



**WETLAND ASSESSMENT
GREAT NORTHERN HIGHWAY, BINDOON BYPASS UPGRADES**

MAY 2018

INTEGRATED PROJECT TEAM (JACOBS, MAIN ROADS WA, ARUP)

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Focused Vision Consulting Pty Ltd
ABN 25 605 804 500

Please direct all inquiries to:
Focused Vision Consulting Pty Ltd
8/83 Mell Road, SPEARWOOD WA 6163
P: (08) 6179 4111 E: admin@focusedvision.com.au

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Rev.	Author	Reviewed	Approved	Date
A	Gaby Martinez Senior Botanist/ Environmental Scientist	Kellie Bauer-Simpson Principal Ecologist		07/03/2018
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Table of Contents

1	Introduction.....	1
1.1	Background.....	1
1.2	Location.....	1
1.3	Scope of Work.....	1
2	Existing Environment	3
2.1	Climate.....	3
2.2	Land Use	3
2.3	IBRA Region.....	4
2.4	Landform, Geology and Soils.....	4
2.5	Hydrology.....	5
2.5.1	Groundwater.....	5
2.5.2	Surface Water.....	5
2.6	Wetlands.....	8
2.7	Vegetation.....	8
2.7.1	Conservation Significant Flora and Vegetation	9
2.8	Heritage	9
3	Methodology.....	13
3.1	Desktop Assessment.....	13
3.2	Field Assessment	14
3.2.1	Soil.....	14
3.2.2	Vegetation.....	14
3.3	Determination of Wetland Boundaries.....	15
3.4	Determination of Wetland Management Categories.....	18
4	Results	19
4.1	Soil Sampling	19
4.2	Vegetation.....	23
4.3	Historic Imagery Analysis	28
5	Discussion	30
5.1	Wetland Boundaries.....	30
5.2	Wetland Categories.....	30
5.3	Wetland Buffers	32
5.4	Request for Modifications.....	32
5.4.1	Application to Modify Wetland Boundaries.....	32
5.4.2	Application to Modify Wetland Categories.....	32
6	Conclusions	33
7	References.....	34
Appendix A	Soil Sampling Results	A1
Appendix B	Soil Sample Photographs.....	B1
Appendix C	Flora Species Recorded within Each Vegetation Unit.....	C1
Appendix D	Vegetation Quadrat Data.....	D1
Appendix E	EPA Bulletin 686 Questionnaire Results	E1

Figures

Figure 1 Study Area	2
Figure 2 Climate Data for Gingin Aero.....	3
Figure 3 Soil Landscape Mapping.....	6
Figure 4 Surface Water Features.....	7
Figure 5 Regional Vegetation	10
Figure 6 Locations of Soil Sampling Sites.....	16
Figure 7 Locations of Quadrats and Relevés	17
Figure 8 Depths to Hydric Soils and Groundwater (Figure Series)	20
Figure 9 Vegetation Units	26
Figure 10 Vegetation Condition	27
Figure 11 Historic Imagery	29
Figure 12 Interpreted Wetland Boundaries	31

1 INTRODUCTION

1.1 BACKGROUND

Main Roads Western Australia (Main Roads) is upgrading the 218 km section of Great Northern Highway between Muchea and Wubin. Main Roads, Jacobs and Arup together have formed a joint venture, the Integrated Project Team (IPT), for the delivery of the upgrade project.

Focused Vision Consulting Pty Ltd (FVC) was engaged by the IPT to conduct spring flora, vegetation, fauna and habitat assessments of study corridors associated with the Bindoon Bypass section of the project during 2016, and this work has continued into 2017.

A wetland system exists within and adjacent to the current study corridor, between Gingilling and the Bindoon-Moora Roads, and a relevant section (designated study area) of these wetlands required assessment, to contribute to the environmental assessment process. Results of this assessment may be used for future applications, such as adjustments to wetland boundaries or conservation categories, as required to facilitate the highway development.

FVC was commissioned by the IPT in November 2017 to undertake a wetland assessment within a designated study area (**Figure 1**). This assessment was undertaken to collect detailed data regarding wetland vegetation, hydrology and soils present in the study area, and this report presents the findings of the assessment.

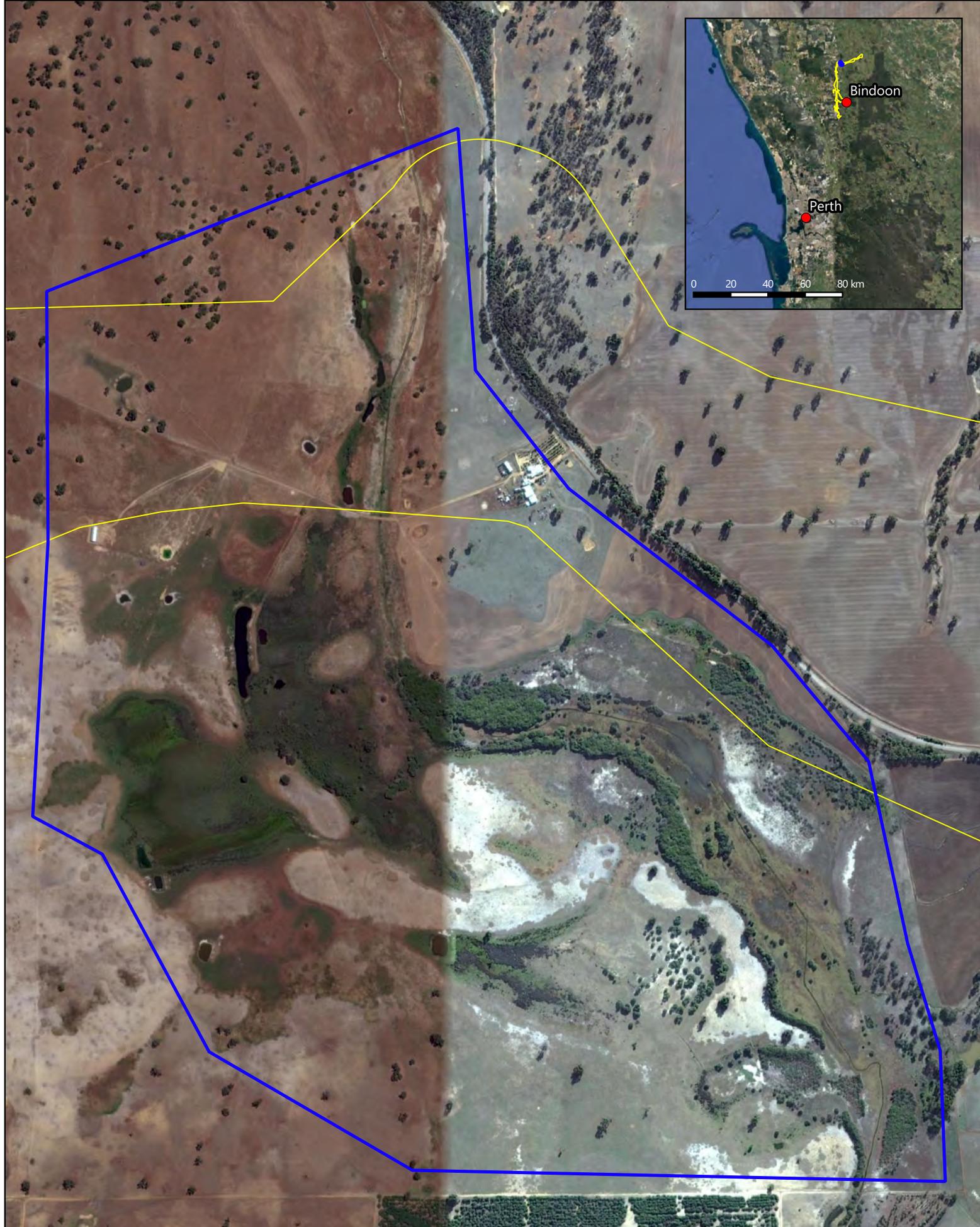
1.2 LOCATION

The study area is located in the Shire of Chittering, on private property, on Lot 2261 Bindoon-Moora Road in Wannamal (**Figure 1**).

1.3 SCOPE OF WORK

The objectives of the wetland assessment were to collect relevant data from the wetland study area to assist in determining:

- The route of least impact for the highway alignment to cross the wetland system
- the environmental values present that require avoidance or mitigation
- the environmental management measures required for the construction and operation phases of the project
- If there are grounds for applications for changes to the wetland boundaries or management categories
- inputs for the environmental impact assessment (EIA) and approvals process.



0 150 300 450 600 m

GDA 94 / MGA Zone 50



Figure 1 - Study Area

Legend

- Study Area
- Referral Boundary



2 EXISTING ENVIRONMENT

2.1 CLIMATE

The study area is situated within the Jarrah Forest Interim Biogeographic Regionalisation for Australia (IBRA) region (Commonwealth of Australia 2013a), directly adjacent to the boundary of the Swan Coastal Plain IBRA region, and which experience a warm Mediterranean climate, characterised by hot summers and cool wet winters (Mitchell, *et al.* 2001). Gingin Aero (site number 9178) is the closest Bureau of Meteorology (BoM) recording station which has been recording since 1968 and in that time, has recorded an average annual rainfall of 657.3 mm. The annual mean maximum temperature ranges from 18.3°C in winter to 33.2°C in summer (BoM 2017).

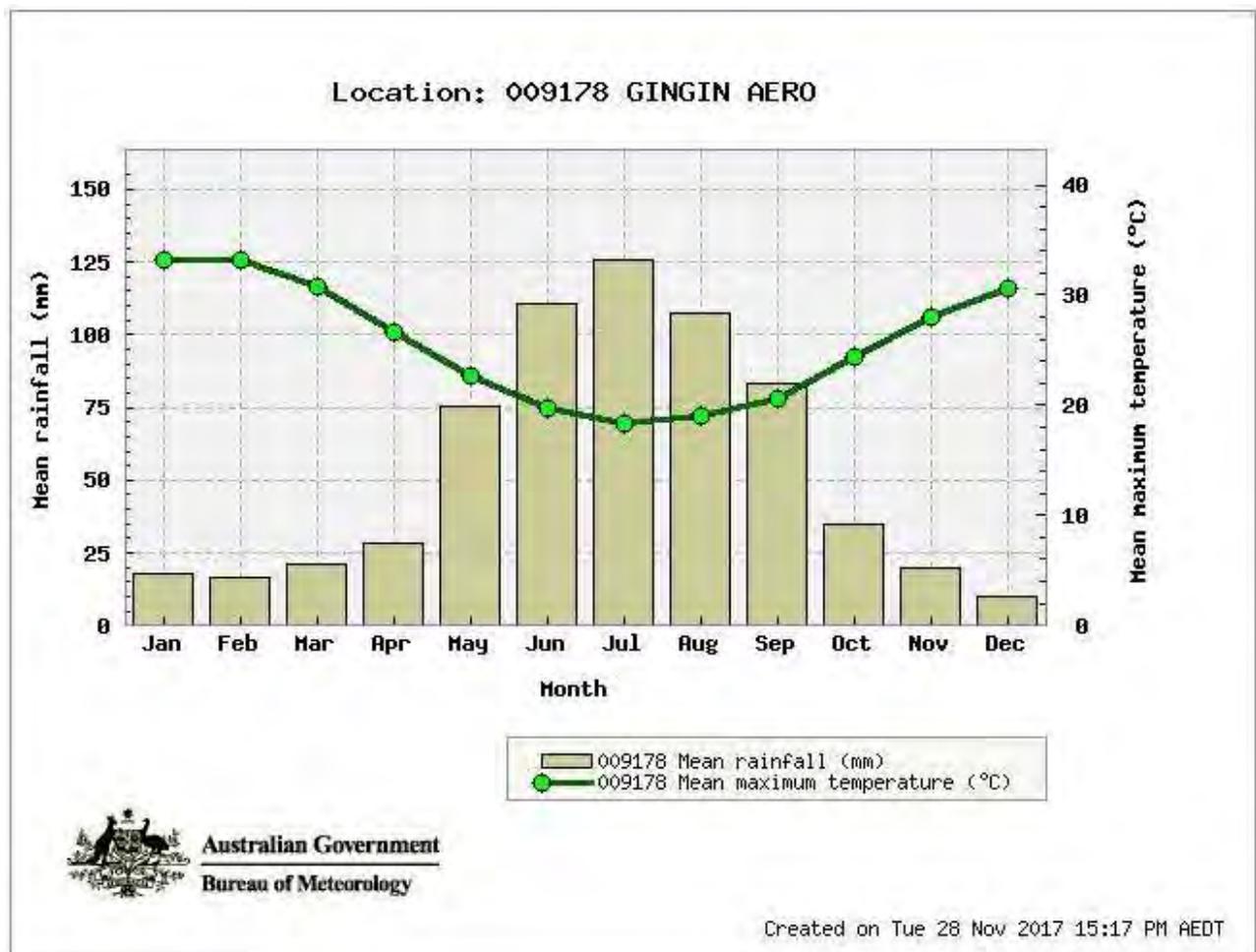


Figure 2 Climate Data for Gingin Aero

2.2 LAND USE

The wetland areas in the region have historically been cleared for rural activities, although some intact native vegetation remains in some wetland areas. Accordingly, the management category of the wetlands in the study area ranges from Multiple Use (MU) to Resource Enhancement (RE) and Conservation Category (CC) (refer to **Section 2.6** for further details).

2.3 IBRA REGION

There are 89 recognised Interim Biogeographic Regionalisation for Australia (IBRA) regions across Australia that have been defined based on climate, geology, landforms and characteristic vegetation and fauna (Commonwealth of Australia 2013). The study area lies within the Jarrah Forest IBRA region. At a finer scale, it falls within the Northern Jarrah Forest (JF 1 – Northern Jarrah Forest) subregion (Mitchell *et al.*, 2001).

The Northern Jarrah Forest subregion of the Jarrah Forest incorporates the area east of the Darling Scarp, overlying Archaean granite and metamorphic rocks. It occurs on plateaus of Yilgarn Craton, characterised by Jarrah-Marri forest on laterite gravels and, in the eastern part, by woodlands of Wandoo. Eluvial and alluvial deposits support *Agonis* shrublands. In areas of Mesozoic sediments, Jarrah forest occur in a mosaic with a variety of species rich shrublands (Mitchell *et al.*, 2001).

2.4 LANDFORM, GEOLOGY AND SOILS

The study area forms part of the Darling Plateau which is dominated by duricrust, gravels and sands and forms a gently undulating surface. According to (Churchward and McArthur 1980) the study area is located on three different landforms and soil units, described as follows:

Michibin – This unit often extends over local divides and has steep slopes and rock outcrop (Churchward and McArthur 1980). Occurs in the south of the Brockman River area as well as on the north-east of the subject land adjacent to Bindoon-Moora Road.

Nooning – Terraces derived from basic rocks which are dominated by red earth soils (Churchward and McArthur 1980). This unit occurs across the majority of the study area.

Yalanbee – This unit has an elevation of 250 to 300 m with a great extent of fine gravels (Churchward and McArthur 1980). A small area of this unit occurs in the north of the study area.

Soil-landscape mapping across Western Australia has been compiled by the Department of Agriculture and Food WA (DAFWA) (2016) using various surveys at different scales varying between 1:20,000 and 1:3,000,000. At the system scale, the study area traverses a number of regional soil-landscape mapping systems, as summarised in **Table 1**, with their extent in the study area shown in **Figure 3**.

Table 1 Summary of Soil-Landscape Systems within the Study Area (DAFWA 2016)

Map Unit	Soil System	Description
222Cp	Capitella System	Subdued stripped lateritic plateau, undulating to gently undulating low rises with gently undulating plain including dunes; pale and yellow deep sands, sandy gravels, some duplex; from sandstones plus alluvial and aeolian deposits.
253Ju	Julimar System	Moderately dissected areas with gravelly slopes and ridges and minor rock outcrop on the eastern side of the Darling Plateau over weathered granite and granitic gneiss. loamy gravel, shallow duplexes and pale deep sand common. Wandoo woodland.
253Yh	Yarawindah System	Dissected lateritic plateau with rolling to undulating low hills and undulating rises; loamy gravel, loamy earth, loamy duplex, some rock; weathered schist and some gneiss.
253Wa	Wannamal System	Alluvial plain and fans; Brown and red loamy earths, Yellow/brown sandy duplexes, loamy duplexes.

2.5 HYDROLOGY

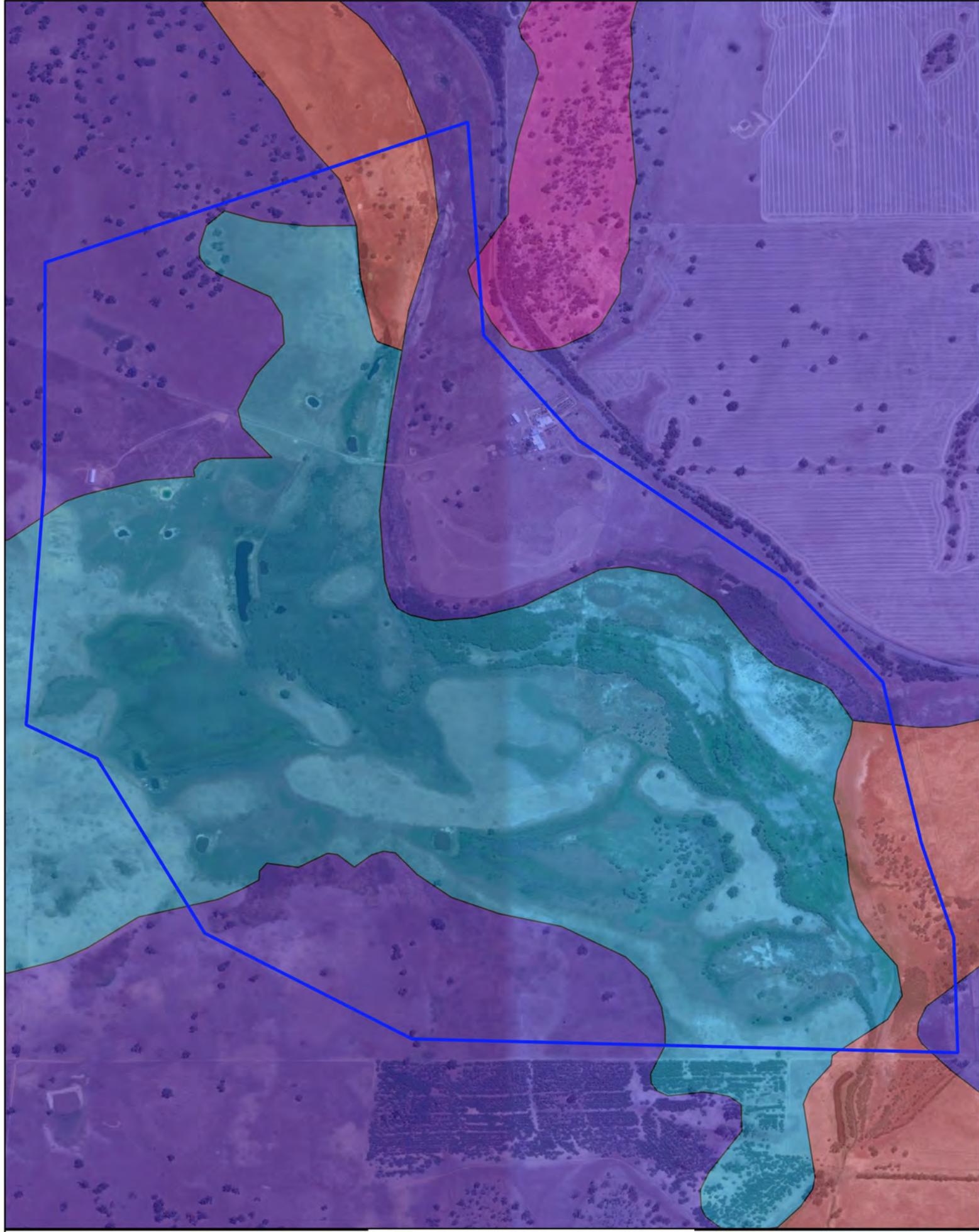
2.5.1 Groundwater

Groundwater contour data for the Perth region does not extend to the study area, and therefore, local bore data is the only available source of groundwater data for the region. However, bores located across the Bindoon-Moora Road and north at the Betts Nature Reserve section of the Lake Wannamal Wetlands are considered to exist in areas of much higher elevation and too great a distance away, respectively, to be considered appropriate in providing an accurate reflection of groundwater depth for the study area. Therefore, the study approach was to instead rely on collected field data from hand auguring, which was recognised as the best approach by Dr Michael Coote, Principal Coordinator of the Wetlands Section (Environmental Management Branch), Department of Biodiversity, Conservation and Attractions (DBCA).

2.5.2 Surface Water

The regional surface drainage of the area is situated within the Brockman River catchment of the Swan Avon - Main Avon System. A section of the Brockman River (3.6 km) runs in an approximate north-south alignment through the eastern half of the study area (**Figure 4**).

Two wetlands intersect this stretch of the Brockman River from north to south; a Multiple Use (MU) wetland, unique feature identifier (UFI) 12762 and a Conservation Category (CC) wetland, UFI 12840, which are classified as palusplain and floodplain, respectively. Two other wetlands are also supported by the designated study area; a MU dampland, UFI 12841 and a Resource Enhancement (RE) wetland, UFI 12838, which is a sumpland (**Figure 4**).



