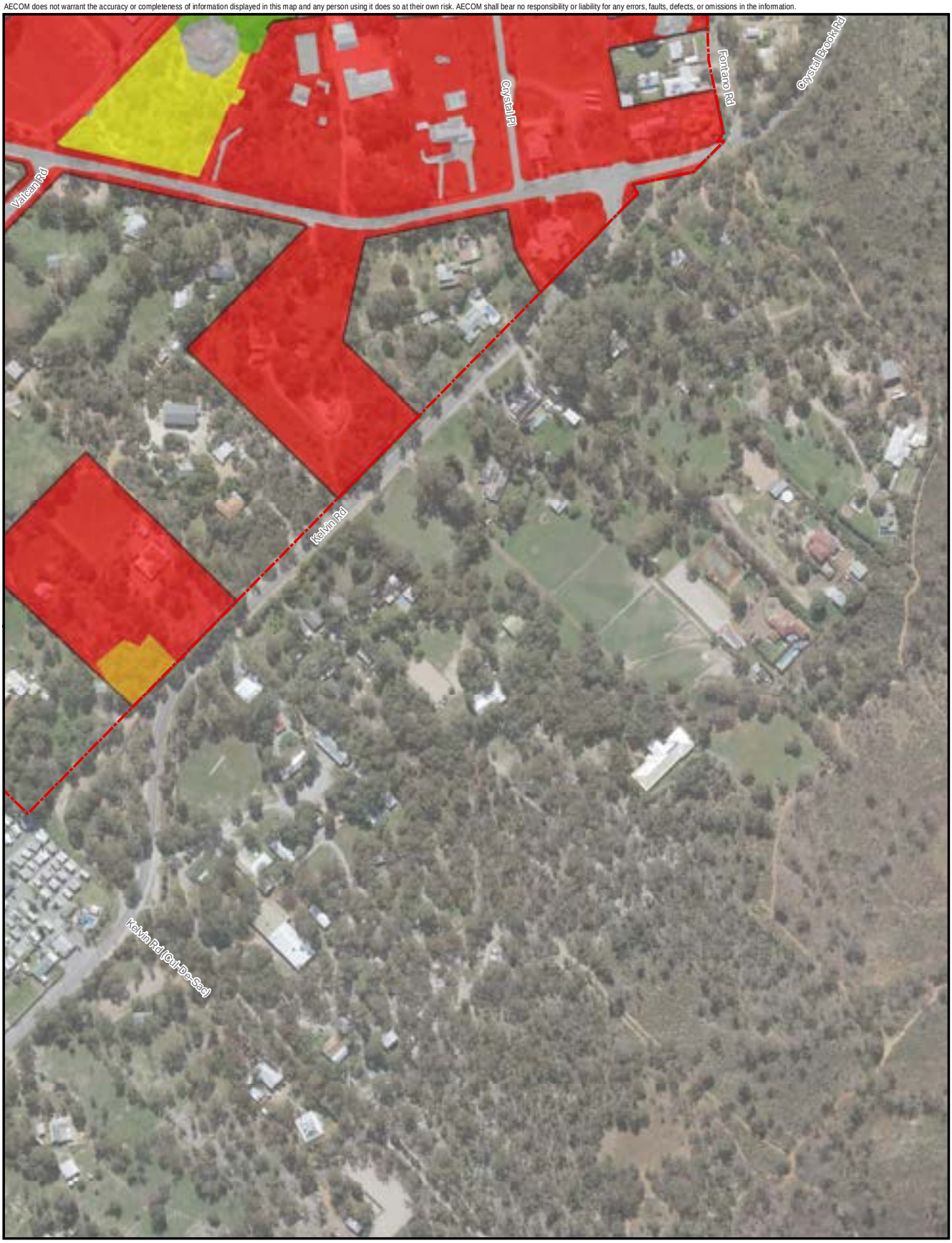
Figure

8.8

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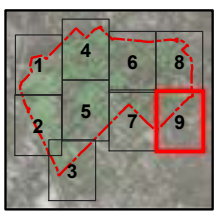
DATUM GDA 1994 MGA Zone 50
0 25 50 75 100
Metres

Data sources:

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LEGEND
- Wattle Grove South Area
- Survey Area

Vegetation Condition
- Very Good
- Good
- Degraded
- Completely Degraded
- Cleared



Vegetation Condition

CITY OF KALAMUNDA

WATTLE GROVE SOUTH ECOLOGICAL SURVEYS

Figure
8.9

Map Document: \\AUPER1FP001\Projects\606X\60611889\900_CAD_GIS\920_GIS\02_MXDs\20200124_ReportFigures\G60611889_Fig8_VegCondition_A4P_v1.mxd (WyattK2)

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6.2 Flora

6.2.1 Threatened and Priority Flora

***Conospermum undulatum* (T)**

One Threatened species listed under the EPBC Act and BC Act was recorded within the survey area. *Conospermum undulatum* (EPBC Vulnerable, BC Vulnerable) has been previously recorded in the survey area. This was verified during the field survey where two populations were recorded comprising 95 individuals (see Table 22 and Figure 9). No photograph was taken of this species in the survey area.

DBCA population 11 is located within the survey area. This population is located on land where no access was granted for this field survey.

Populations of *C. undulatum* recorded during this survey are not represented in the DBCA dataset.

Table 22 *C. undulatum* population information within and in vicinity of survey area

Parameter	AECOM[1]		DBCA[2]	
	Populations	Individuals	Populations	Individuals
Within survey area	2	95	3	528
In vicinity			10	3694

1. Restricted to properties for which access was granted
2. applicable to wider Wattle Grove survey area.

Isopogon drummondii

One Priority 3 species, *Isopogon drummondii*, was recorded in the survey area. These two populations correspond with the *C. undulatum* populations. There is one known record of this species in the survey area from 1990 (see Table 23 and Figure 9). This species is regionally restricted but locally common.

Table 23 *I. drummondii* population information within and in vicinity of survey area

Parameter	AECOM[1]		DBCA[2]	
	Populations	Individuals	Populations	Individuals
Within survey area	2	160	1	Not available
In vicinity			9	Described as ‘locally abundant’

1. Restricted to properties for which access was granted
2. applicable to wider Wattle Grove survey area.

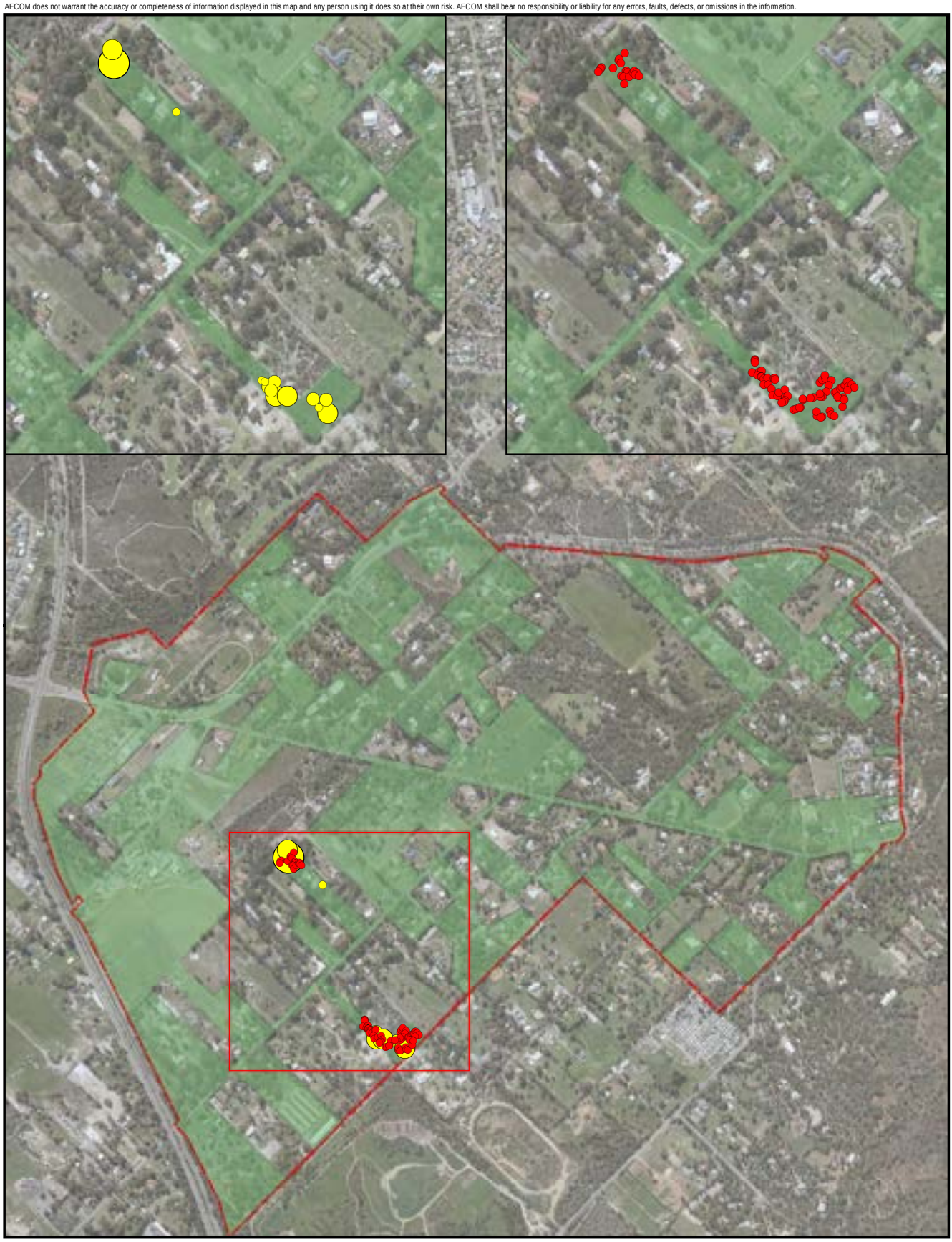


Plate 2 ***Isopogon drummondii*** **recorded in the survey area**

Banksia mimica

The *B. mimica* population (DBCA population 3) was previously recorded south east of the Crystal Brook Road and Brentwood Road junction. All properties in this vicinity have been cleared for development and no native vegetation remains. *B. mimica* was not recorded during the field survey.

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0 100 200 300 400
Metres

Data sources:

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LEGEND

Survey Area
Wattle Grove South Area

Conospermum undulatum T
Abundance:
1

Isopogon drummondii P3
Abundance:
1
2-5
6-25
26-100

Conservation Significant Vegetation

CITY OF KALAMUNDA

WATTLE GROVE SOUTH ECOLOGICAL SURVEYS

Figure
9

Map Document: \\AUPER1FP001\Projects\606X\60611889\900_CAD_GIS\920_GIS\02_MXDs\20200124_ReportFigures\G60611889_Fig9_Conservation Significant Flora_A4P_v1.mxd (WyatiK2)

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6.2.2 Inventory of Flora Species

A total of 165 native species from 95 genera and 38 families were recorded during the field survey. Families with the highest representation are Proteaceae (25 native taxa), Fabaceae (23 native taxa) and Myrtaceae (17 native taxa).

The full list of vascular flora species recorded and representative communities in which they occur in are presented in Appendix C. Qualitative data recorded from individual quadrats is presented in Appendix D.

In total, 21 introduced species were recorded. Of these, one is listed as a Declared Pest under the BAM Act. *Asparagus asparagoides,* Bridal Creeper (Declared Pest – S22(2) is listed as Exempt therefore no permit or conditions are applicable.

Rubus ulmifolius (Declared Pest – s22(2), also known as Blackberry, was observed along a drainage channel where access was restricted due to fencing (despite the area being zoned as Reserve). This species is listed as C3 – Management / Exempt where some form of management should be applied to alleviate the harmful impacts of this species.

6.3 Fauna

6.3.1 Level 1 Fauna Survey

6.3.1.1 Fauna Inventory

Fifty-one vertebrate fauna species were recorded within the survey area during the field survey. This comprised three reptile, one amphibian, 11 mammal and 36 bird species. The observed species are presented in Table 24.

6.3.1.2 Conservation Significant Fauna Species

Seven of the 51 recorded vertebrate fauna species were of conservation significance, including six birds and one mammal. These include:

- Forest Red-Tailed Black Cockatoo *Calyptorhynchus banksii* (listed as Vulnerable under the EPBC Act and the BC Act). Refer to 6.3.3 for further details.
- Carnaby's Cockatoo *Calyptorhynchus latirostris* (listed as Endangered under the EPBC Act and the BC Act). Refer to 6.3.3 for further details.
- Quenda *Isoodon fusciventer* (listed as Priority 4 by DBCA). Refer to Plate 3 for photographs of Quenda diggings and scat recorded within the survey area.
- Fan-Tailed Cuckoo *Cacomantis flabelliformis,* Horsfield's Bronze Cuckoo *Chrysococcyx basalis*, Magpie Lark *Grallina cyanoleuca* and Rainbow Bee-Eater *Merops ornatus* (listed as Marine under the EPBC Act). Species listed as Marine under the EPBC Act are only considered significant in Commonwealth land and as the survey area does not contain Commonwealth land these species will not be further discussed within the report.

Based on the desktop assessment and the field survey, the following additional conservation significant fauna species are considered to have the potential to utilise the habitats within the survey area:

- Baudin’s Cockatoo *Calyptorhynchus baudinii* - listed as Vulnerable under the BC Act and the EPBC Act
- Carter's Freshwater Mussel *Westralunio carteri* - listed as Vulnerable under the BC Act and the EPBC Act.

Refer to Table 25 and Appendix A for further detail on these conservation significant species.



Plate 3 Quenda observations within the survey area

Table 24 Vertebrate fauna species recorded within the survey area

Species	Vernacular	Status	Observations
Birds			
Anas superciliosa	Pacific Black Duck	Native	Observed in artificial ponds
Anthochaera carunculata	Red Wattlebird	Native	Commonly seen and heard throughout survey area
Cacatua roseicapilla roseicapilla	Galah	Native	Observed multiple times during survey
Cacatua sanguinea	Western Corella	Native	Small flock observed in trees
Cacomantis flabelliformis	Fan-tailed Cuckoo	Native	Heard in trees in paddock
Calyptorhynchus banksii	Forest Red-tailed Black Cockatoo	Native	Two birds observed foraging in Marri tree, multiple birds seen flying over area, multiple observations of foraging evidence
Calyptorhynchus latirostris	Carnaby's Cockatoo	Native	Foraging evidence observed
Chenonetta jubata	Australia Wood Duck	Native	Observed multiple times during survey

Species	Vernacular	Status	Observations
Birds			
Chrysococcyx basalis	Horsfield's Bronze Cuckoo	Native	Heard multiple times
Colluricincla harmonica	Grey Shrikethrush	Native	Heard in Flooded Gums adjacent drainage line
Corvus coronoides	Australian Raven	Native	Commonly seen and heard throughout survey
Cracticus tibicen	Australian Magpie	Native	Commonly seen and heard throughout survey
Cracticus torquatus	Grey Butcherbird	Native	Observed flying through maintained gardens
Dacelo novaeguineae	Laughing Kookaburra	Naturalised exotic	Commonly seen and heard throughout survey area
Dromaius novaehollandiae	Emu	Native	Individual observed in an enclosure
Petrochelidon nigricans	Tree Martin	Native	Flock of approx. 10 birds observed flying in survey area
Gerygone fusca	Western Gerygone	Native	Seen in survey area
Grallina cyanoleuca	Magpie Lark	Native	Commonly seen and heard throughout Survey
Gavicalis virescens	Singing Honeyeater	Native	Common throughout survey area
Malurus splendens	Splendid Fairywren	Native	Seen and heard twice in survey area
Merops ornatus	Rainbow Bee-Eater	Native	Multiple observations recorded throughout survey area
Ocyphaps Lophotes	Crested Pigeon	Native	Observed several times
Pardalotus striatus	Striated Pardalote	Native	Commonly seen and heard throughout survey area
Pavo cristatus	Common Peafowl	Introduced	Heard several times
Phaps chalcoptera	Common Bronzewing	Native	Observed several times in survey area
Phylidonyris niger	White-cheeked Honeyeater	Native	Observed multiple times in survey area
Phylidonyris novaehollandiae	New Holland Honeyeater	Native	Commonly seen and heard throughout survey
Platycercus spurius	Red-capped Parrot	Native	Observed individuals and foraging evidence multiple times
Platycercus zonarius	Australian Ringneck	Native	Commonly seen and heard throughout survey area
Rhipidura leucophrys	Willie Wagtail	Native	Commonly seen and heard throughout survey area
Spilopelia senegalensis senegalensis	Laughing Turtle Dove	Introduced	Seen and heard multiple times in trees and flying over survey area
Taeniopygia guttata	Zebra Finch	Native	Two finches observed in Jarrah tree
Threskiornis moluccus	Australian White Ibis	Native	Observed multiple times during survey

Species	Vernacular	Status	Observations
Birds			
Todiramphus sanctus	Sacred Kingfisher	Native	Individual in tree in maintained garden
Trichoglossus moluccanus	Rainbow Lorikeet	Introduced	Seen and heard multiple times within survey area
Zosterops lateralis	Silver Eye	Native	Observed twice in survey area, flying through trees and in banksia woodland
Mammals			
Canis familiaris	Dog	Introduced	Common throughout survey area
Capra hircus	Goat	Introduced	Observed in paddock
Equus asinus	Donkey	Introduced	Observed in field
Equus caballus	Horse	Introduced	Horses observed in multiple paddocks in survey area
Felis catus	Cat	Introduced	Seen once during survey
Isoodon fusciventer	Quenda	Native	Observed directly and indirectly (conical digging and scat) several times in survey area
Lama glama	Llama	Introduced	Observed in field
Macropus fuliginosus	Western Grey Kangaroo	Native	Observed directly and indirectly several times in survey area
Oryctolagus cuniculus	Rabbit	Introduced	Observed directly and indirectly several times in survey area
Ovis aries	Sheep	Introduced	Observed in paddock
Vulpes vulpes	Red Fox	Introduced	Multiple scats recorded
Amphibians			
Crinia glauerti	Clicking Froglet	Native	Heard calling multiple times in drainage lines
Reptiles			
Cryptoblepharus buchananii	Buchanan's Snake-Eyed Skink	Native	Seen multiple times on trees throughout survey area
Pogona minor minor	Western Bearded Dragon	Native	Observed in survey area
Tiliqua rugosa rugosa	Bobtail	Native	Observed twice during survey

6.3.1.3 Introduced Species

Thirteen introduced and naturalised exotic species were recorded during the field survey. The species and their legal status under the BAM Act are listed below:

- Cat *Felis catus* – Permitted – s11
- Common Peafowl *Pavo cristatus* – Permitted – s11 (Exempt)
- Domestic Dog *Canis familiaris* – Permitted – s11
- Donkey *Equus asinu* - Permitted - s11
- Horse *Equus caballus* - Permitted - s11
- European Wild Rabbit *Oryctolagus cuniculus* – Declared Pest – s22(2) (C3 Prohibited)
- Goat *Capra hircus* - Permitted - s11
- Laughing Kookaburra *Dacelo novaeguineae* – Permitted – s11
- Laughing Turtle-Dove *Streptopelia senegalensis* – Permitted – s11.
- Llama *Lama glama* - Permitted - s11
- Rainbow Lorikeet *Trichoglossus haematodus* - Declared Pest - s22(2) (C3 Exempt)
- Red Fox *Vulpes vulpes* - Declared Pest – s22(2) (C3 Prohibited)
- Sheep *Ovis aries* - Permitted - s11.

The European Wild Rabbit, Red Fox and Rainbow Lorikeet are listed as Declared Pests under the BAM Act. Generally, these species were recorded sporadically throughout the survey area and were observed directly, or identified by tracks, scats and burrows.

Refer to Section 3.0 for explanations of BAM Act categories.

6.3.2 Fauna Habitat

Six broadly defined fauna habitats have been mapped within the survey area (Table 25 and Figure 10). Other than cleared areas, the most common fauna habitat is Scattered Trees. This habitat is highly variable and highly modified, and includes a mix of native and non-native eucalypts and other tree species over predominantly cleared ground. This habitat occupies 48.78 ha (28.5%) of the survey area. This habitat may be utilised as breeding, roosting and foraging habitat by the Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*), Carnaby's Cockatoo (*Calyptorhynchus latirostris*) and Baudin's Cockatoo (*Calyptorhynchus baudinii*), depending on the tree species present. This habitat is also likely to be utilised by many of the common avian species in the area.

Table 25 describes these fauna habitats, includes the area and percentage these cover within the survey area, and the conservation significant fauna species likely to utilise these habitats.

6.3.3 Fauna Habitat Linkages

Habitat linkages are typically areas or corridors of vegetation that link (larger) areas of fauna habitat. Linkages are important as they enable fauna to move freely between remnant bushland patches, therefore increasing gene-flow between populations. A study conducted by Gilbert *et al.* (1998) found that corridors and/or linkages do maintain species richness in the fragmented landscapes.

The survey area is located on the edge of a metropolitan area with significant amounts of cleared and highly modified land. Although the survey area probably does not contain any significant habitat linkages, predominantly due to clearing, habitat fragmentation and arterial roads bisecting the area, it does contain degraded drainage lines that may enable some fauna taxa to move through the area. It also sits near the Kenwick Wetlands and habitat adjacent the Hartfield Golf Club, and the survey area may provide for movement of fauna into and out of these areas. In saying the above, avian fauna species are more likely to utilise the survey area as a stepping stone from the larger areas of fauna habitat on the darling scarp, to the fragmented habitats of the Swan Coastal Plain.

Table 25 Fauna habitats recorded within the survey area

Fauna Habitat	Description	Conservation Significant Species with Potential to Utilise Habitat	Area (ha)	% of Survey Area	Photo
Banksia Woodland	This habitat generally comprised a low open woodland of Banksia and Eucalyptus over a low open shrubland on loamy, sandy brown soil. The habitat is generally considered high quality due to presence of Banksia, its complexity and limited disturbance levels. Habitat quality is be reduced where areas are significantly degraded due to impacts from clearing and edge effects. Significant habitat characteristics include: • dense understorey common • logs of various sizes are common • fine and course leaf litter common to abundant • bare ground occasionally present • absence of stones and boulders • Large mature trees in rare to occasional abundance • Large hollows generally absent, small hollows common.	• Generally good quality foraging habitat for Carnaby's Cockatoo and Baudin's Cockatoo • Moderate to low quality foraging habitat for the Forest Red-tailed Black Cockatoo • Contains occasional breeding tree for black cockatoos • Habitat for Quenda.	3.52	2.06	

Fauna Habitat	Description	Conservation Significant Species with Potential to Utilise Habitat	Area (ha)	% of Survey Area	Photo
Drainage Line	This riparian habitat is generally degraded and variable throughout the survey area, but often contains a drainage line with scattered Marri and Flooded Gum over shrubland and introduced weeds / reeds. The habitat is considered high to moderate quality due to its wetland and riparian nature, but often reduced in quality due to limited understorey, high weed cover and disturbance levels.	• May contain foraging, roosting and / or breeding habitat for all three black cockatoo species, where mature eucalypts are present • Habitat for Quenda • Potential marginal habitat for Carter's Freshwater Mussel.	1.27	0.74	 

Fauna Habitat	Description	Conservation Significant Species with Potential to Utilise Habitat	Area (ha)	% of Survey Area	Photo
Eucalyptus Woodland	This habitat is variable throughout the survey area though generally contains a *Eucalyptus* woodland / open forest over a low shrubland over sandy brown soils. This habitat is considered high to moderate (depending on degree of degradation) quality due to the structural complexity and disturbance levels. Significant habitat characteristics include: • presence of large mature eucalypts • dense understorey occasionally present • logs of various sizes in variable abundance • fine and course leaf litter common • bare ground occasionally present • absence of stones and boulders • large hollows occasionally present, small hollows common • soils of areas at base of Darling scarp contained pea gravel.	• Foraging, breeding and roosting habitat for: - Forest Red-tailed Black Cockatoo - Carnaby's Cockatoo - Baudin's Cockatoo • Habitat for Quenda	3.94	2.31	 

Fauna Habitat	Description	Conservation Significant Species with Potential to Utilise Habitat	Area (ha)	% of Survey Area	Photo
Shrubland	This habitat generally comprised small areas of open, often degraded shrubland on sandy soils. This habitat was generally considered moderate to low quality fauna due to being highly modified and disturbed, with limited structural complexity. The significant fauna habitat characteristics include: • bare ground occasional to common abundance • dense understorey present in patches • minimal large trees • vegetation containing occasional small hollows, large hollows rare • decorticating bark and course leaf litter present in patches • stones and boulders generally absent • small and medium sized fallen branches occasional abundance.	• Potentially provides low quality foraging habitat for all three black cockatoo species depending on flora species present. • Habitat for Quenda.	0.30	0.18	

Fauna Habitat	Description	Conservation Significant Species with Potential to Utilise Habitat	Area (ha)	% of Survey Area	Photo
Planted and Maintained Gardens	Highly variable habitat including areas of planted and maintained native and introduced vegetation. The habitat is considered low to moderate quality due to disturbance levels and limited habitat complexity. Significant habitat characteristics include: • mature trees rare • variability of understorey, with areas of dense understorey generally absent • general lack of hollows • bare sandy ground abundant • absence of stones, boulders and rock crevices.	• Predominantly foraging habitat, but also occasionally breeding and roosting habitat for: - Forest Red-tailed Black Cockatoo - Carnaby's Cockatoo - Baudin's Cockatoo • Habitat for Quenda.	7.25	4.24	
Scattered Trees	This habitat is varied and contains large mature native and non-native eucalypt trees, as well as other introduced species such as Cape Lilac and Jacaranda. Trees were generally recorded over cleared areas. The significant fauna habitat characteristics include: • Presence of large mature trees • Absence of dense understorey • Small hollows are common,	• Foraging, breeding and roosting habitat for: - Forest Red-tailed Black Cockatoo - Carnaby's Cockatoo - Baudin's Cockatoo • Marginal habitat for Quenda.	48.78	28.54	

Fauna Habitat	Description	Conservation Significant Species with Potential to Utilise Habitat	Area (ha)	% of Survey Area	Photo
	large hollows are rare • Logs of all sizes are rare to occasionally present • Course and fine litter are present but generally only under trees. • Bare sandy ground abundant • Absence of stones, boulders and rock crevices.				 

Fauna Habitat	Description	Conservation Significant Species with Potential to Utilise Habitat	Area (ha)	% of Survey Area	Photo
Cleared Ground	Generally areas which have been cleared (e.g. paddocks) and now comprise bare soil and / or weeds (may contain the occasional shrub / tree), or hardstand areas (e.g. roads). Habitat is considered very low quality	This habitat may contain the occasional individual foraging tree / shrub for black cockatoos.	71.82	42.02	

Note: Areas of hardstand (e.g. buildings, roads etc) were also mapped, however these provide little in the way of fauna habitat.

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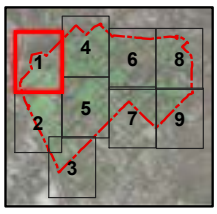
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LEGEND

- Wattle Grove South Area
- Survey Area
- Opportunistic Fauna Observations

FaunaHabit

- Banksia Woodland
- Drainage Line
- Eucalyptus Woodland
- Planted and Maintained Gardens
- Scattered Trees
- Shrubland
- Hardstand
- Cleared



Fauna Habitats

CITY OF KALAMUNDA

WATTLE GROVE SOUTH ECOLOGICAL SURVEYS

Figure

10.1

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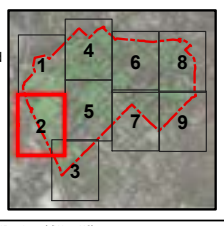
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LEGEND

- Wattle Grove South Area
- Survey Area
- Opportunistic Fauna Observations

FaunaHabit

- Banksia Woodland
- Drainage Line
- Eucalyptus Woodland
- Planted and Maintained Gardens
- Scattered Trees
- Shrubland
- Hardstand
- Cleared



Fauna Habitats

CITY OF KALAMUNDA

WATTLE GROVE SOUTH ECOLOGICAL SURVEYS

Figure

10.2

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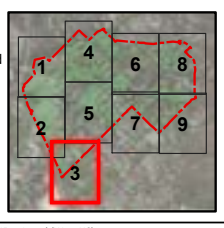
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LEGEND

- Wattle Grove South Area
- Survey Area
- Opportunistic Fauna Observations

FaunaHabit

- Banksia Woodland
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- Eucalyptus Woodland
- Planted and Maintained Gardens
- Scattered Trees
- Shrubland
- Hardstand
- Cleared



Fauna Habitats

CITY OF KALAMUNDA

WATTLE GROVE SOUTH ECOLOGICAL SURVEYS

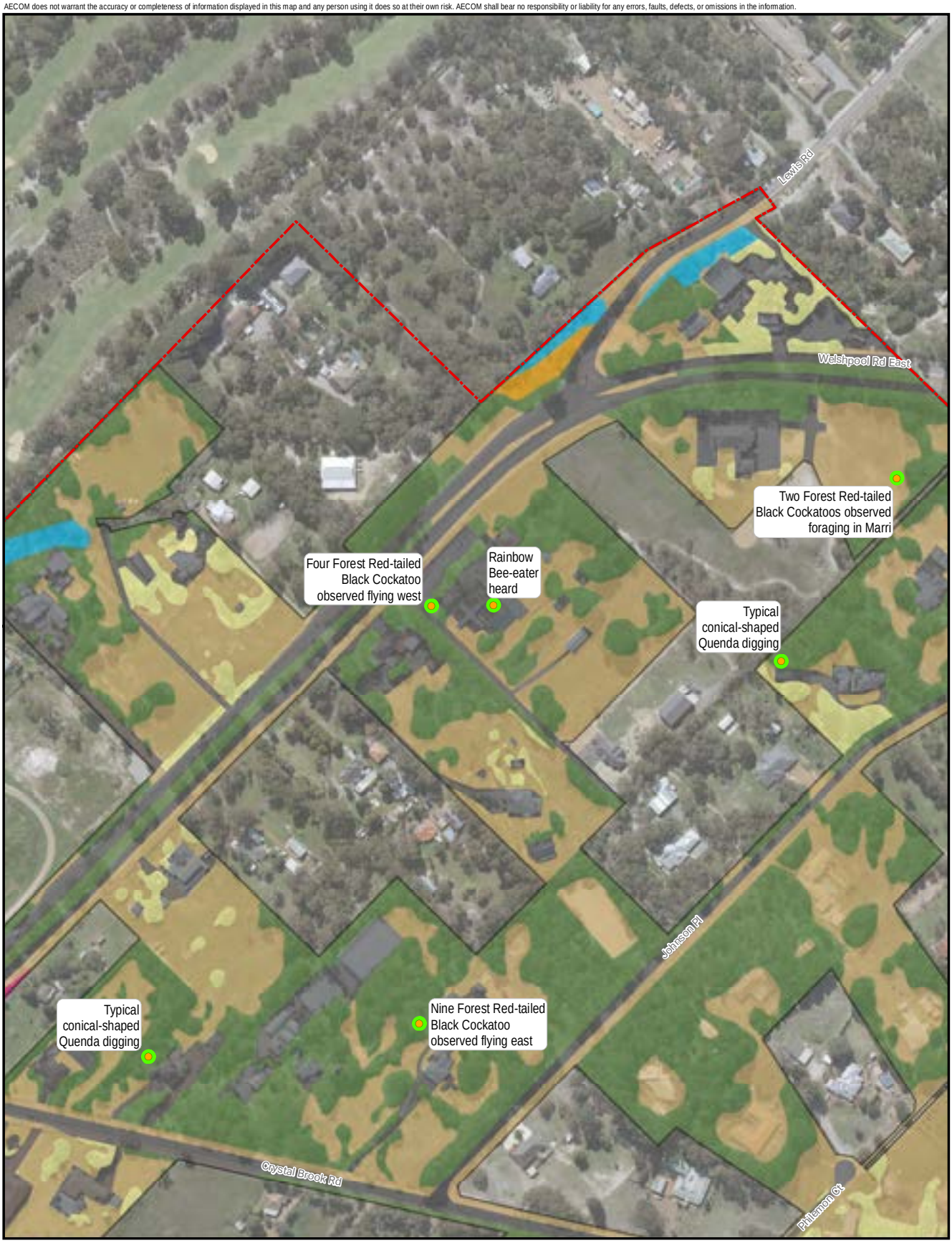
Figure

10.3

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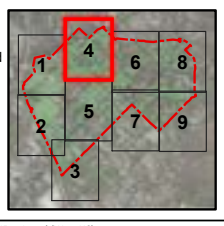
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LEGEND

- Wattle Grove South Area
- Survey Area
- Opportunistic Fauna Observations

FaunaHabit

- Banksia Woodland
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- Planted and Maintained Gardens
- Scattered Trees
- Shrubland
- Hardstand
- Cleared



Fauna Habitats

CITY OF KALAMUNDA

WATTLE GROVE SOUTH ECOLOGICAL SURVEYS

Figure
10.4

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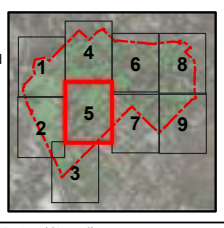
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LEGEND

- Wattle Grove South Area
- Survey Area
- Opportunistic Fauna Observations

FaunaHabit

- Banksia Woodland
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- Scattered Trees
- Shrubland
- Hardstand
- Cleared



Fauna Habitats

CITY OF KALAMUNDA

WATTLE GROVE SOUTH ECOLOGICAL SURVEYS

Figure 10.5

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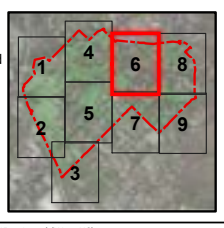
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LEGEND

- Wattle Grove South Area
- Survey Area
- Opportunistic Fauna Observations

FaunaHabit

- Banksia Woodland
- Drainage Line
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- Planted and Maintained Gardens
- Scattered Trees
- Shrubland
- Hardstand
- Cleared



Fauna Habitats

CITY OF KALAMUNDA

WATTLE GROVE SOUTH ECOLOGICAL SURVEYS

Figure

10.6

Map Document: \\AUPER1FP001\Projects\606X\60611889\900_CAD_GIS\920_GIS\02_MXDs\20200124_ReportFigures\G60611889_Fig10_FaunaHabitats_A4P_v1.mxd (WyattK2)

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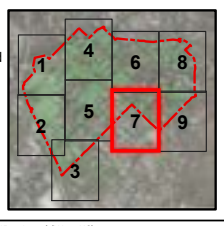
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LEGEND

- Wattle Grove South Area
- Survey Area
- Opportunistic Fauna Observations

FaunaHabit

- Banksia Woodland
- Drainage Line
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- Planted and Maintained Gardens
- Scattered Trees
- Shrubland
- Hardstand
- Cleared



Fauna Habitats

CITY OF KALAMUNDA

WATTLE GROVE SOUTH ECOLOGICAL SURVEYS

Figure

10.7

Map Document: \\AUPER1FP001\Projects\606X\60611889\900_CAD_GIS\920_GIS\02_MXDs\20200124_ReportFigures\G60611889_Fig10_FaunaHabitats_A4P_v1.mxd (WyattK2)

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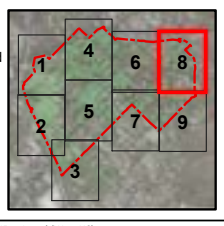
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LEGEND

- Wattle Grove South Area
- Survey Area
- Opportunistic Fauna Observations

FaunaHabit

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- Planted and Maintained Gardens
- Scattered Trees
- Shrubland
- Hardstand
- Cleared



Fauna Habitats

CITY OF KALAMUNDA

WATTLE GROVE SOUTH ECOLOGICAL SURVEYS

Figure

10.8

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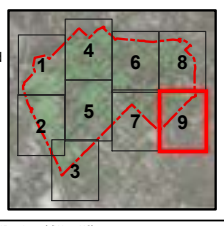
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LEGEND

- Wattle Grove South Area
- Survey Area
- Opportunistic Fauna Observations

FaunaHabit

- Banksia Woodland
- Drainage Line
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- Planted and Maintained Gardens
- Scattered Trees
- Shrubland
- Hardstand
- Cleared



Fauna Habitats

CITY OF KALAMUNDA

WATTLE GROVE SOUTH ECOLOGICAL SURVEYS

Figure

10.9

Map Document: \\AUPER1FP001\Projects\606X\60611889\900_CAD_GIS\920_GIS\02_MXDs\20200124_ReportFigures\G60611889_Fig10_FaunaHabitats_A4P_v1.mxd (WyattK2)

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6.4 Black Cockatoos

6.4.1 Ecology

6.4.1.1 Carnaby's Cockatoo

Carnaby's Cockatoo *Calyptorhynchus latirostris* is endemic to the southwest of Western Australia, extending from the Murchison River to Esperance, and inland to Coorow, Kellerberrin and Lake Cronin. This black cockatoo has a white patch on its cheek, white bands on its tail, and a strong curved bill. Carnaby's Cockatoo is a seasonal visitor to the Swan Coastal Plain, which provides important foraging and roosting habitat during the non-breeding season.

Carnaby's Cockatoo feeds on seeds, nuts and flowers of a variety of native and exotic plants. Feed plants include the various proteaceous species (e.g. *Banksia*, *Grevillea* and *Hakea*), Marri *Corymbia calophylla*, Jarrah *Eucalyptus marginata*, and seeds from the cones of Pine *Pinus* sp. trees. Cockatoo flocks follow vegetation corridors and actively avoid cleared and open areas when moving between roosting, water and food resources. Habitat fragmentation increases the distances cockatoos need to travel between resources. Proximity of foraging habitat and water has been demonstrated to be critical to support roosting and breeding sites (Le Roux, 2017).

Carnaby's Cockatoo displays strong pair bonds and nest in the hollows of live or dead mature eucalypts including Salmon Gum *Eucalyptus salmonophloia*, York *Gum E. loxophleba* subsp*. loxophleba*, Flooded Gum *E. rudis*, Karri *E. diversicolor,* Wandoo *E. wandoo* and Tuart *E. gomphocephala* and Marri *Corymbia calophylla*, (DSEWPaC, 2012). Nest hollows generally range from 2.5-12 m above ground, size of entrance from 23-30 cm and depth of hollows from 1-2.5 m (Johnstone and Storr,1998).

Carnaby's Cockatoo has undergone a dramatic decline of approximately 50 percent in the past 45 years, with the main contributing factors the clearing of core breeding habitat in the Wheatbelt, the deterioration of nesting hollows, and clearing of foraging habitat.

Breeding habitat for this species occurs in the Wheatbelt, Jarrah Forest and South Coast regions, and the species is expanding its current breeding range with small patches of breeding habitat now being utilised across the SCP. After breeding, Carnaby's Cockatoo disperse to the higher rainfall coastal areas of the south-west of Western Australia to feed in late December to July. Breeding has been recorded from early July to mid-December.

Carnaby's Cockatoos were not directly observed during the field survey, however probable foraging evidence was recorded on three occasions.

6.4.1.2 Forest Red-tailed Black Cockatoo

The Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso* is endemic to the south-west humid and semi-humid zones of Western Australia, where it inhabits dense Jarrah, Karri and Marri forests which receive more than 600 mm average annual rainfall (DSEWPaC, 2012). It has a pair of black central tail feathers and a bright red, orange or yellow barring on the tail.

This species predominantly feeds in eucalypt forests, preferring Marri *Corymbia calophylla* and Jarrah *Eucalyptus marginat*a seeds, but also feeding on Blackbutt *E. patens*, Albany Blackbutt *E. staeri*, Karri *E. diversicolor*, Sheoak *Allocasuarina sp.* and Snottygobble *Persoonia longifolia* (Johnstone, 2016 pers. comm.).

Forest Red-tailed Black Cockatoo are monogamous and pairs nest in tree hollows from 6.5 to 33 m above ground. Most nests are in very large and very old, mature Marri (Johnstone, Kirkby & Sarti, 2013), though they will nest in other eucalypts such as Tuart (Johnstone, 2016 pers. comm.). Breeding habitat for this species occurs in the eastern margins of the Jarrah forests of the Wheatbelt, and within the Jarrah Forest regions, and the Forest Red-tailed Black Cockatoo is expanding its current breeding range with small patches of breeding habitat now being utilised across the SCP.

Two individuals of the Forest Red-tailed Black Cockatoo were observed foraging in a Marri tree, multiple birds were seen and heard flying over the survey area, and multiple observations of old and recent foraging evidence (Table 24) was recorded during the field survey.

6.4.1.3 Baudin's Cockatoo

Baudin's Cockatoo *Calyptorhynchus baudinii* is distributed throughout the south-western humid and subhumid zones, from the northern Darling Range and adjacent far east of the SCP (south of the Swan River), south to Bunbury and across to Albany (Johnstone & Storr, 1998). It is a large black cockatoo with rectangular white patches in the tail. Males have a pink eye ring, the female a dark eye ring.

Baudin's Cockatoo forages primarily in eucalypt forest, where it feeds on seeds, flowers, nectar and buds from Marri *Corymbia calophylla*, and seeds of *Eucalyptus* and proteaceous species (e.g. *Banksia* and *Hakea*), as well as orchard fruits and Pines *Pinus* sp. It also takes insect larvae and insects (including beetle, wasp and moth larvae) from under bark and in wood of live and dead trees, from galls and from flower spikes of *Xanthorrhoea* and the pith of *Anigozanthos flavidus* (Johnstone & Kirkby, 2008).

This black cockatoo primarily nests in tree hollows in live or dead Karri *Eucalyptus diversicolor*, Marri *Corymbia calophylla*, Wandoo *Eucalyptus wandoo* and Tuart *Eucalyptus gomphocephala* (DSEWPaC, 2012b). Baudin's Cockatoo nests in spring in the deep southwest of Western Australia.

No Baudin's Cockatoos or foraging evidence were observed in or adjacent the survey area.

6.4.2 Breeding

Hollow formation in Eucalypt trees is a result of a number of processes including fungal attack, termites and fire, and the propensity for hollow formation varies between species (Whitford, 2002). In order to be suitable for black cockatoos, hollow entrances need to be at least 100 mm in diameter.

A total of 730 hollow-forming (generally native) breeding habitat trees were identified within the survey area. Just over 56% of these were Marri and 27% were Jarrah, with the remaining Tuart, stags, Flooded Gums, Wandoo and *Eucalyptus todtiana*. Hollows in Jarrah tend to be smaller than those found in Marri, consequently, black cockatoos, particularly Forest Red-tailed Black Cockatoos breed predominantly in Marri in the Jarrah-Marri forest of the south west (Whitford, 2002; Johnstone *et al*., 2013). On the Swan Coastal Plain most black cockatoo breeding records, particularly for Carnaby's Cockatoo are in Tuart (Johnstone & Kirkby, 2011), which were just over 6% of the total number of breeding habitat trees within the survey area.

Seventeen of the 730 trees contain a total of 26 potentially suitable hollows for breeding black cockatoos. All were considered to be large enough at their entrances with potentially sufficient floor and chamber space (when observed from the ground). However, hollows could not generally be fully inspected from the ground to determine if the hollows were deep enough for nesting to occur.

Refer to Appendix E for the details of the 17 trees with potentially suitable hollows, Figure 11 for locations of these trees and Appendix F full details of all 730 breeding habitat trees.

6.4.3 Roosting

Carnaby's and Baudin's Cockatoos roost in or near riparian environments or near other permanent water sources, generally within any tall trees, but particularly Flat-topped Yate, Salmon Gum, Wandoo, Marri, Karri, Blackbutt, Tuart, introduced eucalypts and introduced pines. The Forest Red-tailed Black Cockatoo prefers the edges of forests for roosting, within any tall trees, but particularly tall Jarrah, Marri, Blackbutt, Tuart and introduced eucalypt trees (DotEE, 2017). The Birdlife (2018) black cockatoo roosting data contains a confirmed Forest Red-tailed Black Cockatoo roosting site in the survey area at 35 Gavour Road, with one unconfirmed roost site located at 121 Crystal Brooke Road.

No additional roosting sites were confirmed during the field survey.

6.4.4 Foraging habitat

6.4.4.1 Carnaby's Cockatoo

The survey area contains a total of 69.39 ha of foraging habitat for Carnaby's Cockatoo. This includes 41.14 ha of Very High and High Quality foraging habitat. This generally consisted of habitats contiaing scattered mature eucalypts (potential breeding trees). Foraging habitat is presented in Figure 12, and total areas for each foraging quality are presented in Table 26. The foraging quality assessments are presented in Appendix E.

Carnaby's Cockatoo foraging evidence was recorded at three locations within the survey area (refer to Table 27).

Table 26 Carnaby's Cockatoo foraging habitat areas

Foraging Quality	Area (ha)
Low Quality (1-3)	10.33
Quality (4-6)	17.91
High Quality (7-8)	4.52
Very High Quality (>8)	36.62
TOTAL	69.39

Table 27 Potential Carnaby's Cockatoo foraging evidence

ID	Coordinates	Plate
16	116.0177, -32.0122	
46	116.004, -32.0048	

ID	Coordinates	Plate
107	116.0022, -32.0219	

6.4.4.2 Forest Red-tailed Black Cockatoo

The survey area contains a total of 59.53 ha of foraging habitat for the Forest Red-tailed Black Cockatoo. This includes 33.52 ha of Very High and High Quality foraging habitat, which generally consists of scattered mature Jarrah and Marri trees (potential breeding trees). Foraging habitat is presented spatially in Figure 13, and the total areas for each foraging quality are presented in Table 28. The foraging quality assessments are presented in Appendix E.

Potential foraging evidence from the Forest Red-tailed Black Cockatoo were recorded commonly throughout the survey area (Table 30).

Table 28 Forest Red-tailed Black Cockatoo foraging habitat areas

Foraging Quality	Area (ha)
Low Quality (1-3)	22.10
Quality (4-6)	3.92
High Quality (7-8)	0.00
Very High Quality (>8)	33.52
TOTAL	59.53

6.4.4.3 Baudin's Cockatoo

The survey area contains a total of 69.39 ha of foraging habitat for the Baudin's Cockatoo. This includes 41.14 ha of High Quality and Very High Quality foraging habitat, which generally consists of scattered eucalypts (potential breeding trees). Foraging habitat is presented spatially in Figure 14, and the total areas for each foraging quality are presented in Table 29. The foraging quality assessments are presented in Appendix E.

No foraging evidence from the Baudin's Cockatoo was recorded within the survey area.

Table 29 Baudin's Cockatoo foraging habitat areas

Foraging Quality	Area (ha)
Low Quality (1-3)	13.73
Quality (4-6)	14.51
High Quality (7-8)	4.52
Very High Quality (>8)	36.62
TOTAL	69.39

Table 30 Potential Forest Red-tailed Black Cockatoo foraging evidence

ID	Coordinates	Plate	ID	Coordinates	Plate
5	116.0183, -32.0100		48	116.0067, -32.0058	
7	116.0177, -32.0105		59	116.0133, -32.0094	
10	116.0207, -32.0128		72	116.0207, -32.0106	
11	116.02, -32.01267		83	116.018, -32.0070	
12	116.0185, -32.01241		85	116.0208, -32.0056	
27	116.0084, -32.0040		87	116.0196, -32.0163	

ID	Coordinates	Plate	ID	Coordinates	Plate
30	116.0051, -32.00934		89	116.02, -32.0162	
31	116.0055, -32.0092		90	116.0233, -32.0129	
39	116.0166, -32.0135		94	116.0071, -32.0058	
42	116.0115, -32.0059		106	116.003, -32.0227	

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LEGEND
- Wattle Grove South Area
- Survey Area

Black Cockatoo Breeding Trees
- Black Cockatoo Breeding Trees
- Potential Black Cockatoo Breeding Trees

Black Cockatoo Breeding Trees

CITY OF KALAMUNDA

WATTLE GROVE SOUTH ECOLOGICAL SURVEYS

Figure 11

Map Document: \\AUPER1FP001\Projects\606X\60611889\900_CAD_GIS\920_GIS\02_MXDs\20200124_ReportFigures\G60611889_Fig11_BC_BreedingTrees_A4P_v1.mxd (WyattK2)

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LEGEND
- Wattle Grove South Area
- Survey Area
- Low Quality
- Quality
- High Quality
- Very High Quality
- ★ Opportunistic Fauna Observations

Carnaby's Cockatoo Foraging Habitat

CITY OF KALAMUNDA

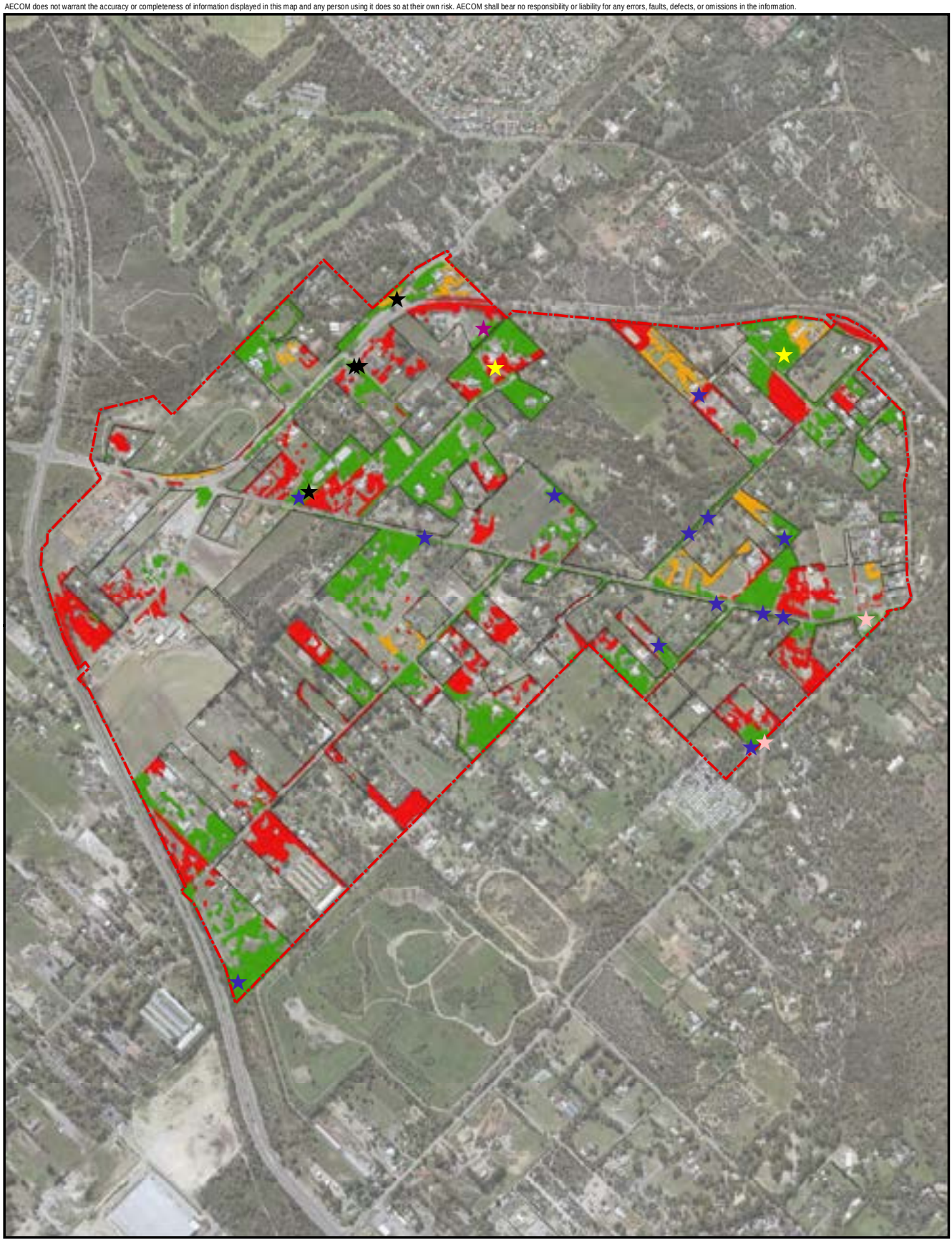
WATTLE GROVE SOUTH ECOLOGICAL SURVEYS

Figure
12

Map Document: \\AUPER1FP001\Projects\606X\60611889\900_CAD_GIS\920_GIS\02_MXDs\20200124_ReportFigures\G60611889_Fig12_CarnabysForagingHabitat_A4P_v1.mxd (WyattK2)

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DATUM GDA 1994 MGA Zone 50
0 100 200 300 400
Metres

Data sources:

Base Data: (c) Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010),Geoscience Australia, Streetpro

LEGEND

- Wattle Grove South Area
- Survey Area
- Low Quality
- Quality
- Very High Quality

Opportunistic Fauna Observations

- Possible foraging evidence
- Possible old foraging evidence
- Possible recent foraging evidence
- Recent and old possible foraging evidence
- Two Forest Red-tailed Black Cockatoos observed foraging in Marri

Forest Red-tailed Black Cockatoo Foraging Habitat

CITY OF KALAMUNDA

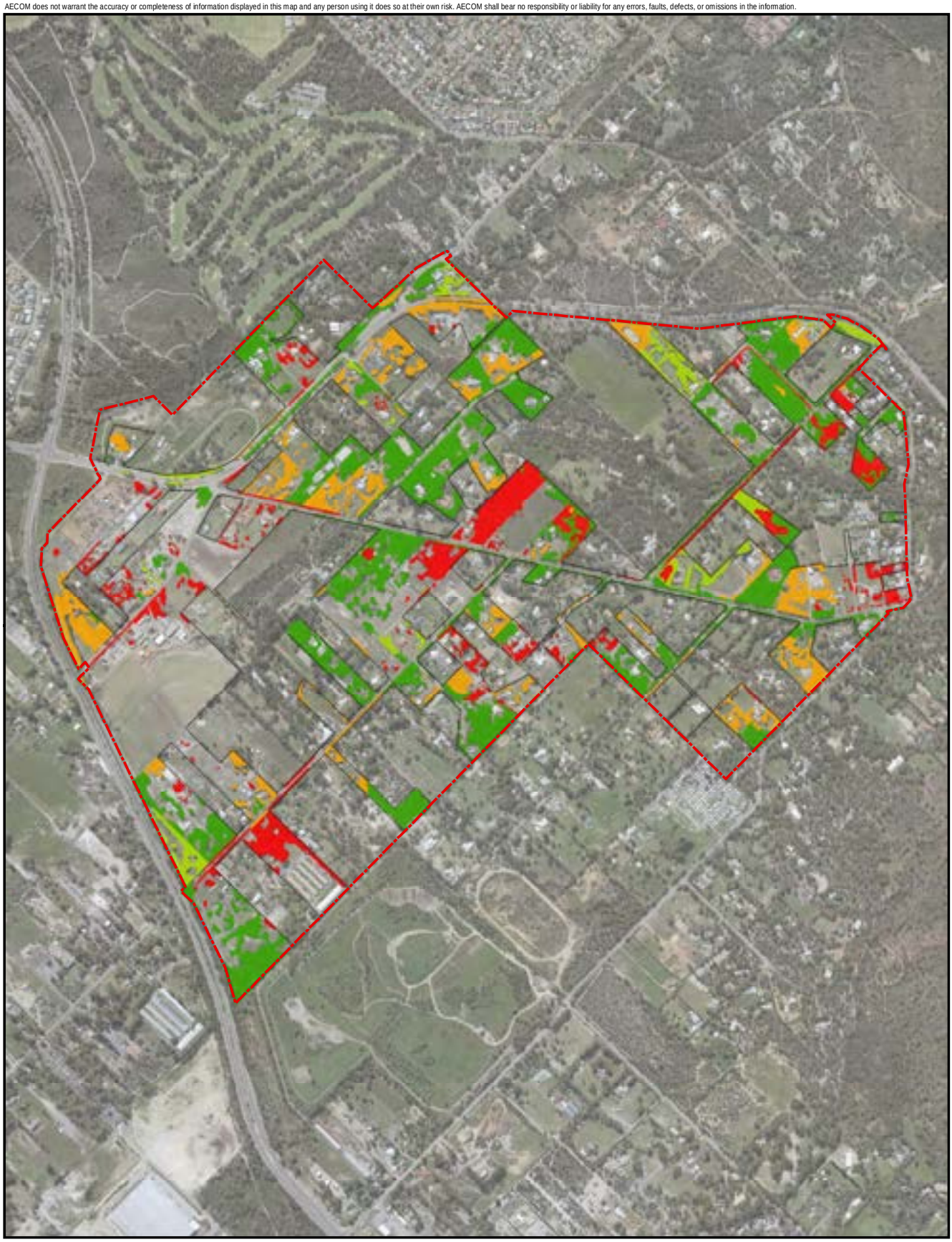
WATTLE GROVE SOUTH ECOLOGICAL SURVEYS

Figure
13

Map Document: \\AUPER1FP001\Projects\606X\60611889\900_CAD_GIS\920_GIS\02_MXDs\20200124_ReportFigures\G60611889_Fig13_FRTBCForagingHabitat_A4P_v1.mxd (WyattK2)

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DATUM GDA 1994 MGA Zone 50
0 100 200 300 400
Metres

Data sources:

Base Data: (c) Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010),Geoscience Australia, Streetpro

LEGEND
- Wattle Grove South Area
- Survey Area
- Low Quality
- Quality
- High Quality
- Very High Quality

Baudin's Cockatoo Foraging Habitat

CITY OF KALAMUNDA

WATTLE GROVE SOUTH ECOLOGICAL SURVEYS

Figure
14

Map Document: \\AUPER1FP001\Projects\606X\60611889\900_CAD_GIS\920_GIS\02_MXDs\20200124_ReportFigures\G60611889_Fig14_BaudinsForagingHabitat_A4P_v1.mxd (WyattK2)

A4 size

6.5 Environmental Values Assessment

The EVA was undertaken for the entire Wattle Grove South survey area (Figure 15). This Figure shows the high, medium and low value areas. Evaluation for areas that were not surveyed was based on observations taken from outside the property and review of aerial photographs. The Environmental Values assessment for areas surveyed is presented in Figure 16.

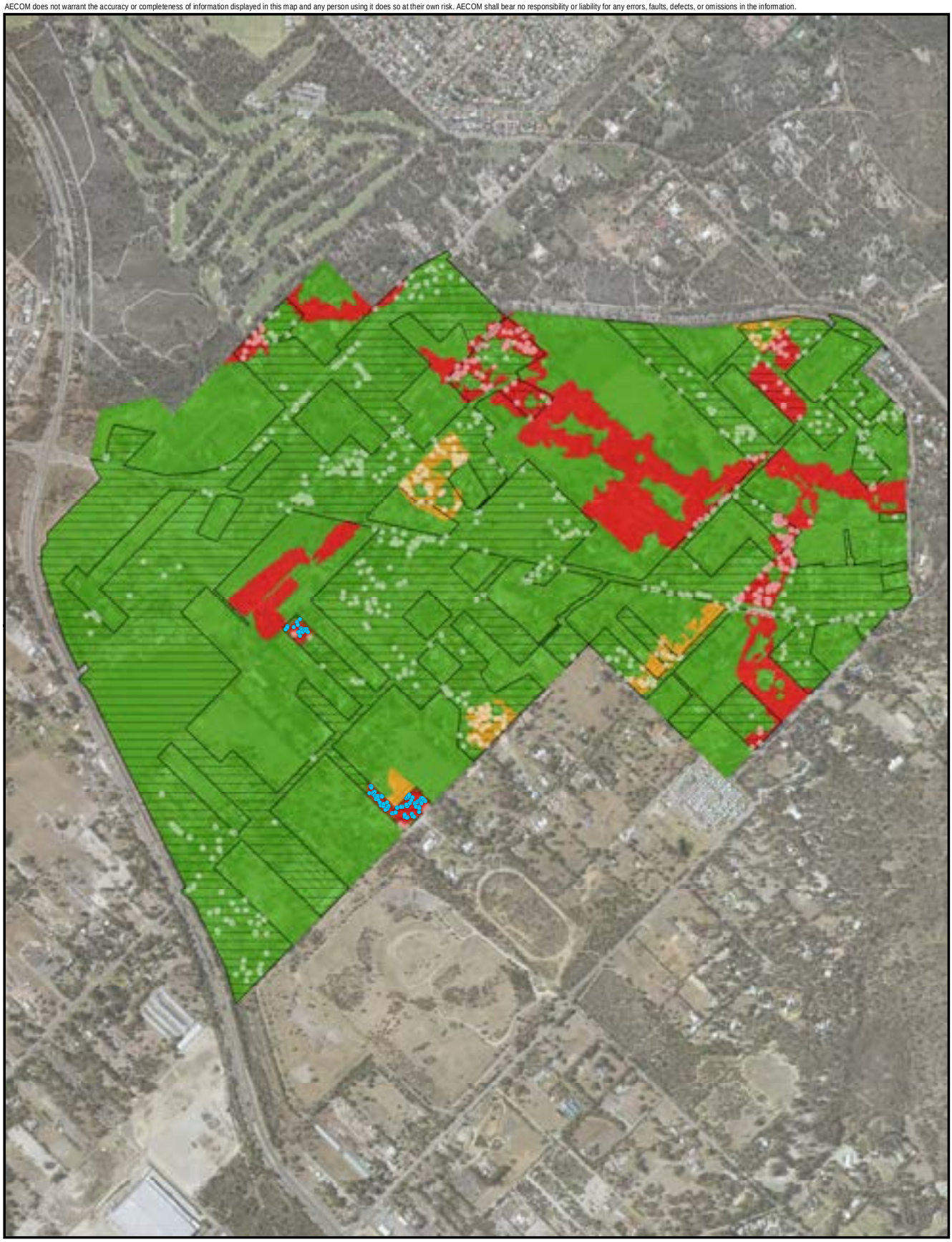
The resultant values assessment map also depicts black cockatoo habitat trees (with a 10 m buffer) to ensure these valuable assets are captured. These buffer areas are not included as part of the EVA unless they form part of a dense collection or support remnant understorey as such because they reflect point data. It is recommended that all trees are retained wherever possible. Mature trees take decades to establish and as such should be considered high value throughout. It is likely that areas not surveyed would also support black cockatoo breeding habitat trees that are as yet undefined in the EVA.

The extent of areas captured in high, medium and low are presented in Table 31.

Table 31 Categories for the environmental values assessment

Category	Values	Area
High	• Good connectivity and/or suitable size for maintaining ecological integrity • BC foraging and/or breeding trees • All populations of *C. undulatum* that were recorded during the survey • Incorporates all TECs with the exception of two patches that are <0.2 ha which are captured as Medium • Includes 90% of areas mapped as “native vegetation” with exception of areas <0.2 ha with poor connectivity.	35.13 ha
Medium	• Connects high value areas to adjacent high value areas or as ‘stepping stone’ • Includes BC foraging and/or breeding • May include native vegetation (understorey) species	6.88 ha
Low	• Mostly cleared open areas or stands of trees over grassland • Includes planted gardens and hardscape	301.36 ha

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0 100 200 300 400
Metres

Data sources:

Base Data: (c) Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010),Geoscience Australia, Streetpro

LEGEND
- Survey Area
- High Value
- Medium Value
- Low Value
- Black Cockatoo Breeding Habitat
- *Conospermum undulatum* Locations

Environmental Values – Extrapolated and Surveyed

CITY OF KALAMUNDA

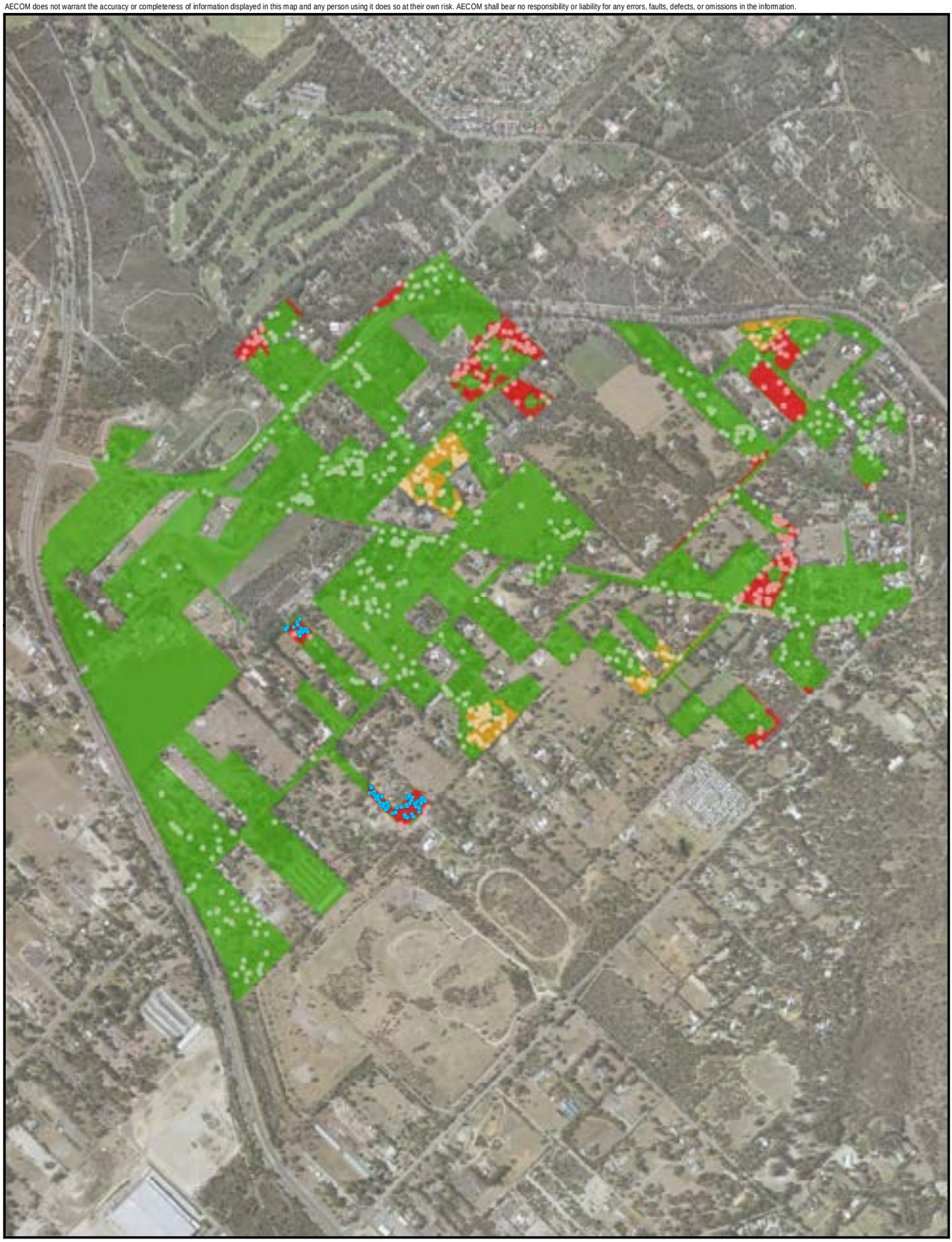
WATTLE GROVE SOUTH ECOLOGICAL SURVEYS

Figure
15

Map Document: \\AUPER1FP001\Projects\606X\60611889\900_CAD_GIS\920_GIS\02_MXDs\20200124_ReportFigures\G60611889_Fig15_EnvironmentalValuesMap1_A4P_v1.mxd (WyattK2)

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0 100 200 300 400
Metres

Data sources:

Base Data: (c) Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010),Geoscience Australia, Streetpro

LEGEND
- High Value
- Medium Value
- Low Value
- Black Cockatoo Breeding Habitat
- *Conospermum undulatum* Locations

Environmental Values – Surveyed

CITY OF KALAMUNDA

WATTLE GROVE SOUTH ECOLOGICAL SURVEYS

Figure
16

Map Document: \\AUPER1FP001\Projects\606X\60611889\900_CAD_GIS\920_GIS\02_MXDs\20200124_ReportFigures\G60611889_Fig16_EnvironmentalValuesMap2_A4P_v1.mxd (WyattK2)

A4 size

7.0 Conclusions

The significant ecological findings from the assessment of the survey area are outlined below:

- The EPBC TEC Banksia Woodlands of the SCP occurs in three patches, extending 2.41 ha.
- Three TECs and one PEC listed by DBCA were identified including;
  - WA TEC *C. calophylla-E. marginata* woodlands on sandy clay soils (SCP3b) – requires verification from DBCA, extending 1.71 ha across two patches
  - WA TEC *B. attenuata* and/or *E. marginata* woodlands of the eastern side of the SCP (SCP20b) – requires verification from DBCA extending 1.80 across three patches
  - WA TEC *Banksia attenuata* woodland over species rich dense shrublands (SCP20a) extending 0.94 ha at one location
  - WA PEC Banksia dominated woodlands of the SCP extending for 0.15 ha at one location.
- One Threatened flora species, *Conospermum undulatum* (Wavy-leaved Smokebush) was recorded on two properties comprising 95 individuals. These locations are not represented in the DBCA database records.
- Three conservation significant fauna species were recorded including the Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii* (listed as Vulnerable under the EPBC Act and the BC Act), Carnaby's Cockatoo *Calyptorhynchus latirostris* (listed as Endangered under the EPBC Act and the BC Act) and the Quenda *Isoodon fusciventer* (listed as Priority 4 by DBCA).
- Six fauna habitats were mapped. The most common fauna habitat is the Scattered Trees habitat which may be utilised by conservation significant species including the Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso*, Carnaby's Cockatoo *Calyptorhynchus latirostris* and Baudin's Cockatoo *Calyptorhynchus baudinii,* as well as by many of the common bird species in the area.
- The presence of 730 hollow-forming (generally native) breeding and potential breeding trees including 410 (56%) Marri *Corymbia calophylla,* 195 (27%) Jarrah *Eucalyptus marginata*, and 125 mixed Flooded Gum **E. grandis*, Tuart *E. gomphocephala*, *E. todtiana*, E. w*andoo*, introduced species and stags (dead unidentifiable trees). Seventeen of the 730 trees contain a total of 26 potentially suitable hollows for breeding black cockatoos.
- A total of 69.39 ha of foraging habitat for Carnaby's Cockatoo. This includes 41.14 ha of Very High and High Quality foraging habitat which generally consisted of eucalypt and Banksia woodland and scattered mature eucalypts.
- A total of 59.53 ha of foraging habitat for the Forest Red-tailed Black Cockatoo. This includes 33.52 ha of Very High Quality foraging habitat which generally consists of eucalypt woodland containing breeding and potential breeding trees.
- A total of 69.39 ha of foraging habitat for Baudin's Cockatoo. This includes 41.14 ha of Very High and High Quality foraging habitat which generally consisted of eucalypt and Banksia woodland and scattered mature eucalypts.

The ecological assessments for the Wattle Grove project included significant access and completeness limitations. This report presents the results for a selection of private properties and public land where access was granted by private land owners. It is not a comprehensive assessment of ecological values of the Wattle Grove area with approximately 50% of landowners denying access.

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Appendix C Quadrat and relevé data sheets

Quadrat and relevé data sheets

Site: 6	**Location:** 116.00805 -32.01803	**Date:** 02-10-2019
Type: Quadrat	Size: 10x10	Community: BaEpPf
Topography: flat	Soils: sand	Colour: Grey
Bare Ground: 20% litter	Fire: 10+	
Vegetation significance: EPBC TEC Banksia Woodlands of the SCP; WA TEC *B. attenuata* over species rich dense shrublands		
Condition: excellent weed encroachment		
Photo		



*	Taxon	Height cm	Foliage %
	Burchardia congesta	20	0.1
	Conostylis setigera	10	0.1
	Dasypogon bromeliifolius	10	0.1
	Hemiphora bartlingii	40	0.1
*	*Hypochaeris glabra*	1	0.1
	Lomandra hermaphrodita	20	0.1
	Lomandra sonderi	30	0.1
	Melaleuca trichophylla	30	0.1

*	Taxon	Height cm	Foliage %
	Mesomelaena tetragona	30	0.1
	Persoonia angustiflora	10	0.1
	Stirlingia latifolia	30	0.1
	Stylidium amoenum	3	0.1
	Thysanotus patersonii		0.1
	Thysanotus thyrsoideus	10	0.1
	Trachymene pilosa	5	0.1
	Banksia dallanneyi	10	0.2
	Cassytha glabella		0.2
	Conospermum undulatum	80	0.2
	Hibbertia huegellii	20	0.2
	Philotheca spicata	80	0.2

*	*Ursinia anthemoides*	10	0.2
*	*Gladiolus caryophyllaceus*	60	0.3
	Isopogon autumnalis	40	0.3
*	*Briza maxima*	30	0.5
	Drosera porrecta	10	0.5
*	*Ehrharta calycina*	80	0.5
	Hovea trisperma	30	0.5
	Lomandra preissii	40	0.5
	Alexgeorgea nitens	10	1
	Hakea prostrata	80	1
	Scaevola repens var. repens	5	1
	Phlebocarya filifolia	10	1
	Schoenus pedicellatus	40	1
	Tetraria octandra	20	1
	Banksia armata var. armata	70	2
	Eremaea pauciflora var. pauciflora	30	2
	Hemiandra pungens	10	2
	Lambertia multiflora var. darlingensis	100	2
	Lyginia imberbis	40	2
	Xanthorrhoea preissii	100	2
	Patersonia occidentalis	30	3
	Tricoryne elatior	20	4
	Banksia attenuata	600	5
	Allocasuarina humilis	150	8
	Mesomelaena pseudostygia	30	8

*	Taxon	Height cm	Foliage %
	Hibbertia hypericoides	50	10
	Banksia menziesii	600	
	Gompholobium confertum		
	Lepidosperma leptostachyum		
	Nuytsia floribunda		
	Petrophile linearis		
	Stylidium schoenoides		

Note: * depicts an introduced (weed) species

Site: 9	**Location:** 116.00003 -32.01200	**Date:** 03-10-2019

Type: Quadrat	Size: 10x10	Community: BmXpEc
Topography: flat	Soils: sand	Colour: Grey
Bare Ground: 20% litter	Fire: 10+	
Vegetation significance: None		
Condition: very good		



*	Taxon	Height cm	Foliage %
*	*Avena barbata*	30	0.1
	Burchardia congesta	20	0.1
	Conostylis aculeata	5	0.1
	Dampiera alata	10	0.1
	Dampiera linearis	20	0.1
*	*Gladiolus caryophyllaceus*	40	0.1
	Hovea trisperma	20	0.1
*	*Hypochaeris glabra*	1	0.1
	Thysanotus patersonii		0.1
	Trachymene Pilosa	5	0.1
	Calectasia narragara	20	0.2
	Cyathochaeta avenacea	40	0.2
	Jacksonia floribunda	20	0.2
	Lyginia imberbis	30	0.2
	Dasypogon bromeliifolius	10	0.5
	Hemiandra pungens	5	0.5
	Mesomelaena tetragona	30	0.5
	Stirlingia latifolia	40	0.5
	Agonis flexuosa	800	1
	Allocasuarina fraseriana	200	1
	Allocasuarina humilis	100	1
	Austrostipa compressa	40	1

*	*Briza maxima*	20	1
	Hemiandra pungens	10	1
	Mesomelaena pseudostygia	30	1
	Patersonia occidentalis	20	1
	Scaevola repens var. repens	5	1
	Lambertia multiflora var. darlingensis	100	1.5
	Alexgeorgea nitens	5	2
*	*Ursinia anthemoides*	10	2
	Xanthorrhoea preissii	80	2
	Adenanthos cygnorum subsp. cygnorum	300	3
	Hibbertia hypericoides	30	3
	Banksia menziesii	600	5
*	*Ehrharta calycina*	70	5
	Eremaea pauciflora var. pauciflora	30	10
	Lomandra micrantha		
	Melaleuca systena		

Note: * depicts an introduced (weed) species

Site: 13	**Location:** 116.00524 -32.01307	**Date:** 03-10-2019
Type: Quadrat	Size: 10x10	Community: BaEpPf
Topography: Flat	Soils: Sand	Colour: Grey
Bare Ground: 20% litter	Fire: 10+	
Vegetation significance: EPBC TEC Banksia Woodlands of the SCP; WA TEC eastern *B. attenuata* and/or *E. marginata* woodlands		
Condition: excellent		



*	Taxon	Height cm	Foliage %
	?Lobelia anceps	20	0.1
	Burchardia congesta	40	0.1
	Conostylis aurea	10	0.1
	Conostylis setigera	15	0.1
	Drosera porrecta	15	0.1
*	*Gladiolus caryophyllaceus*	60	0.1
	Gompholobium confertum	20	0.1
	Haemodorum laxum	100	0.1

*	Taxon	Height cm	Foliage %
*	*Hypochaeris glabra*	1	0.1
	Monotaxis grandiflora var. grandiflora	20	0.1
	Pericalymma ellipticum	40	0.1
	Petrophile linearis	30	0.1
	Tetraria octandra	30	0.1
	Trachymene pilosa	2	0.1
	Tricoryne elatior	30	0.1
	Agrostocrinum hirsutum	50	0.2
	Dampiera linearis	20	0.2
	Desmocladus fasciculatus	10	0.2

	Hovea trisperma	20	0.2
	Patersonia occidentalis	30	0.2
	Tetrarrhena laevis	30	0.2
*	*Ursinia anthemoides*	10	0.2
	Bossiaea eriocarpa	30	0.5
*	*Briza maxima*	30	0.5
	Conospermum undulatum	130	0.5
	Drosera erythrorhiza	1	0.5
	Lomandra sonderi	30	0.5
	Stirlingia latifolia	40	0.5
	Acanthocarpus preissii	40	1
	Lomandra drummondii	30	1
	Philotheca spicata	60	1
	Schoenus pedicellatus	50	1
	Banksia dallanneyi	10	2
	Melaleuca trichophylla	50	2
	Banksia attenuata	300	3
	Lepidosperma leptostachyum	50	3
	Lomandra micrantha	20	3
	Petrophile macrostachya	80	3
	Xanthorrhoea preissii	100	3
	Isopogon autumnalis	60	6
	Hibbertia hypericoides	40	8
	Eremaea pauciflora var. pauciflora	50	12
	Banksia menziesii	600	15
	Mesomelaena pseudostygia	40	15
	Eucalyptus todtiana		

*	Taxon	Height cm	Foliage %
	Adenanthos cygnorum subsp. cygnorum		
	Caladenia flava		
	Daviesia nudiflora subsp. nudiflora		
*	*Eragrostis curvula*		
	Hakea prostrata		
	Hemiphora bartlingii		
	Hybanthus calycinus		
	Jacksonia lehmannii		
	Lysinema pentapetalum		
	Petrophile seminuda		
	Scaevola repens var. repens		
	Thelymitra graminea		

Note: * depicts an introduced (weed) species

JBS&G QUADRAT

Site: Q01	**Location:** 116.003695, -32.012625	**Date:** 24-01-2022
Type: Quadrat	Size: 10x10	Community: BaEpPf
Topography: flat	Soils: sand, sandy loam.	Soil Colour: Light brown gray
Bare Ground: 5% Litter 10%	Fire: 10+ years	
Vegetation significance: EPBC TEC Banksia Woodlands of the SCP; WA TEC eastern *B. attenuata* and/or *E. marginata* woodlands		
Condition: Excellent		



Scientific Name	Height	Cover
Banksia menziesii	500	15
Banksia attenuata	800	10
Xanthorrhoea preissii	120	3
Xanthorrhoea gracilis	110	3
Stirlingia latifolia	60	0.01
Dasypogon bromeliifolius	30	5
Bossiaea eriocarpa	50	0.001
Melaleuca trichophylla	55	0.01
Mesomelaena pseudostygia	50	2
Petrophile macrostachya	60	0.02
Hibbertia hypericoides	30	0.5
Hemiophora bartlingii	30	0.001
Monotaxis grandiflora subsp. *grandiflora*	25	0.001
Lomandra sonderi	30	0.001
Isopogon autumnalis	50	0.03
Pimelia sulphurea	45	0.005
Patersonia occidentalis	40	0.01
Banksia dallanneyi subsp. *dallanneyi ?var. mellicula*	25	0.025
Lyginia imberbis	60	0.001
Trachymene pilosa	10	0.001
Hypochaeris glabra	10	0.001

Scientific Name	Height	Cover
Burchardia congesta	65	0.005
Hakea lissocarpha	150	0.005
Desmocladus fasciculatus	15	0.1
Conostylis setigera subsp. *setigera*	20	0.001
Gladiolus caryophyllaceus	100	0.001
Allocasuarina humilis	60	0.25
Lomandra nigricans	45	0.001
Petrophile rigida	60	0.2
Tetraria octandra	80	5
Hemiandra linearis	30	1
Philotheca spicata	60	0.01
Conospermum undulatum	120	0.5
Eremaea pauciflora var. *pauciflora*	35	2
Haemodorum laxum	35	0.001
Xanthosia huegelii	15	0.001
Isopogon autumnalis	50	1
Drosera erythrorrhiza	0	0.001
Petrophile linearis	60	0.01
Scaevola repens var. repens	20	0.2
Gastrolobium linearifolium	35	0.01
Dampiera linearis	25	0.001
Desmocladus flexuosus	20	0.001
Lepidosperma leptostachyum	45	0.001
Conostylis setigera subsp. *setigera*	20	0.001
Stylidium carnosum	5	0.001
Chaetospora curvifolia	20	0.001
Stachystemon vermicularis	80	0.001
Melaleuca trichophylla	30	0.01
Hovea trisperma var. *trisperma*	40	0.001
Stylidium androsaceum	10	0.001

Scientific Name	Height	Cover
Drosera ?macrantha	60	0.001
Caladenia ?flava	5	0.001
Nuytsia floribunda	1200	5
Pinus pinaster	1800	5
Corymbia calophylla	800	3
Adenanthos cygnorum subsp. *cygnorum*	300	5
Xanthorrhoea preissii	130	1.5
Ehrharta calycina	100	15
*Briza maxima**	25	10
Ursinia anthemoides	20	0.5
Hypochaeris glabra	20	5
*Gladiolus caryophyllaceus**	60	0.001
Erodium botrys	20	0.001
Acacia saligna	170	0.5
*Briza minor**	20	0.001
*Eragrostis curvula**	80	0.001

JBS&G OBSERVATION POINT NOTES

Relevé Number: S1	**Project:** Wattle Grove
Lot/Plan: 804 / P059946	**Location:** 116.004815, -32.01172

Photo:



Site Description:
Area is cleared and contained **Pinus pinaster*, *Corymbia calophylla* (marri) and *Nuytsia floribunda* (Western Australian Christmas tree) over *Adenanthos cygnorum*, *Xanthorrhea preissii*, *Acacia saligna* and weeds.

