Environmental Management Plans

Environmental Management Plan

Type of Environmental Management Plan (EMP)	Wetland Management Plan
New or Revised EMP	☐ New ☑ Revised
Previous online reference number	
Title of EMP	Lots 32, 83, 90 and 91 Wanneroo Road, Woodvale: Wetland and Dieback Management Plan (Rev 4)
Has this EMP been prepared in accordance with the City's EMP guidelines?	☑ Yes ☐ No
If No, please provide reason	
Why is this management plan being lodged with the City?	☐ Requirement of a Condition of Subdivision ☐ Requirement of a Structure Plan ☐ Compliance ☑ Other
Subdivision WAPC Number	155158
Subdivision Condition Number	12 and 14
Structure Plan Name and Number	
Compliance - Subdivision or Planning Application Number	
If Other, please provide details	Please note that, as discussed with Carrie Gaudoin these are minor modifications (amendments to figures 2 and 6 to accurately reflect the requirements of the Bushfire Management Plan) and as such will not require a full assessment.

Applicant Details

Business Name	Strategen-JBS&G
Contact Person	Carli O'Brien
Postal Address	Level 1, 50 Subiaco Square Road Subiaco WA 6008
Contact Number	08 9380 3100
Email Address	cobrien@jbsg.com.au

Online Reference Number: 230931 **Date:** 25/03/2020

intelligent outcomes | respected experience

Lots 32, 83, 90 and 91 Wanneroo Road, Woodvale

Wetland and Dieback Management Plan

Prepared for
Watson Property Group Northern Aspects Pty Ltd
by Strategen

March 2020

strategen
ENVIRONMENTAL

Lots 32, 83, 90 and 91 Wanneroo Road, Woodvale

Wetland and Dieback Management Plan

Strategen is a trading name of
Strategen Environmental Consultants Pty Ltd
Level 1, 50 Subiaco Square Road Subiaco WA 6008
ACN: 056 190 419

March 2020

Limitations

Scope of services

This report ("the report") has been prepared by Strategen Environmental Consultants Pty Ltd (Strategen) in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and Strategen. In some circumstances, a range of factors such as time, budget, access and/or site disturbance constraints may have limited the scope of services. This report is strictly limited to the matters stated in it and is not to be read as extending, by implication, to any other matter in connection with the matters addressed in it.

Reliance on data

In preparing the report, Strategen has relied upon data and other information provided by the Client and other individuals and organisations, most of which are referred to in the report ("the data"). Except as otherwise expressly stated in the report, Strategen has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ("conclusions") are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Strategen has also not attempted to determine whether any material matter has been omitted from the data. Strategen will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to Strategen. The making of any assumption does not imply that Strategen has made any enquiry to verify the correctness of that assumption.

The report is based on conditions encountered and information received at the time of preparation of this report or the time that site investigations were carried out. Strategen disclaims responsibility for any changes that may have occurred after this time. This report and any legal issues arising from it are governed by and construed in accordance with the law of Western Australia as at the date of this report.

Environmental conclusions

Within the limitations imposed by the scope of services, the preparation of this report has been undertaken and performed in a professional manner, in accordance with generally accepted environmental consulting practices. No other warranty, whether express or implied, is made.

Client: Watson Property Group Northern Aspects Pty Ltd

Report Version	Revision No.	Purpose	Strategen author/reviewer	Submitted to Client	
				Form	Date
Draft Report	A	Client review	C Turner / K Cooper	Electronic	08/01/2018
Final Report	0	For submission to CoW and DBCA	C Turner	Electronic	21/05/2018
Final Report	1	For submission to CoW	C Turner	Electronic	03/07/2018
Final Report	2	For submission to CoW	C Turner	Electronic	13/07/2018
Final Report	3	For submission to CoW and DBCA	C Turner	Electronic	30/07/2018
Final Report	4	For submission to CoW and DBCA- minor figure changes	C O'Brien	Electronic	19/03/2020

Filename: PDE17551.01 R001 Rev 4 - 19 March 2020

Table of contents

1. Introduction **1**
1.1 Background 1
1.2 Objectives 1
1.3 Related documents 2

2. Existing environment overview **5**
2.1 Climate 5
2.2 Topography 5
2.3 Geology 5
2.4 Acid Sulfate Soils 5
2.5 Hydrology 6
2.5.1 Surface water and wetlands 6
2.5.2 Groundwater 6
2.5.3 Public drinking water source area 6
2.5.4 Urban water management plan 6
2.6 Vegetation and flora 6
2.6.1 Disease 7
2.7 Fauna 10
2.8 Bush Forever 10
2.9 Ecological linkages 10
2.10 Cultural heritage and social values 10
2.10.1 Aboriginal heritage 10
2.10.2 European Heritage 10
2.11 Contamination 13
2.12 Bushfire risk 13

3. Management and implementation **14**
3.1 Earthworks and dieback 14
3.2 Bushfire 15
3.3 Access 15
3.4 Fauna management 16
3.5 Community awareness and education 16
3.6 Rehabilitation works 16
3.6.1 Weed control 19
3.6.2 Planting 19
3.7 Monitoring and assessment 21
3.7.1 Completion criteria 22
3.7.2 Contingency actions 22
3.8 Reporting 23
3.9 Timeframe 23
3.10 Rehabilitation implementation schedule 24

4. References **26**

List of tables

Table 1: Pathways for dieback to enter the site 14
Table 2: Earthworks and dieback management actions 14
Table 3: Fauna management actions 16
Table 4: Weed management actions 19
Table 5: Rehabilitation and landscaping maintenance actions 21
Table 6. Completion criteria for each planting zone 22
Table 7: Contingency actions 22
Table 8: Indicative implementation schedule 24

List of figures

Figure 1: Locality Plan 3
Figure 2: Wetland management boundaries 4
Figure 3: Topographic and groundwater contours 8
Figure 4: Geology and acid sulfate soils 9
Figure 5: Bush Forever and Ecological Linkages 12
Figure 6: Revegetation planting zones 18

List of appendices

Appendix 1 Subdivision approval
Appendix 2 PSC 88: Use of herbicides in water catchment areas
Appendix 3 Flora and Vegetation Survey
Appendix 4 Level 1 Fauna Assessment

1. Introduction

1.1 Background

This Wetland and Dieback Management Plan (WDMP) has been prepared for Watson Property Group Northern Aspects Pty Ltd (the proponent), to support the development of Lots 32, 83, 90 and 91 (the site; Figure 1) within the City of Wanneroo's (CoW) Structure Plan 64 (SP64) area.

Conditional subdivision approval (WAPC 155158) has been granted to develop the site into 60 residential lots (including 1 strata lot), drainage and public open space (POS) areas (Appendix 1). This WDMP has been prepared to address the following subdivision conditions:

Condition 12

Prior to the commencement of subdivision works a Wetland Management Plan is to be prepared and approved in consultation with the Department of Biodiversity, Conservation and Attractions (DBCA) to ensure the protection and management of the sites environmental assets with satisfactory arrangement being made for the implementation of the approved plan.

Condition 14

Prior to the commencement of subdivision works a Dieback Management Plan is to be prepared and approved in consultation with the Department of Biodiversity, Conservation and Attractions to ensure the protection and management of the sites environmental assets with satisfactory arrangements being made for the implementation of the approved plan.

This WDMP has been prepared in accordance with the above conditions in the context of the overarching *Structure Plan 64: Wetland Management and Rehabilitation Strategy* (WMRS, Cardno 2009).

An endorsed Wetland Management Plan (WMP; Cardno 2011) exists for the site, as part of the broader Chianti Estates development. This WDMP supersedes the existing WMP (Cardno 2011) and incorporates the requirements of *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (SPP 3.7; WAPC 2015) and the *Guidelines for Planning in Bushfire Prone Areas* (WAPC 2017), which have been enforced through the Map of Bushfire Prone Areas (DFES 2017) since the preparation of the 2011 WMP. A Bushfire Management Plan (BMP) (Strategen 2017) has been prepared for the site which identifies areas to be managed as 'low-threat' in accordance with AS 3959–2009 Construction of Buildings in Bushfire-Prone Areas (AS 3959; SA 2009) as to not introduce a bushfire hazard to the proposed development.

The landscaping works on site will include the establishment of two 'low-threat' POS areas in accordance with the endorsed BMP (Strategen 2017), which comprises of:

- parkland, and
- bioretention swales.

These areas have been excluded from this revised WDMP and are subject to a separate landscaping approval.

A large (1.37 ha) CoW drainage basin exists in the centre of the development which maintained and managed by the CoW and therefore has not been included as part of this WDMP.

1.2 Objectives

The WDMP aims to produce an ecologically diverse and functioning wetland buffer that will assist with the protection of the adjacent wetland (associated with Yellagonga Regional Park- YRP) from the potential impacts from the development and provide added visual amenity.

The proposed wetland buffer and revegetation boundaries are identified in Figure 2.

1.3 Related documents

The documents which relate to the site and the WDMP are listed below:

- Local Structure Plan 64 – Wetland Management and Rehabilitation Strategy (Cardno 2009)
- Chianti Private Estate Stage 2, 3 and 4 Wetland Management Plan (Cardno 2011)
- Bushfire Management Plan- Lots 32, 83, 90 and 91 Wanneroo Road, Woodvale (Strategen 2017)

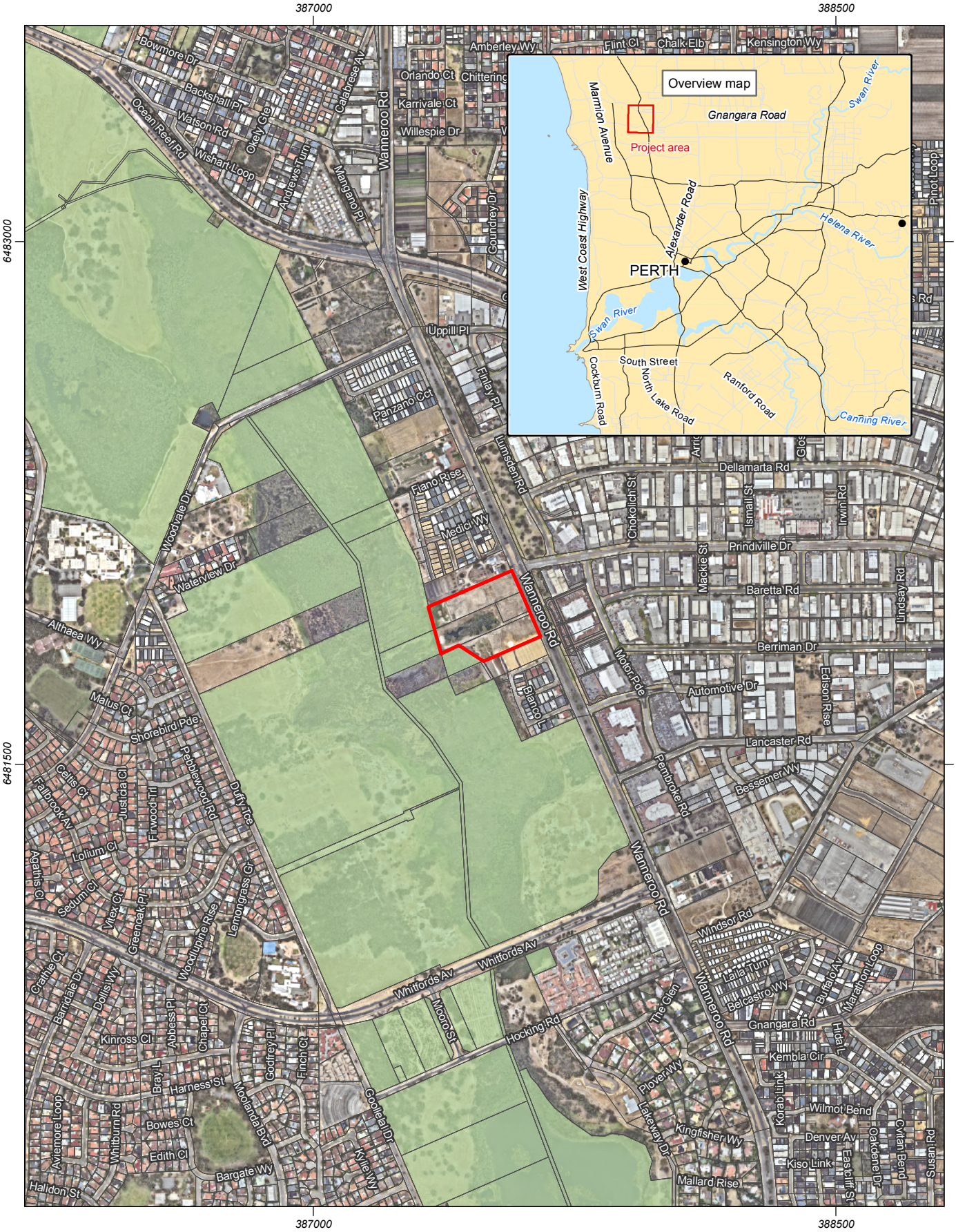


Figure 1: Site location

Scale 1:15,000 at A4

0 150 300 450 m

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 19/12/2017
Author: vdinh
Source: Existing cadastre: SLIP, landgate 2016.

Legend

- Study area
- Cadastre
- Yellagonga regional park

strategen ENVIRONMENTAL

info@strategen.com.au
www.strategen.com.au

Path: Q:\Consult\2017\PDE\PDE17551\01_GIS_documents\ArcMap_documents\PDE17551_G001_RevA.mxd

Figure 2: Wetland management boundaries

Scale 1:2,250 at A4

0 25 50 75 m

N

Legend

- Study area
- Cadastre
- Conservation wetland
- Revegetation boundary
- Design layout
- Wetland buffer boundary

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 17/02/2020
Author: vdinh
Source: Existing cadastre: SLIP, landgate 2016.

info@strategen.com.au
www.strategen.com.au

Path: W:\Strategen\GIS\Consult\2017\PDE\PDE17551\01_GIS_documents\ArcMap_documents\PDE17551_G002_RevF.mxd

2. Existing environment overview

2.1 Climate

The Woodvale area experiences a Mediterranean climate with cool wet winters and hot dry summers. The dry period extends from October – March with the hottest month being February with average minimum and maximum temperatures of 19.8ºC and 28.2ºC respectively recorded at the Hillarys Boat Harbour NTC AWS station (BOM station 9265). The coolest month is July with average minimum and maximum temperatures of 11ºC to 17.8ºC respectively (BOM 2017).

The long-term average annual rainfall recorded at the nearest BOM station with relevant, quality controlled data (Wanneroo, BOM station 9105) is approximately 797 mm (BOM 2017a).

The predicted regional implications of climate change include an increase in mean daily temperatures and reduced rainfall (particularly winter rainfall) in south Western Australia over the coming decades (Yates *et al* 2010). It is possible that the water levels of wetlands on the Swan Coastal Plain will continue to lower as a consequence of these effects, resulting in decreases in inflow (direct and from runoff), lowered groundwater levels and an increase in evaporation. An ongoing reduction in lake water levels threatens the current ecological values of the lake, including the health of fringing vegetation and associated habitat value for water birds.

2.2 Topography

Topographic contours indicate that the surface elevation generally slopes east to west. Surface elevation on the eastern border is approximately 32 m Australian height datum (mAHD) sloping down to 24 mAHD on the eastern edge (Figure 3).

2.3 Geology

Regional geological mapping (Gozzard 1986) indicates that the project area comprises the following two geological units:

- SAND (S7)- pale and olive yellow, medium to coarse-grained, sub-angular to sub-rounded quartz, trace of feldspar, moderately sorted, or residual origin.
- PEATY SAND (Sp)- greyish brown, medium-grained quartz, moderately well sorted, variable organic content, of lacustrine origin.

The soils identified within the wetland area indicated a black organic peaty sand surface, underlain by black silty sand and black clayey sand as depth increases. The soils within the dry land areas all consisted of medium grain grey sands ranging from light to dark grey for the entire profile investigated (Cardno 2007).

2.4 Acid Sulfate Soils

Regional Acid Sulfate Soil (ASS) mapping maintain by the Department of Water and Environmental Regulation (DWER) identifies parts of the site as having a 'high to moderate' risk of ASS within 3 m of the natural surface (Figure 4).

In accordance with Condition 19 (WAPC 443-17) and Condition 43 (WAPC 155158) of the subdivision approvals for the project area, an acid sulphate soils self-assessment form has been prepared and submitted to DWER. No dewatering is proposed during construction of the development, and no natural soils are proposed to be excavated. Therefore, ASS will not be disturbed as a result of implementation of the Project.

2.5 Hydrology

2.5.1 Surface water and wetlands

Regional mapping of the Geomorphic Wetlands of the Swan Coastal Plain (DPAW 2016) identifies Walluburnup Swamp (herein referred to as 'the wetland'), a Conservation Category Wetland (CCW; UFI 15458) located adjacent to the western site boundary (Figure 2).

A large (1.37 ha) CoW drainage basin exists in the centre of the development which is subject to flooding from a large spillway on the western edge of the basin (Cardno 2011). During major flood events, the basin overflows down the spill way into the adjacent Walluburnup Swamp. The location of the drainage basin is shown in Figure 2. The drainage basin is maintained and managed by the CoW and therefore has not been included as part of this WDMP.

2.5.2 Groundwater

The *Perth Groundwater Map* 'May 2003 maximum groundwater contour' mapping indicates that the depth to ground water varies from 26 m AHD at the eastern edge of the site to 22 m AHD at the western boundary (DWER 2017). This equates to approximately 6 m below ground level (bgl) in the eastern portion of the site and 2 m bgl in the western portion (Figure 3).