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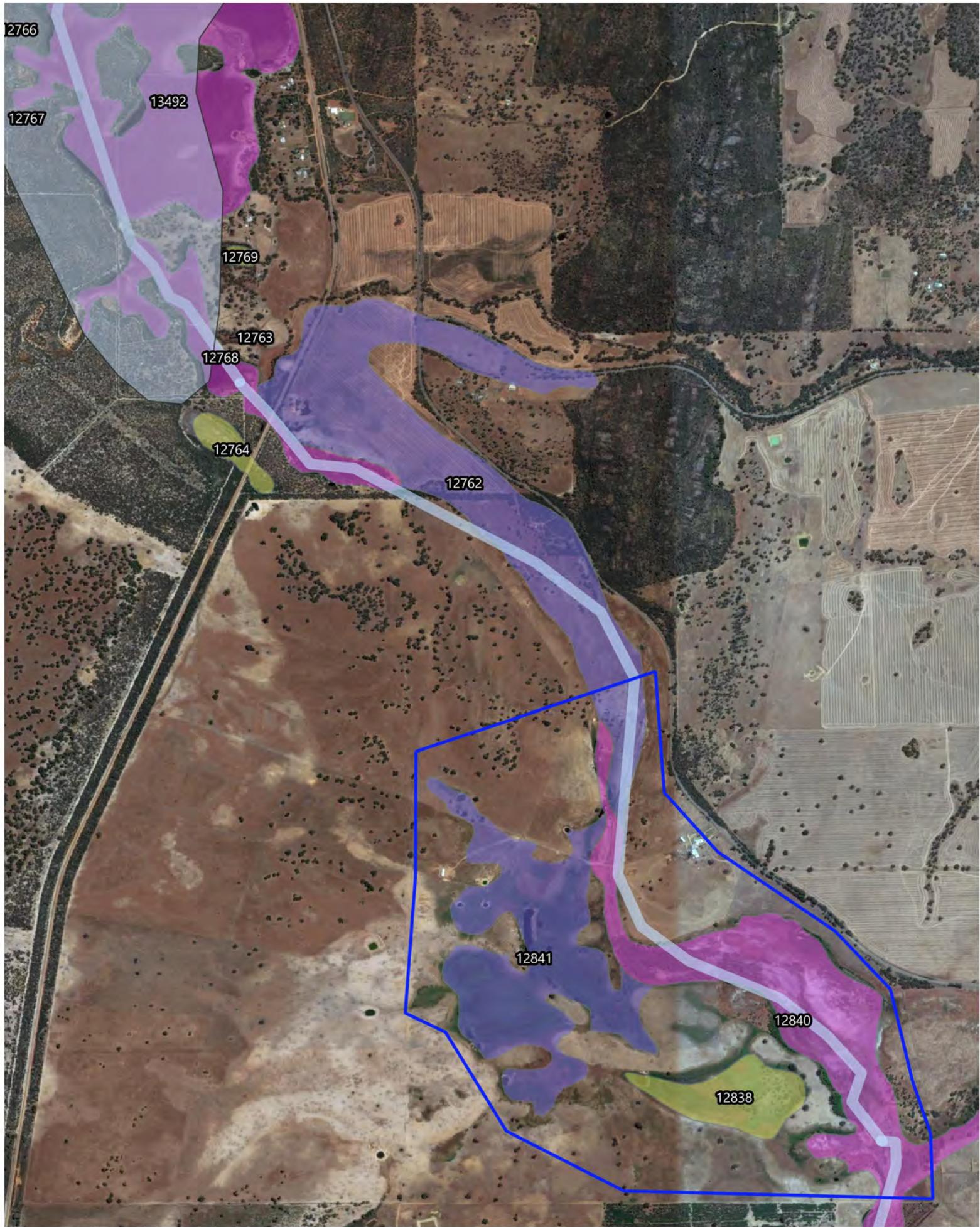


Figure 3 - Soil Landscape Mapping

Legend

- Study Area
- Capitella System
- Julimar System
- Wannamal System
- Yarawindah System





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Figure 4 - Surface Water Features

- Study Area
- Lake Wannamal Wetlands
- Brockman River

Legend

- Geomorphic Wetland Category**
- Conservation
 - Multiple Use
 - Resource Enhancement



2.6 WETLANDS

A large portion of the study area is mapped as wetland, including palusplain (seasonally waterlogged flats), sumplands (seasonally inundated basin), dampland (seasonally waterlogged basin) and floodplain (seasonally inundated flats). The entire study area is situated within the Brockman consanguineous wetland suite (Hill *et al.*, 1996). According to the DBCA *Geomorphic Wetlands of the Swan Coastal Plain* dataset, as previously mentioned, the four wetlands that occur within the study area are as follows (**Figure 4**):

- Conservation Category Wetland (CC) (UFI 12840) (floodplain)
- Resource Enhancement Wetland (RE) (UFI 12838) (sumpland)
- Multiple Use Wetland (MU) (UFI 1762) (palusplain)
- Multiple Use Wetland (MU) (UFI 12841) (dampland).

CC wetlands are defined as the most valuable of wetlands and the highest priority. They support a high level of ecological attributes and functions. Management objectives focus on the preservation of such wetlands through reservation as parks and reserves, protection under Environmental Policies and application of covenants (WRC 2001).

RE category wetlands are defined as priority wetlands that may have been partially modified but still support substantial ecological functions and attributes. They are considered to have the potential to be restored to Conservation category. The management objective of RE wetlands aims to improve the conservation value through management, restoration and protection by restoring wetland structure, function and biodiversity (WRC 2001).

MU wetlands are described as wetlands that are significantly degraded with a limited number of natural attributes and low human-usage (EPA 1993). Remaining important ecological attributes and functions are few (WRC 2001). The objective of an MU wetland is “to use, develop and manage wetlands in the context of water, town and environmental planning” (Hill *et al.*, 1996).

The importance of all of the wetlands present within the study area was verified in the context of the following:

- Ramsar List of Wetlands of International Importance
- A Directory of Important Wetlands in Australia
- Aboriginal Heritage Inquiry Search
- Register of the National Estate
- Conservation Reserves for Western Australia the Darling System – System 6
- Environmental Significance of Wetlands in the Perth Region.

None of the wetlands present within the study area are recognised to be of importance in any of the above listed contexts.

2.7 VEGETATION

The study area is situated within the Dale Botanical Subdistrict of the Northern Jarrah Forest Subregion, which consists of Jarrah (*E. marginata*) forest on ironstone gravels, marri-wandoo (*C. calophylla* – *E. wandoo*) woodlands on loamy soils with sclerophyll understorey (Beard 1990).

The study area traverses two vegetation associations characterised by Shepherd *et al.* (2002) as presented in **Table 2**.

Table 2 Regional Vegetation of the study area (Shepherd *et al.* 2002)

Shepherd Code	Beard Code	Intersects with Study Area	Current Extent (ha)	Pre-European Extent (ha)	Remaining (%)	Description
4	e3,5Mi	CCW (UFI 12840) REW (UFI 12838) MUW (UFI 12762) MUW (UFI 12841)	276,471	1,127,124	24.53	Medium woodland; marri & wandoo
1017	e2,3Mr bLi	MUW (UFI12841)	9,973	17,358	57.46	Medium open woodland; jarrah & marri, with low woodland; banksia

The extent of each of each vegetation association (Shepherd *et al.* 2002) present within the study area is presented in **Figure 5**.

Vegetation complexes within the study area have also been defined by Heddle *et al.*, (1980). These complexes are based on vegetation associations with landforms and underlying geology. Three vegetation complexes occur within the study area. These are described below:

- 1. Michibin Complex.** Open woodland of *Eucalyptus wandoo* over *Acacia acuminata* with some *Eucalyptus loxophleba* on valley slopes, with low woodland of *Allocasuarina huegeliana* on or near shallow granite outcrops in arid and perarid zones.
- 2. Nooning Complex.** This complex is restricted to the upper valley floors of the Brockman River and is characterised by low open forest of *Casuarina obesa* (Swamp sheoak) and the presence of *Casuarina obesa*, *Eucalyptus rudis* and *Melaleuca rhapsiophylla* along streams.
- 3. Yalanbee Complex in low rainfall.** This complex is characterised by woodlands of *Eucalyptus wandoo*-*Eucalyptus accedens*, less consistently open forest of *Eucalyptus marginata* subsp. *Thalassica* – *Corymbia calophylla* on lateritic uplands and breakaway landscapes in arid and perarid zones.

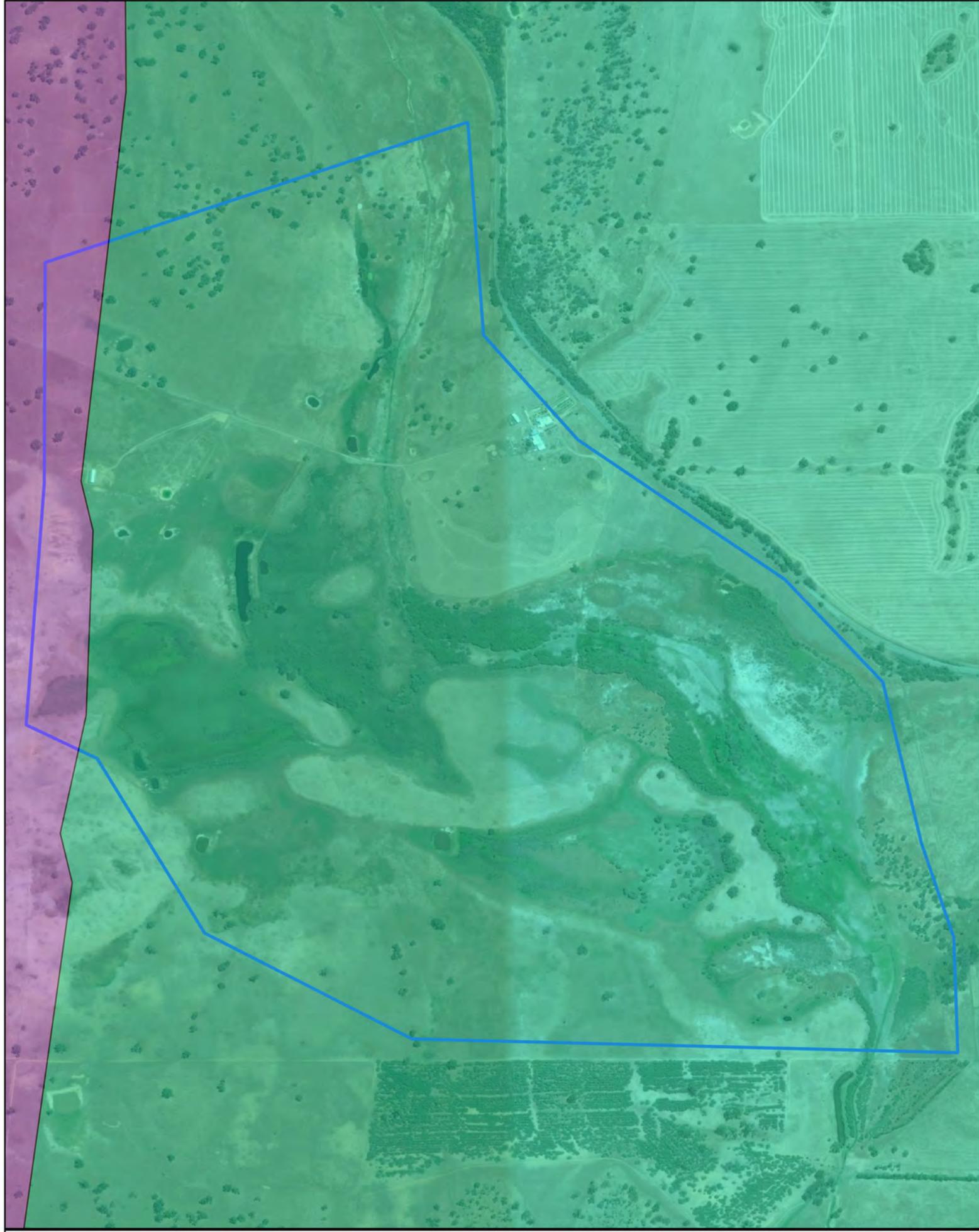
2.7.1 Conservation Significant Flora and Vegetation

A search of DBCA's Threatened and Priority Flora and Ecological Communities database, which included a 4 km buffer of the wider project area (search reference 40-1016FL), identified a total of 15 Threatened or Priority Flora species previously recorded within 5 km of the study area. These comprise three Threatened (T), one Priority One (P1), five Priority Three (P3) and six Priority Four (P4) species as presented in **Table 3**. One of these species, *Acacia drummondii* subsp. *affinis* (P3) has been previously recorded in the study area within MUW (UFI 12762). None of these species were recorded during the field assessment in November 2017, and none have wetland habitat preferences.

No known occurrences of Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs) were identified within the study area. The closest PEC - SCP23b Northern Swan Coastal Plain *Banksia attenuata* – *Banksia menziesii* woodlands (P3) occurs approximately 4.1 km north-west of the study area, on differing soils and elevation to that which is present within the study area.

2.8 HERITAGE

A search of Indigenous Affairs Aboriginal Site Register in November 2017 revealed that the study area is located within the Regional Forest Agreement Aboriginal Consultation Project Heritage Survey Area.



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Legend

- Gingin System
- Mogumber System



Figure 5 - Regional Vegetation

Table 3 Summary of Threatened and Priority Flora previously recorded within 5 km of the Study Area

Species	EPBC Act Cons. Status	WA Cons. Status	Description	Preferred Habitat	Likelihood of Occurrence
<i>Darwinia acerosa</i>	Endangered	Threatened (Endangered)	Prostrate shrub 20 cm high.	Granite rocks and outcrop. Orange - brown gravelly soil. Very Open Woodland	Unlikely to occur, suitable habitat not present within study area
<i>Goodenia arthrotricha</i>		Threatened (Endangered)	Erect perennial, herb, to 0.4 m high. Flowers blue, October to November	Granitic soil. Scattered low forest over mixed scrub.	Unlikely to occur, suitable habitat not present within study area
<i>Spirogardnera rubescens</i>	Endangered	Threatened (Vulnerable)	Spindly leafless shrub, to 1.6 m high. Flowers white, August to December	Wandoo Low Open Woodland. laterite, sand over laterite, loam	Unlikely to occur, suitable habitat not present within study area
<i>Acacia drummondii</i> subsp. <i>affinis</i>		Priority 3	Erect shrub, 0.3-1 m high. Flowers yellow, July to August	Jarraah woodland. Plateau, laterite. Lateritic gravelly soils	May occur, previously recorded within MUW (UFI 12762)
<i>Acacia oncinophylla</i> subsp. <i>oncinophylla</i>		Priority 3	Shrub, 0.9-2.5 m high, 'minni-ritchi' bark, phyllodes mostly 8-13 cm long, 1-2 mm wide. Flowers yellow, August to October	Low Forest B over Scrub over Dwarf Scrub D	Unlikely to occur, suitable habitat not present within study area
<i>Acacia pulchella</i> var. <i>reflexa</i> acuminate bracteole variant (R.J. Cumming 882)		Priority 3	Shrub, 0.3-1 m high. Flowers yellow, July to September	Sandy loam or sandy clay over laterite. Woodland. <i>Eucalyptus calophylla</i> -wandoo woodland	Unlikely to occur, closest record occurs 1.7 km west of study area
<i>Dielsiodoxa leucantha</i> subsp. <i>leucantha</i>		Priority 3	No available information	No available information	Unlikely to occur, closest record occurs 2 km north-east of study area
<i>Guichenotia tuberculata</i>		Priority 3	Erect, open shrub, (0.25-)0.6-0.9 m high. Flowers purple-pink, August to October	<i>Eucalyptus</i> woodland with <i>Hakea trifurcata</i> , Sand clay over laterite, sand	Unlikely to occur, closest record occurs 3 km north of study area
<i>Lasiopetalum caroliae</i>		Priority 3	Low shrub. Flowers pink-purple, October	Heavy soils, clay.	Unlikely to occur, closest record occurs 4.3 km north of study area
<i>Anigozanthos humilis</i> subsp. <i>chrysanthus</i>		Priority 4	Rhizomatous, perennial, herb, 0.2-0.4 (-0.8) m high. Flowers yellow, July to October	<i>Banksia</i> Woodland. Grey or yellow sand	Unlikely to occur, suitable habitat not present within study area

Species	EPBC Act Cons. Status	WA Cons. Status	Description	Preferred Habitat	Likelihood of Occurrence
<i>Boronia tenuis</i>		Priority 4	Procumbent or erect & slender shrub, 0.1-0.5 m high. Flowers blue/pink-white, August to November	Laterite, stony soils, granite. Pale orange sandy gravelly loam. Dense Heath C over Dwarf Scrub D	Unlikely to occur, suitable habitat not present within study area
<i>Hibbertia miniata</i>		Priority 4	Decumbent or erect shrub, 0.1-1 m high. Flowers orange/orange-red, August to November	Open Woodland of <i>Corymbia calophylla</i> . Lateritic gravelly soils	Unlikely to occur, suitable habitat not present within study area
<i>Persoonia sulcata</i>		Priority 4	Much-branched shrub 40 cm tall; fruit green with a few longitudinal brown streaks, white-spotted	In open woodland	Unlikely to occur, suitable habitat not present within study area
<i>Synaphea grandis</i>		Priority 4	Tufted shrub, ca 0.3 m high. Flowers Yellow, October to November	Wandoo/Marri Woodland Laterite	Unlikely to occur, suitable habitat not present within study area
<i>Verticordia lindleyi</i> subsp. <i>lindleyi</i>		Priority 4	Erect shrub, 0.2-0.75 m high. Flowers pink, May or November to December or January	Sand, sandy clay. Winter-wet depressions. <i>Banksia</i> and <i>Melaleuca</i> winter wetland	May occur, suitable habitat present within study area

3 METHODOLOGY

The process of identifying a wetland, its boundaries and management category is outlined in *Protocol for Proposing Modifications to the Geomorphic Wetlands Swan Coastal Plain Dataset* (DEC 2008), which was applied to the assessment reported in this document. The protocol requires a detailed desktop assessment, gathering information regarding regional geology/soil, landforms, elevation/topography, groundwater and vegetation, and a field assessment to describe vegetation and soil (moisture and depth to groundwater and hydric soils), a description of the wetland/s, photographs of the wetland/s and completion of the Environmental Protection Authority (EPA) Bulletin 686 wetland evaluation questionnaire to assist with determination of an applicable management category.

Further to the abovementioned protocol (DEC 2008), the guideline, *Wetland identification and delineation; information for mapping and land use planning on the Swan Coastal Plain with A methodology for the evaluation of wetlands on the Swan Coastal Plain, Western Australia* (DBCA 2017) has been finalised and released for use. The guideline had not yet been finalised and released at the time of the field assessment in November 2017, and therefore, the advice of Dr Michael Coote, Principal Coordinator of the Wetlands Section of the Environmental Management Branch at DBCA was to use the existing protocol (DEC 2008).

The revised procedure for evaluating a wetland on the Swan Coastal Plain comprises a two-tiered approach; a preliminary evaluation and a secondary evaluation. This is to avoid the need for detailed assessments being carried out when they may not be necessary. Across the full preliminary and secondary evaluation approaches, desktop and site assessments are carried out, for which methodologies are comparable to the superseded methodology (DEC 2008) utilised for this assessment. The methodology utilised for the study (DEC 2008) is therefore considered adequate and suitable for the results presented and conclusions and recommendations made.

However, the superseded methodology does not allow proper evaluation of wetlands in complex situations such as a connected wetland systems or palusplains, which the study area is. Additionally, given the release of the revised methodology, it is recommended that if an application to alter a wetland management category is considered, the wetland evaluation be revised to meet the current methodology (DBCA 2017) (Dr Michael Coote, pers. comm.). The existing results and conclusions arising from the application of the superseded methodology (DEC 2008) would however, be considered adequate for consideration of an application to alter wetland boundaries (Dr Michael Coote, pers. comm.).

3.1 DESKTOP ASSESSMENT

A preliminary desktop assessment of the study area was undertaken prior to conducting the field assessment by reviewing publicly available and other databases, relevant shapefiles and web-based mapping tools including:

- A review of DBCA Geomorphic Wetlands database to identify the current boundary, geomorphic category classification (wetland type) and management category as recorded in the Swan Coastal Plain dataset
- Hydrology data (as available)
- Geology and soil data (regional data)
- Vegetation data (regional data, previous field surveys and other sources)

All data with spatial characters was overlaid in GIS as part of study preparations, to best guide field survey design and execution.

3.2 FIELD ASSESSMENT

A wetland assessment including soil sampling was undertaken by Senior Botanists, Gabriela Martinez and Lisa Chappell, and soil specialising Environmental Technician, Matt Magistro on 14-16 November 2017, with a total survey effort of nine person-days.

The timing of the mid-November field assessment was within the optimal spring season, although in the later part of spring. Nevertheless, the timing is considered optimal in the region for flora, vegetation and wetland assessments. The rainfall recorded at Gingin Aero (BoM 2018), representative of the study area region, during the late autumn and winter prior to the spring field assessment showed significantly lower than average levels (during May and June), and null records for July and August (possibly due to a technical difficulty). Rainfall during September was slightly above average (85.2 mm with an average of 83.3 mm), slightly below average in October (23.0 mm with an average of 35.1 mm), and virtually non-existent rainfall during November (1.4 mm with an average of 18.8 mm). This lower than usual rainfall may have had an impact on inferred soil moisture and groundwater depth results, which may have resulted in a slight under-estimation of the wetland extent.

3.2.1 Soil

The soil sampling was carried out alongside the field assessment focused on wetland vegetation. This included the documentation of broad soil observations from within the wetlands, on perceived wetland boundaries and in the locations that transition into upland (**Figure 6**).

Soil data was collected and observations were interpreted from soil profiles collected by hand-held auger. Samples were photographed and logged in the field for various visible characteristics with a focused on the visible depth of hydric soils (based on visible mottling and organic matter) and depth to groundwater (based on soil saturation, auger refusal or both). exhibit the depth at which the hydric soils occur.