Species noted	
Scientific Name	Common Name
**Pinus pinaster*	Pine
Corymbia calophylla	Marri
Adenanthos cygorum	Common Woolybush
Xanthorrhea preissii	Grass Tree
Acacia saligna	Orange Wattle

Relevé Number: S2	**Project:** Wattle Grove
Lot/Plan: 804 / P059946	**Location:** 116.003652, -32.012589

Photo:



Site Description:
Predominantly cleared area., with scattered remnant tree and shrub species.

Species noted	
Scientific Name	Common Name
Allocasuarina sp.	She-oak
Corymbia calophylla	Marri
Adenanthos cygorum	Common Woolybush
Xanthorrhea preissii	Grass Tree
Acacia saligna	Orange Wattle

Relevé Number: S3	**Project:** Wattle Grove
Lot/Plan: 804 / P059946	**Location:** 116.004838, -32.011721

Photo:



Site Description:
Vegetation in Excellent condition consisting of Banksia woodland over a species rich native shrubland. The threatened plant *Conospermum undulatum* was observed in this community.

Species noted	
Scientific Name	Common Name
Banksia menziesii *Xanthorrhea preissii* *Conospermum undulatum*	Grass tree

Relevé Number: S4	**Project:** Wattle Grove
Lot/Plan: 107 / D85261	**Location:** 116.000499, -32.016746
Photo:	



Site Description:
Area completely degraded and has recently been partially cleared.

Species noted	
Scientific Name	Common Name
Eucalyptus marginata *Leptospermum laevigatum**	Jarrah Victorian tea tree

Relevé Number: S5	**Project:** Wattle Grove
Lot/Plan: 81 / D085279	**Location:** 116.006996, -32.013683
Photo:	



Site Description:
Site was cleared and grassed, with planted *Eucalyptus camaldulensis* (River red Gum) along the fence lines. The condition was Completely Degraded (Keighery, 1994).

Species noted	
Scientific Name	Common Name
Eucalyptus camaldulensis	River Red Gum

Relevé Number: S6	**Project:** Wattle Grove
Lot/Plan: 12 / Do69292	**Location:** 115.998016, -32.012823

Photo:



Site Description:
East of the easement is cleared with patches of *Melaleuca preissiana* (moonah) with an understory of **Zantedeschia aethiopica* (arum lily) and mixed grasses. The remainder of the lot is parkland cleared with occasional *Xanthorrrhoea preissii* and planted Eucalypts, including the eastern states **E. robusta*. Condition is completely degraded.

Species noted	
Scientific Name	Common Name
Melaleuca preissiana **Zantedeschia aethiopica* *Xanthorrrhoea preissii* **E. robusta*	Moonah Arum Lily Grass Tree Swmap Mahogany

Relevé Number: S7	**Project:** Wattle Grove
Lot/Plan: 12/ D069292	**Location:** 115.99786, -32.013487
Photo:	



Site Description:
The western side of Lot 12 is an easement for a gas pipeline. Planted *Eucalyptus camaldulensis* line the lot boundary with a walkway beneath them. The remainder of the easement contains weeds and weedy grasses

Species noted	
Scientific Name	Common Name
Eucalyptus camaldulensis	River Red Gum

Relevé Number: S8	**Project:** Wattle Grove
Lot/Plan: 12 / D069292	**Location:** 1155.998315, -32.013406
Photo:	



Site Description:
East of the easement is cleared with patches of *Melaleuca preissiana* (moonah) with an understory of **Zantedeschia aethiopica* (arum lily) and mixed grasses. The remainder of the lot is parkland cleared with occasional *Xanthorrrhoea preissii* and planted Eucalypts, including the eastern states **E. robusta*. Condition is completely degraded.

Species noted	
Scientific Name	Common Name
Melaleuca preissiana	Moonah
**Zantedeschia aethiopica*	Arum Lily
Xanthorrrhoea preissii	Grass Tree
**E. robusta*	Swmap Mahogany

Relevé Number: S9	**Project:** Wattle Grove
Lot/Plan: 13 / D069293	**Location:** 115.997889, -32.011637

Photo:



Site Description:
Lot 13 was parkland cleared and contained numerous introduced trees, including *Melia azedarach (Cape lilac), *Erythrina ×sykesii (coral tree), *Leptospermum laevigatum (Victorian tea tree) and Eastern states ironbarks (*Eucalyptus sp.). One mature Eucalyptus todtiana was also present.

Species noted	
Scientific Name	Common Name
**Melia azedarach*	Cape lilac
**Erythrina ×sykesii*	coral tree
**Leptospermum laevigatum*	Victorian tea tree
**Eucalyptus sp.*	Ironbark (Eastern States)
Eucalyptus todtiana	Pricklybark

Relevé Number: S10	**Project:** Wattle Grove
Lot/Plan: 12 / Do69292	**Location:** 115.998276, -32.013358

Photo:



Site Description:
Area is completely degraded and has recently had trees removed.

Species noted	
Scientific Name	Common Name

Relevé Number: S11	**Project:** Wattle Grove
Lot/Plan: 107 / D85261	**Location:** 116.000315, -32.01701

Photo:



Site Description:
Area completely degraded. Scattered native vegetation present. Recent clearing has taken place.

Species noted	
Scientific Name	Common Name
Melaleuca preissiana	Moonah
Eucalyptus camaldulensis	River Red Gum
Corymbia calophylla	Marri

Relevé Number: S12	**Project:** Wattle Grove
Lot/Plan: 13 / D069293	**Location:** 115.998806, -32.011927

Photo:



Site Description:
Area was parkland cleared and contained numerous introduced trees and one mature *Eucalyptus todtiana* was also present. Area completely degraded.

Species noted	
Scientific Name	Common Name
**Melia azedarach*	Cape lilac
**Erythrina ×sykesii*	coral tree
**Leptospermum laevigatum*	Victorian tea tree
**Eucalyptus sp.*	Eastern states ironbarks
Eucalyptus todtiana	Pricklybark

Relevé Number: S13	**Project:** Wattle Grove
Lot/Plan: 12 / D069292	**Location:** 115.997607, -32.012858

Photo:



Site Description:
The western side of Lot 12 is an easement for a gas pipeline. Planted line of Eucalyptus camaldulensis occurs along the lot boundary with a walkway beneath them. The remainder of the easement contains weeds and weedy grasses. East of the easement is cleared with patches of *Melaleuca preissiana* with an understory of arum lily and grass. The remainder of the lot is parkland cleared with occasional *Xanthorrrhoea preissii* and planted Eucalypt species, including the eastern states **E. robusta*.

Species noted	
Scientific Name	Common Name
Eucalyptus camaldulensis	River Red Gum
Melaleuca preissiana	
Xanthorrrhoea preissii	Grass Tree
**E. robusta*	Swamp Mahogany

Relevé Number: NO1	**Project:** Wattle Grove
Lot/Plan: 210 / P003380	**Location:** 804 / P059946

Photo:



Site Description:
Lot 210 was observed through the fence from Lot 804. The vegetation was consistent with Lot 804's Banksia woodland, condition appeared Excellent and *Conospermum undulatum* (T) was visible through the fence.

Species noted	
Scientific Name	Common Name
Conospermum undulatum *Adenanthos cygnorum* subsp. *cygnorum* *Eremaea pauciflora* var. *pauciflora* *Anigozanthos manglesii* subsp. *manglesii* *Hibbertia hypericoides* *Isopogon autumnalis* *Eucalyptus marginata* *Banksia attenuata* *Allocasuarina fraseriana* *Gompholobium tomentosum* *Bossiaea eriocarpa* *Mesomelaena pseudostygia* *Ehrharta calycina* *Gastrolobium capitatum* *Scholtzia involucrate* *Ursinia anthemoides* *Wahlenbergia capensis*	

Briza maxima *Leptospermum laevigatum* *Acacia saligna* *Tetraria octandra* *Allocasuarina humilis* *Styphelia sp.* *Gladiolus caryophyllaceus* *Scaevola sp.* *Dasypogon bromeliifolius* *Petrophile seminuda* *Xanthorrhoea preissii* *Jacksonia floribunda*	

Relevé Number: NO2	**Project:** Wattle Grove
Lot/Plan: 804 / P059946	**Location:** 116.0043678, -32.0119128

Photo:



Site Description:
Open woodland of *Banksia menziesii*, *B attenuata*, *Euc todtiana* and *Allocasuarina fraseriana* over *Xanthorrhoea preissi*, *Allocasuarina humilis* and *Jacksonia* sp. Area is in excellent condition.

Species noted	
Scientific Name	Common Name
Conospermum undulatum *Adenanthos cygnorum subsp. cygnorum* *Eremaea pauciflora var. pauciflora* *Anigozanthos manglesii subsp. manglesii* *Hibbertia hypericoides* *Isopogon autumnalis* *Eucalyptus marginata* *Banksia attenuata* *Allocasuarina fraseriana* *Gompholobium tomentosum* *Bossiaea eriocarpa* *Mesomelaena pseudostygia* *Ehrharta calycina* *Gastrolobium capitatum* *Scholtzia involucrate* *Ursinia anthemoides* *Wahlenbergia capensis*	

Briza maxima *Leptospermum laevigatum* *Acacia saligna* *Tetraria octandra* *Allocasuarina humilis* *Styphelia sp.* *Gladiolus caryophyllaceus* *Scaevola sp.* *Dasypogon bromeliifolius* *Petrophile seminuda* *Xanthorrhoea preissii* *Jacksonia floribunda*	

Relevé Number: NO3	**Project:** Wattle Grove
Lot/Plan: 804 / P059946	**Location:** 116.0051977, -32.0112041

Photo:



Site Description:
Open woodland of *Banksia menziesii*, *B attenuata*, *Euc todtiana* and *Allocasuarina fraseriana* over *Xanthorrhoea preissi*, *Allocasuarina humilis* and *Jacksonia* sp. Area is in excellent condition.

Species noted	
Scientific Name	Common Name
Conospermum undulatum *Adenanthos cygnorum subsp. cygnorum* *Eremaea pauciflora var. pauciflora* *Anigozanthos manglesii subsp. manglesii*	

Hibbertia hypericoides *Isopogon autumnalis* *Eucalyptus marginata* *Banksia attenuata* *Allocasuarina fraseriana* *Gompholobium tomentosum* *Bossiaea eriocarpa* *Mesomelaena pseudostygia* *Ehrharta calycina* *Gastrolobium capitatum* *Scholtzia involucrate* *Ursinia anthemoides* *Wahlenbergia capensis* *Briza maxima* *Leptospermum laevigatum* *Acacia saligna* *Tetraria octandra* *Allocasuarina humilis* *Styphelia sp.* *Gladiolus caryophyllaceus* *Scaevola sp.* *Dasypogon bromeliifolius* *Petrophile seminuda* *Xanthorrhoea preissii* *Jacksonia floribunda*	

Relevé Number: NO4	**Project:** Wattle Grove
Lot/Plan: 804 / P059946	**Location:** 116.0051, -32.0115
Photo:	



Site Description:
Degraded Banksia woodland with some foraging value. *Leptospermum laevigatum* (Victorian tea tree) common.

Species noted	
Scientific Name	Common Name
Conospermum undulatum *Adenanthos cygnorum subsp. cygnorum* *Eremaea pauciflora var. pauciflora* *Anigozanthos manglesii subsp. manglesii* *Hibbertia hypericoides* *Isopogon autumnalis* *Eucalyptus marginata* *Banksia attenuata* *Allocasuarina fraseriana* *Gompholobium tomentosum* *Bossiaea eriocarpa* *Mesomelaena pseudostygia* *Ehrharta calycina* *Gastrolobium capitatum* *Scholtzia involucrate* *Ursinia anthemoides* *Wahlenbergia capensis* *Briza maxima* *Leptospermum laevigatum* *Acacia saligna* *Tetraria octandra* *Allocasuarina humilis*	

Styphelia sp. *Gladiolus caryophyllaceus* *Scaevola sp.* *Dasypogon bromeliifolius* *Petrophile seminuda* *Xanthorrhoea preissii* *Jacksonia floribunda*	

Relevé Number: NO5	**Project:** Wattle Grove
Lot/Plan: 801 / P059946	**Location:** 116.0053466, -32.0117235

Photo:



Site Description:
Degraded Banksia woodland with some foraging value. The introduced species *Leptospermum laevigatum* was found to be common in this area.

Species noted	
Scientific Name	Common Name
Leptospermum laevigatum *Banksia menziesii* *B attenuata* *Euc todtiana*	

Relevé Number: NO6	**Project:** Wattle Grove
Lot/Plan: 802 /P059946	**Location:** 116.0056487, -32.0117065

Photo:



Site Description:
Area is completely degraded

Species noted	
Scientific Name	Common Name
Xanthorrhoea preissi	Grass Tree
Corymbia calophylla	Marri

Relevé Number: NO7	**Project:** Wattle Grove
Lot/Plan: 802 / P059946	**Location:** 116.0061534, -32.0114913

Photo:



Site Description:
Landscaping around a dwelling. Area is completely degraded.

Species noted	
Scientific Name	Common Name

Relevé Number: NO8	**Project:** Wattle Grove
Lot/Plan: 802 / P059946	**Location:** 116.0072796, -32.0105869

Photo:



Site Description:
This site has been extensively cleared of vegetation. Completely degraded but with scattered tree species.

Species noted	
Scientific Name	Common Name
Xanthorrhoea preissi	Grass Tree
Corymbia calophylla	Marri

Relevé Number: NO9	**Project:** Wattle Grove
Lot/Plan: 801 / P059946	**Location:** 116.0062489, -32.0107514

Photo:



Site Description:
Completely degraded. Area has been historically landscaped and mown. This property is a significant source of weeds invading remnant vegetation on adjacent Lot 210. Lot 801 contained bamboo, Victorian tea tree, common fig, eastern states bottle brush species, Brazilian pepper tree, Flinders Range wattle, Cootamundra wattle and pines. Two old growth Jarrah were present, with a DBH of approximately 1000 mm.

Species noted	
Scientific Name	Common Name
**Poa sp.*	Bamboo
**Leptospermum laevigatum*	Victorian Teatree
**Acacia iteaphylla*	Flinders Ranges Wattle
**Acacia baileyana*	Cootamundra Wattle
**Pinus sp.*	Pine

Relevé Number: NO10	**Project:** Wattle Grove
Lot/Plan: 801 / P059946	Location: 116.0062489, -32.0107514

Photo:



Site Description:
Completely degraded. Area has been historically landscaped and mown.

Species noted	
Scientific Name	Common Name
**Poa sp.*	Bamboo
**Leptospermum laevigatum*	Victorian Teatree
**Acacia iteaphylla*	Flinders Ranges Wattle
**Acacia baileyana*	Cootamundra Wattle
**Pinus sp.*	Pine

Relevé Number: ATT01	**Project:** Wattle Grove
Lot Plan: 12 / D069292	**Location:** 115.998155, -32.013885

Photo:



Site Description:
This property has been substantially cleared and has been maintained for residential/garden purposes. Scattered trees are present.

Species noted	
Scientific Name	Common Name
Eucalyptus marginata	Jarrah

Relevé Number: ATT02	**Project:** Wattle Grove
Lot/Plan: 12 / D069292	**Location:** 115.99767, -32.012668

Photo:



Site Description:

Species noted	
Scientific Name	Common Name
Eucalyptus camaldulensis	River Red Gum
Eucalyptus marginata	Jarrah

Relevé Number: ATT03	**Project:** Wattle Grove
Lot/Plan: 101 / D072046	**Location:** 116.005135, -32.02092

Photo:



Site Description:
Disturbed area with scattered Eucalypt trees remaining. Area appears to be sporadically maintained and affected by the dumping of rubbish.

Species noted	
Scientific Name	Common Name
Eucalyptus marginata	Jarrah

Relevé Number:ATT04	**Project:** Wattle Grove
Lot/Plan: 100 / D072046	**Location:** 116.004757, -32.020907

Photo:



Site Description:
Disturbed area with scattered Eucalypt trees. Area appears to be continuously maintained.

Species noted	
Scientific Name	Common Name

Relevé Number: ATT05	**Project:** Wattle Grove
Lot/Plan: 21 / D080126	**Location:** 116.11642, -32.011233

Photo:



Site Description:
This property has been extensively cleared. Scattered Eucalyptus trees are present. Access to this property could not be obtained. Lot 21 did not contain any native vegetation other than one large tuart (*Eucalyptus gomphocephala*). Several eastern states Eucalypts (**Eucalyptus grandis* and **E. botryoides*) on the property would have roosting or foraging value for black cockatoos and were of greater than 500 mm DBH.

Species	
Scientific Name	Common Name
Eucalyptus gomphocephala **Eucalyptus grandis* **E. botryoides*	Tuart Flooded Gum (Eastern States Species) Bangalay (Eastern States Species)

Relevé Number:6	**Project:** Wattle Grove
Property Lot/Plan: 4 / P061512	**Location:** 116.009968, -32.012962

Photo:



Site Description:
Lot 4 did not contain any native vegetation other than one large jarrah (*Eucalyptus marginata*) of approximately 400 mm DBH. One lemon scented gum (**Corymbia citriodora*) would have roosting or foraging value for black cockatoos and was of greater than 500 mm DBH.

Species noted	
Scientific Name	Common Name
**Corymbia citriodora* *Eucalyptus marginata*	Lemon Scented Gum (Eastern States Species) Jarrah

Relevé Number: ATT07	**Project:** Wattle Grove
Lot/Plan: 54 / D075466	**Location:** 116.00453, -32.017372

Photo:



Site Description:
Completely degraded site, used for horse grazing. Scattered trees present.

Species noted	
Scientific Name	Common Name

Relevé Number: ATT08	**Project:** Wattle Grove
Lot/Plan: 55 / D075466	**Location:** 116.002873, -32.015337

Photo:



Site Description:
Area is completely degraded and has been used for the grazing of livestock.

Species noted	
Scientific Name	Common Name

Relevé Number: ATT9	**Project:** Wattle Grove
Lot/Plan: 3 / D089357	**Location:** 116.002167, -32.009819

Photo:



Site Description:
Area of Banksia woodland in excellent condition.

Species noted	
Scientific Name	Common Name
Leptospermum laevigatum *Banksia menziesii* *B. attenuata* *Euc. todtiana*	Victorian tea tree Firewood banksia Candlestick banksia Pricklybark

Relevé Number: ATT10	**Project:** Wattle Grove
Lot/Plan: 2 / D020390	**Location:** 116.008209, -32.016949

Photo:



Site Description:
Section of property has been disturbed with mowing activities. This has degraded the condition of this area of vegetation.

Species noted	
Scientific Name	Common Name
Banksia menziesii *B attenuata* *Xanthorrea pressei*	Firewood banksia Candlestick banksia Grass tree

Relevé Number: ATT11	**Project:** Wattle Grove
Lot/Plan: 3 / D089357	**Location:** 116.002153, -32.009827

Photo:



Site Description:
Property is completely degraded with disturbance associated with mowing activities.

Species noted	
Scientific Name	Common Name

Relevé Number: ATT12	**Project:** Wattle Grove
Lot/Plan: 3 / D024545	**Location:** 116.006407, -32.012785

Photo:



Site Description:
Area completely degraded. Area dominated by mown lawns and scattered landscaping trees.

Species noted	
Scientific Name	Common Name

Relevé Number: ATT13	**Project:** Wattle Grove
Lot/Plan:	**Location:** 115.997068, -32.010630

Photo:



Site Description:
Completely degraded area, mown and maintained as clear. Photo looking west toward wetland area.

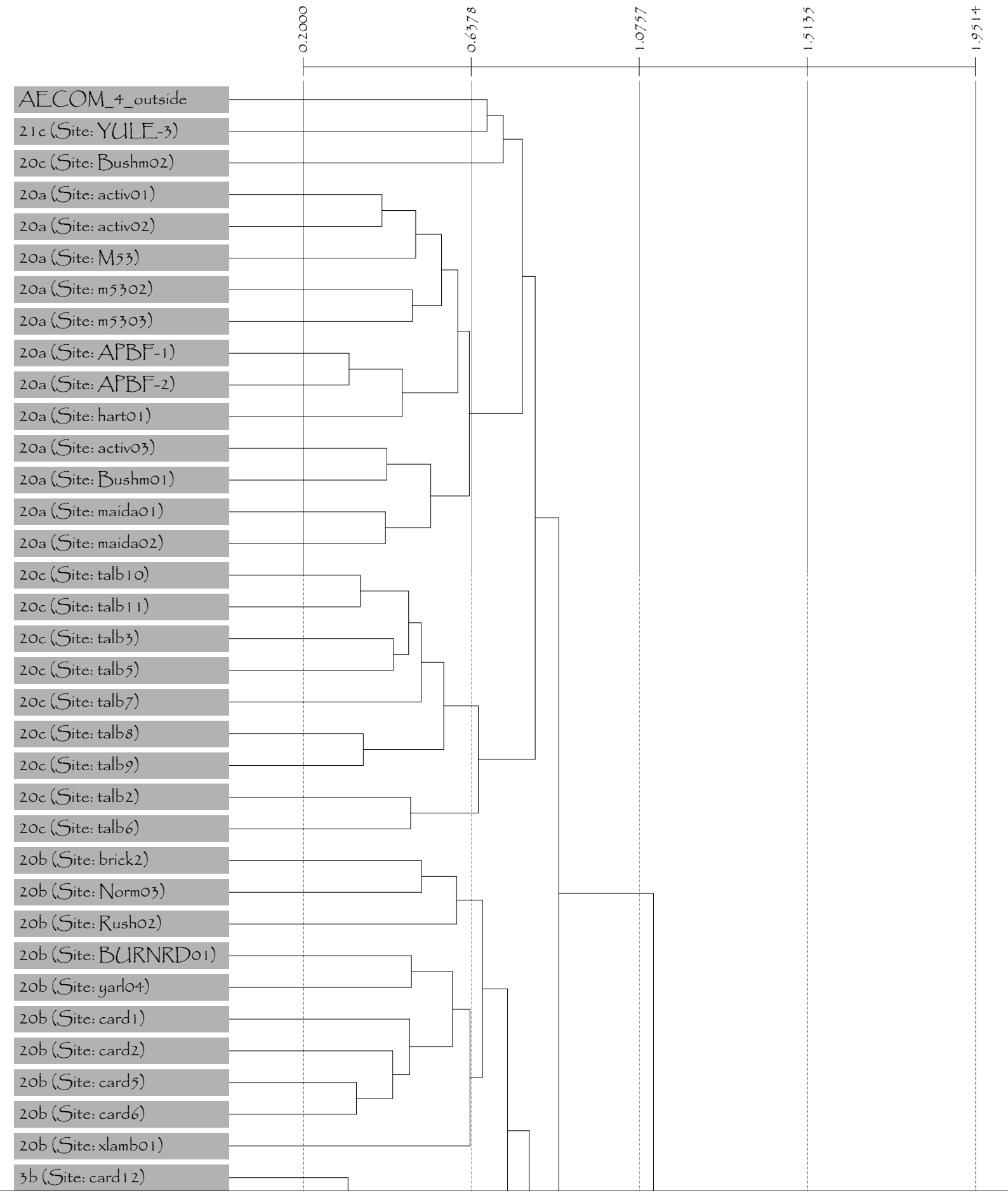
Species noted	
Scientific Name	Common Name
Poa sp.	Various Grasses

Appendix D Floristic Community Type Analysis 2023 (PATN results)

Fusion Type: Flexible UPGMA Beta = -0.10

On Association: Bray & Curtis (Columns) Created on: 12:20:33, March 20, 2023

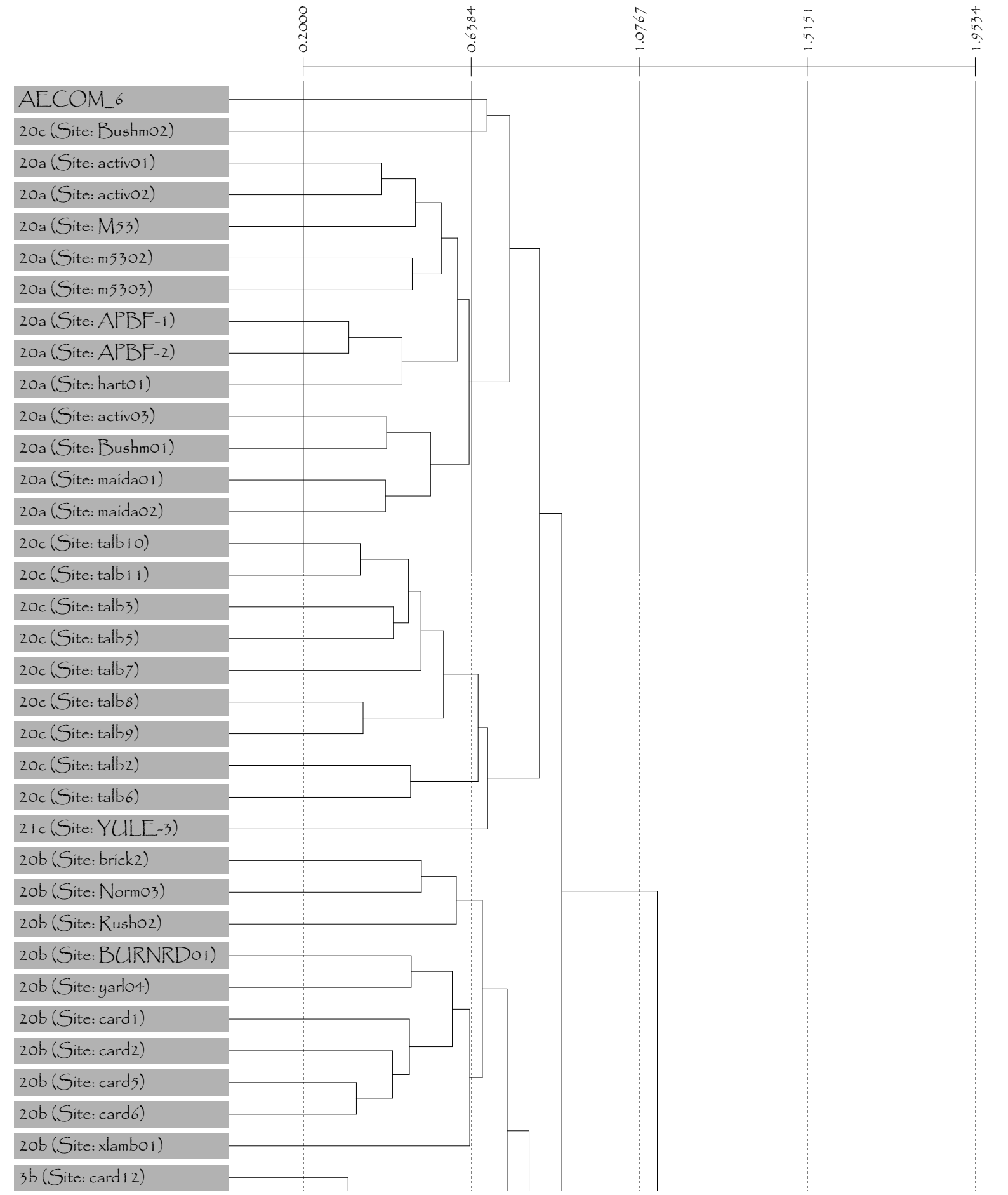
Column Fusion Dendrogram



Fusion Type: Flexible UPGMA Beta = -0.10

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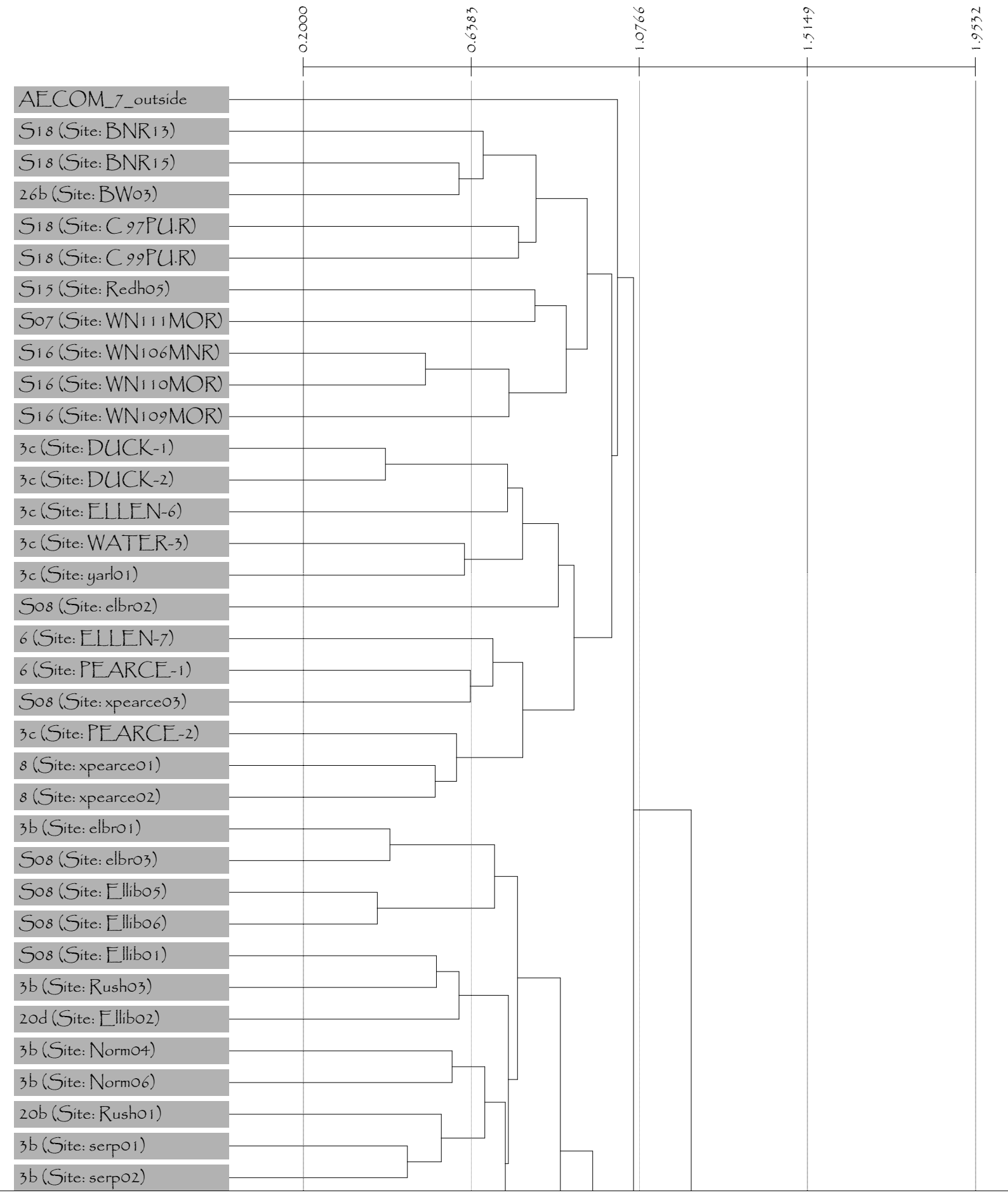
Column Fusion Dendrogram



Fusion Type: Flexible UPGMA Beta = -0.10

On Association: Bray & Curtis (Columns) Created on: 12:42:19, March 20, 2023

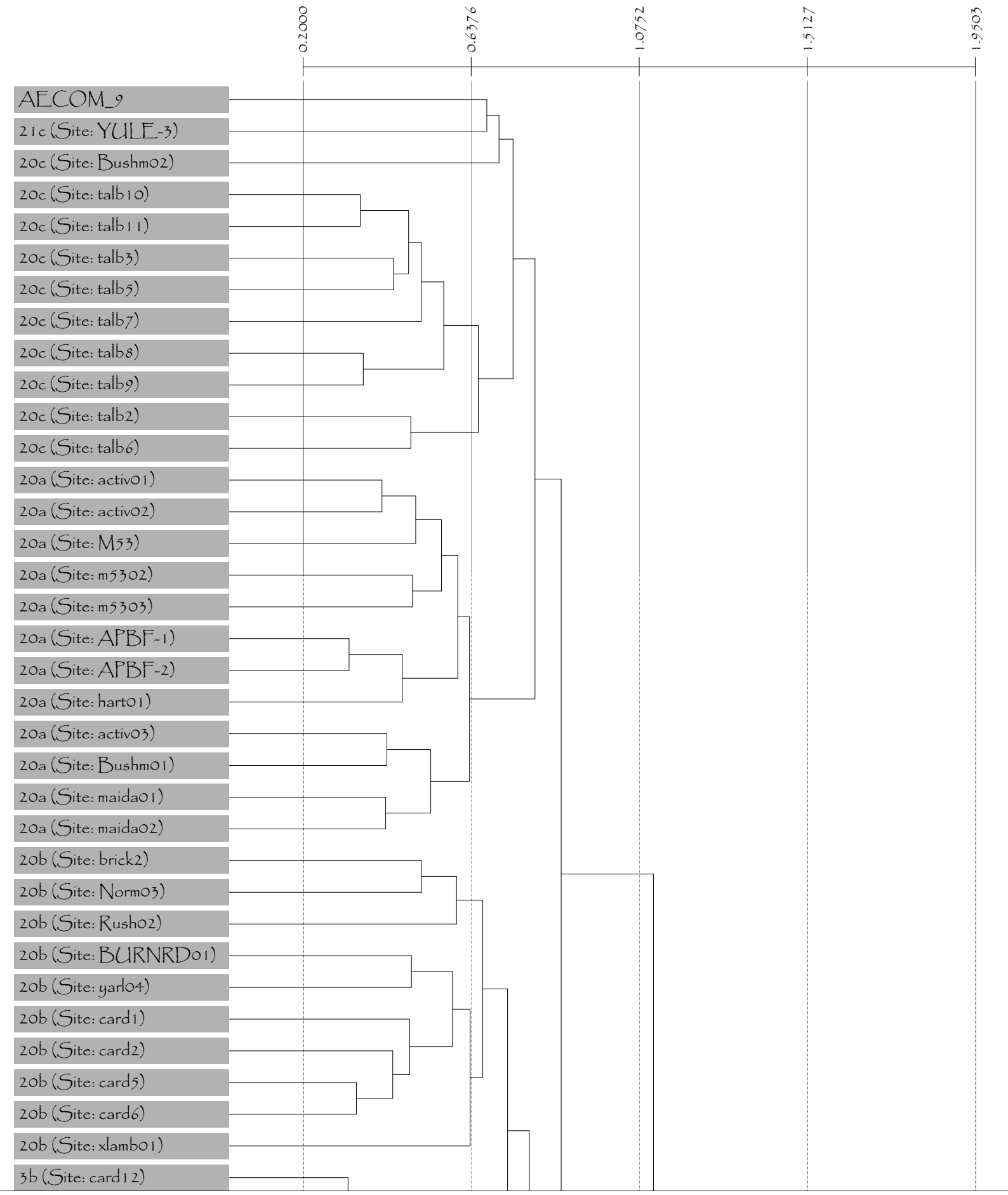
Column Fusion Dendrogram



Fusion Type: Flexible UPGMA Beta = -0.10

On Association: Bray & Curtis (Columns) Created on: 12:44:51, March 20, 2023

Column Fusion Dendrogram



Source Table Name:

Derived From Association of type: Bray & Curtis (Columns)

Fusion Type: Flexible UPGMA Beta = -0.10

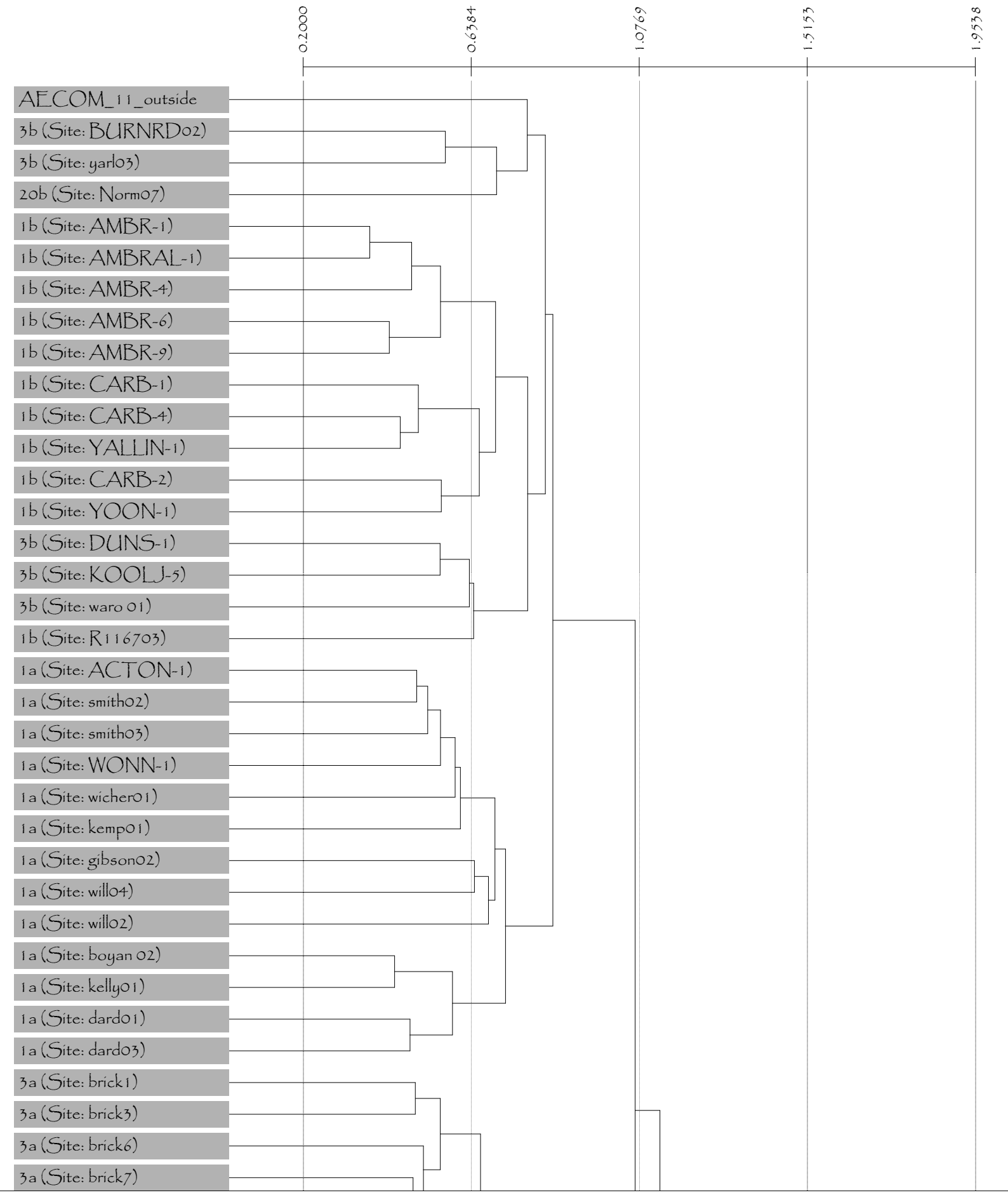
Created: 12:47:29, March 20, 2023

Groups	First Object	Second Object	New Object	Level	Stress Diff
0	S13 (Site: SW02) (852)	+ S13 (Site: SW02) (852)	=GP(852)-	0.200	0.200
1	29b (Site: NWIL-1) (682)	+ 29b (Site: NWIL-1) (682)	=GP(682)-	0.205	0.005
2	23b (Site: MILT-7) (554)	+ 23b (Site: MILT-7) (554)	=GP(554)-	0.232	0.027
3	S11 (Site: MI04) (527)	+ S11 (Site: MI04) (527)	=GP(527)-	0.234	0.002
4	S14 (Site: MI15) (538)	+ S14 (Site: MI15) (538)	=GP(538)-	0.238	0.004
5	23a (Site: YULE-1) (1079)	+ 23a (Site: YULE-1) (1079)	=GP(1079)-	0.246	0.008
6	27 (Site: YALG-4) (1034)	+ 27 (Site: YALG-4) (1034)	=GP(1034)-	0.262	0.016
7	23b (Site: MNP01) (560)	+ 23b (Site: MNP01) (560)	=GP(560)-	0.264	0.002
8	S11 (Site: SW08) (858)	+ S11 (Site: SW08) (858)	=GP(858)-	0.269	0.005
9	23b (Site: ELE08) (279)	+ 23b (Site: ELE08) (279)	=GP(279)-	0.277	0.008
10	23b (Site: MP04) (584)	+ 23b (Site: MP04) (584)	=GP(584)-	0.277	0.000
11	27 (Site: YALG-3) (1033)	+ 27 (Site: YALG-3) (1033)	=GP(1033)-	0.282	0.005
12	4 (Site: MP03) (583)	+ 4 (Site: MP03) (583)	=GP(583)-	0.286	0.004
13	20a (Site: KOON-1) (450)	+ 20a (Site: KOON-1) (450)	=GP(450)-	0.287	0.001
14	S09 (Site: MOOR 01) (569)	+ S09 (Site: MOOR 01) (569)	=GP(569)-	0.289	0.003
15	23a (Site: gosn02) (366)	+ 23a (Site: gosn02) (366)	=GP(366)-	0.295	0.006
16	23a (Site: Light01) (465)	+ 23a (Site: Light01) (465)	=GP(465)-	0.296	0.001
17	S13 (Site: MI11) (534)	+ S13 (Site: MI11) (534)	=GP(534)-	0.300	0.004
18	23b (Site: ELDO-1) (271)	+ 23b (Site: ELDO-1) (271)	=GP(271)-	0.301	0.001
19	23a (Site: WARB-1) (919)	+ 23a (Site: WARB-1) (919)	=GP(919)-	0.301	0.000
20	5 (Site: low09a) (475)	+ 5 (Site: low09a) (475)	=GP(475)-	0.304	0.003
21	23a (Site: kailis02) (430)	+ 23a (Site: kailis02) (430)	=GP(430)-	0.305	0.001
22	23b (Site: ELE01) (272)	+ 23b (Site: ELE01) (272)	=GP(272)-	0.305	0.000
23	23b (Site: MELA-6) (509)	+ 23b (Site: MELA-6) (509)	=GP(509)-	0.309	0.004
24	21b (Site: MANEA-3) (498)	+ 21b (Site: MANEA-3) (498)	=GP(498)-	0.309	0.000
25	S11 (Site: SW08) (858)	+ S11 (Site: SW08) (858)	=GP(858)-	0.315	0.006
26	3b (Site: card12) (201)	+ 3b (Site: card12) (201)	=GP(201)-	0.317	0.002

Fusion Type: Flexible UPGMA Beta = -0.10

On Association: Bray & Curtis (Columns) Created on: 12:50:12, March 20, 2023

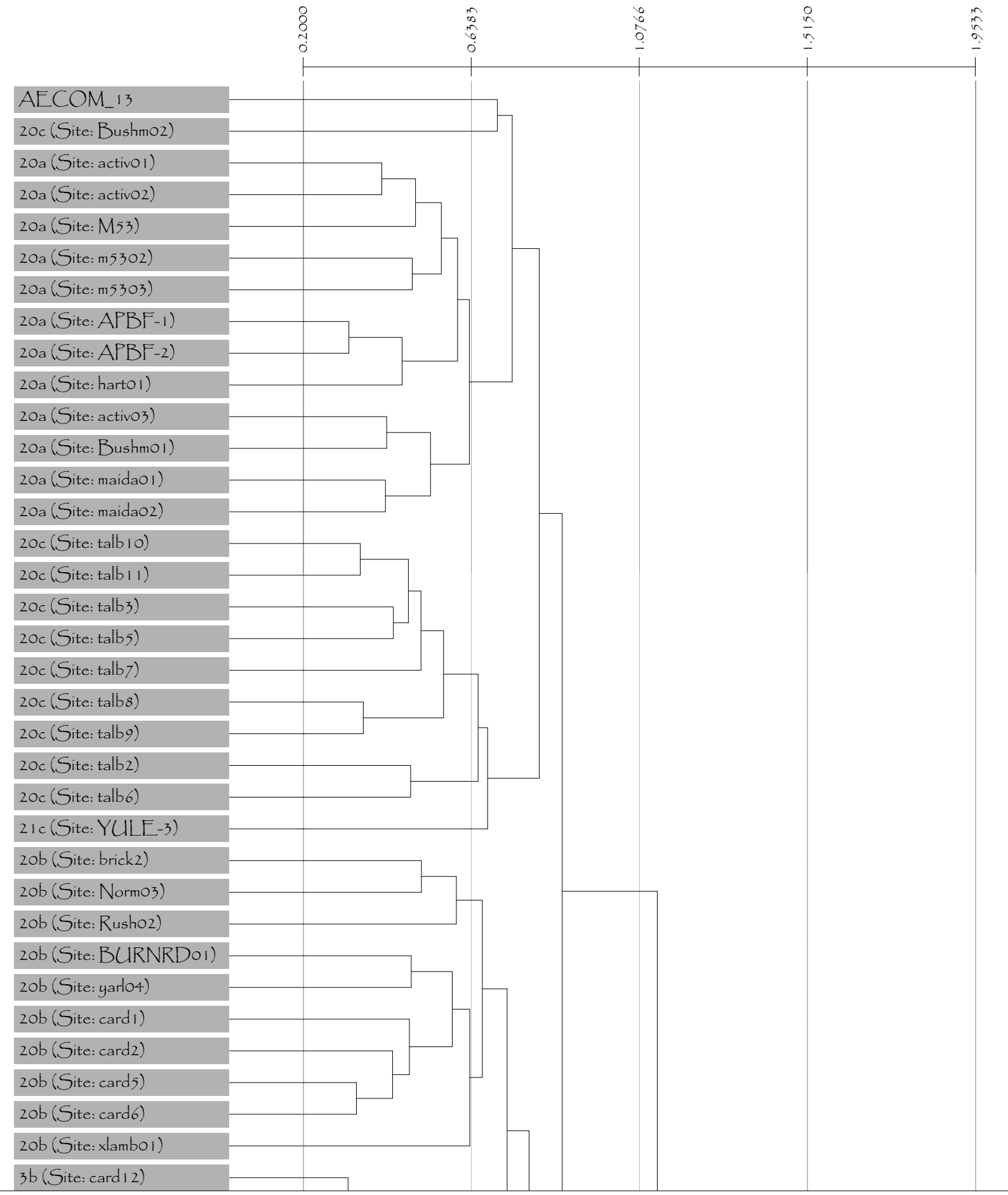
Column Fusion Dendrogram



Fusion Type: Flexible UPGMA Beta = -0.10

On Association: Bray & Curtis (Columns) Created on: 12:52:20, March 20, 2023

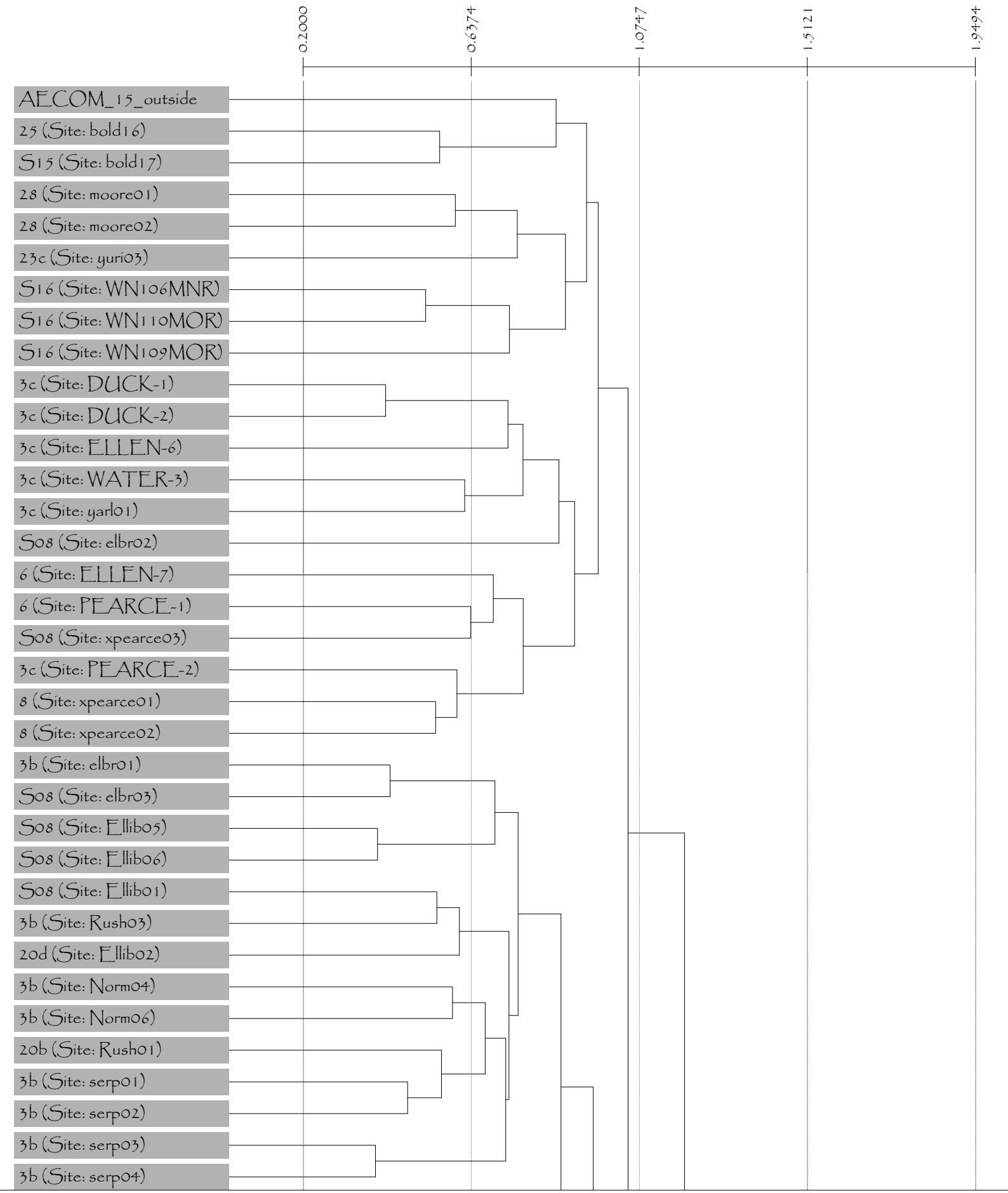
Column Fusion Dendrogram



Fusion Type: Flexible UPGMA Beta = -0.10

On Association: Bray & Curtis (Columns) Created on: 12:55:23, March 20, 2023

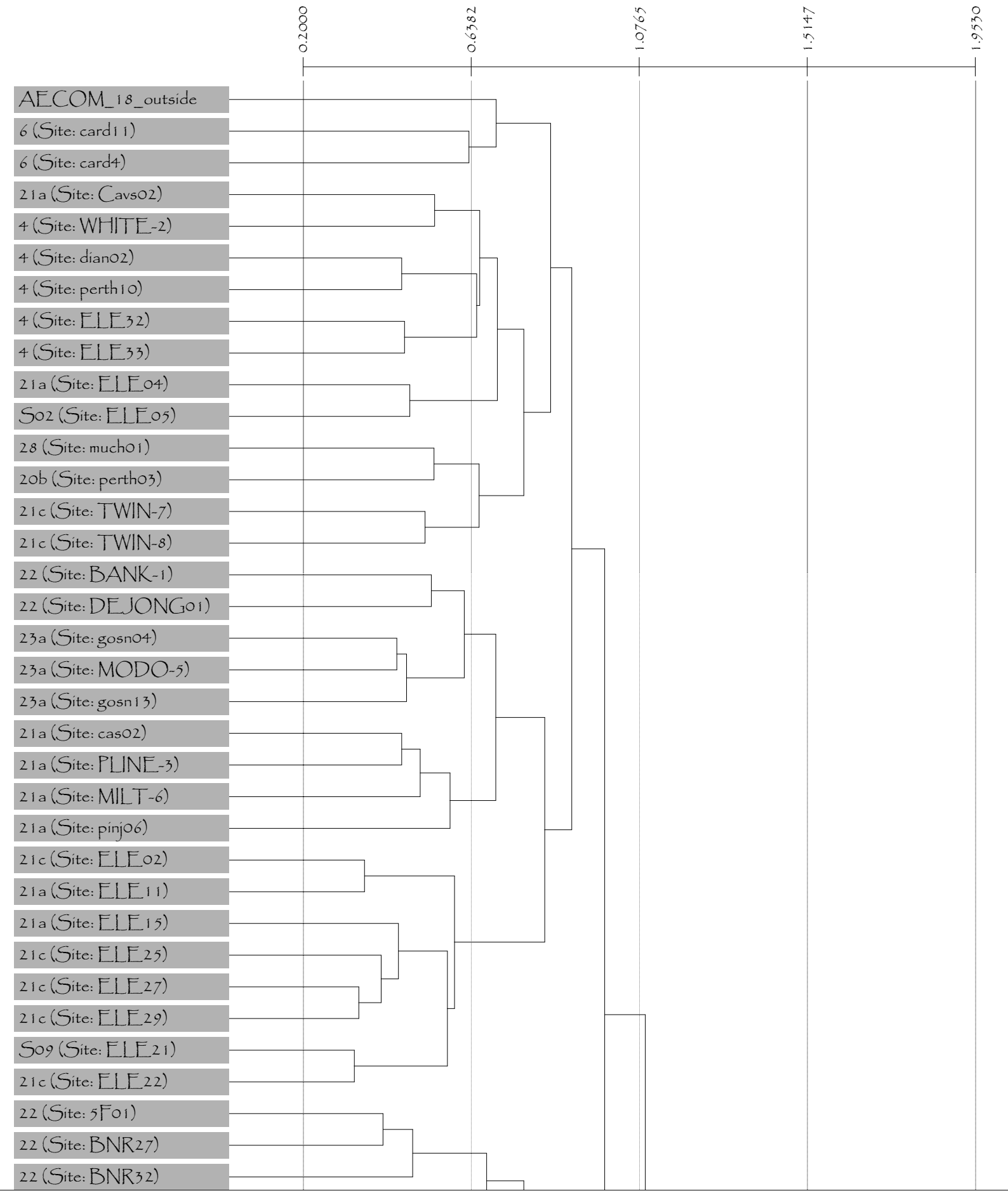
Column Fusion Dendrogram



Fusion Type: Flexible UPGMA Beta = -0.10

On Association: Bray & Curtis (Columns) Created on: 12:57:46, March 20, 2023

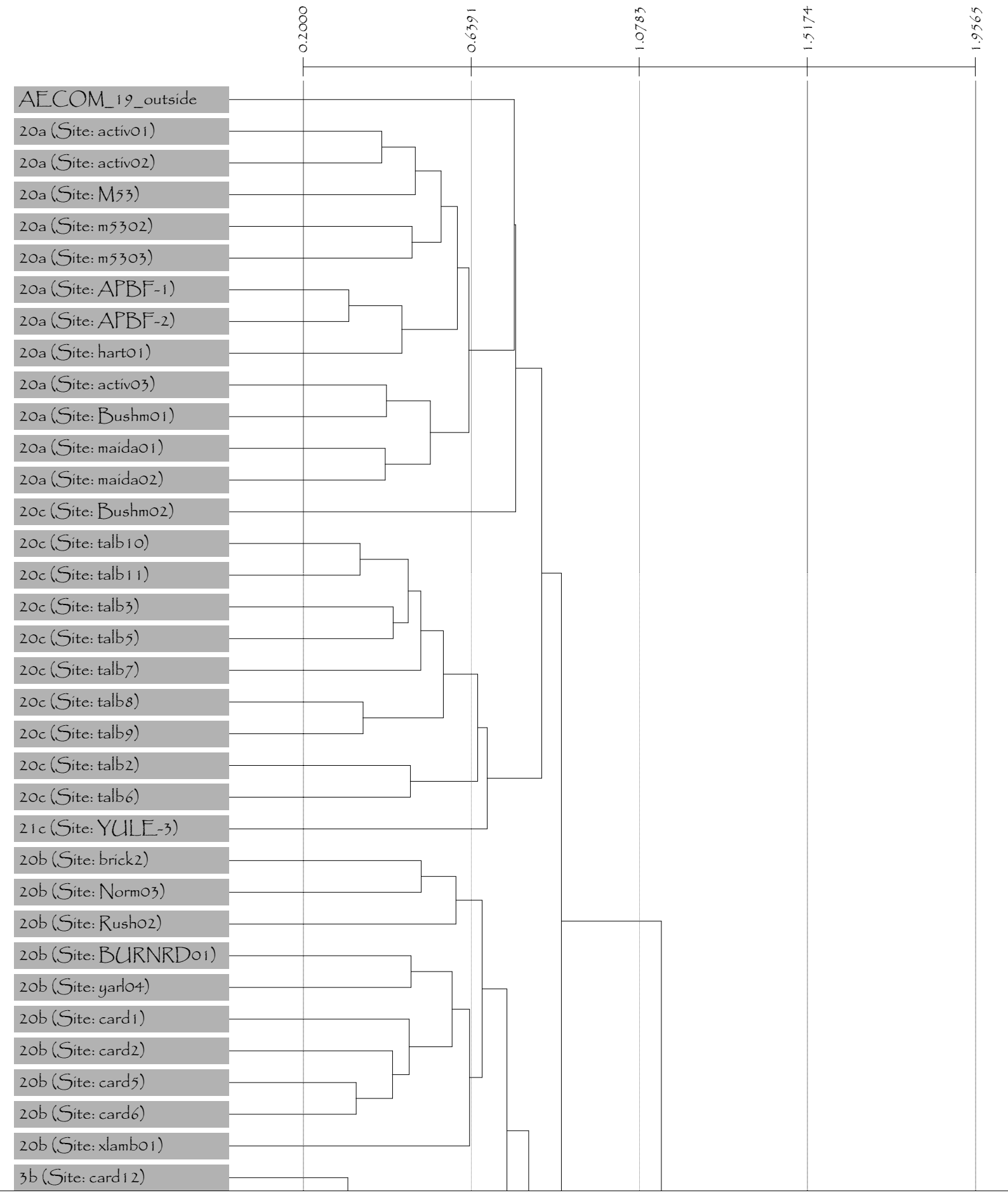
Column Fusion Dendrogram



Fusion Type: Flexible UPGMA Beta = -0.10

On Association: Bray & Curtis (Columns) Created on: 13:00:32, March 20, 2023

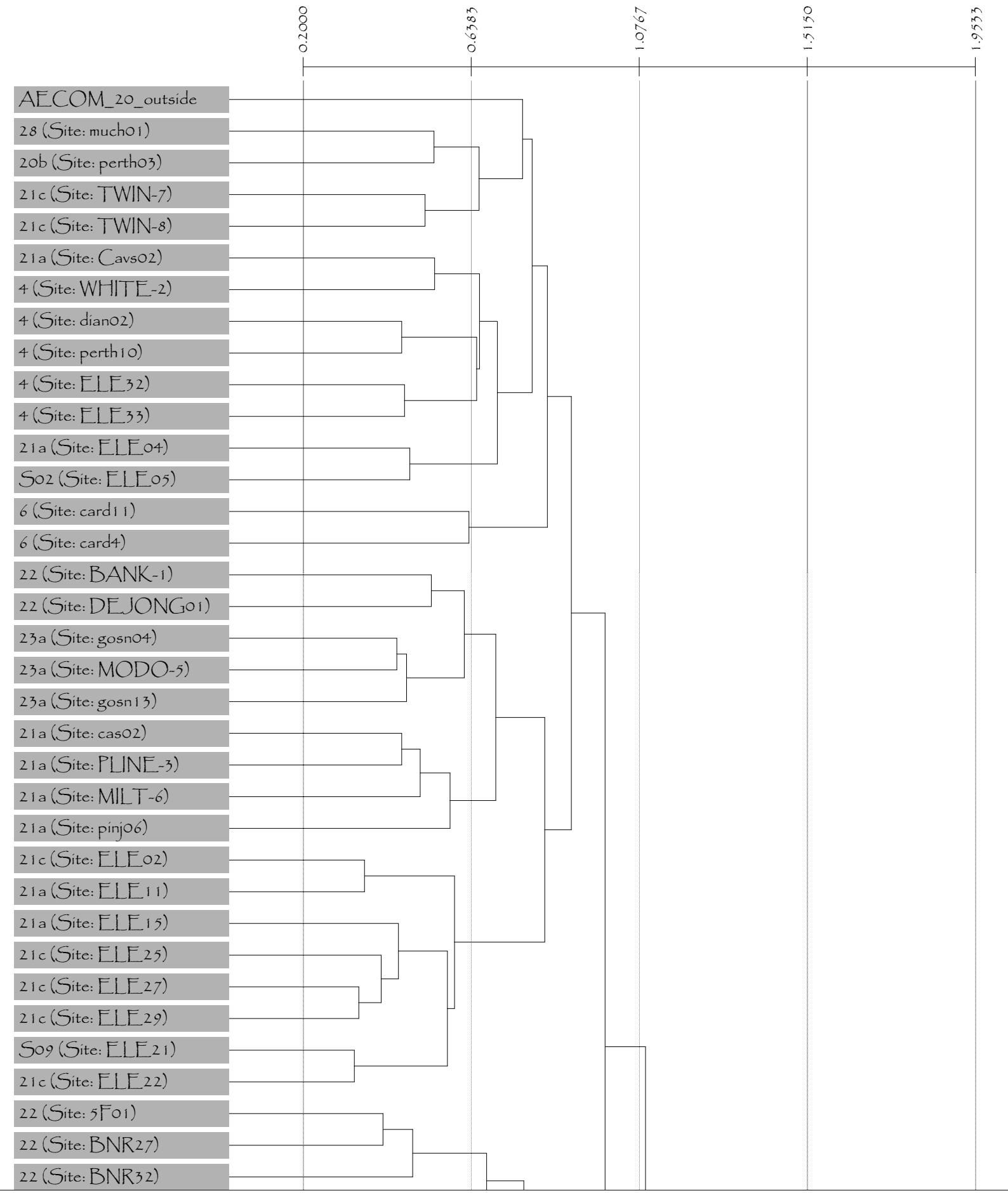
Column Fusion Dendrogram



Fusion Type: Flexible UPGMA Beta = -0.10

On Association: Bray & Curtis (Columns) Created on: 13:02:50, March 20, 2023

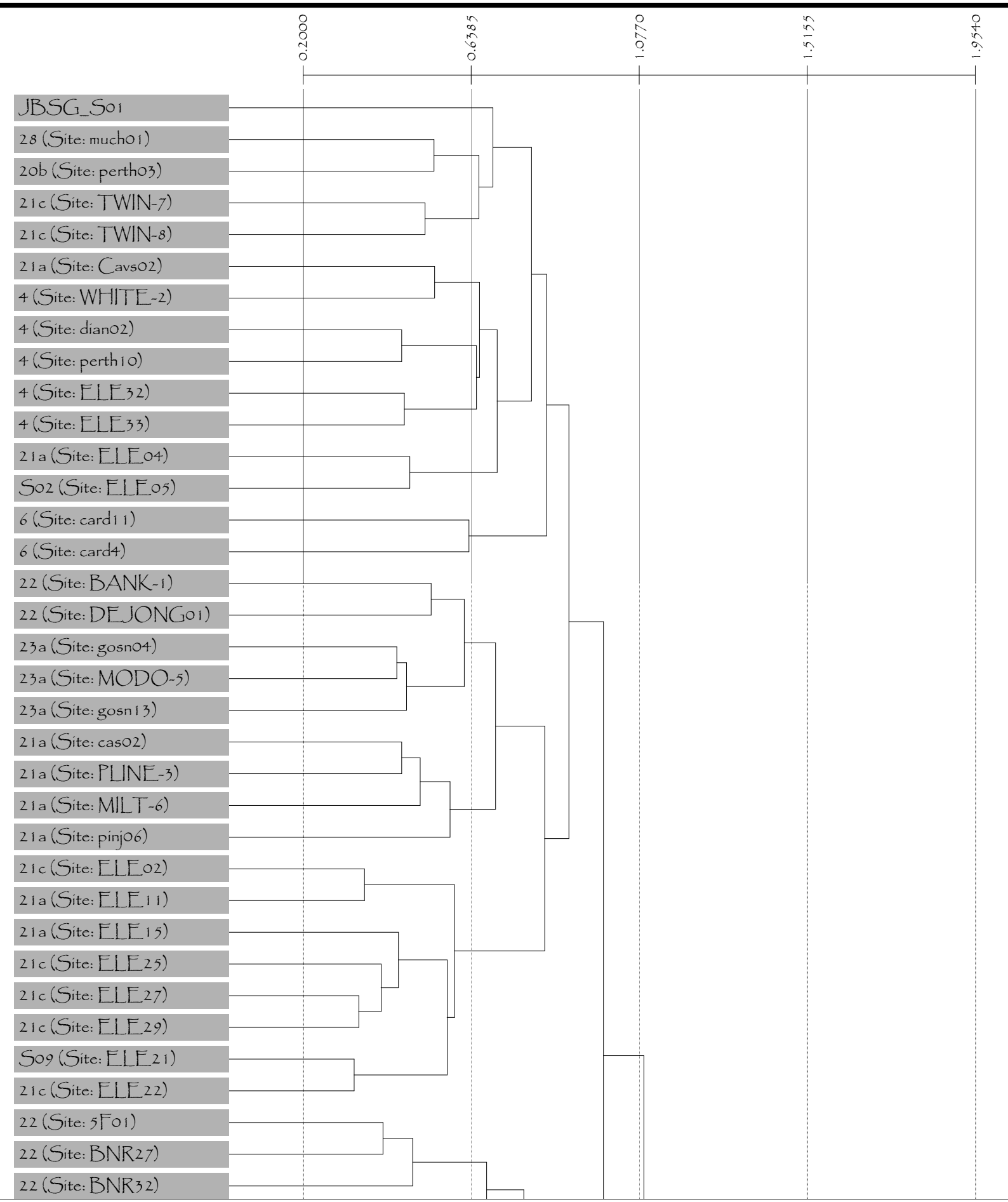
Column Fusion Dendrogram



Fusion Type: Flexible UPGMA Beta = -0.10

On Association: Bray & Curtis (Columns) Created on: 13:07:20, March 20, 2023

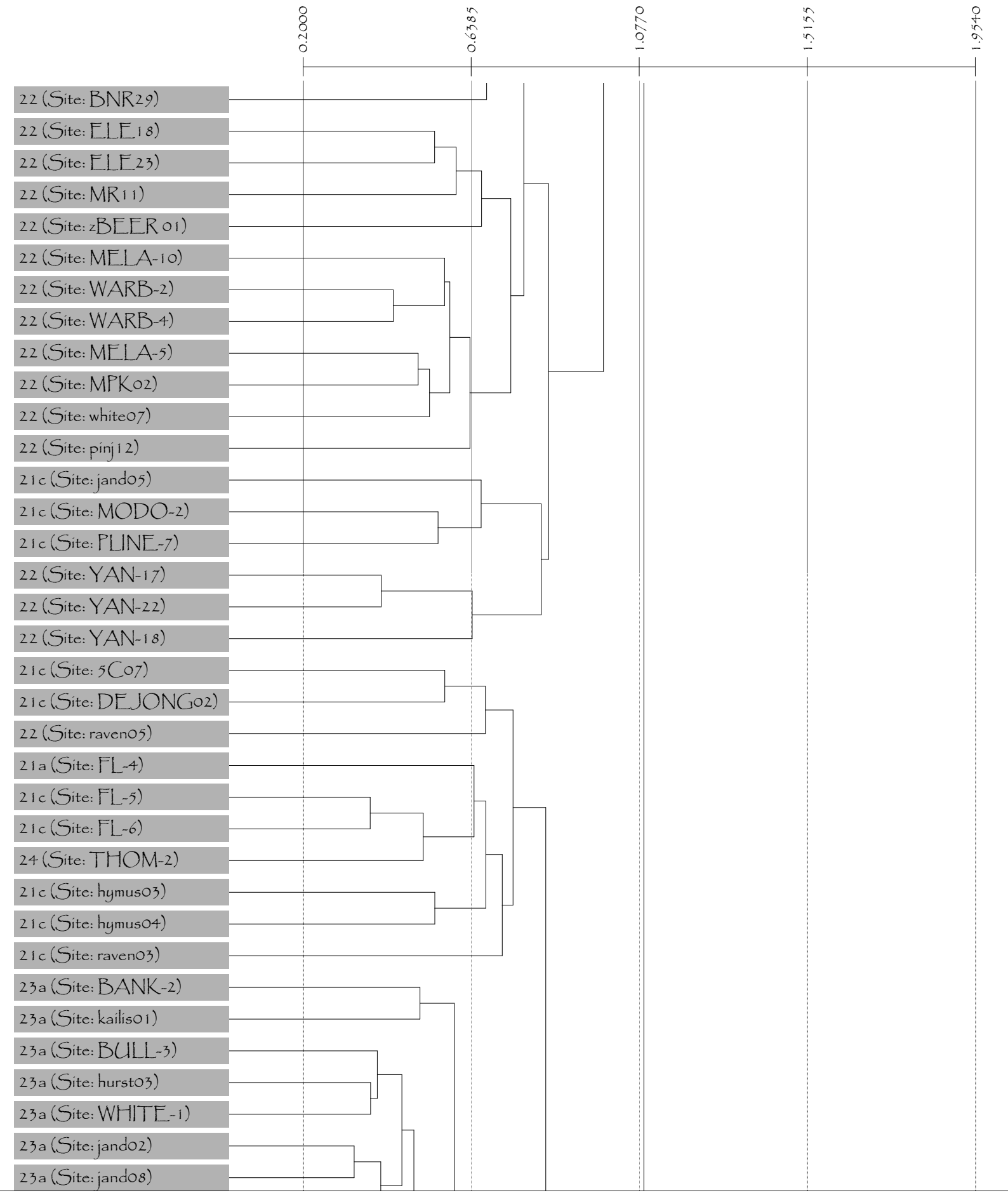
Column Fusion Dendrogram



Fusion Type: Flexible UPGMA Beta = -0.10

On Association: Bray & Curtis (Columns) Created on: 13:07:20, March 20, 2023

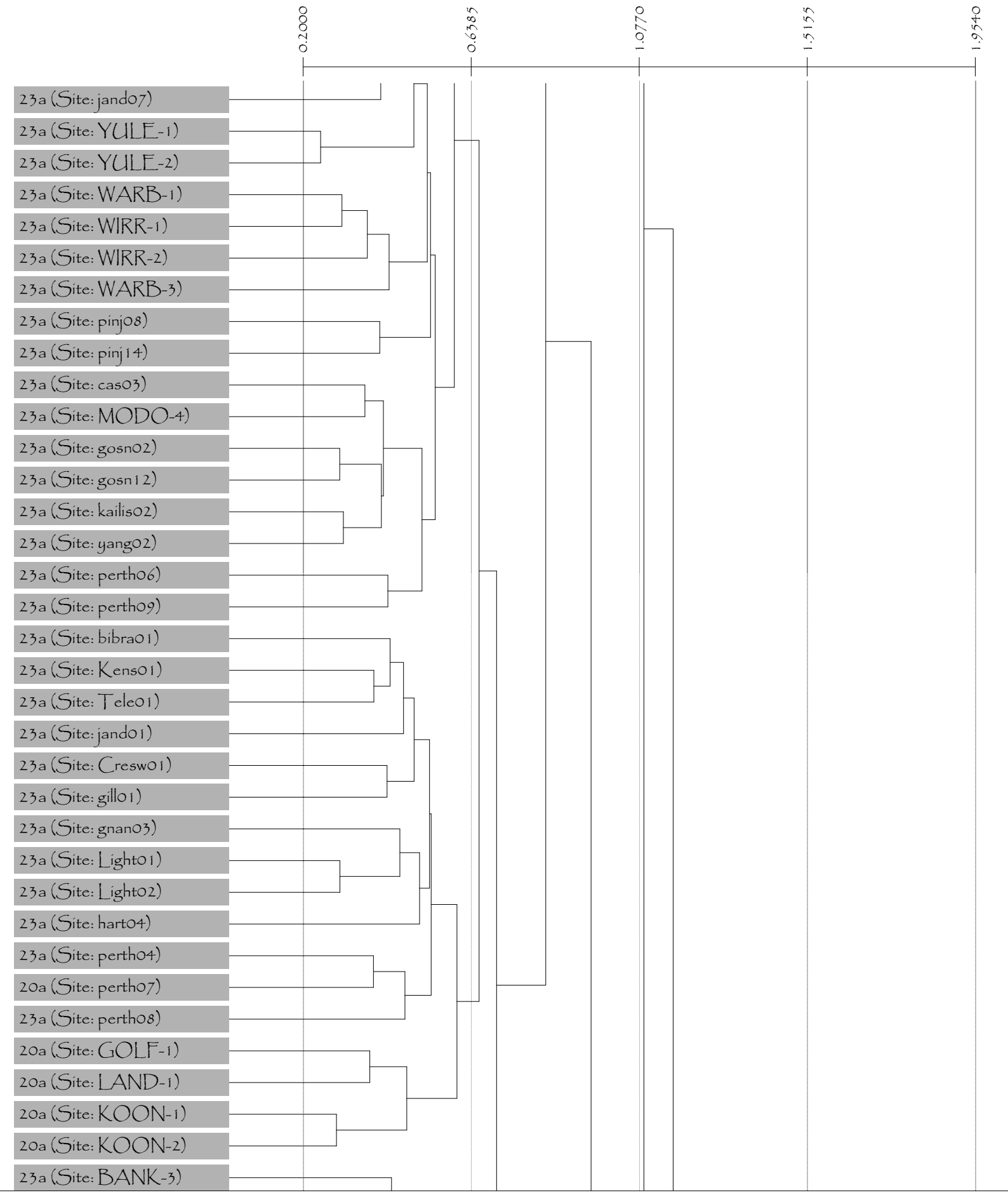
Column Fusion Dendrogram



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On Association: Bray & Curtis (Columns) Created on: 13:07:20, March 20, 2023

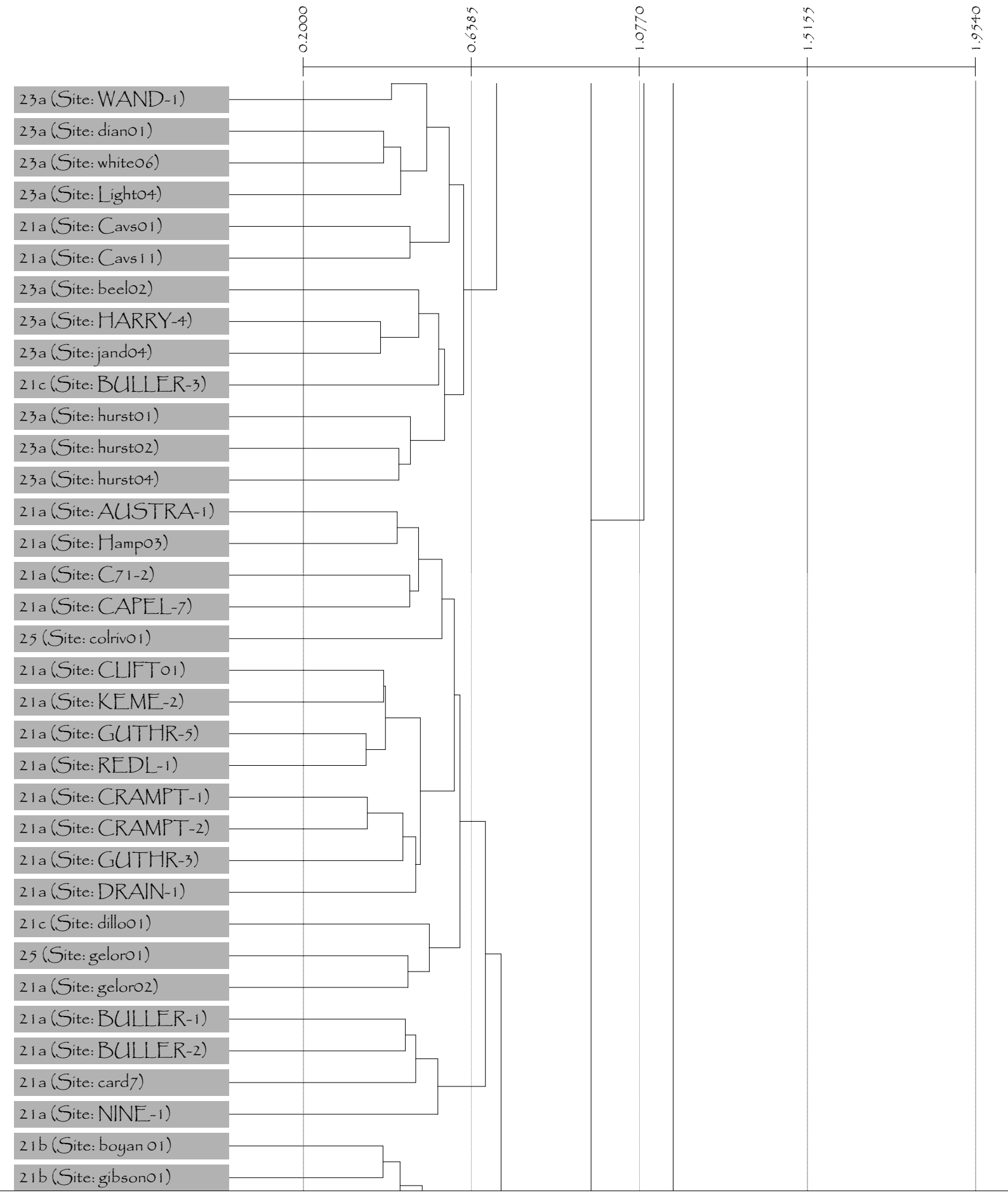
Column Fusion Dendrogram



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On Association: Bray & Curtis (Columns) Created on: 13:07:20, March 20, 2023