2.5.3 Public drinking water source area

The Department of Water and Environment Regulation (DWER) assigns three different priority areas (P1, P2 or P3) to land within public drinking water source areas. The entire site is located within a P3 Public drinking water source area.

Herbicide use in proclaimed drinking water catchment areas are subject to control (Department of Health 2017) and will require management in accordance with PSC 88: Use of herbicides in water catchment areas (Appendix 2).

2.5.4 Urban water management plan

An Urban Water Management Plan (UWMP; Cardno 2010b) has been prepared to support development of the site. The UWMP has been prepared to ensure Water Sensitive Urban Design and aims to address the risk of nutrient rich water entering the wetland, as well as maintaining pre-development hydrological conditions (Cardno 2011).

2.6 Vegetation and flora

A Flora and Vegetation Survey was completed for the entire core wetland area (associated with Yellagonga Regional Park) by Cardno in 2006. In addition, the wetland buffer area of SP64 was subject to a Level 1 Flora and Vegetation Survey (Cardno 2010; Appendix 3) undertaken in accordance with EPA Guidance Statement No. 51 – Terrestrial flora and vegetation survey environmental impact assessment in Western Australia (Environmental Protection Authority, 2004) as part of a broader survey for the wetland buffer area of the SP64 area.

The Cardno (2006) survey identified three vegetation communities within the wetland core, including:

- Melaleuca-Tuart woodland
- Melaleuca-Typha shrubland, and
- exotic grassland dominated by Typha and Kikuyu with intermittent exotic trees.

The 2009 survey of the SP64 area did not identify any native plant communities' due to the degraded nature of the survey area, and only several emergent native plants were identified that did not form a structure that enabled identification of a community type (Cardno 2010). The 2009 survey identified the entire wetland buffer area (within the SP64 area) as 'Completely Degraded' condition. Areas adjacent to the site were dominated by exotic grasses including Typha.

2.6.1 Disease

An assessment of the site for *Phytophthora cinnamomic* (dieback) was undertaken (Cardno 2010a) which classed the site as 'uninterpretable' due to the highly degraded nature of vegetation, and the lack of susceptible (indicator) species available for diagnosis. As the survey was completed over 5 years ago and based on the current site characteristics i.e. lack of indicators including, key vegetation species and organic substrate) a site dieback survey undertaken now would also likely be inconclusive.

Given the uncertainty of the presence of dieback within the site, dieback management will take a precautionary approach and will aim to:

- prevent dieback entering the site
- prevent movement of potentially dieback contaminated soils and other material between the site and YRP.

Implementation of these measures will also assist in preventing the spread of weeds on the site. Refer to Section 3.1.

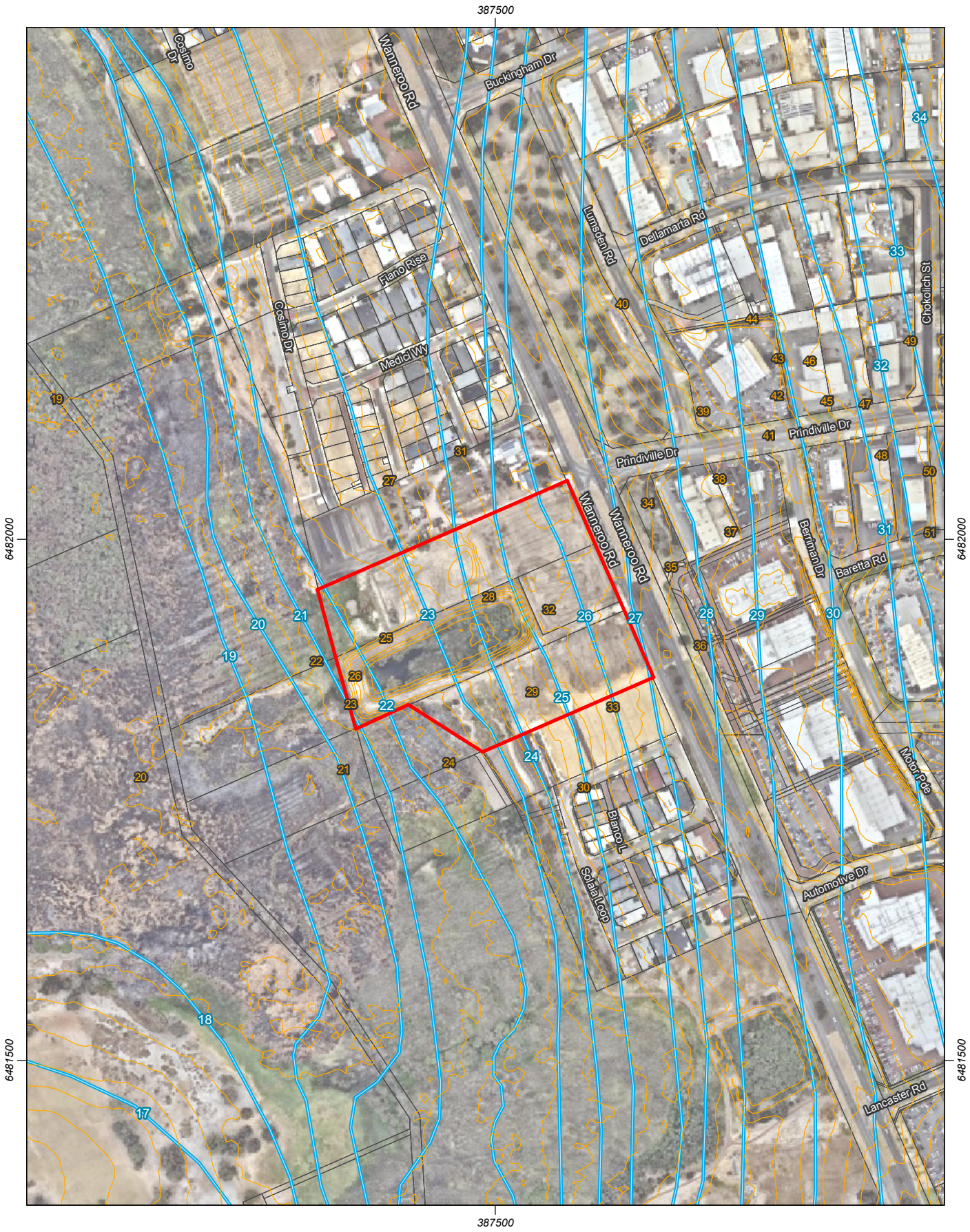


Figure 3: Topographic and groundwater contours

Scale 1:5,000 at A4

0 50 100 150 m

N

Legend

- 1m contour (mAHD)
- Groundwater contour maximum (mAHD)
- Study area
- Cadastre

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 5/01/2018
Author: vdinh
Source: Existing cadastre: SLIP, landgate 2016.

strategen ENVIRONMENTAL
info@strategen.com.au
www.strategen.com.au

Path: Q:\Consult\2017\PDE\PDE17551\01_GIS_documents\ArcMap_documents\PDE17551_G003_RevA.mxd

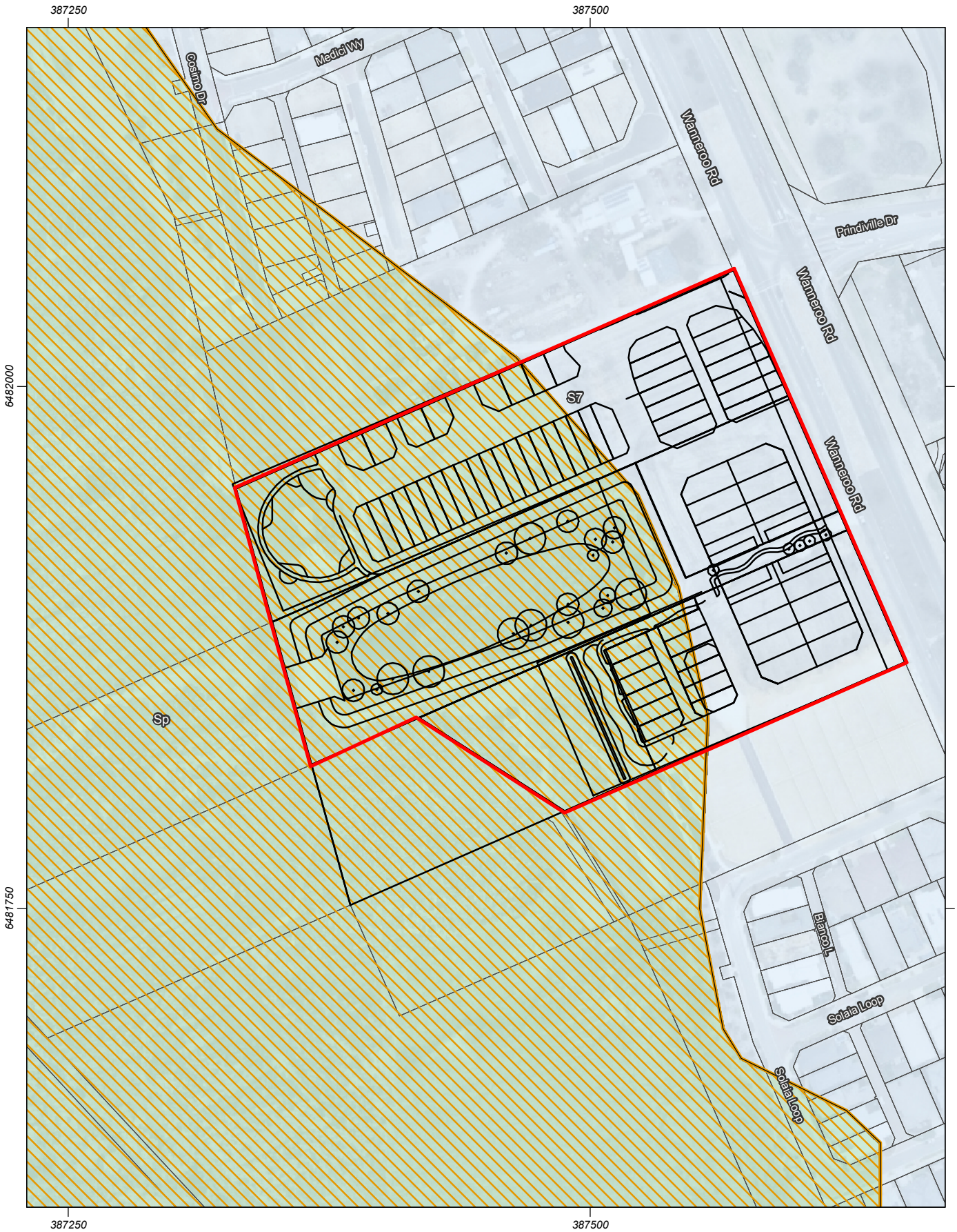


Figure 4: Geology and acid sulfate soils

Scale 1:2,500 at A4

0 25 50 75 m

N

Coordinate System: GDA 1994 MGA Zone 50

Note that positional errors may occur in some areas

Date: 8/01/2018

Author: vdinh

Source: Existing cadastre: SLIP, landgate 2016.

Legend

- Design layout
- Study area
- Cadastre
- High to moderate Acid sulfate soil risk

Sp — PEATY SAND - greyish brown, medium-grained quartz, moderately well sorted, variable organic content, of lacustrine origin

S7 — SAND - pale and olive yellow, medium to coarse-grained, sub-angular to sub-rounded quartz, trace of feldspar, moderately sorted, of residual origin

strategen ENVIRONMENTAL
info@strategen.com.au
www.strategen.com.au

Path: Q:\Consult\2017\PDE\PDE17551\01_GIS_documents\ArcMap_documents\PDE17551_G005_RevA.mxd

2.7 Fauna

A Level 1 Terrestrial Fauna Assessment was completed (Bamford Consulting Ecologists 2010) in accordance with EPA Guidance Statement No. 56 – Terrestrial fauna survey for environmental impact assessment in Western Australia (Environmental Protection Authority, 2004a) for the wetland buffer (which included the site) and adjacent areas of the wetland for the entire SP64 area.

The fauna assessment report concluded that the majority of species known[1] to occur in the general region are not likely to occur on site due to the lack of suitable habitat (Bamford Consulting Ecologists 2010).

The desktop study identified a fauna assemblage that may occur in the project area consisting of: 4 fish, 6 frog, 19 reptile, 85 bird and 13 mammal species. Twenty-two of the species potentially occurring in the SP64 area are of conservation significance. The fauna assessment report concluded that of these species, the proposed development (within the SP64 area) may negatively impact eight of these through a potential increase in predation (from domestic or feral animals) and a loss of grassland/ open habitat areas. The proposed development was considered to have a negligible or beneficial impact on the remaining conservation significant species due to the proposed rehabilitation and creation of habitat.

The fauna assessment is provided in Appendix 4.

2.8 Bush Forever

The Bush Forever program aims to protect native vegetation within the Perth metropolitan area by vesting natural assets in conservation estates for perpetuity (DPI 2000). The wetland forms part of Bush Forever Site 299 which abuts the western site boundary, and intersects the CoW drainage lot (Figure 5).

2.9 Ecological linkages

The wetland is mapped as an ecological linkage between Beenyup Swamp and Lake Goollelal to the south and Lake Joondalup to the north (Figure 5). Rehabilitation of the wetland buffer is proposed to enhance the value of the wetland as an ecological linkage.

2.10 Cultural heritage and social values

The wetland forms part of the YRP, providing amenity and recreation value to the community. The redevelopment of the site is expected to improve the visual amenity and ecological value of the area through rehabilitation and landscaping.

2.10.1 Aboriginal heritage

The Department of Planning, Lands and Heritage *Aboriginal Heritage Inquiry System* (DPLH 2017) did not identify any registered Aboriginal Heritage Sites or 'Other Heritage Places' within or adjacent to the site area.

2.10.2 European Heritage

The State Heritage Office *InHerit* search tool did not identify any sites of European Heritage within the site (SHO 2017).

[1] Based on the following information sources: Bamford Consulting, DBCA's Naturemap, Birds Australia Atlas Database, DBCA's Threatened Fauna Database and Department of Environment and Energy (DEE)'s EPBC Protected Matters Search Tool.

Immediately north of the project area is William Duffy House which is recognised for aesthetic and social significance on the City of Wanneroo's Municipal Inventory (SHO 2017). William Duffy House will not be impacted by the Project.

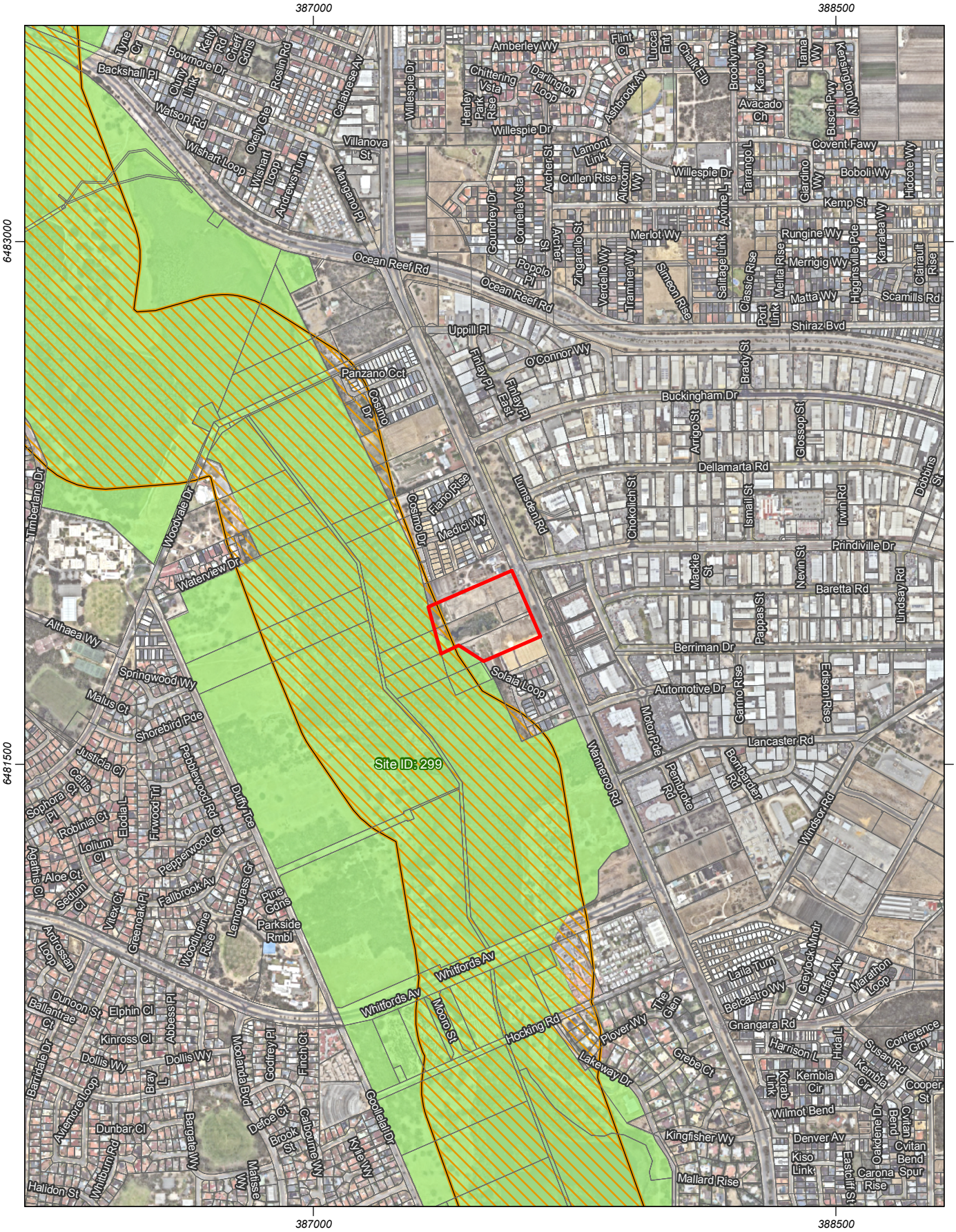


Figure 5: Bush Forever and Ecological Linkages

Scale 1:15,000 at A4

0 150 300 450 m

N

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 8/01/2018
Author: vdinh
Source: Existing cadastre: SLIP, landgate 2016.