3.2.2 Vegetation

The field assessment focused on wetland vegetation and included establishment and scoring of a number of vegetation sampling quadrats (at least one per vegetation type and two or more for dominant vegetation types), recorded in accordance with the Environmental Protection Authority (EPA) (2016) *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment*.

Field data from quadrats, relevés, opportunistic observations and spatial mapping between was collected using electronic tablets equipped with the mobile mapping software, Mappt™. This methodology allowed in-field spatial mapping of boundaries for vegetation communities and condition, as well as the collection of spatial point data where quadrat/relevé data, other observations or photographs were captured.

Vegetation mapping was conducted in the field and refined afterwards by defining the different plant communities based on vegetation structure, dominant species and floristic composition, and extrapolated based on their appearance in aerial imagery.

Vegetation field data was collected from 11 pegged 10 m x 10 m quadrats and seven relevés (**Figure 7**). A single permanent peg was installed in the north-west corner of each quadrat and marked with a quadrat number. Quadrats were established and sampled in areas of good or better vegetation condition, in accordance with the requirements of EPA (2016).

Detailed data collection points (relevés) were utilised in locations where vegetation condition was considered to be in poorer than good condition.

The following information was collected from within each quadrat sampled:

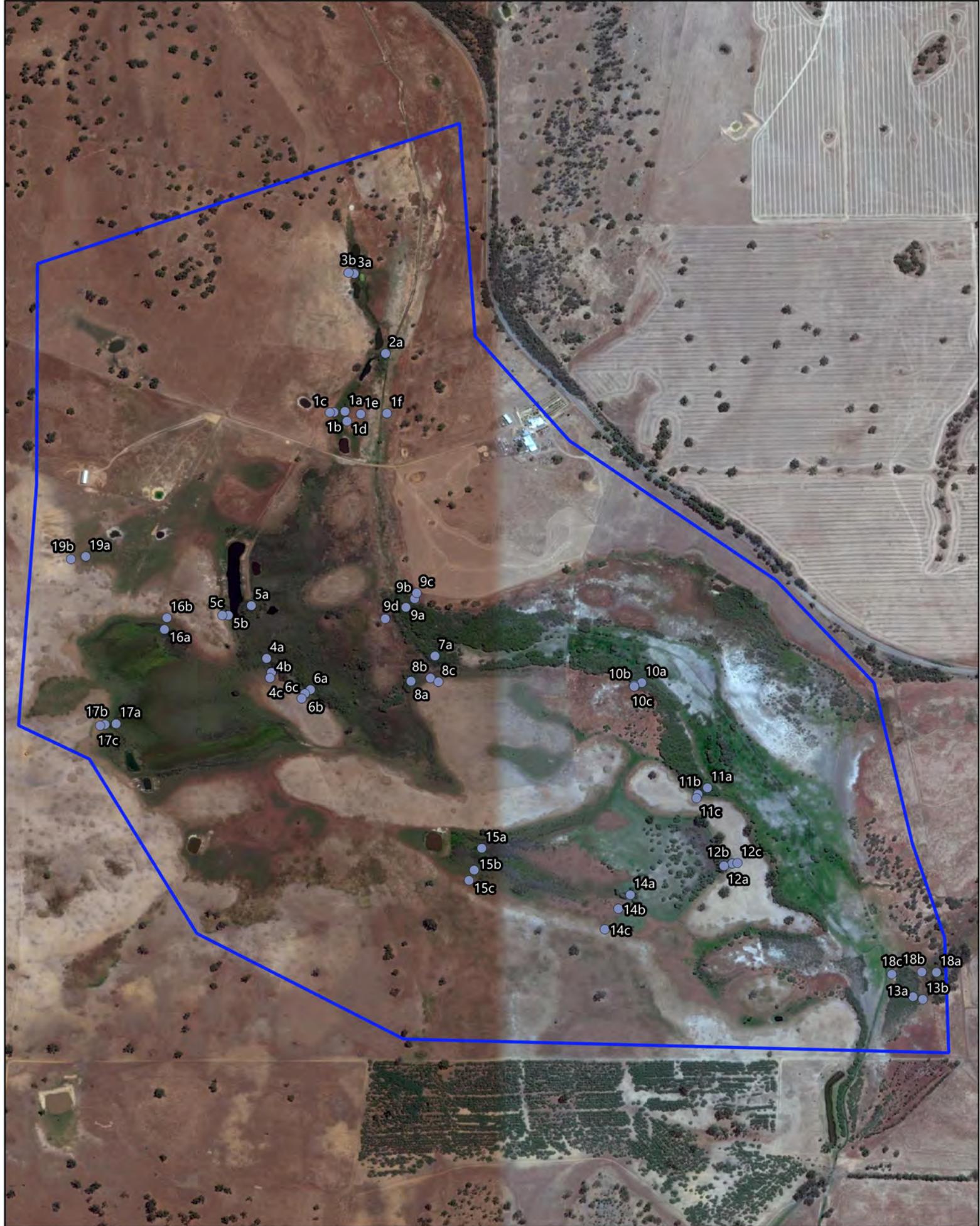
- Observer
- Date
- Location/site
- GPS location (GDA94)
- Digital photograph taken from the north-west corner
- Soil type and colour
- Soil moisture/inundation
- Topography/landscape position
- Vegetation condition/degradation/disturbances (e.g. weed infestation, fire)
- Flora inventory, and for each dominant species:
 - Average height
 - Total projected foliage cover within quadrat
- Vegetation condition as per the currently accepted scale as required by EPA (2016); an adaptation of the Keighery (1994) and Trudgen (1991) condition scales.

Observations and opportunistic data collection was also carried out continuously throughout the assessment of the study area, to draft maps for the extent of vegetation communities and condition, as well as other relevant wetland features. Other general site features were continuously recorded whilst on site, including a traverse of the boundaries of identifiable wetland vegetation, adjacent to paddocks, pasture and other cleared areas and upland vegetation units.

3.3 DETERMINATION OF WETLAND BOUNDARIES

One of the aims of the wetland assessment was to determine if the boundaries of the wetlands present within the study area as per the Geomorphic Wetlands of the Swan Coastal Plain dataset are current and accurate, and if not, what more appropriate boundaries may be, based on the results of this study, and which may be included in an application for changes to be made to the dataset, if required.

In order to map the interpreted boundary of the wetlands within the study area, data was collated relating to groundwater and hydric soil depth, vegetation types, wetland features visible in high-resolution aerial imagery, including vegetation extent/type, as well as visible surface water and soil moisture and other data collected during the desktop assessment.



0 125 250 375 500 m
GDA 94 / MGA Zone 50

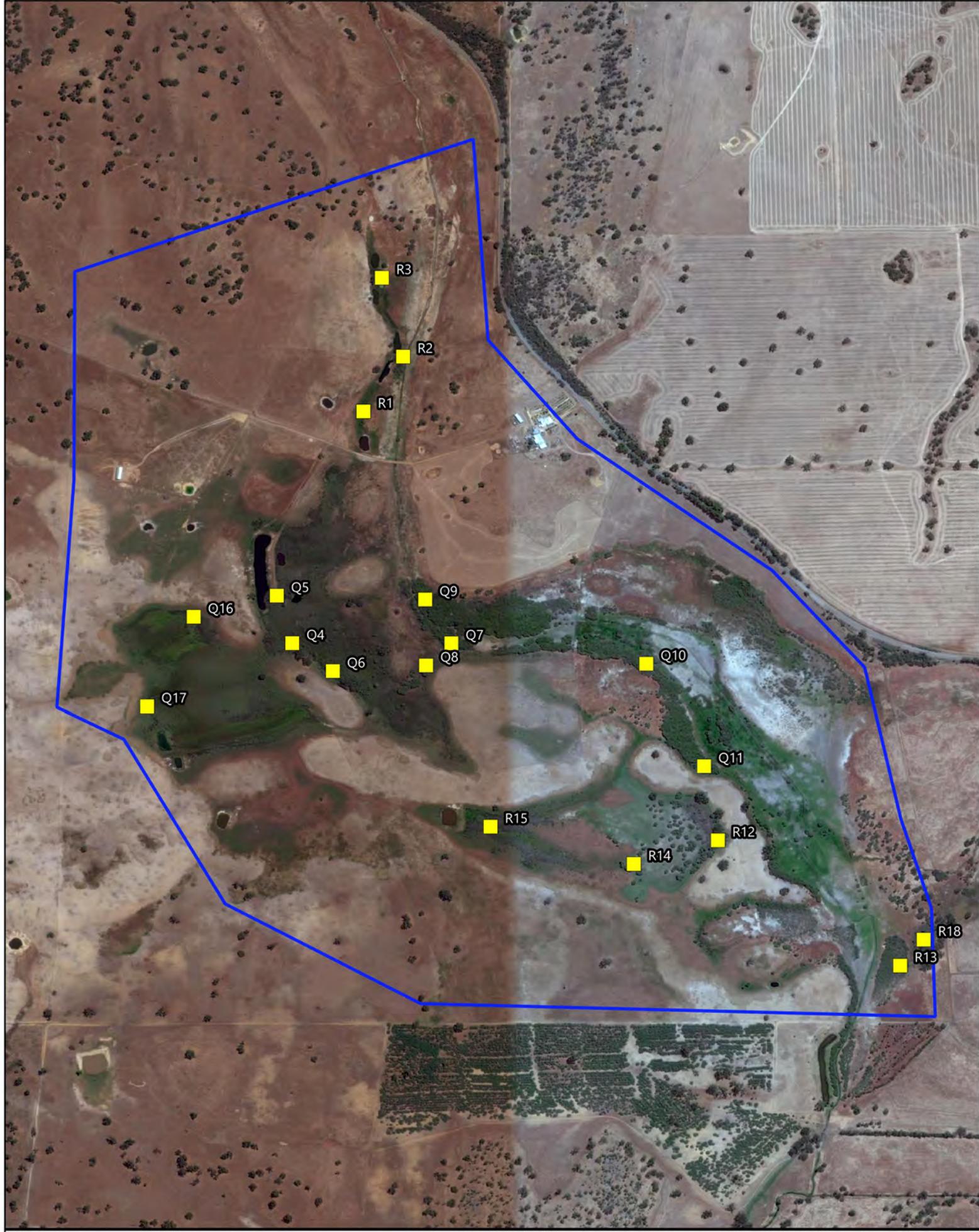


Legend

- Study Area
- Soil Sample Location



Figure 6 - Locations of Soil Sampling Sites



Legend

- Study Area
- Quadrat (Q) or Relevé (R) Location



Figure 7 - Locations of Quadrats Relevés

3.4 DETERMINATION OF WETLAND MANAGEMENT CATEGORIES

The level of significance and values of a wetland is attained through the field assessment, with the information gathered used to assign an appropriate management category. This in turn provides guidance on the management and protection required for the wetland (WRC 2001).

Management categories assigned to the wetlands of the study area are as per the *Swan Coastal Plain* dataset of the *Geomorphic Wetlands* database. The study area supports MU, RE and CC wetlands.

The initial information gathered during the field assessment was supported by a preliminary evaluation of management requirements from the questionnaire from EPA Bulletin 686 – *A Guide to Wetland Management in the Perth and Near Perth Swan Coastal Plain* (EPA 1993). The allocation of management categories through the EPA Bulletin 686 questionnaire is considered a first cut, broad-brush evaluation.

Although the application of Bulletin 686 is now superseded by more recent assessment methodologies, the methods utilised and results obtained are considered suitable for the current study's purposes.

Preliminary wetland management categories considered appropriate for each wetland will be assigned based on the results of the questionnaire, with justification provided if an alternative category was more applicable.

4 RESULTS

4.1 SOIL SAMPLING

The soil sampling program provided the following results at each sampled site:

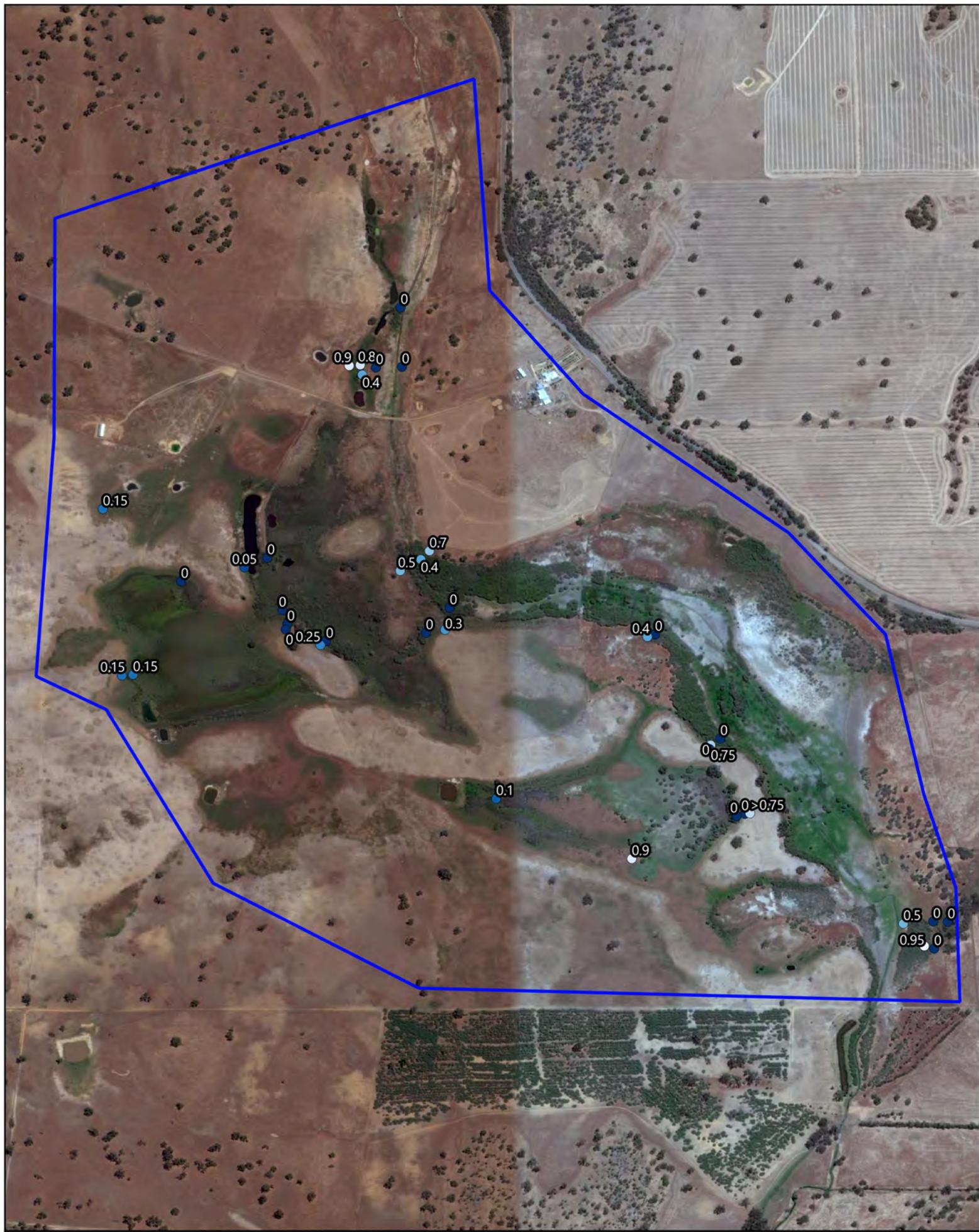
1. Soil profile information, including type, texture, colour and photographic records
2. Depth (metres below ground surface, mbgs) to hydric soil layer (if evident)
3. Depth (mbgs) to groundwater, based on evidence of soil saturation, and/or auger refusal.

A total of 55 soil samples were collected from 19 sampling sites, which correlated with the flora and vegetation assessment sites across the wetland area. The soil sample records for each site are presented in **Appendix A** and photographic records of the sites and soil cores are presented in **Appendix B**.

From the soil sampling results for the various sites, in combination with floristic results and also the interpreted appearance of aerial imagery (wetland appearance, soil moisture visibility), the depth to hydric layer and depth to groundwater was interpreted across the wetland assessment area, as presented in **Figures 8a** and **8b**, respectively.

Grouping of the depth to hydric layer and the depth to ground water at each sampling site enabled the determination the wetland extent across the assessment area (**Figure 8c**). Minor and broad extrapolations based on surrounding vegetation, evidence of soil moisture and other values such as elevation/topography and the appearance of the site characteristics in aerial imagery were made to determine the likely depth to groundwater/hydric soils, and therefore wetland extent.

The majority of the defined wetland areas (UFI 12840, 12838 and 12762) at the time of assessment had groundwater depth between 0.4 - 0.6m (**Figure 8c**). UFI 12841, exhibited areas of surface water and resulted in an interpreted depth to groundwater ranging from 0 - <0.15 mbgs to 0 – 0.6 mbgs.



0 100 200 300 400 500 m

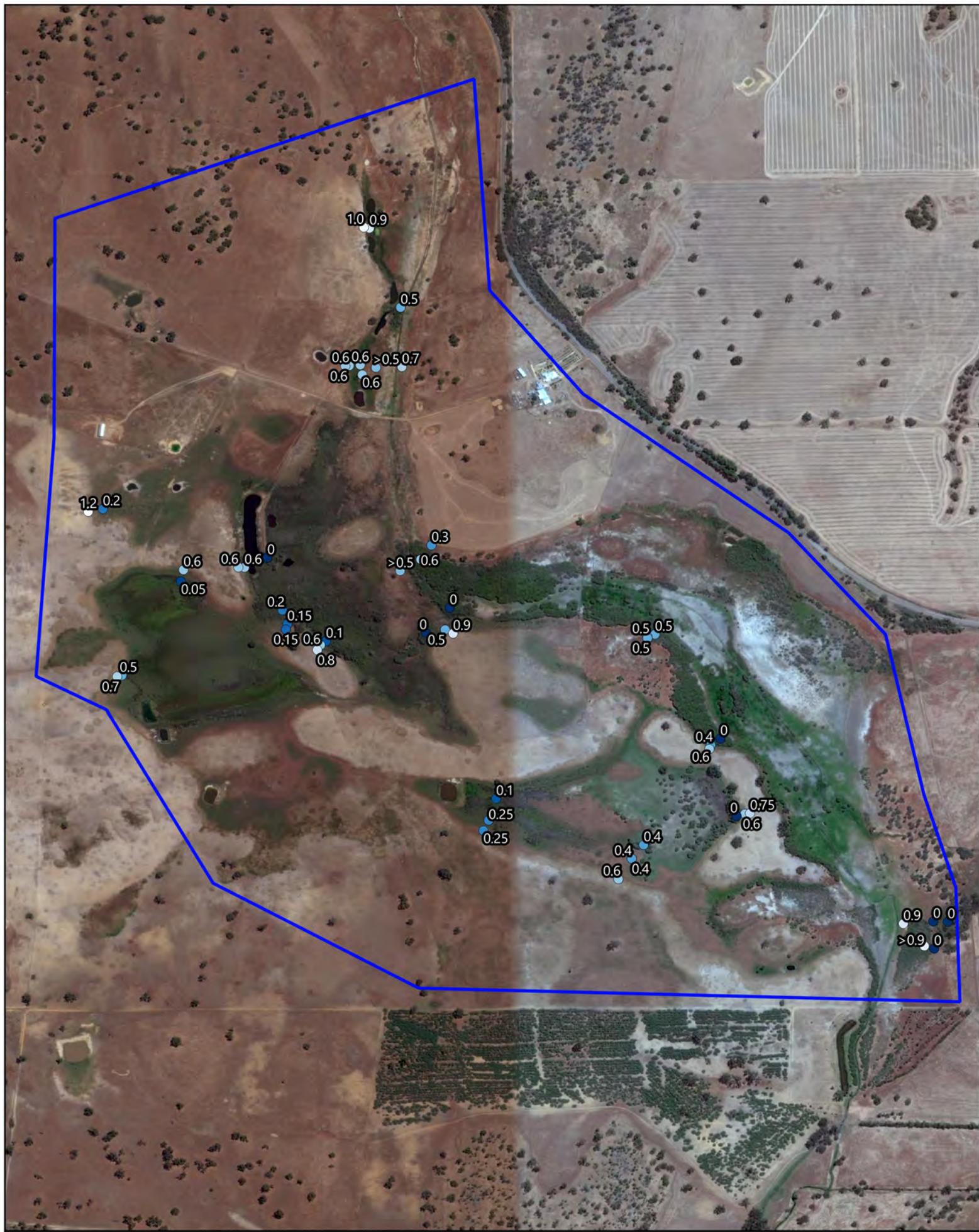
GDA 94 / MGA Zone 50

Figure 8a - Recorded Depth to Hydric Soils



Legend			
	Study Area		>0.75m
	0.95m		0.75m
	0.9m		0.7m
	0.8m		0.5m
			0.4m
			0.3m
			0.25m
			0.15m
			0.1m
			0.05m
			0m