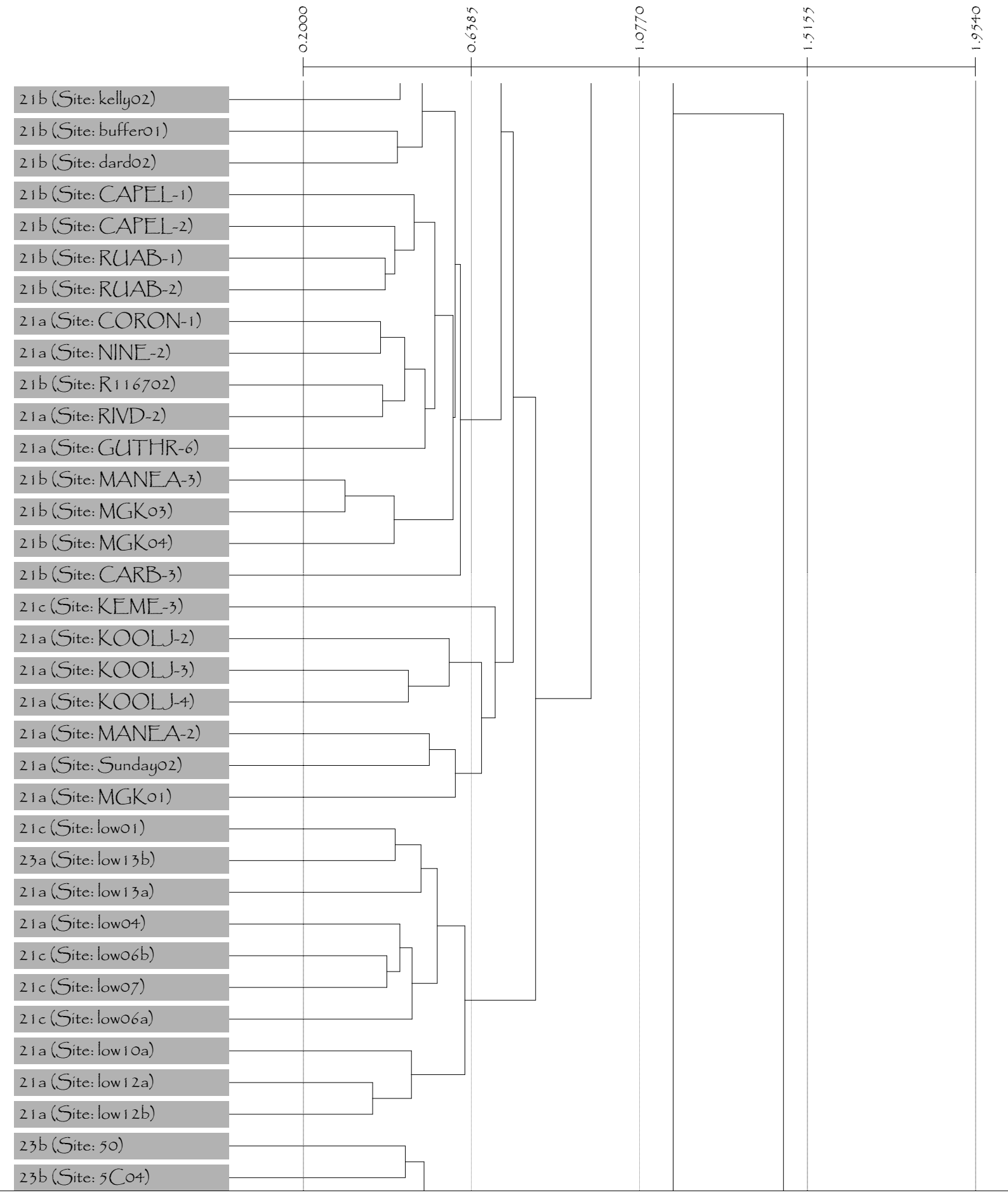
Column Fusion Dendrogram



Fusion Type: Flexible UPGMA Beta = -0.10

On Association: Bray & Curtis (Columns) Created on: 13:07:20, March 20, 2023

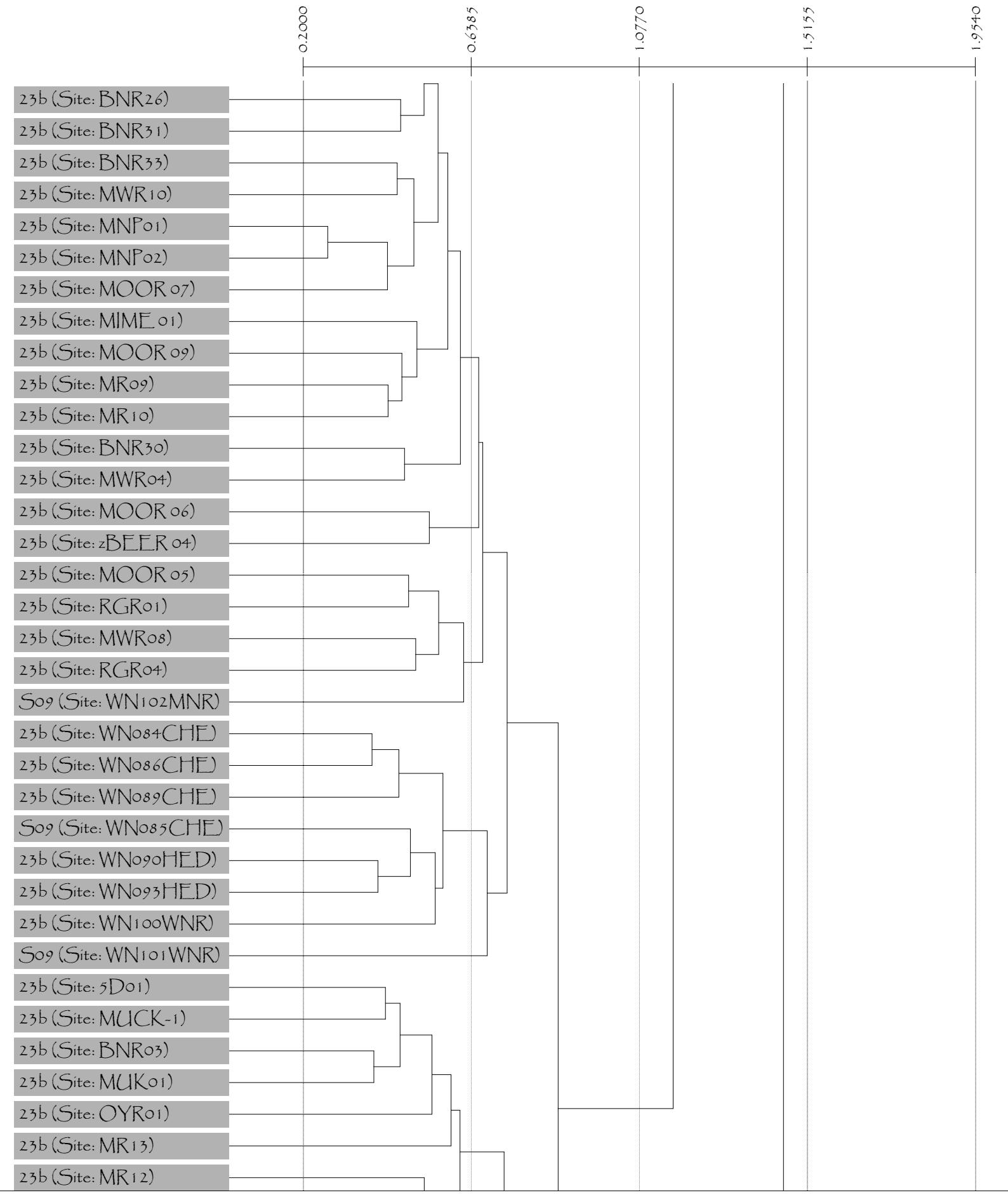
Column Fusion Dendrogram



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On Association: Bray & Curtis (Columns) Created on: 13:07:20, March 20, 2023

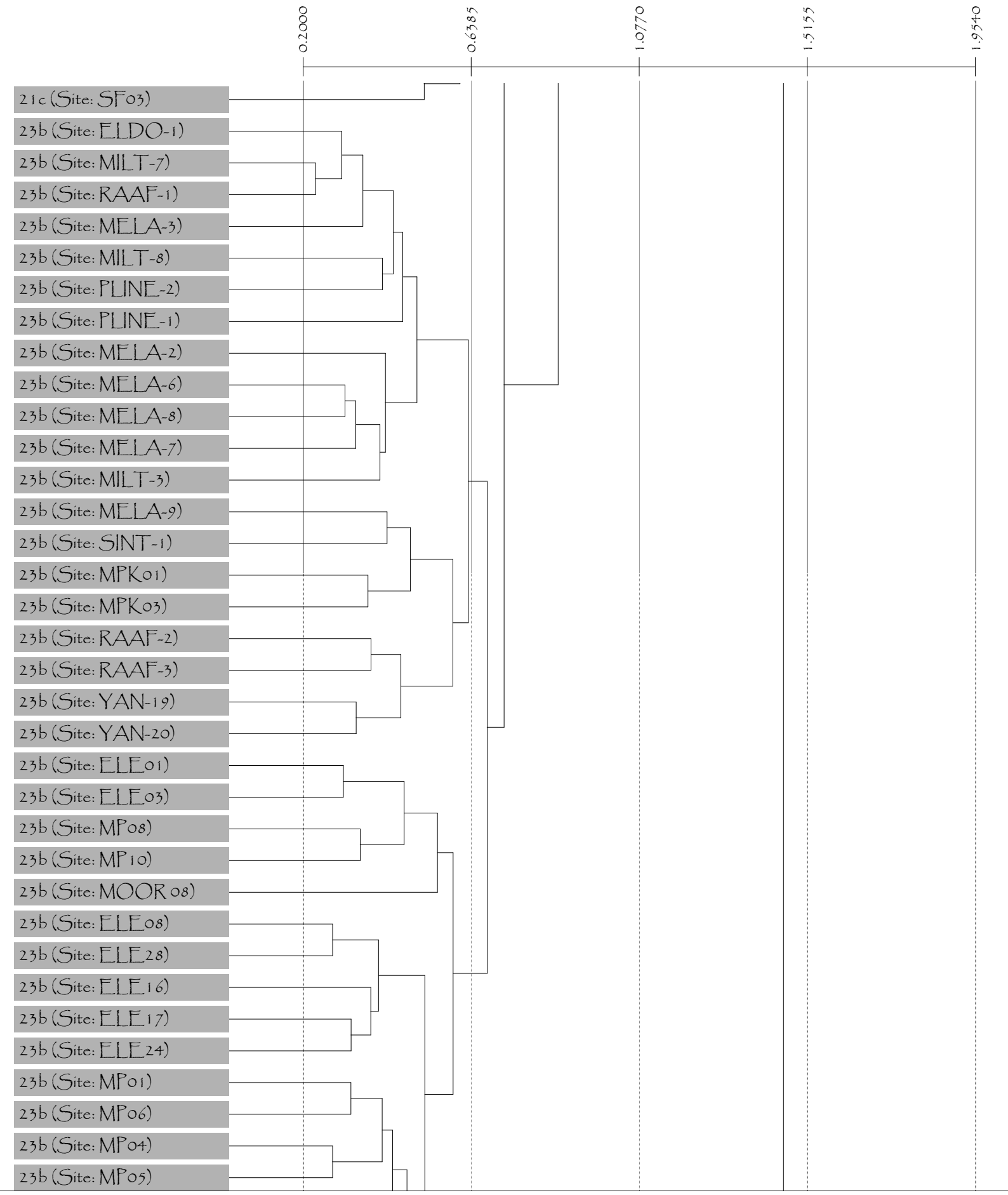
Column Fusion Dendrogram



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On Association: Bray & Curtis (Columns) Created on: 13:07:20, March 20, 2023

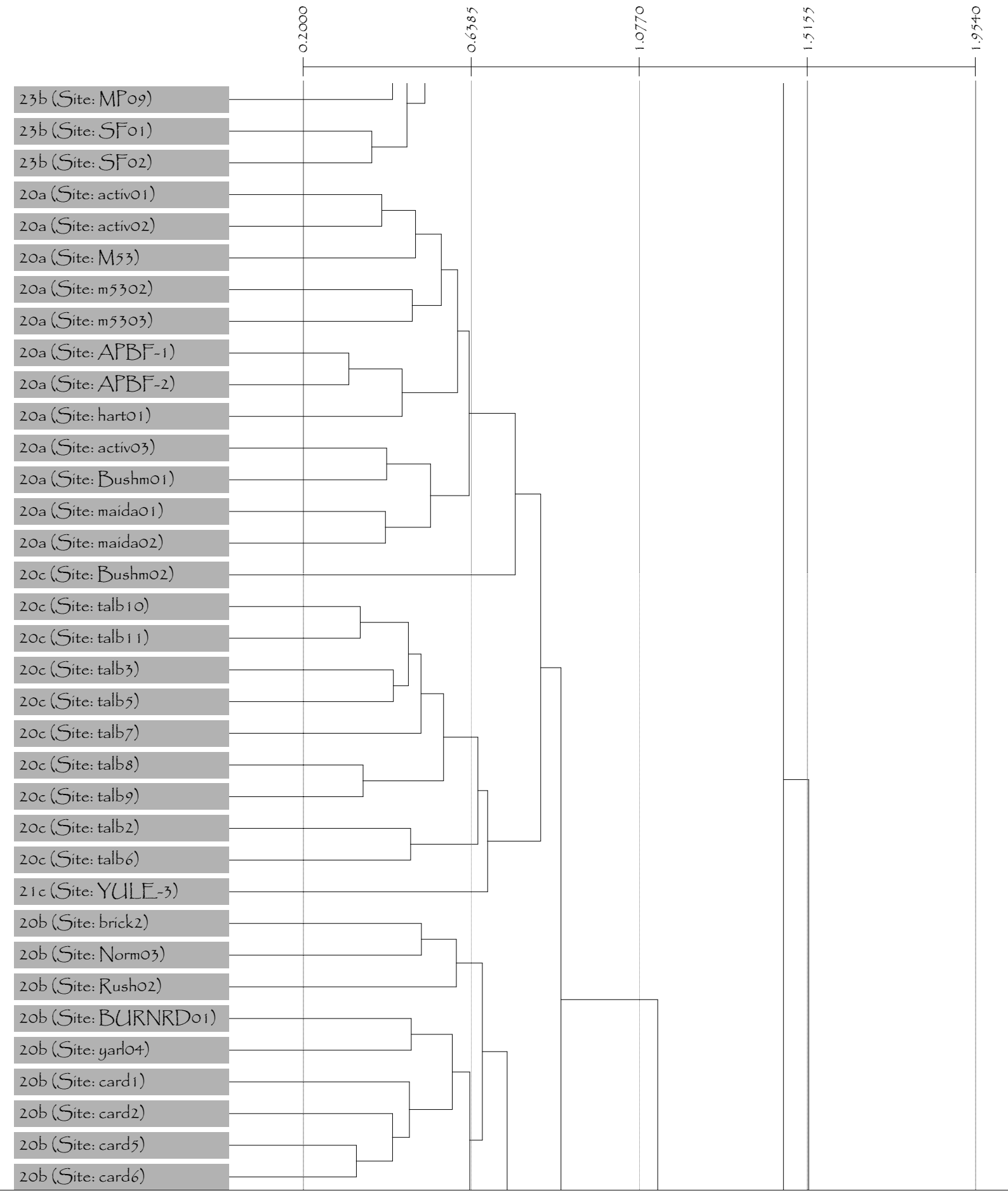
Column Fusion Dendrogram



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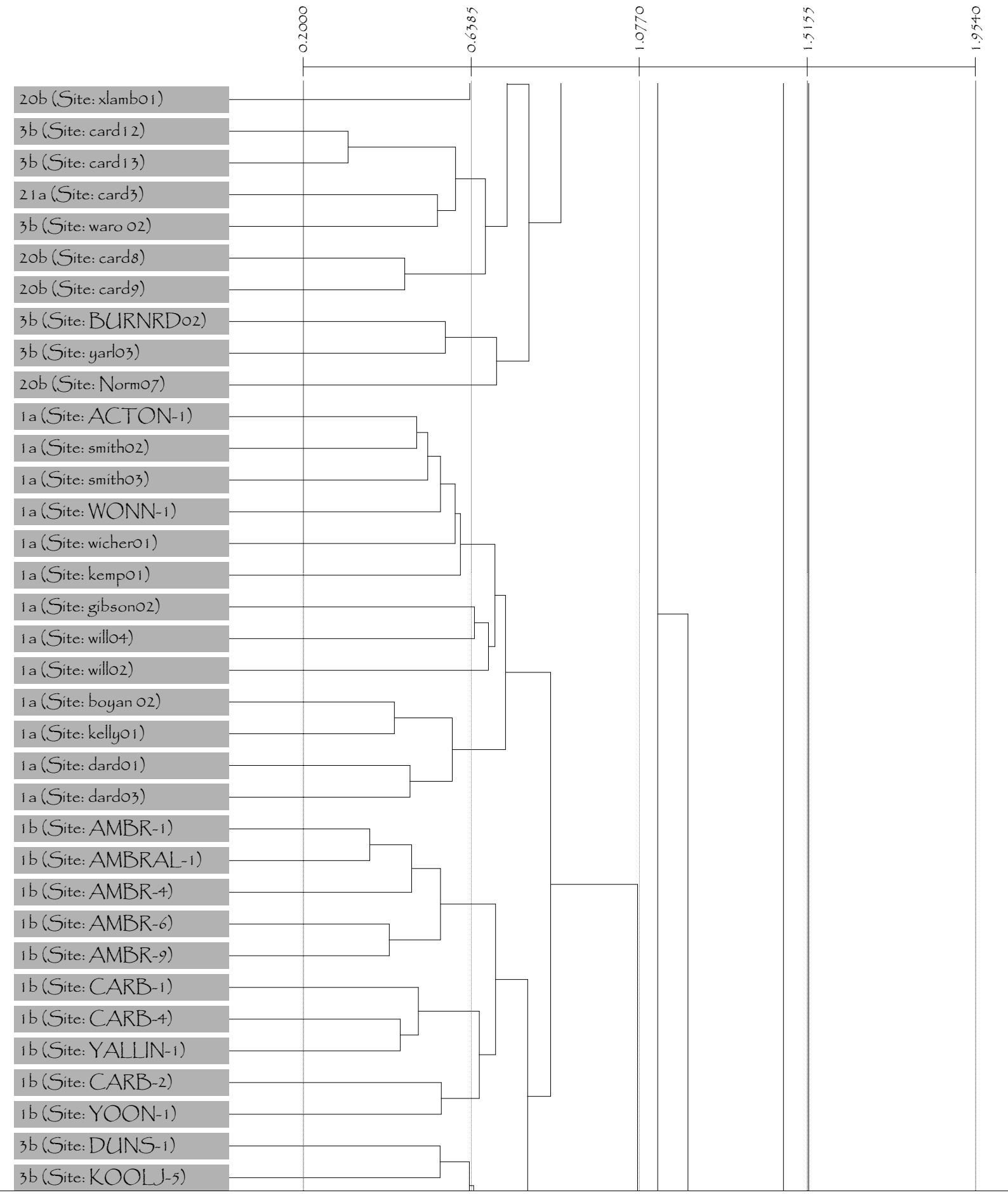
Column Fusion Dendrogram



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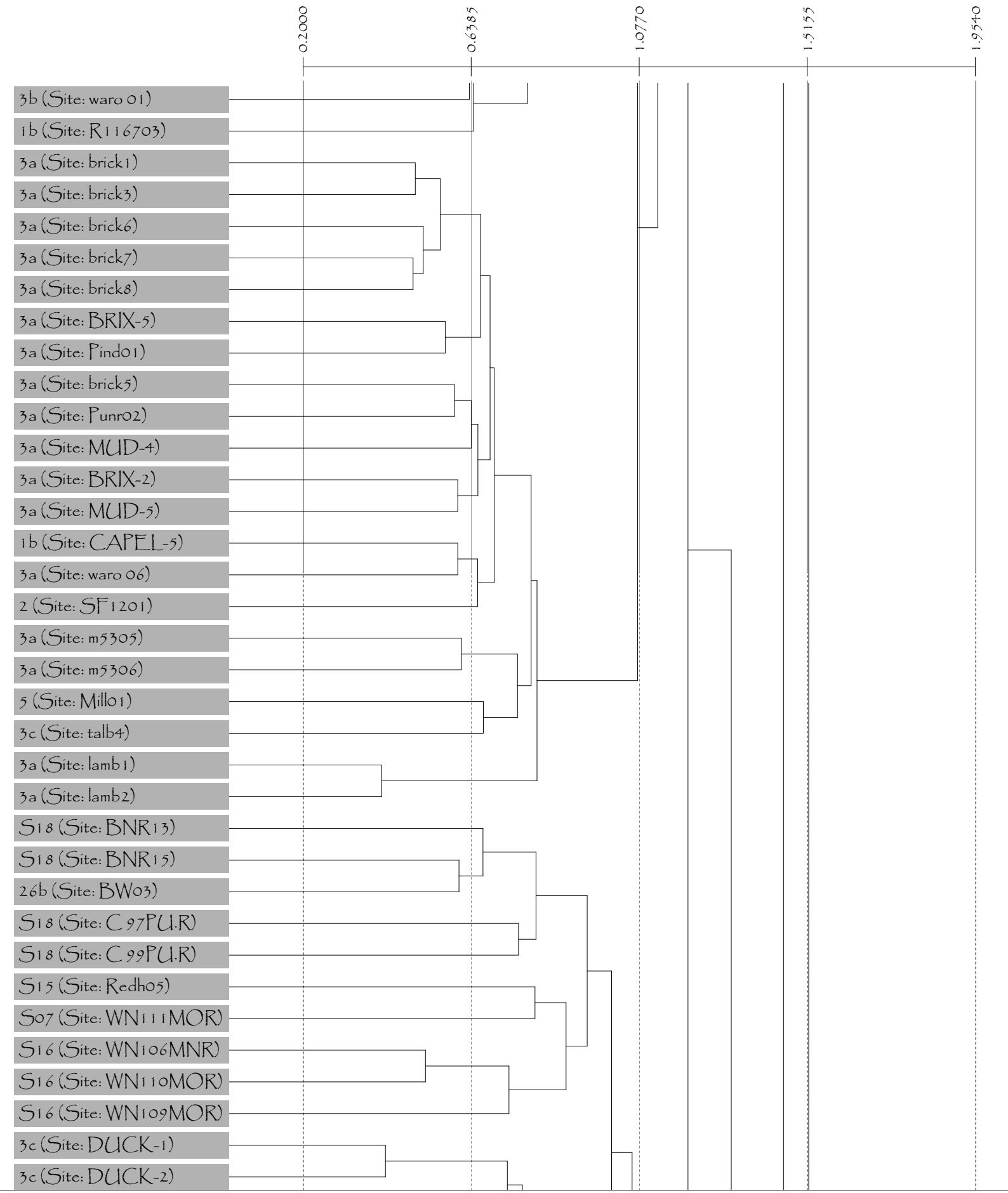
Column Fusion Dendrogram



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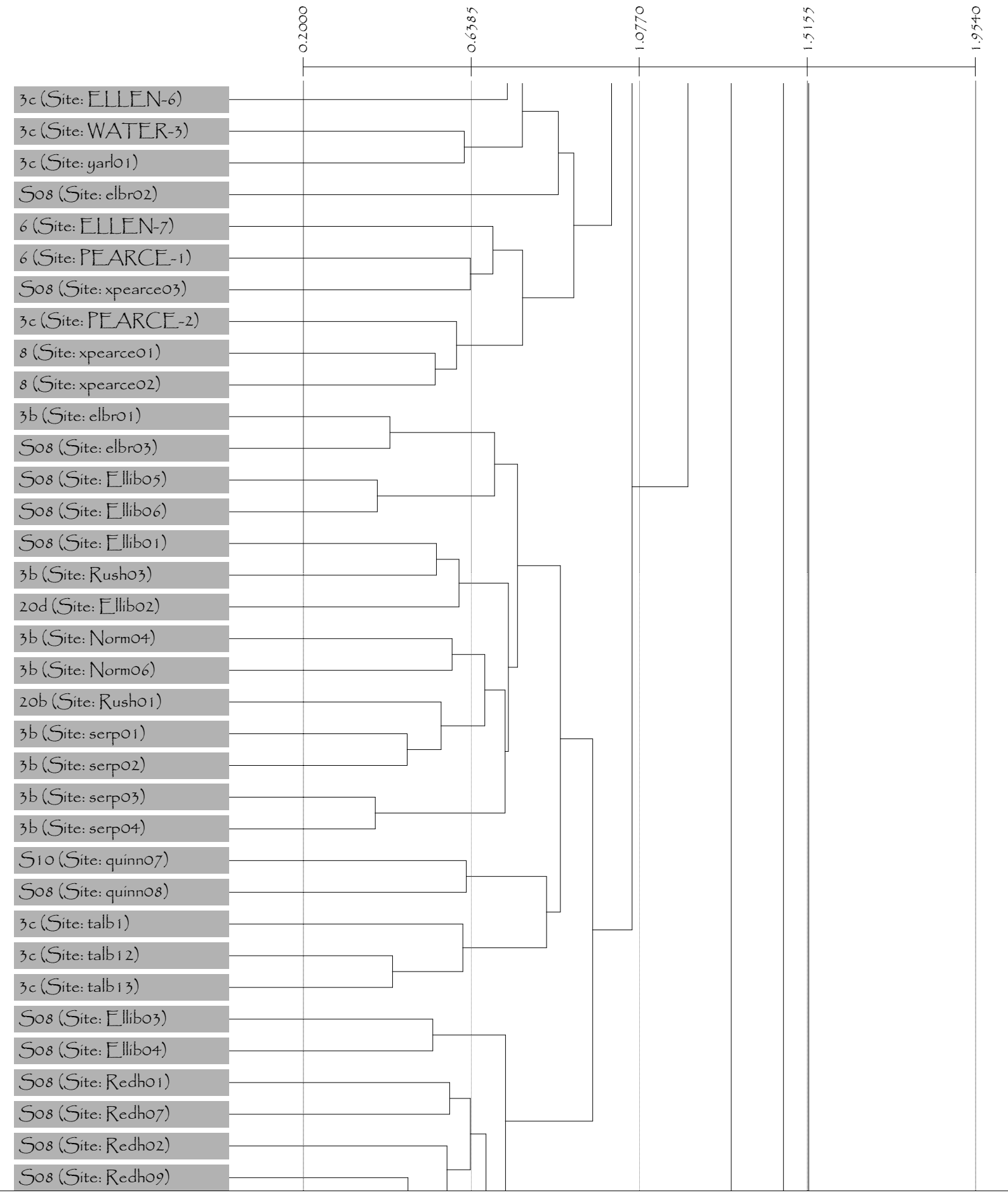
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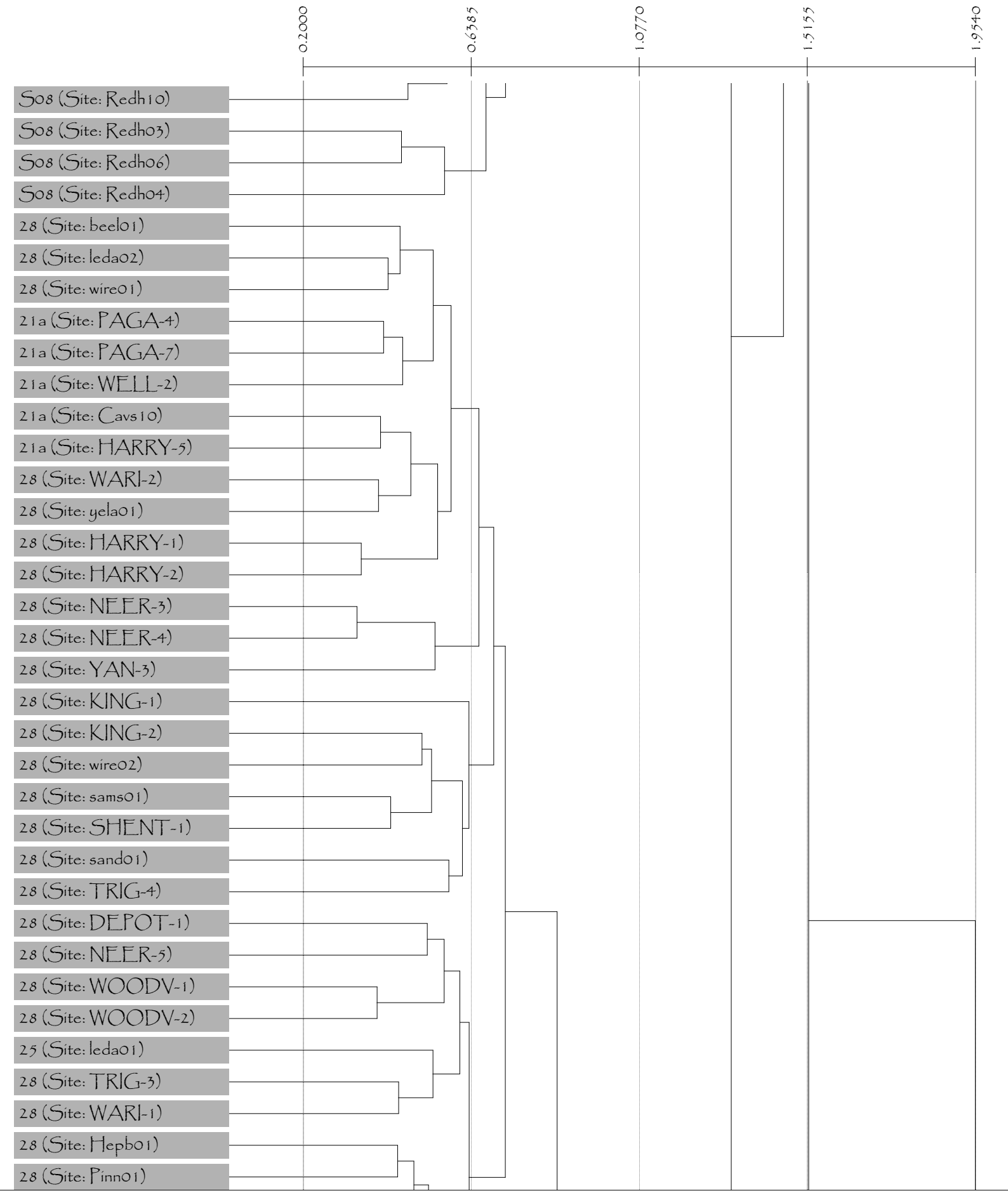
Column Fusion Dendrogram



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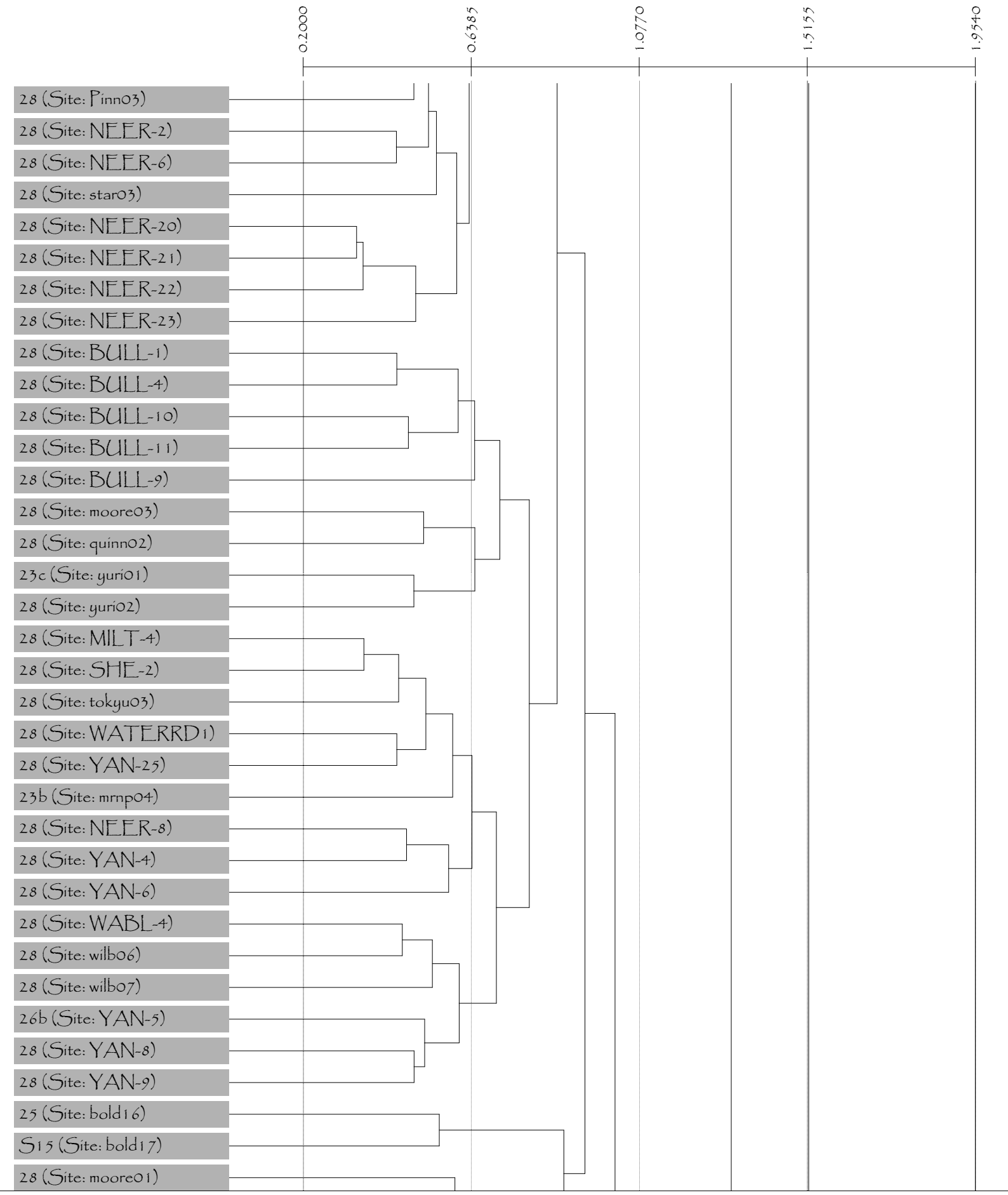
Column Fusion Dendrogram



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On Association: Bray & Curtis (Columns) Created on: 13:07:20, March 20, 2023

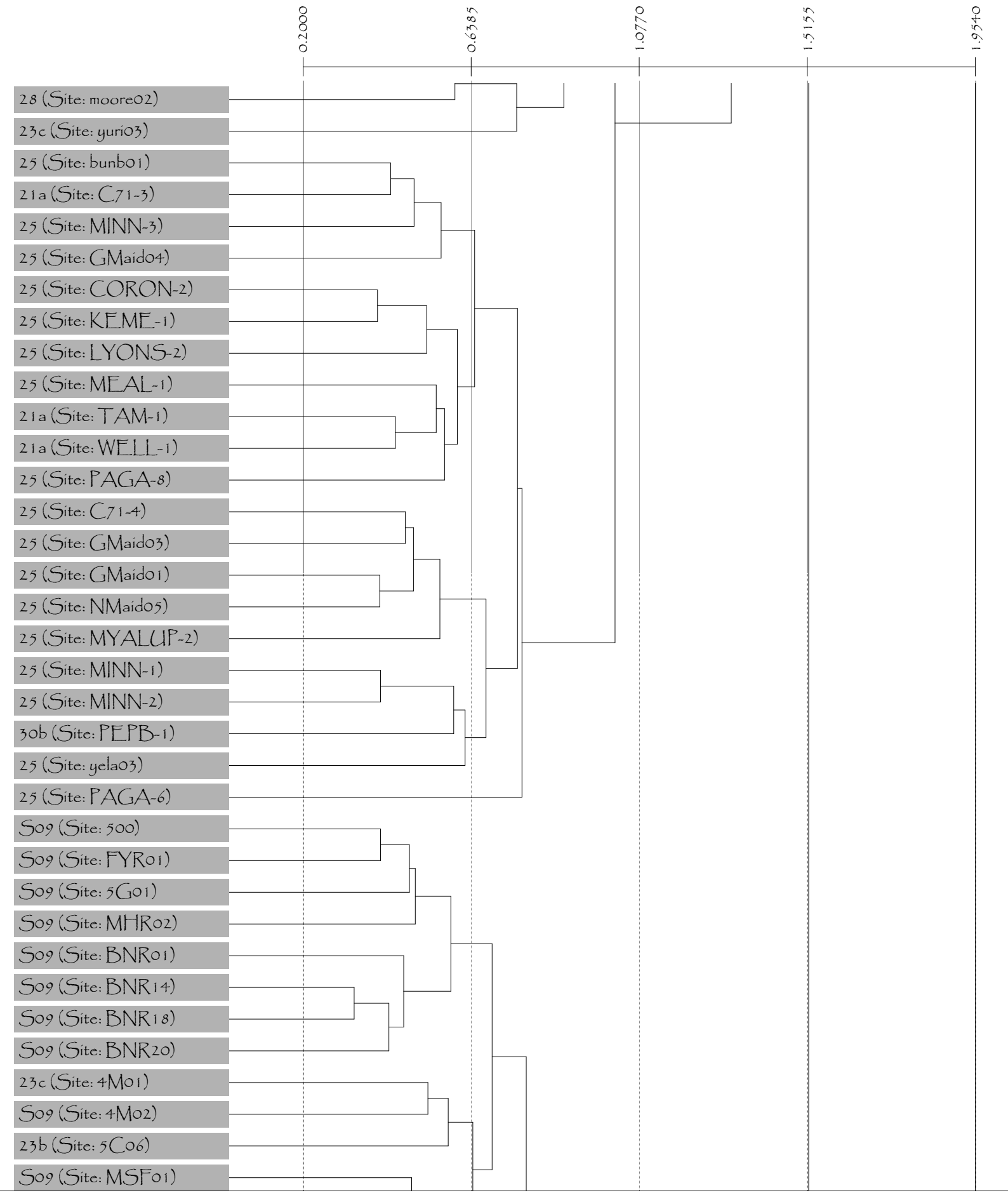
Column Fusion Dendrogram



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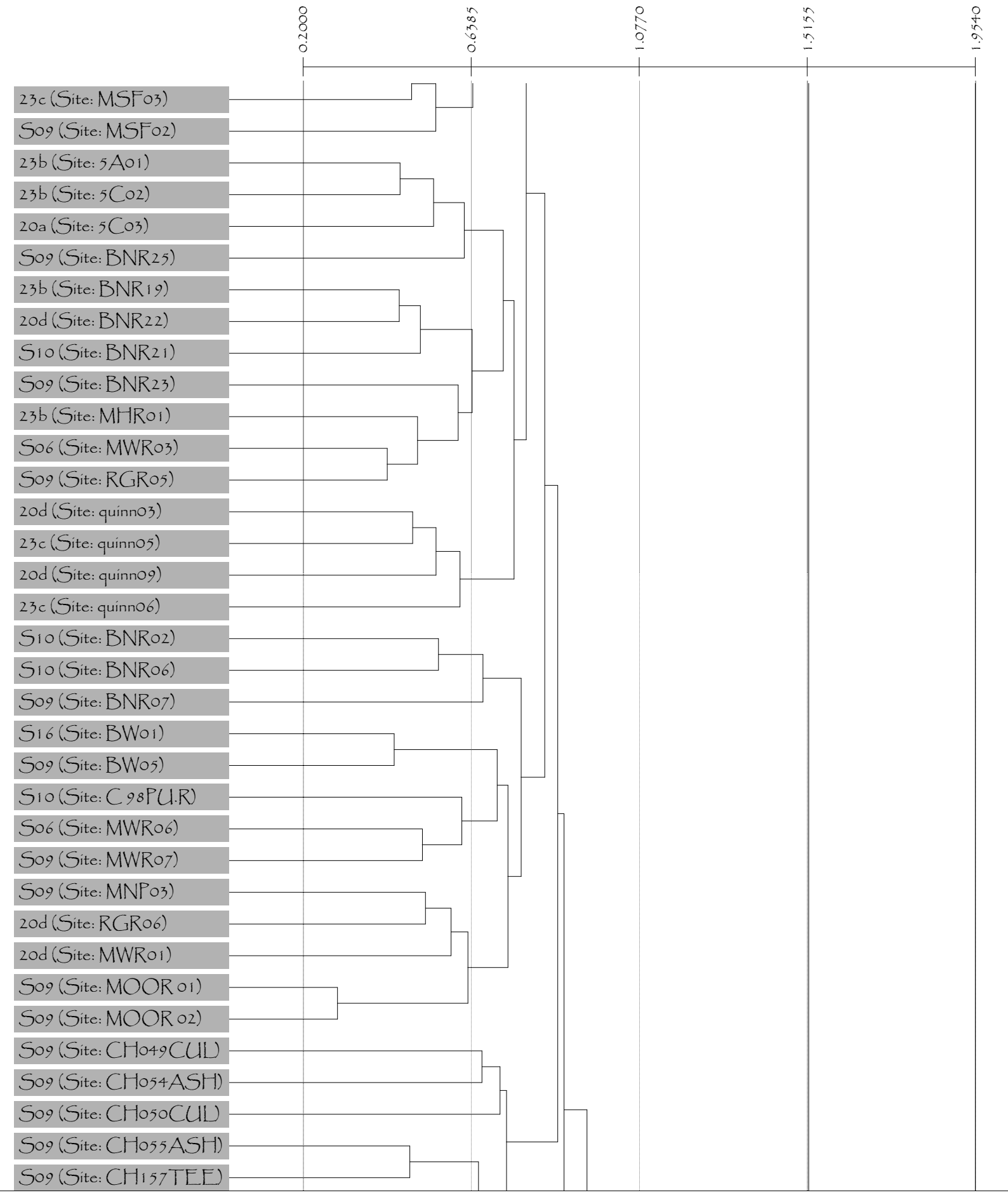
Column Fusion Dendrogram



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On Association: Bray & Curtis (Columns) Created on: 13:07:20, March 20, 2023

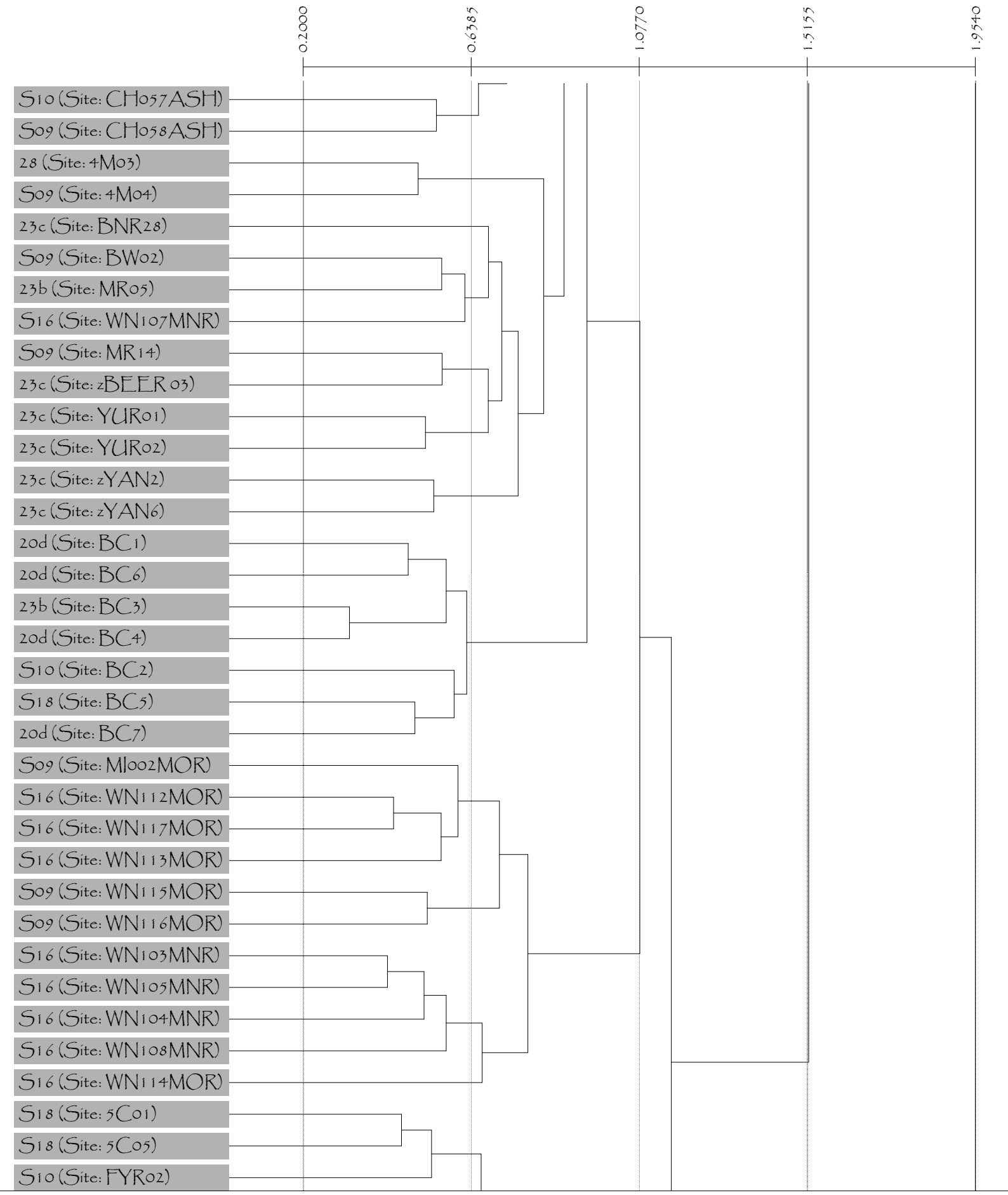
Column Fusion Dendrogram



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On Association: Bray & Curtis (Columns) Created on: 13:07:20, March 20, 2023

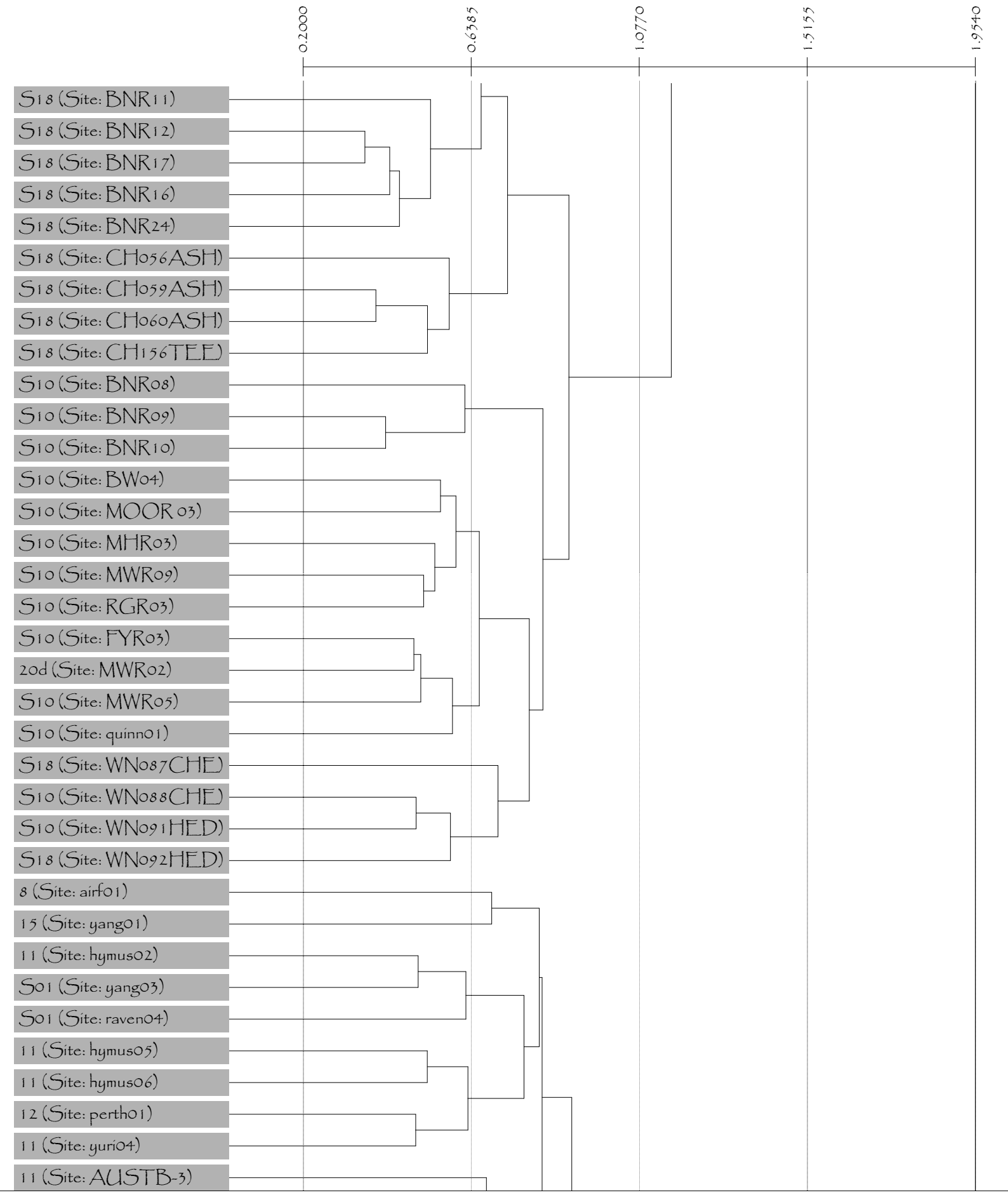
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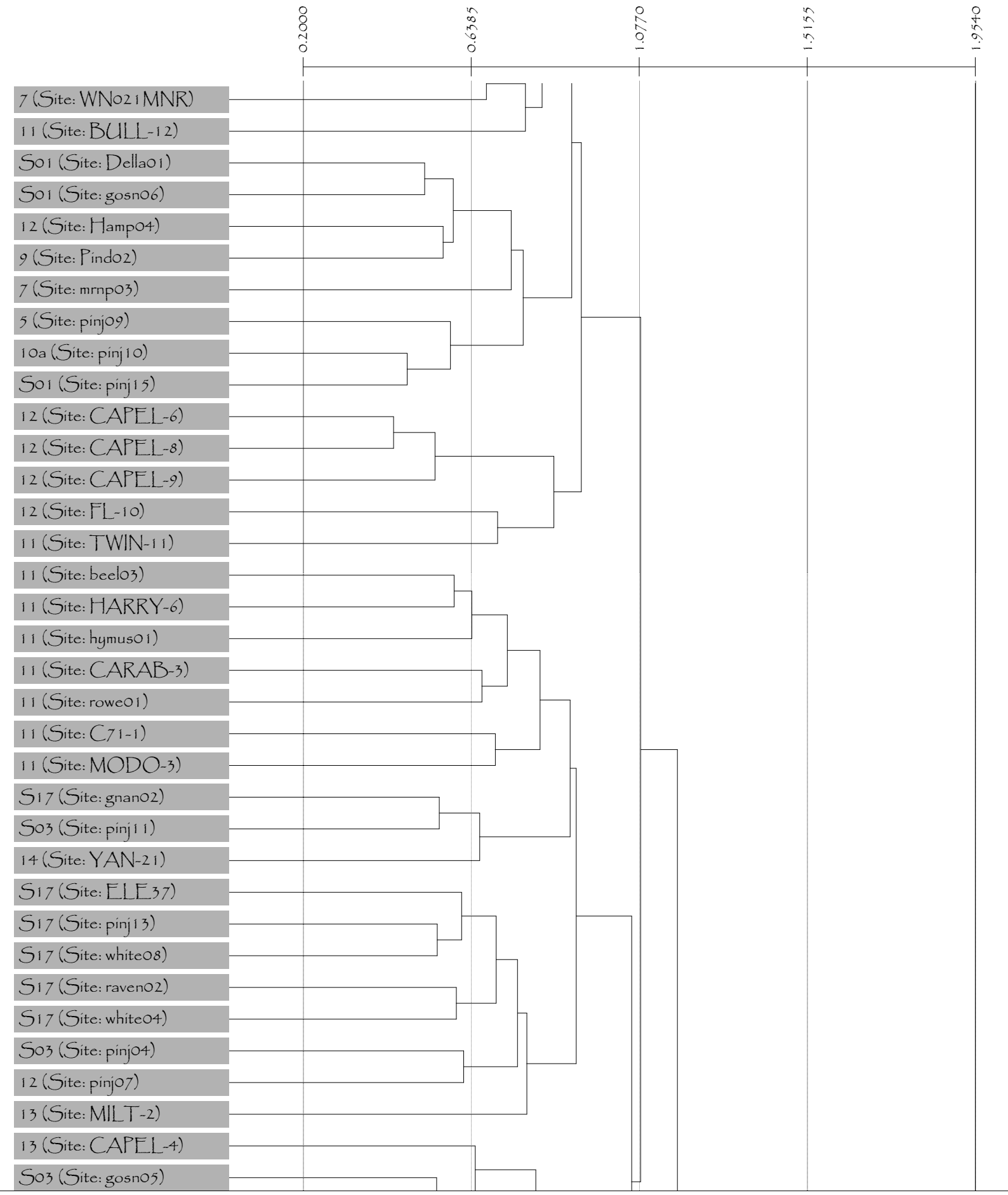
Column Fusion Dendrogram



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On Association: Bray & Curtis (Columns) Created on: 13:07:20, March 20, 2023

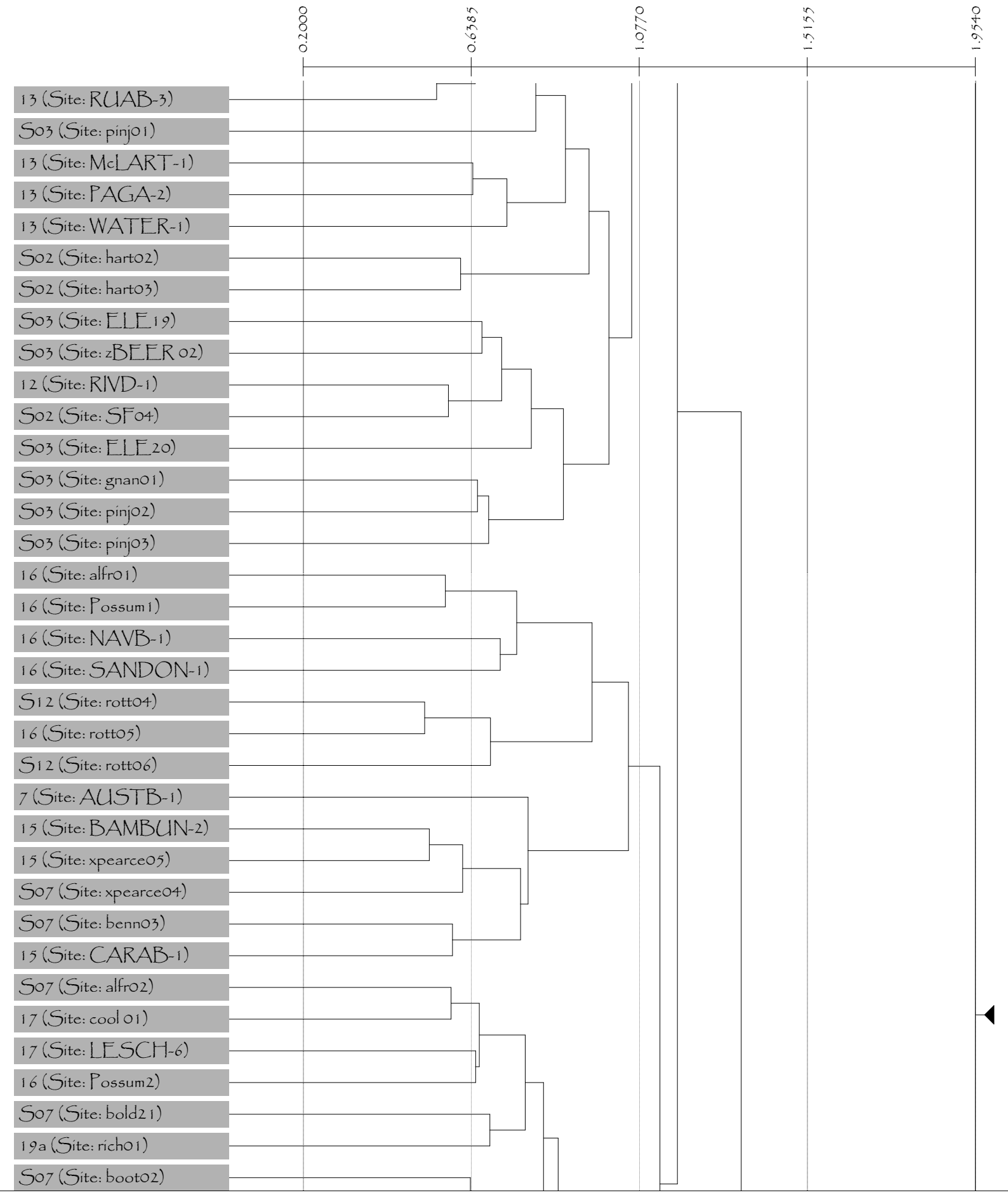
Column Fusion Dendrogram



Fusion Type: Flexible UPGMA Beta = -0.10

On Association: Bray & Curtis (Columns) Created on: 13:07:20, March 20, 2023

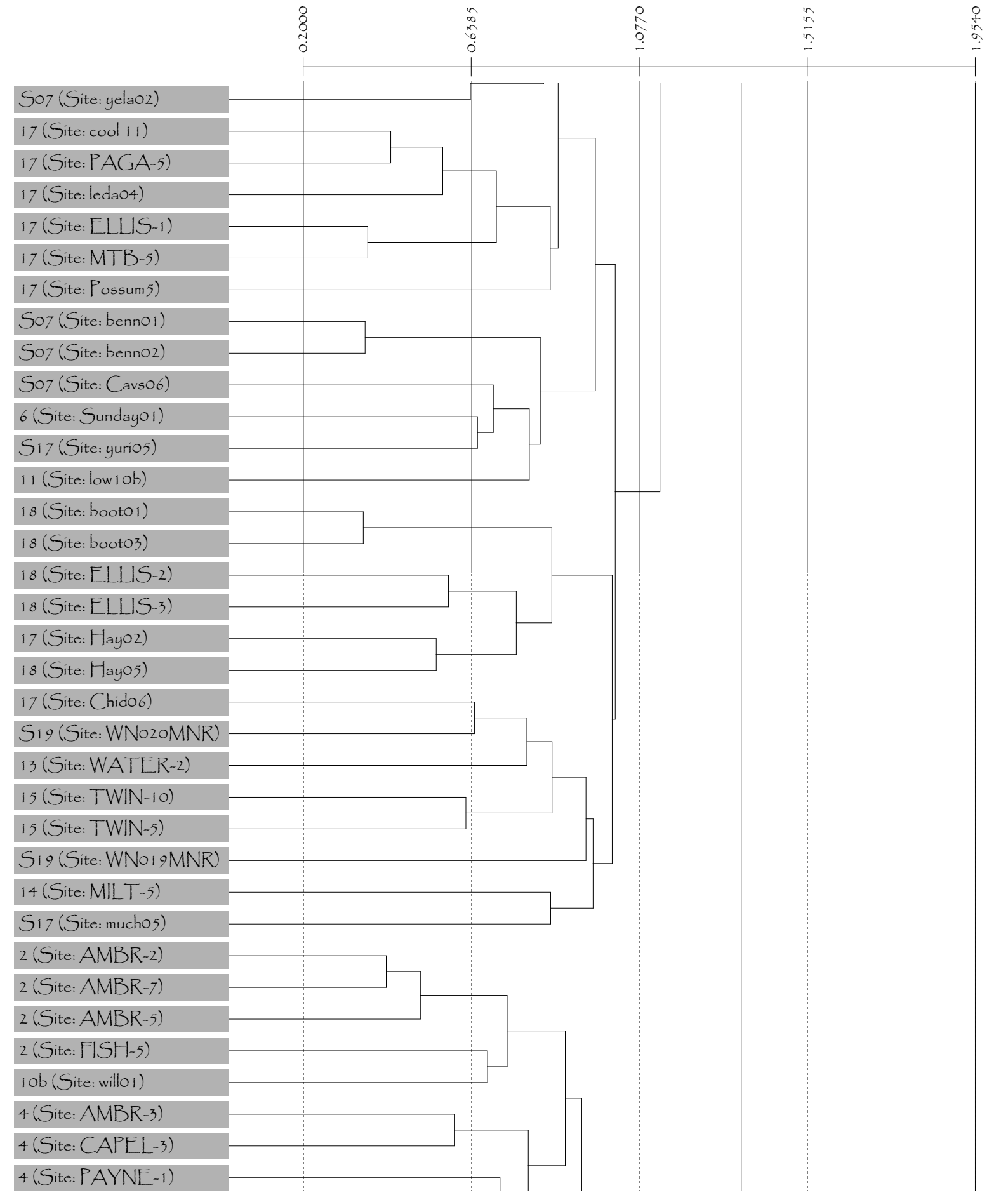
Column Fusion Dendrogram



Fusion Type: Flexible UPGMA Beta = -0.10

On Association: Bray & Curtis (Columns) Created on: 13:07:20, March 20, 2023

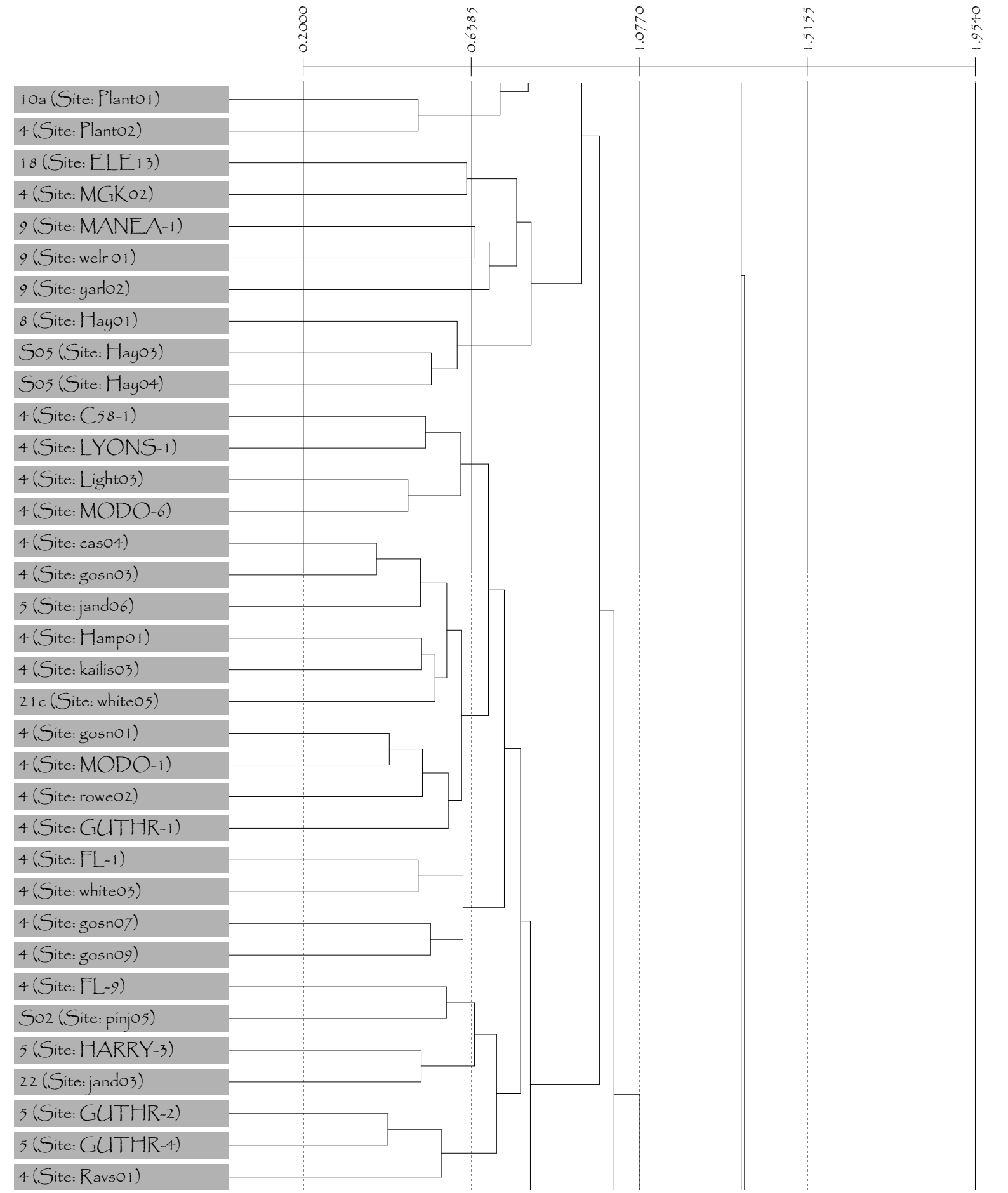
Column Fusion Dendrogram



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On Association: Bray & Curtis (Columns) Created on: 13:07:20, March 20, 2023

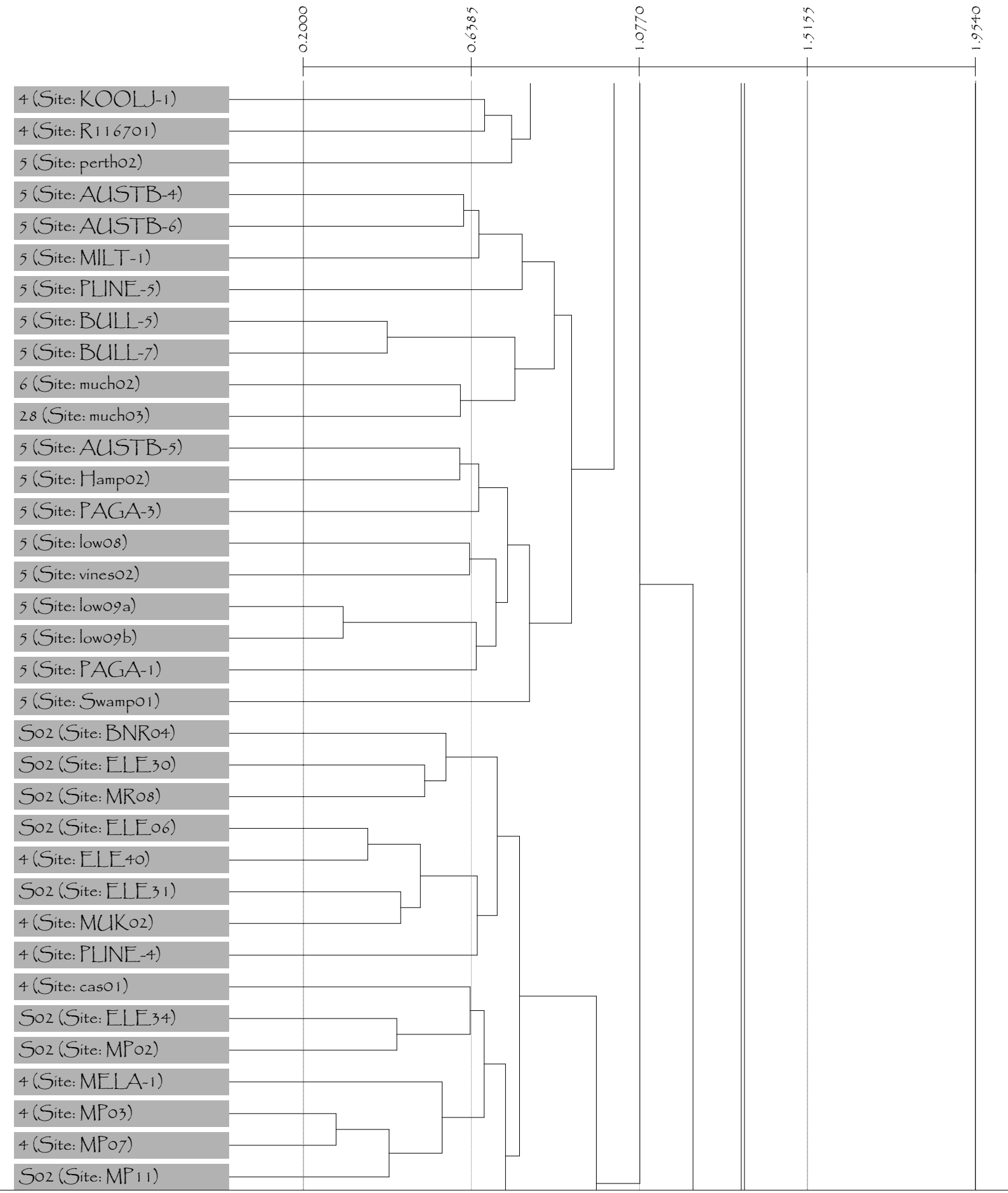
Column Fusion Dendrogram



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On Association: Bray & Curtis (Columns) Created on: 13:07:20, March 20, 2023