Legend

- Study area
- Cadastre
- Bush Forever
- Ecological linkages

strategen ENVIRONMENTAL
info@strategen.com.au
www.strategen.com.au

Path: Q:\Consult\2017\PDE\PDE17551\01_GIS_documents\ArcMap_documents\PDE17551_G004_RevB.mxd

2.11 Contamination

The Contaminated Sites Database (DWER 2018) does not identify any registered contaminated sites within or adjacent to the site area.

An investigation for soil and groundwater contamination is required to be carried out prior to the commencement of subdivision works, in accordance with Condition 18 of the subdivision approval for the project area (WAPC 155158; Appendix 1).

If required (and if contamination is identified), remediation will be undertaken prior to subdivision works and will be undertaken in a manner that does not adversely impact the wetland. Any remediation works required (if any) will be managed and regulated through the Contaminated Sites Branch of DWER.

2.12 Bushfire risk

Wildfire is a significant risk within Yellagonga Regional Park (CALM 2002). In wetland areas, such as Wallaburnup Swamp, heavy infestations of Typha constitute a significant fire hazard. Bushfires in Typha are extremely difficult to control and can cause severe damage to fringing paperbark vegetation. Frequent wild fires in wetland areas will prevent the establishment of paperbark vegetation and encourages further invasion of Typha because it regenerates far quicker than other local rush species.

There is a potential increase in bushfire risk through increased human habitation, disturbance and the use of machinery for construction purposes.

As discussed in Section 1.1, the site has been mapped as occurring within a Bushfire Prone Area and in response to State Planning Policy 3.7 Planning in Bushfire Prone Areas (SPP 3.7; WAPC 2015) and the Guidelines for Planning in Bushfire Prone Areas (WAPC 2017), a Bushfire Management Plan (BMP) (Strategen 2017) has been prepared for the site which identifies areas to be managed as 'low-threat' in accordance with AS 3959–2009 Construction of Buildings in Bushfire-Prone Areas (AS 3959; SA 2009) as to not introduce a bushfire hazard to the proposed development.

The BMP should be read in conjunction with this WDMP.

3. Management and implementation

This section outlines the management proposed on the site to facilitate the revegetation works and to ensure protection of the adjacent wetland area. As the area to be rehabilitation is current in a 'Completely Degraded' condition, the key component of the wetland management approach is with respect to revegetation and weed control of the designated wetland buffer areas.

This section of the Plan describes the general approach to rehabilitation that will be undertaken to restore vegetation to a condition consistent with the proposed key performance indicators (criterion) for the management program.

3.1 Earthworks and dieback

There are several potential pathways for dieback to be introduced or spread throughout the site and potentially to the adjacent wetland. Management of these pathways will be the key focus on mitigating the potential introduction and spread of dieback (Table 1).

Table 1: Pathways for dieback to enter the site

Vector	Potential pathway
Vehicles and machinery	Contaminated mud and dirt on the tyres and undercarriage of cars and construction machinery which has operated on other sites contaminated with dieback.
Personnel	Mud and dirt on the soles of personnel's boots and clothing which is contaminated with dieback.
Water	Runoff from the site may enter the wetland, spreading dieback.
Vegetation	The planned revegetation material (e.g. tube stock) may contain dieback when planted on-site.
Mulch	The spreading of mulch which has come from a dieback contaminated site.

To facilitate the development of the site, areas of fill may be required as part of the civil engineering works. Any imported fill will be 'clean fill' and will be certified dieback free. Where possible the area of fill will be restricted to areas east of the dual use path, which will be dependent on creating aesthetic slopes in the site that will not cause erosion difficulties in revegetation.

To ensure hydrological regimes are maintained within the wetland, water management will be undertaken in accordance with the approved UWMP (Cardno 2010b). Bioretention swales will be constructed and planted with nutrient stripping plant species, with an aim to improve stormwater quality prior to discharge to the wetland area.

No dewatering or excavation of 100 m^3 (or greater) of soil will occur.

The key management actions proposed for earthwork and dieback are detailed below in Table 2.

Table 2: Earthworks and dieback management actions

Parameter	Management issue	Mitigation action	Timing	Responsibility
Fencing and flagging	Unauthorised vehicles and personnel entering the wetland.	Flagging and or temporary fencing to be installed along the western boundary of the revegetation boundary (Figure 2) to prevent vehicle and personnel access.	Pre-construction and during construction	Site manager
Dieback Control		Ensure topsoil and mulch is free from dieback	Prior to entering site	Landscape contractor

Parameter	Management issue	Mitigation action	Timing	Responsibility
	Limit the potential risk of introduction and spread of dieback on site	All machinery will be washed down with water and appropriate reagent. The disturbance of soil will not proceed past the revegetation boundary.	Prior to vehicles entering site	Site manager
		Plants or mulch used in the revegetation works onsite are to be from a dieback free source.	During revegetation works	Revegetation contractor under supervision of environmental consultant and site owner.
		Personnel to the revegetation areas are to ensure that their equipment (including footwear) is free of mud and soil.	During and post construction	Site manager
Dust	Dust generated on site from earthwork activities	Availability of water cart and spraying of Hydro mulching	When required during construction	Site manager / contractor
Erosion	Controlled movement of soil on site	Hydromulch or application of jute matting.	When required	Site manager / contractor

3.2 Bushfire

A Bushfire Management Plan (Strategen 2017) has been prepared to support the residential subdivision of the project area, which specifies 'low-threat' areas in the vicinity of future dwellings to ensure that future life and property assets are not exposed to an unacceptable level of radiant heat flux. Reduced planting densities are required in these areas of POS to ensure compliance with the BMP. As such these areas have been excluded from revegetation works, and will be landscaped to a 'low-threat' standard in accordance with AS3959.

The increase in residential density associated with the proposed development may result in an increased incidence of bushfire. As such, bushfire protection measures are proposed to be put in place to ensure that the risk of bushfire is appropriately managed. The management measures outlined in the BMP (Strategen 2017) include:

- ensuring that the entire development (excluding revegetation areas) is developed and maintained to a 'low-threat' standard in accordance with AS3959
- providing appropriate separation and interface treatments between proposed lots and revegetation areas (i.e. roads and 'low-threat' POS areas)
- providing adequate water supply for firefighting purposes to the development
- ensuring dwellings are constructed with increased construction standards in accordance with their assigned BAL rating
- providing adequate vehicular access to firefighting vehicles, and egress to future residents, in the event of a bushfire.

The measures listed above should assist in reducing the incidence and severity of a bushfire adjacent to the site, and will be implemented in accordance with the endorsed BMP.

3.3 Access

A DUP will be constructed between the Dry Land and Wetland planting zones, along the edge of the mapped CCW boundary, as shown indicatively in Figure 6 . The DUP will be constructed to be compliant with the Austroad standards for DUP (Dual use paths – Austroads Part 14 (bicycles), AS 1742, AS2809.3, AS2156.1, and AS2156.2) and in accordance with DBCA specifications.

The DUP will go around the western side of the drainage sump at Lot 91. The sump outlet will use culverts, a bridge, or other suitable infrastructure, to account for potential high flows following large rainfall events.

3.4 Fauna management

No fauna have been identified to occur on-site, however, the adjacent wetland may act as an ecological corridor in association with the YRP and native fauna may reside in the adjacent wetland area.

Construction activities will be managed to avoid any potential impacts on fauna through the measures outlined in Table 3 below.

Table 3: Fauna management actions

Parameter	Action	Timing	Responsibility
Induction	All construction staff shall be made aware of the potential for impacts to fauna and how to avoid potential impacts. The fauna induction program will implement a procedure for dealing with animals injured on-site.	Prior to commencing work on site	Site manager
Earthworks / construction	Construction of the DUP which delineates the Dry Land and Wetland buffer areas.	In accordance with engineering schedule	Developer
	Ensure any domestic/ security lighting faces away from created/ rehabilitated fauna habitat (where possible).	In accordance with engineering schedule	Developer
	Regular clean-up of rubbish and general waste will occur regularly on-site during construction.	During construction	Site manager
	Staff and contractors will be required to report any witnessed death or injury of any fauna to the site manager.	During construction	All personnel
Environmental incident reporting	Any fauna deaths or injuries will be recorded including date of death and reason (if known).	During Construction	Site manager
Investigate and rectify	Site manager to investigate the cause of any death or injury to native fauna and ensure that appropriate mitigation measures are put in place to prevent further incidents.	During Construction	Site manager

Earthworks/ development activities will not proceed past the eastern extent of the revegetation boundary, and therefore will not interfere with the ecological linkage of the chain of wetlands within the YRP.

3.5 Community awareness and education

Educational signage can be installed along the dual use path to inform the general public about the importance of the revegetated wetland buffer in protecting and enhancing the wetland values (as required). Other information on the signage will aim to inform the public about local native flora and fauna species used in the revegetation, and the roles they play in the Yellagonga Regional Park ecosystem. Signage can be developed in conjunction with the Landscape Management Plan and in accordance with any requirements of the CoW and DBCA.

3.6 Rehabilitation works

As part of the subdivisional works, the 'Revegetation Work Area' identified in the overarching Wetland Management and Rehabilitation Strategy (Cardno 2009) will be rehabilitated and landscaped in accordance with the information below.

The revegetation works will include the establishment of a 'Dry Land' area, a 'Wetland Buffer' area, and Bioretention Swale comprising three vegetation types (see Figure 6). These are:

- Zone A-*Melaleuca rhaphiophylla/ Eucalyptus rudis* forest

- Zone B- *Melaleuca rhaphiophylla* wetland transition zone
- Zone C- *Baumea* sp. sedgeland.

The implementation of the rehabilitation works will be undertaken in three different stages:

- weed control program
- revegetation involving the installation of tubestock (or seeding where appropriate)
- maintenance and monitoring program (3 years).

Figure 6: Revegetation planting zones

Scale 1:2,250 at A4

0 25 50 75

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 17/02/2020
Author: vdinh
Source: Existing cadastre: SLIP, landgate 2016.

Legend

- Study area
- Cadastre
- Design layout
- Indicative DUP

Planting zone

- Vegetation Type A - *Melaleuca Rhaphiophylla / Eucalptus Rudis* Forest
- Vegetation Type B - Wetland Transition Zone
- Vegetation Type C Sedgeland

strategen ENVIRONMENTAL
info@strategen.com.au
www.strategen.com.au

Path: W:\Strategen\GIS\Consult\2017\PDE\PDE17551\01_GIS_documents\ArcMap_documents\PDE17551_G006_RevB.mxd

3.6.1 Weed control

The site has been historically cleared of native vegetation and is currently heavily infested with weeds, namely Typha. One declared plant was identified in the wetland buffer area of the SP64 are, 'the one leafed cape tulip' (*Moraea flaccid*). If encountered, this species along with all other non-native vegetation will be removed from within the POS and rehabilitation areas.

Weed control will be undertaken in accordance with methods outlined in the WMRS including manual removal and/ or chemical control with bio-wise glyphosate or equivalent.

In accordance with the CoW (2016:6) manual removal should be undertaken when:

- weed species occur within 10cm of planted tubestock or retained vegetation.
- weed species are about to go to seed.

When the above is not viable, herbicide application (Maintenance spraying or brush cutting) will be undertaken by a licenced contractor within the rehabilitation areas.

Targeted weed control shall be undertaken prior to and after planting, as required, where weed species comprise more than 20% ground cover and should continue for the three-year maintenance period.

To prevent excessive weed growth the time of subsequent applications will need to be assessed twice each during autumn and winter and then once each during spring and summer. Each weed species will be selectively targeted utilising the most appropriate method to control the species. Weed management will be undertaken as described in Table 4.

As outlined in Section 2.5, the site is located within a Priority 3 Public Drinking Water Source area. Herbicide use in proclaimed drinking water catchment areas are subject to control (Department of Health 2017). Application of herbicides in these areas will be undertaken in accordance with the WMRS and *PSC 88: Use of herbicides in water catchment areas* (PSC 88; Department of Health (2006); Appendix 2).

Table 4: Weed management actions

Parameter	Action	Timing	Responsibility
Weed control and mulching	Remove surface weeds through spraying using chemicals permitted in accordance with PSC 88 and the WMRS.	Prior to planting and prior to weeds going to seed.	Licenced weed contractor
	Mechanically undertake scalping of top 10 cm of soil (no deeper)	Prior to planting and following herbicide spraying,	Site contractor
	Mechanically remove and mulch large woody weeds (trees and shrubs) and any native trees or shrub which are not proposed to be retained.	Prior to rehabilitation and prior to weeds going to seed.	Licenced weed / landscape contractor
Weed monitoring and maintenance	Undertake weed inspections.	April, May, July, August, October and January until handover to CoW	Landscape contractor
	Remove all woody weeds.	As required following inspection	Landscape contractor
	Undertake selective weed control utilising methods appropriate to the species, in accordance with the WMRS.	As required following inspection	Landscape contractor

3.6.2 Planting

Although not expected to be required due to the sandy nature of the soils, deep ripping will be undertaken to 'loosen' the soil profile prior to planting.

The wetland buffer rehabilitation area will be planted in accordance with the zones depicted in Figure 6. Species planted in each zone will include:

***Zone A- Melaleuca rhaphiophylla/ Eucalyptus rudis* forest** comprising:

- *Eucalyptus rudis* (Flooded Gum)
- *Melaleuca rhaphiophylla* (Swamp Paperbark)
- *Melaleuca teretifolia*
- *Melaleuca thymoides* (Sand Wattle Myrtle)
- *Rhagodia baccata* (Berry Saltbush)
- *Viminaria juncea*
- *Hemiandra pungens* (Snakebush)
- *Conostylus juncea*
- *Kennedia prostrata* (Scarlet Runner)
- *Acacia saligna*
- *Jacksonia furcellata*
- *Banksia attenuata*
- *Banksia ilicifolia*
- *Banksia littoralis*
- *Dianella revoluta*
- *Exocarpos sparteus*
- *Myoporum caprarioides*

Zone B- *Melaleuca rhaphiophylla* wetland transition zone comprising:

- *Melaleuca rhaphiophylla* (Swamp Paperbark)
- *Baumea juncea* (Bare Twigrush)
- *Baumea preissii*
- *Baumea juncea*
- *Bolboschoenus caldwellii* (Marsh Club-Rush)
- *Carex appressa* (Tall Sedge)
- *Carex fascicularis* (Tassel Sedge)
- *Centella asiatica*

Zone C- Sedgeland comprising:

- *Baumea articulata*
- *Baumea juncea*
- *Schoenoplectus validus*

Species used have been selected on the basis of the WMRS, species used on surrounding developments, and advice from the City/ DBCA.

Revegetation techniques will be based on the WMRS and shall include:

- planting of tubestock (sourced from the nursery of Friends of Yellagonga or other NIASA accredited nurseries) as the primary means of revegetation.
- the use direct seeding as an alternative, where appropriate, in areas that are relatively free of weeds
- application of ‘Biowise’ (or approved equivalent) mulch, which is certified as being weed and pathogen (dieback) free

- if tubestock is at risk of grazing by pests (i.e. rabbits), install tree guards for protection.

The planting densities proposed for the different planting zones are outlined in Section 3.7. These have been adapted from the WMRS (Cardno 2009). Note that irrigation is not proposed within the rehabilitation areas, if watering is required this will be undertaken via a water irrigation truck for spot watering.

To facilitate planting establishment, planting will take place in late autumn/early winter and supplementary infill planting (if required) will be undertaken the following year in late autumn/early winter. Tubestock will also be watered before transport to the site, to reduce the risk of mortality during/after planting.

Rehabilitation and landscaping management actions are summarised in Table 5.

Table 5: Rehabilitation and landscaping maintenance actions

Action	Timing	Responsibility
Source dieback free tubestock from the nursery of Friends of Yellagonga and/or Nursery NIASA accredited nurseries.	Prior to rehabilitation (at least 6 months prior)	Landscape contractor
Deep rip soil to 'loosen' for planting	If required, prior to planting	Landscape contractor
Plant tubestock/ seedlings (pre-watered treated)	Late autumn to winter	Landscape contractor
Place dieback and weed free mulch over areas of Dry Land and Wetland vegetation to prevent weed growth. Mulch will not be placed in the bioretention swale area.	As part of rehabilitation planting	Landscape contractor
Install tree guards to prevent against rabbits.	As required	Landscape contractor
Spot water tubestock over the summer period	As required	Landscape contractor

3.7 Monitoring and assessment

Monitoring of the revegetation areas will be undertaken in Spring each year and will involve the establishment of quadrats (5m x5m) in areas which provide a good representation of the revegetation progress (i.e. one quadrat in C-Dry land vegetation (Melaleuca Rhaphiophylla / Eucalyptus Rudis Forrest), E-Bioretention Swale (Sedgeland) and D-Wetland Buffer Vegetation (Wetland transition zone). Quadrat location will be GPS and recorded for future reference if needed

Quadrats will be assessed against the completion criteria, and monitoring will identify areas where improvement is required.