0 100 200 300 400 500 m

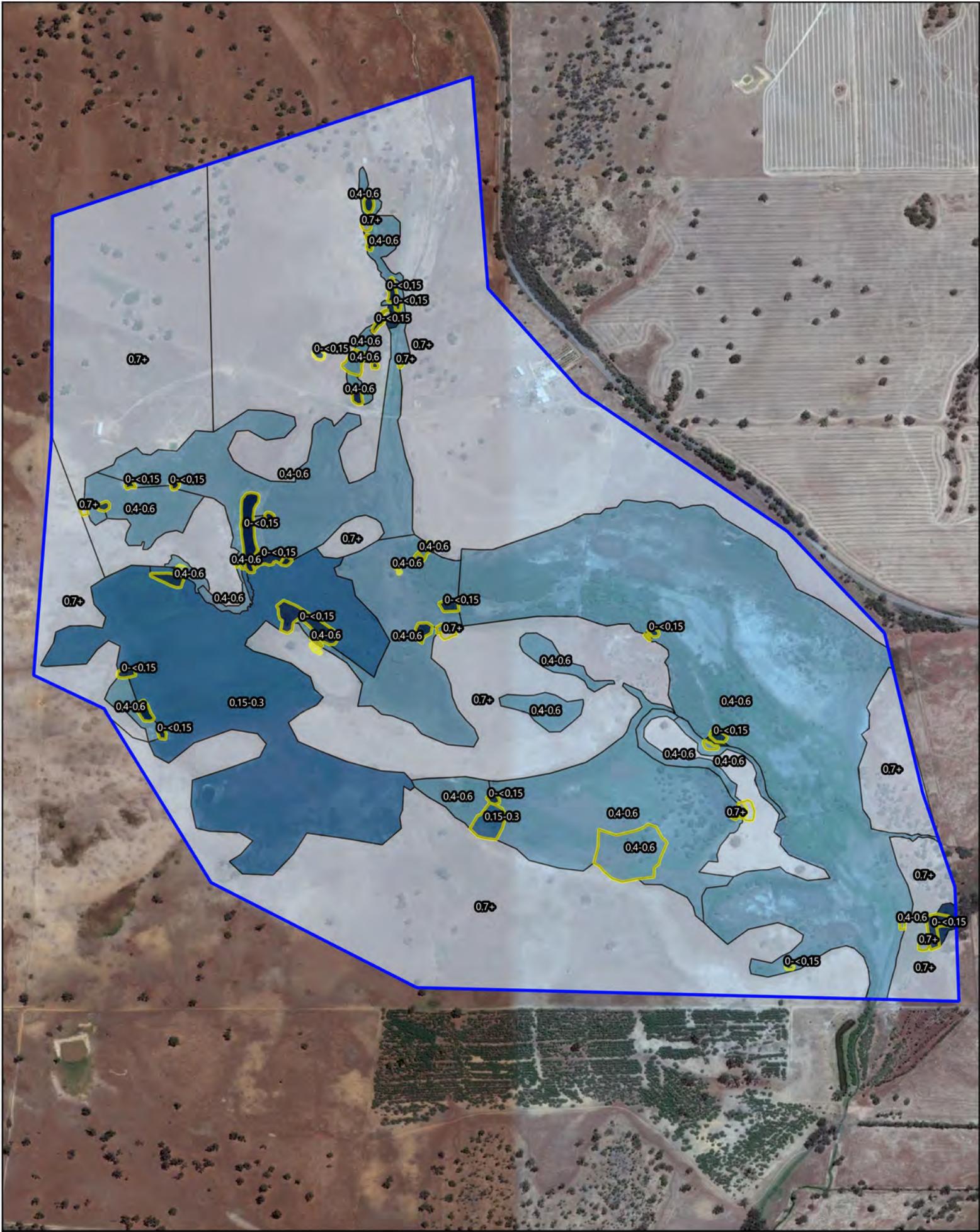
GDA 94 / MGA Zone 50



Figure 8b - Recorded Depth to Groundwater

Study Area		Legend					
○	1.2m	○	0.8m	●	0.5m	●	0.15m
○	1.0m	○	0.75m	●	0.4m	●	0.1m
○	>0.9m	○	0.7m	●	0.3m	●	0.05m
○	0.9m	○	0.6m	●	0.25m	●	0m
		○	>0.5m	●	0.2m		





0 100 200 300 400 500 m

GDA 94 / MGA Zone 50

Figure 8c - Combined Groundwater and Hydric Soil Depth



Legend

Broad extrapolation depths

- 0-<0.15m
- 0.15-0.3m
- 0.4-0.6m
- 0.7m+

Minor extrapolation depths

- 0-<0.15m
- 0.15-0.3m
- 0.4-0.6m
- 0.7m+



4.2 VEGETATION

A total of 12 intact native vegetation units and four varying pasture types were recorded and mapped within the wetland study area, as described in **Table 4** and presented spatially in **Figure 9**. The full list of vascular flora species with the vegetation units and quadrats in which they occur is presented in **Appendices C** and **D**, respectively.

Table 4 Summary of Recorded Vegetation Units

Vegetation Unit Code and Broad Description	Representative Quadrat (Q) or Relevé (R)	Represented within Wetland
<p>MvJspLs <i>Melaleuca viminea</i> shrubland</p> <p><i>Melaleuca viminea</i> tall shrubland over <i>Juncus</i> spp. sparse sedgeland and <i>Cotula coronopifolia</i>, <i>Lotus</i> spp. and <i>Utricularia multifida</i> isolated herbs</p>	B20^	CCW (UFI 12840)
<p>ErWS <i>Eucalyptus rudis</i> Woodland/Sedgeland</p> <p><i>Eucalyptus rudis</i> Low Woodland over *<i>Juncus acutus</i>, <i>Baumea rubiginosa</i> and *<i>Cyperus polystachyos</i> Dense Tall Sedgeland</p>	Q04	MU (UFI 12841)
<p>ErMrWS <i>Eucalyptus rudis</i> - <i>Melaleuca raphiophylla</i> Woodland/Sedgeland</p> <p><i>Eucalyptus rudis</i> and <i>Melaleuca raphiophylla</i> Open Low Woodland over <i>Juncus pallidus</i>, <i>Baumea rubiginosa</i> and <i>Lepidosperma longitudinale</i> Dense Low Sedgeland over *<i>Isolepis prolifera</i> and *<i>Cynodon dactylon</i> Open Herbland</p>	Q05 and Q06	MU (UFI 12841)
<p>MrMtFH <i>Melaleuca raphiophylla</i>-<i>Melaleuca teretifolia</i> Forest/Herbland</p> <p><i>Melaleuca raphiophylla</i> and <i>Melaleuca teretifolia</i> Dense Low Forest over *<i>Cotula coronopifolia</i> and <i>Isolepis cernua</i> Herbland</p>	Q07	CCW (UFI 12840) MU (UFI 12841)
<p>MrF <i>Melaleuca raphiophylla</i> Forest/Sedgeland</p> <p><i>Melaleuca raphiophylla</i> Low Forest over <i>Juncus pallidus</i> Open Sedgeland over *<i>Cotula coronopifolia</i>, *<i>Lotus angustissimus</i> and *<i>Isolepis prolifera</i> Open Herbland over *<i>Cynodon dactylon</i> Dense Low Grassland</p>	Q08, Q09 and R14	CCW (UFI 12840) MU (UFI 12841) RE (UFI 12838)
<p>MrMpFH <i>Melaleuca raphiophylla</i>-<i>Melaleuca preissii</i> Forest/Herbland</p> <p><i>Melaleuca raphiophylla</i> and <i>Melaleuca preissiana</i> Dense Low Forest to Low Forest over *<i>Cotula coronopifolia</i>, <i>Juncus pallidus</i> and <i>Cassytha</i> sp. Very Open Herbland over *<i>Avena barbata</i> and *<i>Ehrharta calycina</i> Open Low Grassland</p>	Q10, Q11 and Q13	CCW (UFI 12840)
<p>JSW <i>Juncus</i> Sedgeland/Weeds</p> <p><i>Juncus pallidus</i> and *<i>Juncus acutus</i> Tall Sedgeland to Open Low Sedgeland over *<i>Isolepis prolifera</i>, <i>Isolepis cernua</i> and <i>Eleocharis acuta</i> Herbland</p>	Q16, Q17 and R01	CCW (UFI 12840) MU (UFI 12841)
<p>MtWS <i>Melaleuca teretifolia</i> Woodland/Sedgeland</p>	R02	CCW (UFI 12840) MU (UFI 12841) MU (UFI 12762)

Vegetation Unit Code and Broad Description	Representative Quadrat (Q) or Relevé (R)	Represented within Wetland
TSW <i>Typha</i> Sedgeland/Weeds <i>Typha</i> sp. and <i>Juncus pallidus</i> Open Low Sedgeland over * <i>Lotus angustissimus</i> , * <i>Lythrum hyssopifolia</i> and * <i>Hordeum leporinum</i> Herbland	R03	CCW (UFI 12840)
ErMrF <i>Eucalyptus rudis</i> - <i>Melaleuca raphiophylla</i> Forest <i>Eucalyptus rudis</i> and <i>Melaleuca raphiophylla</i> Dense Low Forest over * <i>Cynodon dactylon</i> Very Open Low Grassland	R12	RE UFI (12838)
MpS <i>Melaleuca preissiana</i> /Weeds <i>Melaleuca preissiana</i> Open Low Woodland over <i>Juncus pallidus</i> Open Tall Sedgeland over * <i>Cynodon dactylon</i> Dense Low Grassland	R15	RE UFI (12838)
ErMpAWS <i>Eucalyptus rudis</i> - <i>Melaleuca preissiana</i> - <i>Allocasuarina</i> Woodland/Sedgeland <i>Eucalyptus rudis</i> Woodland over <i>Casuarina obesa</i> and <i>Melaleuca preissiana</i> Open Scrub over * <i>Cynodon dactylon</i> , <i>Juncus pallidus</i> and <i>Bolboschoenus caldwellii</i> Dense Herbland	R18	CCW (UFI 12840)
Pa Completely degraded pasture areas	NA	CCW (UFI 12840) MU (UFI 12841) RE UFI (12838) MU (UFI 12762)
P_Er Pasture with scattered <i>Eucalyptus rudis</i>	NA	CCW (UFI 12840) MU (UFI 12841) MU (UFI 12762)
P_Cd Pasture dominated by * <i>Cynodon dactylon</i>	NA	CCW (UFI 12840) RE UFI (12838)
P_Mr Pasture with scattered <i>Melaleuca raphiophylla</i>	NA	CCW (UFI 12840)
CLD Cleared areas void of any native or non-native species	NA	NA
OW Open water associated with constructed dams and natural waterbodies	NA	CCW (UFI 12840) MU (UFI 12841) RE UFI (12838) MU (UFI 12762)

^ Denotes FVC (2016) quadrat

The condition of the vegetation within the study area ranges from 'Completely Degraded' to 'Good – Very Good'. The site has a history of grazing and agriculture, including the construction of dams which is reflected in the vegetation condition. The majority of the study area was found to be in 'Completely Degraded' condition. A summary of the varying vegetation condition within each wetland is summarised in **Table 5** and presented spatially in **Figure 10**.

Table 5 Summary of Varying Vegetation Condition within each Wetland

Condition Rating	CC (UFI 12840) Area (ha)	RE (UFI 12838) Area (ha)	MU (UFI 12762) Area (ha)	MU (UFI 12841) Area (ha)
Good – Very Good	4.58	-	-	11.32
Good	9.96	3.79	-	16.70
Degraded	6.66	2.81	0.22	5.57
Degraded - Good	2.72	0.60	-	4.55
Degraded – Completely Degraded	8.31	1.76	1.99	1.14
Completely Degraded	17.36	3.59	4.69	10.48
TOTAL	49.60	12.56	6.90	49.75

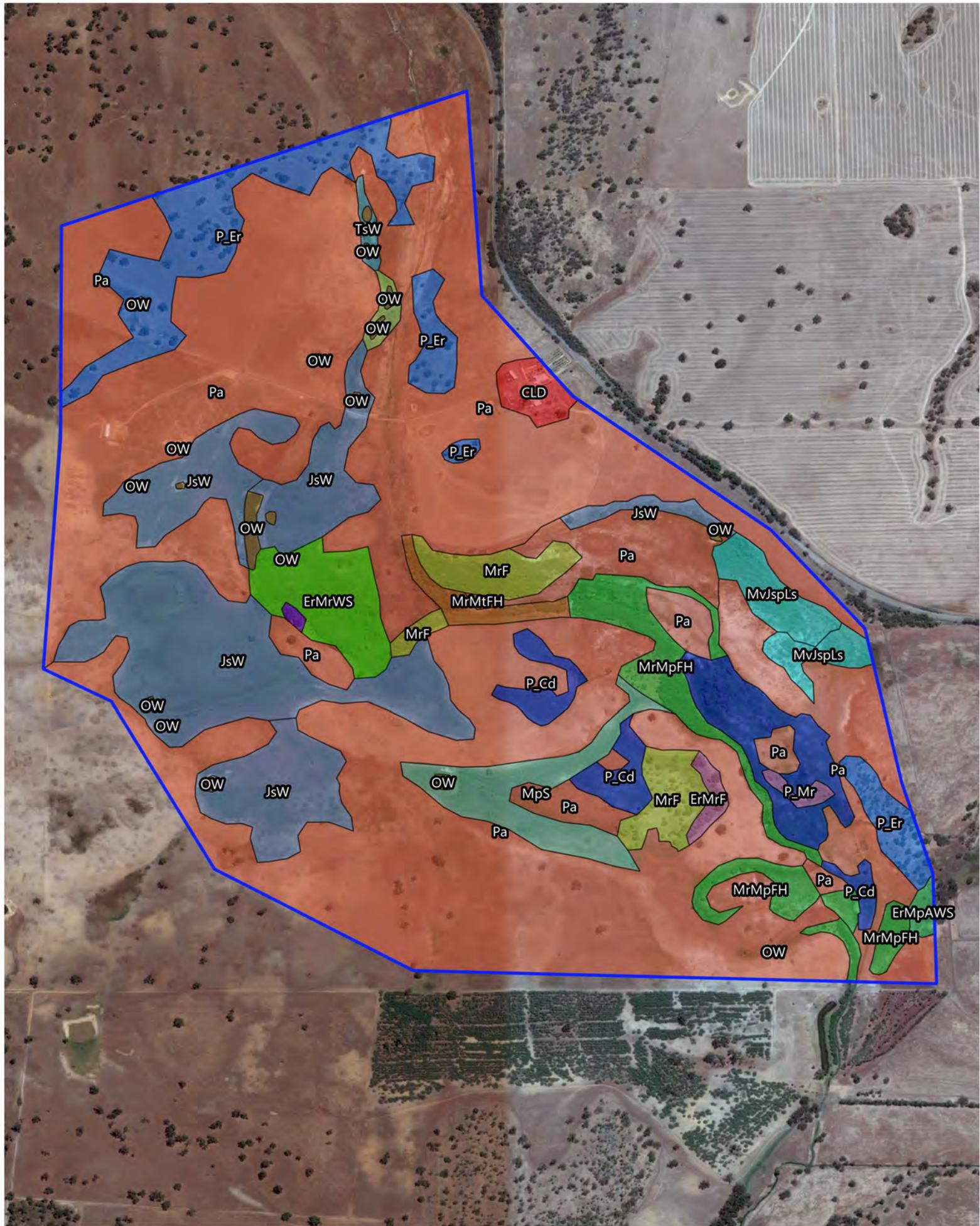


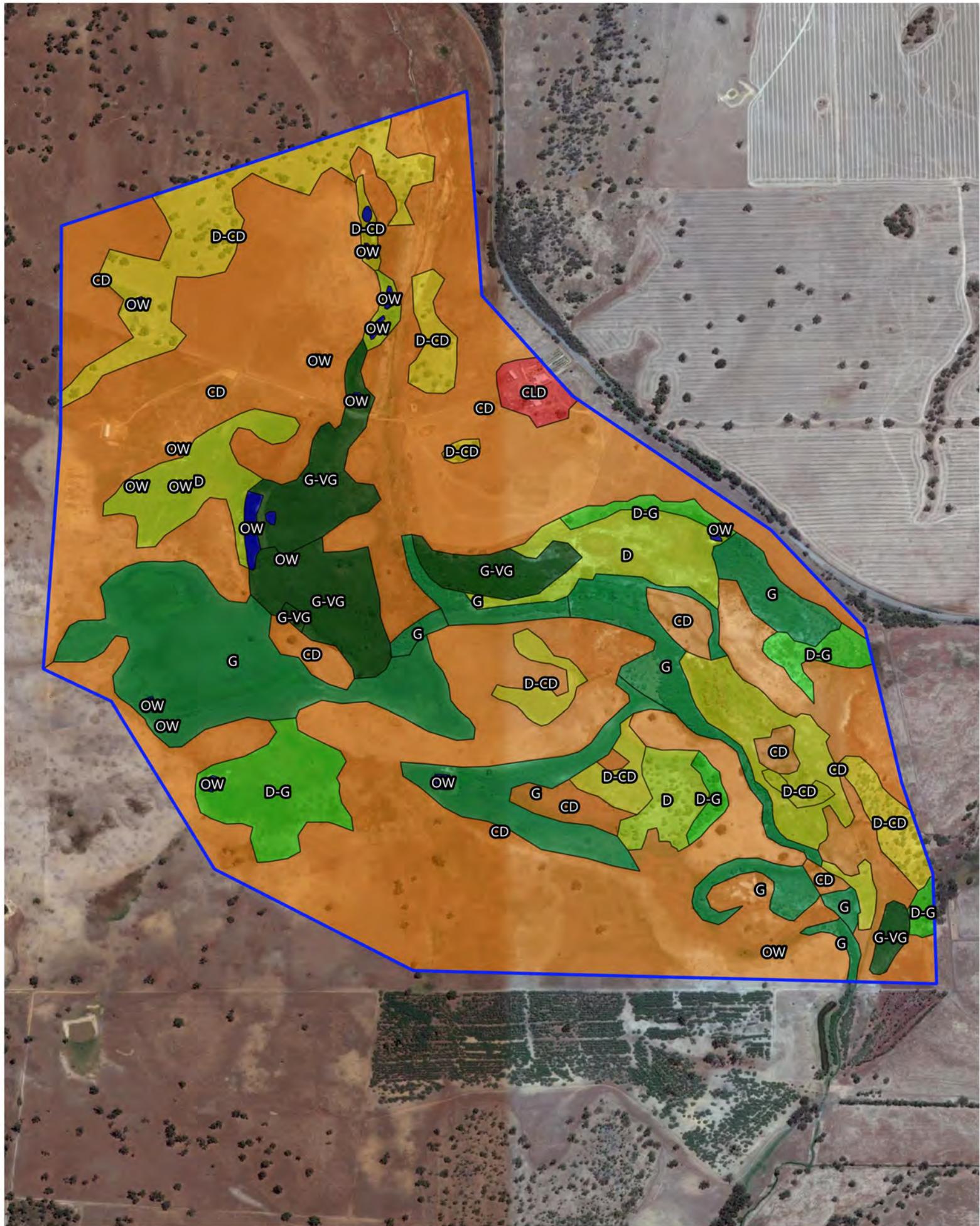
Figure 9 - Vegetation Units



Legend

- | | | | |
|------------|--------|---------|-----------------|
| Study Area | JsW | MtWS | Pa |
| ErMpAWS | MpS | MvJspLs | TsW |
| ErMrF | MrF | P_Cd | OW (Open Water) |
| ErMrWS | MrMpFH | P_Er | CLD (Cleared) |
| ErWS | MrMtFH | P_Mr | |





GDA 94 / MGA Zone 50

Figure 10 - Vegetation Condition



Legend

- Study Area
- OW (Open Water)
- CLD (Cleared)
- CD
- D-CD
- D
- D-G
- G
- G-VG



4.3 HISTORIC IMAGERY ANALYSIS

The oldest available historic imagery from 1963 was sourced from Landgate (2017), for the purposes of visual analysis of the wetland study area, in order to compare current with historic wetland quality and extent. The imagery from 1963 was chosen in order to compare the oldest possible visuals with the imagery from the site during the current day.

A comparison of current and historic (1963) imagery is presented in **Figure 11**. Direct comparison is limited by the lack of colour imagery for comparison, as the 1963 imagery is black and white. However, some general observations are possible.

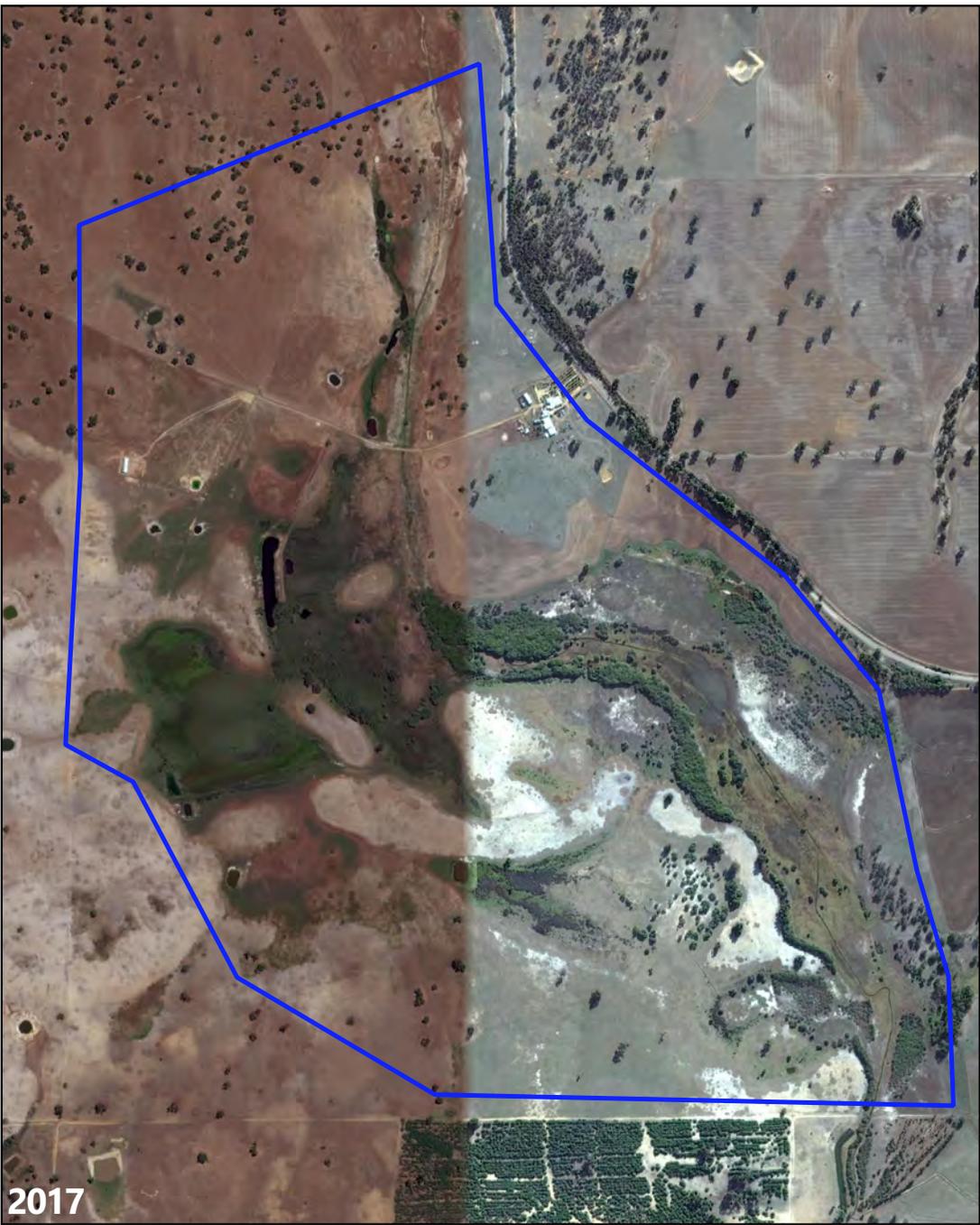
Overall, the total vegetation cover of the general area (paddocks) surrounding the wetlands has not changed significantly, although there are evidently fewer isolated trees in the open pasture surrounding the vegetated wetlands.