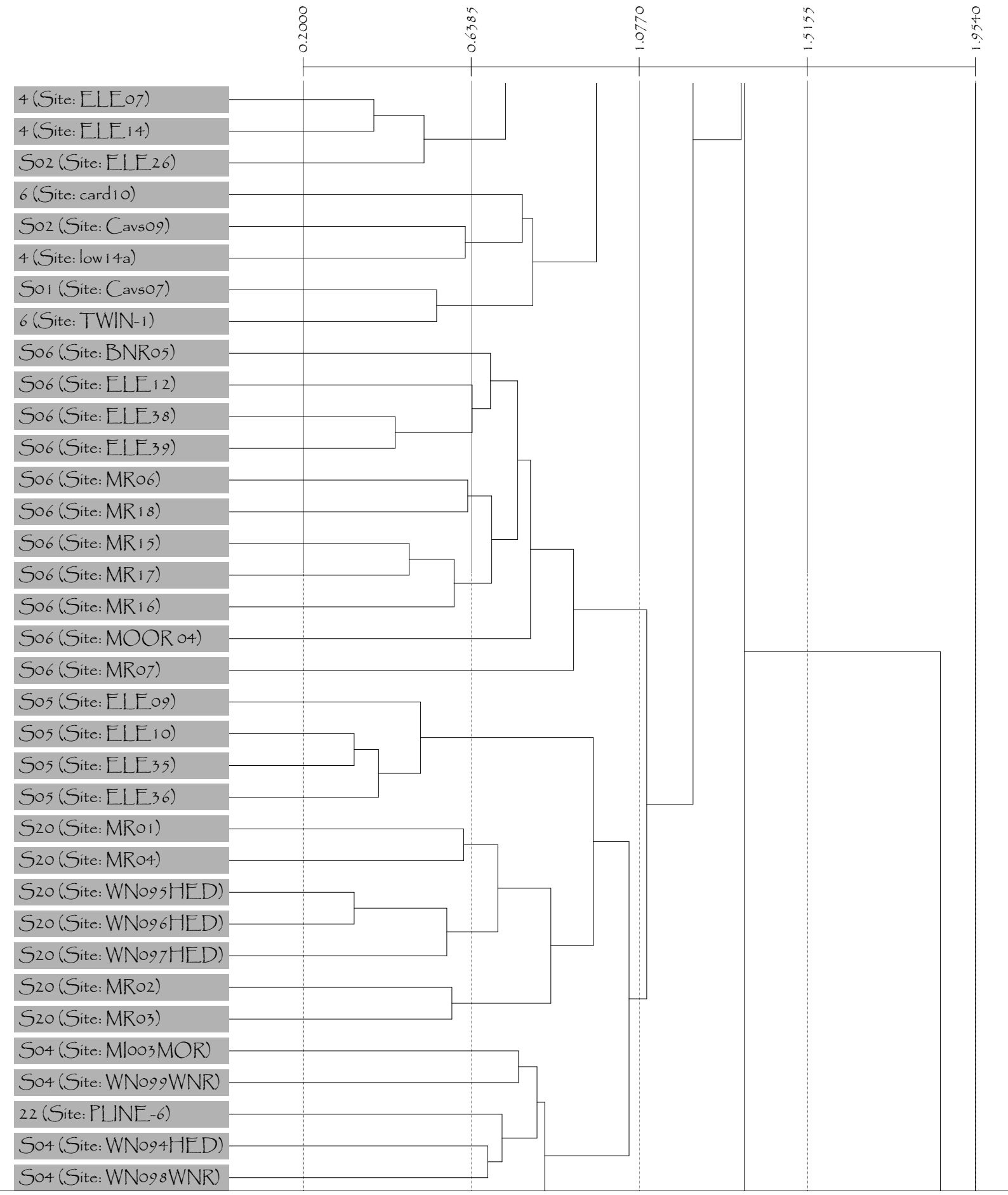
Column Fusion Dendrogram



Fusion Type: Flexible UPGMA Beta = -0.10

On Association: Bray & Curtis (Columns) Created on: 13:07:20, March 20, 2023

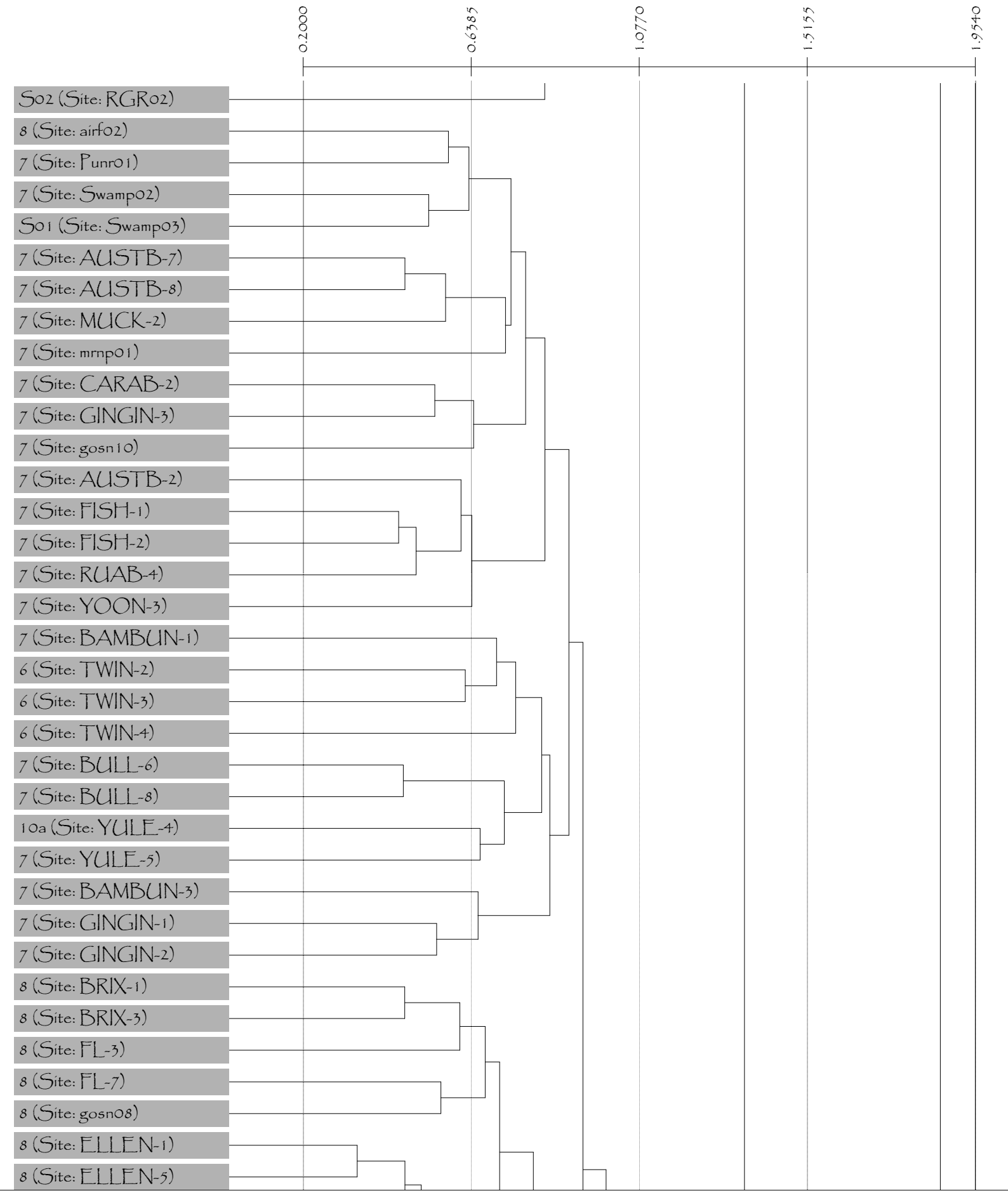
Column Fusion Dendrogram



Fusion Type: Flexible UPGMA Beta = -0.10

On Association: Bray & Curtis (Columns) Created on: 13:07:20, March 20, 2023

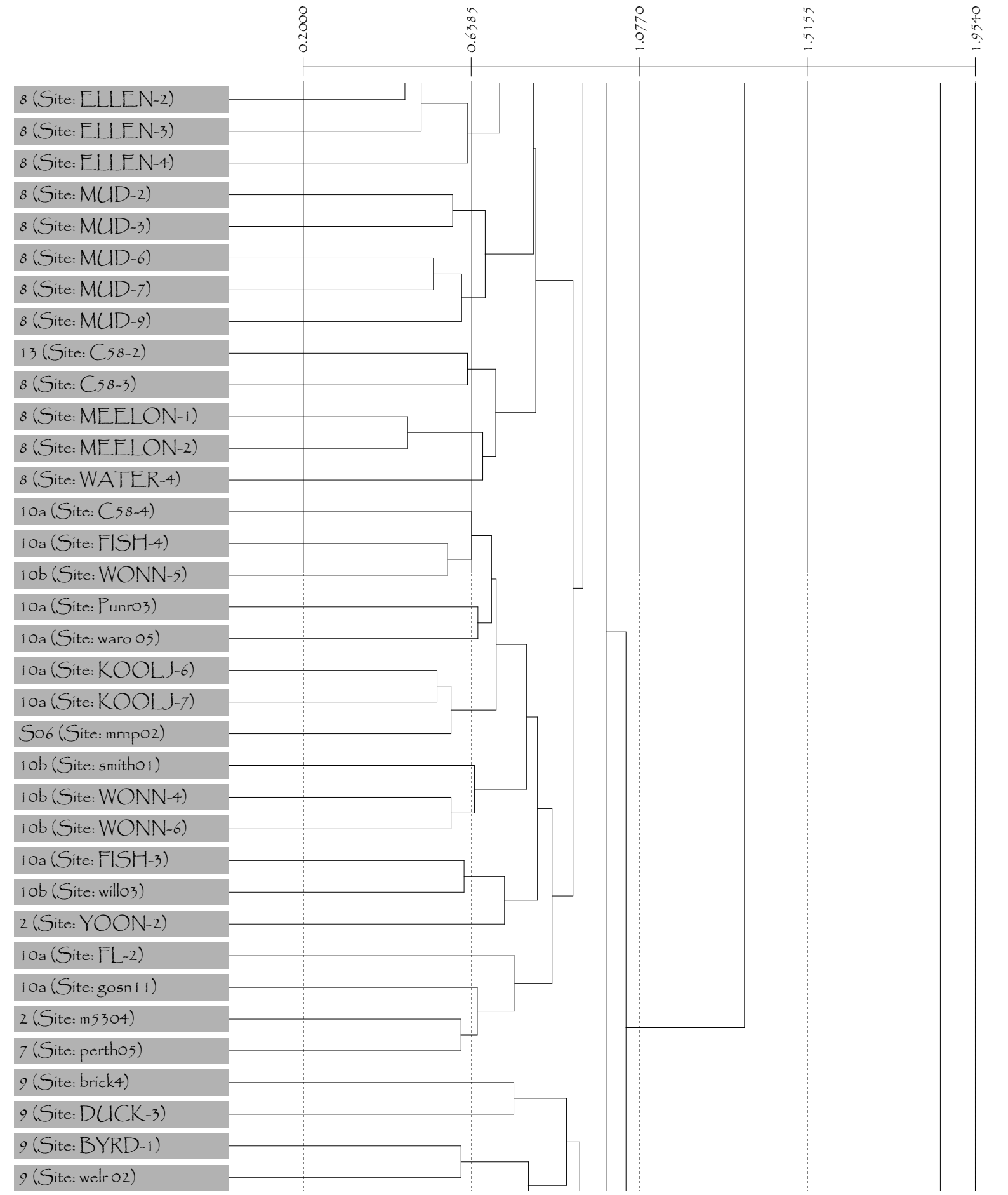
Column Fusion Dendrogram



Fusion Type: Flexible UPGMA Beta = -0.10

On Association: Bray & Curtis (Columns) Created on: 13:07:20, March 20, 2023

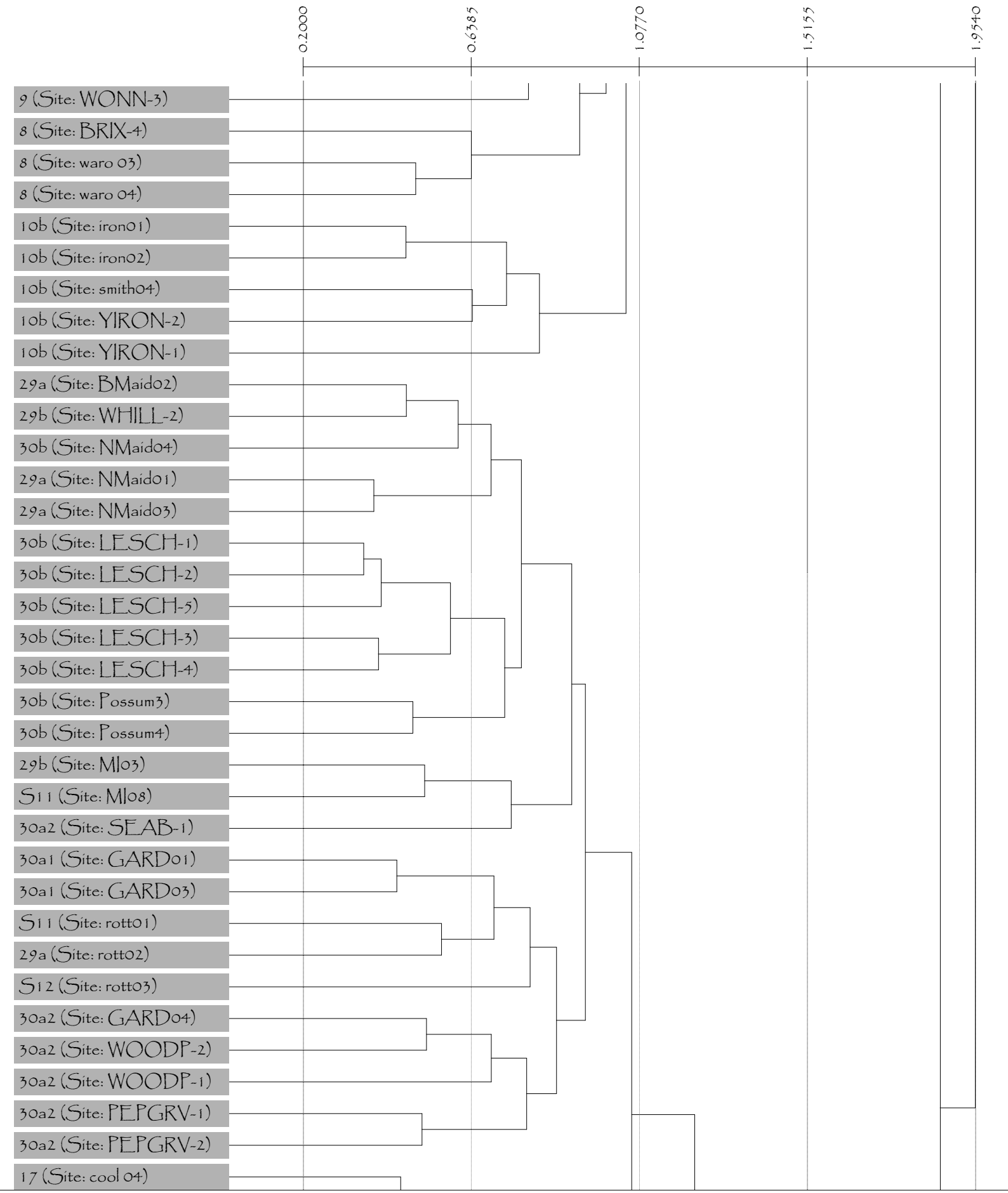
Column Fusion Dendrogram



Fusion Type: Flexible UPGMA Beta = -0.10

On Association: Bray & Curtis (Columns) Created on: 13:07:20, March 20, 2023

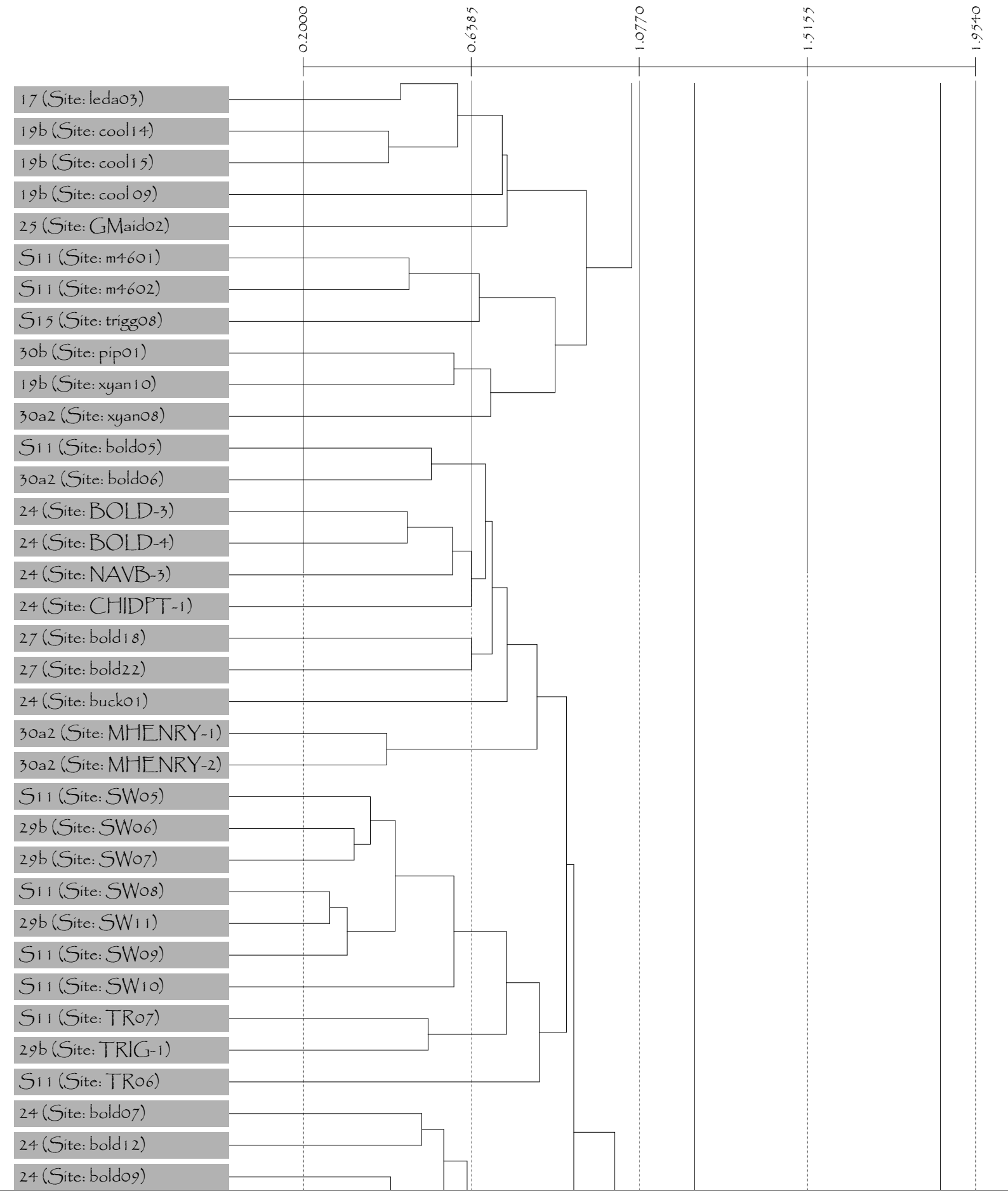
Column Fusion Dendrogram



Fusion Type: Flexible UPGMA Beta = -0.10

On Association: Bray & Curtis (Columns) Created on: 13:07:20, March 20, 2023

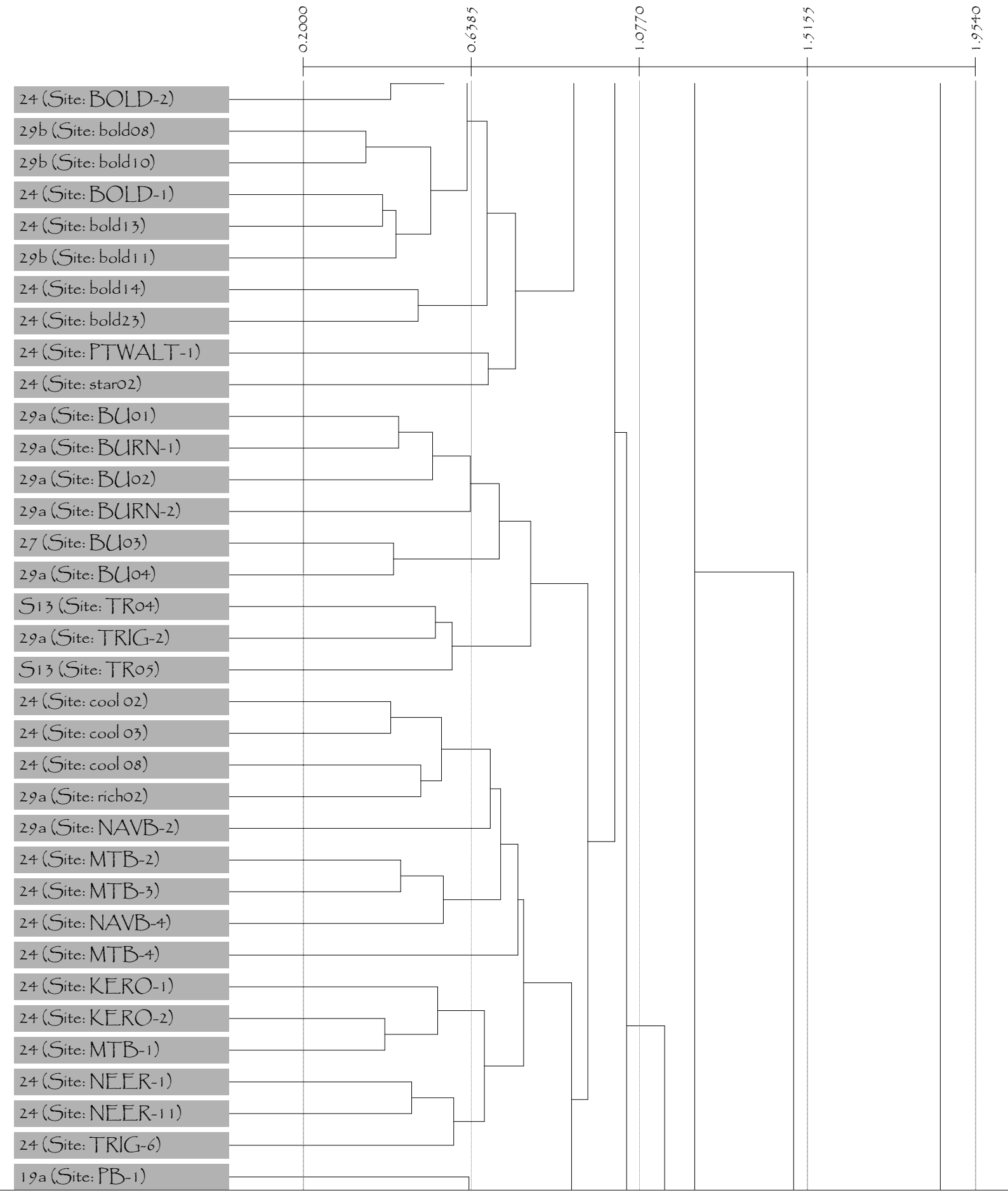
Column Fusion Dendrogram



Fusion Type: Flexible UPGMA Beta = -0.10

On Association: Bray & Curtis (Columns) Created on: 13:07:20, March 20, 2023

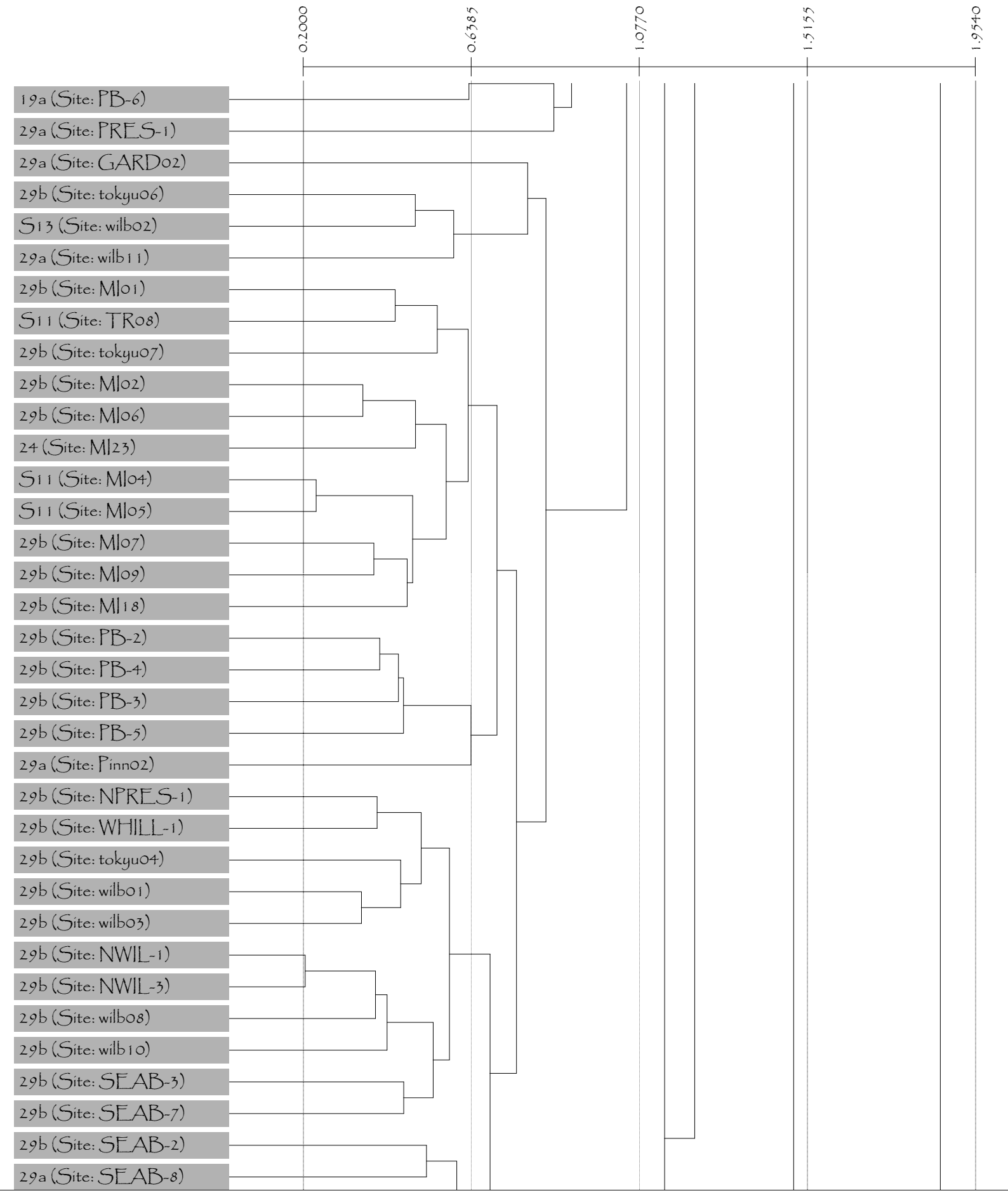
Column Fusion Dendrogram



Fusion Type: Flexible UPGMA Beta = -0.10

On Association: Bray & Curtis (Columns) Created on: 13:07:20, March 20, 2023

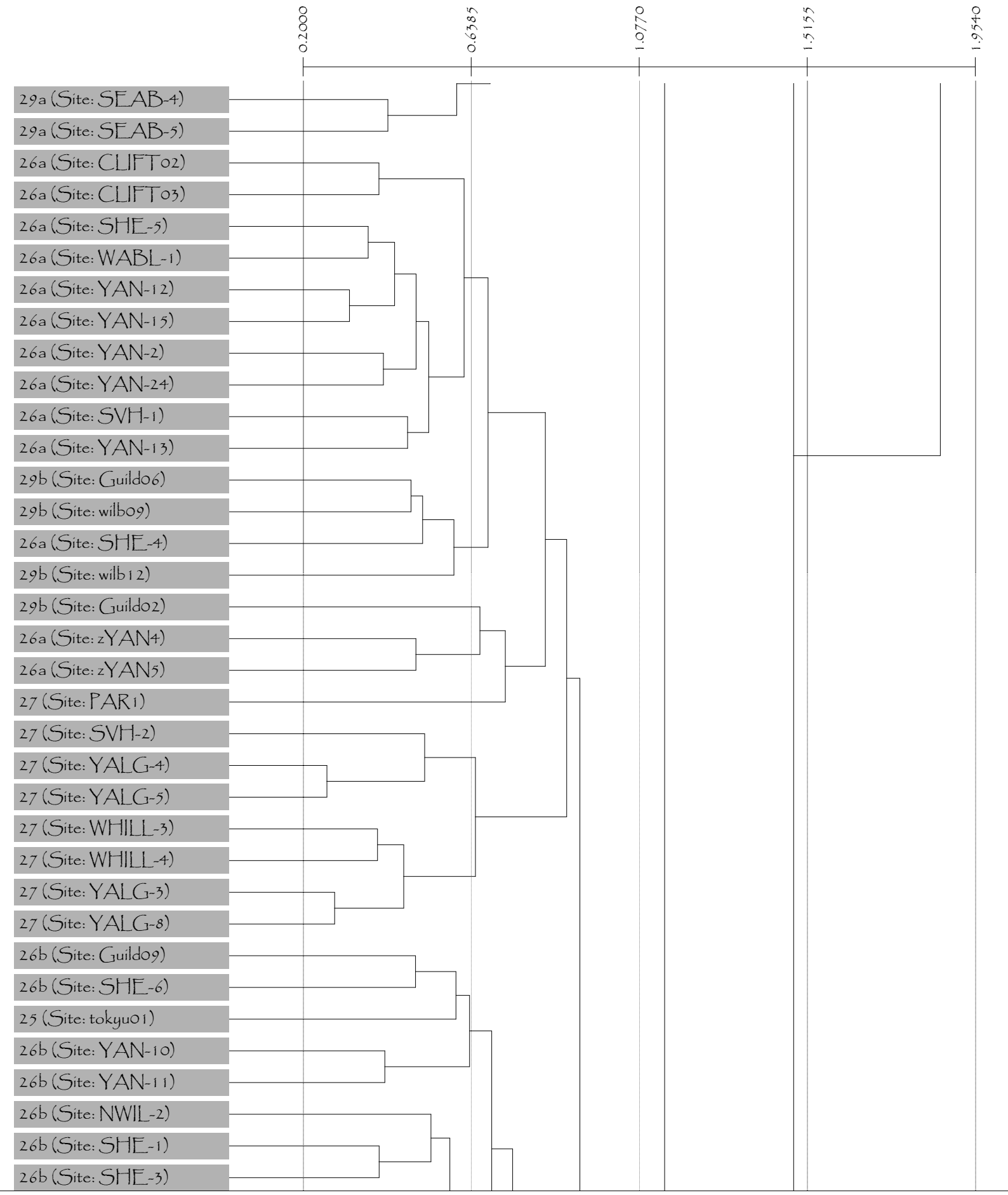
Column Fusion Dendrogram



Fusion Type: Flexible UPGMA Beta = -0.10

On Association: Bray & Curtis (Columns) Created on: 13:07:20, March 20, 2023

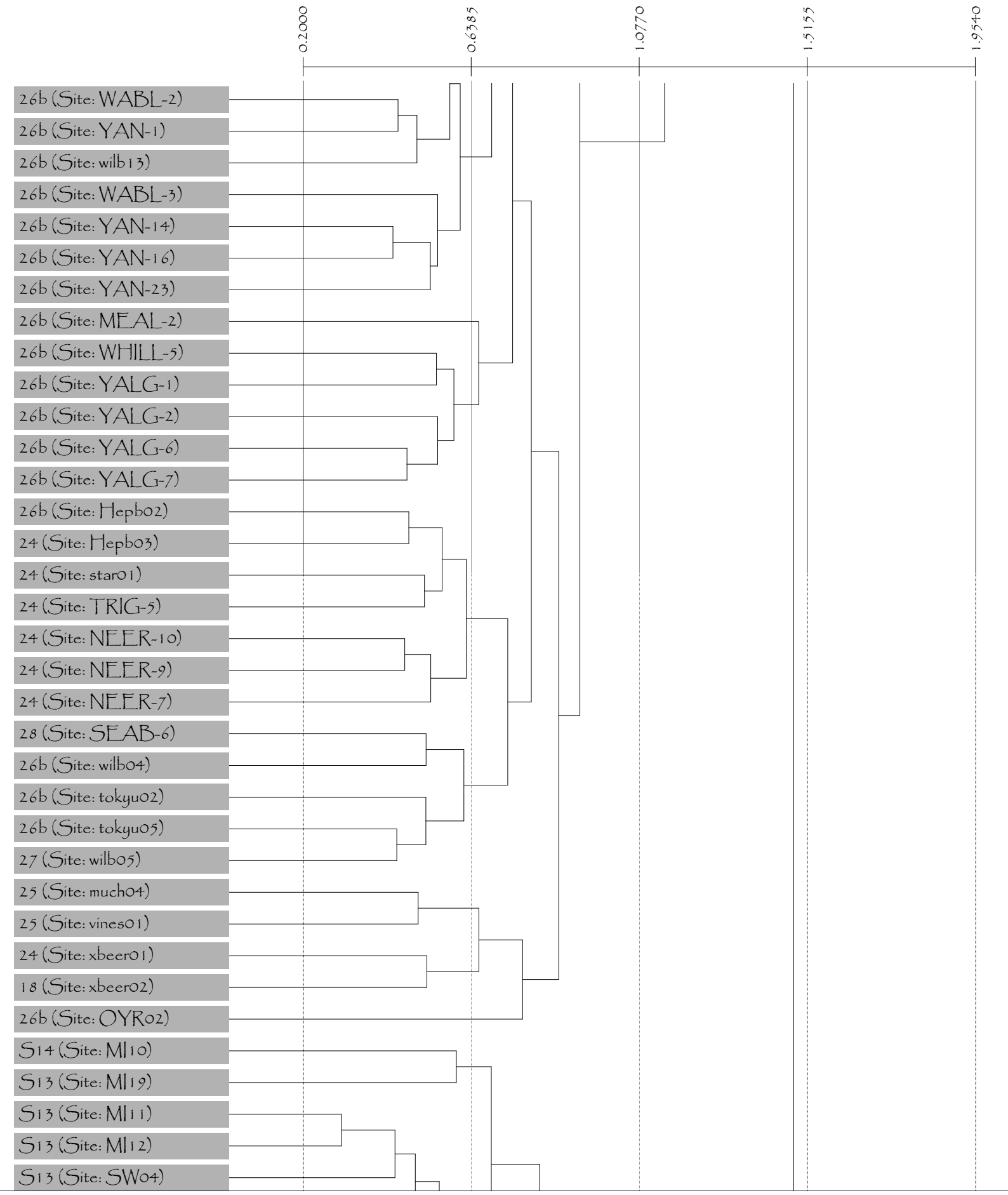
Column Fusion Dendrogram



Fusion Type: Flexible UPGMA Beta = -0.10

On Association: Bray & Curtis (Columns) Created on: 13:07:20, March 20, 2023

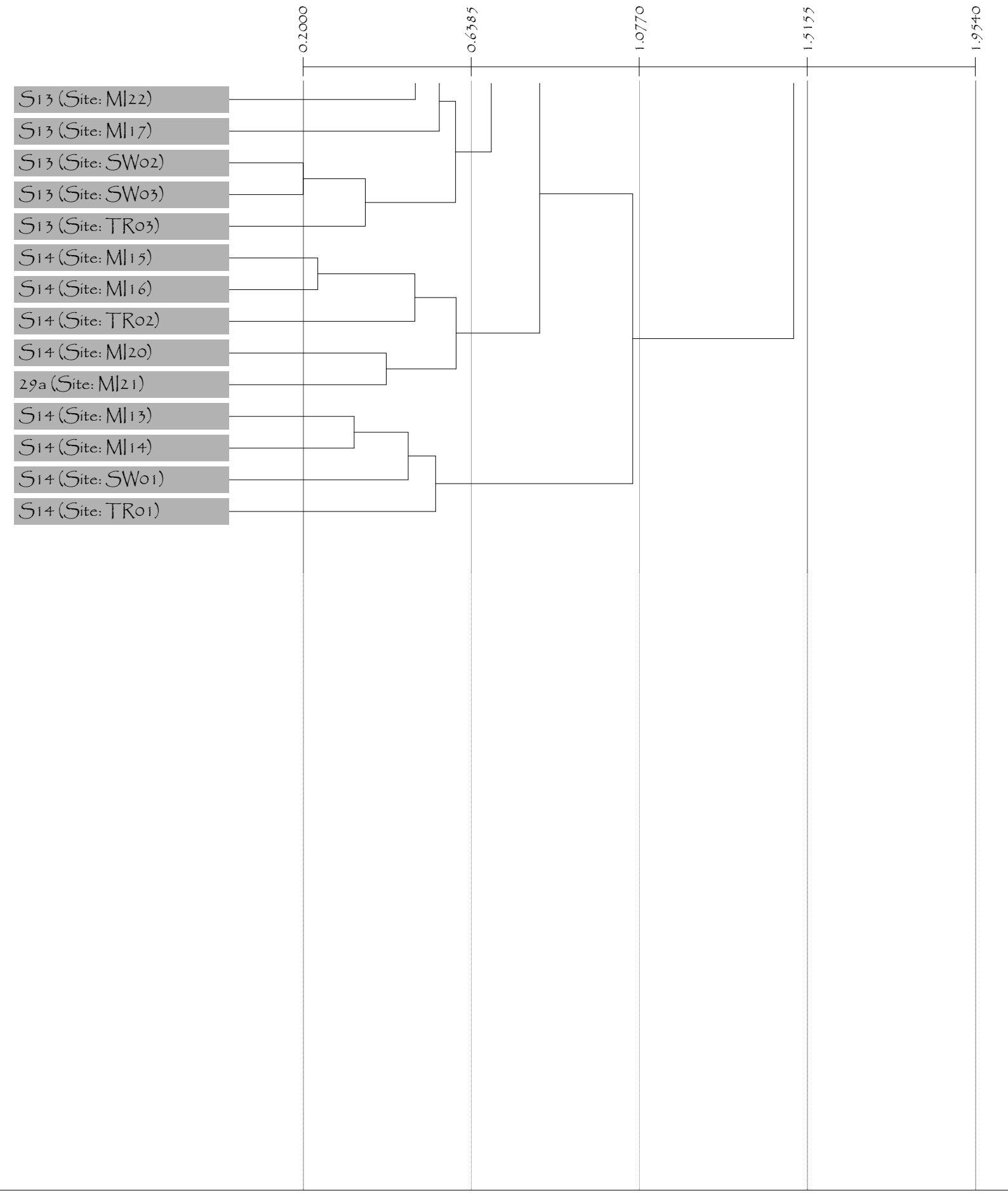
Column Fusion Dendrogram



Fusion Type: Flexible UPGMA Beta = -0.10

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Column Fusion Dendrogram



Appendix E Banksia Woodlands of the Swan Coastal Plain Assessment

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Banksia Woodland of the SCP Assessment

1.0 Methods

1.1 Introduction

The Banksia woodlands of the Swan Coastal Plain encompasses a large natural variation across its range. Furthermore it is subject to varying degrees of disturbance and degradation that have influenced the quality of patches.

The Threatened Species Scientific Committee (TSSC) published the approved Conservation Advice for this community in September 2016. This document details the key diagnostic features applicable for determining the presence of this TEC. Patches must meet the following key diagnostic characteristics, condition thresholds, and minimum patch sizes:

- Step 1: use key diagnostic characteristics to determine if TEC is present
- Step 2: determine condition of patch
- Step 3: consider if patch meets minimum size threshold
- Step 4: surrounding context of a patch must be taken into account when considering factors that add to the importance of a patch that meets the condition thresholds.

1.2 Condition

The condition of vegetation of each patch needs to be determined in accordance with the following:

- The condition assessment of a patch should be centred on the area of highest native floristic diversity and/or cover of the patch.
- Timing of surveys and recent disturbance should be taken into account
- Surrounding context of a patch should be considered
- Certain vegetation components of Banksia Woodlands community merit consideration as critical elements to protect. Three components are recognised as threatened in their own right i.e. Priority Ecological Communities
- A relevant expert may be useful to help identify the ecological community and its condition.
- Vegetation must be in 'Good' or better condition in accordance with **Table 1**.

Table 1 Keighery (1994) Condition Scale For Vegetation

KEIGHERY (1994) VEGETATION CONDITION SCALE	INDICATIVE CONDITION MEASURES/THRESHOLDS	
	TYPICAL NATIVE VEGETATION COMPOSITION	TYPICAL WEED COVER
Pristine No obvious signs of disturbance	Native plant species diversity fully retained or almost so[1].	Zero or almost no weed cover/abundance
Excellent Vegetation structure intact, disturbance only affecting individual species, weeds are non-aggressive species.	High native plant species diversity[1]	Less than 10%
Very Good Vegetation structure altered, obvious signs of disturbance (e.g. repeated fires, dieback, logging,grazing). Aggressive weeds present.	Moderate native plant species diversity[1]	5-20%
Good Vegetation structure altered but retains basic vegetation structure or ability to regenerate it. Obvious signs of disturbance (from partial clearing, dieback, logging, grazing). Presence of very aggressive weeds.	Low native plant species diversity[1]	5-50%
Degraded Basic vegetation structure severely impacted by disturbance. Requires intensive management. Disturbance evident such as partial clearing, dieback, logging and grazing. Presence of very aggressive weeds at high density.	Very low native plant species diversity	20-70%

KEIGHERY (1994) VEGETATION CONDITION SCALE	INDICATIVE CONDITION MEASURES/THRESHOLDS	
Completely Degraded Vegetation structure is no longer intact and the area is completely or almost completely without native flora. Equivalent to 'Parkland Cleared'.	Very low to no native species diversity	Greater than 70%

1. relative to expected natural range of diversity for that vegetation unit e.g. Floristic Community Type where comparative data exists.

1.3 Minimum Patch Size

Different minimum patch sizes apply to different levels of condition, as outlined below:

- Pristine – no minimum patch size
- Excellent – 0.5 ha or 5,000 m^2 (50 x 100 m)
- Very Good – 1 ha or 10,000 m^2 (100 x 100 m)
- Good – 2 ha or 20,000 m^2 (200 x 100 m)

1.4 Further Information

The following information should be taken into consideration when applying the key diagnostic criteria and condition thresholds:

- Land use history and landscape position of patch including position relative to surrounding vegetation
- A patch is a discreet and mostly continuous area of the ecological community and may include small-scale variations (<30 m), gaps and disturbances such as tracks paths or breaks that do not significantly alter the overall functionality of the ecological community.
- Variation in canopy cover, quality or condition of vegetation across a patch should not be considered evidence of multiple patches
- A buffer zone is a contiguous area immediately adjacent to a patch of the ecological community. The recommended minimum buffer zone is 20-50 m. larger buffer zones should be considered for patches of particularly high conservation value, or if patches are down slope of drainage lines or a source of nutrient enrichment, or groundwater drawdown.
- Restored vegetation is not excluded provided it meets the key diagnostic criteria, condition threshold and patch size.
- Sampling protocols includes developing a quick map of the vegetation, landscape qualities and management history. Following this, a thorough sampling exercise must be undertaken to represent the range of variation. At least one hour per plot in early to mid-spring and a second survey in late spring may be required to detect the majority of species. plots to be at least 100 m^2 (10 x 10 m). Search effort (number of person hours per plot across entire patch) and surveyor's level of expertise can be useful for future reference.
- Timing of surveys should allow a reasonable interval after a disturbance. Surveys at least one year post fire may be required to assess a site against the key diagnostic characteristics and minimum condition thresholds.
- Surrounding environment, landscape context and other significance considerations:
    - patches that are more species rich and less disturbed are likely to provide greater biodiversity value.
    - Patches that provide corridors or linkages within a largely modified landscape are particularly important.

The Conservation Advice provides an additional ten indicators to be considered when assessing impacts of actions or proposed actions under the EPBC Act. These are not further listed here.

2.0 Assessment

Patches are defined as a discreet and mostly continuous area of the ecological community. All native vegetation in Good or better condition were considered for an assessment against the key diagnostic criteria for the TEC. A preliminary review of Banksia species present was undertaken. Patches that had no Banksia overstorey species were excluded from further consideration.

The native vegetation has been separated into four patches:

- Patch 1 = quadrat 6
- Patch 2 = quadrat 13
- Patch 3 = quadrat 9; and
- Patch 4 = quadrat S01.

The key diagnostic features have been assessed using quadrats from each patch .

Key diagnostic characteristics of Patch	1	2	3	
Location and physical environment				
The Banksia Woodlands ecological community primarily occurs on the Swan Coastal Plain IBRA bioregion. Pockets of the community also extent into the adjacent lower parts of the Darling and Whicher escarpments that lie within the Jarrah Forest IBRA bioregion to the immediate east and south of the Swan Coastal Plain.	Y	Y	Y	Y

Key diagnostic characteristics of Patch	1	2	3	
Soils and landform				
Typically occurs on well drained, low nutrient soils on sandplain landforms, particularly deep Bassendean and Spearwood sands and occasionally on Quindalup sands. Is also common on sandy colluvium and Aeolian sands of the Ridge Hill Shelf, Whicher Scarp and Dandaragan Plateau. In other less common scenarios (transitional substrates, sandflats)	Y	Interzone of Pinjarra Plain and Bassendean Sands.	Y	Y
Structure				
A distinctive upper sclerophyllous layer of low trees (occasionally large shrubs more than 2 m tall), typically dominated or co-dominated by one or more of the Banksia species identified below; AND	Y – sparse low woodland	Y – low open woodland	Y – low open woodland	Y – low open woodland
Emergent trees of medium or tall (<10 m) height *Eucalyptus* or *Allocasuarina* species may sometimes be present above the *Banksia* canopy; AND	Y – *A. fraseriana*, *Nuytsia floribunda*	Y – *A. fraseriana*, *Nuytsia floribunda*	Y – *E. todtiana*, *A. fraseriana*	Y – *A. fraseriana*, *Nuytsia floribunda*
An often highly species-rich understorey that consists of: · A layer of sclerophyllous shrubs of various heights · A herbaceous ground layer of cord rushes, sedges and perennial and ephemeral forbs that sometimes includes grasses. The development of a ground layer may vary depending on the density of the shrub layer and disturbance history.	Y – 31 sclerophyllous shrubs, 12 sedges and rushes, and 26 forbs	Average – 19 sclerophyllous shrubs, 5 rushes and sedges, and 21 forbs	Average (due to poor condition) – 14 sclerophyllous shrubs, 4 rushes and sedges, 15 forbs.	
Composition				
Canopy is most commonly dominated or co- dominated by *Banksia attenuata* and/or *Banksia menziesii.* Other *Banksia* species that dominate in some examples of the ecological community are *B. prionotes* or *B. ilicifolia*; AND	Y – 5% *B. attenuata*	Y – 3-8% *B. attenuata, 10-15% B. menziesii*	Y – 5% *B. menziesii*	Y – 3-8% *B. attenuata, 10-15% B. menziesii*
Patch must include at least one of the following diagnostic species: · *Banksia attenuata* · *Banksia menziesii* · *Banksia prionotes* · *Banksia ilicifolia*	Y	Y	Y	Y
If present, the emergent tree layer often includes *Corymbia calophylla, E. marginata,* or less commonly *E. gomphocephala*; AND	Not present	Not present	Not present	Not present
Other trees of a medium height may be present and may be co-dominant with the *Banksia* species across a patch, include *E. todtiana, Nuytsia floribunda, Allocasuarina fraseriana, Callitris arenaria, Callitris pyramidalis* and *Xylomelum occidentale*; AND	Sparse *A. fraseriana*	Y – 0-15% *A. fraseriana*, isolated *E. todtiana*	Y – 5% *E. todtiana*	Y – 0-15% *A. fraseriana,* isolated *E. todtiana*
Understorey typically contains high to very high diversity of shrub and herb species that often vary from patch to patch.	Y – 76 total species richness (n=2)	Average – 53 total species richness (n=2)	Average – 42 total species richness (n=2)	Average -
Contra-indicators				

Key diagnostic characteristics of Patch	1	2	3	
Patches clearly dominated by *Banksia littoralis* are not part of the TEC	N	N	N	N
Patches clearly dominated by *Banksia burdettii* are not the TEC	N	N	N	N
FCT 20c – Eastern shrublands and woodlands, corresponds with a separate EPBC ecological community listing, Shrublands and Woodlands of the eastern Swan Coastal Plain. Occurrences of this FCT should be considered under that separate listing.	N	N	N	N

2.1 Patch 1 – 79 Victoria Road

Patch 1 incorporates native vegetation at 79 Victoria Road. This patch meets all the key diagnostic features, size and condition thresholds as published in the approved conservation advice (TSSC, 2016).

It is likely that the patch extends beyond this cadastral boundary however adjacent properties were excluded from the survey. The patch is mapped as Banksia woodland with an isolated pocket of Jarrah woodland on the southern tip. The patch also represents the WA TEC SCP20a *B. attenuata* over species rich dense shrublands. Vegetation condition is excellent.

Site Detail	Site Description
Location	79 Victoria Road, Wattle Grove
Key Diagnostic characteristics	Meets all key diagnostic characteristics. Very open overstorey of Banksia trees over species-rich dense shrublands.
Condition	Excellent
Patch Size	1.8 ha
Additional features	Represents FCT20a *B. attenuata* over species rich dense shrublands. Potential to re-establish connection with adjacent Banksia woodlands beyond survey area. Supports populations of threatened *Conospermum undulatum* and Priority 3 *Isopogon autumnalis*.
Land use history	Rural to urban development
Any variations in patch	Patch has been resilient to significant weed invasion (<1m from edge excluded).
Buffer zone present	Limited buffer present for approximately 25% of patch.
Sampling protocol	Single scoring event of one non-permanent quadrat 10X10m delineated by measuring tape.
Disturbance History	Represents remnant native vegetation
Surrounding environment	Predominantly cleared for lawn, houses and various private estate use.



Plate 1 Patch 1 photograph

2.2 Patch 2 – 58 Victoria Road

Patch 2 is isolated to remnant native vegetation on 58 Victoria Road. This patch meets all key diagnostic criteria, condition and size thresholds.

The patch is likely to extend beyond this cadastral boundary, particularly northwest. The patch includes two discreet areas separated by planted and native trees and a house. Due to the connection of canopies of trees along both sides of the house these two areas are considered representative of the same patch.

The patch represents two vegetation communities, both broadly described as Banksia woodlands. Vegetation condition varied between Degraded to Excellent which reflects historical clearing. In particular, the patch at the front of the house has been subject to partial clearing of the understorey. It falls outside the required 0.5 ha by such a minute amount which relies on precise mapping. The precautionary principle has been applied.

Site Detail	Site Description
Location	58 Victoria Road, Wattle Grove
Key Diagnostic characteristics	Meets all key diagnostic characteristics. Very open overstorey of Banksia trees over species-rich dense shrublands.
Condition	Excellent
Patch Size	0.49
Additional features	Patch represents two occurrences on 58 Victoria Road separated by planted trees and a house. Has the potential to be linked to larger remnant native vegetation on adjacent property. Continues to support high species richness and be resilient to weed invasion. Supports small population of threatened *Conospermum undulatum* flora.
Land use history	Rural to urban development
Any variations in patch	The northwest section of the patch has been resilient to significant weed invasion (<1 m from edge excluded). The area in front of the house has been partially cleared (understorey only) and weeds have displaced some native vegetation.
Buffer zone present	Buffer of native and introduced trees (no hardstand) present around entire patch.
Sampling protocol	Single scoring event of one non-permanent quadrat 10x10 m delineated by measuring tape and one relevé.
Disturbance History	Represents remnant native vegetation
Surrounding environment	Predominantly cleared for lawn, houses and various private estate use.



Plate 2 Patch 2 vegetation

2.4 Patch 3 – 30 and 38 Brentwood Road

Patch 3 is restricted to the southeast corner of 30 and 38 Brentwood Road, separated by a cleared track approximately 15 m wide. The northern area of this patch (represented by relevé 08) is significantly disturbed with understorey species displaced by weeds and suffering from considerable edge effects. The southern area represented by quadrat 09 was in better condition.

This patch is not representative of the EPBC TEC Banksia Woodlands of the SCP due to degradation and size of the patch.

Site Detail	Site Description
Location	30 and 38 Brentwood Road, Wattle Grove
Key Diagnostic characteristics	Arguably could meet the key diagnostic characteristics despite low diversity due to degraded condition.
Condition	Good to Very Good
Patch Size	0.42
Additional features	Isolated from other patches of native vegetation with the exception of native and introduced trees. The quadrat infers FCT23a central *B. attenuata-B. menziesii* woodlands.
Land use history	Rural to urban development
Any variations in patch	Weeds affect 50% of the patch. Edge effects are significant.
Buffer zone present	Surrounded by gardens, road and cleared areas.
Sampling protocol	Single scoring event of one non-permanent 10x10 m quadrat delineated by measuring tape and one relevé.
Disturbance History	Unknown. The area in better condition is likely to represent remnant native vegetation. The other area may represent regrowth or has been significantly cleared.
Surrounding environment	Cleared for lawn, houses and various private estate use.



Plate 4 – Patch 3 vegetation

2.5 Patch 4 – 30 and 38 Crystal Brook Road, Wattle Grove

Patch 4 is restricted to the eastern half of 30 Crystal Brook Road, with some sections of more disturbed vegetation on 38 Crystal Brook Road, separated by a property access road approximately 8 m wide. The western area of this patch (which could not be accessed) appeared to be in excellent condition compared to the more disturbed understorey species displaced by weeds and suffering from considerable edge effects in the eastern section. The eastern area is represented by quadrat N04, with 5 relevés helping to delineate this community.

This patch is representative of the EPBC TEC Banksia Woodlands of the SCP due to its generally excellent condition and the size of the patch.

Site Detail	Site Description
Location	30 and 38 Crystal Brook Road, Wattle Grove
Key Diagnostic characteristics	Meets all key diagnostic characteristics. Very open overstorey of Banksia trees over species-rich dense shrublands.
Condition	Good to Excellent
Patch Size	2.07 ha

Site Detail	Site Description
Additional features	Isolated from other patches of native vegetation with the exception of native and introduced trees. The quadrat infers FCT23a central *B. attenuata-B. menziesii* woodlands.
Land use history	Rural to urban development
Any variations in patch	Western area of vegetation is in excellent condition, but the area on 38 Crystal Brook Road is affected by weeds 50% of the patch and also significant edge effects.
Buffer zone present	Surrounded by gardens, road and cleared areas.
Sampling protocol	Single scoring event of one non-permanent quadrat 10x10 m delineated by measuring tape and five relevés.
Disturbance History	Represents remnant native vegetation
Surrounding environment	Predominantly cleared for lawn, houses and various private estate use.



Plate 5 – Patch 4 vegetation

Flora Species by Family & Community Matrix

Family	Taxon	Community					
		BaEpPf	BmXpEc	CcHaEc	EmCaFa	EmMpLp	EmPcAh
Anarthriaceae							
	Lyginia imberbis	x	x				
Apiaceae							
	Platysace tenuissima				x		
	Xanthosia atkinsoniana				x		
	Xanthosia candida				x		x
	Xanthosia huegelii						x
Araliaceae							
	Trachymene pilosa	x	x			x	
Asparagaceae							
	Acanthocarpus preissii	x					
	Asparagus asparagoides			x			
	Lomandra caespitosa		x				x
	Lomandra drummondii	x					
	Lomandra hermaphrodita	x	x				x
	Lomandra micrantha	x	x				x
	Lomandra preissii	x	x		x	x	x
	Lomandra sonderi	x	x		x	x	x
	Lomandra sp.	x					
	Thysanotus multiflorus					x	
	Thysanotus patersonii	x	x	x		x	x
	Thysanotus thyrsoideus	x					
	Thysanotus triandrus				x		
Asteraceae							
*	*Arctotheca calendula*	x	x				
*	*Hypochaeris glabra*	x	x		x	x	x
	Podolepis gracilis		x				
*	*Sonchus oleraceus*						x
*	*Ursinia anthemoides*	x	x		x		x
Campanulaceae							
	?Lobelia anceps	x		x	x		x
Casuarinaceae							
	Allocasuarina fraseriana	x	x		x	x	
	Allocasuarina humilis	x	x			x	
Celastraceae							
	Tripterococcus brunonis				x		
Colchicaceae							
	Burchardia congesta	x	x		x	x	x
Cyperaceae							
	Cyathochaeta avenacea		x	x	x		
	Lepidosperma leptostachyum	x				x	x
	Lepidosperma pubisquameum				x		
	Lepidosperma sp.				x		
	Lepidosperma tenue		x		x	x	
	Mesomelaena pseudostygia	x	x		x	x	
	Mesomelaena tetragona	x	x		x		
	Phlebocarya filifolia	x	x				
	Schoenus clandestinus	x					
	Schoenus pedicellatus	x	x				
	Tetraria capillaris						x
	Tetraria octandra	x	x	x	x	x	x
Dasypogonaceae							
	Calectasia narragara		x				
	Dasypogon bromeliifolius	x	x			x	
Dillenaceae							
	Hibbertia aurea	x					
	Hibbertia huegellii	x					

Appendix C Flora Species by Family by Community Matrix

Family		Taxon	Community					
			BaEpPf	BmXpEc	CcHaEc	EmCaFa	EmMpLp	EmPcAh
Dillenaceae		*Hibbertia hypericoides*	x	x		x	x	x
		Hibbertia subvaginata			x			
Droseraceae								
		Drosera erythrorhiza	x			x		x
		Drosera gigantea				x		
		Drosera porrecta	x	x			x	x
Ericaceae								
		Conostephium preissii		x			x	
		Leucopogon capitellatus						x
		Lysinema pentapetalum	x					
Euphorbiaceae								
		Monotaxis grandiflora var. *grandiflora*	x					
Fabaceae								
		Acacia alata var. *alata*		x				
		Acacia lasiocarpa var. *lasiocarpa*		x		x	x	x
	*	*Acacia longifolia*					x	
		Acacia nervosa				x		
		Acacia pulchella var. *pulchella*			x	x	x	x
		Acacia sp.		x			x	x
		Bossiaea aquifolium				x		
		Bossiaea eriocarpa	x	x		x	x	
		Bossiaea ornata				x		
	*	*Chamaecytisus palmensis*					x	x
		Daviesia decurrens subsp. *decurrens*	x			x		
		Daviesia divaricata subsp. *divaricata*		x		x		
		Daviesia nudiflora subsp. *nudiflora*	x	x				
		Gompholobium confertum	x					
		Gompholobium knightianum		x		x		x
		Gompholobium tomentosum				x		x
		Hovea chorizemifolia			x			
		Hovea pungens	x	x				
		Hovea trisperma	x	x		x		x
		Isotropis cuneifolia subsp. *cuneifolia*				x		x
		Jacksonia floribunda		x		x		
		Jacksonia furcellata				x	x	
		Jacksonia lehmannii	x					
		Kennedia coccinea				x		x
		Labichea punctata	x	x		x	x	x
	*	*Lotus angustissimus*		x		x	x	
	*	*Lupinus angustifolius*						x
		Sphaerolobium medium	x					
Goodeniaceae								
		Dampiera alata		x				
		Dampiera linearis	x	x			x	x
		Lechenaultia biloba				x	x	x
		Scaevola canescens						x
		Scaevola repens var. *repens*	x	x				
Haemodoraceae								
		Anigozanthos manglesii subsp. *manglesii*		x		x		
		Conostylis aculeata		x				
		Conostylis aurea	x					

Appendix C Flora Species by Family by Community Matrix

Family		Taxon	Community					
			BaEpPf	BmXpEc	CcHaEc	EmCaFa	EmMpLp	EmPcAh
Haemodorum		*Conostylis setigera*	x			x		
		Conostylis setigera subsp. *setigera*		x				
		Haemodorum laxum	x	x		x	x	x
		Haemodorum sp.		x		x	x	
		Haemodorum spicatum	x			x		
Haloragaceae								
		Gonocarpus pithyoides				x	x	
Hemerocallidaceae								
		Agrostocrinum hirsutum	x			x		x
		Caesia micrantha		x		x	x	
		Tricoryne elatior	x	x		x	x	
Iridaceae								
	*	*Freesia alba x leichtlinii*		x		x	x	x
	*	*Gladiolus caryophyllaceus*	x	x		x	x	
		Patersonia juncea				x		
		Patersonia occidentalis	x	x				
		Patersonia pygmaea	x					
	*	*Romulea rosea*				x		
	*	*Watsonia meriana*			x			
Lamiaceae								
		Hemiandra pungens	x	x				
		Hemiphora bartlingii	x					
Lauraceae								
		Cassytha glabella	x			x		
Loranthaceae								
		Nuytsia floribunda	x					
Myrtaceae								
		Agonis flexuosa		x				
		Babingtonia camphorosmae		x				x
		Calytrix glutinosa				x		
		Chamelaucium uncinatum		x				
		Conothamnus trinervis	x					
		Corymbia calophylla			x	x		x
		Darwinia citriodora			x			
		Eremaea pauciflora var. *pauciflora*	x	x		x	x	
		Eucalyptus gomphocephala		x				
		Eucalyptus marginata subsp. *marginata*		x		x	x	x
		Eucalyptus sp.		x		x		
		Eucalyptus todtiana	x	x				
		Hovea chorizemifolia				x		
		Hypocalymma angustifolium			x			
		Hypocalymma robustum		x		x	x	
		Melaleuca systena		x			x	
		Melaleuca trichophylla	x					
		Pericalymma ellipticum	x					
Orchidaceae								
		Caladenia flava	x					
		Prasophyllum sp.				x		
		Pterostylis sanguinea				x		
		Thelymitra graminea	x			x		x
Oxalidaceae								
	*	*Oxalis pes-caprae*		x				

Family		Taxon	Community					
			BaEpPf	BmXpEc	CcHaEc	EmCaFa	EmMpLp	EmPcAh
Phyllanthaceae								
		Phyllanthus calycinus				x		x
		Pittosporaceae				x		
		Billardiera fraseri				x		
Poaceae								
		Austrostipa compressa		x				x
	*	*Avena barbata*		x	x			
	*	*Briza maxima*	x	x		x	x	x
	*	*Briza minor*			x	x		
	*	*Ehrharta calycina*	x	x	x	x	x	x
	*	*Eragrostis curvula*	x			x		
		Neurachne alopecuroidea	x			x		
		Tetrarrhena laevis	x					x
Primulaceae								
	*	*Lysimachia arvensis*				x		x
Proteaceae								
		Adenanthos cygnorum subsp. *cygnorum*	x	x				
		Banksia armata var. *armata*	x			x		
		Banksia attenuata	x	x				
		Banksia dallanneyi	x			x	x	
		Banksia menziesii	x	x				
		Banksia sessilis var. *sessilis*		x				x
		Conospermum undulatum	x					
		Grevillea bipinnatifida subsp. *bipinnatifida*		x		x	x	
		Hakea amplexicaulis		x				
		Hakea conchifolia	x					
		Hakea lissocarpha						x
		Hakea prostrata	x					
		Hakea ruscifolia		x				
		Hakea stenophylla				x		
		Hakea trifurcata		x	x	x	x	
		Hakea undulata		x		x		
		Isopogon autumnalis	x	x				
		Isopogon dubius	x			x	x	
		Lambertia multiflora var. *darlingensis*	x	x		x	x	
		Persoonia angustiflora	x					
		Petrophile linearis	x					
		Petrophile macrostachya	x			x		
		Petrophile seminuda	x					
		Stirlingia latifolia	x	x			x	
		Synaphea spinulosa subsp. *spinulosa*		x			x	
Restionaceae								
		Alexgeorgea nitens	x	x				
		Desmocladus fasciculatus	x	x		x	x	x
		Hypolaena exsulca	x					
		Loxocarya cinerea	x			x		
Rhamnaceae								
		Spyridium globulosum			x			
Rubiaceae								
		Opercularia vaginata		x				
Rutaceae								
		Philotheca spicata	x	x		x	x	

Family	Taxon	Community					
		BaEpPf	BmXpEc	CcHaEc	EmCaFa	EmMpLp	EmPcAh
Solanaceae							
	* *Solanum nigrum*						x
Stylidiaceae							
	Stylidium amoenum	x					
	Stylidium brunonianum		x		x		
	Stylidium hispidum				x		
	Stylidium piliferum				x		x
	Stylidium schoenoides	x	x				x
Violaceae							
	Hybanthus calycinus	x	x				
Xanthorrhoeaceae							
	Chamaescilla corymbosa var. *corymbosa*		x				x
	Xanthorrhoea acanthostachya	x	x				
	Xanthorrhoea gracilis		x				x
	Xanthorrhoea preissii	x	x		x	x	x

Appendix F Reconnaissance Flora and Vegetation Assessment

A reconnaissance flora and vegetation assessment was undertaken by Rachel Pratt, an ecologist with over 20 years' experience undertaking flora and vegetation assessments on the swan coast plan. Surveys were undertaken on 24 January 2022 date on Lot 210, 21, 4, 803, 802 and 801.

Lot 210 (Plate 1; Plate 2) contained an intact Banksia woodland with a high diversity of shrubs and groundcover. Structurally the vegetation was consistent with the *Banksia Woodlands of the Swan Coastal Plain* Threatened Ecological Community (TEC) listed under the EPBC Act. The site showed floristic similarities to the Western Australian listed TEC *Banksia attenuata woodlands over species rich dense shrublands* (SCP20A).

Due to the time of year (summer) and lack of access to the lot, it was not possible to record the quadrat data which would be required for a Floristic Community Analysis using statistical software, however the site appeared floristically similar to vegetation in Lot 804 in which data was collected from a spring quadrat that could be used to infer the Floristic Community Type of Lot 210.



Plate 1: Lot 210

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Plate 2: Lot 210

The following taxa were identifiable from the south-eastern boundary of lot 210:

- **Briza maxima*
- **Ehrharta calycina*
- **Gladiolus caryophyllaceus*
- **Leptospermum laevigatum*
- **Pinus pinaster*
- **Ursinia anthemoides*
- *Adenanthos cygnorum* subsp. *cygnorum*
- *Allocasuarina fraseriana*
- *Allocasuarina humilis*
- *Banksia ?dallanneyi*
- *Banksia attenuata*
- *Banksia dallanneyi*
- *Banksia menziesii*
- *Bossiaea eriocarpa*
- *Burchardia congesta*
- *Calothamnus* sp.
- *Conospermum undulatum* (T)
- *Dampiera linearis*
- *Dasypogon bromeliifolius*
- *Daviesia decurrens* subsp. *decurrens*
- *Daviesia nudiflora*
- *Desmocladus fasciculatus*
- *Desmocladus flexuosus*
- *Eremaea pauciflora* var. *pauciflora*
- *Eucalyptus marginata*
- *Eucalyptus todtiana*
- *Gastrolobium capitatum*
- *Gompholobium tomentosum*
- *Haemodorum* sp.
- *Isopogon autumnalis* (P3)
- *Jacksonia floribunda*
- *Johnsonia pubescens*
- *Lambertia multiflora*
- *Lomandra sonderi*
- *Lyginia* sp.
- *Mesomelaena pseudostygia*
- *Patersonia* sp.
- *Petrophile ?rigida*
- *Petrophile macrostachya*
- *Pterostylis* sp.

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- *Scaevola repens*
- *Scholtzia involucrata*
- *Stirlingia latifolia*
- *Thysanotus* sp.
- *Xanthorrhoea brunonis*
- *Xanthorrhoea preissii*
- *Xylomelum occidentale*

The majority of remnant vegetation on Lot 210 was in Excellent condition, with the north-eastern vegetation being more degraded due to an infestation of Victorian tea tree (**Leptospermum laevigatum*), as shown in Plate 3.



Plate 3: Victorian tea-tree infestation

Two conservation significant flora taxa were identified from Lot 210, *Conospermum undulatum* (T) and *Isopogon autumnalis* (P3). Both taxa have been identified on neighboring lots previously (Plate 4)

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Plate 4 *Conospermum undulatum* on Lot 210

Lot 201 contained suitable foraging habitat for Western Australia's three Threatened black cockatoo species. Based on visual estimates from the site boundary, The lot most likely contained foraging species at sufficient cover to qualify as Moderate (3-4) foraging value (Bamford, 2018). The site context score is low (0) as the local area (within 15 km) contains approximately 32,000 ha of remnant native vegetation. It was not possible to assess the Species Density (stocking rate).
An ecological linkage is present between vegetation in Lot 210 and vegetation in neighbouring lots.

Lot 21
Lot 21 did not contain any native vegetation other than one large tuart (*Eucalyptus gomphocephala*). Several eastern states Eucalypts (**Eucalyptus grandis* and **E. botryoides*) on the property would have roosting or foraging value for black cockatoos and were of greater than 500 mm DBH (Plates 5 and 6)

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Plate 5: Lot 21



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Plate 6: Lot 21

Lot 4

Lot 4 did not contain any native vegetation other than one large jarrah (*Eucalyptus marginata*) of approximately 400 mm DBH. One lemon scented gum (**Corymbia citriodora*) would have roosting or foraging value for black cockatoos and was of greater than 500 mm DBH.



Plate 7: Lot 4

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Plate 8: Lot 4

Lot 803

Lot 803 appears predominately cleared, with the rear of the block appearing to contain pines with no understory (Plate 9).



Plate 9: Lot 803

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Lot 802

Lot 802 was predominantly cleared (Completely Degraded) with a small pocket of native vegetation (Condition: Good) (0.05 ha) at the rear of the block (see photos below of the pocket of veg) as shown in Plate 10, 11, 12 and 13.



Plate 10: Lot 802



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Plate 11 Lot 802



Plate 12 Lot 802



Plate 13 Lot 802

Remnant vegetation on Lot 802 contained the following taxa:

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- **Briza maxima*
- **Ehrharta calycina*
- **Gladiolus caryophyllaceus*
- **Leptospermum laevigatum*
- **Ursinia anthemoides*
- **Wahlenbergia capensis*
- *?Styphelia* sp.
- *Acacia saligna*
- *Adenanthos cygnorum* subsp. *cygnorum*
- *Allocasuarina fraseriana*
- *Allocasuarina humilis*
- *Anigozanthos manglesii* subsp. *manglesii*
- *Banksia attenuata*
- *Banksia menziesii*
- *Bossiaea eriocarpa*
- *Conospermum undulatum* (T)
- *Dasypogon bromeliifolius*
- *Eremaea pauciflora* var. *pauciflora*
- *Eucalyptus marginata*
- *Gastrolobium capitatum*
- *Gompholobium tomentosum*
- *Hibbertia hypericoides*
- *Isopogon autumnalis* (P3)
- *Jacksonia floribunda*
- *Mesomelaena pseudostygia*
- *Petrophile seminuda*
- *Scaevola repens*
- *Scholtzia involucrata*
- *Tetraria octandra*
- *Xanthorrhoea? preissii* (a seedling)

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Plate 14 Conospermum undulatum on Lot 802.

Lot 801

Lot 801 was cleared (Completely Degraded) and is a significant source of weeds invading remnant vegetation on Lot 210. Lot 801 contained bamboo, Victorian tea tree, common fig, eastern states bottle brush species, Brazilian pepper tree, Flinders Range wattle, Cootamundra wattle and pines. Two old growth Jarrah were present, with a DBH of approximately 1000 mm (Plate 15-17).

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Plate 15 Lot 801



Plate 16 Lot 801

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Plate 17 Lot 801

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Appendix 6 FCT analysis (Plantecology 2024)

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15 July 2024

Kathy Choo
Director
CoTerra Environment
Level 1, 98 Colin St
West Perth, WA 6005

Dear Kathy,

Plantecology Consulting was commissioned to undertake the numerical analysis and assignment of plot data to existing Floristic Community Types of the Swan Coastal Plain for a site in Wattle Grove. The methods and results outlined below are based on the data as supplied on the 17th June 2024.

1 Introduction

The remnant vegetation of the southern Swan Coastal Plain (SCP) was surveyed by Gibson et al. (1994) to provide an understanding of the major floristic gradients across the region. The major plant communities (or FCTs) were defined by classifying the data according to the similarities in species composition between plots. When determining the FCT of a new record, a floristic analysis of species composition provides the most robust method that is consistent with the original classification. Presently, a single consistent method for the determination of FCTs for vegetation data in the Swan Coastal Plain is not available. Therefore, it is preferable to use multiple methods and compare the output for the most likely result. The methods used are those outlined in *Methods for Survey and Identification of Western Australian Threatened Ecological Communities* (DBCA 2024) being FCT assignment using the Gibson et al. (1994) and Keighery et al. (2012) datasets, and assignment by the minimum dissimilarity between the Wattle Grove plots and plots from the two regional datasets (nearest neighbour). All analyses described below were undertaken using R packages Cluster (Maechler et al 2019), Vegclust (De Cáceres et al. 2010), optpart (Roberts 2020) and Vegan (Oksanen et al. 2020).

2 Methods

2.1. Hierarchical Clustering Assignments

Hierarchical agglomerative clustering is the usual first stage in classifying vegetation data into community types. This involves calculating the similarity (or more often, the dissimilarity) between plots within the dataset and then sequentially fusing the plots into groups according to their similarity. This type of method was used in the analysis of the original Swan Coastal Plain dataset (Gibson et al. 1994) and to determine the conservation status of additional plots, data is often added to the original dataset and the analysis re-run (Environmental Protection Authority 2016). The direct use of the original dataset as the basis for assigning new plot data to the regional classification has some drawbacks, however. First, a hierarchical clustering only applies to the relationships between plots, and the relative distances between them, within that particular dataset. The addition of new data often alters the relative cophenetic distances and disrupts the clustering output. Second, as an unsupervised method, hierarchical clustering does not define rules for the membership of the defined groups, and so the addition of new plots requires the rebuilding of the entire hierarchy (De Cáceres and Wiser 2012).

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The data for the Swan Coastal Plain regional survey (Gibson et al. 1994) and that of Keighery et al. (2012) was downloaded from the NatureMap website. The current Gibson et al. (1994) dataset has been modified from that of the original survey with the removal of one site (OATES-1), resulting in a dataset of 508 plots. The Keighery et al. (2012) dataset is a compilation of data from a number of floristic studies and extended the Gibson et al. (1994) dataset. The composite dataset used in this analysis was that curated on the NatureMap website as of 2015. Notwithstanding the proviso in Keighery et al. (2012) that the composite dataset should not be used for FCT analyses, it can be useful when assigning new plot data that are potentially from FCT that were under-sampled in in the Gibson et al. (1994) survey e.g. FCT 14 and FCT 18.

The species nomenclature of the datasets was updated to be consistent with current usage. Where original names could not be matched clearly to the updated usage, those taxa were removed from the analysis. Infraspecies ranks were raised to species level when no matching rank had been used in the original datasets. Taxa that could not be identified to species level in the Wattle Grove dataset were removed.

The new data from the Wattle Grove survey was added to both Swan Coastal Plain datasets and the new dataset was then analysed using the Bray-Curtis distance coefficient (or resemblance measure) and the flexible beta linkage method (beta = -0.1). Assignment of the Wattle Grove plots was to the nearest distinct group by inspection of the resulting dendrogram. To examine any effect of spatial correlation between the new plots, data was also added to the matrix one plot a time and the analyses re-run.

In practice, there is often less similarity between a new plot and the plots of the FCT to which it is assigned than between the original plots themselves. That is, new plots are usually most similar to fringing members of the original group.

2.2. Nearest Neighbour

The nearest neighbour assignment method uses the minimum Bray-Curtis distance between a new plot and a plot from the original dataset. The comparison of individual samples is seldom useful as new plots are rarely similar to diagnostic plots from the original FCT classification. More often, the nearest neighbour is a fringe member of a FCT and may not be a 'near' neighbour, which regularly leads to misclassifications. Assignments to the nearest group (as in the clustering methods described above) are more robust.

3 Results

The cluster analysis of the Wattle Grove plots indicates that there are at least three vegetation units present at the Wattle Grove sites (Figure 1). Cluster 1 comprises Aecom plots 1, 7 10 and 11, Cluster 2 comprises Aecom plots 4, 6, 9 and 13 as well as JBSG 01, and Cluster 3 comprises Aecom plots 15, 18, 19 and 20.

When assigning all plots at once to the Gibson et al. (1994) and Keighery et al. (2012) datasets, a strong spatial correlation can be seen (Figures 2 and 3) as all Wattle Grove plots fused together as a group and without altering the structure seen in Figure 1.

Assignment to FCTs was more definitive for the single-plot analysis, with some variation in results between datasets (Figures 4-29). Plots from Cluster 1 are most likely members of FCT 3b '*Corymbia calophylla* – *Eucalyptus marginata* woodlands on sandy clay soils'. The assignments to both Swan Coastal Plain datasets were the same although that of Aecom 7 to the Keighery et al. (2012) dataset was more equivocal (Figure 20).

Plots from Cluster 2 were assigned to FCT 20c 'Eastern shrublands and woodlands', except for Aecom 15, which was assigned to FCT 3b by the Gibson et al. (1994) dataset, and S09 ('*Banksia attenuata*

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woodlands over dense low shrublands') or S16 ('Highly saline seasonal wetlands') when using the Keighery et al. (2012) dataset. The latter assignment appears unlikely.

Apart from Aecom 9, Cluster 3 plots were assigned to FCT 20a '*Banksia attenuata* woodlands over species rich dense shrublands'. Aecom 9 was clearly assigned to FCT 20c using the Gibson et al. (1994) dataset but were equivocal when assigning to the Keighery et al. (2012) dataset.

The presence of typical species for FCTs on the eastern side of the Swan Coastal Plain (DBCA 2024) supports the results of the cluster analysis. Typical species for FCT 3b such as *Gompholobium knightianum, Hakea stenocarpa, Hakea undulata* and *Xanthosia candida* were recorded for the Cluster 1 plots. Within the Cluster 2 plots, *Grevillea bipinnatifida* and *Podolepis gracilis* were both recorded and are typical for FCT 20c, and taxa typical for FCT 20a such as *Conospermum undulatum, Conothamnus trinervis, Isopogon autumnalis, Hemiphora bartlingii* and *Xanthorrhoea acanthostachya* were all present within Cluster 3 plots.

In determining probable FCTs for the Wattle Grove dataset, most weight was given to assignment to the Gibson et al. (1994) dataset, as this produced clearer and more consistent results (Table 1). While assignment to the Keighery et al. (2012) dataset was mostly similar, more disruption to the original classification was observed, with a consequent reduction in confidence of the results. Least weight was given to the nearest neighbour assignments as these were less consistent with the results of the clustering analyses, and none were less 0.5. The cross tabulation of the Bray Curtis dissimilarities between the Swan Coastal Plain and the Wattle Grove plots is shown on Table 2.

Table 1: Floristic Community Type assignment summary.

Plot	Assignment to Gibson et al. (1994)	Assignment to Keighery et al. (2012)	Nearest Neighbour	Probable FCT
AECOM_1_outside	3b	3b	20b	3b
AECOM_4	20a	20a	20a	20a
AECOM_6	20a	20a	20c	20a
AECOM_7_outside	3b	3/20	3b	3b
AECOM_9	20c	Undetermined	20c	20c
AECOM_10_outside	3b	3b	3b	3b
AECOM_11_outside	3b	3b	3b	3b
AECOM_13	20a	20a	20a	20a
AECOM_15_outside	3b	S09/S16	20c	3b
AECOM_18_outside	20c	20b	20b	20c
AECOM_19_outside	20c	20c	20b	20c
AECOM_20_outside	20c	Undetermined	20b	20c
JBSG_S01	20a	20a	20a	20a

4 Discussion

The results of the cluster assignments show that three FCTs are present within the Wattle Grove dataset - FCTs 3b, 20a and 20c. All are listed as Threatened Ecological Communities pursuant to the *Biodiversity Conservation Act 2016.* FCT 20c is also listed as an Endangered TEC pursuant to the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), with FCT 20a forming part of the Endangered 'Banksia woodlands of the Swan Coastal Plain ecological community' TEC. FCT 3b is not listed under the EPBC Act.

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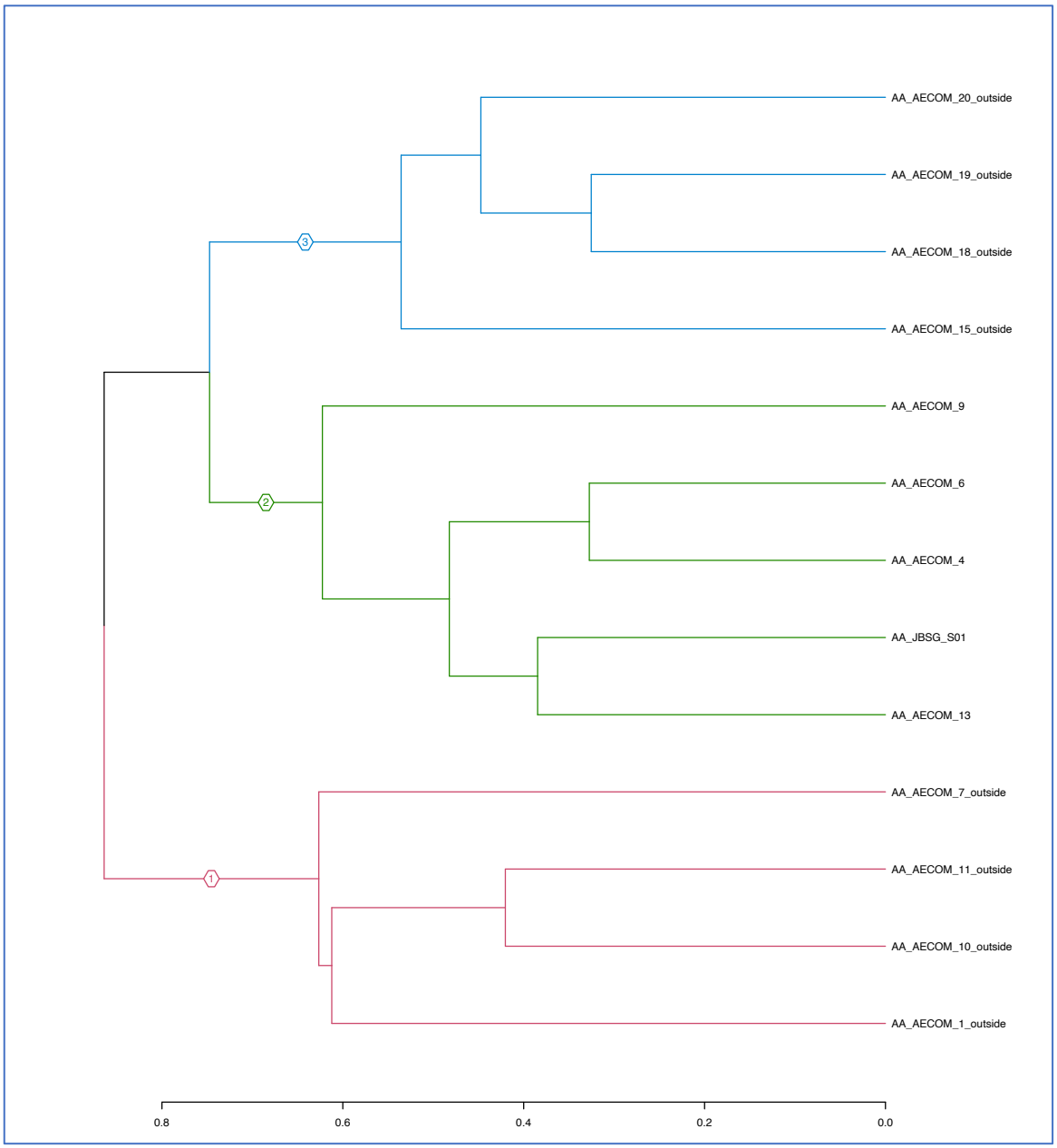


Figure 1: Dendrogram of Wattle Grove plots.

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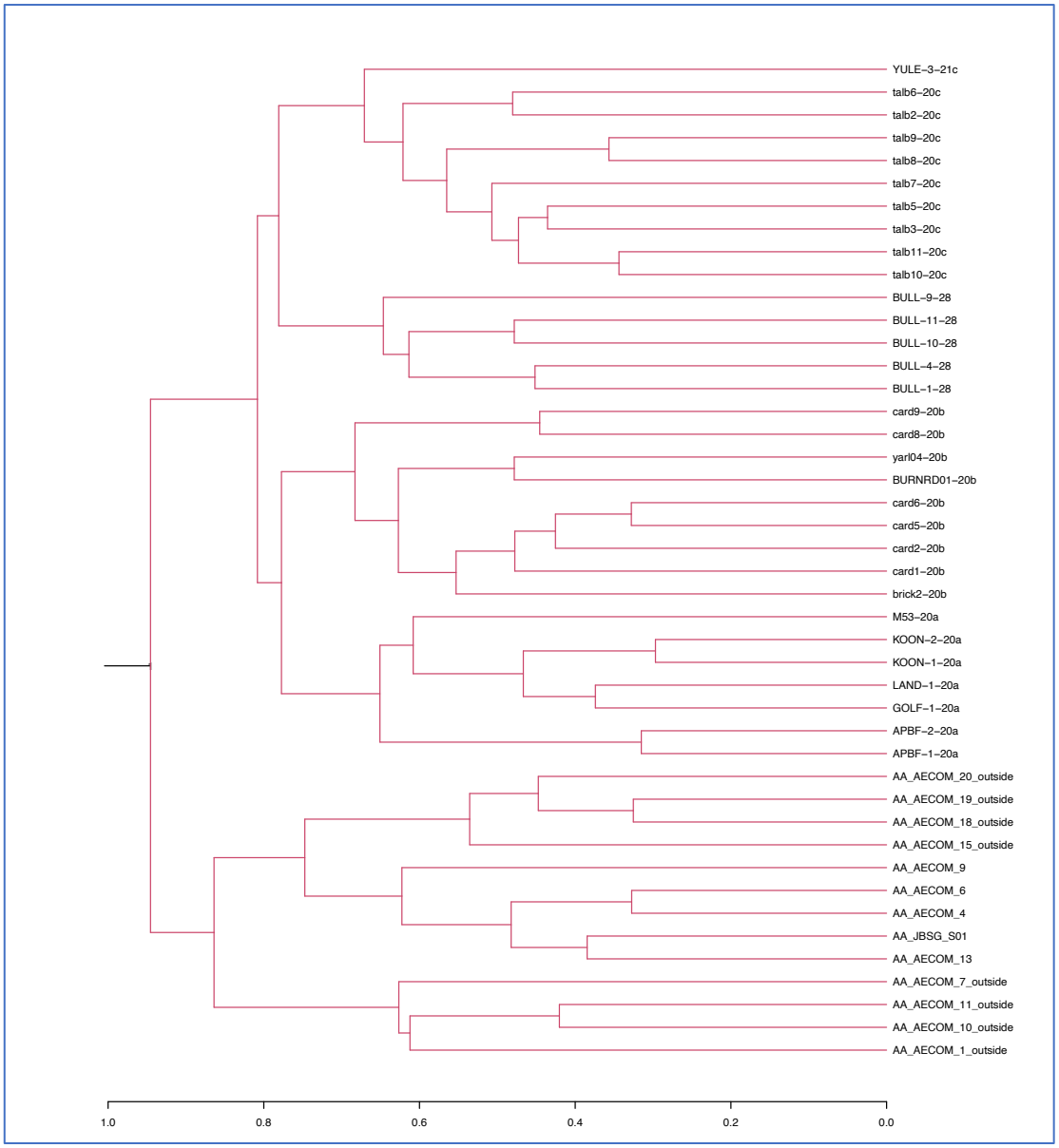


Figure 2: Partial dendrogram for the assignment of the Wattle Grove plots to the Swan Coastal Plain floristic community types.

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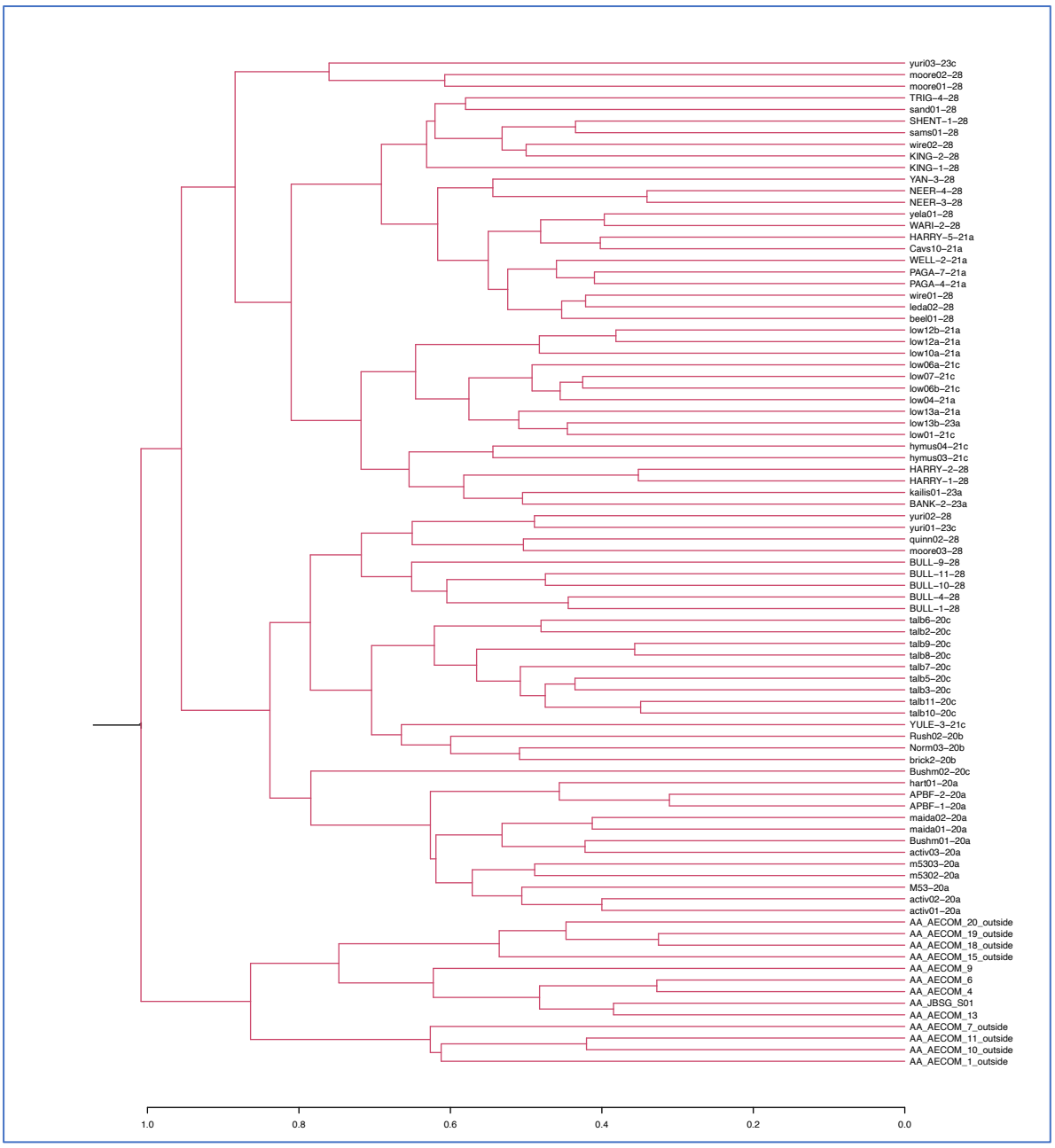


Figure 3: Partial dendrogram for the assignment of the Wattle Grove plots to the Keighery et al. (2012) floristic community types.

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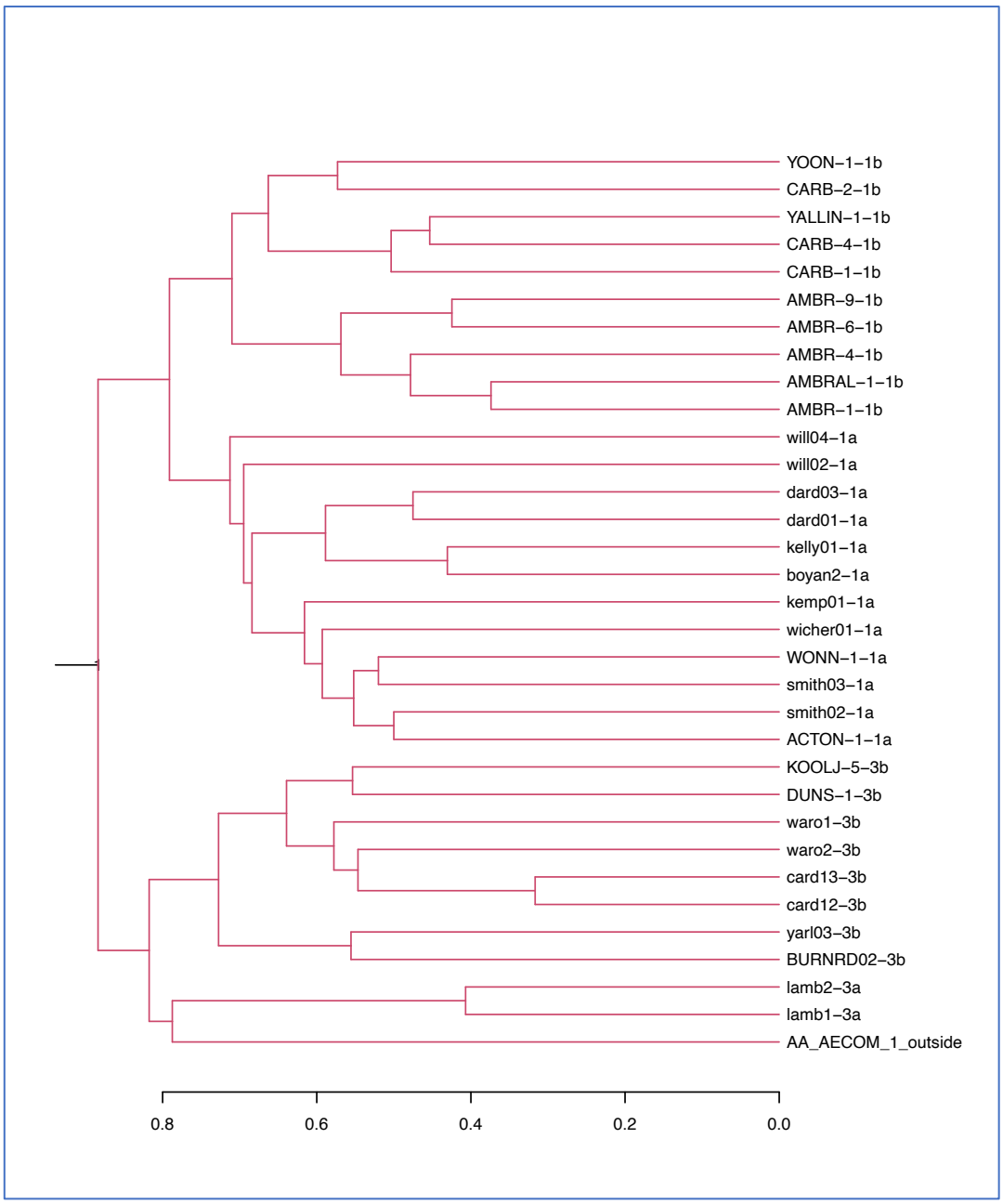


Figure 4: Partial dendrogram for the assignment of plot AECOM_1 to the Swan Coastal Plain floristic community types.

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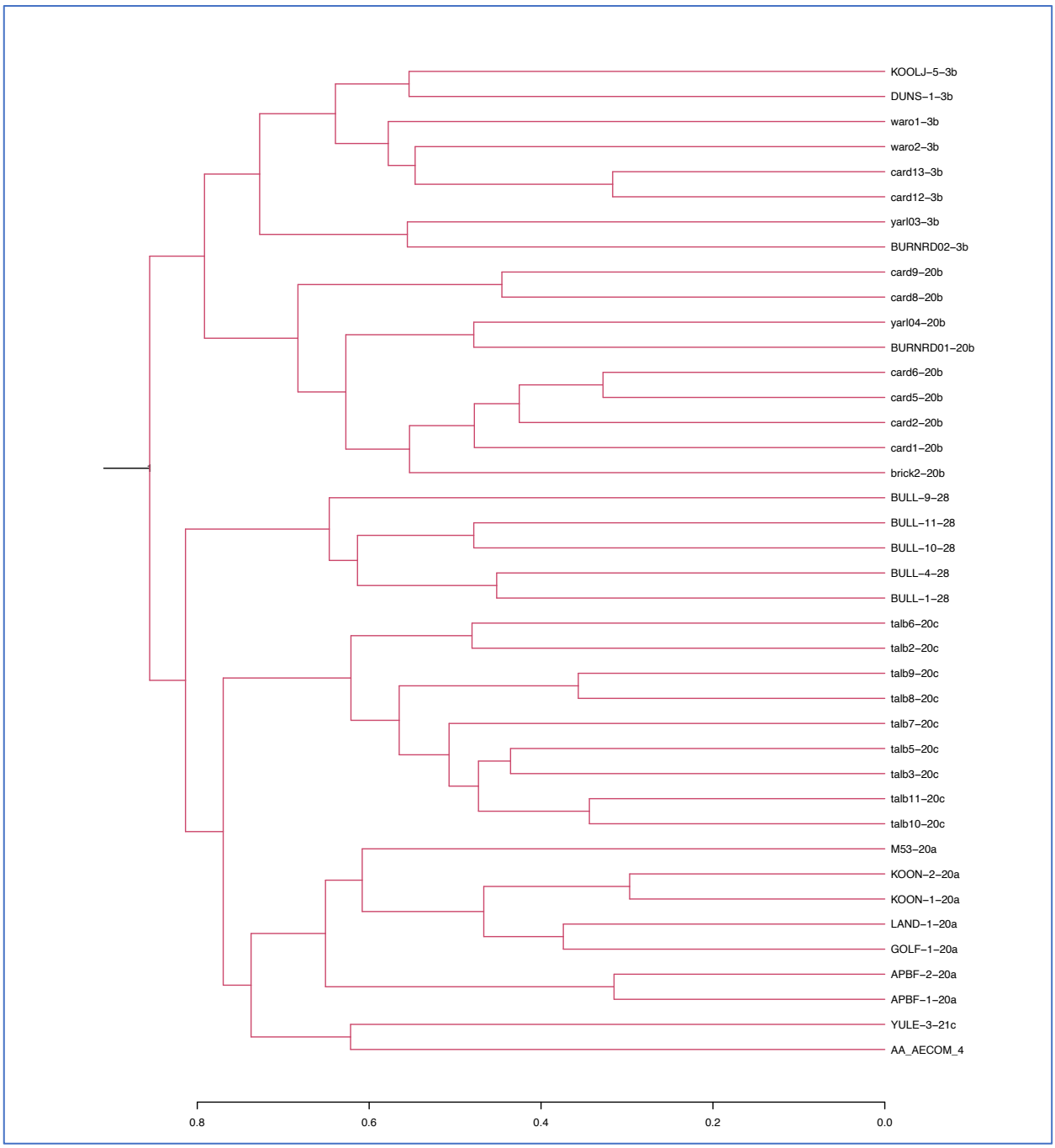


Figure 5: Partial dendrogram for the assignment of Plot AECOM_4 to the Swan Coastal Plain floristic community types.