Weed invasion will be assessed in terms of:
- Dominant species
- Area covered by dominant species
- Total percentage cover

Vegetation monitoring will include monitoring of:
- Area cover of native species (% cover)
- Native species present
- Representation in quadrats of the initial species list.

Where areas of the rehabilitation works do not meet the completion criteria specified above, additional tubestock/ seedlings will be planted, watering, or weed control conducted so completion criteria can be met.

Inherent risks are associated with any rehabilitation programs which may lead to the required completion criteria not been met. To manage this level of risk, a framework of contingency measures has been developed to improve the likelihood that the completion criteria for all components of the offset package can be achieved within the maintenance period.

3.7.1 Completion criteria

Completion criteria for landscaping and rehabilitation are outlined in Table 6.

Table 6. Completion criteria for each planting zone

Vegetation planting zone	Planting density	Completion criteria
Zone A- Dry land vegetation	1 plant/m^2	0.75 established plants/m^2 Weeds are effectively controlled with weed species comprising less than 20% of the groundcover
Zone B - Wetland buffer vegetation	4-6 plants/10m^2 (shrub/tree species) 5-8 plants /m^2 (rush/sedge species)	4 plants / 10m^2 (shrub/tree species) 5 plants /m^2 (rush/sedge species) Rush/sedge species are established with an average projective foliage cover of 50% and/or at a rate of 5 plants per m^2 and have a diversity of at least 4 species per 10 m^2 over at least 70% of the area planted Weeds are effectively controlled with weed species comprising less than 20% of the groundcover
Zone C - Sedgeland	6-8 plants/m^2	6-8 plants/m^2 Weeds are effectively controlled with weed species comprising less than 20% of the groundcover
All	N/A	All species planted are to be represented.

3.7.2 Contingency actions

Monitoring of revegetation after completion of revegetation works may determine whether additional management measures are required to aid vegetation establishment such as weed control, watering, infill planting or pest management.

Contingency actions will be enacted as outlined in Table 7, if monitoring and reporting indicates that rehabilitation sites are not achieving completion criteria. These actions will be undertaken as soon as practical and the outcome assessed and documented in the following annual report.

Table 7: Contingency actions

Trigger	Action
>20 % cover of exotic/ weed species growing in rehabilitation areas	1. Remove/ spray weeds 2. Identify any additional specific actions which may assist with weed removal/ prevention.
Low rate of plant survival (less than density completion criteria)	1. Identify cause. 2. Implement approach to remedy cause, which could include: • watering • application of fertilisers or wetting agents etc • replanting • replacement of tree guards • pest control • installation of signage 3. Monitor success of remedy.

3.8 Reporting

During the three-year monitoring period, Annual monitoring reporting reports will be provided to CoW including the following information for that reporting period:

- survey quadrat data
- revegetation species density and diversity
- weed species density and diversity
- details of any contingency actions undertaken
- status of planting zones in comparison to completion criteria.
- weed control reports and inspections for that year.
- planting lists.

Reports will be provided by 31st January, following the Spring monitoring event.

3.9 Timeframe

This WDMP will be implemented by the proponent within four years, which includes one year for weed control and revegetation and three years for maintenance and monitoring of the wetland buffer areas. All contractors and staff will be required to operate in accordance with this WDMP. Some actions will be required to be implemented during the construction phase of the project and others will be ongoing post-construction.

Following implementation of the revegetation and monitoring (3 year) program the area including the wetland buffer area, up to and including the dual use path (DUP) will be transferred to the CoW (where the completion criteria have been met). The area to the west of the DUP will be handed over to the Department of Biodiversity, Conservation and Attractions for ongoing management (where the completion criteria have been met).

3.10 Rehabilitation implementation schedule

The indicative implementation schedule for the rehabilitation works is provided below in Table 8.

Table 8: Indicative implementation schedule

Action	2018 (Year 1)				2019 (Year 2)				2020 (Year 3)			Post 2020
	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	
Source tubestock/ seedlings												
Initial weed control												
Mulching												
Scalping of Soil												
Planting of tubestock												
Formal quadrat monitoring												
Monitoring to determine if additional weed control is required.												Where completion criteria have not been met.
Maintenance weed control (as required)												
Maintenance watering and/or mulching												
Maintenance planting												

Action	2018 (Year 1)			2019 (Year 2)				2020 (Year 3)				Post 2020
	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	
Reporting											Final handover to CoW	

4. References

Bamford Consulting Ecologists 2010, *Level 1 Fauna Assessment of Chianti Private Estate*, Wanneroo Rd, Woodvale. Prepared for Cardno Pty Ltd.

Bureau of Meteorology (BOM) 2017. *Monthly mean maximum temperature: Hillarys Boat Harbour NTC AWS*. Government of Western Australia. Available at: http://www.bom.gov.au/jsp/ncc/cdio/wData/wdata?p_nccObsCode=36&p_display_type=dataFile&p_stn_num=009265

Bureau of Meteorology (BOM) 2017a, Monthly rainfall: Wanneroo . Government of Western Australia. Available at: http://www.bom.gov.au/jsp/ncc/cdio/wData/wdata?p_nccObsCode=139&p_display_type=dataFile&p_stn_num=009105.

Cardno 2006. *Wetland Boundary Review and Management Category Re-evaluation – Wetland 8168 Woodvale*. Prepared for Watson Property Group Northern Aspects Ltd.

Cardno 2009, Structure Plan 64: Wetland Management and Rehabilitation Strategy, Cardno, Perth.

Cardno, 2010. *Flora and Vegetation Survey*. Prepared for Watson Property Group Northern Aspects Ltd.

Cardno 2010a. *Wetland Management Plan Stage1*. Prepared for Watson Property Group Northern Aspects Ltd.

Cardno 2010b. *Urban Water Management Plan*. Unpublished report prepared for Watson Property Group Northern Aspects Ltd.

Cardno 2011, Chianti Private Estate Stage 2, 3 and 4 Wetland Management Plan.

Cardno. 2007. Preliminary Site Investigation, Woodvale. Prepared for Watson Property Group Northern Aspects Ltd.

City of Wanneroo (2016) WD 13A: *Public Open Space Landscape Design Specification*. May. City of Wanneroo, Perth.

Conservation and Land Management (CALM) (2002). Yellagonga Regional Park Management Plan 2003-2013. Government of Western Australia. Available at: *https://www.dpaw.wa.gov.au/images/documents/parks/management-plans/decarchive/yellagonga_rp_mp.pdf*.

Department of Fire and Emergency Services (DFES) 2017, *Map of Bush Fire Prone Areas*, [Online], Government of Western Australia, available from: *http://www.dfes.wa.gov.au/regulationandcompliance/bushfireproneareas/Pages/default.aspx*.

Department of Health 2017, *Drinking water catchment management.* Accessed via: *http://ww2.health.wa.gov.au/Articles/A_E/Drinking-water-catchment-management*, 04/01/2018).

Department of Parks and Wildlife (DPAW) 2016, *Geomorphic Wetlands of the Swan Coastal Plain* dataset, Government of Western Australia, Perth.

Department of Planning and Infrastructure (DPI) 2000. Bush Forever volume 1: policies, principles and processes. Government of Western Australia. Available at: *http://www.planning.wa.gov.au/dop_pub_pdf/bush_forever_vol1.pdf*.

Department of Planning, Lands and Heritage (DPLH) 2017, *Aboriginal Heritage Inquiry System*, Government of Western Australia. Available via: https://maps.daa.wa.gov.au/ahis/.

Department of Water and Environment Regulation 2017, *Perth Groundwater Map,* Government of Western Australia, Perth. Available via: *https://maps.water.wa.gov.au/#/webmap/gwm*.

Department of Water and Environment Regulation (DWER) 2018, *Contaminated Sites Database,* Government of Western Australia, Perth. Available via: https://dow.maps.arcgis.com/apps/webappviewer/index.html?id=c2ecb74291ae4da2ac32c441819c6d47

Environmental Protection Authority (EPA), 2004, *EPA Guidance Statement No. 51 – Terrestrial flora and vegetation survey environmental impact assessment in Western Australia*, Government of Western Australia, Perth.

Environmental Protection Authority (EPA), 2004a, *EPA Guidance Statement No. 56 – Terrestrial fauna survey for environmental impact assessment in Western Australia*, Government of Western Australia, Perth.

Gozzard J. R., 1986, *Perth, Sheet 2034 II and part 2034 III and 2134 III. Perth Metropolitan Region Environmental Geology Series*, Geological Survey of WA.

Standards Australia (SA) 2009, *Australian Standard AS 3959–2009 Construction of Buildings in Bushfire-prone Areas*, Standards Australia, Sydney.

State Heritage Office (SHO) 2017, *InHerit* search tool, Government of Western Australia, Perth. Available via: http://inherit.stateheritage.wa.gov.au/Public/.

Strategen Environmental (Strategen) 2017, Bushfire Management Plan: *Lots 32, 83, 90 & 91 Wanneroo Road, Woodvale*. Unpublished report prepared for Watson Property Group Northern Aspects Ltd.

Western Australian Planning Commission (WAPC) 2015, *State Planning Policy 3.7 Planning in Bushfire-Prone Areas*, Western Australian Planning Commission, Perth.

Western Australian Planning Commission (WAPC) 2017, *Guidelines for Planning in Bushfire-Prone Areas*, Western Australian Planning Commission, Perth.

Appendix 1
Subdivision approval

Your Ref : 204

Dynamic Planning And Developments Pty Ltd
Po Box 688
INGLEWOOD WA 6932

Approval Subject To Condition(s)
Survey-Strata Plan

Application No : 443-17

Planning and Development Act 2005

Applicant	:	Dynamic Planning And Developments Pty Ltd Po Box 688 INGLEWOOD WA 6932
Owner	:	Progress Developments Pty Ltd Po Box 204 HILLARYS WA 6923
Application Receipt	:	8 May 2017

Lot Number	:	83
Diagram / Plan	:	Diagram 70131
Location	:	-
C/T Volume/Folio	:	2097/613
Street Address	:	Wanneroo Road, Woodvale
Local Government	:	City of Wanneroo

The Western Australian Planning Commission has considered the application referred to and is prepared to endorse a survey-strata plan in accordance with the plan date-stamped **08 May 2017** once the condition(s) set out have been fulfilled.

This decision is valid for **four years** from the date of this advice, which includes the lodgement of the survey-strata plan within this period.

The survey-strata plan for this approval and all required written advice confirming that the requirement(s) outlined in the condition(s) have been fulfilled must be submitted by **13 October 2021** or this approval no longer will remain valid.

Reconsideration - 28 days

Under section 151(1) of the *Planning and Development Act 2005*, the applicant/owner may, within 28 days from the date of this decision, make a written request to the WAPC

to reconsider any condition(s) imposed in its decision. One of the matters to which the WAPC will have regard in reconsideration of its decision is whether there is compelling evidence by way of additional information or justification from the applicant/owner to warrant a reconsideration of the decision. A request for reconsideration is to be submitted to the WAPC on a Form 3A with appropriate fees. An application for reconsideration may be submitted to the WAPC prior to submission of an application for review. Form 3A and a schedule of fees are available on the WAPC website: http://www.planning.wa.gov.au

Right to apply for a review - 28 days

Should the applicant/owner be aggrieved by this decision, there is a right to apply for a review under Part 14 section 251 of the *Planning and Development Act 2005*. The application for review must be submitted in accordance with part 2 of the *State Administrative Tribunal Rules 2004* and should be lodged within 28 days of the date of this decision to: the State Administrative Tribunal, Level 6, State Administrative Tribunal Building, 565 Hay Street, PERTH, WA 6000. It is recommended that you contact the tribunal for further details: telephone 9219 3111 or go to its website: http://www.sat.justice.wa.gov.au

Survey-strata plan

The survey-strata plan is to be submitted to the Western Australian Land Information Authority (Landgate) for certification. Once certified, Landgate will forward it to the WAPC. In addition, the applicant/owner is responsible for submission of a Form 1C with appropriate fees to the WAPC requesting endorsement of the survey-strata plan. A copy of the survey-strata plan with confirmation of submission to Landgate is to be submitted with all required written advice confirming compliance with any condition(s) from the nominated agency/authority or local government. Form 1C and a schedule of fees are available on the WAPC website: http://www.planning.wa.gov.au

Condition(s)

The WAPC is prepared to endorse a survey-strata plan in accordance with the plan submitted once the condition(s) set out have been fulfilled.

The condition(s) of this approval are to be fulfilled to the satisfaction of the WAPC.

The condition(s) must be fulfilled before submission of a copy of the survey-strata plan for endorsement.

The agency/authority or local government noted in brackets at the end of the condition(s) identify the body responsible for providing written advice confirming that the WAPC's requirement(s) outlined in the condition(s) have been fulfilled. The written advice of the agency/authority or local government is to be obtained by the applicant/owner. When the written advice of each identified agency/authority or local government has been obtained, it should be submitted to the WAPC with a Form 1C and appropriate fees and

a copy of the survey-strata plan.

If there is no agency/authority or local government noted in brackets at the end of the condition(s), a written request for confirmation that the requirement(s) outlined in the condition(s) have been fulfilled should be submitted to the WAPC, prior to lodgement of the survey-strata plan for endorsement.

Prior to the commencement of any subdivision works or the implementation of any condition(s) in any other way, the applicant/owner is to liaise with the nominated agency/authority or local government on the requirement(s) it considers necessary to fulfil the condition(s).

The applicant/owner is to make reasonable enquiry to the nominated agency/authority or local government to obtain confirmation that the requirement(s) of the condition(s) have been fulfilled. This may include the provision of supplementary information. In the event that the nominated agency/authority or local government will not provide its written confirmation following reasonable enquiry, the applicant/owner then may approach the WAPC for confirmation that the condition(s) have been fulfilled.

In approaching the WAPC, the applicant/owner is to provide all necessary information, including proof of reasonable enquiry to the nominated agency/authority or local government.

The condition(s) of this approval, with accompanying advice, are:

CONDITION(S):

1. Prior to the Western Australian Planning Commission's endorsement of a diagram or plan of survey (deposited plan) for the creation of the lots proposed by this application, the lot that is the subject of this application being created on a separate diagram or plan of survey (deposited plan) and the plan being endorsed by the Western Australian Planning Commission. (Western Australian Planning Commission)

2. The proposed access way(s) being constructed and drained at the landowner/applicant's cost to the specifications of the local government. (Local Government)

3. Information is to be provided to demonstrate that the measures contained in the Bushfire Management Plan for Lots 32, 83, 90 and 91 Wanneroo Road, Woodvale prepared by Strategen (dated September 2017) have been implemented during subdivisional works. (Local Government)

4. A Notification, pursuant to Section 165 of the *Planning and Development Act 2005* is to be placed on the certificate(s) of title of the proposed lot(s) with a Bushfire Attack Level (BAL) rating of 12.5 or above, advising of the existence of

a hazard or other factor. Notice of this notification is to be included on the diagram or plan of survey (deposited plan). The notification is to state as follows:

'This land is within a bushfire prone area as designated by an Order made by the Fire and Emergency Services Commissioner and may be subject to a Bushfire Management Plan. Additional planning and building requirements may apply to development on this land' (Western Australian Planning Commission)

5. A Notification, pursuant to Section 165 of the *Planning and Development Act 2005* are to be placed on the certificate(s) of title of the proposed lot(s) advising of the existence of a hazard or other factor. Notice of this notification is to be included on the diagram or plan of survey (deposited plan). The notification is to state as follows:

   a) *'This lot is in close proximity to known mosquito breeding areas. The predominant mosquito species is known to carry viruses and other diseases.'*

   b) *'There is a risk of peat fires associated with the nearby wetland (Yellagonga Regional Park).'*

   c) *'the amenity of this lot may be affected by the presence of midges from adjoining wetland'.* (Western Australian Planning Commission)

6. Pursuant to Section 150 of the *Planning and Development Act 2005* and Division 3 of the *Planning and Development Regulations 2009* a covenant preventing vehicular access onto the primary road being lodged on the certificate(s) of title of the proposed lot(s) 60 to 65 and 71 at the full expense of the landowner/applicant. The covenant is to prevent access, to the benefit of the City of Wanneroo, in accordance with the plan dated 8 May 2017 (attached) and the covenant is to specify:

   'No vehicular access is permitted from the primary road.' (Local Government)

7. A restrictive covenant, to the benefit of the Local Government pursuant to Section 129BA of the *Transfer of Land Act 1893* is to be placed on the certificates of title of the proposed lots advising of the existence of a restriction on the use of land. Notice of this restriction is to be included on the diagram or plan of survey (deposited plan). The Restrictive Covenant is to state as follows:

   'The sinking of domestic groundwater bores is prohibited.' (Local Government)

8. Uniform fencing being constructed along the boundaries of the proposed lots and the common property abutting the public open space areas. (Local Government)

9. Local Development Plans being prepared and approved for all lots shown on the plan survey-strata plan to address the following:

a) Appropriate fencing abutting the public open space areas;
b) Dwellings to orientate towards and provide passive surveillance to areas of public open space areas;
c) Location of garages and/or carports;
d) Location of visitor bays; and
e) Height and length of boundary walls;

to the satisfaction of the Western Australian Planning Commission. (Local Government)

10. The landowner/applicant shall make arrangements to ensure that prospective purchases of lots subject of a Local Development Plan are advised in writing that Local Development Plan provisions apply. (Local Government)