Within the mapped extent of the wetlands (UFIs 12840, 12838, 1762 and 12841), the total vegetation cover and density of vegetation has visibly reduced, particularly within the extent of the northern reach and the southern extent of the CCW (UFI 12840) within the study area.

The extent of visible surface water present in current imagery appears to be greater throughout the CCW (UFI 12840) and within the MUW (UFI 12841). However, the extent and depth of surface water present in 1963 throughout the central sections of the CCW (UFI 12840) within the study area is now absent or significantly reduced as visible in current aerial imagery. This is likely due to the reduction in vegetation cover in this location, which historically would have been on overstorey of paperbarks (*Melaleuca*), the dense shade of which would have maintained surface water throughout longer periods (or all) of the year.

The overall surface moisture of the soil also appears to have increased across the site since 1963, with current imagery clearly showing a wider extent of greater moisture, particularly through the MUW (UFI 12841). However, this may be due to the fact that the historic imagery was captured on 2 April 1963, after a full summer season, and before any significant rainfall would have occurred. The precise date and month of the Google (2015) imagery utilised for the analysis has not been able to be ascertained, however, if this was captured during a wetter time of the year (e.g. winter or spring), this may account for the historic imagery demonstrating a drier looking site.

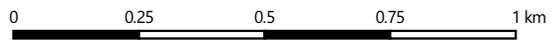
Overall, in comparison to 1963, the wetlands of the study area appear to be in poorer condition, mainly due to a reduction in native vegetation cover throughout most of the wetlands, although the extent and depth of surface water, as well as soil moisture appears to be greater than was evident 45 years ago.



2017



1963



GDA 94 / MGA Zone 50

Figure 11 - Historic Imagery



Legend

 Study Area



5 DISCUSSION

5.1 WETLAND BOUNDARIES

The appropriate boundaries of the wetlands within the study area were determined based on a combined analysis of:

- Depth to groundwater
- Depth to hydric soils
- Regional soil and landscape mapping
- Vegetation types
- Vegetation extent
- Topography/elevation (coarse information based on site observations, as spatial data was not yet available at the time of the preparation of this interim report)
- Surface moisture observations made on site
- Surface moisture and soil moisture levels evident in aerial imagery
- Other evidence detectable from aerial imagery.

Figure 8c demonstrates the likely extent of the wetlands, encompassing depths to groundwater/hydric soils (which also considered the above list of data) at 0.6 mbgs or less, and this overall extent is presented in **Figure 12**.

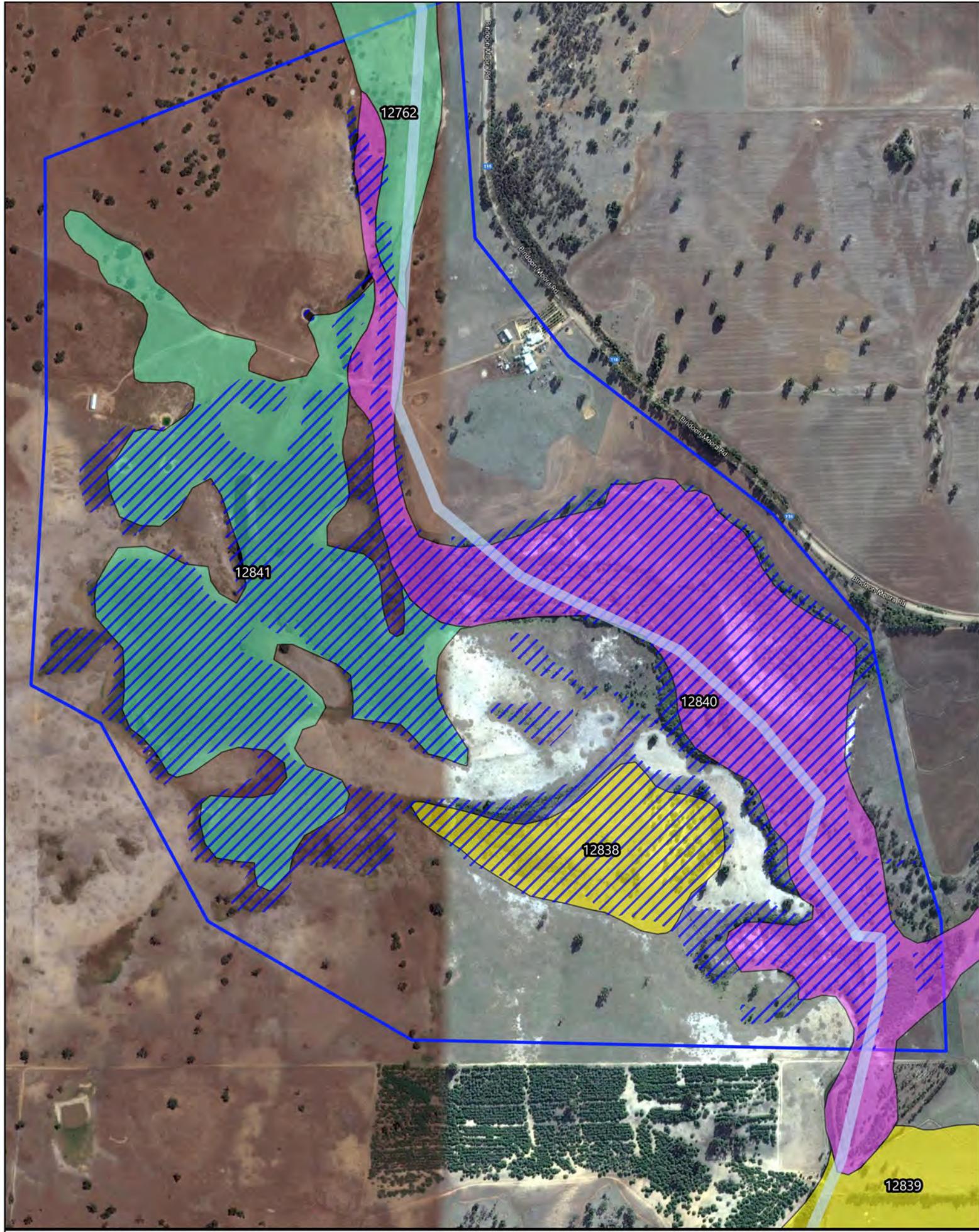
The current wetland boundaries within the study area as mapped in DBCA's *Geomorphic Wetlands of the Swan Coastal Plain* dataset and as interpreted by FVC are presented in **Figure 12**. Based on the extent of wetland vegetation and other biophysical criteria present within the study area, it is evident that some wetland boundary adjustments could be justified in an application, if appropriate. Three out of the four wetlands present on-site (CC UFI 12840, REUFI 12838 and MU UFI 12841) have the potential for boundary change modifications (**Figure 12**).

5.2 WETLAND CATEGORIES

As part of the analysis of data, all of the wetlands were considered in detail. Although now considered out of date, due to a lack of a suitable replacement at the time of the study, Bulletin 686 was still utilised as a reference and guide for the assessment and management of wetland values on the Swan Coastal Plain. Although the application of Bulletin 686 is now superseded by more recent assessment methodologies, the methods utilised and results obtained are considered suitable for the current study's purposes. Bulletin 686 includes the wetland evaluation questionnaire to assist with determination of an applicable management category. The wetlands present at the site were assessed using the questionnaire, and results are presented in **Appendix E**.

The questionnaire results determined that the CCW (UFI 12840) does meet the criteria for identification under the Conservation management category. The wetland assessment results for CCW (UFI 12840), clearly show that approximately 75% of the wetland (southern portion) does support good quality wetland values, and that a management category change would probably only be justifiable for the northern 500-600 m of its extent.

Overall, the Bulletin 686 questionnaire results (**Appendix E**) for all of the wetlands present within the study area (UFI 12840, UFI 12838, UFI 12841, UFI 12762) determined that there is no significant grounds to justify changes to any of the currently assigned wetland categories. Therefore, it is considered unlikely that a down-grading of any of the wetland categories could be justified in applications to do so.



0 150 300 450 600 m
GDA 94 / MGA Zone 50



Figure 12 - Interpreted Wetland Boundaries

Legend

- Study Area
- Interpreted Wetland Boundary
- Geomorphic Wetland within Study Area**
- Conservation
- Multiple Use
- Resource Enhancement



Although regulatory authorities do consider separation of wetlands for the purposes of category changes to only parts of existing wetlands, advice from the Wetlands Section or the Environmental Management Branch of DBCA is that this is usually only done so in certain circumstances. The general advice received also acknowledged the fact that the CCW (UFI 12840) encompasses a channel (the Brockman River), and that therefore, whilst a culvert system may be adequate for a minor road, a major road (highway) development would be unlikely to be acceptable in the absence of a bridge structure over the channel, to prevent unacceptable impacts to flows, water quality downstream and other adverse impacts on the Avon and Swan Rivers downstream.

5.3 WETLAND BUFFERS

Buffer zones are recommended around wetlands as a method of separating human activities of the upland areas from the wetland habitat. They are designed to protect wetlands from negative impacts and help preserve and maintain the ecological functions within the wetland. In addition, vegetated buffer zones provide additional habitats for wildlife using the wetland. Buffer distances are measured from the outside extent of the wetland-dependent vegetation to the outside edge of any proposed development or activity. The required depends on the land use with 50m usually being the minimum buffer applied (WAPC 2005). Wetland buffer distances should be considered around the wetlands which will be impacted by the proposed development.

5.4 REQUEST FOR MODIFICATIONS

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.

5.4.1 Application to Modify Wetland Boundaries

Some adjustments to wetland boundaries for the Geomorphic Wetlands of the Swan Coastal Plain dataset within the study area could be justified in an application, if this would be considered to benefit the project. The proposed preliminary revisions to the wetland boundaries based on re-evaluation of the wetlands in accordance with the Protocol for proposing modifications to the *Geomorphic Wetlands of the Swan Coastal Plain* dataset are shown in **Figure 12**.

5.4.2 Application to Modify Wetland Categories

Further assessment relating to the values of the wetlands present within the study area could be carried out, in order to determine if any adjustments to wetland categories for the Geomorphic Wetlands of the Swan Coastal Plain dataset could be justified in an application, if this would be considered to benefit the project. At this stage, it is considered unlikely that any down-grading of wetland management categories could be justified, and even if a down-grading of the CCW (UFI 12840) were achieved, it is unlikely that this would result in fewer constraints relating to the approvals and management commitments likely to be required for highway construction and operation across the alignment of the Brockman River.

6 CONCLUSIONS

Based on the results of the wetland assessment, the following conclusions and recommendations are provided:

- Overall, in comparison to 1963, the wetlands of the study area appear to be in poorer condition, mainly due to a reduction in native vegetation cover throughout most of the wetlands, although the extent and depth of surface water, as well as soil moisture appears to be greater than evident 45 years ago.
- Based on the extent of wetland vegetation and other biophysical criteria in accordance with the Protocol for proposing modifications to the *Geomorphic Wetlands of the Swan Coastal Plain* dataset present in the study area, it is evident that some wetland boundary adjustments could be justified in an application to DBCA, if appropriate. These boundary changes have been interpreted for three out of the four wetlands (UFI 12840, UFI 12838 and UFI 12841) present on site.
- The evaluation and assessment of wetlands (UFI 12840, UFI 12838, UFI 12841 and UFI 12762) in accordance with the Protocol for proposing modifications to the *Geomorphic Wetlands of the Swan Coastal Plain* dataset determined that the wetland management categories remain current and relevant, and that an application to modify any of these would be unlikely to be justified.
- The specific evaluation and assessment of the CCW (UFI 12840) determined that the wetland does meet the criteria for identification under the 'Conservation' management category. Furthermore, the assessment showed that approximately 75% of the wetland (southern portion) does support good quality wetland values and that a management category change would probably only be justifiable for the northern 500-600m of its extent.
- The general advice received from the Wetlands Section of the Environmental Management Branch of DBCA acknowledged the fact that the CCW (UFI 12840) encompasses a channel (the Brockman River), and that therefore, whilst a culvert system may be adequate for a minor road, a major road (highway) development would be unlikely to be acceptable in the absence of a bridge structure over the channel, to prevent unacceptable impacts to flows, water quality downstream and other adverse impacts on the Avon and Swan Rivers downstream.
- The methodologies of the superseded protocol (DEC 2008) that was utilised for the wetland assessment are comparable to the revised methodology (DBCA 2017) and therefore, are considered adequate and suitable for the results presented and conclusions and recommendations made for this study. These results and conclusions would be considered adequate for consideration of an application to alter wetland boundaries. However, it is recommended that if an application to alter a wetland management category is considered, the wetland evaluation be revised to meet the revised methodology.
- Wetland buffers should be considered around the wetlands which will be impacted by the proposed development.

7 REFERENCES

- Beard, J.S. (1990) *Plant Life of Western Australia*. Kangaroo Press, Kenthurst NSW.
- Beeston, G.R., Hopkins, A.J.M. and Shepherd, D.P (2002) Land Use and Vegetation in Western Australia.
- Bureau of Meteorology (2017) *Climate statistics for Australian locations*. Wannamal. http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=139&p_display_type=dataFile&p_startYear=&p_c=&p_stn_num=009040 Accessed 17 November 2017.
- Churchward, H.M and McArthur, W.M., (1980) Landforms and Soils of the Darling System IN: *Atlas of Natural Resources, Darling System, Western Australia Perth, Pinjarra Sheets*. Department of Conservation and Environment, Western Australia.
- Commonwealth of Australia (2013) *Australia's Bioregions (IBRA)* <http://www.environment.gov.au/land/nrs/science/ibra> Accessed 3 November 2017.
- Department of Environment and Conservation (2008) *Protocol for Proposing Modifications to the Geomorphic Wetlands of the Swan Coastal Plain Dataset*. Perth, Western Australia.
- Department of Biodiversity Conservation and Attractions (2017) Florabase. <https://florabase.dpaw.wa.gov.au> Accessed 28/11/2017.
- Environmental Protection Authority (EPA) (1993) Bulletin 686 – *A Guide to Wetland Management in the Perth and Near Perth Swan Coastal Plain Area*. Perth, Western Australia.
- Environmental Protection Authority (EPA) (2016) Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment.
- Focused Vision Consulting (FVC) (2016) *Level 2 Flora and Vegetation Assessment and Targeted Thelymitra stellate survey, Great Northern Highway, Muchea to Wubin Upgrades, Stage 2 – Bindoon Options, May 2017*. Unpublished document prepared for Arup Jacobs Joint Venture (ASJV).
- Hedde, E. M., Loneragan, O. W., and Havel, J. J (1980) Vegetation Complexes of the Darling System, Western Australia. In: *Atlas of Natural Resources*. Western Australia Department of Conservation and Environment.
- Hill, A.L., Semenuik, C.A., Semenuik, V. and Del Marco, A. (1996) Wetlands of the Swan Coastal Plain *Wetland Mapping, Classification and Evaluation, Main Report*. Volume 2a.
- Landgate (2017) Historic aerial imagery (ecw file format), 1963. Sourced November 2017.
- Mitchell, D., and Williams, K (2001) Jarrah Forest 1 (JF 1 – Northern Jarrah Forest subregion) in a *Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002*. Collaboration between the Department of Conservation and Land Management and the Western Australian Museum.

Muir, B.G. (1977) *Biological Survey of the Western Australian Wheatbelt - Part II*. Records of the Western Australian Museum, Supplement No 3.

M.J. & A.R. Bamford Consulting Ecologists (2017) *Great Northern Highway: Bindoon Bypass Fauna Assessment*. Unpublished Report prepared in association with Focused Vision Consulting for Arup Jacobs Joint Venture.

M.J. & A.R. Bamford Consulting Ecologists (2018) *Great Northern Highway: Bindoon Bypass Targeted Fauna Surveys*. Unpublished Report prepared in association with Focused Vision Consulting for Arup Jacobs Joint Venture.

Tiner, R.W. (1999) *Wetland indicators: A Guide to Wetland Identification, Delineation, Classification, and Mapping*. Lewis Publishers, CRC Press, Boca Raton, FL.

Shepherd, DP, Beeston, GR, and Hopkins, AJM (2002), *Native Vegetation in Western Australia – Extent, Type and Status*, Resource Management Technical Report 249, Perth, Department of Agriculture, Western Australia.

Water and Rivers Commission (WRC) (2001) Position Statement: *Wetlands*. Perth, Western Australia.

Western Australian Planning Commission (WAPC) (2005) *Guideline for the Determination of Wetland Buffer Requirements*. Prepared for the Department of Planning and Infrastructure on behalf of the Western Australian Planning Commission.

APPENDIX A SOIL SAMPLING RESULTS

Site No.	Date	Observation Depth (mbgl)	Observation	Lithology Depth (mbgl)	Lithology	Inferred Hydric Soil Depth (mbgl)	Inferred Groundwater Depth (mbgl)
1a	16/11/2017	0.9	hydric soils present with grey loams at 0.8-0.9mbgs, soils moist becoming saturated at 0.6mbgs	0.9	Topsoil with weed and couch to 0.2mbgs, 0.2-0.9m natural light grey sands becoming saturated at 0.6mbgs, 0.8-0.9m loam, off grey, non plastic, possible hydric layer	0.8	0.6
1b	16/11/2017	1	hydric soils present with grey loams at 0.9mbgs, soils moist becoming saturated at 0.6mbgs	1	Topsoil with weed and couch to 0.2mbgs, 0.2-0.9m natural light grey sands becoming saturated at 0.6mbgs, 0.9-1.0m loam, off grey, non plastic, possible hydric layer	0.9	0.6
1c	16/11/2017	1	Non hydric soils, no organics or clays/loams present, natural sands, soils saturated at 0.6m	1	Topsoil with weed and couch, overlying natural light grey sands becoming saturated at 0.6mbgs, nil organics or clays present		0.6
1d	16/11/2017	0.9	hydric soils present with grey clay/loams at 0.4mbgs, soils moist becoming saturated at 0.6mbgs, refusal at 0.9mbgs due to stiff clays	0.9	Topsoil with weed and couch to 0.1mbgs, 0.1-0.4m natural light grey sands becoming saturated at 0.6mbgs, 0.4-0.9m clay/loam, brown, grey mottled, low plasticity, with trace gravels to 10mm, moist becoming saturated at 0.6mbgs	0.4	0.6
1e	16/11/2017	0.5	hydric soils present with grey clay/loams with organics at 0.0-0.5mbgs, crust formation on surface, refusal at 0.5mbgs due to dry stiff clays	0.5	0.0-0.5 clayey loams, brown/grey mottled, with organics, low plasticity, firm becoming stiff at 0.5mbgs, dry	0	>0.5
1f	16/11/2017	0.7	hydric soils present with grey clay/loams with organics at 0.0-0.7mbgs, crust formation on surface, refusal at 0.7mbgs due to stiff clays	0.7	0.0-0.7, clayey loams, brown/grey mottled, with organics, moderate to high plasticity, firm becoming stiff at 0.7mbgs, damp	0	0.7
2a	16/11/2017	0.6	hydric soils present with dark grey clay/loams with organics at 0.0-0.6mbgs, surface saturated, refusal at 0.6mbgs due to stiff saturated clays	0.6	0.0-0.5 clayey loams, dark grey mottled, with organics, high plasticity, firm becoming stiff at 0.5mbgs, saturated	0	0.5
3a	16/11/2017	1	Non hydric zone, nil clays/organics, natural grey sands saturated at 0.9mbgs	1	0.0-1.0m, Sands, grey, dry becoming saturated at 0.9mbgs		0.9
3b	16/11/2017	1	Non hydric zone, nil clays/organics, natural pale white/yellow sands saturated at 1.0mbgs	1	0.0-1.0m, Sands, pale white becoming creamish/yellow at depth dry becoming saturated at 1.0mbgs		1