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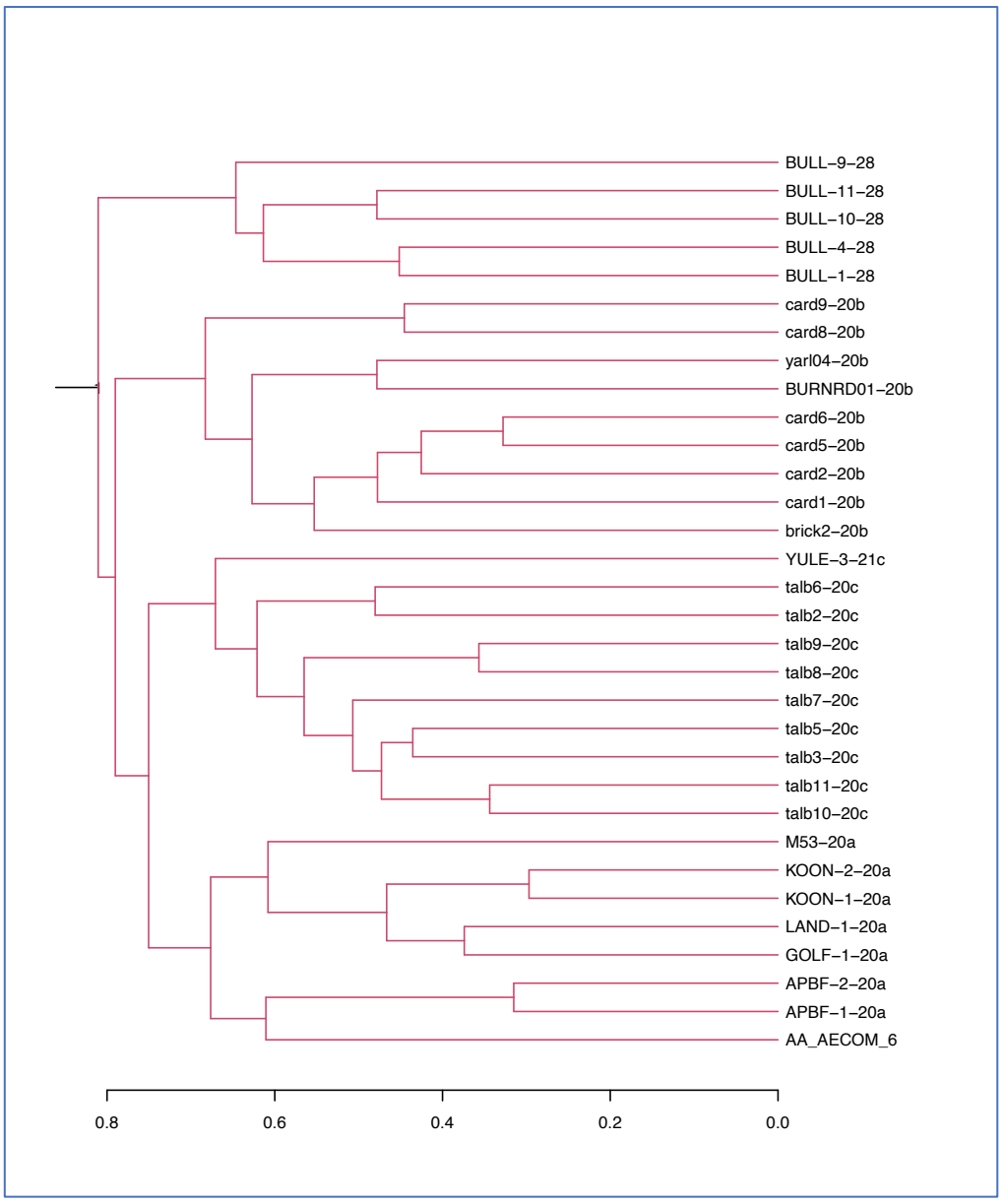


Figure 6: Partial dendrogram for the assignment of Plot AECOM_6 to the Swan Coastal Plain floristic community types.

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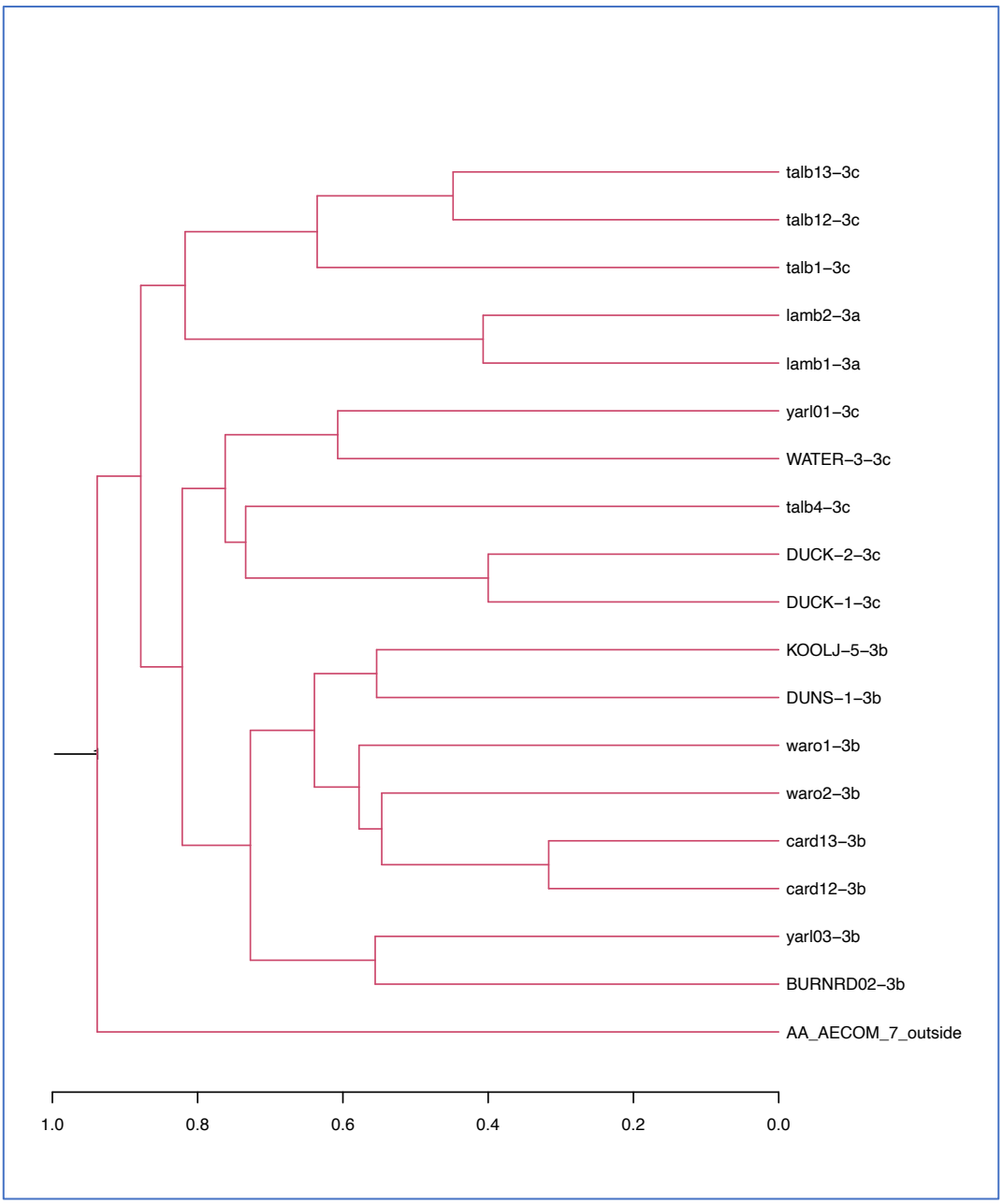


Figure 7: Partial dendrogram for the assignment of Plot AECOM_7 to the Swan Coastal Plain floristic community types.

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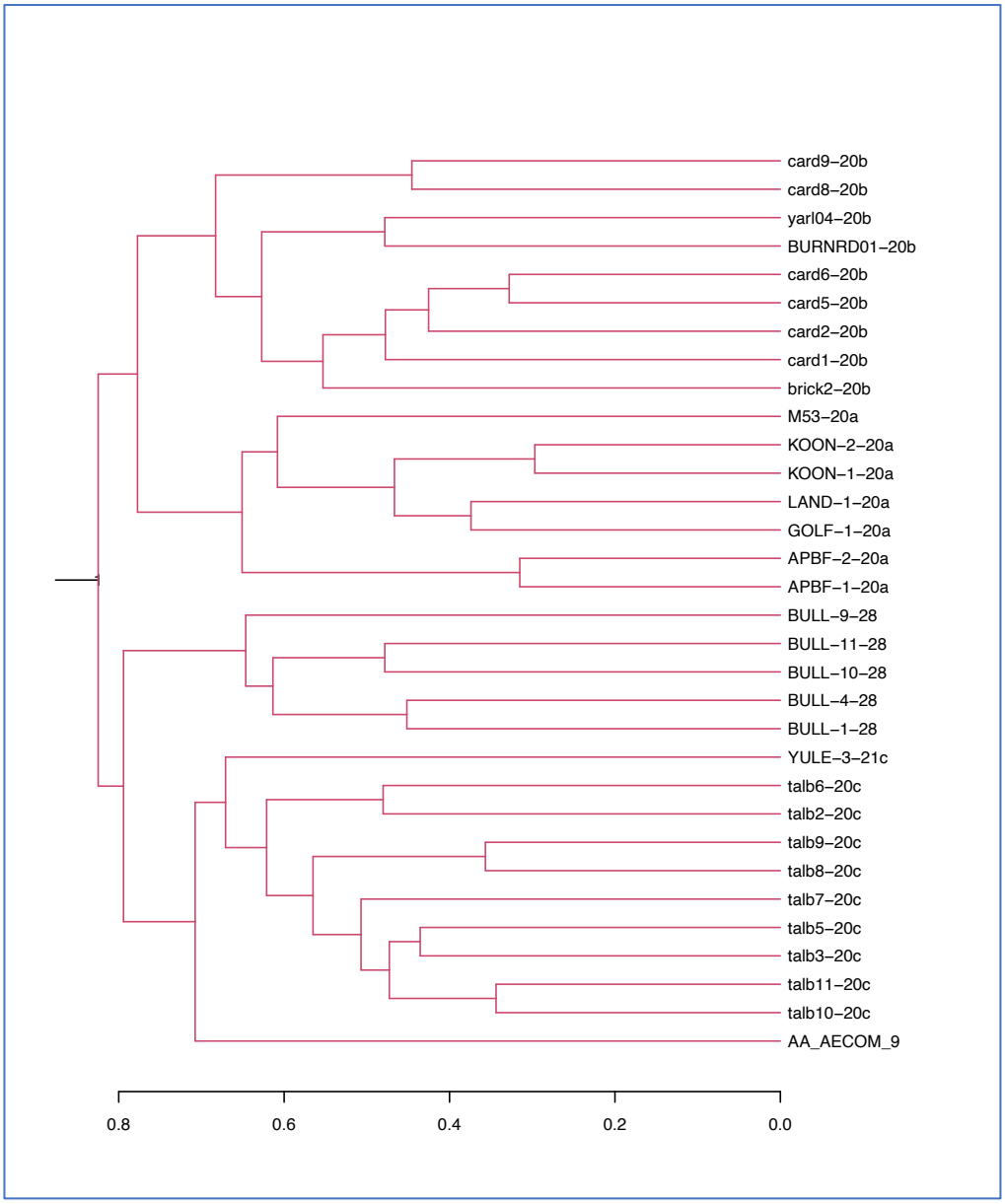


Figure 8: Partial dendrogram for the assignment of Plot AECOM_9 to the Swan Coastal Plain floristic community types.

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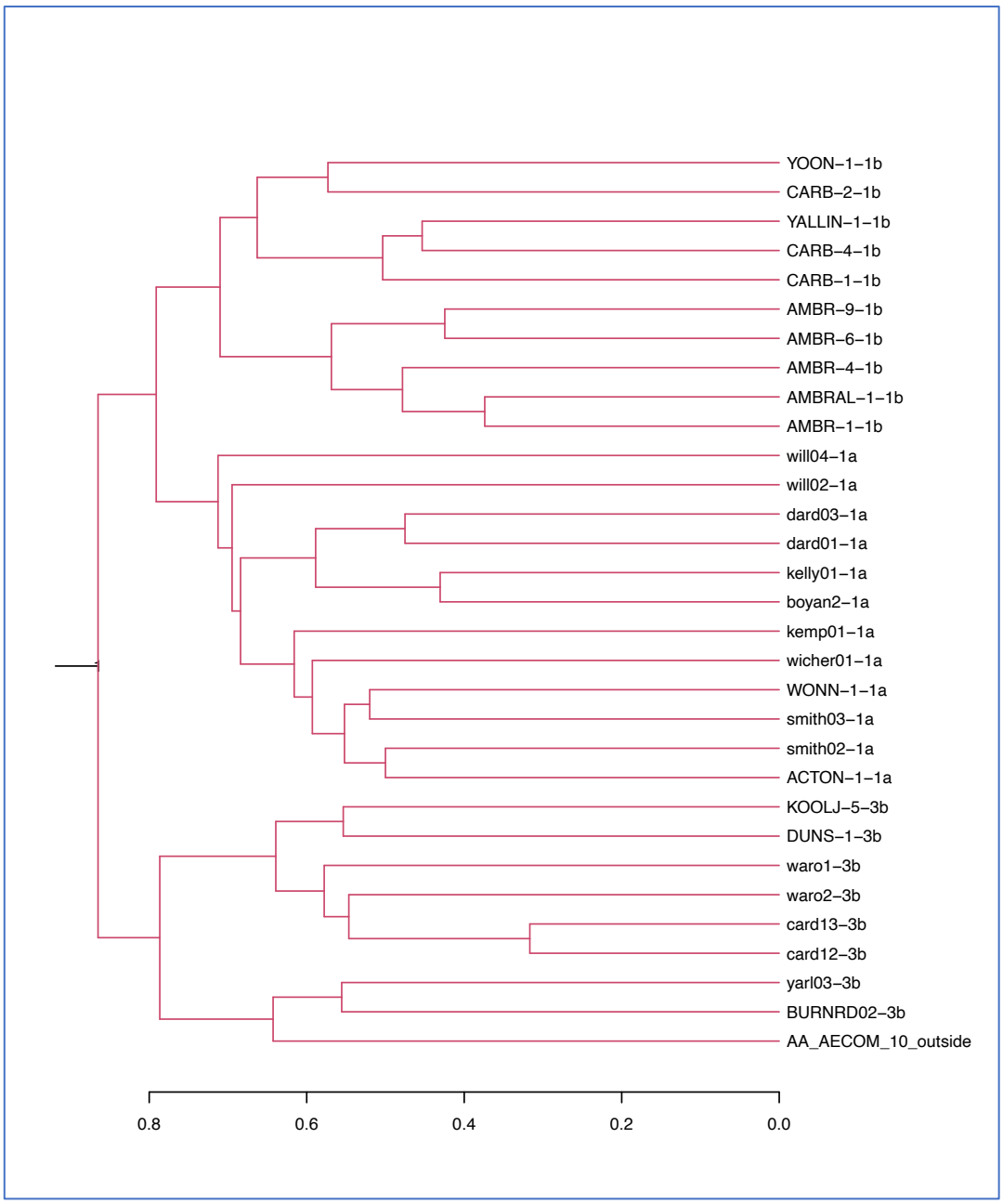


Figure 9: Partial dendrogram for the assignment of Plot AECOM_10 to the Swan Coastal Plain floristic community types.

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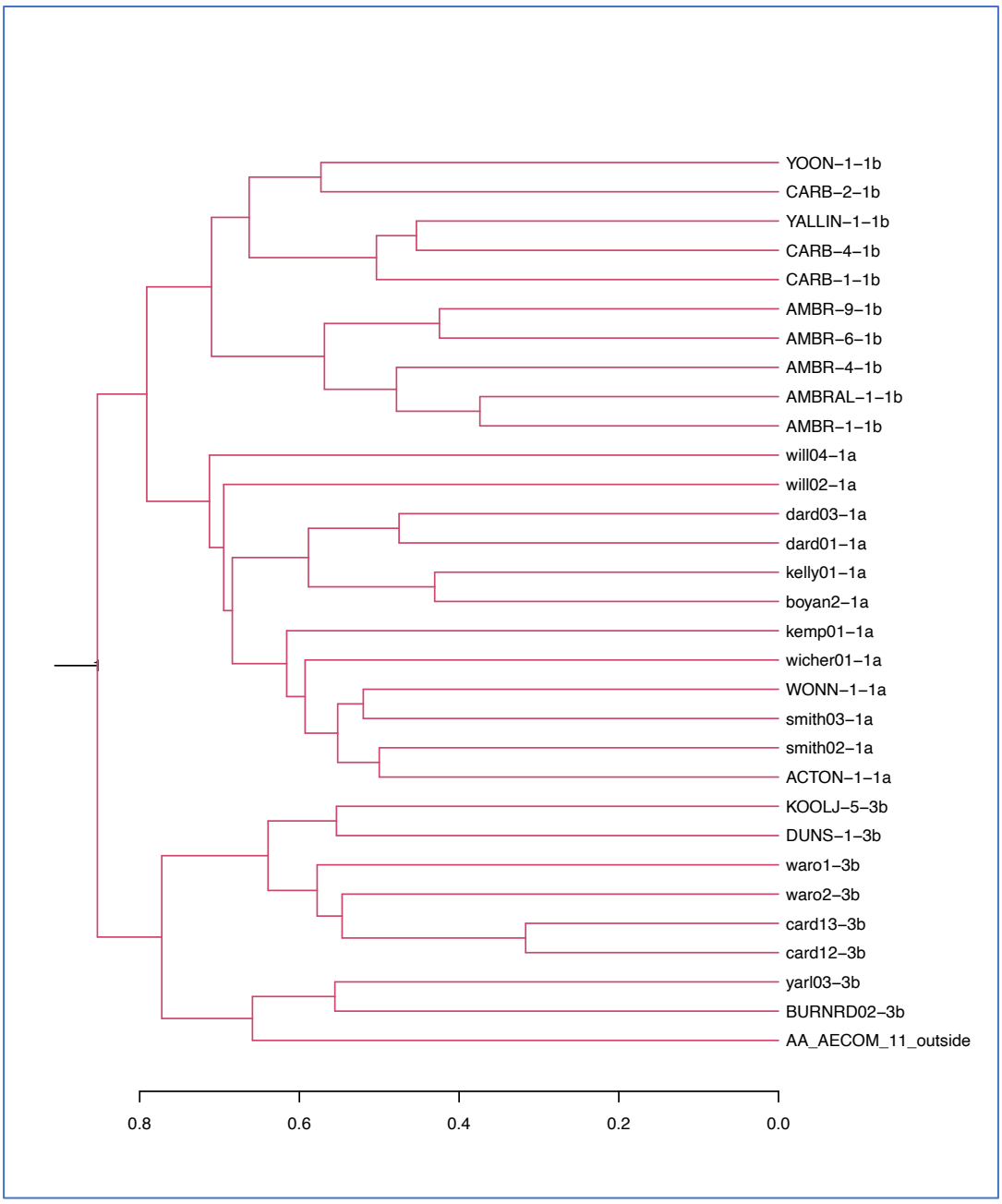


Figure 10: Partial dendrogram for the assignment of Plot AECOM_11 to the Swan Coastal Plain floristic community types.

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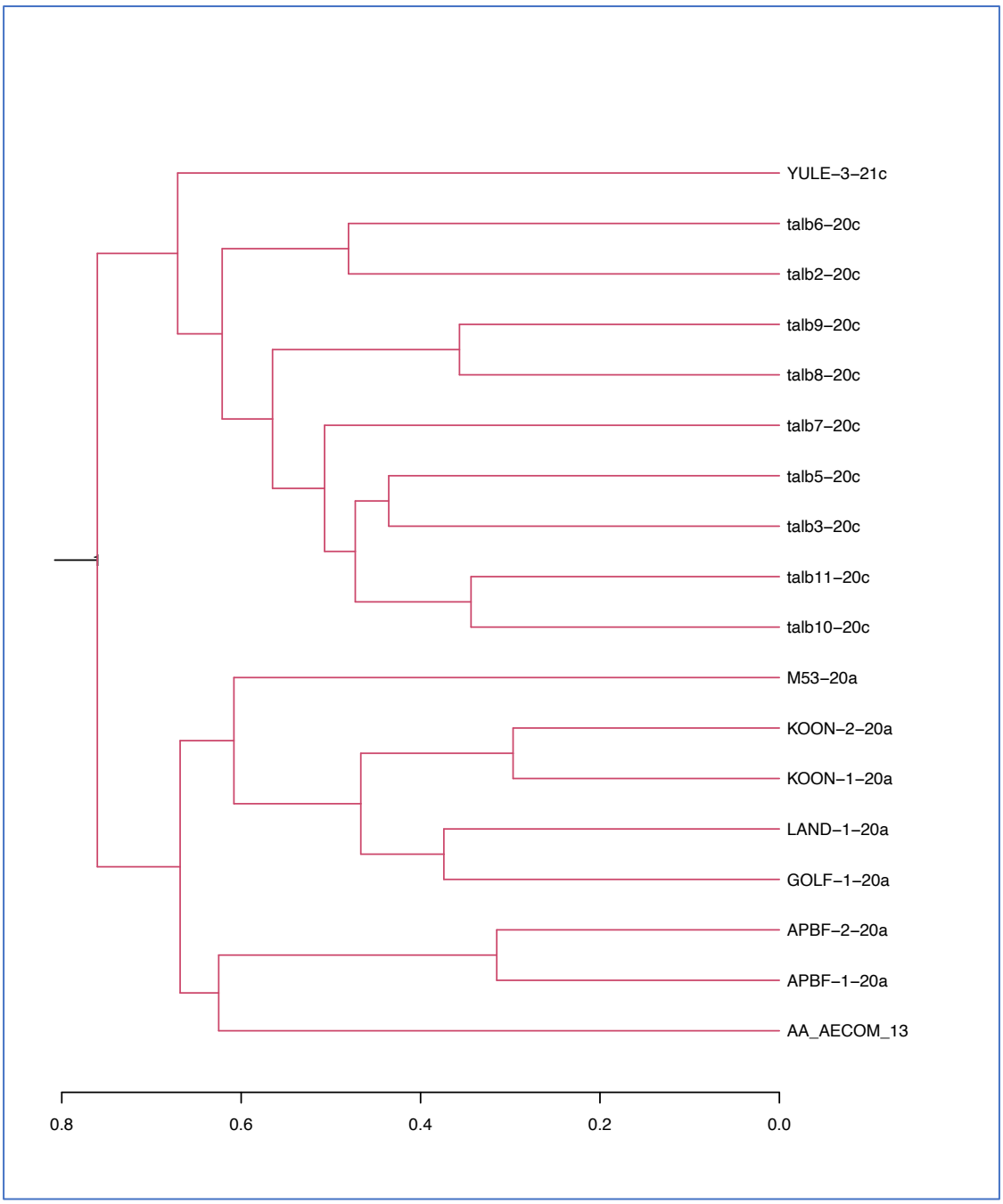


Figure 11: Partial dendrogram for the assignment of Plot AECOM_4 to the Swan Coastal Plain floristic community types.

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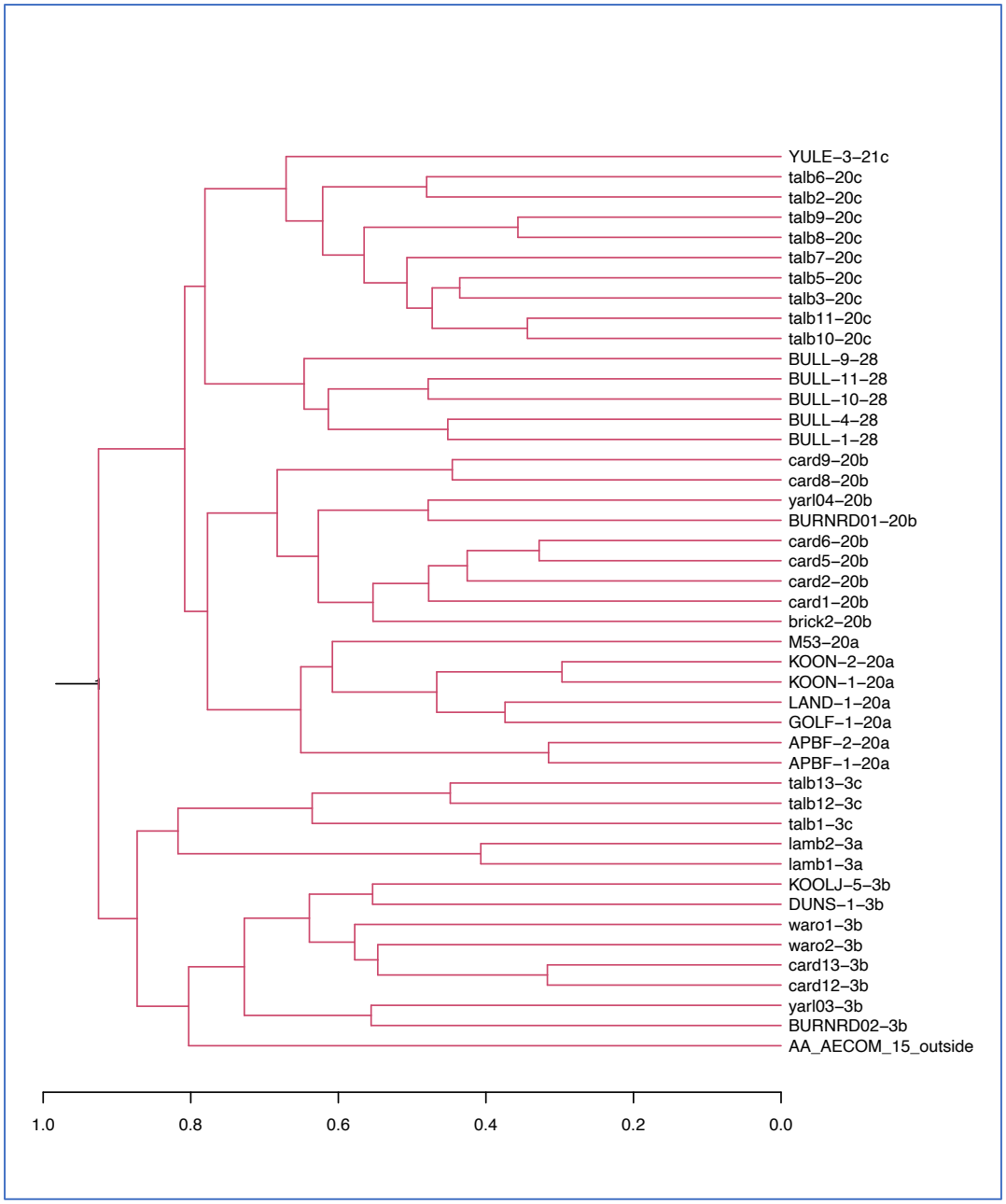


Figure 12: Partial dendrogram for the assignment of Plot AECOM_15 to the Swan Coastal Plain floristic community types.

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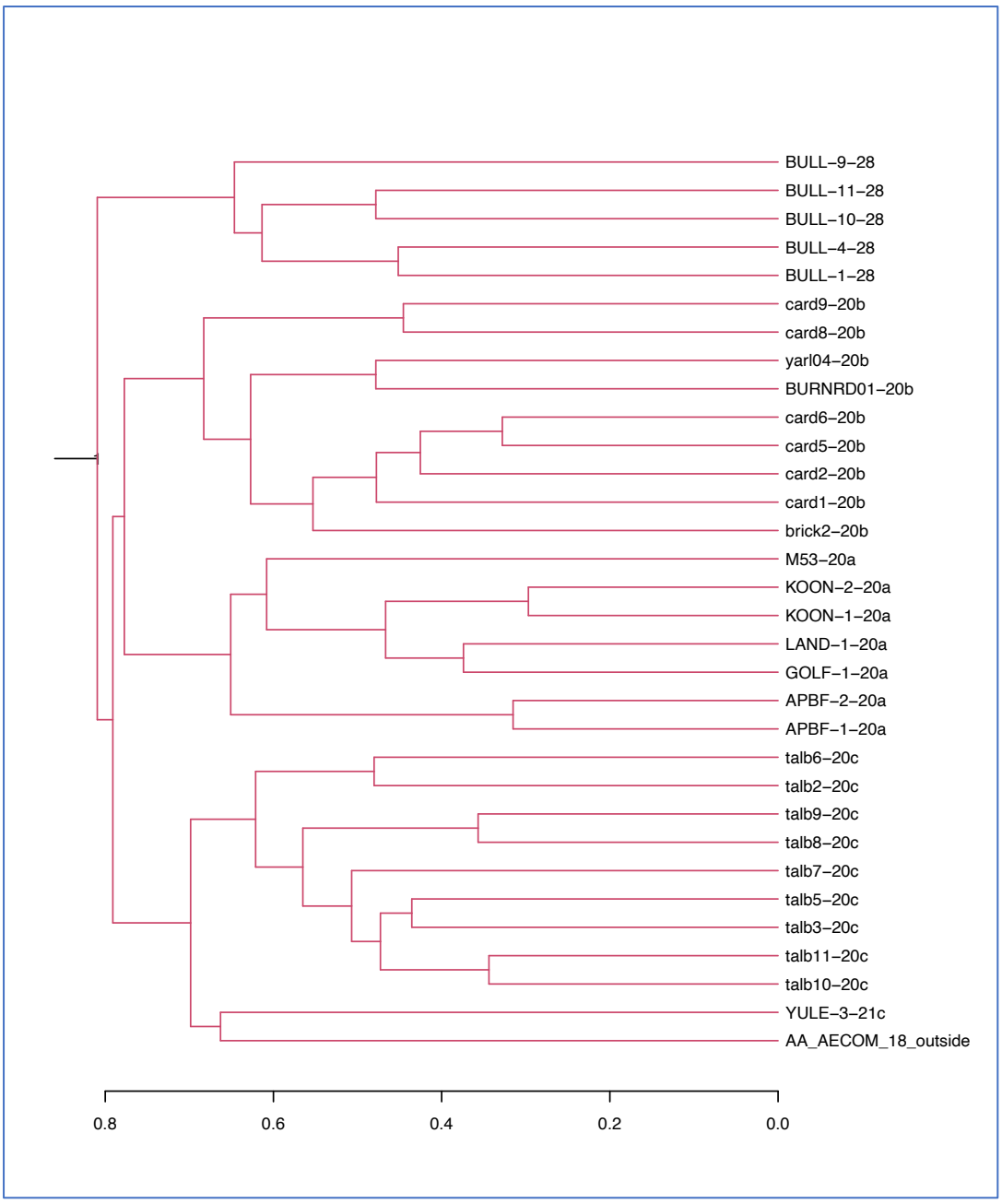


Figure 13: Partial dendrogram for the assignment of Plot AECOM_18 to the Swan Coastal Plain floristic community types.

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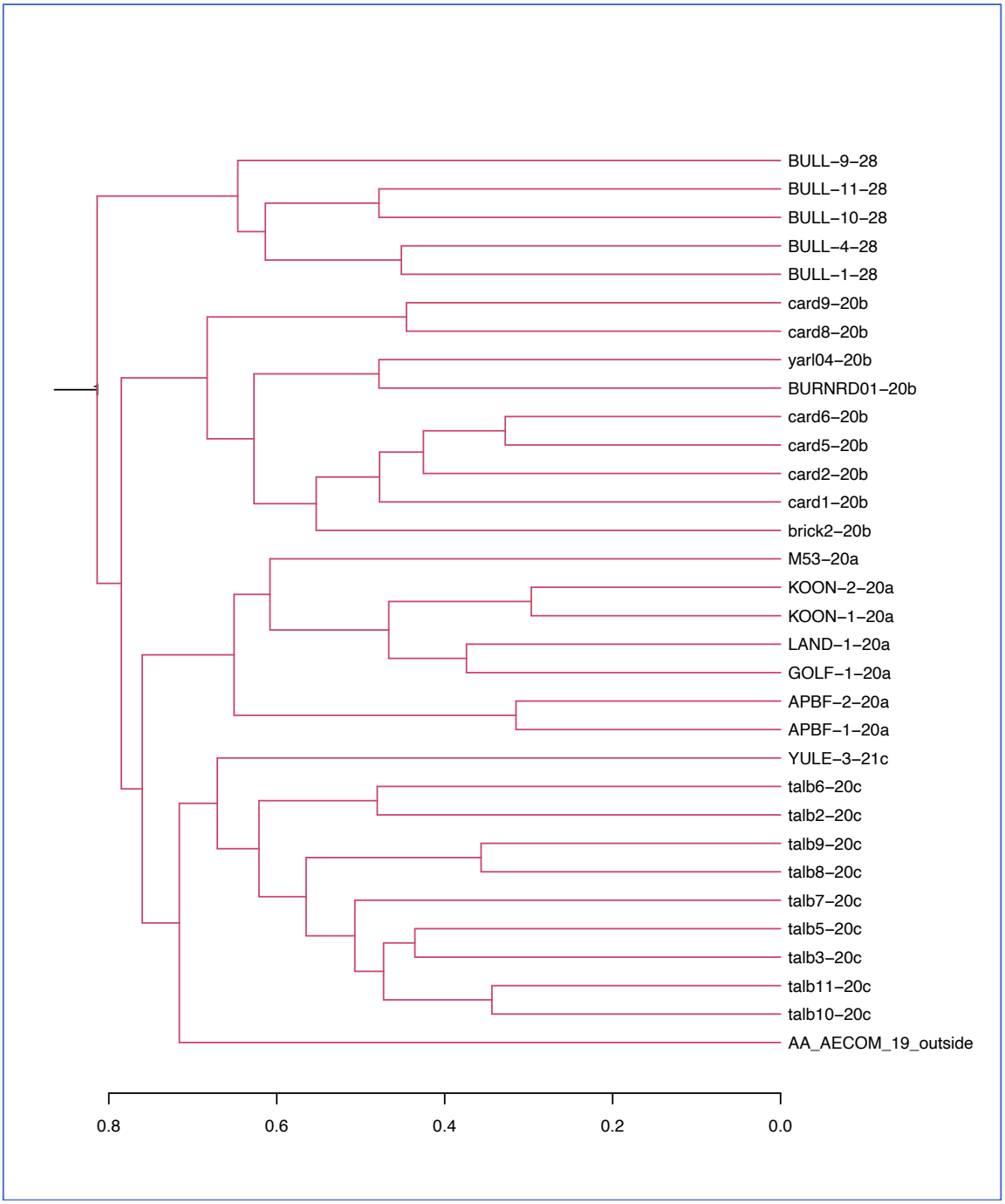


Figure 14: Partial dendrogram for the assignment of Plot AECOM_19 to the Swan Coastal Plain floristic community types.

50 New Cross Rd
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E shane@plantecology.com.au

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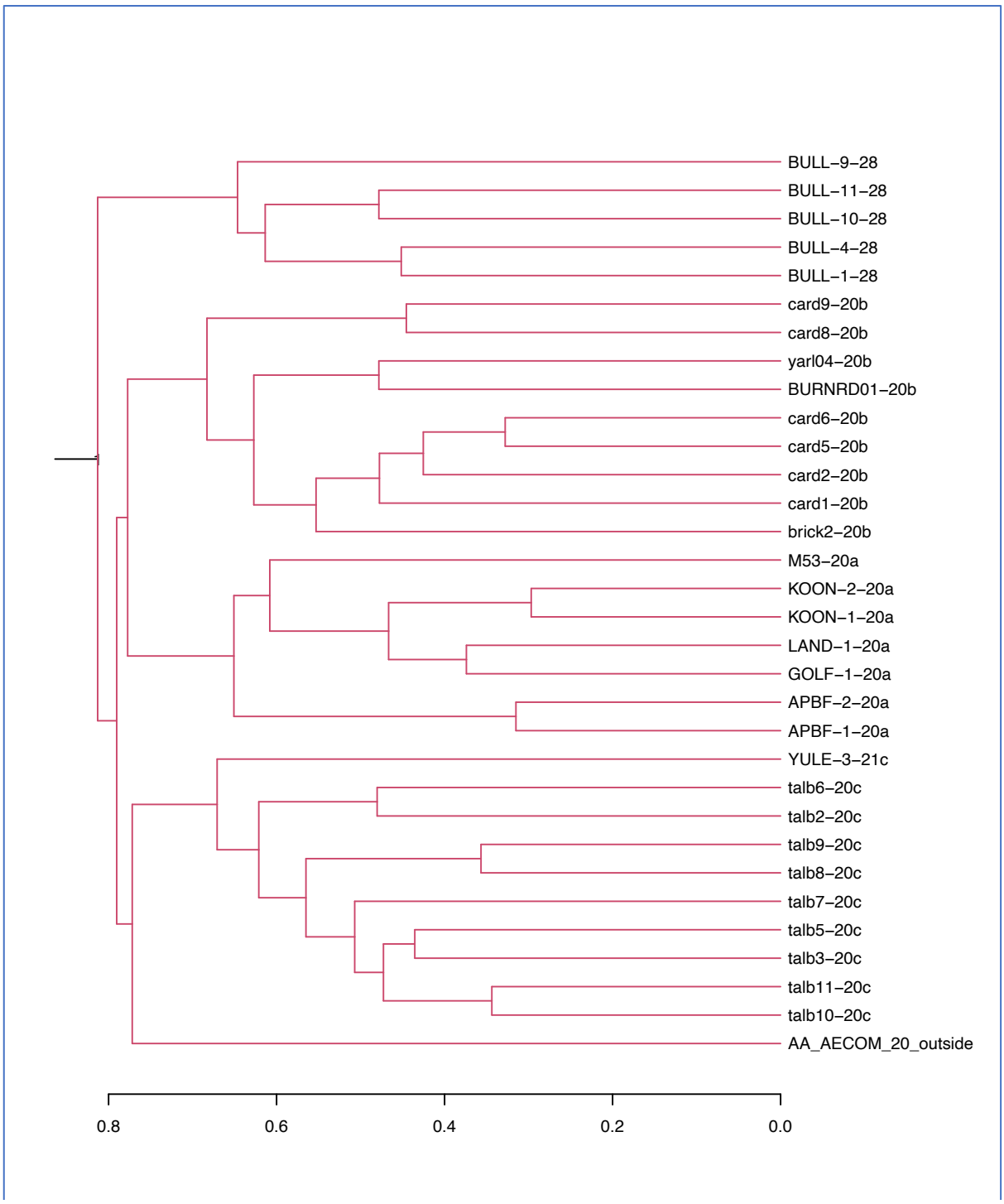


Figure 15: Partial dendrogram for the assignment of Plot AECOM_20 to the Swan Coastal Plain floristic community types.

50 New Cross Rd
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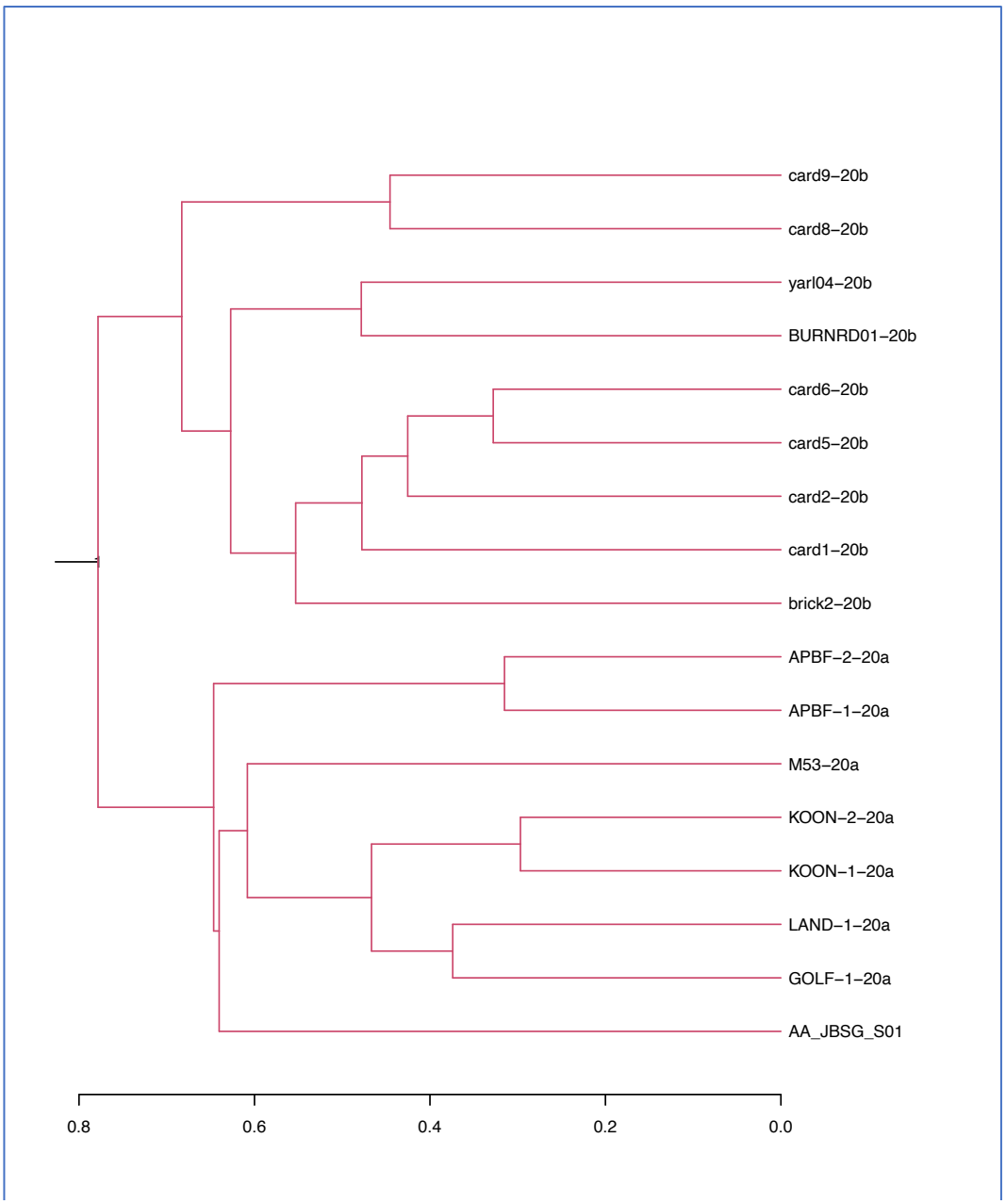


Figure 16: Partial dendrogram for the assignment of Plot JBSG_01 to the Swan Coastal Plain floristic community types.

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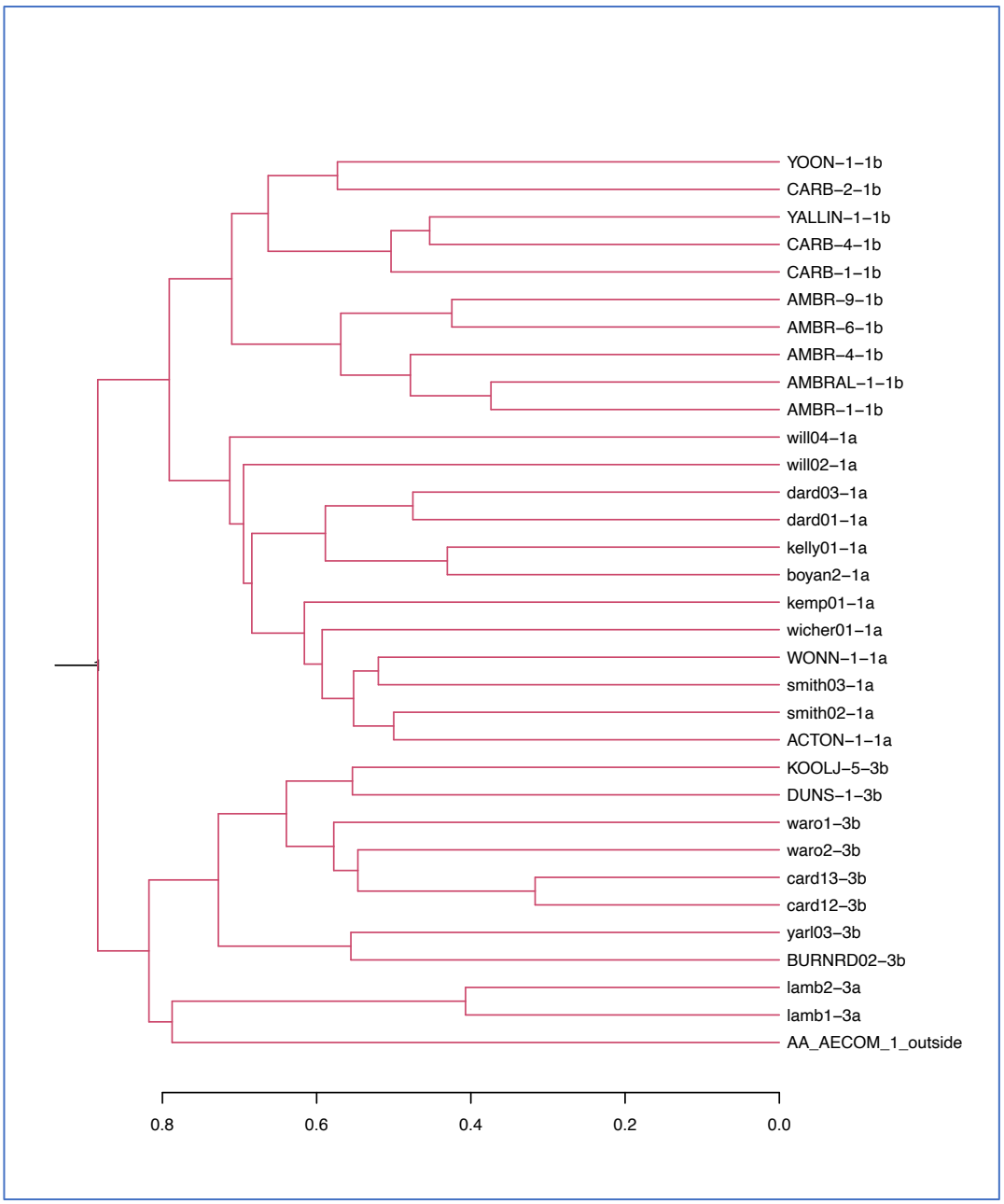


Figure 17: Partial dendrogram for the assignment of Plot AECOM_1 to the Keighery et al. (2012) floristic community types.

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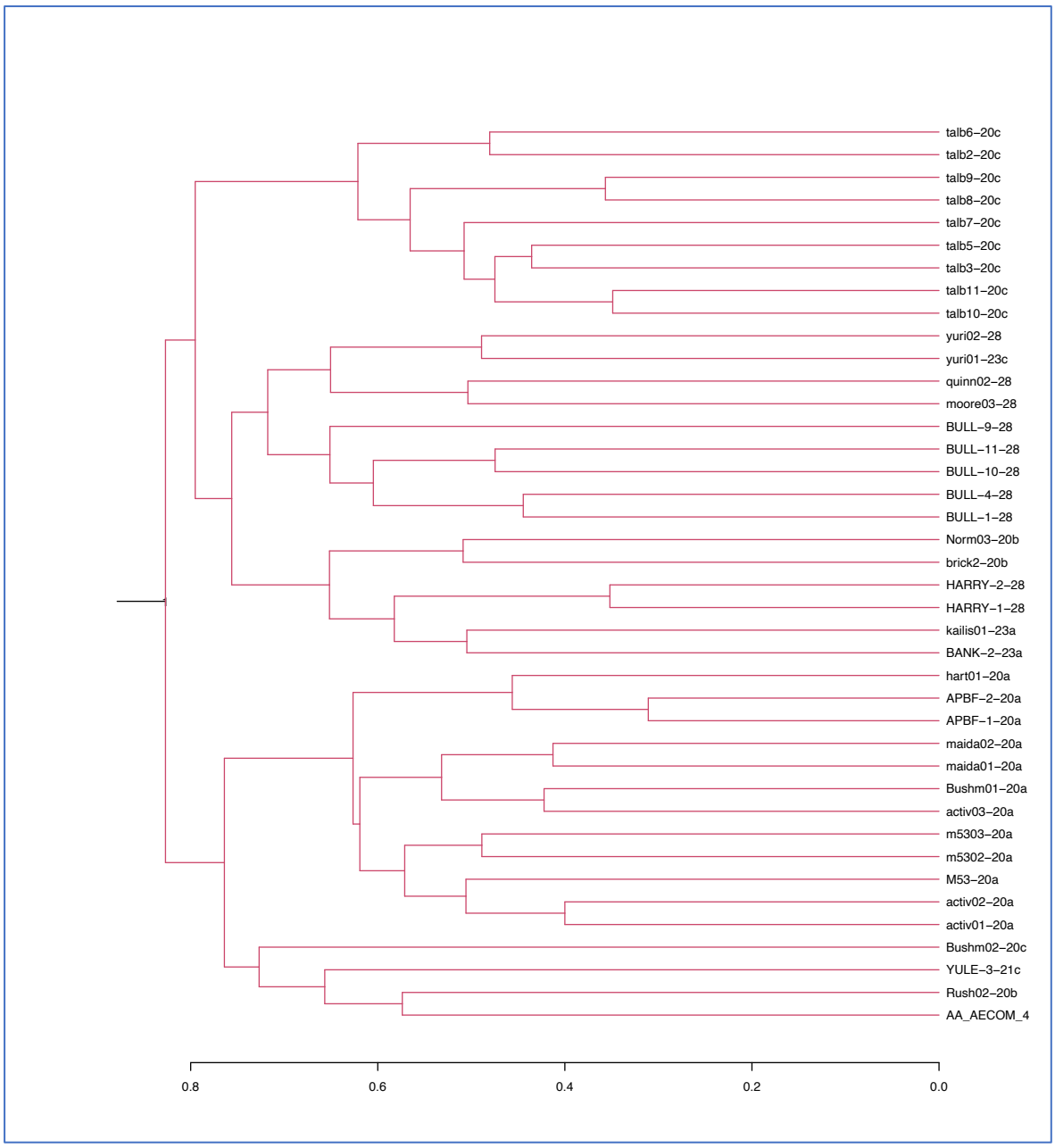


Figure 18: Partial dendrogram for the assignment of Plot AECOM_4 to the Keighery et al. (2012) floristic community types.

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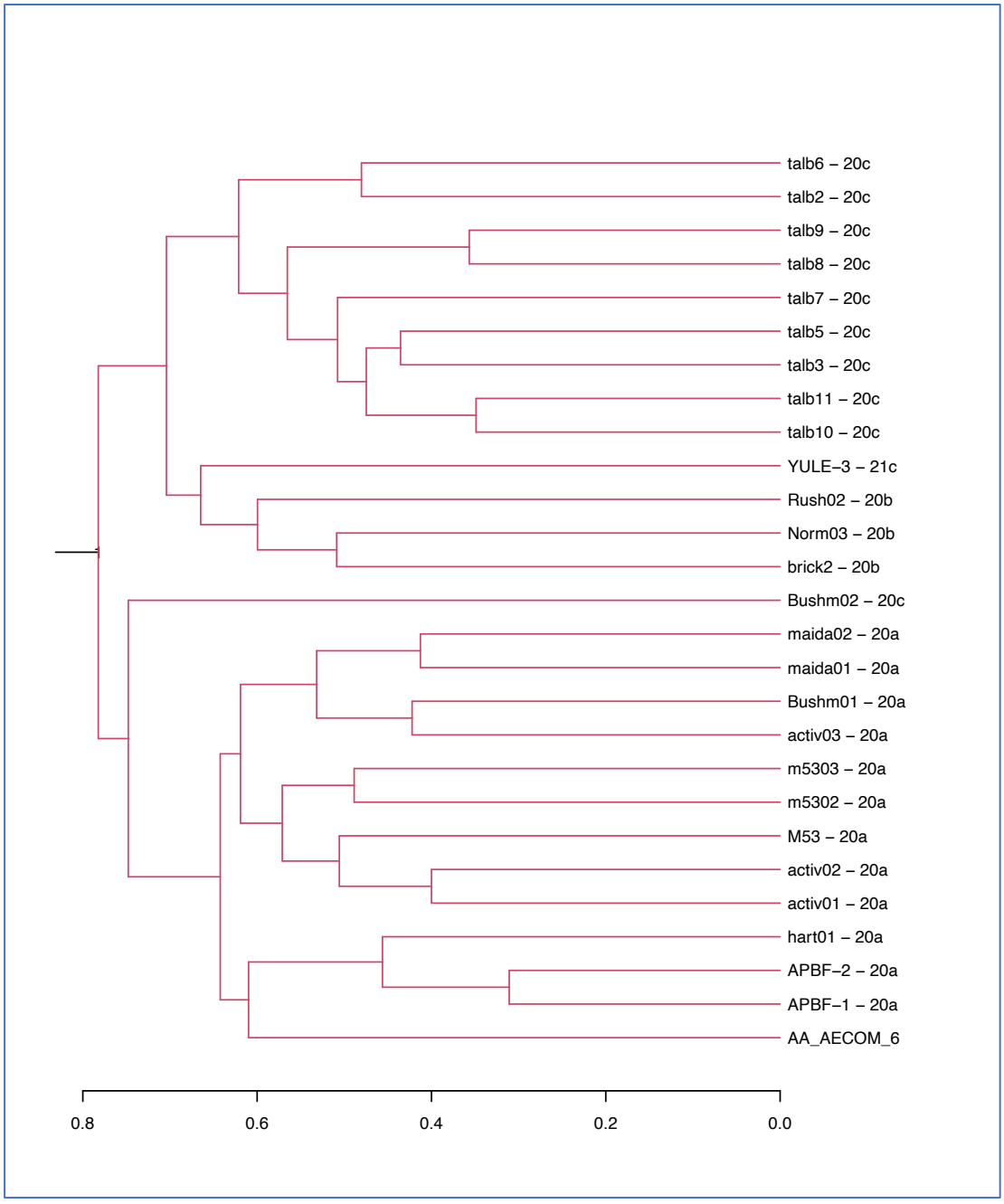


Figure 19: Partial dendrogram for the assignment of Plot AECOM_6 to the Keighery et al. (2012) floristic community types.

50 New Cross Rd
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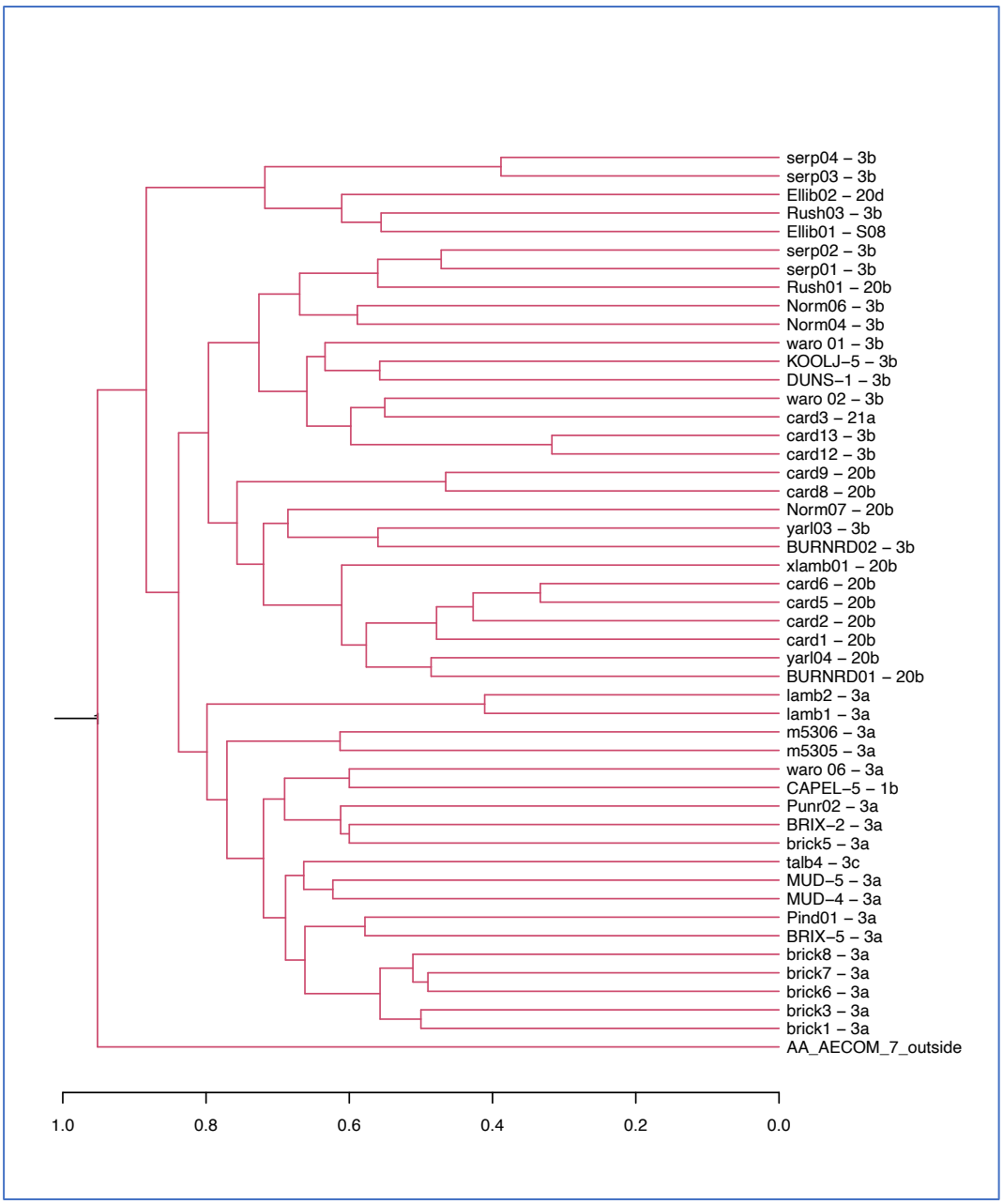


Figure 20: Partial dendrogram for the assignment of Plot AECOM_7 to the Keighery et al. (2012) floristic community types.

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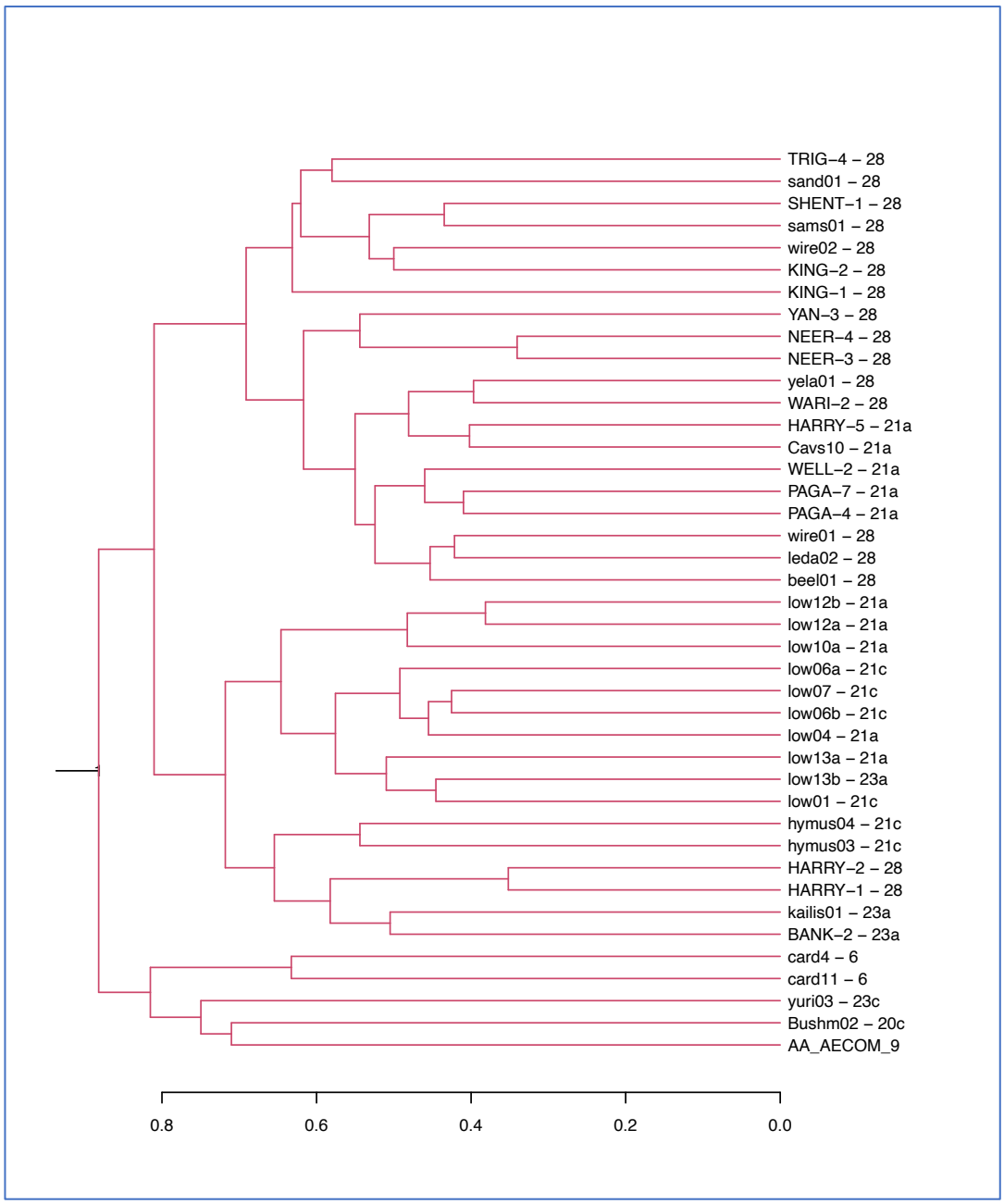


Figure 21: Partial dendrogram for the assignment of Plot AECOM_9 to the Keighery et al. (2012) floristic community types.

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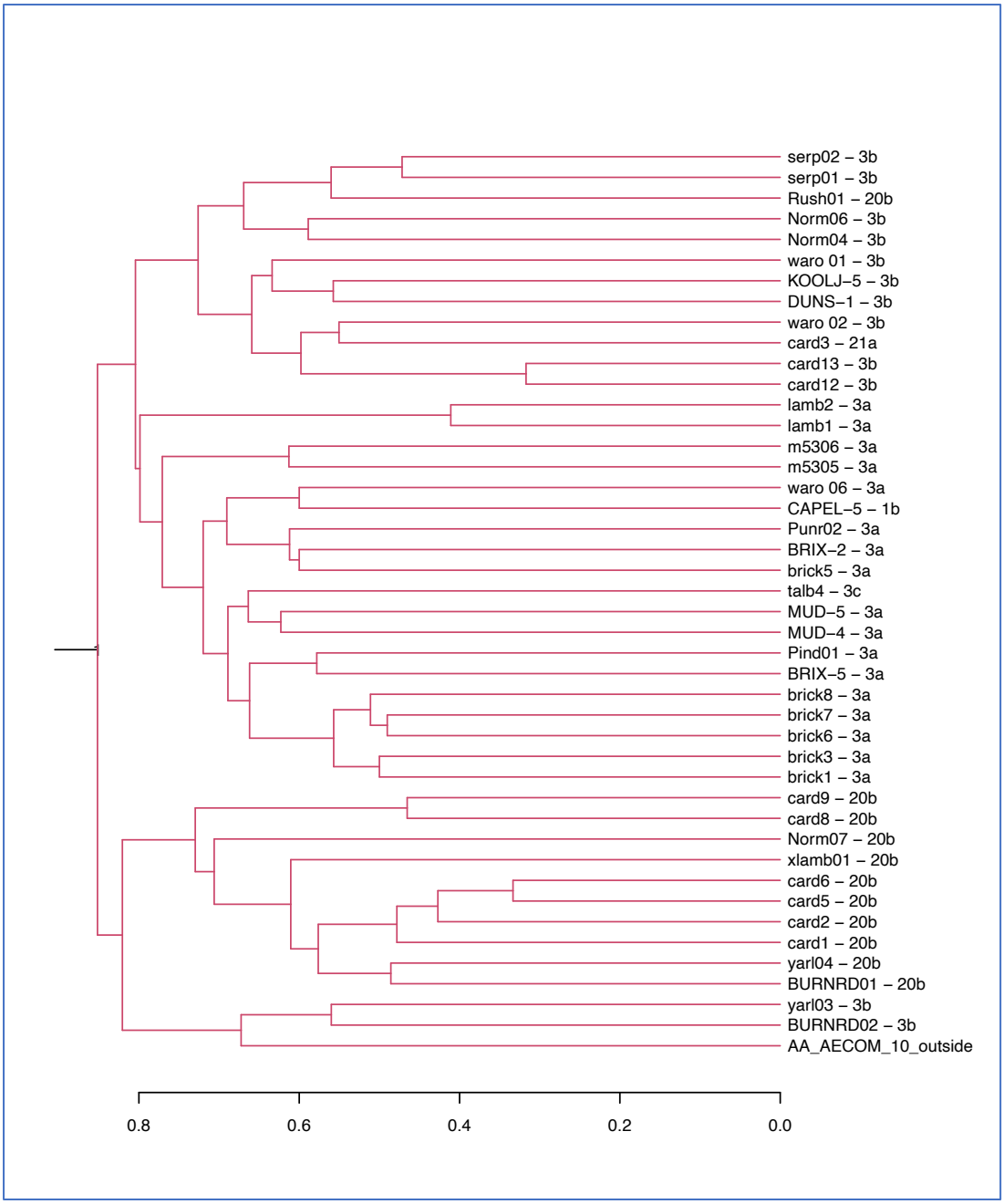


Figure 22: Partial dendrogram for the assignment of Plot AECOM_10 to the Keighery et al. (2012) floristic community types.

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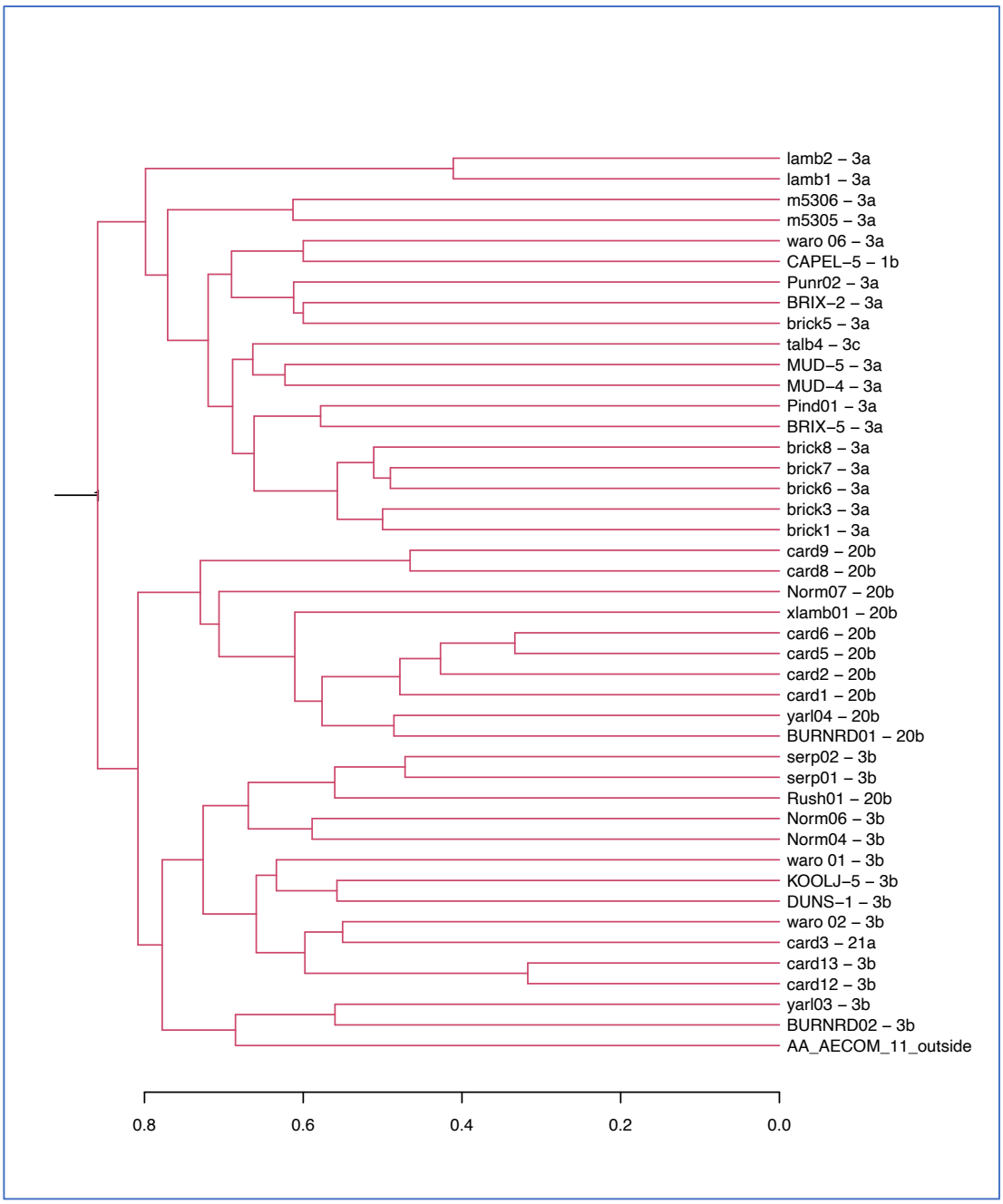


Figure 23: Partial dendrogram for the assignment of Plot AECOM_11 to the Keighery et al. (2012) floristic community types.

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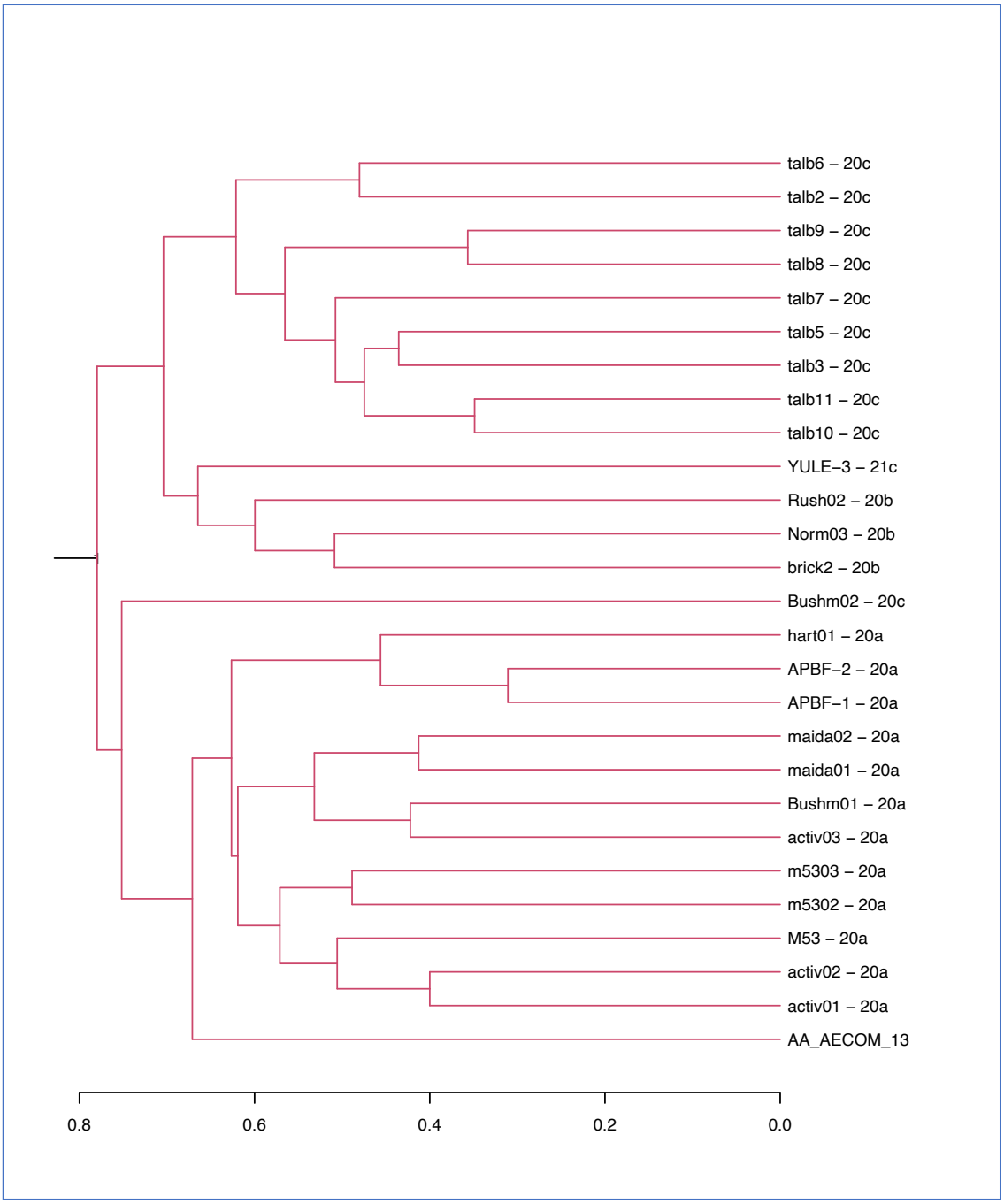


Figure 24: Partial dendrogram for the assignment of Plot AECOM_13 to the Keighery et al. (2012) floristic community types.

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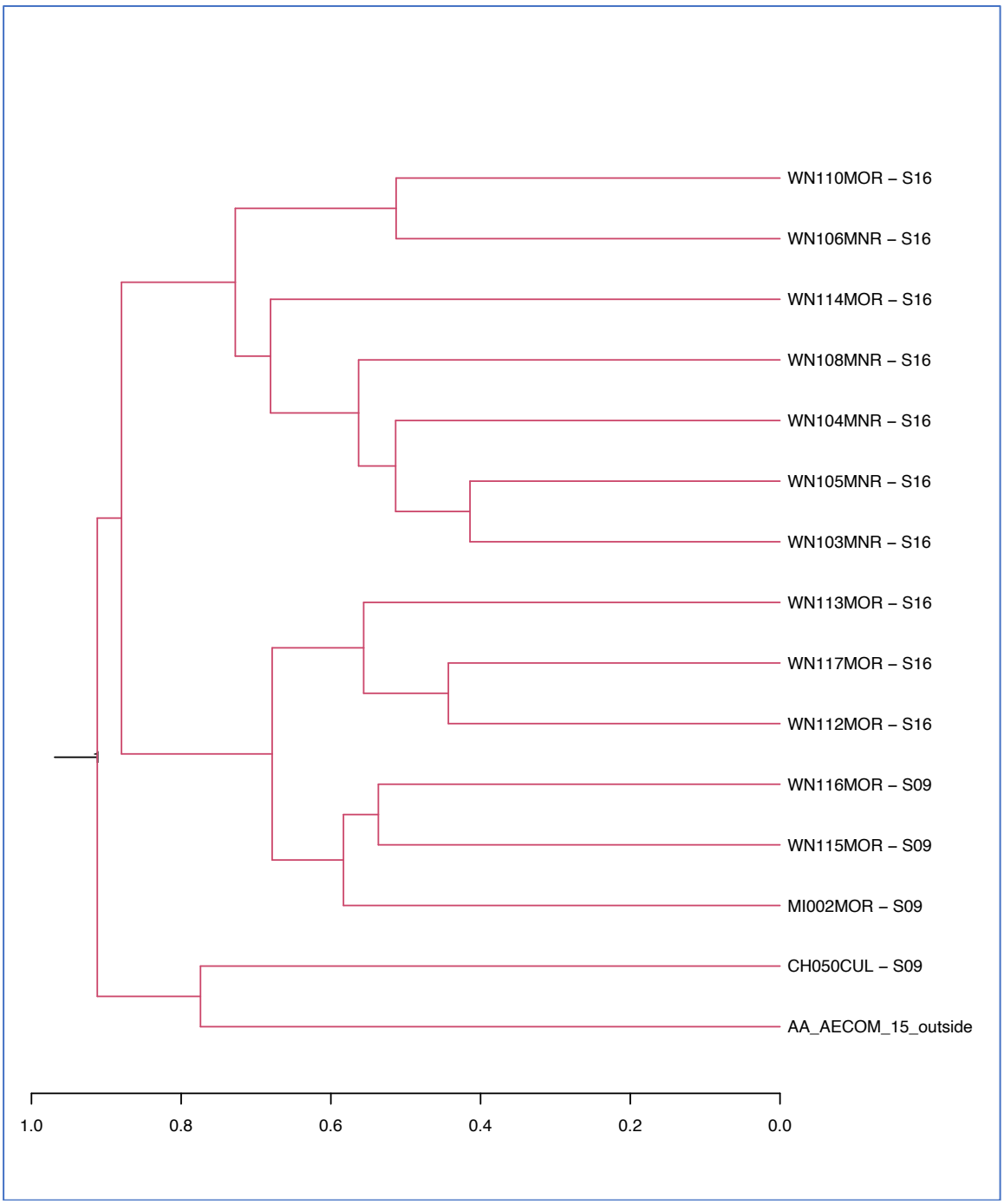


Figure 25: Partial dendrogram for the assignment of Plot AECOM_15 to the Keighery et al. (2012) floristic community types.

50 New Cross Rd
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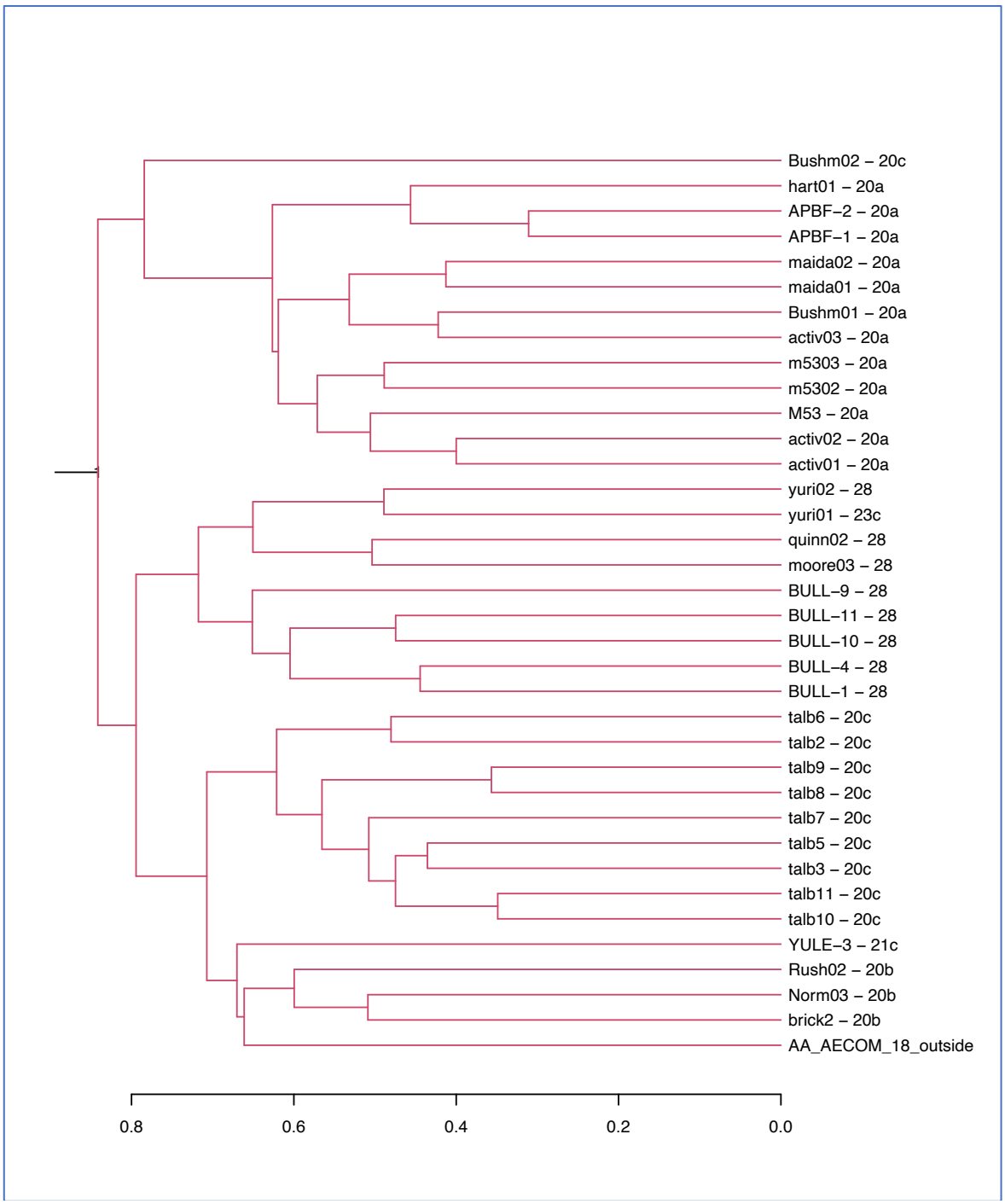


Figure 26: Partial dendrogram for the assignment of Plot AECOM_18 to the Keighery et al. (2012) floristic community types.