11. Suitable arrangements being made with the local government for the provision of vehicular crossover(s) and bin pads to service the lot(s) shown on the approved plan of subdivision. (Local Government)

12. Engineering drawings and specifications are to be submitted and approved, and subdivisional works undertaken in accordance with the approved plan of subdivision, engineering drawings and specifications to ensure that:

a) Visitor embayment parking is provided on Rosso Meander abutting the proposed lots, in accordance with the Residential Design Codes;

to the satisfaction of the Western Australian Planning Commission. (Local Government)

13. The portion of proposed Lot 60 is to be excluded from the application as shown in the plan dated 8 May 2017 (attached). (Local Government)

14. Arrangements being made to the satisfaction of the Western Australian Planning Commission and to the specification of Western Power, for the provision of an electricity supply to the survey- strata lots shown on the approved plan of subdivision, which may include the provision of necessary service access rights either as an easement under Section 136C and Schedule 10 of the *Transfer of Land Act 1893* for the transmission of electricity by underground cable, or (in the case of approvals containing common property) via a portion of the common property suitable for consumer mains. (Western Power)

15. The transfer of land as a Crown reserve free of cost to Western Power for the provision of electricity supply infrastructure. (Western Power)

16. Arrangements being made with the Water Corporation so that provision of a suitable water supply service will be available to the lots shown on the approved plan of subdivision. (Water Corporation)

140 William Street, Perth, Western Australia 6000, Locked Bag 2506 Perth, 6001
Tel: (08) 6551 8002; Fax: (08) 6551 9001; Infoline: 1800 626 477
e-mail: info@dplh.wa.gov.au; web address http://www. dplh.wa.gov.au
ABN 35 482 341 493

17. Arrangements being made with the Water Corporation so that provision of a sewerage service will be available to the lots shown on the approved plan of subdivision. (Water Corporation)

18. Prior to commencement of subdivision works, investigation for soil and groundwater contamination is to be carried out to determine if remediation is required. If required, remediation, including validation of remediation, of any contamination identified shall be completed prior to the issuing of titles to the satisfaction of the Western Australian Planning Commission on advice from the Department of Water and Environment Regulation, to ensure that the lots created are suitable for the proposed use. Investigations and remediation are to be carried out in compliance with the *Contaminated Sites Act 2003* and current Department of Environment Regulation Contaminated Sites Guidelines. (Department of Water and Environment Regulation)

19. An acid sulphate soils self-assessment form and, if required as a result of the self-assessment, an acid sulphate soils report and an acid sulphate soils management plan shall be submitted to and approved by the Department Water of Environment Regulation before any subdivision works or development are commenced. Where an acid sulphate soils management plan is required to be submitted, all subdivision works shall be carried out in accordance with the approved management plan. (Department of Water and Environment Regulation)

ADVICE:

1. In regard to Condition 14, Western Power provides only one underground point of electricity supply per freehold lot.

2. In regard to Conditions 16 and 17, the landowner/applicant shall make arrangements with the Water Corporation for the provision of the necessary services. On receipt of a request from the landowner/applicant, a Land Development Agreement under Section 83 of the *Water Services Act 2012* will be prepared by the Water Corporation to document the specific requirements for the proposed subdivision.

3. In regard to Conditions 14, 16 and 17, it is the Commission's expectation that each strata lot be provided with its own suitable utility service connection, which is protected by easements where necessary. This is to ensure that each strata lot is development ready and does not result in the need to extend the services over adjacent strata lots after titles have been created.

4. In regard to Condition 18 and in accordance with regulation 31(1)(c) of the Contaminated Sites Regulations 2006, a Mandatory Auditor's Report, prepared by an accredited contaminated sites auditor, will need to be submitted to the Department of Water and Environmental Regulation as evidence of compliance with Condition 19. A current list of accredited auditors is available from.

5. Condition 19 makes reference to an 'acid sulphate soils self-assessment form'. This form can be downloaded from the Western Australian Planning Commission's website at:.

The 'acid sulphate soils self-assessment form' makes reference to the Department of Water and Environmental Regulation's 'Identification and Investigation of Acid Sulphate Soils' guideline. This guideline can be obtained from the Department of Water and Environmental Regulation's website at:.

Kerrine Blenkinsop
Secretary
Western Australian Planning Commission
13 October 2017

Enquiries : Alex Campbell (Ph 6551 9183)

140 William Street, Perth, Western Australia 6000, Locked Bag 2506 Perth, 6001
Tel: (08) 6551 8002; Fax: (08) 6551 9001; Infoline: 1800 626 477
e-mail: info@dplh.wa.gov.au; web address http://www. dplh.wa.gov.au
ABN 35 482 341 493

SUBJECT TO SEPARATE
GREEN TITLE SUBDIVISION
5.05ha

91
1.4491ha
EXISTING DRAINAGE
BALANCE LOT

SUBJECT TO SEPARATE
GREEN TITLE SUBDIVISION
1.1528ha

PUBLIC OPEN SPACE

6m C.P.
297m²

1m wide pedestrian path

83
1.3881ha

33
32
1.7367ha
90
4812m²
91 PAW
808
26
27

ROSSO
DOLCETTO WAY
COSIMO
DRIVE
MEANDER
CLARET (13m) LOOP
CLARET (15m) LOOP
ROAD
WANNEROO ROAD
OVERHEAD POWER EASEMENT
INTERIM LEFT-IN
INTERIM LEFT-OUT
LEFT TURN ONLY FROM LANEWAY

260.1
224.1
204.7
178.1
69.0
83.0

168m² (x6)
176m² (x4)
164m² (x1)
178m² (x1)

TRAFFIC LIGHT
POWER POLE
SIGN
STAY POLE
BOLLARD
DRAINAGE MH
SHED
Water Tank
GAS VALVE
BUS STOP
LIGHT POLE
PINE
OLIVE TREE
CYCLONE FENCE
METER BOX POLE
BORE

DEPARTMENT OF PLANNING
DATE 08-May-2017
FILE 443-17

NOTES:
1. Areas and dimensions subject to survey.
2. Carriageways diagrammatic only.
3. All existing improvements to be demolished.

LOT SUMMARY
Application Area: 1.3881ha
Green Title Lots: 1.1528ha
No. of Lots: 1 - Subject to Separate Subdivision
Survey Strata Lots:
No. of Lots: 12
Mimimum Lot Area: 164m²
Average Lot Area: 171m²

Refer to Condition 6 - No Vehicle Access

Refer to Condition 8 - Uniform Fencing

Refer to Condition 9 - Lot subject to LDP

Refer to Condition 13 - Portion of Lot 60 to be excluded from the application

PROPOSED SURVEY STRATA SUBDIVISION

CHIANTI PRIVATE ESTATE
LOT 83 (No. 473) WANNEROO ROAD
WOODVALE

Urban Development Institute of Australia WESTERN AUSTRALIA

Planning Institute Australia

CPP CERTIFIED PRACTISING PLANNER

SCALE: 1:1000 @ A3
DATE: 11th MAY 2017
FILE: 204_11.05.2017.dwg
DRAW: - SB
CHECKED: -

e: admin@dynamicplanning.net.au
t: (08) 9275 4433
f: (08) 9275 4455
m: 0431-111-659
SUITE 15, 29 COLLIER ROAD
MORLEY WA 6062
ABN: 99 169 411 705

DYNAMIC PLANNING AND DEVELOPMENTS

N W E S

Western Australian Planning Commission

Your Ref : 204

Dynamic Planning And Developments Pty Ltd
Po Box 688
INGLEWOOD WA 6932

Approval Subject To Condition(s)
Freehold (Green Title) Subdivision

Application No : 155158

Planning and Development Act 2005

Applicant	:	Dynamic Planning And Developments Pty Ltd Po Box 688 INGLEWOOD WA 6932
Owner	:	City Of Wanneroo Locked Bag 1 WANNEROO WA 6946; Progress Developments Pty Ltd Po Box 204 HILLARYS WA 6923
Application Receipt	:	8 May 2017

Lot Number	:	32, 83, 90 & 91
Diagram / Plan	:	Diagrams 58082, 30185, 508082
Location	:	-
C/T Volume/Folio	:	1576/630, 1576/635, 1581/988, 2097/613
Street Address	:	Wanneroo Road, Woodvale
Local Government	:	City of Wanneroo

The Western Australian Planning Commission has considered the application referred to and is prepared to endorse a deposited plan in accordance with the plan date-stamped **08 May 2017** once the condition(s) set out have been fulfilled.

This decision is valid for **four years** from the date of this advice, which includes the lodgement of the deposited plan within this period.

The deposited plan for this approval and all required written advice confirming that the requirement(s) outlined in the condition(s) have been fulfilled must be submitted by **13 October 2021** or this approval no longer will remain valid.

Reconsideration - 28 days

Under section 151(1) of the *Planning and Development Act 2005*, the applicant/owner

140 William Street, Perth, Western Australia 6000, Locked Bag 2506 Perth, 6001
Tel: (08) 6551 8002; Fax: (08) 6551 9001; Infoline: 1800 626 477
e-mail: info@dplh.wa.gov.au; web address http://www. dplh.wa.gov.au
ABN 35 482 341 493

may, within 28 days from the date of this decision, make a written request to the WAPC to reconsider any condition(s) imposed in its decision. One of the matters to which the WAPC will have regard in reconsideration of its decision is whether there is compelling evidence by way of additional information or justification from the applicant/owner to warrant a reconsideration of the decision. A request for reconsideration is to be submitted to the WAPC on a Form 3A with appropriate fees. An application for reconsideration may be submitted to the WAPC prior to submission of an application for review. Form 3A and a schedule of fees are available on the WAPC website: http://www.planning.wa.gov.au

Right to apply for a review - 28 days

Should the applicant/owner be aggrieved by this decision, there is a right to apply for a review under Part 14 section 251 of the *Planning and Development Act 2005*. The application for review must be submitted in accordance with part 2 of the *State Administrative Tribunal Rules 2004* and should be lodged within 28 days of the date of this decision to: the State Administrative Tribunal, Level 6, State Administrative Tribunal Building, 565 Hay Street, PERTH, WA 6000. It is recommended that you contact the tribunal for further details: telephone 9219 3111 or go to its website: http://www.sat.justice.wa.gov.au

Deposited plan

The deposited plan is to be submitted to the Western Australian Land Information Authority (Landgate) for certification. Once certified, Landgate will forward it to the WAPC. In addition, the applicant/owner is responsible for submission of a Form 1C with appropriate fees to the WAPC requesting endorsement of the deposited plan. A copy of the deposited plan with confirmation of submission to Landgate is to be submitted with all required written advice confirming compliance with any condition(s) from the nominated agency/authority or local government. Form 1C and a schedule of fees are available on the WAPC website: http://www.planning.wa.gov.au

Condition(s)

The WAPC is prepared to endorse a deposited plan in accordance with the plan submitted once the condition(s) set out have been fulfilled.

The condition(s) of this approval are to be fulfilled to the satisfaction of the WAPC.

The condition(s) must be fulfilled before submission of a copy of the deposited plan for endorsement.

The agency/authority or local government noted in brackets at the end of the condition(s) identify the body responsible for providing written advice confirming that the WAPC's requirement(s) outlined in the condition(s) have been fulfilled. The written advice of the agency/authority or local government is to be obtained by the applicant/owner. When the written advice of each identified agency/authority or local government has been

140 William Street, Perth, Western Australia 6000, Locked Bag 2506 Perth, 6001
Tel: (08) 6551 8002; Fax: (08) 6551 9001; Infoline: 1800 626 477
e-mail: info@dplh.wa.gov.au; web address http://www. dplh.wa.gov.au
ABN 35 482 341 493

obtained, it should be submitted to the WAPC with a Form 1C and appropriate fees and a copy of the deposited plan.

If there is no agency/authority or local government noted in brackets at the end of the condition(s), a written request for confirmation that the requirement(s) outlined in the condition(s) have been fulfilled should be submitted to the WAPC, prior to lodgement of the deposited plan for endorsement.

Prior to the commencement of any subdivision works or the implementation of any condition(s) in any other way, the applicant/owner is to liaise with the nominated agency/authority or local government on the requirement(s) it considers necessary to fulfil the condition(s).

The applicant/owner is to make reasonable enquiry to the nominated agency/authority or local government to obtain confirmation that the requirement(s) of the condition(s) have been fulfilled. This may include the provision of supplementary information. In the event that the nominated agency/authority or local government will not provide its written confirmation following reasonable enquiry, the applicant/owner then may approach the WAPC for confirmation that the condition(s) have been fulfilled.

In approaching the WAPC, the applicant/owner is to provide all necessary information, including proof of reasonable enquiry to the nominated agency/authority or local government.

The condition(s) of this approval, with accompanying advice, are:

CONDITION(S):

1. The plan of subdivision being modified to reflect the updated road network and lot configurations in accordance with the plan date stamped 27 September 2017 (attached) and being further updated to widen Rosso Meander road reserve to a minimum of 15m in its entirety. (Western Australian Planning Commission)

2. The landowner/applicant contributing towards development infrastructure provisions pursuant to the Woodvale Agreed Local Structure Plan No. 64. (Local Government)

3. Satisfactory arrangements being made with the local government in consultation with Main Roads Western Australia for the upgrade of the intersection of Wanneroo Road and Prindiville Drive/Rosso Meander. (Local Government)

4. Satisfactory arrangements being made with the local government for the construction of a roundabout at the intersection of Rosso Meander and Corvina Way. (Local Government)

5. Satisfactory arrangements being made with the local government in consultation with Main Roads Western Australia for the closure of the temporary left-out connection to Wanneroo Road from Claret Loop upon the first of either:

   a) the construction of the ultimate design of the Wanneroo Road and Prindiville Road/Rosso Meander intersection; or
   b) completion of the local road network to allow vehicle access onto Wanneroo Road via Solaia Loop. (Local Government)

6. The landowner/applicant shall make arrangements to ensure that prospective purchasers are advised in writing that the access to Wanneroo Road from Claret Loop will be removed upon the first of either:

   a) the construction of the ultimate design of the Wanneroo Road and Prindiville Road/Rosso Meander intersection; or
   b) completion of the local road network to allow vehicle access onto Wanneroo Road via Solaia Loop. (Local Government)

7. Uniform fencing being constructed along the boundaries of all of the proposed lots abutting the public open space and the pedestrian access way. (Local Government)

8. Engineering drawings and specifications are to be submitted, approved, and works undertaken in accordance with the approved engineering drawings, specifications and approved plan of subdivision, for grading and/or stabilisation of the site to ensure that:

   a) lots can accommodate their intended use; and
   b) finished ground levels at the boundaries of the lot(s) the subject of this approval match or otherwise coordinate with the existing and/or proposed finished ground levels of the land abutting. (Local Government)

9. Prior to the commencement of subdivisional works, an Urban Water Management Plan is to be prepared and approved, in consultation with the Department of Water and Environmental Regulation. (Local Government)

10. Engineering drawings and specifications are to be submitted and approved, and works undertaken in accordance with the approved engineering drawings and specifications and approved plan of subdivision, for the filling and/or draining of the land, including ensuring that stormwater is contained on-site, or appropriately treated and connected to the local drainage system. Engineering drawings and specifications are to be in accordance with an approved Urban Water Management Plan (UWMP) for the site, or where no UWMP exists, to the satisfaction of the Western Australian Planning Commission. (Local Government)

11. Prior to the commencement of subdivisional works, the landowner/applicant is to provide a pre-works geotechnical report certifying that the land is physically

capable of development or advising how the land is to be remediated and compacted to ensure it is capable of development. In the event that remediation works are required, the landowner/applicant is to provide a post geotechnical report certifying that all subdivisional works have been carried out in accordance with the pre-works geotechnical report. (Local Government).

12. Prior to the commencement of subdivision works a Wetland Management Plan is to be prepared and approved in consultation with the Department of Biodiversity, Conservation and Attractions to ensure the protection and management of the site's environmental assets with satisfactory arrangements being made for the implementation of the approved plan. (Local Government)

13. Measures being taken to ensure no vegetation within Bush Forever Site No. 299 is removed or disturbed during subdivisional works, including any secondary impacts from works to provide service infrastructure and drainage to implement the approved plan of subdivision and excluding vegetation disturbance required as part of Condition 12 for wetland buffer rehabilitation. (Local Government)

14. Prior to the commencement of subdivisional works a Dieback Management Plan is to be prepared and approved in consultation with the Department of Biodiversity, Conservation and Attractions to ensure the protection and management of the sites environmental assets with the satisfactory arrangements being made for the implementation of the approved plan. (Local Government)

15. Prior to the commencement of subdivisional works a Midge Management Plan is to be prepared and approved in consultation with the Department of Biodiversity, Conservation and Attractions to ensure the protection and management of the sites environmental assets with satisfactory arrangements being made for the implementation of the approved plan. (Local Government)

16. Information is to be provided to demonstrate that the measures contained in the bushfire management plan for Lots 32, 83, 90 and 91 Wanneroo Road, Woodvale prepared by Strategen (dated September 2017) have been implemented during subdivisional works. (Local Government)

17. A Notification, pursuant to Section 165 of the *Planning and Development Act 2005* is to be placed on the certificate(s) of title of the proposed lot(s) with a Bushfire Attack Level (BAL) rating of 12.5 or above, advising of the existence of a hazard or other factor. Notice of this notification is to be included on the diagram or plan of survey (deposited plan). The notification is to state as follows:

'This land is within a bushfire prone area as designated by an Order made by the Fire and Emergency Services Commissioner and may be subject to a Bushfire Management Plan.' (Western Australian Planning Commission)

18. Prior to commencement of subdivision works, investigation for soil and groundwater contamination is to be carried out to determine if remediation is required.