Site No.	Date	Observation Depth (mbgl)	Observation	Lithology Depth (mbgl)	Lithology	Inferred Hydric Soil Depth (mbgl)	Inferred Groundwater Depth (mbgl)
4a	16/11/2017	0.7	Sample location within wetland and hydric soils, surface saturated	0.7	0.0-0.2m loamy clays, dark grey with organics, low plasticity, soft, 0.2-0.7m sands, grey, nil organics, saturated	0	0.2
4b	15/11/2017	0.9	Sample location within wetland with hydric soils present	0.9	0.0-0.15m dark grey sands with organics, 0.15-0.9m light grey sands, nil organics or clay, saturated,	0	0.15
4c	15/11/2017	0.8	Sample location within wetland with hydric soils present as similar lithology as 4b	0.7	0.0-0.15m dark grey sands with organics, 0.15-0.7m light grey sands, nil organics or clay, saturated,	0	0.15
5a	15/11/2017	0.7	Sample location within wetland with hydric soils present, saturated surface conditions	0.7	Hydric soils, loamy sands, dark brown becoming light grey at 0.3m, organics present	0	0
5b	15/11/2017	0.8	hydric soils present, soils moist becoming saturated at 0.6mbgs	0.8	Topsoil with couch and weed to 0.05mbgs, dark grey sands with organics from 0.05-0.4m. Sands light grey from 0.4 to 0.8mbgs, nil organics, saturated at 0.6mbgs	0.05	0.6
5c	15/11/2017	0.7	Non hydric soils, natural sands, soils saturated at 0.6m	0.7	Topsoil with weed and couch, overlying natural light grey sands becoming saturated at 0.6mbgs, nil organics or clays present		0.6
6a	15/11/2017	0.7	Sample collected within saturation zone, hydric soils present 0.0-0.7m	0.7	0.0-0.1m loamy clays, dark brown with organics, low plasticity, soft, 0.1-0.7m loamy sands, grey, with organics, saturated, low plasticity, soft	0	0.1
6b	15/11/2017	0.8	Sample collected within saturated zone, soils saturated at 0.6mbgs	0.8	Topsoil with weed, 0.1-0.25m dark grey sands, moist to saturated, trace organics, 0.25-0.8m light grey sands, nil organics or clay, saturated,	0.25	0.6
6c	15/11/2017	0.9	sample location outside hydric soil zone, dry surface conditions	0.9	topsoil, grey sands with organics, dry overlying pale grey sands at depth, moist becoming saturated at 0.8mbgs		0.8
7a	15/11/2017	1	Sample collected within saturation zone, hydric soils present, refusal at 1.0mbgs	1	0.0-0.6m, Loamy clay, dark grey, with organics, damp, moderate plasticity, soft, 0.6-1.0m, loamy clays, grey/brown, mottled, with organics, moist to saturated	0	0
8a	15/11/2017	1	Hydric soils encountered at surface to 1.0mbgs, surface damp to saturated	1	Hydric soils from surface to end of hole, loamy gravelly clays, brown, dark grey, mottled, moderate to high plasticity, organics from surface to end of hole, saturated, trace gavel content.	0	0

Site No.	Date	Observation Depth (mbgl)	Observation	Lithology Depth (mbgl)	Lithology	Inferred Hydric Soil Depth (mbgl)	Inferred Groundwater Depth (mbgl)
8b	15/11/2017	1.4	Sample collected within saturated zone, ground cover healthy condition, no apparent hydric soils only saturated sands at depth.	1.4	Topsoils with couch/weed, 0.05-0.2m sandy/loam with organics to 0.3mbgs, moist, 0.3-1.4m, sands, light grey/brown, mottled, moist becoming saturated at 0.5mbgs	0.3	0.5
8c	15/11/2017	1.2	Sample collected outside saturation zone, nil hydric soils present	1.2	Sands, pale white becoming pale yellow at depth, nil organics, moist becoming saturated at 0.9mbgs		0.9
9a	15/11/2017	0.9	Hydric soils encountered at 0.4-0.5mbgs, outer bounds of heavily vegetated wetland but within saturation zone	0.9	Hydric soil zone, 0-0.9m clay, loam dark brown/grey, mottled with organics, firm becoming stiff at 0.9mbgs, saturation at 0.6mbgs	0.4	0.6
9b	15/11/2017	0.9	Sample location within hydric soil zone, hydric soils encountered at 0.7mbgs, surface conditions damp	0.9	Topsoils with couch/weed, 0.05-0.35m loam, light grey, moist, soft, low plasticity. 0.35-0.7m sandy loam, mottled, brown/grey, soft, damp, low plasticity. 0.7-0.9m hydric soils loamy clays, pale grey/orange mottled, with organics, moist to saturated, stiff	0.7	
9c	15/11/2017	0.3	Sample collected outside saturation zone, no hydric soils present, refusal at 0.3mbgs due to stiff gravelly loam	0.3	0.0-0.3m gravelly loam, nil plasticity and organics, brown, 20% gravels to 25mm, dry, refusal at 0.3mbgs		0.3
9d	15/11/2017	0.9	Hydric soils encountered at 0.5-0.9mbgs, surface damp, moist soil conditions at depth	0.9	Topsoils with couch/weed, 0.05-0.2m loam, light grey, moist, soft, low plasticity. 0.2-0.5m sandy loam, mottled, brown/grey, soft, damp, low plasticity. 0.5-0.9m hydric soils loamy gravelly clays, with trace organics, pale grey/orange mottled, moist stiff	0.5	>0.5
10a	14/11/2017	0.6	Sample location within hydric soil zone and wetland, surface conditions damp	0.6	Hydric soil zone, 0-0.2m clay, loam dark brown/grey, mottled with organics, 0.2-0.6m, clay, dark grey, moderate to high plasticity, firm becoming stiff at 0.6mbgs, saturation at 0.5mbgs	0	0.5
10b	15/11/2017	0.5	Hydric soils encountered at 0.4-0.5mbgs, outer bounds of heavily vegetated wetland but within saturation zone	0.5	Topsoils with couch/weed to 0.15m, 0.15-0.4m, grey loams, moist, low plasticity, soft. 0.4-0.5m, hydric soils consisting of loamy clays, with organics, grey/brown, mottled, damp, stiff, moderate plasticity.	0.4	0.5

Site No.	Date	Observation Depth (mbgl)	Observation	Lithology Depth (mbgl)	Lithology	Inferred Hydric Soil Depth (mbgl)	Inferred Groundwater Depth (mbgl)
10c	15/11/2017	0.5	nil hydric soils observed, outer bounds of heavily vegetated wetland outside of saturation zone	0.5	Topsoils with couch/weed, 0.05-0.3m loam, light grey, moist, soft, low plasticity. 0.3-0.5m sandy loam, brown/grey, stiff, damp, nil plasticity, auger refusal 0.5mbgs		0.5
11a	15/11/2017	0.8	Sample location within wetland and hydric soils present 0-0.8mbgs	0.8	0.0-0.45m loamy clays, dark brown with organics, low to moderate plasticity, firm, damp. 0.45-0.75m dark green/grey mottled sandy clays, moderate plasticity, firm. 0.75-0.8m loam, brown, soft, damp.	0	0
11b	15/11/2017	0.8	outer bounds of heavily vegetated wetland but within saturation zone	0.8	Topsoils with couch/weed, overlying grey sands, moist becoming saturated at 0.4mbgs, loamy clays, grey, mottled with organics and potential hydric soils at 0.75-0.8mbgs. hand auger refusal at 0.8mbgs	0.75	0.4
11c	15/11/2017	1.3		1.3	Topsoils with couch/weed, overlying light grey sands, moist becoming saturated at 0.6mbgs	0	0.6
12a	15/11/2017		sample location within wetland, unable to sample			0	0
12b	14/11/2017	0.9	topsoil with couch and organics, overlying natural grey sands, damp surface conditions, potential hydric soils from 0.0-0.5mbgs	0.9	0-0.05m, organic surface material with couch grass, overlying grey sands moist becoming saturated at 0.6 mbgs. End of hole at 0.9mbgs	0	0.6
12c	14/11/2017	1.4	Sample location outside hydric soil zone	1.4	light grey sands, dry to 0.2mbgs overlying pale white sands, moist becoming saturated at 0.75mbgs	>0.75	0.75
13a	14/11/2017	1.3	dark brown loamy clays, high plasticity, moist, overlying loam at 0.95,mbgs	1.3	clays and loams	0.95	>0.9
13b	14/11/2017	1.2	hydric soils within wetland, damp, mottled clays crust formation	1.3	clays and loams	0	0
14a	14/11/2017	0.9	couch and organics within wetland, overlying light brown alluvial sands damp becoming saturated at 0.4mbgs	0.9	organic surface material with couch grass, overlying light brown alluvial sands fine to medium grained quartz, saturated at 0.4mbgs. end of hole at 0.9mbgs		0.4
14b	14/11/2017	1.3	damp surface conditions, soils saturated at 0.4mbgs	1.3	organic surface material with couch grass, overlying light brown alluvial sands fine to medium grained quartz, saturated at 0.4mbgs. end of hole at 0.9mbgs		0.4

Site No.	Date	Observation Depth (mbgl)	Observation	Lithology Depth (mbgl)	Lithology	Inferred Hydric Soil Depth (mbgl)	Inferred Groundwater Depth (mbgl)
14b	14/11/2017	1.3	topsoil with couch, hydric soils	1.3	0-0.05m, organic surface material with couch grass, overlying light brown alluvial sands fine to medium grained quartz, saturated at 0.4mbgs to 0.9mbgs. mottled brown sands from 0.9 to 1.3m. end of hole at 1.3mbgs	0.9	0.4
14c	14/11/2017	1	(weed overlying natural sands	1	0-0.05m, organic surface material with couch grass, overlying light grey sands dry becoming saturated at 0.6mbgs. end of hole at 1.0mbgs. nil signs of hydric/clay based soils		0.6
15a	14/11/2017	0.6	saturated surface conditions, surface soils consisting of couch, loam and heavily organic in nature to 0.1mbgs. surface water containing distinct iron sheening	0.6	0-0.01m, organic surface material with couch grass, overlying light grey/brown sands saturated. end of hole at 0.6mbgs	0.1	0.1
15b	14/11/2017	1	topsoil with couch, overlying natural light grey sands, damp surface conditions	1	0-0.01m, organic surface material with couch grass, overlying light grey sands moist becoming saturated at 0.25mbgs end of hole at 1.0mbgs		0.25
15c	14/11/2017	1	topsoil with couch, overlying natural light grey sands, damp surface conditions	1	0-0.01m, organic surface material with couch grass, overlying light grey sands moist becoming saturated at 0.25mbgs end of hole at 1.0mbgs		0.25
16a	14/11/2017	0.6	Sample location within wetland with hydric soils present	0.6	0.0-0.05m loam, dark grey, high organic content, amysands with organics, 0.05-0.6m light grey sands, nil organics or clay, saturated,	0	0.05
16b	15/11/2017	0.8	Non hydric soils, natural sands, soils saturated at 0.6m	0.8	Sands grey, nil organics or clays, moist becoming saturated at 0.6mbgs		0.6
17a	15/11/2017	0.9	Topsoils encountered at surface to 0.15m, saturated surface conditions, nil clays or organics observed within soil profile	0.8	Topsoil with couch and weed, 0.15 to 0.8m, sands grey, fine to medium grained quartz, nil organics, saturated	0.15	
17b	15/11/2017	0.9	Topsoils encountered at surface to 0.15m, saturated surface conditions, nil clays or organics observed within soil profile	0.9	Topsoil with couch and weed, overlying sands grey, fine to medium grained quartz, nil organics, saturated at 0.5mbgs	0.15	0.5
17c	15/11/2017	1	Outside saturation zone, no hydric soils present	1	0.0-0.5m sands, grey, nil organics, dry, 0.5-1.0m, sands, pale yellow brown, mottled, nil organics or clays, dry becoming saturated at 0.7mbgs		0.7

Site No.	Date	Observation Depth (mbgl)	Observation	Lithology Depth (mbgl)	Lithology	Inferred Hydric Soil Depth (mbgl)	Inferred Groundwater Depth (mbgl)
18a	15/11/2017	0.5	hydric soils within wetland, mottled clays, saturated surface, refusal at 0.5mbgs	0.5	weed overlying dark brown clays, saturated, mottled, high plasticity, firm to stiff	0	0
18b	14/11/2017		location not sampled as within wetland			0	0
18c	14/11/2017	0.5-0.9	hydric soils, damp with weed at surface	0.9	dark brown clays, high plasticity, stiff, damp		
19a	14/11/2017	0.7	Sample location within saturated zone, surface damp to saturated, soils saturated at 0.2mbgs	0.7	Organic topsoils to 0.15mbgs, overlying natural grey sands, saturated at 0.2mbgs, nil signs of clays/loams	0.15	0.2
19b	16/11/2017	1.35	Non hydric zone, nil clays/organics, natural light grey becoming yellowish at depth, sands saturated at 1.2mbgs	1.35	0.0-1.0m, Sands, light grey becoming creamish/yellow at depth dry becoming saturated at 1.2mbgs		1.2
1a	16/11/2017	0.9	hydric soils present with grey loams at 0.8-0.9mbgs, soils moist becoming saturated at 0.6mbgs	0.9	Topsoil with weed and couch to 0.2mbgs, 0.2-0.9m natural light grey sands becoming saturated at 0.6mbgs, 0.8-0.9m loam, off grey, non plastic, possible hydric layer	0.8	0.6
1b	16/11/2017	1	hydric soils present with grey loams at 0.9mbgs, soils moist becoming saturated at 0.6mbgs	1	Topsoil with weed and couch to 0.2mbgs, 0.2-0.9m natural light grey sands becoming saturated at 0.6mbgs, 0.9-1.0m loam, off grey, non plastic, possible hydric layer	0.9	0.6
1c	16/11/2017	1	Non hydric soils, no organics or clays/loams present, natural sands, soils saturated at 0.6m	1	Topsoil with weed and couch, overlying natural light grey sands becoming saturated at 0.6mbgs, nil organics or clays present		0.6
1d	16/11/2017	0.9	hydric soils present with grey clay/loams at 0.4mbgs, soils moist becoming saturated at 0.6mbgs, refusal at 0.9mbgs due to stiff clays	0.9	Topsoil with weed and couch to 0.1mbgs, 0.1-0.4m natural light grey sands becoming saturated at 0.6mbgs, 0.4-0.9m clay/loam, brown, grey mottled, low plasticity, with trace gravels to 10mm, moist becoming saturated at 0.6mbgs	0.4	0.6
1e	16/11/2017	0.5	hydric soils present with grey clay/loams with organics at 0.0-0.5mbgs, crust formation on surface, refusal at 0.5mbgs due to dry stiff clays	0.5	0.0-0.5 clayey loams, brown/grey mottled, with organics, low plasticity, firm becoming stiff at 0.5mbgs, dry	0	>0.5
1f	16/11/2017	0.7	hydric soils present with grey clay/loams with organics at 0.0-0.7mbgs, crust formation on surface, refusal at 0.7mbgs due to stiff clays	0.7	0.0-0.7, clayey loams, brown/grey mottled, with organics, moderate to high plasticity, firm becoming stiff at 0.7mbgs, damp	0	0.7

Site No.	Date	Observation Depth (mbgl)	Observation	Lithology Depth (mbgl)	Lithology	Inferred Hydric Soil Depth (mbgl)	Inferred Groundwater Depth (mbgl)
2a	16/11/2017	0.6	hydric soils present with dark grey clay/loams with organics at 0.0-0.6mbgs, surface saturated, refusal at 0.6mbgs due to stiff saturated clays	0.6	0.0-0.5 clayey loams, dark grey mottled, with organics, high plasticity, firm becoming stiff at 0.5mbgs, saturated	0	0.5
3a	16/11/2017	1	Non hydric zone, nil clays/organics, natural grey sands saturated at 0.9mbgs	1	0.0-1.0m, Sands, grey, dry becoming saturated at 0.9mbgs		0.9
3b	16/11/2017	1	Non hydric zone, nil clays/organics, natural pale white/yellow sands saturated at 1.0mbgs	1	0.0-1.0m, Sands, pale white becoming creamish/yellow at depth dry becoming saturated at 1.0mbgs		1
4a	16/11/2017	0.7	Sample location within wetland and hydric soils, surface saturated	0.7	0.0-0.2m loamy clays, dark grey with organics, low plasticity, soft, 0.2-0.7m sands, grey, nil organics, saturated	0	0.2
4b	15/11/2017	0.9	Sample location within wetland with hydric soils present	0.9	0.0-0.15m dark grey sands with organics, 0.15-0.9m light grey sands, nil organics or clay, saturated,	0	0.15
4c	15/11/2017	0.8	Sample location within wetland with hydric soils present as similar lithology as 4b	0.7	0.0-0.15m dark grey sands with organics, 0.15-0.7m light grey sands, nil organics or clay, saturated,	0	0.15
5a	15/11/2017	0.7	Sample location within wetland with hydric soils present, saturated surface conditions	0.7	Hydric soils, loamy sands, dark brown becoming light grey at 0.3m, organics present	0	0
5b	15/11/2017	0.8	hydric soils present, soils moist becoming saturated at 0.6mbgs	0.8	Topsoil with couch and weed to 0.05mbgs, dark grey sands with organics from 0.05-0.4m. Sands light grey from 0.4 to 0.8mbgs, nil organics, saturated at 0.6mbgs	0.05	0.6
5c	15/11/2017	0.7	Non hydric soils, natural sands, soils saturated at 0.6m	0.7	Topsoil with weed and couch, overlying natural light grey sands becoming saturated at 0.6mbgs, nil organics or clays present		0.6
6a	15/11/2017	0.7	Sample collected within saturation zone, hydric soils present 0.0-0.7m	0.7	0.0-0.1m loamy clays, dark brown with organics, low plasticity, soft, 0.1-0.7m loamy sands, grey, with organics, saturated, low plasticity, soft	0	0.1
6b	15/11/2017	0.8	Sample collected within saturated zone, soils saturated at 0.6mbgs	0.8	Topsoil with weed, 0.1-0.25m dark grey sands, moist to saturated, trace organics, 0.25-0.8m light grey sands, nil organics or clay, saturated,	0.25	0.6
6c	15/11/2017	0.9	sample location outside hydric soil zone, dry surface conditions	0.9	topsoil, grey sands with organics, dry overlying pale grey sands at depth, moist becoming saturated at 0.8mbgs		0.8

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7a	15/11/2017	1	Sample collected within saturation zone, hydric soils present, refusal at 1.0mbgs	1	0.0-0.6m, Loamy clay, dark grey, with organics, damp, moderate plasticity, soft, 0.6-1.0m, loamy clays, grey/brown, mottled, with organics, moist to saturated	0	0
8a	15/11/2017	1	Hydric soils encountered at surface to 1.0mbgs, surface damp to saturated	1	Hydric soils from surface to end of hole, loamy gravelly clays, brown, dark grey, mottled, moderate to high plasticity, organics from surface to end of hole, saturated, trace gavel content.	0	0
8b	15/11/2017	1.4	Sample collected within saturated zone, ground cover healthy condition, no apparent hydric soils only saturated sands at depth.	1.4	topsoils with couch/weed, 0.05-0.2m sandy/loam with organics to 0.3mbgs, moist, 0.3-1.4m, sands, light grey/brown, mottled, moist becoming saturated at 0.5mbgs	0.3	0.5
8c	15/11/2017	1.2	Sample collected outside saturation zone, nil hydric soils present	1.2	Sands, pale white becoming pale yellow at depth, nil organics, moist becoming saturated at 0.9mbgs		0.9
9a	15/11/2017	0.9	Hydric soils encountered at 0.4-0.5mbgs, outer bounds of heavily vegetated wetland but within saturation zone	0.9	Hydric soil zone, 0-0.9m clay, loam dark brown/grey, mottled with organics, firm becoming stiff at 0.9mbgs, saturation at 0.6mbgs	0.4	0.6
9b	15/11/2017	0.9	Sample location within hydric soil zone, hydric soils encountered at 0.7mbgs, surface conditions damp	0.9	topsoils with couch/weed, 0.05-0.35m loam, light grey, moist, soft, low plasticity. 0.35-0.7m sandy loam, mottled, brown/grey, soft, damp, low plasticity. 0.7-0.9m hydric soils loamy clays, pale grey/orange mottled, with organics, moist to saturated, sti	0.7	
9c	15/11/2017	0.3	Sample collected outside saturation zone, no hydric soils present, refusal at 0.3mbgs due to stiff gravelly loam	0.3	0.0-0.3m gravelly loam, nil plasticity and organics, brown, 20% gravels to 25mm, dry, refusal at 0.3mbgs		0.3
9d	15/11/2017	0.9	Hydric soils encountered at 0.5-0.9mbgs, surface damp, moist soil conditions at depth	0.9	topsoils with couch/weed, 0.05-0.2m loam, light grey, moist, soft, low plasticity. 0.2-0.5m sandy loam, mottled, brown/grey, soft, damp, low plasticity. 0.5-0.9m hydric soils loamy gravelly clays, with trace organics, pale grey/orange mottled, moist stiff	0.5	>0.5
10a	14/11/2017	0.6	Sample location within hydric soil zone and wetland, surface conditions damp	0.6	Hydric soil zone, 0-0.2m clay, loam dark brown/grey, mottled with organics, 0.2-0.6m, clay, dark grey, moderate	0	0.5