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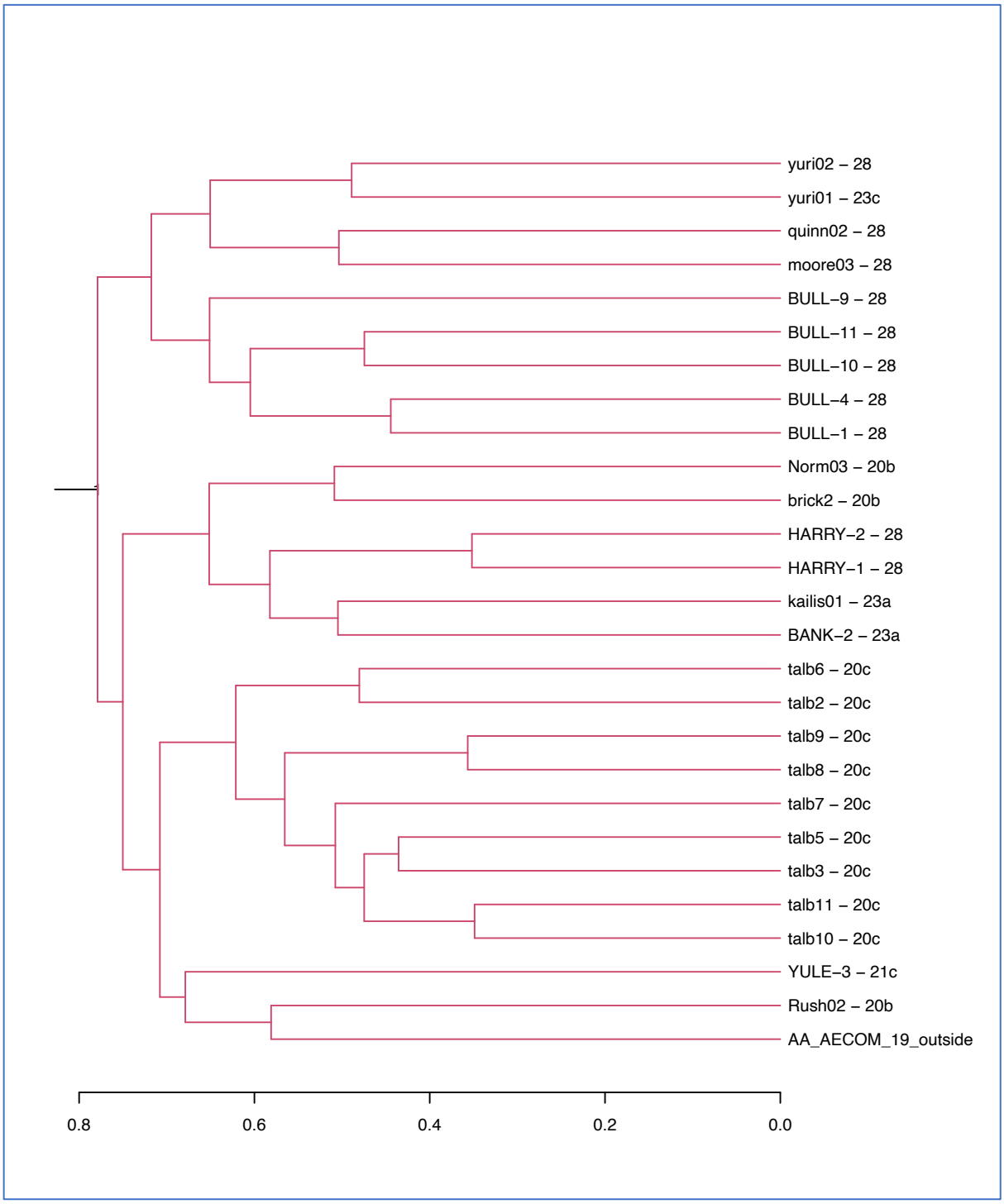


Figure 27: Partial dendrogram for the assignment of Plot AECOM_19 to the Keighery et al. (2012) floristic community types.

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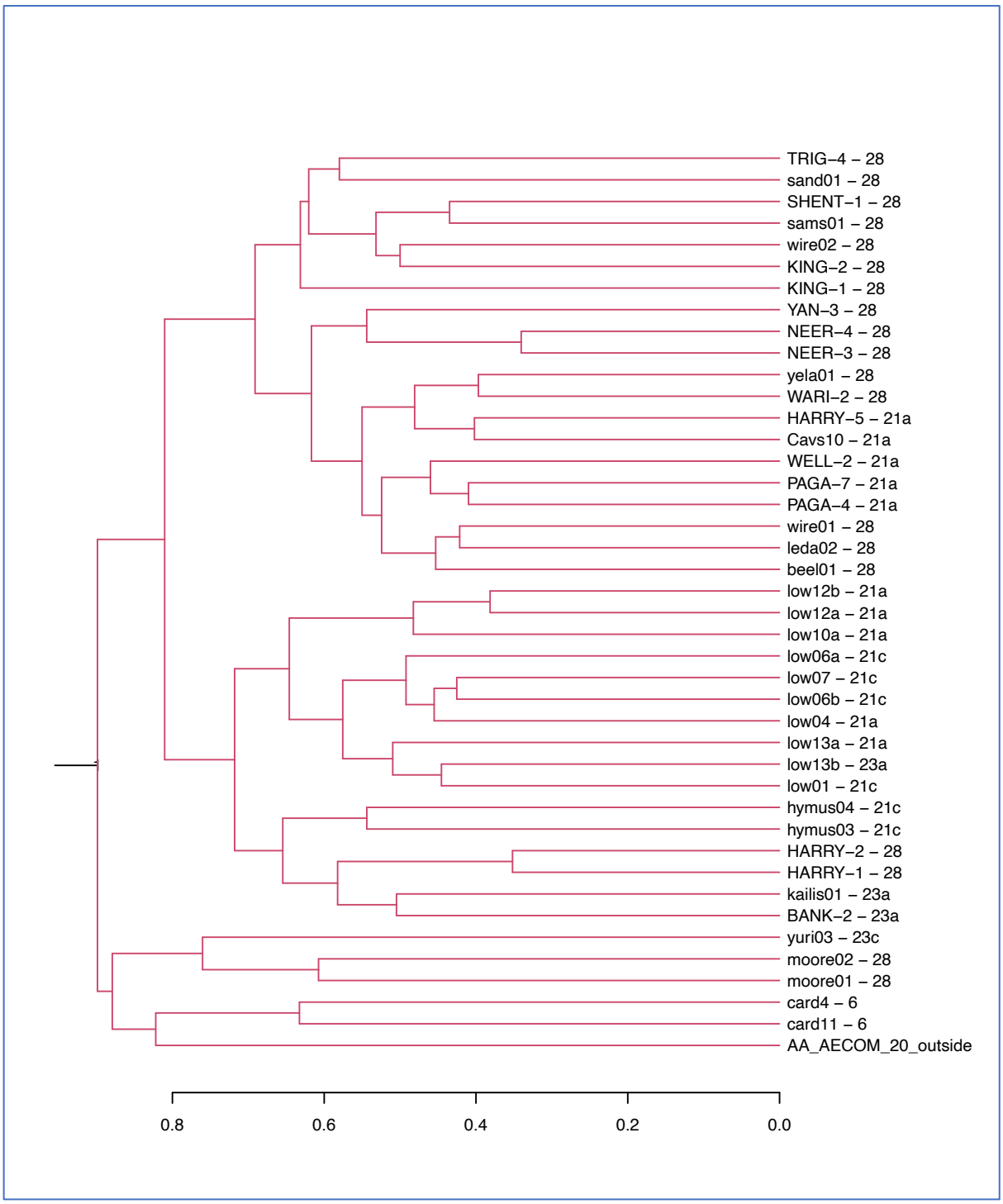


Figure 28: Partial dendrogram for the assignment of Plot AECOM_20 to the Keighery et al. (2012) floristic community types.

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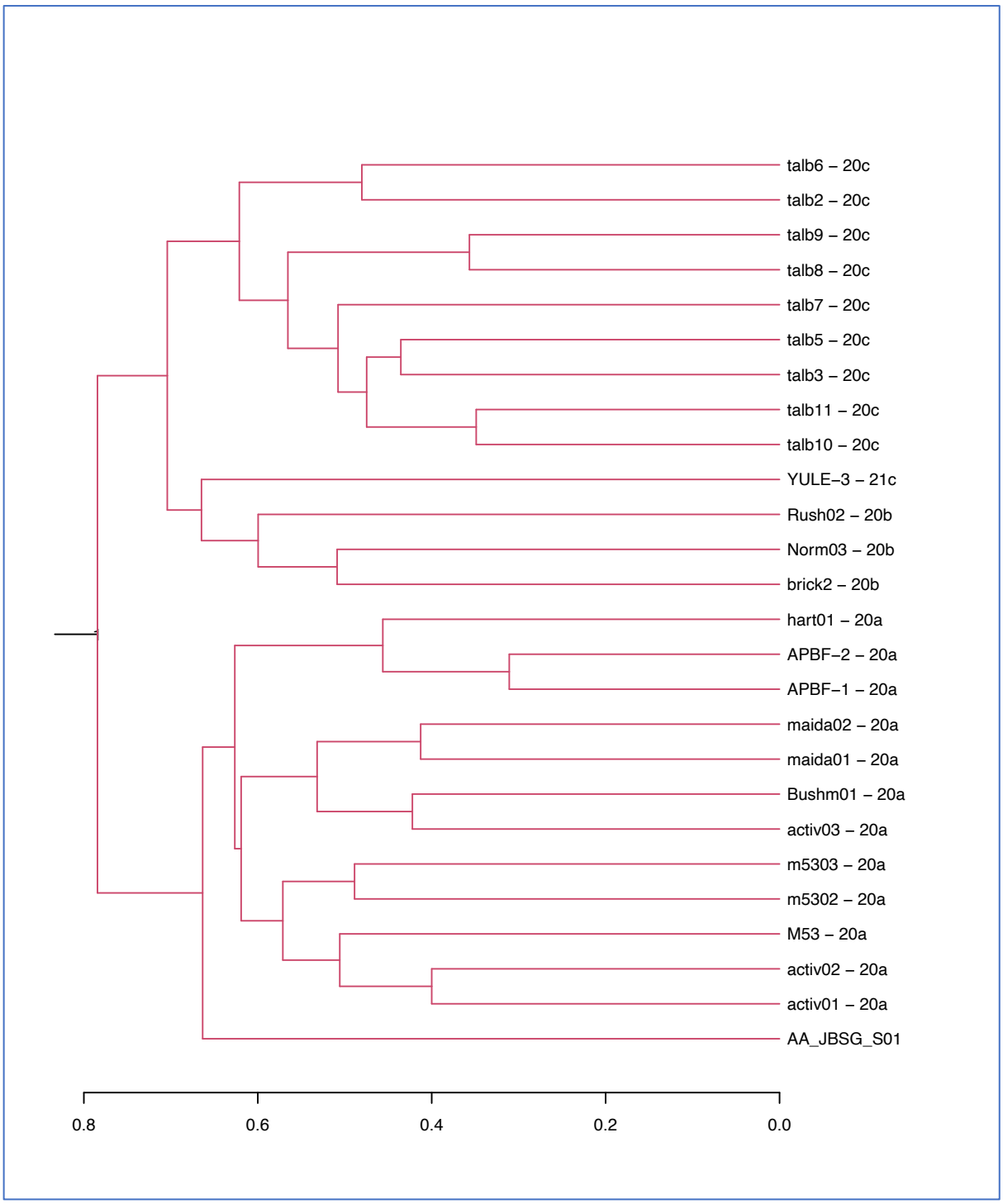


Figure 29: Partial dendrogram for the assignment of Plot AECOM_30 to the Keighery et al. (2012) floristic community types.

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Table 2: Bray Curtis dissimilarity values for Wattle Grove and the closest Swan Coastal Plain plots

Swan Coastal Plain Plot (FCT)	AECOM_11_outside	AECOM_15_outside	AECOM_20_outside	AECOM_7_outside	AECOM_1_outside	AECOM_13	AECOM_9	AECOM_10_outside	AECOM_6	AECOM_19_outside	AECOM_4	JBSG_S01	AECOM_18_outside
activ01-20a	0.855	0.813	0.770	0.940	0.845	0.575	0.704	0.901	0.593	0.670	0.621	0.563	0.745
activ02-20a	0.864	0.791	0.752	0.926	0.871	0.630	0.672	0.890	0.649	0.659	0.657	0.606	0.678
APBF-1-20a	0.772	0.856	0.778	0.885	0.783	0.618	0.768	0.848	0.638	0.714	0.676	0.642	0.772
APBF-2-20a	0.821	0.835	0.774	0.922	0.814	0.612	0.745	0.883	0.568	0.692	0.597	0.620	0.732
brick1-3a	0.808	0.861	0.832	0.894	0.800	0.818	0.824	0.853	0.812	0.835	0.810	0.841	0.846
brick2-20b	0.731	0.802	0.720	0.894	0.836	0.736	0.784	0.789	0.744	0.706	0.746	0.681	0.654
brick3-3a	0.849	0.825	0.817	0.917	0.875	0.805	0.808	0.897	0.782	0.784	0.813	0.791	0.811
brick6-3a	0.795	0.812	0.736	0.897	0.830	0.733	0.791	0.823	0.802	0.763	0.782	0.773	0.795
brick7-3a	0.783	0.775	0.789	0.854	0.816	0.853	0.822	0.880	0.771	0.794	0.807	0.822	0.848
brick8-3a	0.780	0.814	0.806	0.911	0.811	0.778	0.796	0.824	0.699	0.714	0.754	0.798	0.740
BURNRD01-20b	0.727	0.813	0.752	0.840	0.810	0.717	0.815	0.782	0.691	0.722	0.712	0.647	0.745
BURNRD02-3b	0.671	0.780	0.818	0.787	0.802	0.784	0.831	0.658	0.776	0.778	0.776	0.787	0.765
Bushm02-20c	0.915	0.882	0.838	0.934	0.922	0.705	0.710	0.903	0.667	0.763	0.720	0.800	0.746
card1-20b	0.706	0.778	0.771	0.826	0.722	0.714	0.800	0.785	0.687	0.701	0.710	0.694	0.667
card11-6	0.806	0.898	0.815	0.846	0.853	0.823	0.733	0.811	0.760	0.761	0.810	0.803	0.710
card12-3b	0.729	0.763	0.717	0.860	0.765	0.752	0.787	0.793	0.780	0.723	0.729	0.790	0.688
card13-3b	0.714	0.745	0.722	0.832	0.730	0.770	0.806	0.771	0.763	0.691	0.732	0.772	0.695
card2-20b	0.735	0.782	0.707	0.806	0.782	0.646	0.730	0.788	0.651	0.644	0.748	0.639	0.664
card4-6	0.877	0.806	0.794	0.964	0.859	0.854	0.714	0.821	0.769	0.771	0.839	0.865	0.692
card5-20b	0.733	0.824	0.685	0.895	0.748	0.689	0.748	0.792	0.661	0.655	0.701	0.649	0.657
card6-20b	0.750	0.849	0.778	0.860	0.804	0.752	0.787	0.839	0.725	0.762	0.763	0.676	0.729
CH050CUL-S09	0.969	0.774	0.853	0.891	0.944	0.878	0.810	0.929	0.821	0.800	0.885	0.865	0.785
DUNS-1-3b	0.792	0.786	0.798	0.896	0.821	0.805	0.846	0.794	0.815	0.766	0.828	0.791	0.755

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Swan Coastal Plain Plot (FCT)	AECOM_11_outside	AECOM_15_outside	AECOM_20_outside	AECOM_7_outside	AECOM_1_outside	AECOM_13	AECOM_9	AECOM_10_outside	AECOM_6	AECOM_19_outside	AECOM_4	JBSG_S01	AECOM_18_outside
Ellib01-S08	0.828	0.867	0.833	0.880	0.838	0.855	0.868	0.857	0.849	0.796	0.774	0.863	0.806
Ellib02-20d	0.848	0.789	0.805	0.884	0.859	0.833	0.844	0.857	0.804	0.738	0.723	0.795	0.772
GOLF-1-20a	0.859	0.833	0.706	0.933	0.810	0.690	0.670	0.867	0.643	0.712	0.702	0.648	0.737
hart01-20a	0.792	0.806	0.717	0.814	0.745	0.628	0.723	0.839	0.560	0.683	0.559	0.600	0.771
KOOLJ-5-3b	0.788	0.780	0.795	0.920	0.824	0.745	0.759	0.737	0.776	0.756	0.794	0.809	0.741
KOON-1-20a	0.810	0.765	0.722	0.853	0.802	0.574	0.670	0.854	0.678	0.636	0.717	0.544	0.657
KOON-2-20a	0.728	0.860	0.736	0.892	0.853	0.583	0.703	0.851	0.655	0.704	0.712	0.571	0.728
lamb1-3a	0.842	0.838	0.829	0.885	0.817	0.878	0.911	0.905	0.827	0.798	0.809	0.854	0.842
lamb2-3a	0.800	0.813	0.823	0.840	0.741	0.827	0.833	0.802	0.740	0.774	0.773	0.832	0.764
LAND-1-20a	0.818	0.776	0.735	0.880	0.810	0.606	0.722	0.822	0.642	0.635	0.667	0.597	0.655
M53-20a	0.794	0.808	0.745	0.897	0.876	0.694	0.733	0.878	0.667	0.679	0.736	0.655	0.701
m5302-20a	0.820	0.835	0.709	0.911	0.830	0.675	0.633	0.846	0.646	0.695	0.705	0.688	0.700
m5303-20a	0.820	0.833	0.772	0.921	0.846	0.625	0.706	0.863	0.581	0.707	0.624	0.633	0.730
maida01-20a	0.820	0.796	0.737	0.901	0.778	0.734	0.743	0.804	0.677	0.690	0.714	0.717	0.694
maida02-20a	0.806	0.800	0.792	0.904	0.838	0.691	0.802	0.810	0.679	0.673	0.704	0.725	0.656
MI002MOR-S09	0.942	0.909	0.889	1.000	0.893	0.860	0.821	0.967	0.854	0.865	0.846	0.872	0.855
moore01-28	0.860	0.835	0.864	0.956	0.887	0.897	0.816	0.824	0.858	0.886	0.852	0.908	0.840
moore02-28	0.859	0.854	0.818	0.893	0.890	0.863	0.759	0.868	0.796	0.844	0.776	0.894	0.835
Norm03-20b	0.750	0.812	0.736	0.846	0.809	0.695	0.744	0.797	0.703	0.656	0.673	0.629	0.659
Rush02-20b	0.800	0.814	0.709	0.889	0.811	0.641	0.735	0.868	0.628	0.581	0.574	0.651	0.640
Rush03-3b	0.686	0.838	0.771	0.848	0.796	0.832	0.800	0.828	0.809	0.794	0.758	0.838	0.804
serp03-3b	0.718	0.867	0.852	0.824	0.810	0.874	0.895	0.826	0.868	0.807	0.800	0.816	0.744
serp04-3b	0.718	0.878	0.864	0.787	0.780	0.863	0.855	0.816	0.837	0.756	0.813	0.830	0.765
talb10-20c	0.864	0.826	0.802	0.926	0.871	0.630	0.724	0.890	0.634	0.675	0.700	0.638	0.678

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Swan Coastal Plain Plot (FCT)	AECOM_11_outside	AECOM_15_outside	AECOM_20_outside	AECOM_7_outside	AECOM_1_outside	AECOM_13	AECOM_9	AECOM_10_outside	AECOM_6	AECOM_19_outside	AECOM_4	JBSG_S01	AECOM_18_outside
talb11-20c	0.798	0.907	0.783	0.924	0.832	0.642	0.724	0.875	0.627	0.660	0.712	0.633	0.685
talb2-20c	0.778	0.719	0.717	0.888	0.821	0.716	0.739	0.796	0.692	0.672	0.741	0.746	0.658
talb3-20c	0.863	0.859	0.810	0.870	0.889	0.697	0.700	0.871	0.757	0.738	0.790	0.730	0.745
talb5-20c	0.880	0.814	0.786	0.933	0.868	0.744	0.673	0.868	0.735	0.733	0.721	0.743	0.720
talb6-20c	0.886	0.765	0.714	0.923	0.851	0.733	0.674	0.823	0.743	0.763	0.782	0.794	0.682
talb7-20c	0.859	0.805	0.727	0.893	0.868	0.706	0.614	0.895	0.714	0.667	0.738	0.702	0.671
talb8-20c	0.804	0.780	0.791	0.882	0.814	0.659	0.655	0.825	0.552	0.675	0.687	0.653	0.679
talb9-20c	0.798	0.774	0.696	0.899	0.826	0.619	0.664	0.800	0.574	0.632	0.695	0.661	0.651
waro01-3b	0.804	0.817	0.826	0.941	0.814	0.829	0.836	0.864	0.840	0.795	0.821	0.818	0.804
waro02-3b	0.678	0.791	0.752	0.833	0.823	0.733	0.793	0.761	0.756	0.724	0.786	0.748	0.695
WN112MOR-S16	0.950	0.896	0.880	0.943	0.884	0.835	0.846	0.944	0.806	0.835	0.765	0.865	0.850
WN113MOR-S16	0.943	0.910	0.863	0.967	0.947	0.885	0.912	0.967	0.904	0.840	0.848	0.848	0.886
WN115MOR-S09	0.973	0.886	0.921	0.873	0.899	0.800	0.803	0.969	0.860	0.872	0.811	0.878	0.863
WN116MOR-S09	0.977	0.905	0.889	0.948	0.914	0.808	0.859	1.000	0.840	0.826	0.817	0.854	0.862
WN117MOR-S16	0.948	0.919	0.900	0.881	0.928	0.936	0.920	1.000	0.911	0.878	0.818	0.930	0.896
yarl03-3b	0.677	0.778	0.771	0.831	0.758	0.764	0.846	0.667	0.792	0.755	0.774	0.804	0.742
yarl04-20b	0.759	0.810	0.802	0.837	0.789	0.760	0.830	0.798	0.736	0.735	0.769	0.761	0.759
YULE-3-21c	0.783	0.775	0.768	0.902	0.898	0.688	0.689	0.855	0.657	0.691	0.649	0.743	0.674
yuri03-23c	0.873	0.921	0.878	0.942	0.906	0.833	0.714	0.857	0.739	0.833	0.782	0.841	0.797
Minimum dissimilarity	**0.671**	**0.719**	**0.685**	**0.787**	**0.722**	**0.574**	**0.614**	**0.658**	**0.552**	**0.581**	**0.559**	**0.544**	**0.640**

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Appendix 7 Lot 54 Flora and Vegetation Survey (Plantecology 2025)

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16th June 2025

Kathy Choo
Director
CoTerra Environment
Level 1, 98 Colin St
West Perth, WA 6005

Dear Kathy,

This letter outlines the results of a reconnaissance level flora and vegetation survey of at Lot 54 Victoria Rd, Wattle Grove in the City of Kalamunda undertaken by myself on the 27th May 2025 (the site; Figure 1).

1 Introduction

1.1 Existing Environment

The site is situated within the Swan Coastal Plain, approximately 15 km from the Perth CBD. The original vegetation of the northern part site was the Southern River vegetation complex, which is described as an open woodland of *Corymbia calophylla – Eucalyptus marginata – Banksia* species with fringing woodland of *Eucalyptus rudis – Melaleuca rhaphiophylla* along creek beds (Government of Western Australia 2017). The southern part of the site, including the buildings within the property, originally supported the Guildford vegetation complex, which is described as a mixture open forests of *Corymbia calophylla*, *Eucalyptus marginata* and *Eucalyptus wandoo*, and some occurrences of *Eucalyptus rudis* and *Melaleuca rhaphiophylla* (Government of Western Australia 2017).

One soil unit has been mapped across the site, which is the Pinjarra Gf7 phase of deep rapidly drained brownish, siliceous or bleached sands underlain by mottled yellow clay (DPIRD 2022-).

The site has been almost fully developed and now comprises mostly residences, outbuildings, and access roads with planted exotic trees over grass and gardens. Remnant native trees of *Eucalyptus rudis*, *Melaleuca preissiana* and *Eucalyptus marginata* indicates that the original vegetation was largely woodlands of seasonally damp wetlands.

The Wattle Grove area experiences a dry Mediterranean climate of hot dry summers and cool wet winters. Long-term climatic averages indicate the site is located in an area of moderate to high rainfall, receiving 752 mm on average annually (data for Perth Airport, station number 9021, the nearest currently reporting station located on the Swan Coastal Plain) (Bureau of Meteorology 2025) with the majority of rainfall received between May and August. The area experiences rainfall on an average of 81 days per year. Mean maximum temperatures range from 18.0 °C in July to 32.1 °C in February. Mean minimum temperatures range from 8.1 °C in July to 17.6 °C in February.

1.2 Conservation Flora

Under the Biodiversity Conservation Act 2016 ('BC Act'), the Minister for the Environment produces a gazetted list of Threatened Flora under three categories: Critically Endangered, Endangered and Vulnerable. The Department of Biodiversity, Conservation and Attractions (DBCA) also produces a list of Priority Flora that have not been assigned statutory protection under the BC Act but may be under some degree of threat (DBCA 2023a). The DBCA recognises four Priority Flora levels. The definitions for each category of Threatened and Priority Flora are shown in Appendix C.

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Searches of the State databases undertaken in 2023 for JBS&G (FL84-0923) identified 82 conservation significant taxa with the potential to occur within the site (Table 1). Those records within approximately 10 km of the site are shown in Figure 2. Of the identified taxa, 22 are listed as Threatened under the Biodiversity Conservation Act, of which five are orchids and may be cryptic to observe when not flowering. *Caladenia huegelii* (Grand Spider Orchid) occurs in low-lying grey or brown sands and clayey loams. It flowers between September and October. *Diuris drummondii* (Drummond's Donkey Orchid) occurs in wet habitats and flowers between November and January. *Diuris purdiei* (Purdie's Donkey Orchid) is found in swamps and damp shrublands, flowering between September and October. *Thelymitra magnifica* (Crystal Brook Star Orchid) occurs in dense shrubland on clay soils near granite rocks and flowers between September and October. *Thelymitra stellata* occurs in gravelly loam in low heath of *Eucalyptus marginata* and *Eucalyptus wandoo* woodland. It flowers mainly from October to November.

Most taxa are known to occur in substrates or vegetation types that do not occur within the site, such as granite slopes on the Darling Scarp or in Banksia woodlands. Where the habitat may have been suitable to support occurrences of conservation significant flora, the Completely Degraded condition of the vegetation means that it is highly unlikely that any would occur within the site.

1.3 Conservation Communities

The DBCA defines an ecological community as "a naturally occurring assemblage that occurs in a particular type of habitat" (DBCA 2023b). A Threatened Ecological Community (TEC) is one that has declined in area or was originally limited in distribution. Uncommon ecological communities that do not strictly meet TEC defined criteria, or are inadequately defined, are listed by the DBCA as a Priority Ecological Community (PEC). Definitions of the categories of Threatened and Priority Ecological Communities are given in Appendix C.

Eleven terrestrial Threatened Ecological Communities (TECs) endorsed under State legislation are recorded as occurring within 25 km of the site (Table 2; 54-0923EC). Nine of these communities are also listed as a TEC pursuant to the Commonwealth EPBC Act. Five terrestrial Priority Ecological Communities (PECs) are also listed as occurring within 25 km of the site, four of which are also listed as TECs pursuant to the EPBC Act (Table 2).

An assessment of the likelihood for conservation significant communities to occur within the site is shown in Table 2 and the communities of conservation concern occurring within the environs of the site are shown in Figure 3. No TEC or PEC is mapped as occurring within the site, but the site is situated borders DBCA's mapping of the generalised location of one occurrence of the 'Banksia-dominated woodlands of the Swan Coastal Plain IBRA Region'. The vegetation of the site has been completely altered and any remnants of this TEC that may have occurred within the site has been removed.

50 New Cross Rd
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ABN 18 849 210 133

Table 1: Threatened and Priority Flora with the potential to occur within the site.

Taxon	Conservation Status	EPBC Rank	Flowering Period	Known Habitat	Habitat within Study area	Likely to Occur	Comments
Acacia anomala	T	VU	Aug-Sep	Lateritic soils	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Acacia aphylla	T	VU	Aug-Oct	Granite outcrops, hills	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Acacia horridula	3		May-Aug	Gravelly soils over granite	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Acacia oncinophylla subsp. *patulifolia*	4		Aug-Dec	Granitic soils	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Allocasuarina grevilleoides	3			Sand over laterite	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Amanita kalamundae	3		-			Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Amanita quenda	1		-			Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.

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ABN 18 849 210 133

Taxon	Conservation Status	EPBC Rank	Flowering Period	Known Habitat	Habitat within Study area	Likely to Occur	Comments
Amanita wadjukiorum	3		-			Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Andersonia gracilis	T	EN	Sep-Nov	Winter-wet areas	Yes	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Anthocercis gracilis	T	VU	Sep-Oct	Granite outcrops	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Aponogeton hexatepalus	4		Aug-Sep	Freshwater	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Asteridea gracilis	3		Sep-Dec	Sand, gravelly soils	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Austrostipa bronweniae	T	EN	Oct-Nov	Seasonally wet; Muchea Limestone	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Babingtonia urbana	3		Jan-Mar	Wetlands	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Banksia mimica	T	EN	Dec-Jan	Sand over laterite	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.

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ABN 18 849 210 133

Taxon	Conservation Status	EPBC Rank	Flowering Period	Known Habitat	Habitat within Study area	Likely to Occur	Comments
Banksia pteridifolia subsp. *vernalis*	3		Sep-Oct	Sand over laterite	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Beaufortia purpurea	3		Sep-Feb	Rocky slopes	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Bolboschoenus fluviatilis	1		-			Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Boronia humifusa	1		Sep			Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Byblis gigantea	3		Sep-Dec	Sandy peat swamps	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Caladenia huegelii	T	EN	Aug-Oct	Grey, brown sand or clay loam	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Calandrinia uncinella	1		Aug-Oct	Seasonally wet	Yes	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Calectasia grandiflora	2		Jun-Nov	Swampy areas, outcrops, flats, slopes	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.

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Taxon	Conservation Status	EPBC Rank	Flowering Period	Known Habitat	Habitat within Study area	Likely to Occur	Comments
Calothamnus accedens	4		-	Sand over laterite	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Calytrix breviseta subsp. *breviseta*	T	EN	Oct-Nov	Sandy clay, swampy flats	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Carex tereticaulis	3		Sep-Oct	Black peaty sand	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Chamaescilla gibsonii	3		Sep	Winter wet flats	Yes	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Comesperma griffinii	2		Oct	Yellow, grey sand	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Comesperma rhadinocarpum	3		Oct-Nov	Sandy soils	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Commersonia sp. Lesmurdie (A.A. Mitchell 11429)	2		-	-		Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.

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Taxon	Conservation Status	EPBC Rank	Flowering Period	Known Habitat	Habitat within Study area	Likely to Occur	Comments
Conospermum undulatum	T	VU	May-Oct	Clayey sand	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Cyanicula ixioides subsp. *ixioides*	4		Aug-Oct	Laterite	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Cyanothamnus tenuis	4		-		No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Darwinia apiculata	T	EN	Oct	Lateritic soils	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Diuris brevis	2		-		Yes	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Diuris drummondii	T	VU	Nov-Dec	Swamps	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Diuris purdiei	T	EN	Sep-Oct	Winter-wet swamps	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.

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Taxon	Conservation Status	EPBC Rank	Flowering Period	Known Habitat	Habitat within Study area	Likely to Occur	Comments
Drosera occidentalis	4		Oct-Dec		No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Eleocharis keigheryi	T	VU	-		No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Eremophila glabra subsp. *chlorella*	T	EN	Jul-Oct	Winter wet depressions	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Eryngium pinnatifidum subsp. Palustre (G.J. Keighery 13459)	3				No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Eryngium sp. Subdecumbens (G.J. Keighery 5390)	3		-		No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Grevillea thelemanniana	T	CR	May-Nov	Winter-wet flats	Yes	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Haemodorum loratum	3		Nov	Grey or yellow sand, gravel	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.

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Taxon	Conservation Status	EPBC Rank	Flowering Period	Known Habitat	Habitat within Study area	Likely to Occur	Comments
Halgania corymbosa	3		Aug-Nov	Gravelly soils, granite	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Hydrocotyle lemnoides	4		Aug-Oct	Swamps, aquatic	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Isopogon autumnalis	3		Feb-May	Sandy soils, banksia woodlands	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Isotropis cuneifolia subsp. glabra	3		Sep	Winter wet flats	Yes	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Jacksonia gracillima	3		Oct-Nov	Sands	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Johnsonia pubescens subsp. *cygnorum*	2		Sep	Seasonally wet	Yes	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Lasiopetalum bracteatum	4		Aug-Nov	Drainage lines, granite outcrops	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.

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Taxon	Conservation Status	EPBC Rank	Flowering Period	Known Habitat	Habitat within Study area	Likely to Occur	Comments
Lasiopetalum glutinosum subsp. *glutinosum*	3		Sep-Dec	Banksia woodland	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Lepidosperma rostratum	T	EN		Peaty sand, clay	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Lepyrodia curvescens	2		Sep-Nov	Seasonally inundated swamps	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Macarthuria keigheryi	T	EN	Sep-Dec, Feb-Mar	White, grey sand	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Meionectes tenuifolia	3		Nov-Dec	-		Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Morelotia australiensis	T	VU	Dec	Winter-wet depressions	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Myriophyllum echinatum	3		Oct-Nov			Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.

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Taxon	Conservation Status	EPBC Rank	Flowering Period	Known Habitat	Habitat within Study area	Likely to Occur	Comments
Ornduffia submersa	4		Sep-Oct	Wetlands	Yes	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Pimelea rara	4		Dec-Jan	Lateritic soils	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Pithocarpa corymbulosa	3		Jan-Apr	Granite outcrops	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Platysace ramosissima	3		Oct-Nov	Sandy soils	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Ptilotus pyramidatus	T	CR	-	-		Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Rytidosperma racemosum var. *racemosum*	2		-	-		Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Schoenus benthamii	3		Oct-Nov	Winter-wet flats, swamps	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.

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Taxon	Conservation Status	EPBC Rank	Flowering Period	Known Habitat	Habitat within Study area	Likely to Occur	Comments
Schoenus capillifolius	3		Sep-Nov	Brown mud	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Schoenus loliaceus	2		Oct-Nov			Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Schoenus natans	4		Aug-Nov			Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Schoenus pennisetis	3		Aug-Sep	Peaty sand. Winter-wet	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Schoenus sp. Beaufort (G.J. Keighery 6291)	1			Winter wet clay pans	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Schoenus sp. Waroona (G.J. Keighery 12235)	3		Oct-Nov	Winter wet flats	Yes	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Senecio leucoglossus	4		Aug-Dec	Granite outcrops and slopes	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.

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Taxon	Conservation Status	EPBC Rank	Flowering Period	Known Habitat	Habitat within Study area	Likely to Occur	Comments
Stylidium aceratum	3		Oct-Nov	Sandy soils, swamp	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Stylidium longitubum	4		Nov	Sandy clay. Wetlands	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Stylidium striatum	4		Oct-Nov	Clay loam over laterite	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Styphelia filifolia	3		Mar-May	Sandy soils. Banksia woodland	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	T	CR	Oct	Winter wet flats	Yes	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Thelymitra magnifica	T	-	Sep-Oct	Surrounding granite outcrops	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Thelymitra stellata	T	EN	Oct-Nov	Lateritic soil in woodlands	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.

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Taxon	Conservation Status	EPBC Rank	Flowering Period	Known Habitat	Habitat within Study area	Likely to Occur	Comments
Thysanotus anceps	3		Oct-Dec	Lateritic gravel	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Thysanotus cymosus	3		Sep-Oct	Granitic or lateritic sand	Yes	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.
Verticordia lindleyi subsp. *lindleyi*	4		Nov-jan	Sandy clay. Winter-wet	No	Unlikely	The Completely Degraded vegetation condition precludes the likelihood of occurrence within the site.

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Table 2: Priority and Threatened Ecological Communities with the potential to occur within the site.

Community Name	WA Conservation Category	EPBC Act Conservation Category	Known Habitat and characteristics	Habitat within Study area	Pre-European Occurrence	Likely to Occur	Comments
Banksia Woodlands of the Swan Coastal Plain ecological community	Priority 3	Endangered	Well-drained, low nutrient soils on sandplains; canopy dominated by *Banksia attenuata, Banksia menziesii, Banksia prionotes or Banksia ilicifolia.* Vegetation condition rating is Good or higher.	No	No	No	The Completely Degraded vegetation condition has removed most native taxa.
Corymbia calophylla - Kingia australis woodlands on heavy soils of the SCP (SCP3a)	Critically Endangered	Endangered	Heavy soils of the eastern side of the Swan Coastal Plain. Similar to 3c but with groundwater closer to the surface and therefore likely to be wetter than the former.	No	No	No	The Completely Degraded vegetation condition has removed most native taxa.
Corymbia calophylla – Eucalyptus marginata woodlands on sandy clay soils of the southern SCP (SCP 3b)	Endangered		Heavy soils of the eastern side of the Swan Coastal Plain, often with an impervious clay layer. Typical species may include *Corymbia calophylla, Eucalyptus wandoo, Xanthorrhoea preissii, Acacia pulchella* and *Hypocalymma angustifolium.*	No	No	No	The Completely Degraded vegetation condition has removed most native taxa.

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ABN 18 849 210 133

Community Name	WA Conservation Category	EPBC Act Conservation Category	Known Habitat and characteristics	Habitat within Study area	Pre-European Occurrence	Likely to Occur	Comments
Corymbia calophylla — Xanthorrhoea preissii woodlands and shrublands, Swan Coastal Plain (SCP 3c)	Endangered	Endangered	Heavy soils of the eastern side of the Swan Coastal Plain. Extends farther north than either SCP 3a or SCP 3b.	No	No	No	The Completely Degraded vegetation condition of the site has removed most native taxa
Low lying *Banksia attenuata* woodlands or shrublands (SCP 21c)	Priority 3	Endangered	Associated with the Bassendean Dune System on lower lying wetter sites.	No	No	No	The Completely Degraded vegetation condition of the site has removed most native taxa
Banksia attenuata woodlands over species rich dense shrublands (SCP 20a)	Critically Endangered	Endangered	Sands associated with the Karrakatta unit, and with the Southern River unit at the base of the Darling Scarp.	No	No	No	The Completely Degraded vegetation condition of the site has removed most native taxa

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ABN 18 849 210 133

Community Name	WA Conservation Category	EPBC Act Conservation Category	Known Habitat and characteristics	Habitat within Study area	Pre-European Occurrence	Likely to Occur	Comments
Banksia attenuata – Eucalyptus marginata woodlands of the eastern side of the Swan Coastal Plain (SCP 20b)	Critically Endangered	Endangered	Sands associated with the Guildford and Forrestfield units at the base of the Darling Scarp.	No	No	No	The Completely Degraded vegetation condition of the site has removed most native taxa.
Shrublands and woodlands of the eastern side of the Swan Coastal Plain (SCP 20c)	Critically Endangered	Endangered	Sands of the Forrestfield or Guildford units. Contains taxa more typical of the Darling Scarp.	No	No	No	The Completely Degraded vegetation condition of the site has removed most native taxa.
Shrublands on dry clay flats (SCP 10a)	Endangered	Critically Endangered	Shallow microtopography or skeletal soils of the eastern side of the Swan Coastal Plain that rapidly dry out.	No	No	No	The Completely Degraded vegetation condition of the site has removed most native taxa.

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Community Name	WA Conservation Category	EPBC Act Conservation Category	Known Habitat and characteristics	Habitat within Study area	Pre-European Occurrence	Likely to Occur	Comments
Herb rich shrublands in clay pans (SCP 08)	Endangered	Critically Endangered	Dominated by *Melaleuca viminea, Viminaria juncea, Melaleuca lateritia* or *Melaleuca osullivanii* on heavy clay soils of the eastern side of the Swan Coastal Plain.	No	No	No	The Completely Degraded vegetation condition of the site has removed most native taxa.
Herb rich saline shrublands (SCP 07)	Endangered	Critically Endangered	Heavy clay soils often inundated into mid-summer. Dominated by *Melaleuca viminea, Melaleuca cuticularis, Melaleuca lateritia* or *Melaleuca osullivanii.*	No	No	No	The Completely Degraded vegetation condition of the site has removed most native taxa.
Southern wet shrublands, Swan Coastal Plain (SCP 02)	Critically Endangered		Seasonally inundated sandy clay soils. Shrub rich, often with *Calothamni=us lateralis, Eutaxia virgata* and *Kingia australis.*	No	No	No	The Completely Degraded vegetation condition of the site has removed most native taxa.

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Community Name	WA Conservation Category	EPBC Act Conservation Category	Known Habitat and characteristics	Habitat within Study area	Pre-European Occurrence	Likely to Occur	Comments
Shrublands and woodlands on Muchea Limestone of the Swan Coastal Plain	Endangered	Endangered	Substrate with a limestone influence. May be wetlands or well-drained habitats on the eastern side of the Swan Coastal Plain.	No	No	No	The Completely Degraded vegetation condition of the site has removed most native taxa.
Subtropical and Temperate Coastal Saltmarsh	Priority 3	Vulnerable	Saltmarshes in coastal regions, along estuaries.	No	No	No	Associated with the Swan River estuary.
Claypans with mid dense shrublands of *Melaleuca lateritia* over herbs	Priority 1	Critically Endangered	Claypans of basins usually *Melaleuca lateritia*. Characterized by aquatic and amphibious taxa.	No	No	No	The Completely Degraded vegetation condition of the site has removed most native taxa.

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Community Name	WA Conservation Category	EPBC Act Conservation Category	Known Habitat and characteristics	Habitat within Study area	Pre-European Occurrence	Likely to Occur	Comments
Central Northern Darling Scarp Granite Shrubland Community	Priority 4		Deeper loams and red earths on fragmented granite of the Northern Darling Scarp.	No	No	No	Does not occur on the Swan Coastal Plain.

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1.4 Geomorphic Wetlands of the Swan Coastal Plain

Hill et al. (1996) has mapped all wetlands of the Swan Coastal Plain using the classification system of Semeniuk (1987). This classification system is based on the geomorphic setting and hydrological processes associated with a wetland. The classification allocates individual wetlands with shared characteristics to wetland suites. According to the geomorphic classification system of Semeniuk (1987), the wetlands within the site are classified as sumplands, which are ephemeral or seasonally inundated basins. Table 3 below indicates the wetland types and their geomorphic setting.

Table 3: Geomorphic Wetland Classification, adapted from Semeniuk (1987)

	Basin	Flat	Channel	Slope
Permanently inundated	Lake	River		
Seasonally inundated	Sumpland	Floodplain	Creek	
Seasonally waterlogged	Dampland	Palusplain		Paluslope

The Hill et al. (1996) wetland mapping was digitised by the Department of Biodiversity, Conservation and Attractions (DBCA) to create the Geomorphic Wetland Swan Coastal Plain dataset (the dataset), which is managed and maintained by the DBCA. Each classified wetland listed in the dataset has a Unique Feature Identifier (UFI), however in the case of many large wetlands that have sustained a degree of disturbance, a separate management category may be assigned to parts of the wetland in order to reflect the current values. The description and management objectives of each management category are listed in Table 4. The wetland management category is important as it categorises wetlands on their significance, based on hydrological, biological and human use features. This dynamic dataset is continually updated with site-specific wetland surveys providing new and relevant information.

Table 4: Wetland Management Categories and Objectives (Western Australian Planning Commission 2005)

Management Category	Description of Wetland	Management Objectives
Conservation Category Wetland (CCW)	Wetlands that support high levels of attributes and functions.	To preserve wetland attributes and functions through reservation in national parks, crown reserves, state owned land and protection under environmental protection policies.
Resource Enhancement Wetland (REW)	Wetlands that have been partly modified but still support substantial functions and attributes.	To restore wetlands through maintenance and enhancement of wetland functions and attributes by protection in crown reserves, state or local government owned land and by environmental protection policies, or in private property by sustainable management.
Multiple Use Wetland (MUW)	Wetlands with few attributes, which still provide important wetland functions.	Use, development and management should be considered in the context of water, town and environmental planning through landcare.

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The Geomorphic Wetlands of the Swan Coastal Plain (GWSCP) dataset indicates that no wetlands are mapped within the site (Figure 4).

1.5 Ecological Linkages

The Local Government Biodiversity Planning Guidelines for the Perth Metropolitan Region (Del Marco et al. 2004) identified regional and local ecological linkages, which are non-contiguous natural areas that maintain ecological functioning of a landscape by connecting larger natural areas. Although ecological linkages are mapped to the north and south of the site that connect the Darling Scarp vegetation with the Kenwick Wetlands, none intersect the site (Figure 5).

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2 Methods

2.1 Field Survey

The site was traversed on foot by an experienced botanist on the 27th May 2025 and observations made on the current vegetation condition at two EPA-defined relevés. At each point, photographs of the vegetation were taken, a list of the common plant taxa recorded and an assessment of the vegetation condition made using the criteria defined in Table 5, taking into account the integrity of the vertical structure, the presence and density of weeds, signs of disturbance and the ability of the vegetation to maintain, or regenerate to, a natural state. The identity of mature remnant trees within the site was also noted.

Table 5: Vegetation Condition Scale (Keighery 1994)

Vegetation Condition Rank	Definition
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	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 very 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.

2.2 Survey Limitations

Various factors can limit the effectiveness of a vegetation survey. Pursuant to EPA Technical Guidance: Flora and Vegetation Survey for Environmental Impact Assessment (EPA 2016), these factors have been identified and their potential impact on the effectiveness of the survey has been assessed (Table 6).

The survey was undertaken in late May 2025 and was planned to intercept the flowering period of the Threatened species *Conospermum undulatum* and the Priority 3 taxon *Isopogon autumnalis,* both of which have been recorded in the Wattle Grove area. The survey would likely not have intercepted the flowering period of most other taxa of conservation concern with the potential to occur within the site, in particular the Threatened annual and geophytic taxa. The temperatures within the preceding three months were above average for the region, while rainfall for both April and May were well below

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average. These factors would not have affected the results of the survey as the purpose of a reconnaissance level survey does not include a comprehensive species inventory.

Table 6: Potential limitations affecting the vegetation survey.

Potential limitations	Constraint	Comment
Availability of contextual information	No	Sufficient regional and local information was available to place the survey site in its environmental context.
Competency and experience of the botanists	No	The survey was undertaken by botanists with a comprehensive knowledge of South West vegetation, with at least 20 years experience in vegetation surveys in Western Australia.
Seasonality	Major	The rainfall in the preceding 3 months was well below average, and minimum and maximum temperatures were higher than their means. As the purpose of a reconnaissance level survey is not a comprehensive species inventory, these factors have not affected the results of the study.
Adequate coverage and intensity of survey	No	The survey area was traversed on foot. It is considered the sampling points provided adequate coverage of the site.
Proportion of Flora identified	No	It is estimated that the majority of perennial native taxa present would have been observable at the time of the survey.
Disturbance	Yes	The vegetation was highly disturbed and the majority of species were exotics.
Resources	No	Adequate resources were available to conduct the survey.
Access restrictions	No	All areas of the site were fully accessible.

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ABN 18 849 210 133

3 Results

No native vegetation types can be mapped for the site as it has been completely modified for residential and rural purposes. Trees within the site mainly consist of planted exotic species such as **Eucalyptus major, *Eucalyptus goniocalyx, *Corymbia maculata* and **Angophora costata* (Figure 6). The understorey has been replaced by pasture grasses such as **Ehrharta calycina* and other exotic herbs including **Arctotheca calendula* (Plates 1 and 2). Introduced shrubs recorded within the site include **Leptospermum laevigatum, *Gomphocarpus fruticosus* and **Melaleuca viminalis.*

Some remnant native trees of *Melaleuca preissiana* (Plate 4), *Eucalyptus marginata, Eucalyptus camaldulensis* (Plate 5) and *Eucalyptus rudis* are still present within the site.

The condition of the vegetation is rated as 'Completely Degraded' for the entire site as it has been cleared for urban and rural development (Figure 7). The original vegetation structure has been lost and shows signs of chronic high disturbance with weeds such as **Cynodon dactylon. *Gomphocarpus fruticosus*. Only seven native taxa were identified within the site, with most (eleven) being weeds and planted non-native species. No taxa of conservation concern were recorded during the survey.

No Weeds of National Significance were recorded. **Gomphocarpus fruticosus* is a Declared Pest under the Biosecurity and Agriculture Management Act 2007.

4 Discussion

The site at Lot 54 Victoria Rd, Wattle Grove is situated in a fragmented landscape, which contains many ecological values including a range of taxa and vegetation types of conservation concern. Many of these values are associated with Kenwick Wetlands about 1 km to the west. The immediate environs of the site have been converted to semi-rural purposes and retains few ecological values.

The site itself is highly degraded and has been modified for residential and grazing purposes. Remnant native trees of *Melaleuca preissiana* and *Eucalyptus rudis* indicate that much of the site originally supported wetland vegetation.

Most of the ecological values have now been lost within the site from the land clearing and a conversion to a semi-rural land use. No Threatened or Priority Flora were recorded within the site and are not likely to be present. Also, no communities of conservation concern are inferred to be present nor is the site part of an ecological linkage.

No weeds of National Significance were recorded within the site. **Gomphocarpus fruticosus* is a Declared Pest under the Biosecurity and Agriculture Management Act 2007, and has been assigned a 'C3 Management' control category. Plants under this control category require some form of management to reduce the numbers or distribution of the organism and prevent further spread.

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5 Summary

The site at Lot 54 Victoria Rd, Wattle Grove has been completely modified for semi-rural development and retains limited ecological values. No taxa nor communities of conservation concern were recorded within the site and are not likely to be present.

Should you require any further information or have any other queries, please feel free to contact me.

Sincerely yours,



Dr. Shane Chalwell

Plantecology Consulting

6 References

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Plates

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Plate 1: Remnant *Melaleuca preissiana* over pasture grasses in 'Completely Degraded' condition, looking north-west (Plot 1).



Plate 2: Grassed area in 'Completely Degraded' condition, looking south-east (Plot 2).

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Figures

Figure 1: Locality Plan Lot 54 Victoria Rd, Wattle Grove Flora and Vegetation Survey

Figure 2: Conservation Significant Flora from the Local Region

Figure 3: Conservation Significant Communities with Potential to Occur within the Site

Figure 4: Geomorphic Wetlands

Figure 5: Ecological Linkages

Figure 6: Tree Locations

Figure 7: Vegetation Condition



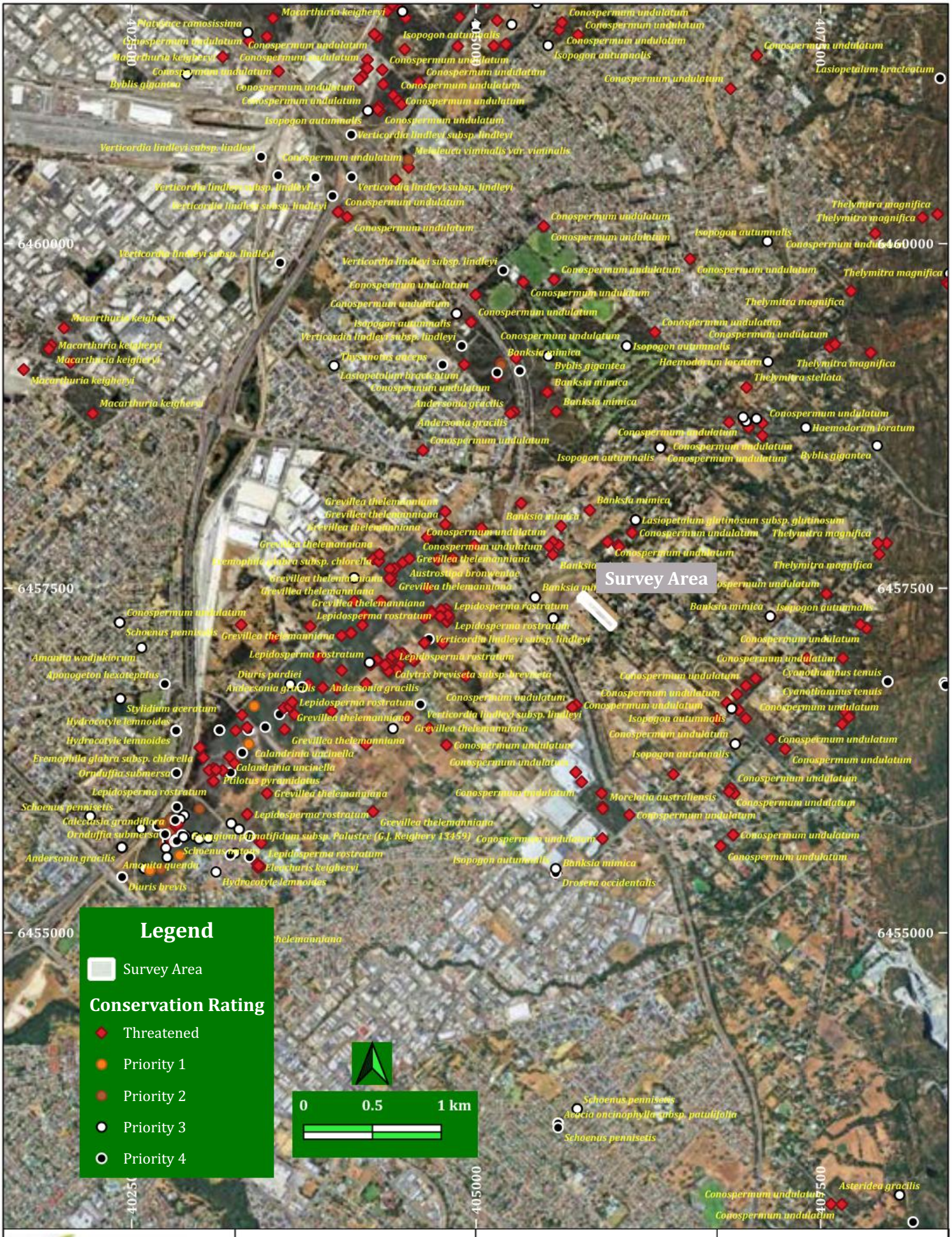
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Scale: 1:6 000
Basemap Source: Google Satellite Hybrid
Datum: GDA2020
Projection: EPSG7850

Client: CoTerra Environment
Project: Wattle Grove Flora Survey
Location: Lot 54 Victoria Rd, Wattle Grove
Author: S.T.S. Chalwell
Drawn: S.T.S. Chalwell

Figure 1: Locality Plan



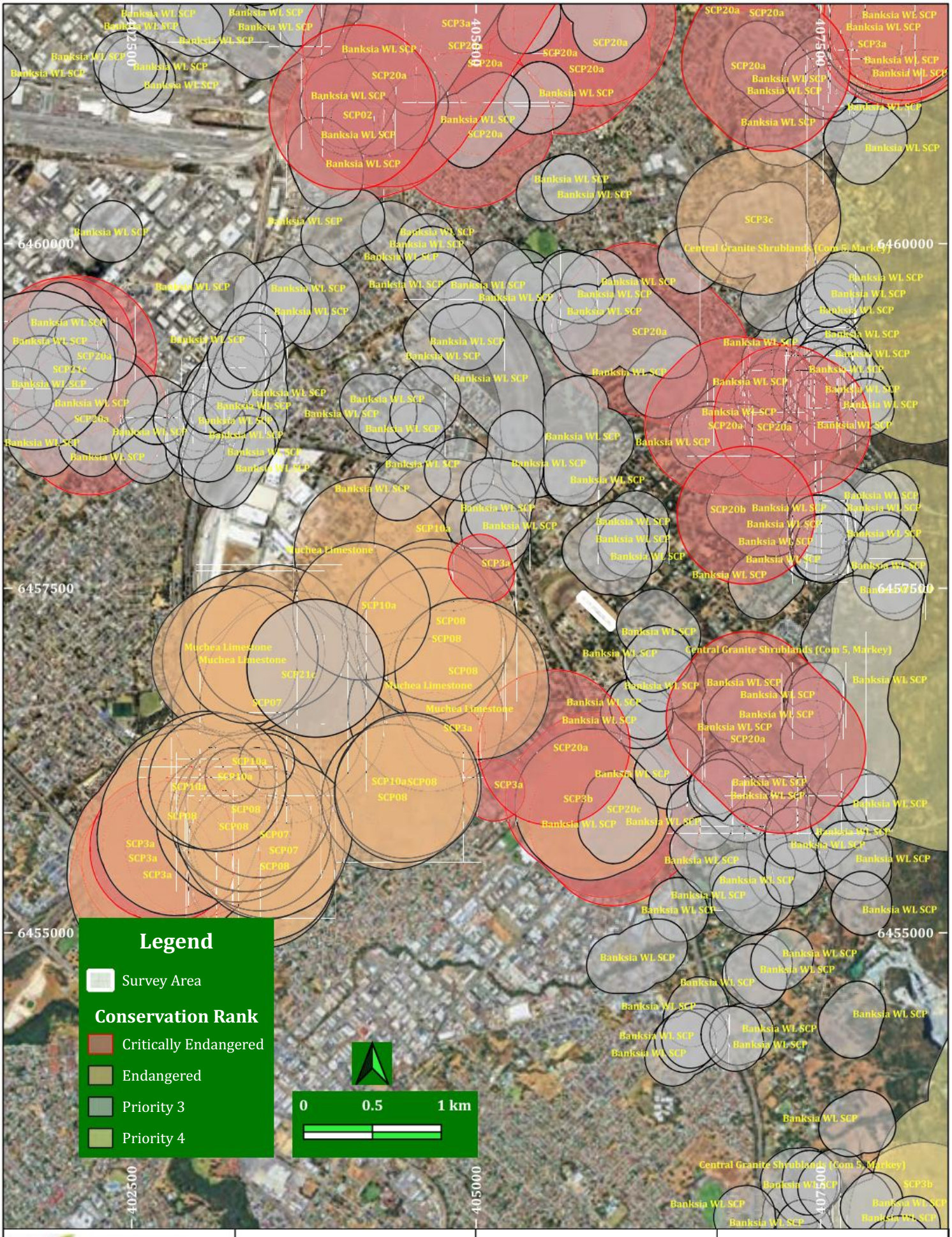
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Datum: GDA2020
Projection: EPSG7850

Client: CoTerra Environment
Project: Wattle Grove Flora Survey
Location: Lot 54 Victoria Rd, Wattle Grove
Author: S.T.S. Chalwell
Drawn: S.T.S. Chalwell

Figure 2: Conservation Flora



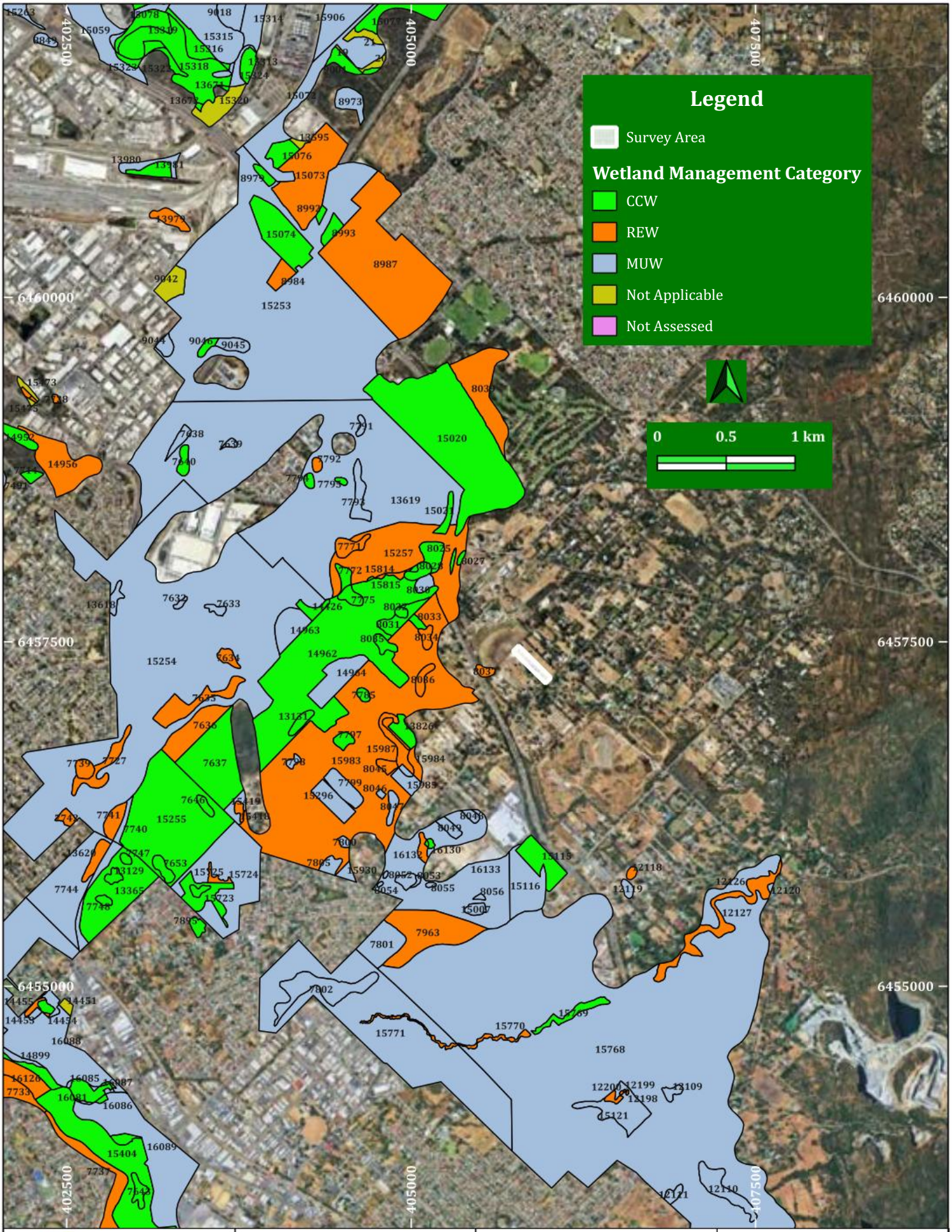
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Figure 3: Conservation Communities



Plantecology CONSULTING 50 New Cross Rd Kingsley WA 6026	Scale: 1:35 000 Basemap Source: Google Satellite Datum: GDA2020 Projection: EPSG7850	Client: CoTerra Environment Project: Wattle Grove Flora Survey Location: Lot 54 Victoria Rd, Wattle Grove Author: S.T.S. Chalwell Drawn: S.T.S. Chalwell	**Figure 4: Geomorphic Wetlands**



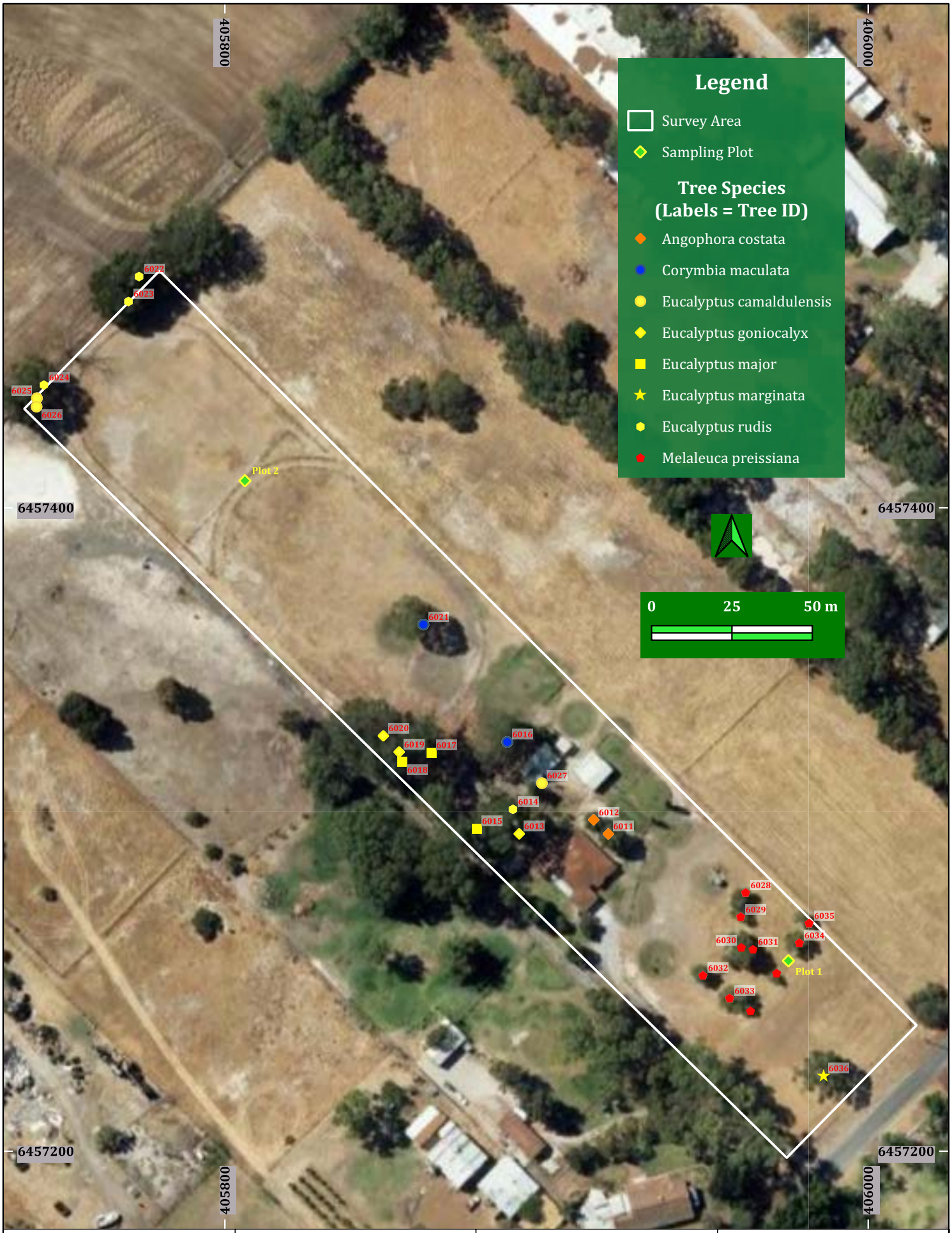
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Datum: GDA2020
Projection: EPSG7850

Client: CoTerra Environment
Project: Wattle Grove Flora Survey
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Figure 5: Ecological Linkages



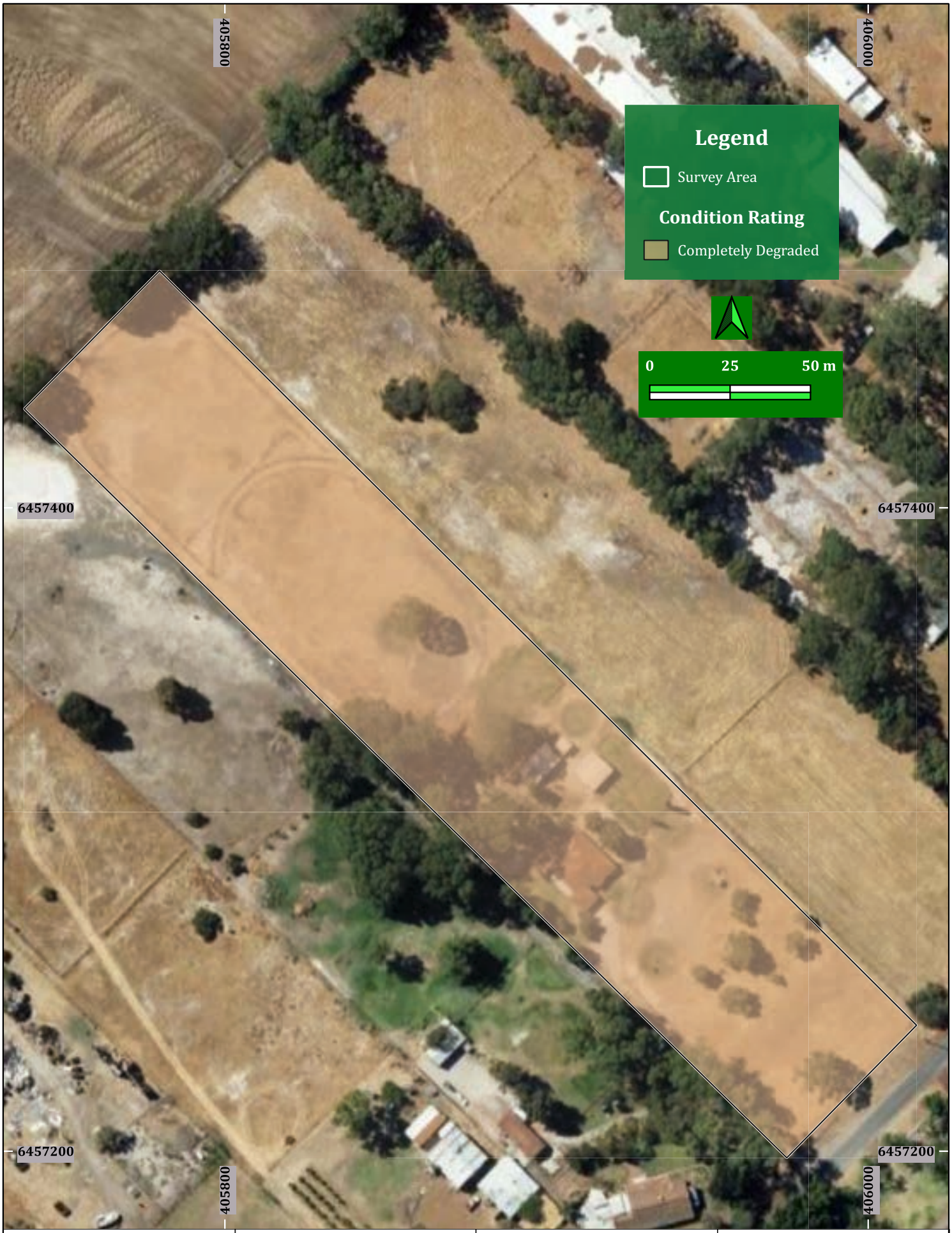
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Scale: 1:1 500
Basemap Source: Google Satellite
Datum: GDA2020
Projection: EPSG7850

Client: CoTerra Environment
Project: Wattle Grove Flora Survey
Location: Lot 54 Victoria Rd, Wattle Grove
Author: S.T.S. Chalwell
Drawn: S.T.S. Chalwell

Figure 6: Tree Locations



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Scale: 1:1 500
Basemap Source: Google Satellite
Datum: GDA2020
Projection: EPSG7850

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Project: Wattle Grove Flora Survey
Location: Lot 54 Victoria Rd, Wattle Grove
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Figure 7: Vegetation Condition

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Appendix A

Taxa recorded within the site (including opportunistic observations).