    If required, remediation, including validation of remediation, of any contamination identified shall be completed prior to the issuing it titles to the satisfaction of the Western Australian Planning Commission on advice from the Department of Environment and Conservation, to ensure that the lots created are suitable for the proposed use.

    Investigations and remediation are to be carried out in compliance with the Contaminated Sites Act 2003 and current Department of Water and Environment Regulation Contaminated Sites Guidelines. (Local Government)

19. Local Development Plan(s) being prepared and approved for lots shown on the plan dated 27 September 2017 (attached) that address the following:

    a) Quiet House Design in accordance with the recommendations of the Transportation Noise Assessment prepared by Lloyd George Acoustics (dated 29 January 2017 and updated 4 September 2017);

    b) Development standards for laneway lots;

    c) Bin collection for laneway lots 28-41; and

    d) Interface with the pedestrian access way

    to the satisfaction of the Western Australian Planning Commission.
    (Local Government)

20. The landowner/applicant shall make arrangements to ensure that prospective purchases of lots subject of a Local Development Plan are advised in writing that Local Development Plan provisions apply. (Local Government)

21. The proposed reserve(s) shown on the approved plan of subdivision being shown on the diagram or plan of survey (deposited plan) as reserve(s) for recreation and drainage and vested in the Crown under Section 152 of the *Planning and Development Act 2005*, such land to be ceded free of cost and without any payment of compensation by the Crown. (Local Government)

22. Arrangements being made for the proposed public open space to be developed by the landowner/applicant to a minimum standard and maintained for two summers through the implementation of an approved landscape plan providing for the development and maintenance of the proposed public open space in accordance with the requirements of Liveable Neighbourhoods and to the specifications of the local government. (Local Government)

23. Engineering drawings and specifications are to be submitted, approved, and subdivisional works undertaken in accordance with the approved plan of subdivision, engineering drawings and specifications, to ensure that those lots not fronting an existing road are provided with frontage to a constructed road(s) connected by a constructed road(s) to the local road system and such road(s) are constructed and drained at the landowner/applicant's cost.

As an alternative, and subject to the agreement of the Local Government the Western Australian Planning Commission (WAPC) is prepared to accept the landowner/applicant paying to the local government the cost of such road works as estimated by the local government and the local government providing formal assurance to the WAPC confirming that the works will be completed within a reasonable period as agreed by the WAPC. (Local Government)

24. All local streets within the subdivision being truncated in accordance with the Western Australian Planning Commission's *Liveable Neighbourhoods* policy.(Local Government)

25. The pedestrian access way(s) within the subdivision being constructed and drained at the landowner/applicant's cost and shown on the diagram or plan of survey (deposited plan) as such and vested in the Crown under Section 152 of the *Planning and Development Act 2005*, such land to be ceded free of cost and without any payment of compensation by the Crown. (Local Government)

26. Engineering drawings and specifications are to be submitted, approved, and subdivisional works undertaken in accordance with the approved plan of subdivision, engineering drawings and specifications, for the provision of shared paths and footpaths including a shared path along the common boundary of the subject land and Yellagonga Regional Park in accordance with the *Woodvale Agreed Structure Plan No. 64* and as shown on the plan dated 27 September 2017 (attached). The footpaths and shared paths are to be constructed by the landowner/applicant. (Local Government)

27. Engineering drawings and specifications are to be submitted and approved, and subdivisional works undertaken in accordance with the approved plan of subdivision, engineering drawings and specifications to ensure that:

a) roads that have been designed to connect with existing or proposed roads abutting the subject land are coordinated so that the road reserve location and width connect seamlessly;

b) temporary turning areas are provided to those subdivisional roads that are subject to future extension; and

c) embayment parking provided abutting the proposed public open space, the 2337m^2 survey-strata lot and laneway lots,

140 William Street, Perth, Western Australia 6000, Locked Bag 2506 Perth, 6001
Tel: (08) 6551 8002; Fax: (08) 6551 9001; Infoline: 1800 626 477
e-mail: info@dplh.wa.gov.au; web address http://www. dplh.wa.gov.au
ABN 35 482 341 493

to the satisfaction of the Western Australian Planning Commission. (Local Government)

28. Pursuant to Section 150 of the *Planning and Development Act 2005* and Division 3 of the *Planning and Development Regulations 2009* a covenant preventing vehicular access onto Wanneroo Road being lodged on the certificate(s) of title of the proposed lot(s) at the full expense of the landowner/applicant. The covenant is to prevent access, to the benefit of Main Roads Western Australia, in accordance with the plan dated 27 September 2017 (attached) and the covenant is to specify:

"*No vehicular access is permitted from Wanneroo Road*." (Main Roads Western Australia)

29. Pursuant to Section 150 of the Planning and Development Act 2005 and Division 3 of the *Planning and Development Regulations 2009* a covenant preventing vehicular access onto the primary street being lodged on the certificate(s) of title of the proposed laneway lot(s) at the full expense of the landowner/applicant. The covenant is to prevent access, to the benefit of City of Wanneroo, in accordance with the plan dated 27 September 2017 (attached) and the covenant is to specify:

'No vehicular access is permitted from the primary street.' (Local Government)

30. Redundant vehicle crossover(s) to be removed and the kerbing, verge, and footpath (where relevant) reinstated with grass or landscaping to the satisfaction of the Western Australian Planning Commission and to the specifications of the local government. (Local Government)

31. A notification, pursuant to Section 70A of the *Transfer of Land Act 1893* is to be placed on the certificate(s) of title of the proposed lot(s) shown on the plan date stamped 27 September 2017 (attached). Notice of this notification is to be included on the diagram or plan of survey (deposited plan). The notification is to state as follows:

'The lot/s is/are situated in the vicinity of a transport corridor and is currently affected, or may in the future be affected by transport noise.' (Local Government)

32. Notifications, pursuant to Section 165 of the Planning and Development Act 2005 are to be placed on the certificate(s) of title of the proposed lot(s) advising of the existence of a hazard or other factor. Notice of this notification is to be included on the diagram or plan of survey (deposited plan). The notification is to state as follows:

a) *'The amenity of the lots may be affected by the presence of midges from the adjoining wetland.'*

140 William Street, Perth, Western Australia 6000, Locked Bag 2506 Perth, 6001
Tel: (08) 6551 8002; Fax: (08) 6551 9001; Infoline: 1800 626 477
e-mail: info@dplh.wa.gov.au; web address http://www. dplh.wa.gov.au
ABN 35 482 341 493

b) *'This lot is in close proximity to known mosquito breeding areas. The predominant mosquito species is known to carry viruses and other diseases.'*

c) *'There is a risk of peat fires associated with the nearby wetland (Yellagonga Regional Park)'* (Western Australian Planning Commission)

33. A restrictive covenant, to the benefit of the local government, pursuant to section 129BA of the *Transfer of Land Act 1893* (as amended) is to be placed on the certificates of title of the proposed lot(s) advising of the existence of a restriction on the use of the land. Notice of this restriction to be included on the diagram or plan of survey (deposited plan). The restrictive covenant is to state as follows:

'The sinking of domestic groundwater bores is prohibited.' (Local Government)

34. A 2m high noise barrier being provided in the locations as shown on the plan dated 27 September 2017 in accordance with the recommendations of the Transportation Noise Assessment prepared by Lloyd George Acoustics (dated 29 January 2017 and updated 4 September 2017). (Local Government)

35. Measures being taken to ensure the identification and protection of any vegetation on the site worthy of retention that is not impacted by subdivisional works prior to commencement of subdivisional works. (Local Government)

36. All septic sewer systems including all tanks and pipes and associated drainage systems (soak wells or leach drains) and any stormwater disposal systems are to be decommissioned, in accordance with the *Health (Treatment of Sewerage and Disposal of Effluent and Liquid Waste) Regulations 1974*, removed, filled with clean sand and compacted. Proof of decommissioning is to be provided in the form of either certification from a licensed plumber or a statutory declaration from the landowner/applicant, confirming that the site has been inspected and all septic tanks, soakwells, leach drains and associated pipework have been removed. (Local Government)

37. A fence restricting vehicle access is to be constructed along the boundary between the public open space and the Yellagonga regional park. (Local Government)

38. Arrangements being made to the satisfaction of the Western Australian Planning Commission and to the specification of Western Power for the provision of an underground electricity supply to the lot(s) shown on the approved plan of subdivision. (Western Power)

39. Arrangements being made to the satisfaction of the Western Australian Planning Commission and to the specifications of Western Power for the provision of necessary electricity easement(s) to the lot(s) shown on the approved plan of subdivision/plan dated 27 September 2017 (attached). (Western Power)

40. The transfer of land as a Crown reserve free of cost to Western Power for the provision of electricity supply infrastructure. (Western Power)

41. Arrangements being made with the Water Corporation so that provision of a suitable water supply service will be available to the lots shown on the approved plan of subdivision. (Water Corporation)

42. Arrangements being made with the Water Corporation so that provision of a sewerage service will be available to the lots shown on the approved plan of subdivision. (Water Corporation)

43. An acid sulphate soils self-assessment form and, if required as a result of the self-assessment, an acid sulphate soils report and an acid sulphate soils management plan shall be submitted to and approved by the Department of Environment Regulation before any subdivision works or development are commenced. Where an acid sulphate soils management plan is required to be submitted, all subdivision works shall be carried out in accordance with the approved management plan. (Department of Water and Environmental Regulation)

ADVICE:

1. With regard to Condition 3, Main Roads approval for the construction drawings for the interim access arrangement at the intersection of Prindiville Drive/Rosso Meander and Wanneroo Road is required before any work is undertaken within the Wanneroo Road reservation. A detailed traffic management safety plan while working within the road reservation is to be submitted as part of this approval.

2. With regard to Condition 4, the construction of the roundabout at the intersection of Rosso Meander and Corvina Way shall occur upon the first of either:
   a) the subdivision of Lot 33 (No. 489) Wanneroo Road, Woodvale; or
   b) the ultimate upgrade of the intersection of Wanneroo Road and Prindiville Drive/Rosso Meander as four way controlled intersection.

3. Condition 9 has been imposed in accordance with *Better Urban Water Management Guidelines (WAPC 2008).* Further guidance on the contents of urban water management plans is provided in *'Urban Water Management Plans: Guidelines for preparing and complying with subdivision conditions'* (Department of Water 2008).

4. With regard to Condition 12, the Department of Water and Environmental Regulation advises that the Wetland Management Plan is to include rehabilitation of a 20 metre strip from the Conservation category wetland boundary towards Wallaburnup Swamp.

5. With regard to Condition 18 and in accordance with regulation 31(1)(c) of the *Contaminated Sites Regulations 2006*, a Mandatory Auditor's Report, prepared

by an accredited contaminated sites auditor, will need to be submitted to the Department of Water and Environment Regulation as evidence of compliance with Condition 16. A current list of accredited auditors is available from.

6. Condition 19(c) has been imposed to ensure suitable development standards are put in place for the storage and collection of bins for Lots 28-41. This is because the City's Waste Collection trucks are unable to collect all bins for these lots from the rear laneway.

7. With regard to Condition 22, the development is to include full earthworks, basic reticulation, grassing of key areas and pathways that form part of the overall pedestrian and/or cycle network.

8. With regard to Condition 26, there is to be no vegetation, earth spoil or any other debris disposed of within Yellagonga Regional Park.

9. With regard to Condition 34, the noise wall including the footings needs to be contained within the Claret Loop road reserve and must not encroach into the Wanneroo Road road reserve.

10. In regard to Condition 38, Western Power provides only one underground point of electricity supply per freehold lot.

11. In regard to Conditions 41 and 42, the landowner/applicant shall make arrangements with the Water Corporation for the provision of the necessary services. On receipt of a request from the landowner/applicant, a Land Development Agreement under Section 83 of the *Water Services Act 2012* will be prepared by the Water Corporation to document the specific requirements for the proposed subdivision.

12. Condition 43 makes reference to an 'acid sulphate soils self-assessment form'. This form can be downloaded from the Western Australian Planning Commission's website at:.

    The 'acid sulphate soils self-assessment form' makes reference to the Department of Environment Regulation's 'Identification and Investigation of Acid Sulphate Soils' guideline. This guideline can be obtained from the Department of Water and Environment Regulation's website at:.

13. Anyone proposing to carry out construction or excavation works must contact 'Dial Before You Dig' (Ph 1100) to determine the location of buried gas infrastructure.

14. The Department of Conservation, Biodiversity and Attractions advises that flora species known to be invasive or environmentally damaging shall not be used in any landscaping, where they may spread into the adjacent Bush Forever Site.

15. Main Roads Western Australia advises the landowner/application with regard to the Wanneroo Road road reserve:

a) no earthworks are to encroach onto the road reserve;
b) no stormwater drainage is to be discharged onto the road reserve;
c) the landowner/applicant shall make good any damage to the existing verge vegetation within the road reserve; and
d) The applicant must obtain approval from Main Roads before any works are undertaken within the Wanneroo Road road reserve. The applicant seeking access to the Main Roads network will be required to submit an Application as outlined on Main Roads website >'Our Roads' > 'Conducting Works on Roads'.

Kerrine Blenkinsop
Secretary
Western Australian Planning Commission
13 October 2017

Enquiries : Alex Campbell (Ph 6551 9183)

140 William Street, Perth, Western Australia 6000, Locked Bag 2506 Perth, 6001
Tel: (08) 6551 8002; Fax: (08) 6551 9001; Infoline: 1800 626 477
e-mail: info@dplh.wa.gov.au; web address http://www. dplh.wa.gov.au
ABN 35 482 341 493

DEPARTMENT OF PLANNING

DATE	FILE
08-May-2017	155158

STAGE 3

91
1.4491ha
EXISTING DRAINAGE
BALANCE LOT
1.37ha

PUBLIC OPEN SPACE
2952m²

PUBLIC OPEN SPACE
5205m²

SUBJECT TO SEPARATE
SURVEY STRATA
SUBDIVISION
83
1.3881ha

32
1.7367ha

90
4812m²

1m wide pedestrian path

LEFT TURN ONLY
FROM LANEWAY

INTERIM LEFT-IN

INTERIM
LEFT-OUT

DOLCETTO WAY (15m)

LAZIO LANE (6m)

LAZIO DRIVE (15m)

COSIMO DRIVE (15m)

VENETO COURT (13m)

ROSSO WAY (15m)

MEANDER (6m)

WANNEROO ROAD (15m)

CLARET LOOP (13m)

PRINDIVILLE DRIVE

OVERHEAD POWER EASEMENT

NOTES:
1. Areas and dimensions subject to survey.
2. Carriageways diagrammatic only.
3. All existing improvements to be demolished.

LOT SUMMARY

Application Area: 5.0551ha
Green Title Lots:
No. of Lots: 59 + 1 Lot for future Survey Strata subdivision
Mimimum Lot Area: 182m²
Average Lot Area: 226m²

Total POS: 8157m²
Total Drainage: 1.37ha

PROPOSED GREEN TITLE SUBDIVISION

CHIANTI PRIVATE ESTATE
LOT 32 (No. 487), LOT 90 (No. 481) LOT 91 (No. 477) AND LOT 83 (No. 473) WANNEROO ROAD
WOODVALE

Urban Development Institute of Australia WESTERN AUSTRALIA

Planning Institute Australia

CPP CERTIFIED PRACTISING PLANNER

SCALE: 1:1250 @ A3
DATE: 7th APRIL 2017
FILE: 204_07.04.2017.dwg
DRAW: - SB
CHECKED: -

e: admin@dynamicplanning.net.au
t: (08) 9275 4433
f: (08) 9275 4455
m: 0431-111-659
SUITE 15, 29 COLLIER ROAD
MORLEY WA 6062
ABN: 99 169 411 705

DYNAMIC PLANNING
AND DEVELOPMENTS

N W E S

Appendix 2
PSC 88: Use of herbicides in water catchment areas

CIRCULAR NO: PSC 88

SUBJECT : USE OF HERBICIDES IN WATER CATCHMENT AREAS

Purpose

PSC 88 is for the purpose of protecting surface and ground water sources that are used as sources of water for human consumption from contamination by herbicides. The document is a best practice policy statement that applies to all government departments and their contractors.

Definitions

The term "Water Catchment Area" refers to:

(a) proclaimed public drinking water source areas (i.e. water reserves, catchment areas and underground water pollution control areas proclaimed under the *Country Areas Water Supply Act 1947* or *Metropolitan Water Supply, Sewerage and Drainage Act 1909*), and
(b) reserves vested for the purpose of water supply; and
(c) any other area that is designated by licensed water service providers and the Department of Water and confirmed by the Executive Director, Public Health

"Blanket Area Spraying" means the application of herbicide by boom sprayer, aircraft, misting machines, and like apparatus capable of treating a wide swath at one pass and these swaths being matched by continuous passes.

1. Other than with the expressed written approval of the Executive Director, Public Health, the only herbicides that may be used in water catchment areas are:

2,4-D	amitrole
fluazifop-p-butyl	glyphosate
hexazinone*	triclopyr

metsulfuron methyl - **only** when used for hand/spot spraying of weeds (eg blackberry and cape tulip)

*(hexazinone can affect native vegetation and therefore should be used with care or advice sought from the Department of Environment where sensitive native plants are present.)

2. These herbicides may only be used when no other means are suitable for the control of weeds.

3. 2,4-D may only be used when the weeds are resistant to the other specified herbicides or when other chemicals are not sufficiently selective.