Site No.	Date	Observation Depth (mbgl)	Observation	Lithology Depth (mbgl)	Lithology	Inferred Hydric Soil Depth (mbgl)	Inferred Groundwater Depth (mbgl)
					to high plasticity, firm becoming stiff at 0.6mbgs, saturation at 0.5mbgs		
10b	15/11/2017	0.5	Hydric soils encountered at 0.4-0.5mbgs, outer bounds of heavily vegetated wetland but within saturation zone	0.5	topsoils with couch/weed to 0.15m, 0.15-0.4m, grey loams, moist, low plasticity, soft. 0.4-0.5m, hydric soils consisting of loamy clays, with organics, grey/brown, mottled, damp, stiff, moderate plasticity.	0.4	0.5
10c	15/11/2017	0.5	nil hydric soils observed, outer bounds of heavily vegetated wetland outside of saturation zone	0.5	topsoils with couch/weed, 0.05-0.3m loam, light grey, moist, soft, low plasticity. 0.3-0.5m sandy loam, brown/grey, stiff, damp, nil plasticity, auger refusal 0.5mbgs		0.5
11a	15/11/2017	0.8	Sample location within wetland and hydric soils present 0-0.8mbgs	0.8	0.0-0.45m loamy clays, dark brown with organics, low to moderate plasticity, firm, damp. 0.45-0.75m dark green/grey mottled sandy clays, moderate plasticity, firm. 0.75-0.8m loam, brown, soft, damp.	0	0
11b	15/11/2017	0.8	outer bounds of heavily vegetated wetland but within saturation zone	0.8	topsoils with couch/weed, overlying grey sands, moist becoming saturated at 0.4mbgs, loamy clays, grey, mottled with organics and potential hydric soils at 0.75-0.8mbgs. hand auger refusal at 0.8mbgs	0.75	0.4
11c	15/11/2017	1.3		1.3	topsoils with couch/weed, overlying light grey sands, moist becoming saturated at 0.6mbgs	0	0.6
12a	15/11/2017		sample location within wetland, unable to sample			0	0
12b	14/11/2017	0.9	topsoil with couch and organics, overlying natural grey sands, damp surface conditions, potential hydric soils from 0.0-0.5mbgs	0.9	0-0.05m, organic surface material with couch grass, overlying grey sands moist becoming saturated at 0.6mbgs end of hole at 0.9mbgs	0	0.6
12c	14/11/2017	1.4	Sample location outside hydric soil zone	1.4	light grey sands, dry to 0.2mbgs overlying pale white sands, moist becoming saturated at 0.75mbgs	>0.75	0.75
13a	14/11/2017	1.3	dark brown loamy clays, high plasticity, moist, overlying loam at 0.95,mbgs	1.3	clays and loams	0.95	>0.9
13b	14/11/2017	1.2	hydric soils within wetland, damp, mottled clays crust formation	1.3	clays and loams	0	0

Site No.	Date	Observation Depth (mbgl)	Observation	Lithology Depth (mbgl)	Lithology	Inferred Hydric Soil Depth (mbgl)	Inferred Groundwater Depth (mbgl)
14a	14/11/2017	0.9	couch and organics within wetland, overlying light brown alluvial sands damp becoming saturated at 0.4mbgs	0.9	organic surface material with couch grass, overlying light brown alluvial sands fine to medium grained quartz, saturated at 0.4mbgs. end of hole at 0.9mbgs		0.4
14b	14/11/2017	1.3	damp surface conditions, soils saturated at 0.4mbgs	1.3	organic surface material with couch grass, overlying light brown alluvial sands fine to medium grained quartz, saturated at 0.4mbgs. end of hole at 0.9mbgs		0.4
14b	14/11/2017	1.3	topsoil with couch, hydric soils	1.3	0-0.05m, organic surface material with couch grass, overlying light brown alluvial sands fine to medium grained quartz, saturated at 0.4mbgs to 0.9mbgs. mottled brown sands from 0.9 to 1.3m. end of hole at 1.3mbgs	0.9	0.4
14c	14/11/2017	1	(weed overlying natural sands	1	0-0.05m, organic surface material with couch grass, overlying light grey sands dry becoming saturated at 0.6mbgs. end of hole at 1.0mbgs. nil signs of hydric/clay based soils		0.6
15a	14/11/2017	0.6	saturated surface conditions, surface soils consisting of couch, loam and heavily organic in nature to 0.1mbgs. surface water containing distinct iron sheening	0.6	0-0.01m, organic surface material with couch grass, overlying light grey/brown sands saturated. end of hole at 0.6mbgs	0.1	0.1
15b	14/11/2017	1	topsoil with couch, overlying natural light grey sands, damp surface conditions	1	0-0.01m, organic surface material with couch grass, overlying light grey sands moist becoming saturated at 0.25mbgs end of hole at 1.0mbgs		0.25
15c	14/11/2017	1	topsoil with couch, overlying natural light grey sands, damp surface conditions	1	0-0.01m, organic surface material with couch grass, overlying light grey sands moist becoming saturated at 0.25mbgs end of hole at 1.0mbgs		0.25
16a	14/11/2017	0.6	Sample location within wetland with hydric soils present	0.6	0.0-0.05m loam, dark grey, high organic content, sand with organics, 0.05-0.6m light grey sands, nil organics or clay, saturated,	0	0.05
16b	15/11/2017	0.8	Non hydric soils, natural sands, soils saturated at 0.6m	0.8	Sands grey, nil organics or clays, moist becoming saturated at 0.6mbgs		0.6

APPENDIX B SOIL SAMPLE PHOTOGRAPHS

APPENDIX B SOIL SAMPLING PHOTOGRAPH RECORDS

									
<table border="1"> <thead> <tr> <th>Site</th> <th>1a</th> <th>Description</th> <th>Site</th> </tr> </thead> </table>	Site	1a	Description	Site	<table border="1"> <thead> <tr> <th>Site</th> <th>1a</th> <th>Description</th> <th>Soil core</th> </tr> </thead> </table>	Site	1a	Description	Soil core
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	Site	1e	Description	Site		Site	1e	Description	Soil core
	Site	1f	Description	Site		Site	1f	Description	Soil core
	Site	2a	Description	Site		Site	2a	Description	Soil core
	Site	3a	Description	Site		Site	3a	Description	Soil core

									
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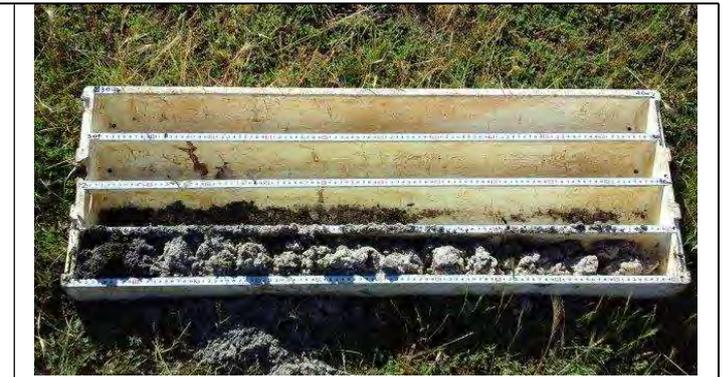
							
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Site	8a	Description	Site	Site	8a	Description	Soil core
							
Site	8b	Description	Site	Site	8b	Description	Soil core
							
Site	8c	Description	Site	Site	8c	Description	Soil core

N/A							
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Site	10a	Description	Site	Site	10a	Description	Soil core
							
Site	10b	Description	Site	Site	10b	Description	Soil core
							
Site	10c	Description	Site	Site	10c	Description	Soil core

	
Site 11a Description	Site 11a Description Soil core
	
Site 11b Description	Site 11b Description Soil core
	
Site 11c Description	Site 11c Description Soil core
	
Site 12b Description	Site 12b Description Soil core

			
<p>Site 12c Description</p>	<p>Site</p>	<p>Site 12c Description</p>	<p>Soil core</p>
<p>NA</p>			
<p>Site 13a Description</p>	<p>Site</p>	<p>Site 13a Description</p>	<p>Soil core</p>
			
<p>Site 13b Description</p>	<p>Site</p>	<p>Site 13b Description</p>	<p>Soil core</p>
			
<p>Site 14a Description</p>	<p>Site</p>	<p>Site 14a Description</p>	<p>Soil core</p>

	
Site 14b Description	Site 14b Description
	
Site 14c Description	Site 14c Description
	
Site 15a Description	Site 15a Description
	
Site 15b Description	Site 15b Description

									
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<p>Site 17b</p>	<p>Description</p>	<p>Site</p>	<p>Site 17b</p>	<p>Description</p>	<p>Soil core</p>
<p>Site 17c</p>	<p>Description</p>	<p>Site</p>	<p>Site 17c</p>	<p>Description</p>	<p>Soil core</p>
<p>Site 18a</p>	<p>Description</p>	<p>Site</p>	<p>Site 18a</p>	<p>Description</p>	<p>Soil core</p>
<p>Site 18c</p>	<p>Description</p>	<p>Site</p>	<p>Site 18c</p>	<p>Description</p>	<p>Soil core</p>

			
Site	19a	Description	Site
Site	19a	Description	Soil core
			
Site	19b	Description	Site
Site	19b	Description	Soil core

APPENDIX C FLORA SPECIES RECORDED WITHIN EACH VEGETATION UNIT

Family	Species	Vegetation Unit											
		ErMpAWS	ErMrF	ErMrWS	ErWS	JSW	MpS	MrF	MrMpFH	MrMtFH	MtWS	MvJspLs	TSW
Typhaceae	<i>Typha</i> sp.										+		+
Poaceae	* <i>Avena barbata</i>								+				
	* <i>Briza minor</i>					+		+		+		+	+
	* <i>Bromus diandrus</i>								+				
	* <i>Cynodon dactylon</i>	+	+	+	+	+	+	+	+				
	* <i>Ehrharta calycina</i>							+	+				
	* <i>Holcus lanatus</i>			+							+		
	* <i>Hordeum leporinum</i>					+		+	+			+	+
	* <i>Lagurus ovatus</i>									+			
	* <i>Lolium perenne</i>					+		+	+				+
	* <i>Lolium rigidum</i>											+	
	* <i>Paspalum dilatatum</i>					+							+
	<i>Paspalum vaginatum</i>			+		+							
	* <i>Polypogon monspeliensis</i>				+	+		+		+			
	* <i>Romulea rosea</i>									+			
Cyperaceae	<i>Baumea juncea</i>			+									
	<i>Baumea rubiginosa</i>			+	+								
	<i>Bolboschoenus caldwellii</i>	+											
	* <i>Cyperus polystachyos</i>			+	+	+							
	* <i>Cyperus tenuiflorus</i>										+		
	<i>Eleocharis acuta</i>					+							
	<i>Isolepis cernua</i>					+		+	+				
	<i>Isolepis marginata</i>											+	
	* <i>Isolepis prolifera</i>			+		+		+		+			
	<i>Lepidosperma longitudinale</i>			+	+								
Restionaceae	<i>Hypolaena exsulca</i>							+					
	<i>Leptocarpus coangustatus</i>									+			
Juncaceae	* <i>Juncus acutus</i>				+	+				+		+	+
	<i>Juncus caespiticius</i>								+				
	<i>Juncus pallidus</i>	+		+	+	+	+	+	+	+			+
	<i>Juncus</i> sp.				+	+							
Asphodelaceae	* <i>Asphodelus fistulosus</i>									+			
Colchicaceae	<i>Burchardia congesta</i>			+									
Casuarinaceae	<i>Casuarina obesa</i>	+											+
Polygonaceae	<i>Rumex crispus</i>							+	+	+			+
Chenopodiaceae	* <i>Atriplex prostrata</i>			+	+			+	+	+			

Family	Species	Vegetation Unit											
		ErMpAWS	ErMrF	ErMrWS	ErWS	JSW	MpS	MrF	MrMpFH	MrMtFH	MtWS	MvJspLs	TSW
Lauraceae	<i>Cassytha racemosa</i> <i>Cassytha</i> sp.							+	+	+			
Fabaceae	* <i>Lotus angustissimus</i>			+	+	+		+	+	+			+
	* <i>Lotus subbiflorus</i>											+	
	* <i>Lupinus cosentinii</i>			+									
	* <i>Lupinus luteus</i>								+				
	* <i>Trifolium fragiferum</i>					+		+					+
Lythraceae	* <i>Lythrum hyssopifolia</i>	+			+	+		+	+	+			+
Myrtaceae	<i>Eucalyptus rudis</i>	+	+	+	+								
	<i>Melaleuca preissiana</i>	+					+		+				
	<i>Melaleuca raphiophylla</i>		+	+				+	+	+			
	<i>Melaleuca teretifolia</i>								+	+	+	+	
	<i>Melaleuca viminea</i>											+	
Haloragaceae	<i>Myriophyllum tillaeoides</i>					+							
Campanulaceae	* <i>Grammatotheca bergiana</i>			+	+	+		+	+	+			
Asteraceae	* <i>Arctotheca calendula</i>					+							
	* <i>Cirsium vulgare</i>							+					
	* <i>Conyza sumatrensis</i>			+					+	+	+	+	
	* <i>Cotula coronopifolia</i>			+		+		+	+	+	+	+	
	* <i>Hypochaeris glabra</i>			+		+		+	+	+			+
	* <i>Sonchus asper</i>			+		+		+	+	+			+
	* <i>Sonchus oleraceus</i>								+				
	* <i>Vellereophyton dealbatum</i>				+			+					

APPENDIX D VEGETATION QUADRAT DATA

Site R01

Date	15/11/2017
Botanist	Gabriela Martinez, Lisa Chappell
Quadrat Size	Releve
Slope	Gentle
Landform	Wetland
Soil Colour	Grey
Soil Type	clayey loam
Litter %	0.5
Bare Ground %	0
Vegetation Condition	Degraded
Disturbance Type	weeds, cattle
Time since Fire	>10 years



Species	Cover (%)	Height (m)
<i>*Sonchus asper</i>	1	0.8
<i>Juncus pallidus</i>	3	1.3
<i>*Juncus acutus</i>	10	1.8
<i>*Lolium perenne</i>	30	0.4
<i>*Hordeum leporinum</i>	35	0.3
<i>*Lotus angustissimus</i>	35	0.3

Site R02

Date	15/11/2017
Botanist	Gabriela Martinez, Lisa Chappell
Quadrat Size	Releve
Slope	Flat
Landform	Wetland
Soil Colour	Grey
Soil Type	clayey loam
Litter %	0.5
Bare Ground %	0
Vegetation Condition	Degraded
Disturbance Type	weeds,cattle
Time since Fire	>10 years



Species	Cover (%)	Height (m)
<i>Melaleuca teretifolia</i>	10	4
<i>Typha</i> sp.	40	2
<i>Juncus pallidus</i>	10	1.8
* <i>Cotula coronopifolia</i>	15	0.3
* <i>Isolepis prolifera</i>	25	0.6
* <i>Cyperus tenuiflorus</i>	3	0.2
* <i>Holcus lanatus</i>	2	0.3

Site R03

Date	15/11/2017
Botanist	Gabriela Martinez, Lisa Chappell
Quadrat Size	Releve
Slope	Gentle
Landform	Wetland
Soil Colour	Brown
Soil Type	loamy sand
Litter %	0.5
Bare Ground %	0
Vegetation Condition	Degraded - Good
Disturbance Type	weeds,cattle
Time since Fire	>10 years



Species	Cover (%)	Height (m)
<i>Typha</i> sp.	10	2
* <i>Sonchus asper</i>	5	1.5
<i>Juncus pallidus</i>	10	1.5
* <i>Paspalum dilatatum</i>	5	1.5
* <i>Lotus angustissimus</i>	40	0.6
* <i>Hordeum leporinum</i>	25	0.4
* <i>Lythrum hyssopifolia</i>	3	0.2

Species	Cover (%)	Height (m)
<i>*Rumex crispus</i>	2	0.6
<i>*Trifolium fragiferum</i>	+	
<i>*Hypochaeris glabra</i>	+	
<i>*Lolium perenne</i>	+	
<i>*Briza minor</i>	+	
<i>Casuarina obesa</i>	+	
<i>*Juncus acutus</i>	+	

Site Q04

Date	15/11/2017
Botanist	Gabriela Martinez, Lisa Chappell
Quadrat Size	10m x 10m
Slope	Flat
Landform	Wetland
Soil Colour	Brown
Soil Type	clayey loam
Litter %	0.5
Bare Ground %	0
Vegetation Condition	Good – Very Good
Disturbance Type	weeds
Time since Fire	> 10 years



Species	Cover (%)	Height (m)
<i>Eucalyptus rudis</i>	25	15
* <i>Juncus acutus</i>	30	1.5
<i>Baumea rubiginosa</i>	20	0.8
* <i>Cyperus polystachyos</i>	10	0.6
<i>Juncus</i> sp.	5	1
<i>Lepidosperma longitudinale</i>	25	1.2
* <i>Vellereophyton dealbatum</i>	+	

Species	Cover (%)	Height (m)
<i>Juncus ?pallidus</i>	+	
* <i>Cynodon dactylon</i>	+	
* <i>Lotus angustissimus</i>	*	
* <i>Grammatotheca bergiana</i>	+	
* <i>Lythrum hyssopifolia</i>	+	
* <i>Atriplex prostrata</i>	*	
* <i>Polypogon monspeliensis</i>	*	
* <i>Sonchus asper</i>	+	
* <i>Cotula coronopifolia</i>	+	

Site Q05

Date	15/11/2017
Botanist	Gabriela Martinez, Lisa Chappell
Quadrat Size	10m x 10m
Slope	Flat
Landform	Wetland
Soil Colour	Brown
Soil Type	clayey loam
Litter %	0.5
Bare Ground %	0
Vegetation Condition	Good – Very Good
Disturbance Type	weeds
Time since Fire	> 10 years

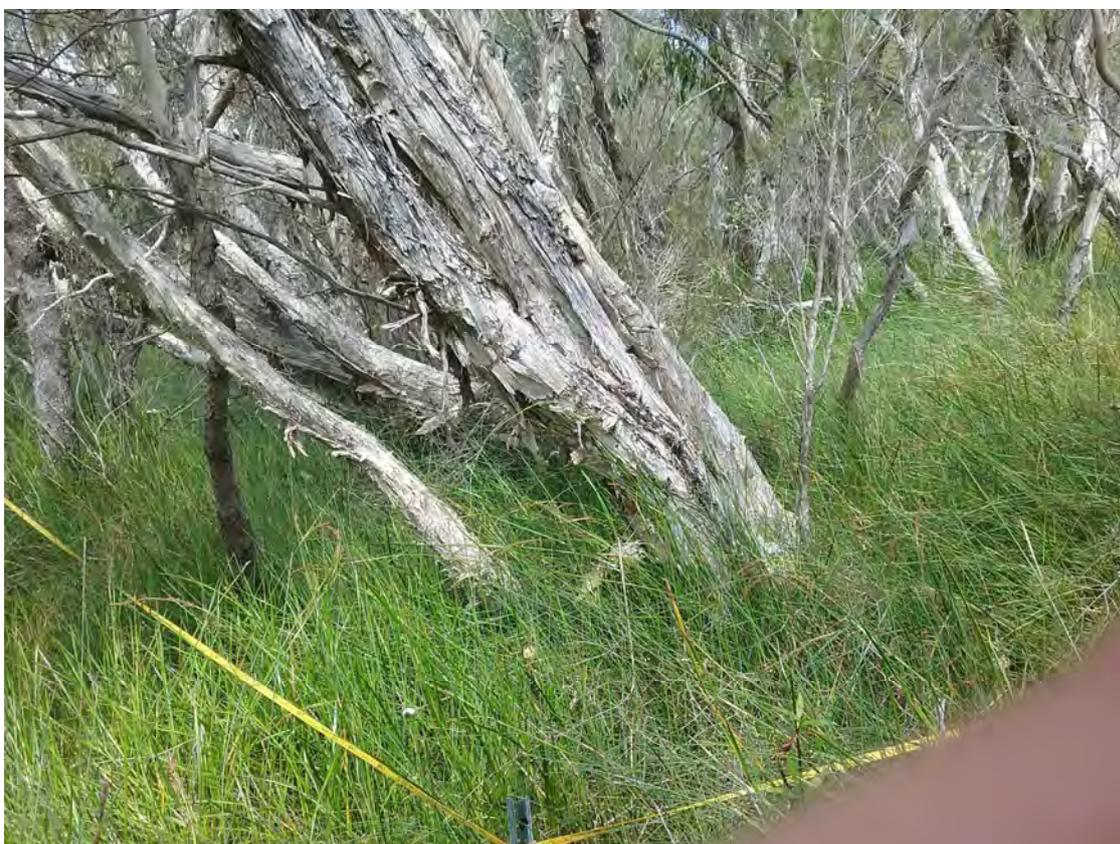


Species	Cover (%)	Height (m)
<i>Eucalyptus rudis</i>	8	8
<i>Melaleuca raphiophylla</i>	1	8
<i>Juncus pallidus</i>	50	1.7
<i>Lepidosperma longitdinale</i>	30	1.6
* <i>Isolepis prolifera</i>	15	0.6
* <i>Cynodon dactylon</i>	5	0.4

Species	Cover (%)	Height (m)
<i>*Grammatotheca bergiana</i>	+	
<i>*Cyperus polystachyos</i>	+	
<i>*Cotula coronopifolia</i>	+	
<i>Paspalum vaginatum</i>	+	
<i>*Atriplex prostrata</i>	+	
<i>*Lotus angustissimus</i>	+	

Site Q06

Date	15/11/2017
Botanist	Gabriela Martinez, Lisa Chappell
Quadrat Size	10m x10m
Slope	Flat
Landform	Wetland
Soil Colour	Brown
Soil Type	clayey loam
Litter %	1
Bare Ground %	0
Vegetation Condition	Good – Very Good
Disturbance Type	weeds, cattle
Time since Fire	>10 years



Species	Cover (%)	Height (m)
<i>Eucalyptus rudis</i>	5	8
<i>Melaleuca raphiophylla</i>	25	6
<i>Baumea juncea</i>	30	1
* <i>Isolepis prolifera</i>	10	0.5
<i>Baumea rubiginosa</i>	20	0.8
<i>Lepidosperma longitudinale</i>	25	1.5
* <i>Cotula coronopifolia</i>	10	0.8