* Introduced taxon

Family	Taxon
Cupressaceae	* *Cupressus glauca*
Juncaceae	*Juncus pallidus*
	Cyperus vaginatus
Poaceae	* *Cynodon dactylon*
	* *Ehrharta calycina*
Myrtaceae	*Eucalyptus marginata*
	Eucalyptus rudis
	* *Eucalyptus goniocalyx*
	Eucalyptus camaldulensis
	* *Eucalyptus major*
	Melaleuca preissiana
	* *Leptospermum laevigatum*
	* *Melaleuca viminalis*
	Eucalyptus camaldulensis
Apocynaceae	* *Gomphocarpus fruticosus*
Asteraceae	* *Arctotheca calendula*
	* *Hypochaeris glabra*

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Appendix B

EPBC Protected Matters Search Results

Australian Government

Department of Climate Change, Energy, the Environment and Water

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 14-Jun-2025

Summary

Details

- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat

Acknowledgements

Summary

Matters of National Environment Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	7
Listed Threatened Species:	71
Listed Migratory Species:	26

Other Matters Protected by the EPBC Act

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

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

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

Commonwealth Lands:	284
Commonwealth Heritage Places:	None
Listed Marine Species:	30
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

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

State and Territory Reserves:	18
Regional Forest Agreements:	1
Nationally Important Wetlands:	4
EPBC Act Referrals:	52
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar Wetlands) [Resource Information]

Ramsar Site Name	Proximity	Buffer Status
Forrestdale and thomsons lakes	Within 10km of Ramsar site	In buffer area only

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text	Buffer Status
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Community likely to occur within area	In feature area
Clay Pans of the Swan Coastal Plain	Critically Endangered	Community likely to occur within area	In feature area
Corymbia calophylla - Kingia australis woodlands on heavy soils of the Swan Coastal Plain	Endangered	Community known to occur within area	In buffer area only
Empodisma peatlands of southwestern Australia	Endangered	Community may occur within area	In buffer area only
Shrublands and Woodlands of the eastern Swan Coastal Plain	Endangered	Community known to occur within area	In buffer area only
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area	In buffer area only
Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain ecological community	Critically Endangered	Community likely to occur within area	In feature area

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Botaurus poiciloptilus			
Australasian Bittern [1001]	Endangered	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat known to occur within area	In feature area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat may occur within area	In buffer area only
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Species or species habitat may occur within area	In buffer area only
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In buffer area only
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Phaethon rubricauda westralis Red-tailed Tropicbird (Indian Ocean), Indian Ocean Red-tailed Tropicbird [91824]	Endangered	Species or species habitat may occur within area	In buffer area only
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area	In feature area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Thalassarche cauta Shy Albatross [89224]	Endangered	Species or species habitat may occur within area	In buffer area only
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat likely to occur within area	In feature area
Zanda baudinii listed as Calyptorhynchus baudinii Baudin's Cockatoo, Baudin's Black-Cockatoo, Long-billed Black-cockatoo [87736]	Endangered	Roosting known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Zanda latirostris listed as Calyptorhynchus latirostris			
Carnaby's Black Cockatoo, Short-billed Black-cockatoo [87737]	Endangered	Breeding known to occur within area	In feature area
INSECT			
Leioproctus douglasiellus			
a short-tongued bee [66756]	Critically Endangered	Species or species habitat known to occur within area	In feature area
MAMMAL			
Bettongia penicillata ogilbyi			
Woylie [66844]	Endangered	Species or species habitat known to occur within area	In buffer area only
Dasyurus geoffroii			
Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat known to occur within area	In feature area
Myrmecobius fasciatus			
Numbat [294]	Endangered	Species or species habitat may occur within area	In buffer area only
Pseudocheirus occidentalis			
Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Critically Endangered	Species or species habitat may occur within area	In feature area
Setonix brachyurus			
Quokka [229]	Vulnerable	Species or species habitat known to occur within area	In feature area
OTHER			
Westralunio carteri			
Carter's Freshwater Mussel, Freshwater Mussel [86266]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
PLANT			
Acacia anomala			
Grass Wattle, Chittering Grass Wattle [8153]	Vulnerable	Species or species habitat known to occur within area	In feature area
Acacia aphylla			
Leafless Rock Wattle [13553]	Vulnerable	Species or species habitat known to occur within area	In feature area
Andersonia gracilis			
Slender Andersonia [14470]	Endangered	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Anigozanthos viridis subsp. terraspectans Dwarf Green Kangaroo Paw [3435]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Anthocercis gracilis Slender Tailflower [11103]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Austrostipa bronweniae listed as Austrostipa bronwenae [92773]	Endangered	Species or species habitat known to occur within area	In feature area
Austrostipa jacobsiana [87809]	Critically Endangered	Species or species habitat likely to occur within area	In buffer area only
Banksia mimica Summer Honeypot [82765]	Endangered	Species or species habitat known to occur within area	In feature area
Caladenia huegelii King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat known to occur within area	In buffer area only
Calytrix breviseta subsp. breviseta Swamp Starflower [23879]	Endangered	Species or species habitat known to occur within area	In feature area
Chamelaucium lullfitzii listed as Chamelaucium sp. Gingin (N.G.Marchant 6) Gingin Wax [92777]	Endangered (listed as Chamelaucium sp. Gingin	Species or species habitat may occur within area	In feature area
Conospermum undulatum Wavy-leaved Smokebush [24435]	Vulnerable	Species or species habitat known to occur within area	In feature area
Darwinia apiculata Scarp Darwinia [8763]	Endangered	Species or species habitat known to occur within area	In buffer area only
Diplolaena andrewsii [6601]	Endangered	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Diuris drummondii Tall Donkey Orchid [4365]	Vulnerable	Species or species habitat known to occur within area	In feature area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Diuris purdiei Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat known to occur within area	In feature area
Drakaea elastica Glossy-leafed Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid [16753]	Endangered	Species or species habitat known to occur within area	In feature area
Drakaea micrantha Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Eleocharis keigheryi Keighery's Eleocharis [64893]	Vulnerable	Species or species habitat known to occur within area	In feature area
Eremophila glabra subsp. chlorella [84927]	Endangered	Species or species habitat known to occur within area	In feature area
Eucalyptus x balanites Cadda Road Mallee, Cadda Mallee [87816]	Endangered	Species or species habitat may occur within area	In feature area
Goodenia arthrotricha [12448]	Endangered	Species or species habitat known to occur within area	In buffer area only
Grevillea curviloba subsp. incurva Narrow curved-leaf Grevillea [64909]	Endangered	Species or species habitat likely to occur within area	In feature area
Grevillea flexuosa Zig Zag Grevillea [2957]	Vulnerable	Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Grevillea thelemanniana Spider Net Grevillea [32835]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Lepidosperma rostratum Beaked Lepidosperma [14152]	Endangered	Species or species habitat known to occur within area	In feature area
Macarthuria keigheryi Keighery's Macarthuria [64930]	Endangered	Species or species habitat known to occur within area	In feature area
Morelotia australiensis listed as Tetraria australiensis Southern Tetraria [92784]	Vulnerable	Species or species habitat known to occur within area	In feature area
Ptilotus pyramidatus Pyramid Mulla-mulla [18216]	Critically Endangered	Species or species habitat known to occur within area	In buffer area only
Synaphea sp. Fairbridge Farm (D.Papenfus 696) Selena's Synaphea [82881]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Synaphea sp. Pinjarra Plain (A.S.George 17182) [86878]	Endangered	Species or species habitat may occur within area	In feature area
Synaphea sp. Serpentine (G.R.Brand 103) [86879]	Critically Endangered	Species or species habitat may occur within area	In buffer area only
Thelymitra dedmaniarum Cinnamon Sun Orchid [65105]	Endangered	Species or species habitat may occur within area	In buffer area only
Thelymitra stellata Star Sun-orchid [7060]	Endangered	Species or species habitat known to occur within area	In feature area
REPTILE			
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Chelonia mydas](#) Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
[Dermochelys coriacea](#) Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area	In buffer area only
[Natator depressus](#) Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
SHARK			
[Sphyrna lewini](#) Scalloped Hammerhead [85267]	Conservation Dependent	Species or species habitat likely to occur within area	In buffer area only

Listed Migratory Species			[Resource Information]
Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
[Apus pacificus](#) Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
[Diomedea amsterdamensis](#) Amsterdam Albatross [64405]	Endangered	Species or species habitat may occur within area	In buffer area only
[Diomedea epomophora](#) Southern Royal Albatross [89221]	Vulnerable	Species or species habitat may occur within area	In buffer area only
[Diomedea exulans](#) Wandering Albatross [89223]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
[Diomedea sanfordi](#) Northern Royal Albatross [64456]	Endangered	Species or species habitat may occur within area	In buffer area only
[Macronectes giganteus](#) Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Thalassarche cauta Shy Albatross [89224]	Endangered	Species or species habitat may occur within area	In buffer area only
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Migratory Marine Species			
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area	In buffer area only
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area	In buffer area only
Mobula alfredi as Manta alfredi Reef Manta Ray, Coastal Manta Ray [90033]		Species or species habitat may occur within area	In buffer area only
Mobula birostris as Manta birostris Giant Manta Ray [90034]		Species or species habitat may occur within area	In buffer area only
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Terrestrial Species			
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area	In feature area
Migratory Wetlands Species			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat likely to occur within area	In feature area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area
Pandion haliaetus Osprey [952]		Breeding known to occur within area	In buffer area only
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat likely to occur within area	In feature area

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Commonwealth Land Name	State	Buffer Status
Defence		

Commonwealth Land Name	State	Buffer Status
Defence - AIRTC CANNINGTON [50232]	WA	In buffer area only
Defence - AIRTC CANNINGTON [50231]	WA	In buffer area only
Defence - AIRTC CANNINGTON [50229]	WA	In buffer area only
Defence - AIRTC CANNINGTON [50233]	WA	In buffer area only
Defence - AIRTC CANNINGTON [50230]	WA	In buffer area only
Defence - BUSHMEAD RIFLE RANGE [50143]	WA	In buffer area only
Defence - BUSHMEAD TRAINING AREA [50260]	WA	In buffer area only
Defence - BUSHMEAD TRAINING AREA [50259]	WA	In buffer area only
Defence - BUSHMEAD TRAINING AREA [50258]	WA	In buffer area only
Defence - PALMER BARRACKS - SOUTH GUILDFORD [50180]	WA	In buffer area only
Defence - PALMER BARRACKS - SOUTH GUILDFORD [50179]	WA	In buffer area only
Defence - PALMER BARRACKS - SOUTH GUILDFORD [50178]	WA	In buffer area only
Defence - PALMER BARRACKS - SOUTH GUILDFORD [50177]	WA	In buffer area only
Defence - PALMER BARRACKS - SOUTH GUILDFORD [50176]	WA	In buffer area only
Unknown		
Commonwealth Land - [51355]	WA	In buffer area only
Commonwealth Land - [51324]	WA	In buffer area only
Commonwealth Land - [51250]	WA	In buffer area only
Commonwealth Land - [51922]	WA	In buffer area only
Commonwealth Land - [51190]	WA	In buffer area only
Commonwealth Land - [51252]	WA	In buffer area only
Commonwealth Land - [51251]	WA	In buffer area only
Commonwealth Land - [51518]	WA	In buffer area only
Commonwealth Land - [51359]	WA	In buffer area only
Commonwealth Land - [51294]	WA	In buffer area only
Commonwealth Land - [51358]	WA	In buffer area only
Commonwealth Land - [51295]	WA	In buffer area only

Commonwealth Land Name	State	Buffer Status
Commonwealth Land - [51290]	WA	In buffer area only
Commonwealth Land - [51297]	WA	In buffer area only
Commonwealth Land - [51357]	WA	In buffer area only
Commonwealth Land - [51305]	WA	In buffer area only
Commonwealth Land - [51185]	WA	In buffer area only
Commonwealth Land - [51184]	WA	In buffer area only
Commonwealth Land - [51189]	WA	In buffer area only
Commonwealth Land - [51180]	WA	In buffer area only
Commonwealth Land - [51187]	WA	In buffer area only
Commonwealth Land - [50950]	WA	In buffer area only
Commonwealth Land - [51365]	WA	In buffer area only
Commonwealth Land - [51927]	WA	In buffer area only
Commonwealth Land - [51300]	WA	In buffer area only
Commonwealth Land - [50833]	WA	In buffer area only
Commonwealth Land - [51368]	WA	In buffer area only
Commonwealth Land - [51188]	WA	In buffer area only
Commonwealth Land - [51303]	WA	In buffer area only
Commonwealth Land - [51369]	WA	In buffer area only
Commonwealth Land - [51249]	WA	In buffer area only
Commonwealth Land - [51302]	WA	In buffer area only
Commonwealth Land - [51366]	WA	In buffer area only
Commonwealth Land - [51330]	WA	In buffer area only
Commonwealth Land - [51375]	WA	In buffer area only
Commonwealth Land - [51367]	WA	In buffer area only
Commonwealth Land - [51920]	WA	In buffer area only
Commonwealth Land - [51192]	WA	In buffer area only
Commonwealth Land - [51193]	WA	In buffer area only

Commonwealth Land Name	State	Buffer Status
Commonwealth Land - [51194]	WA	In buffer area only
Commonwealth Land - [51195]	WA	In buffer area only
Commonwealth Land - [51301]	WA	In buffer area only
Commonwealth Land - [51191]	WA	In buffer area only
Commonwealth Land - [51333]	WA	In buffer area only
Commonwealth Land - [51334]	WA	In buffer area only
Commonwealth Land - [51332]	WA	In buffer area only
Commonwealth Land - [51337]	WA	In buffer area only
Commonwealth Land - [51309]	WA	In buffer area only
Commonwealth Land - [51338]	WA	In buffer area only
Commonwealth Land - [51308]	WA	In buffer area only
Commonwealth Land - [51335]	WA	In buffer area only
Commonwealth Land - [51928]	WA	In buffer area only
Commonwealth Land - [51336]	WA	In buffer area only
Commonwealth Land - [51186]	WA	In buffer area only
Commonwealth Land - [51222]	WA	In buffer area only
Commonwealth Land - [51197]	WA	In buffer area only
Commonwealth Land - [50949]	WA	In buffer area only
Commonwealth Land - [51225]	WA	In buffer area only
Commonwealth Land - [50838]	WA	In buffer area only
Commonwealth Land - [51224]	WA	In buffer area only
Commonwealth Land - [51339]	WA	In buffer area only
Commonwealth Land - [50827]	WA	In buffer area only
Commonwealth Land - [51227]	WA	In buffer area only
Commonwealth Land - [51268]	WA	In buffer area only
Commonwealth Land - [50824]	WA	In buffer area only
Commonwealth Land - [50866]	WA	In buffer area only

Commonwealth Land Name	State	Buffer Status
Commonwealth Land - [50828]	WA	In buffer area only
Commonwealth Land - [51364]	WA	In buffer area only
Commonwealth Land - [51363]	WA	In buffer area only
Commonwealth Land - [51360]	WA	In buffer area only
Commonwealth Land - [51226]	WA	In buffer area only
Commonwealth Land - [51362]	WA	In buffer area only
Commonwealth Land - [51361]	WA	In buffer area only
Commonwealth Land - [51427]	WA	In buffer area only
Commonwealth Land - [51271]	WA	In buffer area only
Commonwealth Land - [51198]	WA	In buffer area only
Commonwealth Land - [51907]	WA	In buffer area only
Commonwealth Land - [51255]	WA	In buffer area only
Commonwealth Land - [51906]	WA	In buffer area only
Commonwealth Land - [51254]	WA	In buffer area only
Commonwealth Land - [50850]	WA	In buffer area only
Commonwealth Land - [51253]	WA	In buffer area only
Commonwealth Land - [51199]	WA	In buffer area only
Commonwealth Land - [51912]	WA	In buffer area only
Commonwealth Land - [51909]	WA	In buffer area only
Commonwealth Land - [51259]	WA	In buffer area only
Commonwealth Land - [51911]	WA	In buffer area only
Commonwealth Land - [51908]	WA	In buffer area only
Commonwealth Land - [51258]	WA	In buffer area only
Commonwealth Land - [51257]	WA	In buffer area only
Commonwealth Land - [51913]	WA	In buffer area only
Commonwealth Land - [51256]	WA	In buffer area only
Commonwealth Land - [51260]	WA	In buffer area only

Commonwealth Land Name	State	Buffer Status
Commonwealth Land - [51921]	WA	In buffer area only
Commonwealth Land - [51261]	WA	In buffer area only
Commonwealth Land - [51223]	WA	In buffer area only
Commonwealth Land - [51220]	WA	In buffer area only
Commonwealth Land - [51221]	WA	In buffer area only
Commonwealth Land - [51196]	WA	In buffer area only
Commonwealth Land - [51228]	WA	In buffer area only
Commonwealth Land - [51229]	WA	In buffer area only
Commonwealth Land - [51910]	WA	In buffer area only
Commonwealth Land - [51169]	WA	In buffer area only
Commonwealth Land - [51168]	WA	In buffer area only
Commonwealth Land - [51277]	WA	In buffer area only
Commonwealth Land - [51351]	WA	In buffer area only
Commonwealth Land - [51275]	WA	In buffer area only
Commonwealth Land - [51274]	WA	In buffer area only
Commonwealth Land - [51350]	WA	In buffer area only
Commonwealth Land - [51296]	WA	In buffer area only
Commonwealth Land - [51273]	WA	In buffer area only
Commonwealth Land - [51272]	WA	In buffer area only
Commonwealth Land - [51371]	WA	In buffer area only
Commonwealth Land - [51163]	WA	In buffer area only
Commonwealth Land - [51162]	WA	In buffer area only
Commonwealth Land - [51298]	WA	In buffer area only
Commonwealth Land - [51213]	WA	In buffer area only
Commonwealth Land - [51356]	WA	In buffer area only
Commonwealth Land - [51248]	WA	In buffer area only
Commonwealth Land - [51167]	WA	In buffer area only

Commonwealth Land Name	State	Buffer Status
Commonwealth Land - [50860]	WA	In buffer area only
Commonwealth Land - [51166]	WA	In buffer area only
Commonwealth Land - [51244]	WA	In buffer area only
Commonwealth Land - [51279]	WA	In buffer area only
Commonwealth Land - [51372]	WA	In buffer area only
Commonwealth Land - [51280]	WA	In buffer area only
Commonwealth Land - [50867]	WA	In buffer area only
Commonwealth Land - [51241]	WA	In buffer area only
Commonwealth Land - [51373]	WA	In buffer area only
Commonwealth Land - [51212]	WA	In buffer area only
Commonwealth Land - [51242]	WA	In buffer area only
Commonwealth Land - [51165]	WA	In buffer area only
Commonwealth Land - [51215]	WA	In buffer area only
Commonwealth Land - [51214]	WA	In buffer area only
Commonwealth Land - [51217]	WA	In buffer area only
Commonwealth Land - [51216]	WA	In buffer area only
Commonwealth Land - [51218]	WA	In buffer area only
Commonwealth Land - [51160]	WA	In buffer area only
Commonwealth Land - [51328]	WA	In buffer area only
Commonwealth Land - [51219]	WA	In buffer area only
Commonwealth Land - [51210]	WA	In buffer area only
Commonwealth Land - [51211]	WA	In buffer area only
Commonwealth Land - [50872]	WA	In buffer area only
Commonwealth Land - [50873]	WA	In buffer area only
Commonwealth Land - [50874]	WA	In buffer area only
Commonwealth Land - [51293]	WA	In buffer area only
Commonwealth Land - [51292]	WA	In buffer area only

Commonwealth Land Name	State	Buffer Status
Commonwealth Land - [51291]	WA	In buffer area only
Commonwealth Land - [51159]	WA	In buffer area only
Commonwealth Land - [50870]	WA	In buffer area only
Commonwealth Land - [51923]	WA	In buffer area only
Commonwealth Land - [51918]	WA	In buffer area only
Commonwealth Land - [51183]	WA	In buffer area only
Commonwealth Land - [51354]	WA	In buffer area only
Commonwealth Land - [51915]	WA	In buffer area only
Commonwealth Land - [51914]	WA	In buffer area only
Commonwealth Land - [51917]	WA	In buffer area only
Commonwealth Land - [51916]	WA	In buffer area only
Commonwealth Land - [51182]	WA	In buffer area only
Commonwealth Land - [51181]	WA	In buffer area only
Commonwealth Land - [51202]	WA	In buffer area only
Commonwealth Land - [51203]	WA	In buffer area only
Commonwealth Land - [51972]	WA	In buffer area only
Commonwealth Land - [51200]	WA	In buffer area only
Commonwealth Land - [51313]	WA	In buffer area only
Commonwealth Land - [51312]	WA	In buffer area only
Commonwealth Land - [50835]	WA	In buffer area only
Commonwealth Land - [50834]	WA	In buffer area only
Commonwealth Land - [51311]	WA	In buffer area only
Commonwealth Land - [51310]	WA	In buffer area only
Commonwealth Land - [51924]	WA	In buffer area only
Commonwealth Land - [51318]	WA	In buffer area only
Commonwealth Land - [50836]	WA	In buffer area only
Commonwealth Land - [50837]	WA	In buffer area only

Commonwealth Land Name	State	Buffer Status
Commonwealth Land - [51233]	WA	In buffer area only
Commonwealth Land - [51235]	WA	In buffer area only
Commonwealth Land - [51232]	WA	In buffer area only
Commonwealth Land - [51237]	WA	In buffer area only
Commonwealth Land - [51234]	WA	In buffer area only
Commonwealth Land - [51236]	WA	In buffer area only
Commonwealth Land - [51316]	WA	In buffer area only
Commonwealth Land - [51317]	WA	In buffer area only
Commonwealth Land - [51314]	WA	In buffer area only
Commonwealth Land - [51315]	WA	In buffer area only
Commonwealth Land - [51207]	WA	In buffer area only
Commonwealth Land - [51329]	WA	In buffer area only
Commonwealth Land - [51353]	WA	In buffer area only
Commonwealth Land - [51352]	WA	In buffer area only
Commonwealth Land - [51287]	WA	In buffer area only
Commonwealth Land - [51286]	WA	In buffer area only
Commonwealth Land - [51285]	WA	In buffer area only
Commonwealth Land - [51284]	WA	In buffer area only
Commonwealth Land - [51281]	WA	In buffer area only
Commonwealth Land - [51283]	WA	In buffer area only
Commonwealth Land - [51282]	WA	In buffer area only
Commonwealth Land - [50885]	WA	In buffer area only
Commonwealth Land - [51971]	WA	In buffer area only
Commonwealth Land - [51289]	WA	In buffer area only
Commonwealth Land - [51288]	WA	In buffer area only
Commonwealth Land - [51269]	WA	In buffer area only
Commonwealth Land - [51209]	WA	In buffer area only

Commonwealth Land Name	State	Buffer Status
Commonwealth Land - [51208]	WA	In buffer area only
Commonwealth Land - [51201]	WA	In buffer area only
Commonwealth Land - [51206]	WA	In buffer area only
Commonwealth Land - [51243]	WA	In buffer area only
Commonwealth Land - [51245]	WA	In buffer area only
Commonwealth Land - [51370]	WA	In buffer area only
Commonwealth Land - [50862]	WA	In buffer area only
Commonwealth Land - [51319]	WA	In buffer area only
Commonwealth Land - [51164]	WA	In buffer area only
Commonwealth Land - [51374]	WA	In buffer area only
Commonwealth Land - [50861]	WA	In buffer area only
Commonwealth Land - [51278]	WA	In buffer area only
Commonwealth Land - [51204]	WA	In buffer area only
Commonwealth Land - [51205]	WA	In buffer area only
Commonwealth Land - [51341]	WA	In buffer area only
Commonwealth Land - [51340]	WA	In buffer area only
Commonwealth Land - [51349]	WA	In buffer area only
Commonwealth Land - [51270]	WA	In buffer area only
Commonwealth Land - [51342]	WA	In buffer area only
Commonwealth Land - [51343]	WA	In buffer area only
Commonwealth Land - [50848]	WA	In buffer area only
Commonwealth Land - [50849]	WA	In buffer area only
Commonwealth Land - [51323]	WA	In buffer area only
Commonwealth Land - [51348]	WA	In buffer area only
Commonwealth Land - [51246]	WA	In buffer area only
Commonwealth Land - [51346]	WA	In buffer area only
Commonwealth Land - [51247]	WA	In buffer area only

Commonwealth Land Name	State	Buffer Status
Commonwealth Land - [50859]	WA	In buffer area only
Commonwealth Land - [51307]	WA	In buffer area only
Commonwealth Land - [51345]	WA	In buffer area only
Commonwealth Land - [51986]	WA	In buffer area only
Commonwealth Land - [51347]	WA	In buffer area only
Commonwealth Land - [51344]	WA	In buffer area only
Commonwealth Land - [51525]	WA	In buffer area only
Commonwealth Land - [50847]	WA	In buffer area only
Commonwealth Land - [51322]	WA	In buffer area only
Commonwealth Land - [51173]	WA	In buffer area only
Commonwealth Land - [51170]	WA	In buffer area only
Commonwealth Land - [51172]	WA	In buffer area only
Commonwealth Land - [51174]	WA	In buffer area only
Commonwealth Land - [51177]	WA	In buffer area only
Commonwealth Land - [51176]	WA	In buffer area only
Commonwealth Land - [51171]	WA	In buffer area only
Commonwealth Land - [51175]	WA	In buffer area only
Commonwealth Land - [51230]	WA	In buffer area only
Commonwealth Land - [51231]	WA	In buffer area only
Commonwealth Land - [51276]	WA	In buffer area only
Commonwealth Land - [51523]	WA	In buffer area only
Commonwealth Land - [51526]	WA	In buffer area only
Commonwealth Land - [51321]	WA	In buffer area only
Commonwealth Land - [51320]	WA	In buffer area only
Commonwealth Land - [51327]	WA	In buffer area only
Commonwealth Land - [51299]	WA	In buffer area only
Commonwealth Land - [51304]	WA	In buffer area only

Commonwealth Land Name	State	Buffer Status
Commonwealth Land - [51263]	WA	In buffer area only
Commonwealth Land - [51262]	WA	In buffer area only
Commonwealth Land - [51179]	WA	In buffer area only
Commonwealth Land - [51178]	WA	In buffer area only
Commonwealth Land - [51267]	WA	In buffer area only
Commonwealth Land - [51266]	WA	In buffer area only
Commonwealth Land - [51265]	WA	In buffer area only
Commonwealth Land - [51264]	WA	In buffer area only
Commonwealth Land - [50845]	WA	In buffer area only
Commonwealth Land - [50842]	WA	In buffer area only
Commonwealth Land - [50844]	WA	In buffer area only
Commonwealth Land - [51325]	WA	In buffer area only
Commonwealth Land - [51326]	WA	In buffer area only
Commonwealth Land - [50843]	WA	In buffer area only
Commonwealth Land - [51306]	WA	In buffer area only

Listed Marine Species			[Resource Information]
Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
Bubulcus ibis as Ardea ibis Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat likely to occur within area overfly marine area	In feature area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat may occur within area	In buffer area only
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Species or species habitat may occur within area	In buffer area only
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area	In feature area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In buffer area only
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area overfly marine area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat likely to occur within area	In buffer area only
Pandion haliaetus Osprey [952]		Breeding known to occur within area	In buffer area only
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area overfly marine area	In feature area
Thalassarche cauta Shy Albatross [89224]	Endangered	Species or species habitat may occur within area	In buffer area only
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thinornis cucullatus as Thinornis rubricollis			
Hooded Plover, Hooded Dotterel [87735]		Species or species habitat likely to occur within area overfly marine area	In buffer area only
Tringa nebularia			
Common Greenshank, Greenshank [832]	Endangered	Species or species habitat likely to occur within area overfly marine area	In feature area
Reptile			
Caretta caretta			
Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area	In buffer area only
Chelonia mydas			
Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Dermochelys coriacea			
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area	In buffer area only
Natator depressus			
Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area	In buffer area only

Extra Information

State and Territory Reserves			[Resource Information]
Protected Area Name	Reserve Type	State	Buffer Status
Beelu	National Park	WA	In buffer area only
Canning River	Management Area	WA	In buffer area only
Dundas Road	Nature Reserve	WA	In buffer area only
Gooseberry Hill	National Park	WA	In buffer area only
Helena River	Management Area	WA	In buffer area only
Kalamunda	National Park	WA	In buffer area only
Kenwick Wetlands	Nature Reserve	WA	In buffer area only
Korung	National Park	WA	In buffer area only

Protected Area Name	Reserve Type	State	Buffer Status
Lesmurdie Falls	National Park	WA	In buffer area only
Swan River	Management Area	WA	In buffer area only
Unnamed WA23076	Nature Reserve	WA	In buffer area only
Unnamed WA24657	Conservation Park	WA	In buffer area only
Unnamed WA29815	5(1)(h) Reserve	WA	In buffer area only
Unnamed WA37997	Nature Reserve	WA	In buffer area only
Unnamed WA49079	Nature Reserve	WA	In buffer area only
Unnamed WA49299	Nature Reserve	WA	In buffer area only
Unnamed WA49362	Nature Reserve	WA	In buffer area only
Unnamed WA49363	Conservation Park	WA	In buffer area only

Regional Forest Agreements

[Resource Information]

Note that all areas with completed RFAs have been included. Please see the associated resource information for specific caveats and use limitations associated with RFA boundary information.

RFA Name	State	Buffer Status
South West WA RFA	Western Australia	In buffer area only

Nationally Important Wetlands

[Resource Information]

Wetland Name	State	Buffer Status
Brixton Street Swamps	WA	In buffer area only
Gibbs Road Swamp System	WA	In buffer area only
Perth Airport Woodland Swamps	WA	In buffer area only
Swan-Canning Estuary	WA	In buffer area only

EPBC Act Referrals

[Resource Information]

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Commercial development of Lot 414 Grove Road, Kenwick	2021/9022		Completed	In buffer area only
Eradication of the European House Borer, Perth metropolitan area, WA	2009/5027		Completed	In feature area
Industrial Development MKSEA Precinct 1	2023/09760		Completed	In buffer area only
Residential subdivision of Lot 126 Lawnbrook Road, Walliston	2021/9105		Completed	In buffer area only

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Roe Highway and Great Eastern Highway Bypass Grade Separation Interchange, Hazelmere WA	2020/8784		Post-Approval	In buffer area only
Southern Link Road Stage 3 City of Canning	2020/8809		Assessment	In buffer area only
Talbot Road Asbestos Water Supply Pipe Decommissioning Project	2023/09661		Completed	In buffer area only
Controlled action				
Airport & Freight Access Gateway	2010/5384	Controlled Action	Post-Approval	In buffer area only
Bushmead Residential Development, Hazelmere, WA	2015/7414	Controlled Action	Post-Approval	In buffer area only
Clearing for orchard expansion, Lot 400 Canning Road, Carmel, WA	2016/7647	Controlled Action	Completed	In buffer area only
Construction of Residential Dwelling, Ozone Terrace, Kalamunda	2006/3147	Controlled Action	Post-Approval	In buffer area only
Development of an Integrated Aged Care Facility, Kalumunda, WA	2013/6990	Controlled Action	Completed	In buffer area only
Garden Street road extension, Huntingdale, city of Gosnells, WA	2016/7735	Controlled Action	Post-Approval	In buffer area only
National Lifestyle Village, Lot 97 Adelaide Street	2009/5141	Controlled Action	Post-Approval	In buffer area only
Native vegetation clearing of Lot 21 Webster Road for Industrial Development	2011/6186	Controlled Action	Post-Approval	In buffer area only
Natural Gas Pipeline Expansion	2006/2813	Controlled Action	Post-Approval	In feature area
Nava-1 Cable System	2001/510	Controlled Action	Completed	In buffer area only
Residential Estate at Lot 1580 Warton Road, Southern River	2004/1471	Controlled Action	Post-Approval	In buffer area only
Roe Highway and Kalamunda Road Interchange upgrade, WA	2018/8316	Controlled Action	Post-Approval	In buffer area only
Thornlie-Cockburn Link Project, WA	2018/8188	Controlled Action	Post-Approval	In buffer area only
Tonkin Highway Grade Separated Interchanges	2019/8529	Controlled Action	Post-Approval	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action				
Berkshire Road and Roe Highway Interchange, Forrestfield, East Perth, WA	2014/7243	Not Controlled Action	Completed	In buffer area only
Burslem Drive Bridge Duplication Over Canning River, Maddington, WA	2014/7115	Not Controlled Action	Completed	In buffer area only
Canning Mills Road Improvement Project, Martin, WA	2015/7426	Not Controlled Action	Completed	In buffer area only
Clearing of Lot 400 Canning Road, Carmel, WA	2017/7979	Not Controlled Action	Completed	In buffer area only
Commercial development of Lot 106 Wright Road, Forrestdale WA	2003/1255	Not Controlled Action	Completed	In buffer area only
Community Centre Project, Kalamunda, WA	2019/8473	Not Controlled Action	Completed	In buffer area only
Construction of international rowing course and commercial/residential areas	2003/1034	Not Controlled Action	Completed	In feature area
Denny Avenue Level Crossing Removal, Kelmscott WA	2018/8377	Not Controlled Action	Completed	In buffer area only
Forrestfield Airport Link, WA	2015/7399	Not Controlled Action	Completed	In buffer area only
Grazing of stock and associated works on Lot 1790 Passmore Street, Southern River Western Australia	2018/8176	Not Controlled Action	Completed	In buffer area only
Hartfield Park Sporting Field Extension	2013/7008	Not Controlled Action	Completed	In buffer area only
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In feature area
INDIGO Central Submarine Telecommunications Cable	2017/8127	Not Controlled Action	Completed	In feature area
Industrial Development (multiple lots) Edward Street, Kenwick, WA	2018/8231	Not Controlled Action	Completed	In buffer area only
Pipeline Extension, Hazelmere and Helena Valley, WA	2018/8239	Not Controlled Action	Completed	In buffer area only
Residential Development - Lot 608 Dixon Road, Kalamundah, WA	2014/7389	Not Controlled Action	Completed	In buffer area only
Residential development of Lots 302, 308, 320 and part of Lot 9502, Hawtin Rd, Forrestfield, WA	2016/7770	Not Controlled Action	Completed	In buffer area only

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action				
Ridge Hill Road intersection modification and offsite water main installation, Gooseberry Hill, WA	2020/8842	Not Controlled Action	Completed	In buffer area only
Roe Highway Noise Wall, High Wycombe, WA	2014/7149	Not Controlled Action	Completed	In buffer area only
Southern River Mixed Business Precinct F, City of Gosnells, WA	2013/6813	Not Controlled Action	Completed	In buffer area only
Southern River Precinct 3E	2017/7900	Not Controlled Action	Completed	In buffer area only
To develop a residential development at Glyde Road, Lesmurdie, WA	2013/7096	Not Controlled Action	Completed	In buffer area only
Tonkin Highway Extension	2001/470	Not Controlled Action	Completed	In buffer area only
Tonkin Highway Upgrade, Guildford Road to Great Eastern Highway, WA	2019/8545	Not Controlled Action	Completed	In buffer area only
Translocation of orchids (Caladenia huegelii) from Roe Hway Reserve	2002/781	Not Controlled Action	Completed	In buffer area only
Wungong Transfer Mains Project	2007/3532	Not Controlled Action	Completed	In buffer area only
Yule Brook Main Drain Flood Mitigation Works	2019/8572	Not Controlled Action	Completed	In buffer area only
Not controlled action (particular manner)				
Commercial Estate and Aeronautical Infrastructure Development, Precincts 2A & 2B	2006/3021	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
INDIGO Marine Cable Route Survey (INDIGO)	2017/7996	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
South West Metropolitan Railway Project	2003/1175	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
State Football Centre	2020/8824	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data is available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on the contents of this report.

3 DATA SOURCES

Threatened ecological communities

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

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions when time permits.

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

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

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded breeding sites; and
- seals which have only been mapped for breeding sites near the Australian continent

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

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

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

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

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

Please feel free to provide feedback via the Contact us page.

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Appendix C

Definitions of Threatened and Priority Flora and Communities

Conservation Codes for Western Australian Flora and Fauna

Specially protected fauna or flora are species* which have been adequately searched for and are deemed to be, in the wild, either rare, at risk of extinction, or otherwise in need of special protection, and have been gazetted as such. Conservation codes have been transitioned under regulations 170, 171 and 172 of the *Biodiversity Conservation Regulations 2018.*

T Threatened species – Schedules 1-4

Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the *Biodiversity Conservation Act 2016* (BC Act).

- **Threatened fauna** is that subset of 'Specially Protected Fauna' listed under schedules 1 to 3 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for Threatened Fauna.
- **Threatened flora** is that subset of 'Rare Flora' listed under schedules 1 to 3 of the *Wildlife Conservation (Rare Flora) Notice 2018* for Threatened Flora.

The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.

CR Critically endangered species

Threatened species considered to be "*facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines*".

Listed as critically endangered under section 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines. Published under schedule 1 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for critically endangered fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for critically endangered flora.

EN Endangered species

Threatened species considered to be "*facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines*".

Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines. Published under schedule 2 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for endangered fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for endangered flora.

VU Vulnerable species

Threatened species considered to be "*facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines*".

Listed as vulnerable under section 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines. Published under schedule 3 of the *Wildlife*

Conservation (Specially Protected Fauna) Notice 2018 for vulnerable fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for vulnerable flora.

EX Presumed extinct species

Species where "*there is no reasonable doubt that the last member of the species has died*", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act).

Published as presumed extinct under schedule 4 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for extinct fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for extinct flora.

EW Extinct in the wild species

Species that "*is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form*", and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act).

Currently there are no threatened fauna or threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice.

Specially protected species

Listed by order of the Minister as specially protected under section 13(1) of the BC Act. Meeting one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection.

Species that are listed as threatened species (critically endangered, endangered or vulnerable) or extinct species under the BC Act cannot also be listed as Specially Protected species.

MI Migratory species

Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act).

Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals, that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species.

Published as migratory birds protected under an international agreement under schedule 5 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018.*

CD Species of special conservation interest (conservation dependent fauna)

Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14 of the BC Act).

Published as conservation dependent fauna under schedule 6 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.

OS Other specially protected species

Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act).

Published as other specially protected fauna under schedule 7 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.

P Priority species

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna or flora.

Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.

Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

Priority 1: Poorly-known species

Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.

Priority 2: Poorly-known species

Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.

Priority 3: Poorly-known species

Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

Priority 4: Rare, Near Threatened and other species in need of monitoring

(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands.

(b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent.

(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

*Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies or variety, or a distinct population).

Western Australian Ecological Communities

Threatened Ecological Communities

The BC Act provides for the statutory listing of threatened ecological communities (TECs) by the Minister.

Presumed Totally Destroyed (PD)

An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future.

Critically Endangered (CR)

An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated.

Endangered (EN)

An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.

Vulnerable (VU)

An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.

Priority Ecological Communities

Possible threatened ecological communities that do not meet survey criteria or that are not adequately defined are added to the Priority Ecological Community List under priorities 1, 2 and 3. These three categories are ranked in order of priority for survey and/or definition of the community. Ecological communities that are adequately known, and are rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5.

Priority One: Poorly-known ecological communities

Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤5 occurrences or a total area of ≤ 100ha).

Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.

Priority Two: Poorly-known ecological communities

Communities that are known from few occurrences with a restricted distribution (generally ≤10 occurrences or a total area of ≤200ha). At least some occurrences are not believed to be under immediate threat (within approximately 10 years) of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.

Priority Three: Poorly known ecological communities

(i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or:

(ii) communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat (within approximately 10 years), or;

(iii) munities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, inappropriate fire regimes, clearing, hydrological change etc.

Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.

Priority Four: Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.

(i) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands.

(ii) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for a higher threat category.

(iii) Ecological communities that have been removed from the list of threatened communities during the past five years.

Priority Five: Conservation Dependent ecological communities

Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

Commonwealth of Australia Conservation Codes

Threatened Flora and Fauna

Threatened fauna and flora may be listed under Section 178 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) in any one of the following six categories:

Extinct

A native species is eligible to be included in the extinct category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.

Extinct in the wild

A native species is eligible to be included in the extinct in the wild category at a particular time if, at that time:

a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or
b) it 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

A taxon is Critically Endangered when the best available evidence indicates that it meets any of the five criteria for the category identified in Part 7.01 of the EPBC Regulations, and it is therefore considered to be facing an extremely high risk of extinction in the wild.

Endangered

A taxon is Endangered when the best available evidence indicates that it meets any of the five criteria for the category identified in Part 7.01 of the EPBC Regulations, and it is therefore considered to be facing a very high risk of extinction in the wild.

Vulnerable

A taxon is Vulnerable when the best available evidence indicates that it meets any of the five criteria for the category identified in Part 7.01 of the EPBC Regulations, and it is therefore considered to be facing a high risk of extinction in the wild.

Conservation dependent

A native species is eligible to be included in the conservation dependent category at a particular time if, at that time:

a) the species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered; or
b) the following subparagraphs are satisfied:
    i. the species is a species of fish;

ii. the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long term survival in nature are maximised;
iii. the plan of management is in force under a law of the Commonwealth or of a State or Territory;
iv. cessation of the plan of management would adversely affect the conservation status of the species.

The EPBC Act does not provide for listing in a data deficient category. Where sufficient data (evidence) is unavailable to allow assessment by the Threatened Species Scientific Committee against the criteria for listing, the species are found to be ineligible. A recommendation is made to the Minister to not include the species in any category under the EPBC Act. For reasons of transparency and to inform future research, the Threatened Species Scientific Committee publishes the names of those species found to be data deficient. As data deficient is not a listing category under the EPBC Act, this has no statutory implications and the species is not considered to be listed under the EPBC Act.

Threatened Ecological Communities

Threatened Ecological communities under the EPBC Act are listed in three categories.

Critically endangered

If, at that time, an ecological community is facing an extremely high risk of extinction in the wild in the immediate future (indicative timeframe being the next 10 years).

Endangered

If, at that time, an ecological community is not critically endangered but is facing a very high risk of extinction in the wild in the near future (indicative timeframe being the next 20 years).

Vulnerable

If, at that time, an ecological community is not critically endangered or endangered, but is facing a high risk of extinction in the wild in the medium–term future (indicative timeframe being the next 50 years).

Categories of Threatened Species pursuant to the Environment Protection and Biodiversity Conservation Act 1999

EPBC Act Category	Department of Environment and Energy Definition
Extinct	A native species is eligible to be included in the extinct category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
Extinct in the wild	A native species is eligible to be included in the extinct in the wild category at a particular time if, at that time: (a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) it 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	A native species is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered	A native species is eligible to be included in the endangered category at a particular time if, at that time (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable	A native species is eligible to be included in the vulnerable category at a particular time if, at that time: (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria.
Conservation dependent	A native species is eligible to be included in the conservation dependent category at a particular time if, at that time: (a) the species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered; or (b) the following subparagraphs are satisfied: (i) the species is a species of fish; (ii) the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long term survival in nature are maximised; (iii) the plan of management is in force under a law of the Commonwealth or of a State or Territory; (iv) cessation of the plan of management would adversely affect the conservation status of the species.

CONSERVATION CATEGORY DEFINITIONS

for Western Australian Ecological Communities

GENERAL DEFINITIONS

An **ecological community** is a naturally occurring assemblage of organisms that occurs in a particular habitat, as defined in the *Biodiversity Conservation Act 2016* (BC Act). Ecological communities may comprise various life forms including plants, animals and microorganisms.

Note: The scale at which ecological communities are defined will often depend on the level of detail in the information source, therefore no particular scale is specified.

A **threatened ecological community** (TEC) means an ecological community that is listed under section 27(1) of the BC Act as a critically endangered, endangered or vulnerable ecological community, or is a rediscovered ecological community to be regarded as a threatened ecological community under section 33 of the BC Act.

An **assemblage** is a defined group of biological entities.

Habitat, as defined in the BC Act, means the biophysical medium or media —

a) occupied (continuously, periodically or occasionally) by an organism or group of organisms, or
b) once occupied (continuously, periodically or occasionally) by an organism, or group of organisms, and into which organisms of that kind have the potential to be reintroduced.

An **occurrence** is a discrete example of an ecological community, separated from other examples of the same community by more than 20 metres with, for example: a different ecological community, a sealed road, a building, a water body (for terrestrial communities), or a terrestrial body (for aquatic communities). There is no minimum size of an occurrence of a threatened or priority ecological community. By ensuring that every discrete occurrence is recognised and recorded, future changes in status can be readily monitored.

Adequately surveyed is defined as an ecological community that has been searched for thoroughly in most likely habitats, by relevant experts.

Community structure is defined as the spatial organisation, construction and arrangement of the biological elements comprising a biological assemblage. For example, the vegetation structure (e.g., *Eucalyptus salmonophloia* woodland over scattered small shrubs over dense herbs) or the trophic structure in a faunal assemblage (e.g., dominance by feeders on detritus as distinct from feeders on live plants).

To **modify** an occurrence of an ecological community, as defined in section 44 of the BC Act, means to take action that results in —

(a) the modification of the occurrence of the threatened ecological community to such an extent that the occurrence is unlikely to recover —
    (i) its species composition or structure; or
    (ii) its species composition and structure; or
(b) the destruction of the occurrence of the threatened ecological community.

Destruction of an occurrence of an ecological community means modification such that reestablishment of ecological processes, species composition or community structure within the range of variability exhibited by the original community is unlikely within the foreseeable future even with positive human intervention.

Modification and destruction are difficult concepts to quantify, and their application will be determined by scientific judgement. Refer to the document Guidance note – Modification of an occurrence of a threatened ecological community for more information on what constitutes modification and how to determine whether an action is likely to modify an occurrence of a threatened ecological community.

Threatening process means a process that threatens, or may threaten, the survival, abundance or evolutionary development of a native species or ecological community, as defined under the BC Act. Examples of some of the continuing threatening processes in Western Australia include: vegetation clearance; competition and land degradation by introduced fauna; dieback caused by the root-rot fungus (*Phytophthora cinnamomi*); competition and displacement of native plants by introduced flora; hydrological changes (declining groundwater levels); drying climate, fire regimes that cause declines in biodiversity; direct human exploitation and disturbance of ecological communities.

Restoration is defined as returning an ecological community to its pre-disturbance or natural state in terms of abiotic conditions, community structure and species composition.

Rehabilitation is defined as the re-establishment of ecological attributes in a damaged ecological community although the community will remain modified.

LISTED ECOLOGICAL COMMUNITIES

Assessment of the conservation status of ecological communities is carried out in accordance with the BC Act listing criteria and the requirements of Ministerial Guideline Number 1 and Ministerial Guideline Number 4 that adopt the use of the International Union for Conservation of Nature (IUCN) Red List of Ecosystems Categories and Criteria.

CO Collapsed ecological communities

An ecological community listed by order of the Minister as collapsed under section 31(1) of the BC Act. As determined by criteria set out in section 32 of the BC Act, an ecological community is eligible for listing as a collapsed ecological community at a particular time if, at that time —

(a) there is no reasonable doubt that the last occurrence of the ecological community has collapsed; or
(b) the ecological community has been so extensively modified throughout its range that no occurrence of it is likely to recover —
    (i) its species composition or structure; or
    (ii) its species composition and structure.

CR Critically endangered ecological communities

A threatened ecological community listed in the category of critically endangered under section 27(1)(a) of the BC Act, as determined by criteria set out in section 28 of the BC Act and the ministerial guidelines. A critically endangered ecological community faces an extremely high risk of becoming eligible for listing as a collapsed ecological community in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines.

Examples of use:

- ‘Assemblages of the organic springs and mound springs of the Mandora Marsh area’ is listed as a critically endangered threatened ecological community under the *Biodiversity Conservation Act 2016.*
- ‘Assemblages of the organic springs and mound springs of the Mandora Marsh area’ is listed as critically endangered under the *Biodiversity Conservation Act 2016.*
- Listing reference in a table – column heading: BC Act; row text: CR.

EN Endangered ecological communities

A threatened ecological community listed in the category of endangered ecological community under section 27(1)(b) of the BC Act, as determined by criteria set out in section 29 of the BC Act and the ministerial guidelines. A threatened ecological community faces a very high risk of becoming eligible for listing as a collapsed ecological community in the near future, as determined in accordance with criteria set out in the ministerial guidelines.

Examples of use:

- ‘Herb rich shrublands in clay pans (floristic community type 8 as originally described in Gibson *et al*. (1994))’ is listed as an endangered threatened ecological community under the *Biodiversity Conservation Act 2016.*
- ‘Herb rich shrublands in clay pans (floristic community type 8 as originally described in Gibson et al. (1994))’ is listed as endangered under the *Biodiversity Conservation Act 2016.*
- Listing reference in a table – column heading: BC Act; row text: EN.

VU Vulnerable ecological communities

A threatened ecological community listed in the category of vulnerable ecological community under section 27(1)(c) of the BC Act, as determined by criteria set out in section 30 of the BC Act and the ministerial guidelines. A vulnerable ecological community faces a high risk of becoming eligible for listing as a collapsed ecological community in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines.

Examples of use:

- '*Calothamnus graniticus* subsp. *graniticus* heaths on south west coastal granites' is listed as a vulnerable threatened ecological community under the *Biodiversity Conservation Act 2016.*
- '*Calothamnus graniticus* subsp. *graniticus* heaths on south west coastal granites' is listed as vulnerable under the *Biodiversity Conservation Act 2016.*
- Listing reference in a table – column heading: BC Act; row text: VU.

PRIORITY ECOLOGICAL COMMUNITIES

Priority is not a listing category under the BC Act. The Priority Ecological Communities list is maintained by the department and is published on the department's website.

All fauna and flora that may be present in an ecological community are protected in WA following the provisions in Part 10 of the BC Act. The protection applies even when these species occur in an ecological community that is not listed as threatened, and regardless of land tenure (State managed land (Crown land), private land, or Commonwealth land).

Possible threatened ecological communities that do not meet survey criteria or are not adequately defined to enable listing are added to the department's Priority Ecological Communities for Western Australia list under priority 1, 2 or 3. Ecological communities that are adequately known and not threatened but rare, near threatened, or have recently been removed from the threatened list are placed in priority 4. Conservation dependent ecological communities are placed in priority 5.

P1 Priority 1: Poorly known ecological communities – very few occurrences, very restricted distribution

Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤5 occurrences or a total area of ≤100ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g., within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.

Examples of use:

- 'Banded Ironstone Hills with *Dryandra arborea*' is listed as a Priority 1 ecological community by the Department of Biodiversity, Conservation and Attractions.
- 'Banded Ironstone Hills with *Dryandra arborea*' is listed as Priority 1 on the DBCA Priority Ecological Communities List.
- Listing reference in a table – column heading: DBCA; row text: P1.

P2 Priority 2: Poorly known ecological communities – few occurrences, restricted distribution

Communities that are known from few occurrences with a restricted distribution (generally ≤10 occurrences or a total area of ≤200ha). At least some occurrences are not believed to be under immediate threat (within approximately 10 years) of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.

Examples of use:

- 'Aquatic invertebrate communities of peat swamps' is listed as a Priority 2 ecological community by the Department of Biodiversity, Conservation and Attractions.
- 'Aquatic invertebrate communities of peat swamps' is listed as Priority 2 on the DBCA Priority Ecological Communities List.
- Listing reference in a table – column heading: DBCA; row text: P2.

P3 Priority 3: Poorly known ecological communities – inadequately surveyed or not well defined

Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them. This category includes three sub-categories:

(i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation.

(ii) Communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat (within approximately 10 years).

(iii) Communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, inappropriate fire regimes, clearing, hydrological change, etc.

Examples of use:

- 'Assemblages of gypsum dunes of the central and southern wheatbelt' is listed as a Priority 3(iii) ecological community by the Department of Biodiversity, Conservation and Attractions.
- 'Assemblages of gypsum dunes of the central and southern wheatbelt' is listed as Priority 3(iii) on the DBCA Priority Ecological Communities List.
- Listing reference in a table – column heading: DBCA; row text: P3(iii).

P4 Priority 4: Adequately known ecological communities – rare, near threatened, or recently removed from the threatened list

Ecological communities that are adequately known and either rare but not threatened, near threatened, or have recently been removed from the threatened list. These communities require regular monitoring.

(i) Rare: ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands.

(ii) Near threatened: ecological communities that are considered to have been adequately surveyed and that do not qualify as conservation dependent, but that are close to qualifying for a higher threat category.

(iii) Ecological communities that have been removed from the list of threatened communities during the past five years.

Examples of use:

- 'Nimalaica (Nimalarragun) claypan and associated wetland assemblages' is listed as a Priority 4(ii) ecological community by the Department of Biodiversity, Conservation and Attractions.
- 'Nimalaica (Nimalarragun) claypan and associated wetland assemblages' is listed as Priority 4(ii) on the DBCA Priority Ecological Communities List.
- Listing reference in a table: column heading: DBCA, row text: P4(ii).

P5 Priority 5: Conservation dependent ecological communities

Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

Categories of Threatened Communities pursuant to the Environment Protection and Biodiversity Conservation Act 1999

Category	Definition
Critically Endangered	(1) An ecological community is eligible to be included in the ***critically endangered*** category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered	(2) An ecological community is eligible to be included in the ***endangered*** category at a particular time if, at that time: (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable	(3) An ecological community is eligible to be included in the ***vulnerable*** category at a particular time if, at that time: (a) it is not critically endangered nor endangered; and (b) it is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.

Appendix 8 Black Cockatoo Habitat Assessment (Phoenix Environmental 2024)

PHOENIX
ENVIRONMENTAL SCIENCES

Black cockatoo habitat assessment for the Wattle Grove (South) MRS Rezoning Project

Hesperia on behalf of the Western Australian Planning Commission

July 2024

Final



Black cockatoo habitat assessment for the Wattle Grove (South) MRS Rezoning Project

Prepared for Hesperia on behalf of the Western Australian Planning Commission

Version history

Author/s	Reviewer/s	Version	Version number	Date submitted	Submitted to
Deon Loo and Anna Jacks	J. Clark	Draft for client comments	0.1	14-Mar-24	K. Choo (Coterra Environment)
J. Clark		Final, client comments addressed	1.0	18-Mar-24	K. Choo (Coterra Environment)
A. Jacks		Final, client comments addressed	2.0	11-July-24	K. Choo (Coterra Environment)

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CONTENTS

Contents ii
1 Introduction 1
1.1 Background 1
1.2 Scope of work 2
1.3 Project area 2
2 Legislative context 4
2.1 Commonwealth 4
2.2 State 4
2.2.1 Threatened and Priority species 4
2.2.2 Critical habitat 5
3 Methods 6
3.1 Breeding habitat analysis 6
3.2 Roosting habitat analysis 7
3.3 Foraging habitat analysis 7
4 Results 8
4.1 Breeding habitat analysis 8
4.2 Roosting habitat analysis 20
4.3 Foraging habitat analysis 21
5 Discussion and conclusion 31
References 33

LIST OF FIGURES

Figure 1-1 Project location and study area 3
Figure 4-1 Potential habitat trees in the Wattle Grove (South) MRS Amendment Area 9
Figure 4-2 Potential habitat trees re-assessed by Phoenix in 2024 12
Figure 4-3 Trees at location of habitat tree 417 13
Figure 4-4 Habitat tree 438 14
Figure 4-5 Hollow of habitat tree 438 15
Figure 4-6 Habitat tree 482 16
Figure 4-7 Habitat tree 491 17
Figure 4-8 Hollow 1 in habitat tree 491 18
Figure 4-9 Hollow 2 in habitat tree 491 18
Figure 4-10 Foraging evidence and black cockatoo feathers underneath habitat tree 491 19
Figure 4-11 Roosting locations within 12 km of the study area (Birdlife 2024) 21
Figure 4-12 Carnaby's Cockatoo foraging habitat value per Bamford (2021) scoring method 28
Figure 4-13 Baudin's cockatoo foraging habitat value per Bamford (2021) scoring method 29
Figure 4-14 FRTBC foraging habitat value per Bamford (2021) scoring method 30

LIST OF TABLES

Table 4-1 Potential habitat trees with hollows within the Wattle Grove (South) MRS Amendment Area re-assessed in January 2024 10
Table 4-2 Site score for Carnaby's Cockatoo 23
Table 4-3 Site score for Baudin's Cockatoo 24
Table 4-4 Site score for FRTBC 25
Table 4-5 Black cockatoo foraging habitat value per Bamford 2021 scoring method. Low value habitat (1-3) is in green, Moderate value habitat (4-6) is in yellow, High value habitat (7-10) is in Red. 26
Table 4-6 Summary of foraging habitat scores and species 26
Table 4-5 Summary statistics for remnant vegetation within 15 km of the study area 27

LIST OF APPENDICES

Appendix 1 Scoring system for the assessment of foraging value of vegetation for black cockatoos (Bamford 2021)
Appendix 2 Potential habitat trees within the study area

ACRONYMS AND ABBREVIATIONS

Abbreviations	Definition
BC Act	Biodiversity Conservation Act (WA)
CD	Species considered 'Conservation Dependent' and protected under the BC Act (WA)
CR	Species considered 'Critically Endangered' and protected under the EPBC or BC Acts
DBCA	Department of Biodiversity, Conservation and Attractions
DBH	Diameter at breast height
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DWER	Department of Water and Environmental Regulation
EN	Species considered 'Endangered' and protected under the EPBC or BC Acts
EPA	Environmental Protection Authority
EPBC Act	Environmental Protection and Biodiversity Conservation Act
FRTBC	Forest Red-tailed Black Cockatoo
Mig.	A migratory species protected under the EPBC or BC Acts
MRS	Metropolitan Region Scheme
NES	National Environmental Significance
OS	Species otherwise in need of special protection under the BC Act
PHT	Potential habitat tree
SP	Specially protected species under the BC Act
SQL	Structured Query Language
TEC	Threatened Ecological Community, protected under the EPBC and BC Acts
VU	Species considered 'Vulnerable' and protected under the EPBC or BC Acts
WA	Western Australia
WAPC	Western Australia Planning Commission

1 INTRODUCTION

The Wattle Grove (South) Metropolitan Regional Scheme (MRS) Amendment Project (the 'Project') involves the Western Australia Planning Commission (WAPC) plans to re-zone 126 ha of 'Rural' zoned land (77 lots) for residential purposes within Wattle Grove, under MRS Amendment 1388/57.

The Project has been investigated since at least 2019, with numerous consultants having undertaken biological surveys in that time. Phoenix was approached to review biological work done to date with respect to current Environmental Protection Authority (EPA) and Department of Climate Change, Energy, the Environment and Water (DCCEEW) guidelines. This report specifically provides technical assessment and advice in respect to the black cockatoo habitat assessment for the Project area, including the compliance and adequacy of historic biological surveys and any additional work required.

In order to obtain necessary approvals environmental impact assessment documentation is being prepared for the Project on behalf of the WAPC.

The Project lies within the Perth subregion of the Swan Coastal Plain bioregion.

1.1 BACKGROUND

Since 2019, multiple black cockatoo surveys have been completed for the (larger) Project:

- In spring of 2019 AECOM (2020) undertook biological surveys, including a Level 1 (equivalent to a Basic) fauna survey and a Targeted black cockatoo survey of a larger 340 ha area, which included the current Project area. The survey involved mapping fauna habitat, fauna observations, and recording of potential habitat trees (PHTs). The surveys of the larger area (noting that not all of these findings relate specifically to the Project area) recorded:
    - direct sightings foraging in the study area and multiple foraging evidence of Forest Red-Tailed Black Cockatoo (FRTBC) (*Calyptorhynchus banksii naso*; VU)
    - foraging evidence of Carnaby's Cockatoo (*Zanda latirostris*; EN)
    - 730 PHTs, including 17 trees with one or more hollows considered potentially suitable for breeding black cockatoos (27 hollows in total).
    - a total of 41.14 ha of very high and high-quality foraging habitat for Carnaby's Cockatoo and Baudin's Cockatoo, and 33.52 ha of very high and high-quality foraging habitat for the FRTBC.
- In February and August 2021, and May 2022, JBS&G (2023) conducted a black cockatoo habitat assessment within the current Wattle Grove (South) MRS Amendment (Project) Area. The results from this survey took into consideration AECOM (2020) survey data in addition to new survey data:
    - a total of 153 PHTs were recorded of which 3 had potentially suitable hollows
    - a total of 32.44 ha of vegetation both native and introduced, of varying quality suitable for foraging for all 3 black-cockatoo species.
- In January 2024, Phoenix undertook a review of the previous biological surveys to ensure they adhered to current State and Federal government guidelines for the species (Bamford 2020; DAWE 2022a, b; EPA 2019). In regards to black cockatoos both the AECOM (2020) and JBS&G (2023) surveys were found to be compliant with current guidelines for those species, however several items required re-analysis:
    - foraging habitat required re-scoring due to 2 components of the analysis being incorrectly interpreted (Site context and Species stocking rate)
    - inconsistencies between the reported number of PHTs reported (AECOM 2020; JBS&G 2023) and in the supplied spatial data, which resulted in uncertainty around the

correct number of PHTs and PHTs with possibly suitable hollows within the Wattle Grove (South) MRS Amendment Area.

The Department of Biodiversity, Conservation and Attractions (DBCA) Threatened fauna dataset (DBCA 2023) includes 32 monitored black cockatoo sites within 10 km of the study area. The maximum number of white-tailed black cockatoos (Carnaby's and Baudin's Cockatoo) sighted was 215 individuals located 7 km NE of the study area in 2017. The maximum number of FRTBC sighted in 2018 was 334 individuals at a site located 2.5 km west of the study area.

Black cockatoos utilise the Swan Coastal Plain mainly for foraging resources and breeding habitat in small patches of suitable habitat. Carnaby's Cockatoo primarily use vegetation dominated by *Banksia* spp. and Tuart (*Eucalyptus gomphocephala*) woodlands, as well as Marri (*Corymbia calophylla*), with Jarrah (*E. marginata*) in the east. An important focus for this region is the ongoing viability of foraging resources for black cockatoos, particularly Carnaby's Cockatoo (*Zanda latirostris*).

The Jarrah Forest, just east of the study area provides breeding habitat for all 3 black cockatoo species as well as providing key foraging and wintering areas for Baudin's Cockatoo (*Zanda baudinii*) and the FRTBC. Marri is a primary food resource for Baudin's Cockatoo and the FRTBC. Foraging areas associated with breeding are critical for all species (DAWE 2022b).

The results of Phoenix' re-assessment of foraging habitat value per the Bamford (2021) method is presented below in section 0.

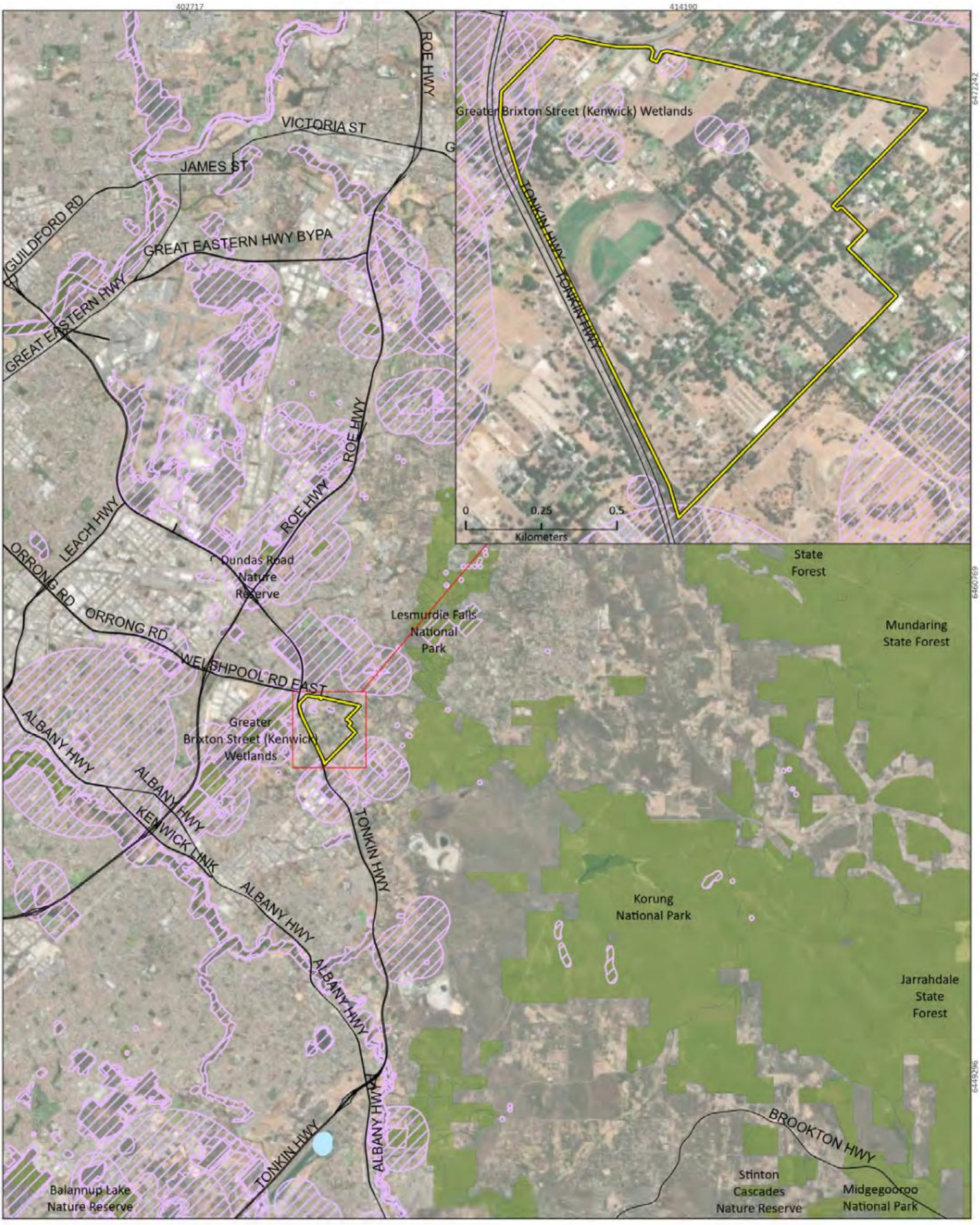
1.2 SCOPE OF WORK

The scope of work for the black cockatoo habitat assessment of the Project area was as follows:

- review habitat mapping with respect to consistency with the vegetation type and condition mapping and black cockatoo species foraging habitat
- review the potential habitat tree dataset
- undertake a hollow inspection, if required
- undertake black cockatoo species foraging habitat quality scoring per the "Bamford Method" (Bamford 2021).

1.3 PROJECT AREA

The Wattle Grove (South) MRS Amendment Area (the 'Project area') is located within Wattle Grove, approximately 15 km ESE from Perth, Western Australia (WA; Figure 1-1). The Project area is bound by Welshpool Road East and Crystal Brook Road to the north, and Tonkin Highway to the west.





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Wattle grove MRS Rezoning

Project No	1633
Date	28/02/2024
Drawn by	JL
Map author	BK

0 2 4
Kilometers

1:113,600(at A4) GDA 1994 MGA Zone 50

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- Study area
- Lakes
- DBCA managed land
- Environmentally Sensitive Areas

Figure 1-1

Project location and study area

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2 LEGISLATIVE CONTEXT

The protection of fauna in WA is principally governed by 3 acts:

- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- State *Biodiversity Conservation Act 2016* (BC Act)
- State *Environmental Protection Act 1986* (EP Act).

2.1 COMMONWEALTH

The EPBC Act is administered by the Federal DCCEEW. The EPBC Act provides for the listing of Threatened fauna as matters of National Environmental Significance (NES). Under the EPBC Act, actions that have, or are likely to have, a significant impact on a matter of NES, require approval from the Australian Government Minister for the Environment through a formal referral process. Key threats and habitat critical to the survival of EPBC Act Threatened species are usually defined in the conservation advice and/or recovery plan for the species.

Conservation categories applicable to Threatened fauna species under the EPBC Act are as follows:

- Extinct (EX)[1] – there is no reasonable doubt that the last individual has died
- Extinct in the Wild (EW) – taxa known to survive only in captivity
- Critically Endangered (CR) – taxa facing an extremely high risk of extinction in the wild in the immediate future
- Endangered (EN) – taxa facing a very high risk of extinction in the wild in the near future
- Vulnerable (VU) – taxa facing a high risk of extinction in the wild in the medium-term
- Conservation Dependent (CD)[1] – taxa whose survival depends upon ongoing conservation measures; without these measures, a conservation dependent taxon would be classified as Vulnerable, Endangered or Critically Endangered.

2.2 STATE

2.2.1 Threatened and Priority species

In WA, the BC Act provides for the listing of Threatened fauna species (Government of Western Australia 2018a, b) in the following categories:

- Critically Endangered (CR) – species facing an extremely high risk of extinction in the wild in the immediate future[2]
- Endangered (EN) – species facing a very high risk of extinction in the wild in the near future[2]
- Vulnerable (VU) – species facing a high risk of extinction in the wild in the medium-term future[2].

Species may also be listed as specially protected (SP) under the BC Act in one or more of the following categories:

- species of special conservation interest (conservation dependent fauna, CD) – species with a naturally low population, restricted natural range, of special interest to science, or subject to or recovering from a significant population decline or reduction in natural range

[1] Species listed as Extinct and Conservation Dependent are not matters of NES and therefore do not trigger the EPBC Act.

[2] As determined in accordance with criteria set out in the ministerial guidelines.

- migratory species (Mig.), including birds subject to international agreement
- species otherwise in need of special protection (OS).

DBCA administers the BC Act and also maintains a non-statutory list of Priority fauna. Priority species are still considered to be of conservation significance – that is they may be Threatened – but cannot be considered for listing under the BC Act until there is adequate understanding of threat levels imposed on them. Species on the Priority fauna list are assigned to one of 4 Priority (P) categories, P1 (highest) – P4 (lowest), based on level of knowledge/concern.

2.2.2 Critical habitat

Under the BC Act, habitat is eligible for listing as critical habitat if it is critical to the survival of a Threatened species or a Threatened Ecological Community (TEC) and its listing is otherwise in accordance with the ministerial guidelines.

3 METHODS

This memo has been written with consideration of the following guidelines and guidance:

- Referral guideline for 3 WA threatened black cockatoo species Carnaby's Cockatoo (*Zanda latirostris*), Baudin's Cockatoo (*Zanda baudinii*) and the FRTBC (*Calyptorhynchus banksii naso*) (DAWE 2022b).
- Black cockatoos and development in South-West Western Australia (DAWE 2022a).
- Scoring System for the Assessment of Foraging Value of Vegetation for Black-Cockatoos (Bamford 2021).

3.1 BREEDING HABITAT ANALYSIS

Breeding habitat for black cockatoos consists of woodland or forest; however, they will also breed in areas of former woodland or forest habitats which consist of now fragmented patches of habitat and/or isolated trees. Breeding habitat is defined in DAWE (2022b) as "habitat that contains known, suitable or potential nesting trees."

A breeding tree is considered by DAWE (2022b) as any tree species where "suitable nest hollows" are present. Suitable nest hollows are only found in live trees with a diameter at breast height (DBH) of at least 500 mm. Trees suitable to develop a nest hollow in the future are 300-500 mm DBH. Note that many species of eucalypt may develop suitable hollows for breeding DAWE (2022b), however, All *E. todtiana* and introduced eucalypts were removed from the dataset on the basis the form, habit, and/or hollow forming properties of these species is generally unsuitable for black cockatoo nesting.

AECOM (2020) and JBS&G (2023) recorded trees with a DBH equal to or greater than 500 mm, including any hollow-bearing trees. The following information was recorded for each tree:

- tree species
- DBH (mm)
- number of hollows present
- hollow height (m) and orientation
- hollow suitability (e.g. size of entrance, condition of outside of the hollow)
- evidence of use.

After reviewing the previous reports (AECOM 2020; JBS&G 2023) and associated data provided it was determined that 7 PHT within the study area required re-inspection to confirm the precise location (as there were discrepancies with locations in the different datasets) and suitability of those hollows as nests for black cockatoos. In particular, 3 of these trees had been previously identified as having 'possibly suitable' hollows, however, no further investigation of these tree hollows was undertaken during or immediately after the previous biological surveys.

Subsequently, on 19 January 2024 Anna Jacks (Phoenix) and Steve Robertson (Activate Projects) inspected those 7 trees. After each tree was located, their position was again recorded using a GPS and the same data as recorded previous was re-collected. Binoculars were used to assess each hollow from ground-level and then inspected with a GoPro camera mounted on a pole to verify suitability, if necessary. The information collected during the survey was compared to the original descriptions to determine accuracy of initial recordings and any changes to tree and hollow condition since the original survey was noted.

3.2 ROOSTING HABITAT ANALYSIS

Roosting habitat within the Wattle Grove (South) MRS Amendment Area was determined using trees known as roosting for any of the black cockatoo species and the habitat types containing these trees:

- Carnaby's Roosting habitat is found in any tall trees near or in riparian environments or permanent water sources. These trees include Flat-topped Yate, Salmon Gum, Wandoo, Marri, Karri, Blackbutt, Tuart, introduced eucalypts and introduced pines.
- RFTBC favour tall trees such as Jarrah, Marri, Blackbutt, Tuart and introduced eucalypt trees or large trees on the edge of forests. The pine plantations between Mandurah, Bunbury and north of the Perth metropolitan area can provide foraging and night roosting habitat in the Swan Coastal Plain.
- Baudin's Cockatoo also prefer to be near riparian environments or other permanent water sources. Any tall trees may provide roosting habitat for Baudin's Cockatoo, but particularly Jarrah, Flooded Gum, Blackbutt, Tuart and introduced eucalypts such as Blue Gum (*E. globulus*) and Lemon Scented Gum (*Corymbia citriodora*) (DAWE 2022b). Suitable roosting habitat has to also be within 20 km of foraging habitat (DAWE 2022a).

3.3 FORAGING HABITAT ANALYSIS

The foraging value of each habitat type within the Wattle Grove (South) MRS Amendment Area was assessed for each black cockatoo species using the HQS methodology developed by Bamford Consulting Ecologists (Appendix 1). The scoring system provides a numerical value that reflects the significance of vegetation as foraging habitat for black cockatoos and this numerical value is designed to provide the information needed by DCCEEW, Department of Water and Environmental Regulation (DWER) and the EPA to assess impact significance and offset requirements.

The foraging value of the vegetation is dependent on the type, density and condition of vegetation in an area and is determined by factors such as foraging habitats near it.

Calculating the total score (out of 10) requires these following steps:

A. Site condition. Finding out a score out of 6 for the vegetation composition, condition, and structure; plus
B. Site context. Find out a score out of 3 for the context of the site; plus
C. Species stocking rate. Determining a score out of one for species density.
D. Determining the total score out of 10, which may require moderation for context and species density with respect to the site condition (vegetation) score. Moderation also includes consideration of pine plantations as a special case for foraging value.

Site condition was determined using existing vegetation mapping and compiling all the relevé and quadrat species-level spatial data and imported it into Phoenix' biological database, along with the supplied vegetation type spatial dataset. Using spatial Structured Query Language (SQL) we then used a series of stored routines to:

- gather the array of foraging species present within each sample plot for each cockatoo species, their respective cover (%) and height (cm) values, and the total number foraging species.
- intersect species records with vegetation type and vegetation condition.
- output a polygon dataset containing the above information.

4 RESULTS

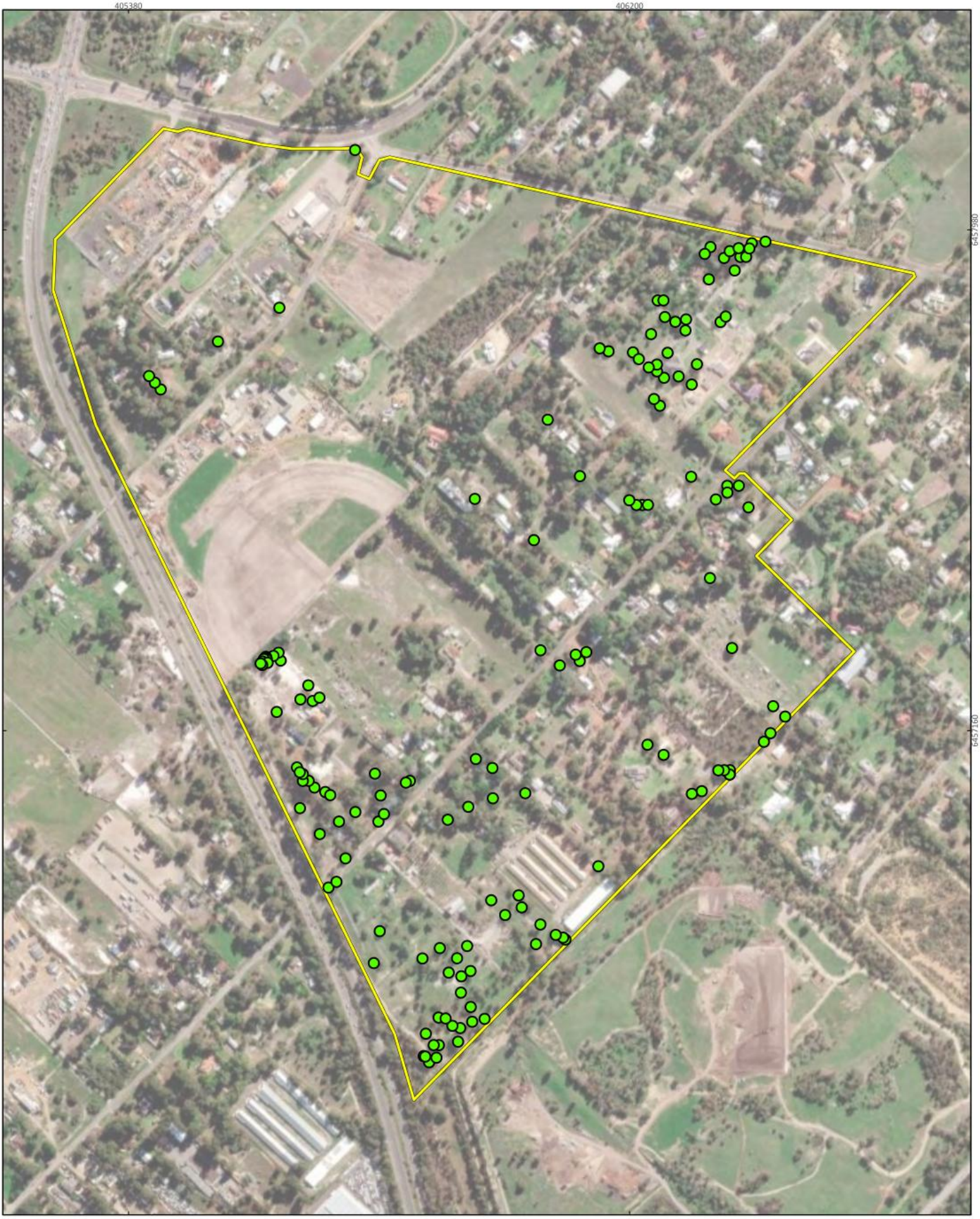
4.1 BREEDING HABITAT ANALYSIS

A total of 153 PHTs occur within the Wattle Grove (South) MRS Amendment Area Figure 4-1; Appendix 2). These consist of native WA trees known to support breeding, that is, Jarrah, Marri, Tuart, Flooded Gums and stag trees. The majority of trees are scattered in areas of degraded habitat or cleared land/paddocks.

As above, a total of 7 trees identified previously (DAWE 2022b; JBS&G 2023) as having possibly suitable breeding hollows were inspected again on 19 January 2024 by Phoenix (Figure 4-2), and the following was observed (Table 4-1):

- Two records are considered to be erroneous and were removed from the dataset (NewID = 0).
- Habitat tree 417 is no longer present; given its age and comments at the time of the original inspection, it is assumed that this tree had further deteriorated and been removed.
- Habitat tree 482 was in poor condition and no longer contained suitable hollows.
- The remaining 3 trees (438, 491, 561) contained unsuitable hollows (too small and/or inhabited by bees).
- Tree 491 appears to be regularly visited with both preening and old and new foraging evidence present; but it is not a breeding tree.

As a result, Phoenix has confirmed that no breeding trees occur within the Wattle Grove (South) MRS Amendment Area.





Coterra Environment
Wat le Grove MRS Re-zoning

Project No	1633
Date	14/03/2024
Drawn by	AJ
Map author	AJ

0 140 280
Metres

1:8,000 (at A4) GCS WGS 1984

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Wat le Grove (South) MRS Amendment Area

Potent al habitat trees

Figure 4-1

Potent al habitat trees in the Wat le Grove (South) MRS Amendment Area

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Table 4-1 Potential habitat trees with hollows within the Wattle Grove (South) MRS Amendment Area re-assessed in January 2024

NewID / Tree ID	Latitude	Longitude	Species	DBH (mm)	AECOM (2019) hollow comments and determination		Phoenix (2024) hollow comments and determination	
417	116.0034	-32.0213	Jarrah	1,100	very stressed, dead old	Possibly suitable	A stand of 3 young Jarrah present at this location. None contain hollows. No very old Jarrah were near this location, assumed no longer present (Figure 4-3).	Not no longer present
438	116.0037	-32.0211	Jarrah	1,300	healthy	Possibly suitable	Hollow in fork of tree at about 5 m (Figure 4-4). Opening and inside is too narrow (Figure 4-5).	Not suitable
482	116.0024	-32.0212	Stag	600	Hollow 1: 15x20 cm, west facing, vertical on trunk, 6 m above ground, no evidence of use. Hollow 2: 30x30 cm entrance, facing upward/vertical on spout, 7 m above ground	Possibly suitable	Tree now very degraded and does not contain any suitable hollows (Figure 4-6). Two adjacent alive trees did not contain any hollows.	Not suitable
491	116.0036	-32.0213	Jarrah	1,200	Tree split into 2. Hollow 1: East facing branch, 8 m above ground, 10x40 cm, tree utilised by Lorikeets. Hollow 2: West facing branch, 6 m above ground, 15x50 cm, at 45 degrees. Hollow 3: South facing branch, 7 m above ground, 15x20 cm, at 45 degrees.	Possibly suitable	Tree split in 2 with 4 potential hollows (Figure 4-7): • Hollow 1 western branch is not hollow inside (Figure 4-8) • Hollow 2 in northwestern branch is too small inside (Figure 4-9). Evidence of nesting from other species such as galahs (scarring below hollow) • Hollow 3 in northwestern branch is occupied by bees • Hollow 4 is too narrow inside. Abundant new to old foraging on Jarrah nuts and at least 4 preened black cockatoo feathers under tree (Figure 4-10).	Not suitable

NewID / Tree ID	Latitude	Longitude	Species	DBH (mm)	AECOM (2019) hollow comments and determination		Phoenix (2024) hollow comments and determination	
561	116.0088	-32.0108	Jarrah	900	Hollow 1: West facing branch, 11 m above ground, 50x10 cm, 45 degrees, unable to assess chamber size, hollow occupied by Galahs Hollow 2: North-west facing branch, 10 m above ground, 10x100 cm, 45 degrees, old evidence of use, occupied by bees.	Possibly suitable	Tree viewed from road as no access to property. Several hollows were noticed, however one had bees and the others were too small, but had evidence of scarring indicating possible use by other species, e.g. the Australian Ringneck present in tree at the time of survey. Female Carnaby's Cockatoo perched in adjacent planted eucalypt.	Not suitable
0 (north)	116.0088	-32.0108	Jarrah	0	Hollow 1: West facing branch hollow, 11 m above ground, 50x10 cm entrance at 45 degrees, unable to assess chamber size, hollow occupied by pink and grey galahs Hollow 2: North-west facing branch hollow 10 m above ground, 10x100 cm entrance at 45 degrees.	Possibly suitable	Given there is no tree ID, the description is very similar to habitat tree 561 (a Marri tree with no suitable hollows) and the point is 2 m away, it is assumed this is a duplicate.	Not suitable
0 (south)	116.0023	-32.0212	Stag	0	Hollow 1: 15x20 cm entrance, west facing hollow, vertical on trunk, 6 m above ground, unable to assess depth, no evidence of use Hollow 2: 30x30 cm entrance, facing upward/vertical on spout, 7 m above ground.	Possibly suitable	The tree at this point location was an *Allocasuarina*. No other trees nearby. Given there is no "NewID" for this record, this is likely to represent a data error. No habitat tree present.	Not suitable

405445
405980
406515
6458045
6457510
6456975
6456440
0
482
438
417
491
561
0
0
50
100 m
0
20
40 m
PERTH

Coterra
Wattle Grove MRS Amendment

Project No	1633
Date	19 Jan 2024
Drawn by	AJ
Map author	AJ

0 125 250
Metres

1:5,380 (at A3) GDA 1994 MGA Zone 50

Potential habitat trees
Wattle Grove MRS Amendment Area

Figure 4-2

Potential habitat trees re-assessed by Phoenix in 2024

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Figure 4-3 Trees at location of habitat tree 417



Figure 4-4 Habitat tree 438



Figure 4-5 Hollow of habitat tree 438



Figure 4-6 Habitat tree 482



Figure 4-7 Habitat tree 491



Figure 4-8 Hollow 1 in habitat tree 491



Figure 4-9 Hollow 2 in habitat tree 491



Figure 4-10 Foraging evidence and black cockatoo feathers underneath habitat tree 491

4.2 ROOSTING HABITAT ANALYSIS

There are 50 confirmed roosting sites (23 FRT roosting sites, 7 White-tailed sp. roosting sites, 20 White-tailed and FRT roosting sites) and 10 unconfirmed roosting sites within 12 km of the study area (Figure 4-11) (Birdlife 2024).

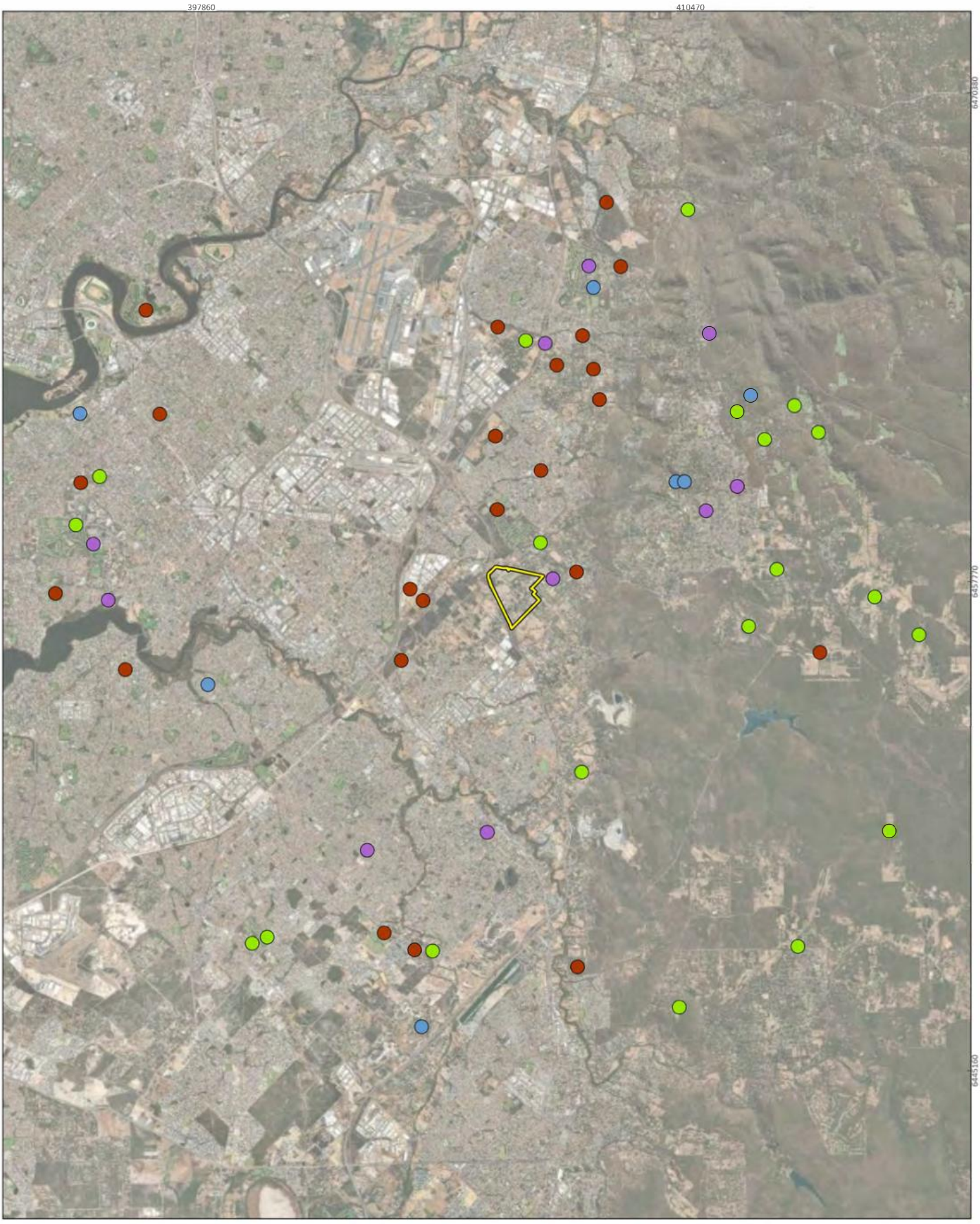
The nearest roosting site to the study area is an unconfirmed roosting site located 250 m east of the study area (KALWATR001). An unconfirmed roosting site is where roosting black-cockatoos have been reported but have not had a positive count recorded (≥1 bird) during any GCC; these sites may be used at other times of year or may have only recently been added to the GCC database (Birdlife 2024).

The nearest FRT and white-tailed sp. roosting site is 825 m north of the study area (KALWATR003) recorded 21 and 28 individuals in 2021 and 2023 respectively during the Great cocky Count census.

The confirmed site (KALWATR002), recorded 850 m east of the study area supports FRTBC roosting of up to 150 individuals (Great Cocky Count Census 2016, 2018), with lower numbers recorded in subsequent years (23, 87, 0, and 37)

The unconfirmed roosting site (KALWATR001) is just 350 m east of the study area (DBCA 2023).

The habitat assessment undertaken by (AECOM 2020) determined that 29.8 ha of suitable roosting habitat was present, consisting of remnant native vegetation, planted gardens and scattered trees (Figure 4-1). Numerous surveys have been undertaken for this Project since 2019, and numerous sites in close proximity are part of annual black cockatoo monitoring, and to date no roosting sites for black cockatoo species have been identified within the study area. So while there may be habitat considered suitable for roosting, it does not appear to have been used as such for almost the last decade.





Hesperia Projects Pty Ltd
Wattle Grove Metropolitan Region Scheme

Project No	1647
Date	11/07/2024
Drawn by	JL
Map author	AJ

0 1.5 3
Kilometers

1:126,100 (at A4) GDA 1994 MGA Zone 50

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Study area

Site category

- FRT - roost site
- WT - roost site
- WT and FRT roost site
- unconfirmed roost site

Figure 4-11

Roosting locations within 12 km of the study area (Birdlife 2024)

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4.3 FORAGING HABITAT ANALYSIS

Foraging habitat scores have been calculated per the methods presented in Bamford (2021) (Table 4-2, Table 4-3, Table 4-4).

4.3.1 Site context

Site context was allocated a '3' to all species in being that:

- Carnaby's cockatoo: local breeding is also known and 32.9% of native vegetation remains within 15km of the Amendment Area
- Baudin's cockatoo: no local breeding is known or likely, but 32.9% of native vegetation remains within 15km of the Amendment Area
- FRTBC: no local breeding is known or likely, but 32.9% of native vegetation remains within 15km of the Amendment Area.

4.3.2 Species stocking rate

Species stocking rate was given '1' for Carnaby's Cockatoo and FRTBC and '0' for Baudin's Cockatoo:

- Carnaby's Cockatoo: stocking rate = 1, observed feeding and multiple recent and historic evidence of feeding activity were recorded (i.e. AECOM 2020; DBCA 2023; JBS&G 2023 and here).
- Baudin's Cockatoo: stocking rate = 0, as no feeding was directly observed, nor was recent or historical evidence found and desktop records are also absent within 15km of the Amendment Area .
- FRTBC: stocking rate = 1 as observed feeding and multiple recent and historic evidence of feeding activity have been recorded (i.e. AECOM 2020; DBCA 2023; JBS&G 2023 and here).

4.3.3 Site condition

Per Bamford (2021) "site condition" is scored out of 6 and is the biggest factor in the overall score. Site condition varied between vegetation types and between species of black cockatoo, with higher scores being attributed to those vegetation units/habitats with a higher density of foraging species.

4.3.4 Moderation

Moderation has been applied to parts of the habitat polygons that did not record a known forage species (native or introduced).

4.3.5 Site score

The results for the black cockatoo foraging habitat analysis are summarised below, per vegetation type (Table 4-2; Table 4-3; Table 4-4), per relative score (Table 4-5; Table 4-6) and shown visually in Figure 4-12 (Carnaby's Cockatoo), Figure 4-13 (Baudin's Cockatoo) and Figure 4-14 (FRTBC).