4. The specified herbicides may be used against declared plants and other undesired weeds on water catchments and water channels or in the vicinity of reservoirs provided timings, techniques and precautions ensure there is no spray drift or early run off from treated areas likely to contaminate reservoirs, rivers or streams. All applications must be under the supervision of a person experienced in the use of herbicides.

5. Application is to be limited to injection techniques or direct spraying of individual weeds or clumps of weeds by apparatus producing a coarse or large droplet spray. Other than with the expressed written approval of the Executive Director, Public Health, blanket area spraying is not acceptable.

6. No mixing of the herbicide is to occur within 50 metres of reservoirs, rivers or streams. Except with the written permission of the Executive Director, Public Health, no application is to be made within 20 metres of reservoirs or rivers and streams when flowing. Application may be made within 20 metres of dry river and stream beds during the summer months.

7. Empty containers and all equipment to be removed from the catchment area before washing and disposal.

8. Other than with the expressed written approval of the Executive Director, Public Health, any unused herbicide is to be removed from the catchment area and no other herbicide except for immediate requirements is to be stored there.

9. Rates of application, safety directions and precautions on labels of the original container of the herbicide shall be strictly adhered to.

10. Records of the amounts and dates of use of herbicides on catchments are to be retained. They maybe required for investigation of incidents or complaints.

Dr M Stevens
Delegate of the
EXECUTIVE DIRECTOR, PUBLIC HEALTH

29 August 2006

Appendix 3
Flora and Vegetation Survey

Cardno
Shaping the Future

Chianti Private Estate

Flora and Vegetation Survey Report

Prepared for Watson Property Group

April 2010

Project Number V9076

Cardno (WA) Pty Ltd
ABN 77 009 119 000
2 Bagot Road
Subiaco WA 6008
PO Box 155, Subiaco
Western Australia 6904 Australia
Telephone: 08 9273 3888
Facsimile: 08 9388 3831
International: +61 8 9273 3888
perth@cardno.com.au
www.cardno.com.au

Document Control

Version	Date	Author		Reviewer	
1	April 2010	Matt Field	MJF	Jason Hick	JDH
Filename	V9076--Mjf100006.10--Mjf				

Author: Matt Field
Position Title: Restoration Ecologist

Reviewer: Jason Hick
Position Title: Principle Environmental Scientist

Printed on 100% Australian Recycled Paper

Executive Summary

Cardno (WA) Pty Ltd was commissioned by Watsons Property Group (WPG) in October 2009 to produce a Flora and Vegetation Survey for the Chianti Private Estate residential subdivision development. Botanists from Cardno visited the site in October 2009 and undertook field surveys, conducted in accordance with EPA Guidance Statement No. 51 – Terrestrial flora and vegetation survey environmental impact assessment in Western Australia (2004) to the level of a detailed survey.

Plants species were recorded during this survey along with vegetation condition and other environmental site data. Most plant species were identified to species level and compared against regional species lists to ascertain whether there are any rare and priority species present.

A total of 52 vascular plant species were recorded in the site with only 6 species native to West Australia, none of which are classed as rare or as a priority. There were no native plant communities that were able to be identified due to the degraded nature of the site and only several emergent native plants that did not form a structure that enabled identification of a community type. Consequently it was difficult to determine the Floristic Community Type (FCT) that is present on the site. Vegetation condition across the site has been rated as being in a 'Completely Degraded' condition (**Figure 3**). This condition rating was due to the site having little to no native vegetation structure and a very high intensity of invasive weed species.

The site has been heavily disturbed in the past due to impacts from agriculture, market gardening and viticulture. The result of these impacts is a highly disturbed wetland and wetland buffer which is dominated by *Pennisetum clandestinum* (Kikuyu), *Typha orientalis* (Typha) and other invasive weed species.

Cardno recommendations that the spread of invasive weed species into and around the site should be restricted (including specifically the movement of One Cape Tulip) and any vegetation and remnant trees should be retained where possible.

Table of Contents

Executive Summary ii

1 Introduction 1

1.1 Background 1

1.2 Purpose of Report 1

2 Existing Environment 2

2.1 Geomorphology and Soils 2

2.2 Climate 2

2.3 Vegetation Description and Soil and Vegetation Relationships 2

3 Methods 3

3.1 Field Survey 3

3.2 Limitations of the Assessment 4

4 Results 5

4.1 Site observations 5

4.2 Flora 5

4.3 Declared Weeds 5

4.4 Vegetation Condition 5

5 Discussion 6

6 Conclusions and Recommendations 7

7 References 8

List of Tables

Table 1: Vegetation Condition Scale (Keighery 1994)

List of Figures

Figure 1: Locality Plan

Figure 2: Vegetation Survey Locations

Figure 3: Vegetation Condition Map

Plates

Plate 1: Survey Location 1

Plate 2: Survey Location 2

Plate 3: Survey Location 3

Plate 4: Survey Location 4

Plate 5: Survey Location 5

Plate 6: Survey Location 6

Appendices

Appendix A Flora and Vegetation Species List

Appendix B Raw Data

1 Introduction

1.1 Background

Cardno (WA) Pty Ltd was commissioned by Watsons Property Group (WPG) in October 2009 to undertake a Flora and Vegetation Survey for the wetland buffer area of the Structure Plan 64 (SP64) subdivision development. The SP64 development is located on lots 0, 22, 23, 26 - 28, 32 - 34, 83 and 801 Wanneroo Road, Woodvale (**Figure 1**) and is situated in the south-western extent of the City of Wanneroo (CoW) municipal boundary.

The wetland buffer area (to be herein described as the subject site) is located between the Wallenburnup Swamp wetland boundary to the east and the SP64 development to the west. The subject site is approximately 8ha in size and is mapped in **Figure 2**.

1.2 Purpose of Report

This report aims to provide detailed botanical attributes for the subject site and provide recommendations for the management of the site which would be included in the Wetland Management Plan.

This report will include the following aspects:

- A desktop study of publicly available, relevant background material including previous flora surveys of the subject site and relevant policies and legislation;
- The results of a detailed flora survey conducted in spring (October and November) 2009;
- A discussion of the conservation significance of the vegetation encountered across the site; and
- Conclusions and recommendations about the future constraints and protection issues that may arise through the development of the site.

2 Existing Environment

2.1 Geomorphology and Soils

The site occurs on the Swan Coastal Plain, which is the surface expression of a small part of the Perth Basin, and characterises the Perth region and surrounds (Seddon 2004). It is a geomorphologic unit approximately 20 – 30 km wide consisting of two sedimentary belts of different origin. On the eastern side of the Swan Coastal Plain (SCP), the Pinjarra Plain has been formed from the deposition of alluvial material whilst the three dune systems (Quindalup, Spearwood and Bassendean) that form the western part of the Swan Coastal Plain are of Aeolian origin (Seddon 2004). The subject site is located within the Spearwood dune system on the Swan Coastal Plain.

The site contains two soil complexes which are classed as:

- Herdsman complex: - which is described as peaty swamps with black organic sands, peaty loams, black clays and true peats; and
- Karrakatta complex: - which is described an undulating landscape with deep yellow brown sands.

2.2 Climate

The climate of the Yellagonga area can be described as a warm Mediterranean climate with mild wet winters and hot dry summers, with 5-6 dry months per year (Beard 1990). Climatic data from the closest climatic station (Perth metro), utilising data from 1965 to 2010, indicates an annual rainfall average of 744.0mm. July has the highest mean rainfall, with 152.9mm, and December has the lowest with 6.0mm. The mean maximum temperature ranges from 31.3°C in February to 18.3°C in July, and the mean minimum temperature ranges from 18°C in February to 7.8°C in August (Bureau of Meteorology 2010).

2.3 Vegetation Description and Soil and Vegetation Relationships

The site lies within the Swan Coastal Plain Interim Biogeographic Regionalisation for Australia (IBRA) region (Thackway and Cresswell 1995). The Swan Coastal Plain IBRA Region is broadly compatible with the Swan Coastal Plain (Drummond Botanical Subdistrict) Phytogeographical Subregion as described by Beard (1990). This region is characterised by *Banksia* low woodlands on leached sands, woodlands of Tuart (*Eucalyptus gomphocephala*), Jarrah (*Eucalyptus marginata*) and Marri (*Eucalyptus calophylla*) on less leached soils and *Melaleuca* swamps.

Vegetation complex mapping undertaken by Heddle et al. (1980) indicates the basic relationship between vegetation, soils and rainfall. Two vegetation complexes have been mapped for the subject site, which are the Herdsman Complex in the wetland and the Karrakatta Complex - Central and South in the fringing and dryland areas. These complexes are described below:

- Herdsman Complex: - Wetland complex that is dominated by sedgelands of *Typha, Juncus* and *Baumea*; and woodlands of *Eucalyptus rudis* and *Melaleuca* species. The species of *Melaleuca* depend the local drainage and adjacent soils; and
- Karrakatta Complex: - The fringing and dryland areas upland from the wetland which are dominated by Jarrah-Marri-Tuart woodlands that exist with *Banksia attenuata* and *B. menziesii*. Tuarts tend to occur on deeper sands in more upland locations. Shrubs species include *Jacksonia, Acacia, Casuarina, Hibbertia* and *Calothamnus*.

3 Methods

3.1 Field Survey

Botanists from Cardno visited the site in October 2009 and undertook level 1 field surveys, conducted in accordance with EPA Guidance Statement No. 51 – Terrestrial flora and vegetation survey environmental impact assessment in Western Australia (2004). The site was traversed on foot and the vegetation assessed at six survey locations (**Figure 2**), which were selected to adequately sample each plant community observed within the subject site. The position of each survey location was recorded with a hand-held GPS unit and all vascular plant species were recorded within a radius of at least 15 metres from that point. In addition, opportunistic plant taxa that were observed, but not located at a particular survey location, were also recorded through the course of the survey. An estimate of the Foliage Projective Cover (FPC) percentage was made for each species at each survey location.

Environmental data recorded from each survey location included topographic position, aspect, slope, soil colour and texture class, rock outcropping, litter cover as well as the degree of disturbance and an estimate of the time since the last fire event. The condition of the vegetation was assessed to assist in determining the conservation values of the site. The vegetation condition was rated according to Keighery (1994), a vegetation condition scale commonly used in the Perth Metropolitan Region, but which is also appropriate for other urbanised and agricultural areas. The categories are listed and defined in Table 1.

All plant specimens collected during the field survey were dried, pressed and then sorted in accordance with requirements of the Western Australian Herbarium. Identification of specimens occurred through comparison with named material and through the use of taxonomic keys.

Table 1: Vegetation Condition Scale (Keighery 1994)

Vegetation Condition	Definition
1. Pristine (1)	Pristine or nearly so, no obvious signs of disturbance.
2. Excellent (2)	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
3. Very Good	Vegetation structure altered and obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing
4. Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
5. Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
6. Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

3.2 Limitations of the Assessment

It is generally not possible to obtain a comprehensive species list of an area from a single visit or even multiple visits, due to some species, especially herbaceous ones, being inconspicuous for much of the year and becoming obvious only during flowering. In addition, not all species will flower in the same season and some will not flower every year.

However, the assessment was conducted in spring 2009 and followed the field methods in accordance with the EPA Guidance Statement No. 51 (EPA 2004) level 1 survey. A level 1 survey indicates that there was background information gathered along with a reconnaissance field survey into the floristics of the area. One site visit was undertaken during in the main flowering period (spring) to survey within different vegetation units and a second survey in a different season (Level 2 survey method) was judged to not be required due to the completely degraded nature of the site.

4 Results

4.1 Site observations

The site was observed to comprise two distinctly different areas:

- A wetland area that is the Wallenburnup Swamp which is highly degrade and is dominated by *Typha*, Kikuyu and several patches of *Melaleuca rhaphiophylla*; and
- The wetland buffer/fringe area which is also high degraded and is dominated by *Ehrharta calycina*, *Eragrostis curvula* and *Pennisetum clandestinum*.

4.2 Flora

A total of 52 vascular plant species were recorded in the site with only six species native to West Australia, none of which are classed as "Declared Rare" or "Priority" flora pursuant to the Wildlife Conservation Act 1952. The species were split into 16 families with the dominant families being *Poaceae* (16 species), *Fabaceae* (10 species) and *Asteraceae* (6 species). The dominant plant species recorded in the wetland buffer and fringe areas included *Typhya orientalis, Ehrharta calycina, Eragrostis curvula and Pennisetum clandestinum*. The wetland area was dominated by *Pennisetum clandestinum and Typhya orientalis*, with some areas showing a projective foliage cover (FPC) of over 90%. A full species list is provided in **Appendix A** and the raw data from the quadrants are provided in **Appendix B**.

There were no native plant communities that were able to be identified due to the degraded nature of the site and only several emergent native plants that did not form a structure that enabled identification of a community type. Consequently it was difficult to determine the Floristic Community Type (FCT) that is present on the subject site.

4.3 Declared Weeds

One weed species recorded within the site is classed as a 'Declared' weed species as listed on the Declared Plants of Western Australia list (Department of Agriculture and Food 2009) pursuant to the *Agriculture and Related Resources Protection Act 1976*. 'Declared' status means weed species are highly invasive and aggressive and should be controlled by the landholder. One leafed Cape Tulip (*Moraea flaccida*) is declared a Priority 1 (P1) weed which occurs across the entire state. P1 status prohibits the movement of plants or their seeds within the State. This means active control of this weed is not required but the movement of contaminated machinery and produce including livestock and fodder is prohibited.

The one leafed cape tulip (*Moraea flaccid*) was recorded at survey locations 3 and 6, with 3 showing a 5% projective foliage coverage while 6 only had a few recordings.

4.4 Vegetation Condition

Vegetation condition across the site has been rated as being 'Completely Degraded' (**Figure 3**). This condition rating was due to the site having little to no native vegetation structure. The site is also highly infested with invasive weeds species which have overtaken the vast majority of the site, are smothering any native species currently growing there.

5 Discussion

The subject site has been heavily disturbed in the past due to impacts from agriculture, market gardening and viticulture. These disturbances included extensive clearing of native vegetation, infilling parts of the wetland, introduction of invasive weed species, use of chemicals and fertilizers close to and dumping of rubbish. The result of all of these impacts is a highly disturbed buffer which is dominated by Typha, Kikuyu and other weed species.

Only six out of the 52 plant species indentified within the site are native to West Australia and the occurrence of these native species is extremely sparse and isolated from other remnant vegetation in the surrounding areas. Due to the dominance of weed species and the lack of native vegetation structure in the site, the vegetation condition is 'Completely Degraded.'

The nature of the dominant highly invasive weed species present in the site has resulted in the inability of native vegetation of the surrounding areas to naturally recolonise disturbed sites which is thus preventing the improvement in the condition of this vegetation.

The vegetation communities that would have most likely occurred in the site prior to European settlement (as stated in the regional vegetation mapping) would have been Melaleuca shrublands with a sedge and rush understory in the wetland, a mixture of Melaleuca, Eucalyptus, sedges and rushes and woodland shrubs in the wetland fringe area and Jarrah/Marri/Tuart woodland in the dryland areas.

6 Conclusions and Recommendations

A detailed flora and vegetation survey was undertaken by Cardno in spring 2009 in accordance with EPA Guidance Statement No. 51. The following botanical information was gathered about the site:

- 52 flora species from 16 families were recorded within the site;
- No Declared Rare or Priority flora species were identified, pursuant to the Wildlife Conservation Act 1952;
- Vegetation condition within the site was in 'Completely Degraded' condition, in accordance with the Keighey (1994) scale; and
- There were no native plant communities described within the site due to vegetation structure being absent and the dominance of weed species.

In summary, Cardno recommends that:

- Restrict the spread of invasive weed species into and around the site (including specifically the movement of One Cape Tulip); and
- Retain vegetation and remnant trees where possible.

7 References

Beard, JS 1990, Plant life of Western Australia, Kangaroo Press, Perth.

Environmental Protection Authority, 2004, Guidance statement No. 51. Guidance for the Assessment of Environmental Factors – Terrestrial flora and vegetation surveys for environmental impact assessment in Western Australia, Environmental Protection Authority, Perth.

Gibson, N, Keighery, BJ, Keighery, GJ, Burbidge, AH and Lyons, MN 1994, A floristic survey of the southern Swan Coastal Plain, Unpublished Report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc), Perth.

Heddle, EM, Loneragan, OW and Havel, JJ 1980, 'Darling Systems – Vegetation Complexes' in Atlas of Natural Resources Darling System, Western Australia, Department of Conservation and Environment, Perth.

Keighery, BJ 1994, *Bushland plant survey: A Guide to Plant Community Survey for the Community*, Wildflower Society of WA (inc), Nedlands, Western Australia.

Seddon, G 2004, A Sense of Place, Blooming Books, Melbourne.

Thackway, R and Cresswell ID 1995 (Eds), An Interim Biogeographical Regionalisation for Australia: a framework for establishing the national system of reserves, Version 4.0, Australian Nature Conservation Agency, Canberra.