Species	Cover (%)	Height (m)
<i>*Atriplex prostrata</i>	+	
<i>*Hypochoeris glabra</i>	+	
<i>*Holcus lanatus</i>	+	
<i>*Cyperus polystachyos</i>	+	
<i>*Grammatotheca bergiana</i>	+	
<i>Burchardia congesta</i>	+	
<i>*Lotus angustissimus</i>	+	
<i>*Conyza sumatrensis</i>	+	
<i>*Lupinus cosentinii</i>	+	

Site Q07

Date	15/11/2017
Botanist	Gabriela Martinez, Lisa Chappell
Quadrat Size	10m x 10m
Slope	Flat
Landform	Wetland
Soil Colour	Brown
Soil Type	clayey loam
Litter %	20
Bare Ground %	35
Vegetation Condition	Good
Disturbance Type	weeds
Time since Fire	> 10 years



Species	Cover (%)	Height (m)
<i>Melaleuca teretifolia</i>	10	4
<i>Melaleuca raphiophylla</i>	70	8
* <i>Cotula coronopifolia</i>	25	0.2
<i>Isolepis cernua</i>	15	0.1
* <i>Polypogon monspeliensis</i>	+	
* <i>Atriplex prostrata</i>	+	
* <i>Grammatotheca bergiana</i>	+	

Species	Cover (%)	Height (m)
<i>*Juncus acutus</i>	+	
<i>*Rumex crispus</i>	+	
<i>*Sonchus asper</i>	+	
<i>*Romulea rosea</i>	+	
<i>*Lythrum hyssopifolia</i>	+	
<i>*Lotus angustissimus</i>	+	
<i>*Briza minor</i>	+	
<i>*Lagurus ovatus</i>	+	
<i>Cassutha racemose</i>	+	
<i>*Lolium perenne</i>	+	
<i>Leptocarpus ?coangustatus</i>	+	

Site Q08

Date	15/11/2017
Botanist	Gabriela Martinez, Lisa Chappell
Quadrat Size	10m x 10m
Slope	Flat
Landform	Wetland
Soil Colour	Brown
Soil Type	clayey loam
Litter %	5
Bare Ground %	1
Vegetation Condition	Good
Disturbance Type	weeds
Time since Fire	> 10 years



Species	Cover (%)	Height (m)
<i>Melaleuca raphiophylla</i>	50	12
<i>Juncus pallidus</i>	10	1.5
* <i>Cotula coronopifolia</i>	10	0.3
* <i>Lotus angustissimus</i>	10	0.3
* <i>Isolepis prolifera</i>	1	0.5
* <i>Trifolium fragiferum</i>	+	
* <i>Ehrharta calycina</i>	+	

Species	Cover (%)	Height (m)
<i>*Polypogon monspeliensis</i>	+	
<i>*Cirsium vulgare</i>	+	
<i>*Lolium perenne</i>	+	
<i>*Rumex crispus</i>	+	
<i>*Hypochaeris glabra</i>	+	
<i>*Grammatotheca bergiana</i>	+	
<i>*Hordeum leporinum</i>	+	
<i>*Lythrum hyssopifolia</i>	+	
<i>*Sonchus asper</i>	+	
<i>Isolepis cernua</i>	+	
<i>*Briza minor</i>	+	
<i>Juncus caespiticus</i>	+	
<i>*Cynodon dactylon</i>	+	
<i>*Atriplex prostrata</i>	+	
<i>*Vellereophyton dealbatum</i>	+	
<i>*Hypochaeris glabra</i>	+	
<i>Pseudognaphalium luteoalbum</i>	+	

Site Q09

Date	15/11/2017
Botanist	Gabriela Martinez, Lisa Chappell
Quadrat Size	10m x 10m
Slope	Flat
Landform	Wetland
Soil Colour	Brown
Soil Type	clayey loam
Litter %	80
Bare Ground %	1
Vegetation Condition	Good – Very Good
Disturbance Type	NA
Time since Fire	> 10 years



Species	Cover (%)	Height (m)
<i>Melaleuca raphiophylla</i>	80	12
* <i>Atriplex prostrata</i>	+	
* <i>Lythrum hyssopifolia</i>	+	
* <i>Grammatotheca bergiana</i>	+	
<i>Isolepis cernua</i>	+	
<i>Cassutha</i> sp.	+	

Site Q10

Date	15/11/2017
Botanist	Gabriela Martinez, Lisa Chappell
Quadrat Size	10m x 10m
Slope	Flat
Landform	Wetland
Soil Colour	Brown
Soil Type	clayey loam
Litter %	0.5
Bare Ground %	1
Vegetation Condition	Good
Disturbance Type	weeds
Time since Fire	> 10 years



Species	Cover (%)	Height (m)
<i>Melaleuca raphiophylla</i>	40	10
<i>Melaleuca preissiana</i>	20	10
* <i>Cotula coronopifolia</i>	1.5	0.1
<i>Cassytha</i> sp.	3	Creeper
<i>Juncus pallidus</i>	1	0.6
* <i>Ehrharta calycina</i>	+	
* <i>Lythrum hyssopifolia</i>	+	

Species	Cover (%)	Height (m)
<i>Isolepis cernua</i>	+	
* <i>Atriplex prostrata</i>	+	
* <i>Hordeum leporinum</i>	+	

Site Q11

Date	15/11/2017
Botanist	Gabriela Martinez, Lisa Chappell
Quadrat Size	10m x 10m
Slope	Flat
Landform	Wetland
Soil Colour	Brown
Soil Type	clayey loam
Litter %	30
Bare Ground %	5
Vegetation Condition	Good
Disturbance Type	weeds
Time since Fire	> 10 years



Species	Cover (%)	Height (m)
<i>Melaleuca preissiana</i>	60	12
<i>Melaleuca raphiophylla</i>	20	12
* <i>Avena barbata</i>	25	0.3
<i>Isolepis cernua</i>	8	0.1
* <i>Ehrharta calycina</i>	3	0.3
* <i>Hypochoeris glabra</i>	+	
* <i>Cynodon dactylon</i>	+	

Species	Cover (%)	Height (m)
<i>*Atriplex prostrata</i>	+	
<i>*Lythrum hyssopifolia</i>	+	
<i>*Rumex crispus</i>	+	
<i>*Lotus angustissimus</i>	+	
<i>*Grammatotheca bergiana</i>	+	
<i>*Sonchus oleraceus</i>	+	
<i>Melaleuca teretifolia</i>	Associated	
<i>*Lolium perenne</i>	+	
<i>*Bromus diandrus</i>	+	
<i>*Lupinus luteus</i>	+	
<i>Juncus pallidus</i>	Associated	

Site R12

Date	15/11/2017
Botanist	Gabriela Martinez, Lisa Chappell
Quadrat Size	Releve
Slope	Flat
Landform	Wetland
Soil Colour	Brown
Soil Type	clayey loam
Litter %	40
Bare Ground %	0
Vegetation Condition	Degraded - Good
Disturbance Type	weeds
Time since Fire	> 10 years



Species	Cover (%)	Height (m)
<i>Eucalyptus rudis</i>	60	12
<i>Melaleuca raphiophylla</i>	20	8
* <i>Cynodon dactylon</i>	0.5	0.2

Site Q13

Date	15/11/2017
Botanist	Gabriela Martinez, Lisa Chappell
Quadrat Size	10m x 10m
Slope	Flat
Landform	Wetland
Soil Colour	Brown
Soil Type	clayey loam
Litter %	15
Bare Ground %	30
Vegetation Condition	Good – Very Good
Disturbance Type	weeds
Time since Fire	> 10 years



Species	Cover (%)	Height (m)
<i>Melaleuca preissiana</i>	40	5
<i>Melaleuca raphiophylla</i>	5	4
<i>Isolepis cernua</i>	30	0.1
* <i>Hordeum leporinum</i>	5	0.2
* <i>Cotula coronopifolia</i>	+	
* <i>Rumex crispus</i>	+	
* <i>Lythrum hyssopifolia</i>	+	

Species	Cover (%)	Height (m)
<i>*Asphodelus fistulosus</i>	+	
<i>*Atriplex prostrata</i>	+	
<i>*Lolium perenne</i>	+	

Site R14

Date	15/11/2017
Botanist	Gabriela Martinez, Lisa Chappell
Quadrat Size	Releve
Slope	Flat
Landform	Wetland
Soil Colour	Brown
Soil Type	clayey loam
Litter %	1
Bare Ground %	15
Vegetation Condition	Degraded
Disturbance Type	weeds
Time since Fire	> 10 years



Species	Cover (%)	Height (m)
<i>Melaleuca raphiophylla</i>	10	8
* <i>Cynodon dactylon</i>	80	0.1
<i>Juncus pallidus</i>	2	1
<i>Hypolaena exsulca</i>	0.5	0.3

Site R15

Date	15/11/2017
Botanist	Gabriela Martinez, Lisa Chappell
Quadrat Size	Releve
Slope	Flat
Landform	Wetland
Soil Colour	Brown
Soil Type	sand
Litter %	0
Bare Ground %	0
Vegetation Condition	Degraded
Disturbance Type	weeds
Time since Fire	>10 years



Species	Cover (%)	Height (m)
<i>Melaleuca preissiana</i>	1	8
<i>Juncus pallidus</i>	5	1.2
* <i>Juncus acutus</i>	15	1.6
* <i>Cynodon dactylon</i>	95	0.2

Site Q16

Date	15/11/2017
Botanist	Gabriela Martinez, Lisa Chappell
Quadrat Size	10m x 10m
Slope	Flat
Landform	Wetland
Soil Colour	Brown
Soil Type	clayey loam
Litter %	0.5
Bare Ground %	1
Vegetation Condition	Good
Disturbance Type	weeds
Time since Fire	> 10 years



Species	Cover (%)	Height (m)
<i>Juncus pallidus</i>	50	1.5
<i>Isolepis cernua</i>	10	0.1
* <i>Cynodon dactylon</i>	15	0.1
* <i>Isolepis prolifera</i>	18	0.2
<i>Eleocharis acuta</i>	3	0.3
* <i>Cotula coronopifolia</i>	+	
<i>Paspalum vaginatum</i>	+	

Species	Cover (%)	Height (m)
<i>*Polypogon monspeliensis</i>	+	
<i>*Grammatotheca bergiana</i>	+	
<i>*Trifolium fragiferum</i>	+	

Site Q17

Date	15/11/2017
Botanist	Gabriela Martinez, Lisa Chappell
Quadrat Size	10m x 10m
Slope	Flat
Landform	Wetland
Soil Colour	Brown
Soil Type	clayey loam
Litter %	0.5
Bare Ground %	0
Vegetation Condition	Good
Disturbance Type	weeds
Time since Fire	> 10 years



Species	Cover (%)	Height (m)
<i>*Juncus acutus</i>	10	1.6
<i>Juncus pallidus</i>	15	1.3
<i>*Cyperus polystachyos</i>	12	0.3
<i>Juncus</i> sp.	6	0.2
<i>Isolepis cernua</i>	40	0.1
<i>*Briza minor</i>	+	
<i>*Lotus angustissimus</i>	+	

Species	Cover (%)	Height (m)
<i>*Paspalum dilatatum</i>	+	
<i>*Hypochoeris glabra</i>	+	
<i>Myriophyllum tillaeoides</i>	+	
<i>*Lythrum hyssopifolia</i>	+	
<i>*Cynodon dactylon</i>	+	
<i>*Arctotheca calendula</i>	+	
<i>Styloidium piliferum</i>	+	
<i>Styloidium repens</i>	+	
<i>Synaphea spinulosa</i>	+	
<i>Trachymene pilosa</i>	+	
<i>Wahlenbergia capensis</i>	+	
<i>Xanthosia huegelii</i>	+	

Site R18

Date	15/11/2017
Botanist	Gabriela Martinez, Lisa Chappell
Quadrat Size	Releve
Slope	Gentle
Landform	Wetland
Soil Colour	Brown
Soil Type	clayey loam
Litter %	0
Bare Ground %	0
Vegetation Condition	Good - Degraded
Disturbance Type	weeds
Time since Fire	> 10 years



Species	Cover (%)	Height (m)
<i>Eucalyptus rudis</i>	15	20
<i>Casuarina obesa</i>	5	5
<i>Melaleuca preissiana</i>	5	4
<i>Juncus pallidus</i>	20	1
* <i>Cynodon dactylon</i>	50	0.6
* <i>Lythrum hyssopifolia</i>	10	0.1
<i>Bolboschoenus caldwellii</i>	10	0.8

Site B20

Date	13/10/2016
Botanist	Kellie Bauer-Simpson, Gabriela Martinez
Quadrat Size	10 x 10 m
Habitat and Waterway	Creek
Slope	Valley floor
Surface Layer	Moist Soil
Soil Colour	Brown
Soil Texture	Loamy clay
Rock Type	No Rocks
Rock Size and Abundance	No Rocks - N/A
Vegetation Condition	Degraded
Disturbance Type	Weeds, Grazing
Time since Fire	>5 years
Leaf Litter Distribution/Cover	No litter; 0%



Species	Cover (%)	Height (m)
<i>Melaleuca teretifolia</i>	16	4
<i>Melaleuca viminea</i>	20	3
<i>Juncus acutus</i>	0.5	1
<i>Cotula coronopifolia</i>	2	0.1
<i>Hordeum leporinum</i>	20	0.3
<i>Isolepis marginata</i>	5	0.05
<i>Briza minor</i>	+	
<i>Lolium rigidum</i>	+	
<i>Lotus subbiflorus</i>	+	

APPENDIX E EPA BULLETIN 686 QUESTIONNAIRE RESULTS

RESOURCE DATA – CONSERVATION CATEGORY WETLAND UFI 12840		
Name:	UFI No. 12840	
Location:	On private property, on Lot 2261 Bindoon-Moora Road in Wannamal	
Aerial Photography:	Yes	
Local Government Authority:	Shire of Chittering	
Boundary Definition:	Seasonal and episodic wetlands with poorly defined boundaries	
Assessment Type:	Part IIB	
DBCA's Wetland Classification:	Conservation Category, Floodplain	
PART I – PRESENCE OF RARE SPECIES		
<p>No species of Threatened or Priority Flora were recorded by FVC during the field assessment in 2017. However, Bamford, (2017) recorded <i>Ardea alba</i> (Eastern Great Egret) within CCW UFI 12840, which is listed as a Schedule 5 species under the WC Act.</p>		
PART IIB – NATURAL ATTRIBUTES		SCORE
1	Environmental Geology Classification: Soil Systems (Capitella, Mogumber, Wannamal and Yarawindah)	5
2	Adjacent Wetlands: Wetlands are present within a 2km radius	0
3	Habitat Diversity: Habitat composition and structure is not significantly different	1
4	Habitat Type: Large paperbarks (>2.5m tall) in dense clumps	1
	Low thickets (<2.5m tall) of Melaleuca	1
	Paperbark fringe	1
	Fringing rushes and sedges	1
	Scattered dense clumps of rushes or sedges	1
	Flooded grassland in winter/spring	1
	Mudflats or seasonally dry open water	1
	Fringing woodland or heath	1
	Permanent shallow water open water (<50cm deep)	1
	Scattered paperbarks	0.5
Scattered rushes	0.5	
5	Drainage: No	5
6	Area of wetland modified: 31-40%	2
7	Wetland Size: 25-50ha	3
TOTAL		26

PART III – HUMAN USE		SCORE
1	Aesthetics:	
	Little if any artificial noise	2
	Visible steep ridges in scenery	1
	Accessible ridge provides view of wetland viewed	1
2	Historical/Archaeological Features: Nil	0
3	Security of Wetland: Other (private)	1
4	Protection Groups: Nil	0
5	Passive Recreation: Nil	0
6	Active Recreation: Nil	0
7	Other Human Uses: Agricultural activities	1
TOTAL		6

SCORE: Natural Attributes – 26, Human Use – 6

MANAGEMENT CATEGORY: Conservation Category

RESOURCE DATA – RESOURCE ENHANCEMENT CATEGORY WETLAND UFI 12838		
Name:	UFI No. 12838	
Location:	Private property, on Lot 2261 Bindoon-Moora Road in Wannamal	
Aerial Photography:	Yes	
Local Government Authority:	Shire of Chittering	
Boundary Definition:	Seasonal and episodic wetlands with poorly defined boundaries	
Assessment Type:	Part IIB	
DBCA's Wetland Classification:	Resource Enhancement Category, Sumpland	
PART I – PRESENCE OF RARE SPECIES		
<p><i>Ardea modesta</i> was recorded within the wetland study area (BCE 2017), migratory bird species are likely to frequent the wetland. Carnaby's cockatoo may roost in the vicinity of wetlands in the survey area (VSA 7) and was recorded within the wetland study area during 2017. No threatened flora species were recorded during the field assessment in 2017.</p>		
PART IIB – NATURAL ATTRIBUTES		SCORE
1	Environmental Geology Classification: Soil System (Capitella)	1
2	Adjacent Wetlands: Wetlands are present within a 2km radius	0
3	Habitat Diversity: Habitat composition and structure is not significantly different	1
4	Habitat Type: Low thickets (<2.5m tall) of Melaleuca	1
	Fringing rushes and sedges	1
	Scattered dense clumps of rushes or sedges	1
	Fringing woodland or heath	1
5	Drainage: No drains directly discharging into or out of wetland	0
6	Area modified: 31 – 40%	2
7	Wetland size: 10 - 25ha	2
TOTAL		15
PART III – HUMAN USE		SCORE
1	Aesthetics: Little if any artificial noise	2
2	Historical/Archaeological Features: 0	0
3	Security of Wetland: Private Land	1

4	Protection Groups: No groups	0
5	Passive Recreation: No known passive recreation	0
6	Active Recreation: No known active recreation	0
7	Other Human Uses: agricultural activities, proposed infrastructure corridor, water supply	3
TOTAL		6

SCORE: Natural Attributes – 15, Human Use – 6

MANAGEMENT CATEGORY: Resource Enhancement

RESOURCE DATA – MULTIPLE USE UFI 12841		
Name:	UFI No. 12841	
Location:	on private property, on Lot 2261 Bindoon-Moora Road in Wannamal	
Aerial Photography:	Yes	
Local Government Authority:	Shire of Chittering	
Boundary Definition:	Seasonal and episodic wetlands with poorly defined boundaries	
Assessment Type:	Part IIB	
DBCA's Wetland Classification:	Multiple Use, Dampland	
PART I – PRESENCE OF RARE SPECIES		
<p><i>Ardea modesta</i> was recorded within the wetland study area (BCE 2017), migratory bird species are likely to frequent the wetland. Carnaby's cockatoo may roost in the vicinity of wetlands in the survey area (VSA 7) and was recorded within the wetland study area during 2017. No Threatened or Priority Flora species were identified during the field assessment by FVC in 2017.</p>		
PART IIB – NATURAL ATTRIBUTES		SCORE
1	Environmental Geology Classification: Capitella and Yarawindah Soil Systems	1
2	Adjacent Wetlands: Wetlands are present within a 2km radius	0
3	Habitat Diversity: Habitat composition and structure is not significantly different	1
4	Habitat Type: Fringing rushes and sedges	1
5	Drainage: Yes	0
6	Area of wetland modified: >40%	1
7	Wetland Size: 25-50ha	3
TOTAL		7
PART III – HUMAN USE		SCORE
1	Aesthetics: Little if any artificial noise	2
2	Historical/Archaeological Features: Nil	0
3	Security of Wetland: Other (private)	1
4	Protection Groups: Nil	0
5	Passive Recreation: Nil	0

6	Active Recreation: Nil	0
7	Other Human Uses: Agricultural	1
TOTAL		4

SCORE: Natural Attributes – 7, Human Use – 4

MANAGEMENT CATEGORY: Multiple Use

RESOURCE DATA – MULTIPLE USE UFI 12762		
Name:	UFI No. 12762	
Location:	on private property, on Lot 2261 Bindoon-Moora Road in Wannamal	
Aerial Photography:	Yes	
Local Government Authority:	Shire of Chittering	
Boundary Definition:	Seasonal and episodic wetlands with poorly defined boundaries	
Assessment Type:	Part IIB	
DBCA's Wetland Classification:	Multiple Use, Palusplain	
PART I – PRESENCE OF RARE SPECIES		
No Threatened or Priority Flora species were identified during the field assessment by FVC in 2017, however, one historical record of <i>Acacia drummondii</i> subsp. <i>affinis</i> (P3) occurs within the wetland study area.		
PART IIB – NATURAL ATTRIBUTES		SCORE
1	Environmental Geology Classification: Wannamal and Yarawindah Soil System	1
2	Adjacent Wetlands: Wetlands are present within a 2km radius	0
3	Habitat Diversity: Habitat composition and structure is not significantly different	1
4	Habitat Type: Fringing <i>Typha</i>	1
5	Drainage: Yes	0
6	Area of wetland modified: >40%	1
7	Wetland Size: 50-100ha	4
TOTAL		8
PART III – HUMAN USE		SCORE
1	Aesthetics: Little if any artificial noise	2
2	Historical/Archaeological Features: Nil	0
3	Security of Wetland: Other (private)	1
4	Protection Groups: Nil	0
5	Passive Recreation: Nil	0
6	Active Recreation: Nil	0

7	Other Human Uses: Agricultural	1
TOTAL		4
SUPPLEMENTARY QUESTIONS		
1	Species Rarity: No Rare (and not gazetted) species of animals or plants are not present and there are no communities represented which have limited distribution	Multiple Use

SCORE: Natural Attributes – 8, Human Use – 4

MANAGEMENT CATEGORY: Multiple Use