Table 4-2 Site score for Carnaby's Cockatoo

Veg. type/ Site score with justification	2	3	5	6	8	Total
BaEpPf				**0.82**	**3.41**	**4.23**
32.9% native veg. remaining (within 15km). Local breeding confirmed (within 12km).					3.41	3.41
32.9% native veg. remaining (within 15km). Some foraging species present, but moderated down due to degraded condition.				0.82		0.82
BmXpEc					**0.29**	**0.29**
32.9% native veg. remaining (within 15km). Local breeding confirmed (within 12km).					0.29	0.29
32.9% native veg. remaining (within 15km). Some foraging species present, but moderated down due to degraded condition.				0.13		0.13
Cleared	**91.23**					**91.23**
32.9% native veg. remaining (within 15km). But no foraging species present; 32.9% native veg. remaining (within 15km). Local breeding confirmed (within 12km).	91.23					91.23
EmMpLp	**0.08**				**0.05**	**0.13**
32.9% native veg. remaining (within 15km). But no foraging species present.	0.08					0.08
32.9% native veg. remaining (within 15km). Local breeding confirmed (within 12km).					0.05	0.05
Planted	**2.80**					**2.80**
32.9% native veg. remaining (within 15km). But no foraging species present.	2.80					2.80
Trees	**20.43**	**5.84**	**0.59**	**0.05**		**26.91**
32.9% native veg. remaining (within 15km). But no foraging species present; moderated down due to degraded condition.	20.43					20.43
32.9% native veg. remaining (within 15km). Local breeding confirmed (within 12km).			0.59			0.59
32.9% native veg. remaining (within 15km). Some foraging species present, but moderated down due to degraded condition.		5.84		0.05		5.89
Total	**114.54**	**5.84**	**0.59**	**0.87**	**3.75**	**125.59**

Table 4-3 Site score for Baudin's Cockatoo

Veg. type/ site score with justification	2	3	5	7	Total
BaEpPf	**0.82**		**1.34**	**2.08**	**4.24**
32.9% native veg. remaining (within 15km). Foraging species present.			1.34		1.34
32.9% native veg. remaining (within 15km). Foraging species present. Moderated down due to degraded condition.	0.82				0.82
32.9% native veg. remaining (within 15km). Multiple foraging species present, veg in good or better condition.				2.08	2.08
BmXpEc				**0.29**	**0.29**
32.9% native veg. remaining (within 15km). Multiple foraging species present, veg in good or better condition.				0.29	0.29
Cleared	**91.23**				**91.23**
32.9% native veg. remaining (within 15km). Foraging species present. Moderated down due to degraded condition.	91.23				91.23
EmMpLp	**0.08**			**0.05**	**0.13**
32.9% native veg. remaining (within 15km). Foraging species present. Moderated down due to degraded condition.	0.08				0.08
32.9% native veg. remaining (within 15km). Multiple foraging species present, veg in good or better condition.				0.05	0.05
Planted	**2.80**				**2.80**
32.9% native veg. remaining (within 15km).	2.80				2.80
Trees	**21.63**	**4.48**	**0.81**		**26.92**
32.9% native veg. remaining (within 15km). Moderated down due to degraded condition.	21.06				20.66
32.9% native veg. remaining (within 15km). Foraging species present. Moderated down due to degraded condition.	0.57	4.48	0.81		6.25
Total	**116.55**	**4.48**	**2.14**	**2.41**	**125.59**

Table 4-4 Site score for FRTBC

Veg. type/ site score with justification	2	3	7	8	Total
BaEpPf		**0.82**		**3.41**	**4.23**
32.9% native veg. remaining				2.42	2.42
32.9% native veg. remaining (within 15km). But Moderated down due to clearing, despite foraging species present.		0.82			0.82
32.9% native veg. remaining (within 15km). No foraging species present.				0.99	0.99
BmXpEc			**0.05**	**0.24**	**0.29**
32.9% native veg. remaining (within 15km)			0.05	0.24	0.29
Cleared	**91.23**				**91.23**
32.9% native veg. remaining (within 15km). But Moderated down due to clearing, despite foraging species present.	84.45				84.45
32.9% native veg. remaining (within 15km). But Moderated down due to clearing.	0.13				0.13
32.9% native veg. remaining (within 15km). No foraging species present. Moderated down due to condition.	6.64				6.64
EmMpLp		**0.08**		**0.05**	**0.13**
32.9% native veg. remaining (within 15km)				0.05	0.05
32.9% native veg. remaining (within 15km). But Moderated down due to clearing, despite foraging species present.		0.08			0.08
Planted	**2.80**				**2.80**
32.9% native veg. remaining (within 15km). No foraging species present. Moderated down due to condition.	2.80				2.80
Trees	**20.61**	**6.30**			**26.91**
32.9% native veg. remaining (within 15km). But Moderated down due to clearing, despite foraging species present.		6.30			6.30
32.9% native veg. remaining (within 15km). No foraging species present. Moderated down due to condition.	20.61				20.61
Total	**114.63**	**7.20**	**0.05**	**3.70**	**125.59**

Overall, the majority of the Project Area has low value foraging habitat for Carnaby's Cockatoo (120.38 ha; 95.86%), Baudin's Cockatoo (121.03 ha; 96.37%) and FRTBC (121.84 ha; 97.02%) as the area is comprised largely of cleared areas and degraded remnant vegetation (Table 4-6). A small proportion of the study area consists of high value foraging habitat for Carnaby's Cockatoo (3.75 ha; 2.99%), Baudin's Cockatoo (2.413 ha; 1.92%) and FRTBC (3.75 ha; 2.99%).

Table 4-5 Black cockatoo foraging habitat value per Bamford 2021 scoring method. Low value habitat (1-3) is in green, Moderate value habitat (4-6) is in yellow, High value habitat (7-10) is in Red.

Veg. type	Relative rating	Carnaby's Cockatoo		Baudin's Cockatoo		FRTBC	
		Score	Sum area (ha)	Score	Sum area (ha)	Score	Sum area (ha)
BaEpPf	Low			2	0.822	3	0.822
	Med.	6	0.82	5	1.337		
	High	8	3.41	7	2.075	8	3.412
BmXpEc	High			7	0.29	7	0.051
		8	0.29	-	-	8	0.239
Cleared	Low	2	91.229	2	91.229	2	91.229
EmMpLp	Low	2	0.079	3	0.079	3	0.079
	High	8	0.048	7	0.048	8	0.048
Planted	Low	2	2.80	3	2.796	2	2.796
Trees	Low	2	20.43	2	21.627	2	20.609
		3	5.84	3	4.476	3	6.3
	Med.	5	0.59	5	0.806	-	-
		6	0.05	-	-	-	-
Total area (ha)			**125.59**		**125.59**		**125.59**

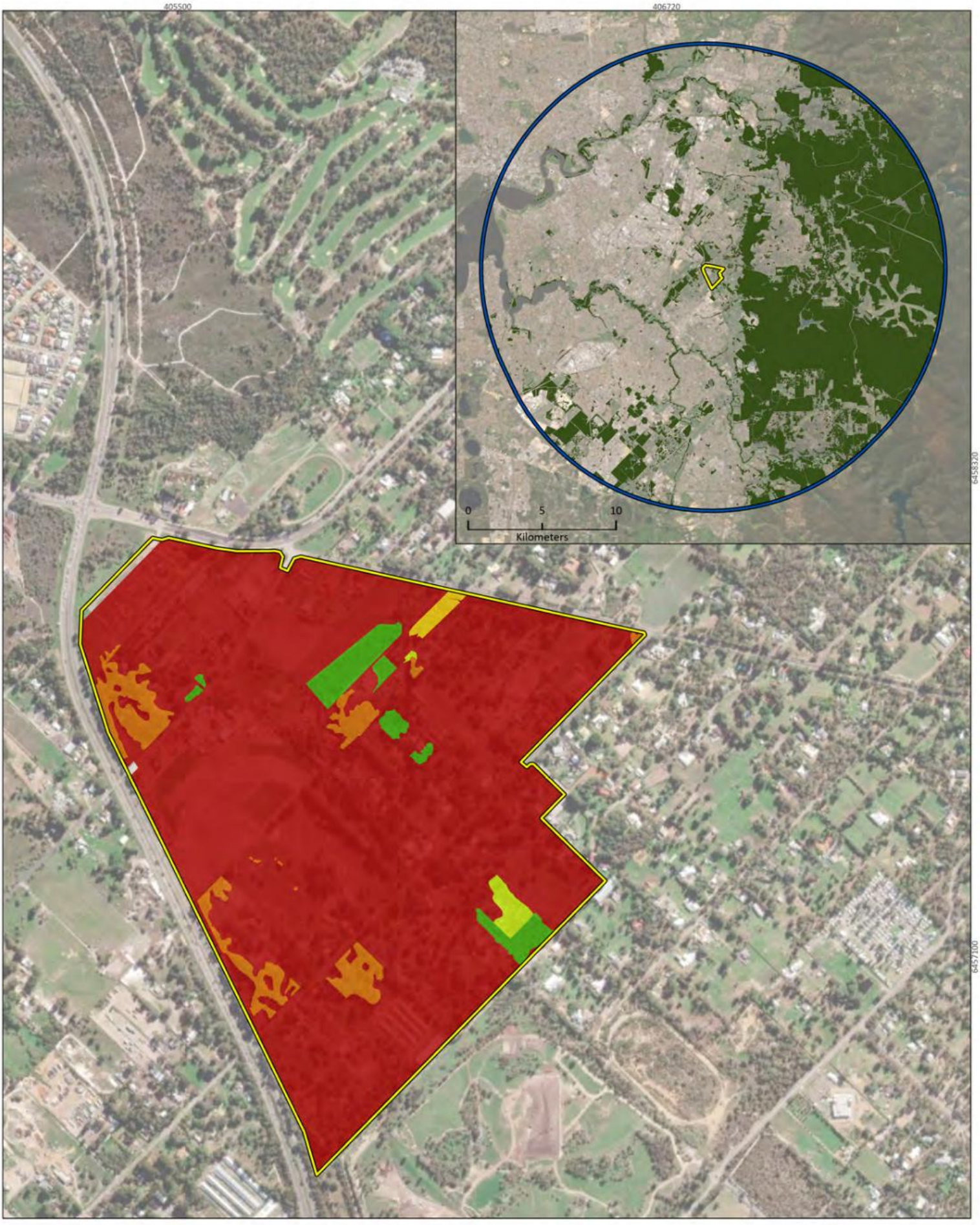
Table 4-6 Summary of foraging habitat scores and species

Habitat value/Score		Carnaby's Cockatoo	Baudin's Cockatoo	FRTBC
Low	2	114.5	113.68	114.63
	3	5.8	7.35	7.20
Subtotal		**120.38**	**121.03**	**121.84**
Med.	5	0.59	2.14	0
	6	0.87	0	0
Subtotal		**1.46**	**2.14**	**0.00**
High	7	0	2.41	0.05
	8	3.75	0	3.69
Subtotal		**3.75**	**2.413**	**3.75**
Total		**125.585**	**125.585**	**125.585**

It is also worth noting that 'local' native remnant vegetation (within 15km of the Amendment Area) is comprised of thousands of small, fragmented remnants (to the north, south and west), and a handful of very large, connected remnants to the east (comprising National Park, Nature Reserve, Conservation Park and Conservation Covenanted land) that dramatically impact the summary statistics (Table 4-7), e.g. the mean size of remnants is 10.1 ha, but the median size is just 0.8 ha.

Table 4-7 Summary statistics for remnant vegetation within 15 km of the study area

Statistic	**Result**
Count	2,543.0
Min.	0.0
Max.	4,689.5
Range	4,689.5
Sum	25,632.5
Mean	10.1
Median	0.8
Std.dev.	116.8
q1	0.3
q3	2.3





Hesperia Projects Pty Ltd
Wattle Grove Metropolitan Region Scheme

Project No	1633
Date	15/03/2024
Drawn by	JL
Map author	JC

0 250 500
Meters

1:12,200(at A4) GDA 1994 MGA Zone 50

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- Study area
- 15 km buffer
- Remaining native vegetation

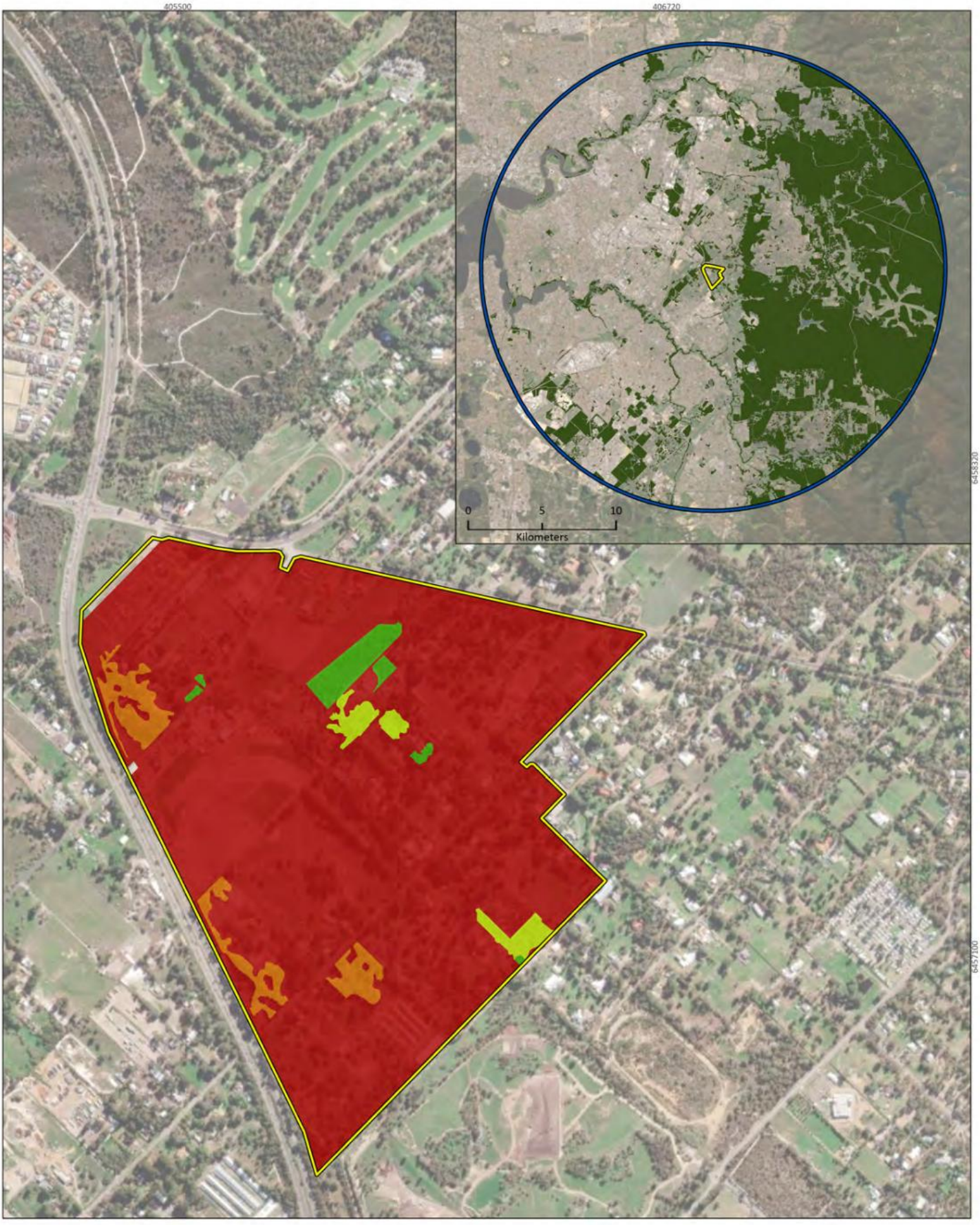
Foraging habitat score

- 2
- 3
- 5
- 6
- 8

Figure 4-12

Carnaby's Cockatoo foraging habitat value per Bamford (2021) scoring method

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Hesperia Projects Pty Ltd
Wattle Grove Metropolitan Region Scheme

Project No	1633
Date	15/03/2024
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0 250 500
Meters

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- Study area
- 15 km buffer
- Remaining native vegetation

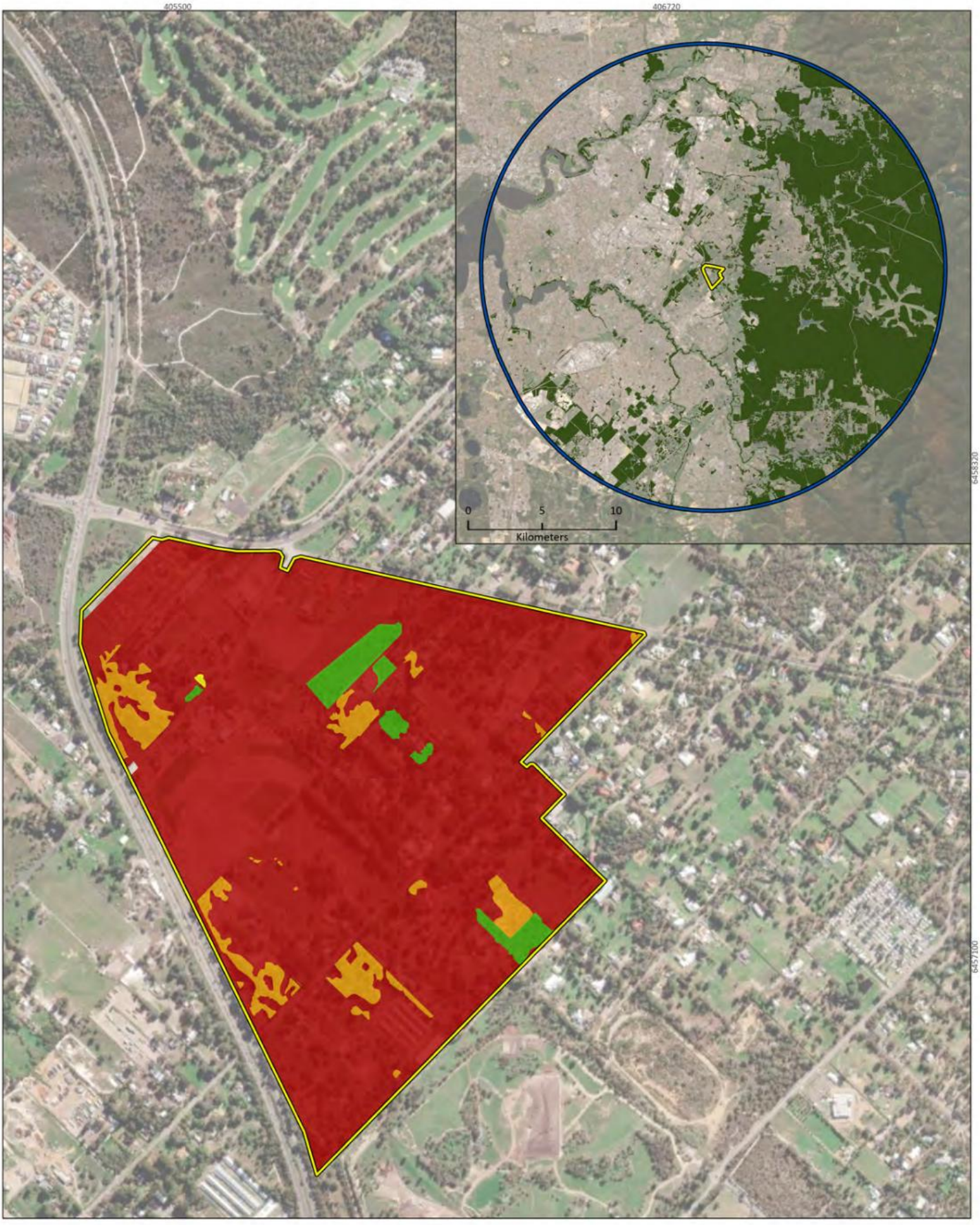
Foraging habitat score

- 2
- 3
- 4
- 5
- 7

Figure 4-13

Baudin's Cockatoo foraging habitat value per Bamford (2021) scoring method

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Hesperia Projects Pty Ltd
Wattle Grove Metropolitan Region Scheme

Project No	1633
Date	15/03/2024
Drawn by	JL
Map author	JC

0 250 500
Meters

1:12,200(at A4) GDA 1994 MGA Zone 50

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Study area
15 km buffer
Remaining native vegetation

Foraging habitat score
2
3
7
8

Figure 4-14

FRTBC foraging habitat value per Bamford (2021) scoring method

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5 DISCUSSION AND CONCLUSION

DAWE's (2022b) objective for black cockatoos is to promote avoidance and mitigation of impacts. Black cockatoos have been and may continue to be impacted through various mechanisms, of which are essentially related to the loss or degradation of breeding habitat (in the form of hollow-bearing trees), roosting habitat (suitable trees in proximity to water, breeding trees and foraging habitat) and foraging habitat (food resources).

In terms of breeding habitat, none of the PHTs in the study area are suitable for black cockatoo nesting. All hollows are either too degraded, too small or too young to contain suitable hollows at present, as per the inspection undertaken for this report which further ground-truthed using a pole camera, 7 hollow-containing trees identified previously (AECOM 2020; JBS&G 2023). Hollows can take hundreds of years to develop, therefore, a lack of suitable hollows today does not necessarily downgrade the value of breeding habitat. Trees with hollows today are the "foundation of life for future generations of black cockatoos" (DAWE 2022a). In this case the study area contains a small area of high-quality foraging habitat and extensive areas of high-quality foraging habitat is found nearby to the east, there are water sources and roosting sites in close proximity. Thus, the study area could be considered high-quality 'future breeding habitat'. However, the study area comprises semi-rural residential land that is heavily developed, and in only the last 3 years numerous PHTs have been lost due to age and condition. In the context of the current land use, it is considered highly unlikely that the current crop of trees will still be standing in 50-100 years, when they may begin to offer the larger hollows needed for breeding, regardless of the current proposed scheme amendment change.

Similarly for roosting habitat, the currently standing trees do present potential habitat in the form of planted trees, scattered native trees and remnant eucalypt woodland, but has been found to be of largely of low value. In the absence of the proposed scheme amendment roosting cannot be ruled out as there is one confirmed and one unconfirmed roosting location within 1km of the Project area, and foraging evidence over a number of years tells us that Carnaby's Cockatoo and FRTBC are using this area regularly. However, over the last decade local black cockatoo monitoring and the surveys completed for this Project (AECOM 2020; JBS&G 2023) have failed to identified any evidence of roosting in this Project area, and, the nearby roosting sites are in riparian vegetation which does not occur in the Project area.

The value of the Project area to black cockatoos is therefore primarily as foraging habitat. Evidence of Carnaby's Cockatoo and FRTBC foraging has been recorded on all 3 surveys (AECOM 2020; JBS&G 2023 and in this survey) in the form of clipped branches and chewed nuts, as well as by direct sighting. Baudin's Cockatoo however is considered far less likely to occur. It may occur on occasion as vagrants from the Perth foothills, and records further west onto the Swan Coastal Plain are known (Bamford 2019), however no sightings or evidence have been recorded during the surveys completed to date (AECOM 2020; JBS&G 2023) or by inspection of the most relevant databases (DBCA 2023).

According to the calculations per the Bamford (2021) methods 4% of the study area is considered medium-high quality foraging habitat, and 96% is low value habitat. Given all of the above, it is entirely appropriate that the approximately 3.75 ha (3%) of high-quality TEC remnant vegetation present be retained to support local breeding, roosting and foraging for Carnaby's Cockatoo and FRTBC. With the remainder offering little value to those species.

The foraging habitat scores obtained using BCE's black cockatoo foraging habitat scoring method were lower than those used by AECOM in 2020. The reasons for this pertain to a more accurate depiction of foraging value used in the current scoring system. The factors used in the DCCEEW scoring tool include foraging potential, connectivity, proximity to breeding, proximity to roosting and plant disease, and since all of these factors favour the site, a larger area was considered Very high and High value for all 3 species of black cockatoo, when in reality, the abundance of forage species is minimal for both high quality forage species such as Marri, *Banksia* and Pine (predominantly < 10 % foliage cover), and also for lower quality forage species such as small fruited eucalypts and introduced fruit

trees. BCEs method also takes into account actual foraging observations, as well as predicted distribution.

There are no recent records of fire at the time of the vegetation survey so this is not likely to have impacted forage species coverage scores. The presence of weeds and introduced forage species does indicate low value forage habitat due to their sparse coverage and/or poor quality food source and poor accessibility, compared to native forage species which are generally higher quality and in higher abundance when in native remnant patches.

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Appendix 1 Scoring system for the assessment of foraging value of vegetation for black cockatoos (Bamford 2021)

Total score (out of 10) comprises:

- A score out of 6 for the vegetation composition, condition and structure, plus
- A score out of 3 for the context of the site, plus
- A score out of one for species density.

These are described in detail below.

A. Vegetation composition, condition and structure scoring

Site score	Description of vegetation values		
	Carnaby's Black-Cockatoo	**Baudin's Black-Cockatoo**	**FRTBC**
0	No foraging value. No Proteaceae, eucalypts or other potential sources of food. Examples: • Water bodies (e.g. salt lakes, dams, rivers) • Bare ground • Developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits).	No foraging value. No eucalypts or other potential sources of food. Examples: • Water bodies (e.g. dams, rivers) • Bare ground • Developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits).	No foraging value. No eucalypts or other potential sources of food. Examples: • Water bodies (e.g. dams, rivers) • Bare ground • Developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits).
1	Negligible to low foraging value. Examples: • Scattered specimens of known food plants but projected foliage cover of these is < 2%. This could include urban areas with scattered foraging trees • Paddocks that are partly vegetated with melons or other known food-source weeds (e.g. Erodium spp.) that represent a short-term and/or seasonal food-source • Blue Gum plantations (foraging by Carnaby's Cockatoos has been reported but appears to be unusual).	Negligible to low foraging value. Scattered specimens of known food plants but projected foliage cover of these < 1%. This could include urban areas with scattered foraging trees.	Negligible to low foraging value. Scattered specimens of known food plants but projected foliage cover of these < 1%. Could include urban areas with scattered foraging trees.

Site score	Description of vegetation values		
	Carnaby's Black-Cockatoo	**Baudin's Black-Cockatoo**	**FRTBC**
2	Low foraging value. Examples: • Shrubland in which species of foraging value, such as shrubby banksias, have < 10% projected foliage cover • Woodland with tree banksias 2-5% projected foliage cover • Woodland with tree banksias (of key species *B.attenuata* and *B. menziesii*) with <10%projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths • Open eucalypt woodland/mallee of small-fruited species • Paddocks that are densely vegetated with melons or other known food-source weeds (e.g. Erodium spp.) that represent a short-term and/or seasonal food-source.	Low foraging value. Examples: • Woodland with scattered specimens of known food plants (e.g. Marri and Jarrah) 1-5% projected foliage cover • Marri-Jarrah Woodland with <10% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths • Parkland-cleared Eucalypt Woodland/Forest with known food plants <10% projected foliage cover (poor long-term viability without management) • Younger areas of (managed) revegetation with known food plants <10% projected foliage cover (establishing food sources with good long-term viability) • Urban areas with scattered foraging trees.	Low foraging value. Examples: • Woodland with scattered specimens of known food plants (e.g. Marri, Jarrah) 1-5%projected foliage cover • Marri-Jarrah Woodland with <10% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths • Sheoak Woodland with <10% projected foliage cover • Parkland-cleared Eucalypt Woodland/Forest with known food plants <10% projected foliage cover (poor long-term viability without management) • Younger areas of (managed) revegetation with known food plants <10% projected foliage cover (establishing food sources with good long-term viability) • Urban areas with scattered food plants such as Cape Lilac, Eucalyptus caesia and E. erythrocorys.

Site score	Description of vegetation values		
	Carnaby's Black-Cockatoo	**Baudin's Black-Cockatoo**	**FRTBC**
3	Low to Moderate foraging value. Examples: • Shrubland in which species of foraging value, such as shrubby banksias, have 10-20% projected foliage cover • Woodland with tree banksias 5-20% projected foliage cover • Woodland with tree Banksia (of key species *B. attenuata* and *B. menziesii*) with 10-40%projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths • Eucalypt Woodland/Mallee of small-fruited species • Eucalypt Woodland with Marri < 10% projected foliage cover.	Low to Moderate foraging value. Examples: • Eucalypt Woodland with known food plants (especially Marri) 5-20% projected foliage cover • Marri-Jarrah Woodland with 10-40% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths • Parkland-cleared Eucalypt Woodland/Forest with known food plants 10-40% projected foliage cover (poor long-term viability without management) • Younger areas of (managed) revegetation with known food plants 10-40% projected foliage cover (establishing food sources with good long-term viability).	Low to Moderate foraging value. Examples: • Eucalypt Woodland with known food plants (especially Marri and Jarrah) 5-20% projected foliage cover • Marri-Jarrah Woodland with 10-40%projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree d • Sheoak Forest with 10-40% projected foliage cover • Parkland-cleared Eucalypt Woodland/Forest with known food plants 10-40% projected foliage cover (poor long-term viability without management) • Younger areas of (managed) revegetation with known food plants 10-40% projected foliage cover (establishing food sources with good long-term viability).
4	Moderate foraging value. Examples: • Woodland/low forest with tree banksias (of key species *B. attenuata* and *B. menziesii*) 20-40% projected foliage cover • Woodland/low forest with tree banksias (of key species *B. attenuata* and *B. menziesii*) with 40-60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths • Kwongan/ Shrubland in which species of foraging value, such as shrubby banksias, have 20-40% projected foliage cover • Eucalypt Woodland/Forest with Marri 20–40% projected foliage cover.	Moderate foraging value. Examples: • Marri-Jarrah Woodland/Forest with 20-40% projected foliage cover • Marri-Jarrah Forest with 40-60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths • Parkland-cleared Eucalypt Woodland/Forest with known food plants 40-60% projected foliage cover (poor long-term viability without management) • Younger areas of (managed) revegetation with known food plants 40-60% projected foliage cover (establishing food sources with good long-term viability) • Orchards with highly desirable food sources (e.g. apples, pears, some stone fruits).	Moderate foraging value. Examples: • Marri-Jarrah Woodland/Forest with 20-40% projected foliage cover • Marri-Jarrah Forest with 40-60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths • Sheoak Forest with 40-60% projected foliage cover • Parkland-cleared Eucalypt Woodland/Forest with known food plants 40-60% projected foliage cover (poor long-term viability without management) • Younger areas of (managed) revegetation with known food plants 40-60% projected foliage cover (establishing food sources with good long-term viability).

Site score	Description of vegetation values		
	Carnaby's Black-Cockatoo	**Baudin's Black-Cockatoo**	**FRTBC**
5	Moderate to High foraging value. Examples: • Banksia Forest with 40-60% projected foliage cover • Banksia Forest with > 60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths • Kwongan/ Shrubland in which species of foraging value, such as shrubby banksias, have 40-60% projected foliage cover • Marri-Jarrah Forest with 40-60% projected foliage cover and vegetation condition good with low weed invasion and/or low tree deaths (indicating it is robust and unlikely to decline in the medium-term) • Pine plantations with trees more than 10 years old.	Moderate to High foraging value. Examples: • Marri-Jarrah Forest with 40-60% projected foliage cover • Marri-Jarrah Forest with > 60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths • Parkland-cleared Eucalypt Woodland/Forest with known food plants >60% projected foliage cover (poor long-term viability without management) • Younger areas of (managed) revegetation with known food plants >60% projected foliage cover (establishing food sources with good long-term viability).	Moderate to High foraging value. Examples: • Marri-Jarrah Forest with 40-60% projected foliage cover • Marri-Jarrah Forest with > 60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths • Sheoak Forest with > 60% projected foliage cover • Parkland-cleared Eucalypt Woodland/Forest with known food plants >60% projected foliage cover (poor long-term viability without management) • Younger areas of (managed) revegetation with known food plants >60% projected foliage cover (establishing food sources with good long-term viability).
6	High foraging value. Example: • Banksia Forest with > 60% projected foliage cover and vegetation condition good with low weed invasion and/or low tree deaths (indicating it is robust and unlikely to decline in the medium-term) • Kwongan/ Shrubland in which species of foraging value, such as shrubby banksias, have >60% projected foliage cover • Marri-Jarrah Forest with > 60% projected foliage cover and vegetation condition good with low weed invasion and/or low tree deaths (indicating it is robust and unlikely to decline in the medium-term).	High foraging value. Example: • Marri-Jarrah Forest with > 60% projected foliage cover and vegetation condition good with low weed invasion and/or low tree deaths (indicating it is robust and unlikely to decline in the medium-term).	High foraging value. Example: • Marri-Jarrah Forest with > 60% projected foliage cover and vegetation condition good with low weed invasion and/or low tree deaths (indicating it is robust and unlikely to decline in the medium-term).

Vegetation structural class terminology follows Keighery (1994).

B. Site context.

The maximum score is given in situations where foraging habitat is supporting breeding birds. It can also be given in fragmented landscapes where there is little foraging habitat remaining and thus what is left has a high contextual value. The site context score is species specific as it depends upon factors such as the vegetation type and extent, and the presence of breeding birds, and the following table, developed by Bamford consulting in conjunction with DCCEEW, provides a *guide* to the assignation of site context scores (note that 'local area' is defined as within a 15 km radius of the centre point of the study site):

Site context score	Percentage of the existing native vegetation within the 'local' area that the study site represents	
	'Local' breeding known/likely	**'Local' breeding unlikely**
3	> 5%	> 10%
2	1– 5%	5–10%
1	0.1–1%	0.1–5%
0	< 0.1%	< 0.1%

C. Species density.

Assignation of the species density score (0 or 1) is based upon the black-cockatoo species being either abundant or not abundant, and is species specific. A score of 1 is used where the species is seen or reported regularly and/or there is abundant foraging evidence. Regularly is when the species is seen at intervals of every few days or weeks for at least several months of the year. A score of 0 is used when the species is recorded or reported very infrequently and there is little or no foraging evidence.

D. Moderation of scores.

The context and species density scores need to be moderated based on the vegetation condition score to prevent vegetation of little or no foraging value receiving an excessive score out of 10. For example, a habitat with no black cockatoo foraging value (such as a wetland) may receive a foraging score as high as 4 out of 10 if it occurs in an area where the species breed (context score of 3) and are abundant (context score of 1). Black cockatoos would only be present in habitat with foraging value, so applying the context and species scores to vegetation that received a low condition score would not give an accurate reflection of their foraging value.

The moderation approach is outlined below, where context and species density scores of zero are given to sites with a condition score of 3 or less.

Vegetation composition, condition and structure score	Context score	Species density score
3-6 (low/moderate to high value)	Assessed as per B above	Assessed as per C above
0-2 (no to low value)	0	0

Appendix 2 Potential habitat trees within the study area

Tree code	Species	Tree height	DBH (cm)	# of possible hollows	suitable hollows	condition	Author	Latitude	Longitude	Comment
	C. calophylla	17	52	0	No		AECOM, 2020	-32.0106	116.0092	
	C. calophylla	25	53	0	No		AECOM, 2020	-32.00919	116.0021	
	C. calophylla	18	70	0	No		AECOM, 2020	-32.02267	116.0032	
	C. calophylla	17	70	0	No		AECOM, 2020	-32.012	115.9997	
358	*C. calophylla*	0	60	0	No	healthy	JBS&G, 2021	-32.02258	116.0031	
215	*C. calophylla*	0	55	0	No	stressed	JBS&G, 2021	-32.01929	116.0014	
359	*C. calophylla*	0	55	0	No	healthy	JBS&G, 2021	-32.02261	116.0034	
360	*C. calophylla*	0	65	0	No	healthy	JBS&G, 2021	-32.02259	116.0032	
372	*C. calophylla*	0	70	0	No	healthy	JBS&G, 2021	-32.02242	116.0034	
374	*C. calophylla*	0	60	0	No	healthy	JBS&G, 2021	-32.02237	116.0037	
1221	*C. calophylla*	0	0	0	No	slightly stressed	JBS&G, 2022	-32.0173	116.0011	
1222	*C. calophylla*	0	0	0	No	slightly stressed	JBS&G, 2022	-32.01732	116.0013	
1223	*C. calophylla*	0	0	0	No	healthy	JBS&G, 2022	-32.01727	116.0014	
1226	*C. calophylla*	0	0	0	No	stressed	JBS&G, 2022	-32.01672	116.0007	
1227	*C. calophylla*	0	0	0	No	healthy	JBS&G, 2022	-32.0166	116.0007	
1228	*C. calophylla*	0	0	0	No	healthy	JBS&G, 2022	-32.01665	116.0006	
1229	*C. calophylla*	0	0	0	No	slightly stressed	JBS&G, 2022	-32.01666	116.0005	
1230	*C. calophylla*	0	0	0	No	slightly stressed	JBS&G, 2022	-32.01668	116.0005	
1231	*C. calophylla*	0	0	0	No	healthy, slightly stressed	JBS&G, 2022	-32.0167	116.0005	
1232	*C. calophylla*	0	0	0	No	healthy	JBS&G, 2022	-32.0167	116.0004	
1233	*C. calophylla*	0	0	0	No	slightly stressed, healthy	JBS&G, 2022	-32.01673	116.0004	
1234	*C. calophylla*	0	0	0	No	stressed	JBS&G, 2022	-32.01675	116.0005	
1235	*C. calophylla*	0	0	0	No	stressed	JBS&G, 2022	-32.01678	116.0004	
1236	*C. calophylla*	0	0	0	No	slightly stressed	JBS&G, 2022	-32.01676	116.0004	
	E. gomphocephala	25	70	0	No		AECOM, 2020	-32.01911	116.0024	
	E. gomphocephala	25	100	0	No		AECOM, 2020	-32.0182	116.0041	
	E. gomphocephala	22	60	0	No		AECOM, 2020	-32.019	116.0025	
	E. gomphocephala	18	60	0	No		AECOM, 2020	-32.0186	116.0013	
	E. gomphocephala	20	65	0	No		AECOM, 2020	-32.0185	116.0012	DBH measured above fork
	E. gomphocephala	20	100	0	No		AECOM, 2020	-32.0185	116.0011	
	E. gomphocephala	22	130	0	No		AECOM, 2020	-32.0184	116.0011	
	E. gomphocephala	22	65	0	No		AECOM, 2020	-32.0183	116.001	
	E. gomphocephala	25	120	0	No		AECOM, 2020	-32.0127	115.9987	
	E. gomphocephala	20	100	0	No		AECOM, 2020	-32.0126	115.9986	
	E. gomphocephala	25	75	0	No		AECOM, 2020	-32.0125	115.9985	
151	*E. gomphocephala*	0	60	0	No	healthy	JBS&G, 2021	-32.01867	116.0015	
153	*E. gomphocephala*	0	60	0	No	healthy	JBS&G, 2021	-32.01871	116.0016	

Tree code	Species	Tree height	DBH (cm)	# of possible hollows	suitable hollows	condition	Author	Latitude	Longitude	Comment
179	*E. gomphocephala*	0	50	0	No	slightly stressed	JBS&G, 2021	-32.01897	116.002	
1	*E. gomphocephala*	0	50	0	No	healthy	JBS&G, 2021	-32.01851	116.003	
2	*E. gomphocephala*	0	100	0	No	healthy	JBS&G, 2021	-32.01854	116.0029	
21	*E. gomphocephala*	0	60	0	No	healthy	JBS&G, 2021	-32.0184	116.0024	
25	*E. gomphocephala*	0	65	0	No	slightly stressed	JBS&G, 2021	-32.01873	116.0024	
1143	*E. gomphocephala*	0	70	0	No		JBS&G, 2021	-32.01871	116.005	
1158	*E. gomphocephala*	0	100	0	No		JBS&G, 2021	-32.01834	116.0044	
230	*E. gomphocephala*	0	50	0	No	slightly stressed	JBS&G, 2021	-32.0189	116.001	
404	*E. gomphocephala*	0	55	0	No	very stressed	JBS&G, 2021	-32.02096	116.0039	
1060	*E. gomphocephala*	0	100	0	No		JBS&G, 2021	-32.01878	116.0044	
Road Reserve	*E. gomphocephala*	0	70	0	No		JBS&G, 2021	-32.02	116.0017	
	E. marginata	15	100	0	No		AECOM, 2020	-32.0142	116.0085	
	E. marginata	17	60	0	No		AECOM, 2020	-32.0144	116.0083	
	E. marginata	12	51	0	No		AECOM, 2020	-32.01447	116.007	
	E. marginata	16	52	0	No		AECOM, 2020	-32.01447	116.0069	
	E. marginata	15	55	0	No		AECOM, 2020	-32.01404	116.0059	
	E. marginata	15	55	0	No		AECOM, 2020	-32.02073	116.0024	
	E. marginata	18	80	0	No		AECOM, 2020	-32.02217	116.0038	
	E. marginata	18	60	0	No		AECOM, 2020	-32.02201	116.0034	
	E. marginata	14	90	0	No		AECOM, 2020	-32.02186	116.004	
	E. marginata	14	55	0	No		AECOM, 2020	-32.02135	116.0036	Hollow checked by Phoenix Jan 2024, not suitable
	E. marginata	16	65	0	No		AECOM, 2020	-32.02099	116.0034	
	E. marginata	15	60	0	No		AECOM, 2020	-32.0144	116.0068	
	E. marginata	18	110	0	No		AECOM, 2020	-32.01447	116.0071	
	E. marginata	10	70	0	No		AECOM, 2020	-32.01799	116.0091	
	E. marginata	10	80	0	No		AECOM, 2020	-32.01786	116.0092	
	E. marginata	13	60	0	No		AECOM, 2020	-32.01846	116.0085	
	E. marginata	13	60	0	No		AECOM, 2020	-32.0184	116.0085	
	E. marginata	12	55	0	No		AECOM, 2020	-32.01846	116.0085	
	E. marginata	14	65	0	No		AECOM, 2020	-32.0184	116.0084	
	E. marginata	12	55	0	No		AECOM, 2020	-32.0184	116.0083	Two trunks on tree
	E. marginata	17	80	0	No		AECOM, 2020	-32.0124	116.008	
	E. marginata	15	65	0	No		AECOM, 2020	-32.01258	116.0077	Tree has multiple large trunks
	E. marginata	18	80	0	No		AECOM, 2020	-32.01301	116.0073	
	E. marginata	15	75	0	No		AECOM, 2020	-32.01291	116.0072	
	E. marginata	17	62	0	No		AECOM, 2020	-32.0126	116.0074	
	E. marginata	10	52	0	No		AECOM, 2020	-32.01115	116.0082	
	E. marginata	15	75	0	No		AECOM, 2020	-32.0117	116.0074	
	E. marginata	18	85	0	No		AECOM, 2020	-32.01177	116.0076	
	E. marginata	15	60	0	No		AECOM, 2020	-32.01195	116.0072	Multiple trunks on tree

Tree code	Species	Tree height	DBH (cm)	# of possible hollows	suitable hollows	condition	Author	Latitude	Longitude	Comment
	E. marginata	16	75	0	No		AECOM, 2020	-32.01222	116.0069	
	E. marginata	12	51	0	No		AECOM, 2020	-32.01232	116.007	
	E. marginata	18	70	0	No		AECOM, 2020	-32.0122	116.0065	
	E. marginata	16	60	0	No		AECOM, 2020	-32.01215	116.0063	
	E. marginata	16	90	0	No		AECOM, 2020	-32.01145	116.0073	
	E. marginata	16	65	0	No		AECOM, 2020	-32.01145	116.0074	
	E. marginata	18	70	0	No		AECOM, 2020	-32.01084	116.0085	
	E. marginata	10	56	0	No		AECOM, 2020	-32.01102	116.0087	
	E. marginata	14	53	0	No		AECOM, 2020	-32.01178	116.0084	
	E. marginata	15	60	0	No		AECOM, 2020	-32.0127	116.0079	
	E. marginata	18	70	0	No		AECOM, 2020	-32.01151	116.0008	
	E. marginata	14	52	0	No		AECOM, 2020	-32.0143	116.0085	
	E. marginata	10	55	0	No		AECOM, 2020	-32.0142	116.0087	
	E. marginata	20	70	0	No		AECOM, 2020	-32.01452	116.0089	Two trunks
	E. marginata	16	60	0	No		AECOM, 2020	-32.01406	116.0079	
	E. marginata	8	55	0	No		AECOM, 2020	-32.0132	116.0054	
	E. marginata	12	55	0	No		AECOM, 2020	-32.0117	116.0085	Multiple trunks
	E. marginata	22	110	0	No		AECOM, 2020	-32.01074	116.0086	
	E. marginata	20	90	2	No		AECOM, 2020	-32.01082	116.0088	Hollow 1: West facing branch hollow, 11 m above ground, 50x10 cm entrance at 45 degrees, unable to assess chamber size, hollow occupied by pink and grey galahs Hollow 2: North-west facing branch hollow 10 m above ground, 10x100 cm entrance at 45 degrees, Hollow checked by Phoenix Jan 2024, not suitable
	E. marginata	14	60	0	No		AECOM, 2020	-32.01082	116.0089	
	E. marginata	15	55	0	No		AECOM, 2020	-32.01062	116.009	
	E. marginata	14	90	0	No		AECOM, 2020	-32.0107	116.0089	
	E. marginata	16	110	0	No		AECOM, 2020	-32.01069	116.0087	
	E. marginata	14	65	0	No		AECOM, 2020	-32.01067	116.0082	
	E. marginata	18	110	0	No		AECOM, 2020	-32.01077	116.0081	
	E. marginata	14	50	0	No		AECOM, 2020	-32.0125	116.0073	
	E. marginata	18	50	0	No		AECOM, 2020	-32.0124	116.0073	
	E. marginata	14	80	0	No		AECOM, 2020	-32.01174	116.0078	
	E. marginata	17	52	0	No		AECOM, 2020	-32.0119	116.0078	
	E. marginata	16	52	0	No		AECOM, 2020	-32.01223	116.0075	
	E. marginata	18	60	0	No		AECOM, 2020	-32.01244	116.0072	
1113	*E. marginata*	0	60	0	No		JBS&G, 2021	-32.0198	116.0062	
1033	*E. marginata*	0	60	0	No		JBS&G, 2021	-32.01871	116.008	

Tree code	Species	Tree height	DBH (cm)	# of possible hollows	suitable hollows	condition	Author	Latitude	Longitude	Comment
1038	*E. marginata*	0	60	0	No		JBS&G, 2021	-32.01664	116.006	
1039	*E. marginata*	0	70	0	No		JBS&G, 2021	-32.01677	116.0059	
1187	*E. marginata*	0	90	0	No	very stressed	JBS&G, 2021	-32.02094	116.0051	
1180	*E. marginata*	0	50	0	No		JBS&G, 2021	-32.02029	116.0043	
1181	*E. marginata*	0	50	0	No		JBS&G, 2021	-32.02051	116.0046	
1197	*E. marginata*	0	60	0	No		JBS&G, 2021	-32.02088	116.0056	
1198	*E. marginata*	0	70	0	No		JBS&G, 2021	-32.02085	116.0056	
1199	*E. marginata*	0	50	0	No		JBS&G, 2021	-32.02081	116.0055	
1202	*E. marginata*	0	60	0	No		JBS&G, 2021	-32.02065	116.0052	
1210	*E. marginata*	0	50	0	No		JBS&G, 2021	-32.0204	116.0049	
1211	*E. marginata*	0	50	0	No		JBS&G, 2021	-32.02022	116.0048	
378	*E. marginata*	0	50	0	No	healthy	JBS&G, 2021	-32.02208	116.004	
385	*E. marginata*	0	80	0	No	healthy	JBS&G, 2021	-32.02214	116.0037	
393	*E. marginata*	0	60	0	No	very stressed	JBS&G, 2021	-32.02203	116.0035	
361	*E. marginata*	0	60	0	No	healthy	JBS&G, 2021	-32.02242	116.0033	
414	*E. marginata*	0	50	0	No	healthy	JBS&G, 2021	-32.02114	116.0031	
418	*E. marginata*	0	60	0	No	slightly stressed	JBS&G, 2021	-32.02141	116.0038	
399	*E. marginata*	0	50	0	No	healthy	JBS&G, 2021	-32.02225	116.0032	
403	*E. marginata*	0	50	0	No	slightly stressed	JBS&G, 2021	-32.02204	116.0042	
435	*E. marginata*	0	50	0	No	healthy	JBS&G, 2021	-32.02133	116.004	
525	*E. marginata*	0	80	0	No		JBS&G, 2021	-32.01436	116.0041	
421	*E. marginata*	0	55	0	No	slightly stressed	JBS&G, 2021	-32.02165	116.0038	
438	*E. marginata*	0	130	0	No	healthy	JBS&G, 2021	-32.02114	116.0037	checked by Phoenix 2024, not suitable
829	*E. marginata*	0	60	0	No	healthy	JBS&G, 2021	-32.01556	116.0082	
988	*E. marginata*	0	60	0	No		JBS&G, 2021	-32.01667	116.0058	
797	*E. marginata*	0	90	0	No	healthy	JBS&G, 2021	-32.01746	116.0093	
798	*E. marginata*	0	55	0	No	healthy	JBS&G, 2021	-32.01762	116.0095	
799	*E. marginata*	0	60	0	No	healthy	JBS&G, 2021	-32.0166	116.0086	
1013	*E. marginata*	0	50	0	No		JBS&G, 2021	-32.01801	116.0071	
1028	*E. marginata*	0	70	0	No		JBS&G, 2021	-32.01874	116.0078	
1021	*E. marginata*	0	60	0	No		JBS&G, 2021	-32.01817	116.0074	
989	*E. patens*	0	60	0	No		JBS&G, 2021	-32.01683	116.0056	
1057	*E. patens*	0	60	0	No		JBS&G, 2021	-32.01891	116.004	
1171	*E. patens*	0	50	0	No		JBS&G, 2021	-32.01909	116.0036	
	E. rudis	8	0	0	No		AECOM, 2020	-32.01965	116.0018	Hollow 2: 30x30 cm entrance, facing upward/vertical on spout, 7 m above ground
846	*E. rudis*	0	50	0	No		JBS&G, 2021	-32.01498	116.0051	
46	*E. rudis*	0	60	0	No	healthy, slightly stressed	JBS&G, 2021	-32.01748	116.0007	
110	*E. rudis*	0	50	0	No	slightly stressed	JBS&G, 2021	-32.01837	116.001	
306	*E. rudis*	0	50	0	No	stressed	JBS&G, 2021	-32.0166	116.0052	

Tree code	Species	Tree height	DBH (cm)	# of possible hollows	suitable hollows	condition	Author	Latitude	Longitude	Comment
	E. rudis	0	60	0	No	healthy	JBS&G, 2021	-32.01911	116.0017	
	Introduced sp.	12	52	0	No		AECOM, 2020	-32.02008	116.0015	
1225	Introduced sp.	0	0	0	No		JBS&G, 2022	-32.01709	116.0012	
	Stag	12	60	2	No		JBS&G, 2022	-32.0212	116.0023	Hollow 1: 15x20 cm entrance, west facing hollow, vertical on trunk, 6 m above ground, unable to assess depth, no evidence of use Hollow checked by Phoenix Jan 2024, not suitable



Appendix 9 Lot 54 Black Cockatoo Habitat Assessment

PHOENIX
ENVIRONMENTAL SCIENCES

Black cockatoo habitat assessment - 96 (Lot 54) Victoria Road, Wattle Grove

Hesperia

June 2025

Final



Black cockatoo habitat assessment - 96 (Lot 54) Victoria Road, Wattle Grove– 96 (Lot 54) Victoria Road, Wattle Grove

Prepared for Hesperia

Version history

Author/s	Reviewer/s	Version	Version number	Date submitted	Submitted to
A. Jacks	J. Clark	Draft for client comments	0.1	24-Jun-25	K. Choo (Coterra Environment)
A. Jacks	J. Clark	Final, client comments addressed	1.0	17-Jul-25	K. Choo (Coterra Environment)

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CONTENTS

Contents ii
1 Introduction 1
1.1 Background 1
1.2 Scope of work 1
1.3 Project area 2
2 Methods 4
2.1 Breeding habitat analysis 4
2.2 Roosting habitat analysis 5
2.3 Foraging habitat analysis 5
3 Results and discussion 7
3.1 Breeding habitat analysis 7
3.2 Roosting habitat analysis 7
3.3 Foraging habitat analysis 9
References 10

LIST OF FIGURES

Figure 1-1 Study area and vegetation types 3
Figure 3-1 Potential nesting trees and known roosting trees within proximity of 96 (Lot 54) Victoria Road 8

LIST OF TABLES

Table 3-1 Potential nesting trees within 96 (Lot 54) Victoria Road, Wattle Grove 7
Table 3-2 Foraging habitat assessment results (Bamford 2021) 9

LIST OF APPENDICES

Appendix 1 Scoring system for the assessment of foraging value of vegetation for black cockatoos (Bamford 2021)

1 INTRODUCTION

The Wattle Grove (South) Local Structure Plan Project (the 'Project') is located on the Swan Coastal Plain IBRA region. The landholdings within the Project area are currently undergoing a rezoning under the Metropolitan Region Scheme (MRS), (MRS Amendment 1388/57 – Wattle Grove South), and proposes to rezone the site from Rural to Urban under the MRS.

Previous fauna surveys have been undertaken within the Project area by AECOM (2020) and JBS&G (2023) and Phoenix (2024), however not all properties were accessed. Number 96 (Lot 54) Victoria Road, Wattle Grove was not surveyed, however is currently being investigated for purchase as part of future urban redevelopment.

It is anticipated the final environmental conditions for MRS Amendment 1388/57 – Wattle Grove South will require any lots that were not directly accessed to be surveyed for black cockatoo habitat, and that any future survey must be consistent with terrestrial fauna technical guidance and include a black cockatoo hollow inspection to determine whether there are any suitable nesting hollows.

1.1 BACKGROUND

Black cockatoos utilise the Swan Coastal Plain mainly for foraging resources (DAWE 2022b). Three species of black cockatoo may occur in the region:

- Carnaby's Cockatoo (*Zanda latirostris*) primarily use vegetation dominated by *Banksia* spp. and Tuart (*Eucalyptus gomphocephala*) woodlands, as well as Marri (*Corymbia calophylla*), with Jarrah (*E. marginata*) for foraging. There are several records of breeding on the Swan Coastal Plain, however these are restricted to areas further north and south of Perth (DAWE 2022b).
- Baudin's Cockatoo (*Zanda baudinii*) are less common on the Swan Coastal Plain than Carnaby's Cockatoo. Records of Baudin's Cockatoo are primarily from areas east of Perth, closer to the Jarrah Forest (DBCA 2023). Baudin's cockatoo may use the area for foraging, particularly on Marri, but are unlikely to breed.
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) forage, roost, and breed in woodland or isolated trees. Their main food source is Marri, Jarrah, however, they also forage on other species such as *Allocasuarina* spp. and other *Eucalyptus* spp. (both native and introduced) fruits and nectar (DAWE 2022b). There are few records of breeding on the Swan Coastal Plain.

The Jarrah Forest, just east of the study area, provides breeding habitat for all 3 black cockatoo species as well as providing key foraging and wintering areas for Baudin's Cockatoo and the Forest Red-tailed Black Cockatoo. Foraging areas associated with breeding areas are critical for all species (DAWE 2022b).

1.2 SCOPE OF WORK

The scope of work for the black cockatoo habitat assessment for 96 (Lot 54) Victoria Road, Wattle Grove was as follows:

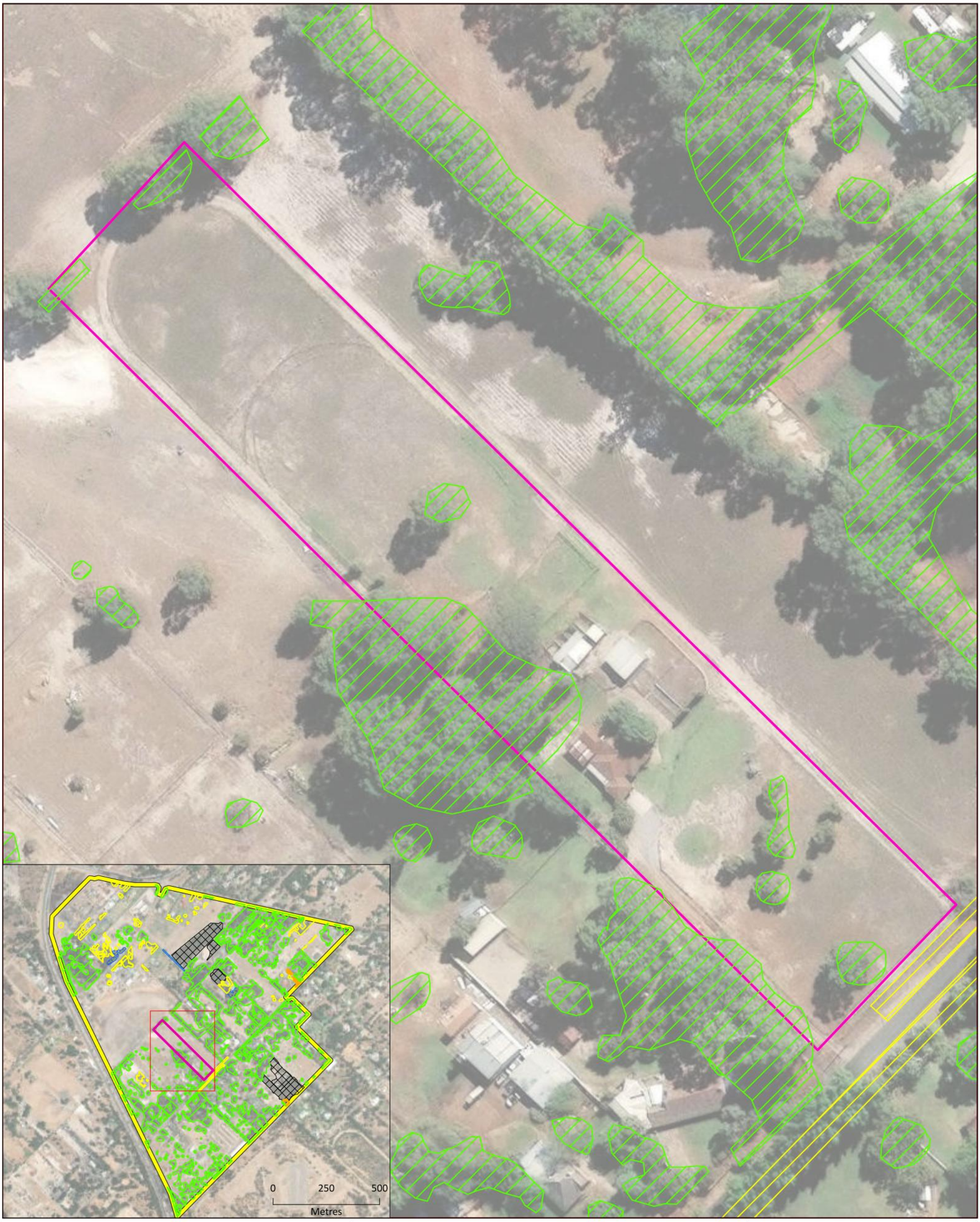
- verify the habitat mapping, including re-assessment of foraging habitat scores, roosting habitat, and breeding habitat undertaken by Phoenix (2024)
- undertake a Potential nesting tree (PNT; previously referred to as 'potential habitat tree'[PBT] Phoenix 2024)) assessment that encompasses identifying trees with hollows, and if present recording any nesting evidence and assessing their suitability for black cockatoo nesting

- record any evidence of black cockatoos usage, such as direct sightings, feeding debris, feathers.

1.3 PROJECT AREA

The Wattle Grove (South) MRS Amendment Area (the 'Project area') is located within Wattle Grove, approximately 15 km ESE from Perth, Western Australia (WA; Figure 1-1). The Project area is bound by Welshpool Road East and Crystal Brook Road to the north, and Tonkin Highway to the west.

The study area for this assessment at 96 (Lot 54) Victoria Road is approximately 2 ha.



PERTH

Hesperia: Wattle Grove MRS Amendment 96 (Lot 54) Victoria Road

Project No	1633
Date	19 Jan 2024
Drawn by	AJ
Map author	AJ

0 25 50
Metres

1:1,055 (at A3) GDA 1994 MGA Zone 50

All information within this map is current as of 17/07/2025. This product is subject to COPYRIGHT and is property of Phoenix Environmental Sciences (Phoenix). While Phoenix has taken care to ensure the accuracy of this product, Phoenix make no representations or warranties about its accuracy, completeness or suitability for any particular purpose.

- Wattle Grove MRS Amendment Area
- 96 (Lot 54) Victoria Road, Wattle Grove

Vegetation

- Banksia spp. woodland
- Banksia menziesii, Allocasuarina fraseriana and Eucalyptus todtiana woodland
- Eucalyptus marginata and Allocasuarina fraseriana mid open forest
- Planted
- Trees

Figure 1-1

Study area and vegetation types

PHOENIX ENVIRONMENTAL SCIENCES

P:\Data\Projects\WattleGroveMRSRezoning\1731-WGM-HP-VER\GIS\Mapping\MapDocuments\Figures\1731maps_edited_17_july\1731maps_edited_17_july.aprx

2 METHODS

This report has been written with consideration of the following guidelines and guidance:

- Referral guideline for 3 WA threatened black cockatoo species Carnaby's Cockatoo (*Zanda latirostris*), Baudin's Cockatoo (*Zanda baudinii*) and the FRTBC (*Calyptorhynchus banksii naso*) (DAWE 2022b).
- Black cockatoos and development in South-West Western Australia (DAWE 2022a).
- Scoring System for the Assessment of Foraging Value of Vegetation for Black-Cockatoos (Bamford 2021).

The study area was visited on 27th May 2025. As per the above survey guidelines, the assessment took into consideration breeding, roosting and foraging habitat for all 3 species of black cockatoo.

2.1 BREEDING HABITAT ANALYSIS

Breeding habitat for black cockatoos consists of woodland or forest; however, they will also breed in areas of former woodland or forest habitats which consist of now fragmented patches of habitat and/or isolated trees. Breeding habitat is defined in DAWE (2022b) as "habitat that contains known, suitable or potential nesting trees."

A nesting tree is considered by DAWE (2022b) to be any tree species where "suitable nest hollows" are present. Suitable nest hollows are only found in trees with a diameter at breast height (DBH) of at least 500 mm or 300 mm for Wandoo.

The breeding habitat assessment followed the methods of AECOM (2020), JBS&G (2023), and (Phoenix 2024). The following information was recorded for each native tree species:

- DBH (mm)
- number of hollows
- hollow height (m)
- hollow diameter (mm)
- hollow type/category
- presence of feral bees
- presence of other species using a hollow
- evidence of use by black cockatoo species.

PNTs with hollows were inspected from ground level using binoculars and later classified according to the following parameters, which largely align with the definition of DAWE (2022b):

- **Known nesting tree** – trees which contain a hollow where a black cockatoo has been directly recorded breeding, or has evidence of use, such as chewings/scratches around the hollow and/or feathers.
- **Suitable nesting tree** – trees with suitable DBH for the species, containing a suitable hollow, i.e. hollow of near vertical alignment, >300 mm in internal diameter (DCCEEW 2024a, b), >5 m above the ground, but no evidence of use.
- **Possible nesting tree** – trees with suitable DBH for the species and at least 1 hollow <300mm internal diameter and in near vertical orientation which may possibly develop into a suitable hollow in the future.
- **Potential nesting tree** – trees with suitable DBH for the species, maybe or may not have a hollow but if present due to orientation is unlikely to ever develop a hollow that would be used by a black cockatoo, but the tree may develop additional hollows into the future.

2.2 ROOSTING HABITAT ANALYSIS

Roosting habitat within the study area was considered to be any individual tree known to support roosting, or habitat types containing these trees:

- Carnaby's roosting habitat comprises of tall trees near or in riparian environments or permanent water sources. These trees include Flat-topped Yate, Salmon Gum, Wandoo, Marri, Karri, Blackbutt, Tuart, introduced eucalypts and introduced pines.
- FRTBC favour tall trees such as Jarrah, Marri, Blackbutt, Tuart and introduced eucalypt trees or large trees on the edge of forests. The pine plantations between Mandurah, Bunbury and north of the Perth metropolitan area can provide foraging and night roosting habitat in the Swan Coastal Plain.
- Baudin's Cockatoo also prefer to be near riparian environments or other permanent water sources. Any tall trees may provide roosting habitat for Baudin's Cockatoo, but particularly Jarrah, Flooded Gum, Blackbutt, Tuart and introduced eucalypts such as Blue Gum (*E. globulus*) and Lemon Scented Gum (*Corymbia citriodora*) (DAWE 2022b). Suitable roosting habitat has to also be within 20 km of foraging habitat (DAWE 2022a).

2.3 FORAGING HABITAT ANALYSIS

The foraging value of each habitat type within the study area was assessed for each black cockatoo species using the Habitat Quality Score (HQS) methodology developed by Bamford Consulting Ecologists (Bamford 2021); Appendix 1). The scoring system provides a numerical value that reflects the significance of vegetation as foraging habitat for black cockatoos and is designed to provide the information needed by the Department of Climate Change, Energy, The Environment, and Water (DCCEEW), Department of Water and Environmental Regulation (DWER) and the Environmental Protection Authority (EPA) to assess impact significance and offset requirements.

The foraging value of the vegetation is dependent on the type, density and condition of vegetation in the assessment area as well as factors external to the assessment area, such as local breeding or roosting and extent of foraging habitat in close proximity.

Calculating the HQS (out of 10) considers the following:

A. Site condition (out of 6) – Vegetation composition, condition, and structure determines the quality and quantity of forage resources (see Appendix 1 for guide on determining this score for each species of black cockatoo)
B. Site context (a score out of 3) – Refers to whether breeding habitat occurs locally (15 km radius) and the quantity/proportion of foraging habitat within the site. For example, foraging habitat within range of breeding habitat scores higher)
C. Species stocking rate (out of 1) – Whether the species occurs in abundance, where abundant = 1, not abundant = 0.
D. Sum of the above to arrive at a total score out of 10. The score may however require moderation for context and species density with respect to the site condition (vegetation) score, such as at a site where a species is abundant and the site is within range of breeding, with little other available foraging resources nearby, but the site condition is very poor and does not provide quality foraging resources.

Site condition was determined using existing vegetation mapping and compiling all the relevé and quadrat species-level spatial data, imported into Phoenix' biological database, along with the supplied vegetation type spatial dataset. Using spatial Structured Query Language (SQL) we then used a series of stored routines to:

- gather the array of foraging species present within each sample plot for each cockatoo species, their respective cover (%) and height (cm) values, and the total number foraging species.
- intersect species records with vegetation type and vegetation condition.
- output a polygon dataset containing the above information that is then used to generate the HQS.

3 RESULTS AND DISCUSSION

3.1 BREEDING HABITAT ANALYSIS

A total of 5 PNTs were recorded within 96 (Lot 54) Victoria Road (Table 3-1; Figure 3-1) comprising Jarrah (*E. marginata*) and Flooded Gum (*E. rudis*); none contained a hollow. On the basis of the results of this survey, plus that of (AECOM 2020), (JBS&G 2023) and (Phoenix 2024) the study area is currently not considered breeding habitat for any of the 3 black cockatoo species.

Table 3-1 Potential nesting trees within 96 (Lot 54) Victoria Road, Wattle Grove

Tree ID	Species	Latitude	Longitude	DBH (mm)	Comments
6014	*E. rudis*	-32.0164	116.0035	1,000	No hollows present
6022	*E. rudis*	-32.0149	116.0023	900	No hollows present
6023	*E. rudis*	-32.0150	116.0023	1,500	No hollows present
6024	*E. rudis*	-32.0152	116.0020	550	No hollows present
6036	*E. marginata*	-32.0174	116.0042	600	No hollows present

3.2 ROOSTING HABITAT ANALYSIS

Several black cockatoo roost sites are known within the vicinity of the Project area (Figure 3-1). The habitat assessment undertaken by AECOM (2020) determined that 29.8 ha of suitable roosting habitat was present throughout the Project area, consisting of remnant native vegetation, planted gardens and scattered trees; Notwithstanding the fact that no roosting trees occur within the study area.

6022
6023
6024
6014
6036
0
1
2
Kilometers
PERTH
Hesperia: Wattle Grove MRS Amendment 96 (Lot 54) Victoria Road
Project No 1633
Date 19 Jan 2024
Drawn by AJ
Map author AJ
0
25
50
Metres
1:1,055 (at A3)
GDA 1994 MGA Zone 50
Wattle Grove MRS Amendment Area
96 (Lot 54) Victoria Road, Wattle Grove
Potential Nesting Tree
Trees
Forest Red-tailed black cockatoo roost
White-tailed and Red-tailed black cockatoo roost
unconfirmed roost
Figure 3-1
Potential nesting trees and known roosting trees within proximity of 96 (Lot 54) Victoria Road
PHOENIX ENVIRONMENTAL SCIENCES
All information within this map is current as of 17/07/2025. This product is subject to COPYRIGHT and is property of Phoenix Environmental Sciences (Phoenix). While Phoenix has taken care to ensure the accuracy of this product, Phoenix make no representations or warranties about its accuracy, completeness or suitability for any particular purpose.
P:\Data\Projects\WattleGroveMRSRezoning\1731-WGM-HP-VER\GIS\Mapping\MapDocuments\Figures\1731maps_edited_17_july\1731maps_edited_17_july.aprx

3.3 FORAGING HABITAT ANALYSIS

Foraging habitat scores have been calculated per the methods of Bamford (2021) (section 2.3; Appendix 1) and are presented in Table 3-2. The assessment found the foraging habitat value within the study area to be low for all 3 species for both the 'cleared' and 'trees' vegetation types.

The site condition was rated as 1 for each species:

- Carnaby's cockatoo – scattered specimens of known food plants but projected foliage cover < 2%, including urban areas with scattered foraging trees
- Baudin's cockatoo – scattered specimens of known food plants but projected foliage cover of these < 1%. This includes urban areas with scattered foraging trees
- FRTBC –scattered specimens of known food plants but projected foliage cover of these < 1%. This includes urban areas with scattered foraging trees.

Site context was allocated a '3' to all species given that:

- Carnaby's cockatoo – local breeding is known and 32.9% of native vegetation remains within 15km of the Amendment Area
- Baudin's cockatoo – no local breeding is known or likely, but 32.9% of native vegetation remains within 15km of the Amendment Area
- FRTBC – no local breeding is known or likely, but 32.9% of native vegetation remains within 15km of the Amendment Area.

Species stocking rate was given a score of '1' for Carnaby's Cockatoo and FRTBC and '0' for Baudin's Cockatoo:

- Carnaby's Cockatoo – directly observed feeding in this survey and there has been multiple, recent and historic records of feeding activity (AECOM 2020; DBCA 2023; JBS&G 2023)
- Baudin's Cockatoo – no feeding was directly observed, nor was recent or historical evidence found, and desktop records are also absent within 15km of the Amendment Area
- FRTBC– directly observed feeding in this survey and there has been multiple, recent and historic records of feeding activity (AECOM 2020; DBCA 2023; JBS&G 2023).

Bamford (2021) allows for score moderation where the system has clearly over-scored habitats/vegetation types that provide negligible foraging value, such as for cleared areas, as is the case here. Accordingly, this assessment has found that the study area contains ~2 ha of low-value foraging habitat (score = 2), for all 3 black cockatoo species, for both "trees" (0.23 ha) and "cleared" habitat areas (1.77 ha) .

Table 3-2 Foraging habitat assessment results (Bamford 2021)

Assessment parameters	Carnaby's Cockatoo	Baudin's Cockatoo	FRTBC
Site condition	1	1	1
Site context	3	3	3
Stocking rate	1	0	1
Moderation	-3	-2	-3
Score	**2**	**2**	**2**
Relative value	**Low**	**Low**	**Low**

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Appendix 1 Scoring system for the assessment of foraging value of vegetation for black cockatoos (Bamford 2021)

Total score (out of 10) comprises:

- a score out of 6 for the vegetation composition, condition and structure, plus
- a score out of 3 for the context of the site, plus
- a score out of one for species density.

These are described in detail below.

A. Vegetation composition, condition and structure scoring

Site score	Description of vegetation values		
	Carnaby's Black-Cockatoo	**Baudin's Black-Cockatoo**	**FRTBC**
0	No foraging value. No Proteaceae, eucalypts or other potential sources of food. Examples: • Water bodies (e.g. salt lakes, dams, rivers) • Bare ground • Developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits).	No foraging value. No eucalypts or other potential sources of food. Examples: • Water bodies (e.g. dams, rivers) • Bare ground • Developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits).	No foraging value. No eucalypts or other potential sources of food. Examples: • Water bodies (e.g. dams, rivers) • Bare ground • Developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits).
1	Negligible to low foraging value. Examples: • Scattered specimens of known food plants but projected foliage cover of these is < 2%. This could include urban areas with scattered foraging trees • Paddocks that are partly vegetated with melons or other known food-source weeds (e.g. *Erodium* spp.) that represent a short-term and/or seasonal food-source • Blue Gum plantations (foraging by Carnaby's Cockatoos has been reported but appears to be unusual).	Negligible to low foraging value. Scattered specimens of known food plants but projected foliage cover of these is < 1%. This could include urban areas with scattered foraging trees.	Negligible to low foraging value. Scattered specimens of known food plants but projected foliage cover of these is < 1%. Could include urban areas with scattered foraging trees.

Site score	Description of vegetation values		
	Carnaby's Black-Cockatoo	**Baudin's Black-Cockatoo**	**FRTBC**
2	Low foraging value. Examples: • Shrubland in which species of foraging value, such as shrubby banksias, have < 10% projected foliage cover • Woodland with tree banksias with 2-5% projected foliage cover • Woodland with tree banksias (of key species *B. attenuata* and *B. menziesii*) with < 10% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths • Open eucalypt woodland/mallee of small-fruited species • Paddocks that are densely vegetated with melons or other known food-source weeds (e.g. *Erodium* spp.) that represent a short-term and/or seasonal food-source.	Low foraging value. Examples: • Woodland with scattered specimens of known food plants (e.g. Marri and Jarrah) with 1-5% projected foliage cover • Marri-Jarrah Woodland with < 10% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths • Parkland-cleared Eucalypt Woodland/Forest with known food plants with < 10% projected foliage cover (poor long-term viability without management) • Younger areas of (managed) revegetation with known food plants with < 10% projected foliage cover (establishing food sources with good long-term viability) • Urban areas with scattered foraging trees.	Low foraging value. Examples: • Woodland with scattered specimens of known food plants (e.g. Marri, Jarrah) with 1-5% projected foliage cover • Marri-Jarrah Woodland with < 10% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths • Sheoak Woodland with < 10% projected foliage cover • Parkland - cleared Eucalypt Woodland/Forest with known food plants with < 10% projected foliage cover (poor long-term viability without management) • Younger areas of (managed) revegetation with known food plants with < 10% projected foliage cover (establishing food sources with good long-term viability) • Urban areas with scattered food plants such as Cape Lilac, *Eucalyptus caesia* and *E. erythrocorys*.

Site score	Description of vegetation values		
	Carnaby's Black-Cockatoo	**Baudin's Black-Cockatoo**	**FRTBC**
3	Low to Moderate foraging value. Examples: • Shrubland in which species of foraging value, such as shrubby banksias, have 10-20% projected foliage cover • Woodland with tree banksias with 5-20% projected foliage cover • Woodland with tree Banksia (of key species *B. attenuata* and *B. menziesii*) with 10-40% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths • Eucalypt Woodland/Mallee of small-fruited species • Eucalypt Woodland with Marri with < 10% projected foliage cover.	Low to Moderate foraging value. Examples: • Eucalypt Woodland with known food plants (especially Marri) with 5-20% projected foliage cover • Marri-Jarrah Woodland with 10-40% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths • Parkland - cleared Eucalypt Woodland/Forest with known food plants with 10-40% projected foliage cover (poor long-term viability without management) • Younger areas of (managed) revegetation with known food plants with 10-40% projected foliage cover (establishing food sources with good long-term viability).	Low to Moderate foraging value. Examples: • Eucalypt Woodland with known food plants (especially Marri and Jarrah) with 5-20% projected foliage cover • Marri-Jarrah Woodland with 10-40% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths • Sheoak Forest with 10-40% projected foliage cover • Parkland - cleared Eucalypt Woodland/Forest with known food plants with 10-40% projected foliage cover (poor long-term viability without management) • Younger areas of (managed) revegetation with known food plants with 10-40% projected foliage cover (establishing food sources with good long-term viability).
4	Moderate foraging value. Examples: • Woodland/low forest with tree banksias (of key species *B. attenuata* and *B. menziesii*) with 20-40% projected foliage cover • Woodland/low forest with tree banksias (of key species *B. attenuata* and *B. menziesii*) with 40-60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths • Kwongan/Shrubland in which species of foraging value, such as shrubby banksias, have 20-40% projected foliage cover • Eucalypt Woodland/Forest with Marri with 20–40% projected foliage cover.	Moderate foraging value. Examples: • Marri-Jarrah Woodland/Forest with 20-40% projected foliage cover • Marri-Jarrah Forest with 40-60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths • Parkland - cleared Eucalypt Woodland/Forest with known food plants with 40-60% projected foliage cover (poor long-term viability without management) • Younger areas of (managed) revegetation with known food plants with 40-60% projected foliage cover (establishing food sources with good long-term viability) • Orchards with highly desirable food sources (e.g. apples, pears, some stone fruits).	Moderate foraging value. Examples: • Marri-Jarrah Woodland/Forest with 20-40% projected foliage cover • Marri-Jarrah Forest with 40-60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths • Sheoak Forest with 40-60% projected foliage cover • Parkland - cleared Eucalypt Woodland/Forest with known food plants with 40-60% projected foliage cover (poor long-term viability without management) • Younger areas of (managed) revegetation with known food plants with 40-60% projected foliage cover (establishing food sources with good long-term viability).

Site score	Description of vegetation values		
	Carnaby's Black-Cockatoo	**Baudin's Black-Cockatoo**	**FRTBC**
5	Moderate to High foraging value. Examples: • Banksia Forest with 40-60% projected foliage cover • Banksia Forest with > 60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths • Kwongan/ Shrubland in which species of foraging value, such as shrubby banksias, have 40-60% projected foliage cover • Marri-Jarrah Forest with 40-60% projected foliage cover and vegetation condition good with low weed invasion and/or low tree deaths (indicating it is robust and unlikely to decline in the medium-term) • Pine plantations with trees more than 10 years old.	Moderate to High foraging value. Examples: • Marri-Jarrah Forest with 40-60% projected foliage cover • Marri-Jarrah Forest with > 60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths • Parkland - cleared Eucalypt Woodland/Forest with known food plants > 60% projected foliage cover (poor long-term viability without management) • Younger areas of (managed) revegetation with known food plants with > 60% projected foliage cover (establishing food sources with good long-term viability).	Moderate to High foraging value. Examples: • Marri-Jarrah Forest with 40-60% projected foliage cover • Marri-Jarrah Forest with > 60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths • Sheoak Forest with > 60% projected foliage cover • Parkland - cleared Eucalypt Woodland/Forest with known food plants with > 60% projected foliage cover (poor long-term viability without management) • Younger areas of (managed) revegetation with known food plants with > 60% projected foliage cover (establishing food sources with good long-term viability).
6	High foraging value. Example: • Banksia Forest with > 60% projected foliage cover and vegetation condition good with low weed invasion and/or low tree deaths (indicating it is robust and unlikely to decline in the medium-term) • Kwongan/ Shrubland in which species of foraging value, such as shrubby banksias, have > 60% projected foliage cover • Marri-Jarrah Forest with > 60% projected foliage cover and vegetation condition good with low weed invasion and/or low tree deaths (indicating it is robust and unlikely to decline in the medium-term).	High foraging value. Example: • Marri-Jarrah Forest with > 60% projected foliage cover and vegetation condition good with low weed invasion and/or low tree deaths (indicating it is robust and unlikely to decline in the medium-term).	High foraging value. Example: • Marri-Jarrah Forest with > 60% projected foliage cover and vegetation condition good with low weed invasion and/or low tree deaths (indicating it is robust and unlikely to decline in the medium-term).

Vegetation structural class terminology follows Keighery (1994).

B. Site context.

The maximum score is given in situations where foraging habitat is supporting breeding birds. It can also be given in fragmented landscapes where there is little foraging habitat remaining and thus what is left has a high contextual value. The site context score is species specific as it depends upon factors such as the vegetation type and extent, and the presence of breeding birds, and the following table, developed by Bamford consulting in conjunction with DCCEEW, provides a *guide* to the assignation of site context scores (note that 'local area' is defined as within a 15 km radius of the centre point of the study site):

Site context score	Percentage of the existing native vegetation within the 'local' area that the study site represents	
	'Local' breeding known/likely	**'Local' breeding unlikely**
3	> 5%	> 10%
2	1– 5%	5–10%
1	0.1–1%	0.1–5%
0	< 0.1%	< 0.1%

C. Species density.

Assignation of the species density score (0 or 1) is based upon the black-cockatoo species being either abundant or not abundant, and is species specific. A score of 1 is used where the species is seen or reported regularly and/or there is abundant foraging evidence. Regularly is when the species is seen at intervals of every few days or weeks for at least several months of the year. A score of 0 is used when the species is recorded or reported very infrequently and there is little or no foraging evidence.

D. Moderation of scores.

The context and species density scores need to be moderated based on the vegetation condition score to prevent vegetation of little or no foraging value receiving an excessive score out of 10. For example, a habitat with no black cockatoo foraging value (such as a wetland) may receive a foraging score as high as 4 out of 10 if it occurs in an area where the species breed (context score of 3) and are abundant (context score of 1). Black cockatoos would only be present in habitat with foraging value, so applying the context and species scores to vegetation that received a low condition score would not give an accurate reflection of their foraging value.

The moderation approach is outlined below, where context and species density scores of zero are given to sites with a condition score of 3 or less.

Vegetation composition, condition and structure score	Context score	Species density score
3-6 (low/moderate to high value)	Assessed as per B above	Assessed as per C above
0-2 (no to low value)	0	0