Figure 1: Locality Plan

Figure 2: Vegetation Survey Locations

Figure 3: Vegetation Condition Map

Figures

DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHKD	APPD	DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHKD	APPD

Cardno

CONSULTING ENGINEERS
TOWN PLANNERS
PROJECT MANAGERS
ENVIRONMENTAL CONSULTANTS

Cardno Centre 2 Bagot Road
P.O. Box 155 Subiaco
Western Australia 6904

Telephone [08] 9273 3888
Facsimile [08] 9388 3831

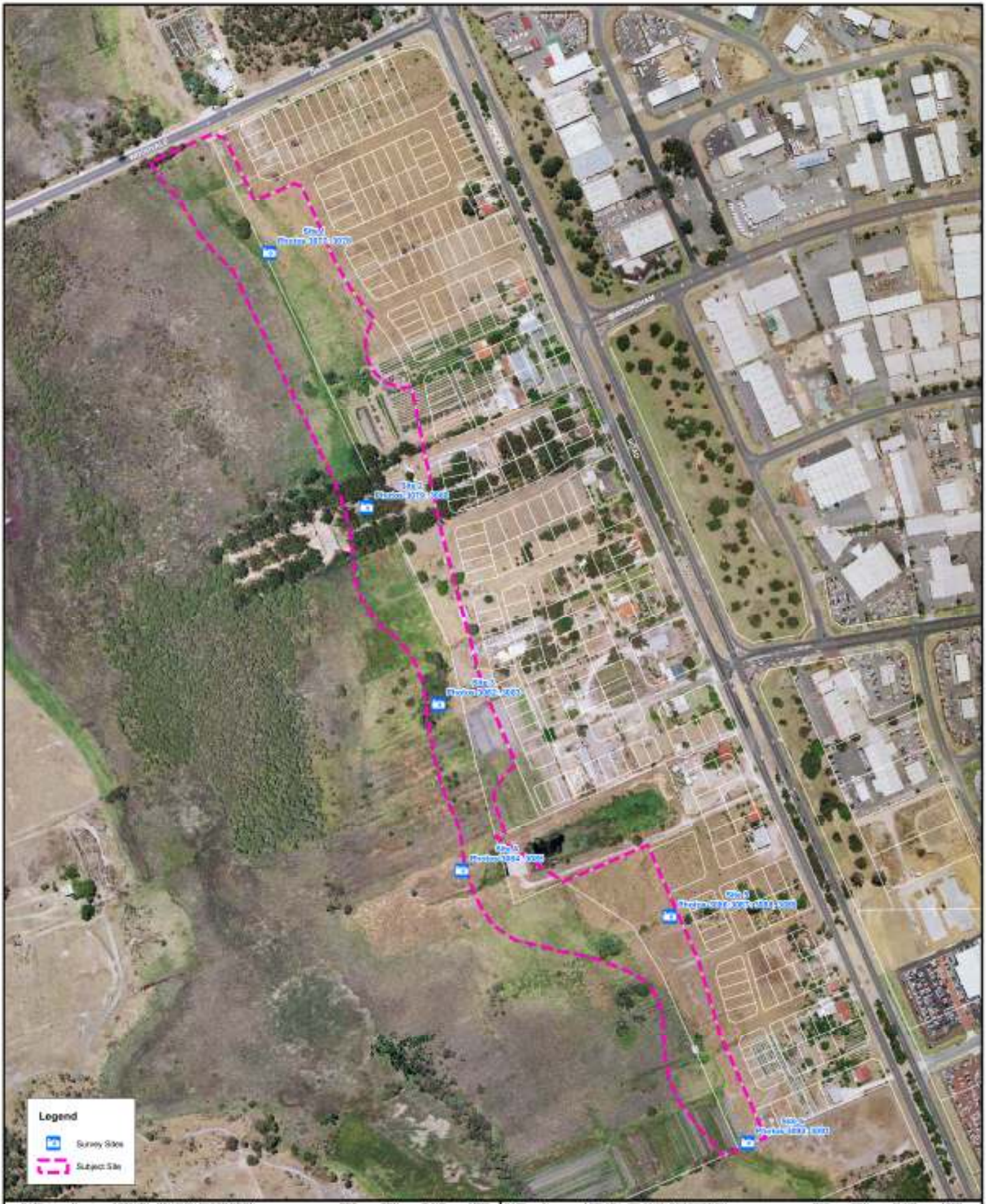
Scale: 1:20,000 (0 200 400 800 1,200 1,600 2,000 Metres)

PROJECT: Woodvale Flora and Vegetation Survey

DRAWING TITLE: FIGURE 1 : Locality Plan

PRINCIPAL: Watson Property Group Northern Aspect Ltd

Project Number: V9076
Original: A4
Drawing Number: SK01
Revision:
Designed: MF
Checked:
Drawn: MGW
Approved:
Local Authority: City of Joondalup
Sheet 1 of 1
Date: 24/02/10



DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APP'D

DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APP'D

Cardno

CONSULTING ENGINEERS
TOWN PLANNERS
PROJECT MANAGERS
ENVIRONMENTAL CONSULTANTS

Cardno Centre 2 Bagot Road
P.O. Box 155 Subiaco
Western Australia 6904

Telephone (08) 9273 3500
Facsimile (08) 9388 3631

Scale: 1:3,500

0 50 100 200 300 400 500 Metres

PROJECT: Woodvale Flora and Vegetation Survey

DRAWING TITLE: FIGURE 2 : Vegetation Survey Locations

PRINCIPAL: Watson Property Group Northern Aspect Ltd

Project Number: V9076

Original: A3

Drawing Number: SK02

Revision:

Designed: GT

Checked:

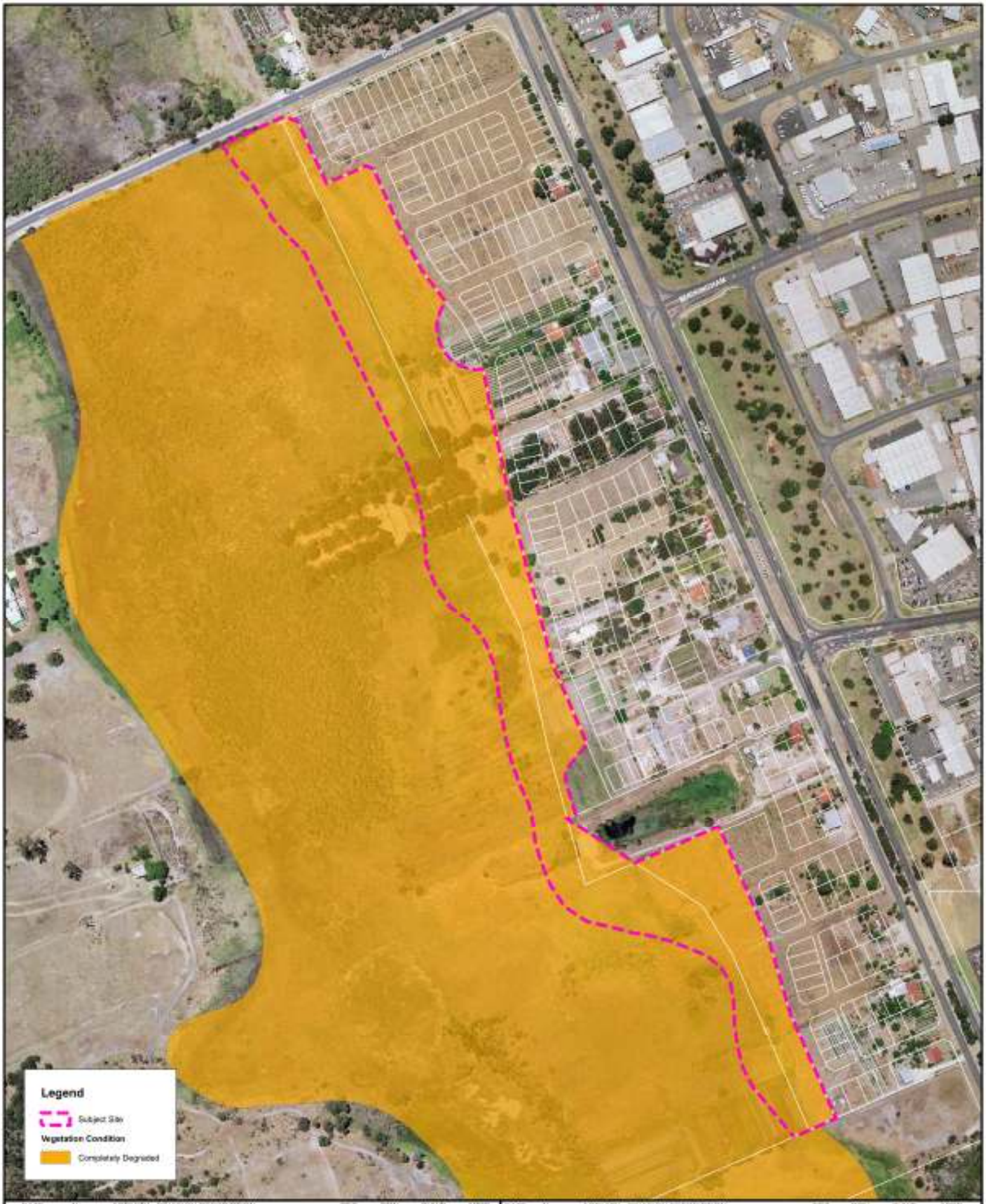
Drawn: MGW

Approved:

Local Authority: City of Joondalup

Sheet 1 of 1

Date: 15/03/10



DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APP'D

DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APP'D

Cardno

CONSULTING ENGINEERS
TOWN PLANNERS
PROJECT MANAGERS
ENVIRONMENTAL CONSULTANTS

Cardno Centre 2 Bagot Road
P.O. Box 158 Subiaco
Western Australia 6904

Telephone (08) 9273 3888
Facsimile (08) 9388 3831

Scale: 1:3,500

0 50 100 200 300 400 500 Metres

PROJECT: Woodvale Flora and Vegetation Survey

DRAWING TITLE: FIGURE 3: Vegetation Condition Map

PRINCIPAL: Watson Property Group Northern Aspect Ltd

Project Number: V9076

Original: A3

Drawing Number: SK03

Revision:

Designed: MP

Checked:

Drawn: MGW

Approved:

Local Authority: City of Joondalup

Sheet: 1 of 1

Date: 24/02/10

Plates

Plate 1: Survey Location 1

Plate 2: Survey Location 2

Plate 3: Survey Location 3

Plate 4: Survey Location 4

Plate 5: Survey Location 5

Plate 6: Survey Location 6

Appendix A

Flora and Vegetation Species List

Appendix A: Plant Taxa Recorded within Woodvale Wetland and Buffer Area, October 2009.

Family Name		Plant Taxa
Aizoaceae	*	*Carpobrotus edulis*
Apiaceae	*	*Centella asiatica*
	*	*Foeniculum vulgare*
Asteraceae	*	*Arctotheca calendula*
	*	*Conyza bonoriensis*
	*	*Gazania linearis*
	*	*Hypochaeris glabra*
	*	*Lactuca serriola*
	*	*Sonchus oleraceus*
Basellaceae	*	*Anredera cordifolia*
Brassicaceae	*	*Brassica fruiticulosa*
	*	*Brassica tournefortii*
Cyperaceae		*Baumea articulata*
	*	*Cyperus triangle*
		Juncus pallidus
Euphorbiaceae	*	*Euphorbia terracina*
	*	*Ricinis communis*
Fabaceae		*Acacia iteaphylla*
		Jacksonia furcellata
	*	*Lotus subbiflorus*
	*	*Lupinis cosentinii*
	*	*Melilotus albus*
	*	*Trifolium arvense*
	*	*Trifolium campestre*
	*	*Trifolium subterraneum*
	*	*Vicia sativa subsp. nigra*
	*	*Viminaria juncea*
Geraniaceae	*	*Pelargonium capitatum*
Iridaceae	*	*Moraea flaccida*
Moraceae	*	*Ficus carica*
Myrtaceae		*Eucalyptus rudis*
	*	*Eucalyptus sp.*
		Melaleuca lateritia
Oleaceae	*	*Olea europaea*
Poaceae	*	*Avena barbata*
	*	*Bromus catharticus*
	*	*Bromus diandrus*
	*	*Cortedaria selloana*

Family Name		Plant Taxa
	*	*Cynodon dactylon*
	*	*Ehrharta calycina*
	*	*Ehrharta longiflora*
	*	*Eragrostis curvula*
	*	*Holcus lanatus*
	*	*Hordeum vulgare*
	*	*Lagurus ovatus*
	*	*Lolium rigidum*
	*	*Pennisetum clandestinum*
	*	*Phalaris paradoxa*
	*	*Stenotaphrum secondatum*
	*	*Vulpia myuros*
Typhaceae	*	*Typha orientalis*
Vitaceae	*	*Vitis vinifera*

Appendix B

Raw Data

Site:	1	Camera	SC			
Date:	17/10/09	Photo #	3077: 3078			
Initials:	sc	Direction	W: E			
Zone:	50	Soils	ls			
Datum:	GDA	Soil colour:	black			
Easting:	387115	Soil comments:	saturated			
Northing:	6482489	Outcrop:	n/a			
Topography	ls	Outcrop Type:				
Aspect	w	Litter cover (%)	Logs	Twigs	Leaves	
Slope	<5		0	0	0	
Fire (yrs)	>5	STRATA		Ht (cm)	% Cover	
Disturbance	HIGH		Upper			
Condition	CD		Mid			
Bare ground (%):	0		Lower	100	100	
Observations	Paddock					

Community Description pasture grasses

Coll. No.	Species	% Cover	
	Typha orientalis	100	
	Pennisetum clandestinum	30	
	Bromus diandrus	25	
	Ehrharta calycina	25	
	Holcus lanatus	15	
	Ehrharta longiflora	10	
	Lolium rigidum	5	
	Trifolium subterraneum	4	
	Carpobrotus edulis	2	
	Avena barbata	1	
	Vicia sativa subsp. nigra	1	where present

Site:		2	Camera	SC	
Date:		17/10/09	Photo #	3079: 3080	
Initials:	sc		Direction	W: E	
Zone:		50	Soils	ls	
Datum:	GDA		Soil colour:	brown	
Easting:		387215	Soil comments:	dry; hard packed	
Northing:		6482227	Outcrop:	n/a	
Topography	f		Outcrop Type:		
Aspect	w		Litter cover (%)	Logs	Twigs
Slope	<5			0	5
Fire (yrs)	>5		STRATA		Ht (cm)
Disturbance	HIGH			Upper	2500
Condition	CD			Mid	
Bare ground (%):		5		Lower	100
Observations	planted eucs; west of Conti's - old dam with typha , patch of bamboo, patch of Arun				

Community Description exotic eucs over grasses

Coll. No.	Species	% Cover
	Lactuca serriola	few
	Pennisetum clandestinum	60
	Eucalyptus sp.	50
	Bromus diandrus	15
	Ficus carica	10
	Ehrharta calycina	5
SC01	*Anredera cordifolia*	3
	Cynodon dactylon	3
	Ricinis communis	3
SC05	*Bromus catharticus*	2
	Hordeum vulgare	2
	Conyza bonoriensis	1
	Lolium rigidum	1

Site:		3	Camera	SC		
Date:		17/10/09	Photo #	3082: 3083		
Initials:	sc		Direction	W: E		
Zone:		50	Soils	ls		
Datum:	GDA		Soil colour:	brown		
Easting:		387289	Soil comments:	wet		
Northing:		6482024	Outcrop:	n/a		
Topography	ls		Outcrop Type:			
Aspect	w		Litter cover (%)	Logs	Twigs	Leaves
Slope	<5			0	1	3
Fire (yrs)	>5		STRATA		Ht (cm)	% Cover
Disturbance	HIGH			Upper	1500	50
Condition	CD			Mid	400	25
Bare ground (%):		0		Lower	100	100
Observations	pennisetum clandestinum grassland between this site and chook farm; Chamelaucium uncinata 50m to the east					
Community Description			eucalyptus rudis over pennisetum clandestinum			

Coll. No.	Species	% Cover
	Pennisetum clandestinum	95
	Eucalyptus rudis	50
	Ficus carica	20
	Typha orientalis	20
	Bromus diandrus	5
SC03	*Melilotus albus*	5
	Moraea flaccida	5
	Jacksonia furcellata	2
	Vicia sativa subsp. nigra	2
	Centella asiatica	1
	Pelargonium capitatum	1

Site:		4	Camera	SC		
Date:		17/10/09	Photo #	3084: 3085		
Initials:	sc		Direction	W: E		
Zone:		50	Soils	ls		
Datum:	GDA		Soil colour:	brown		
Easting:		387313	Soil comments:	wet in parts below sump		
Northing:		6481853	Outcrop:	n/a		
Topography	ls		Outcrop Type:			
Aspect	w		Litter cover (%)	Logs	Twigs	Leaves
Slope	<5			0	0	0
Fire (yrs)	>5		STRATA		Ht (cm)	% Cover
Disturbance	HIGH			Upper		
Condition	CD			Mid	300	25
Bare ground (%):		5		Lower	100	95

Observations

Community Description: Eragrostis grassland , typha orientalis where wet

Coll. No.	Species	% Cover
	Acacia iteaphylla	few
	Cortedaria selloana	few
	Gazania linearis	few
	Melaleuca lateritia	few
	Sonchus oleraceus	few
	Eragrostis curvula	60
	Typha orientalis	20
	Trifolium campestre	15
	Lolium rigidum	10
	Trifolium arvense	5
	Vulpia myuros	5
	Avena barbata	4
	Brassica tournefortii	4
	Lotus subbiflorus	4
	Foeniculum vulgare	3
	Stenotaphrum secondatum	3
	Lagurus ovatus	1
	Lupinis cosentinii	1
	Phalaris paradoxa	1
SC04	*Viminaria juncea*	1
	Vitis vinifera	1

Site:		5	Camera	SC			
Date:		17/10/09	Photo #	3086: 3087; 3088; 3089			
Initials:	sc		Direction	W: S: E: N			
Zone:		50	Soils	ls			
Datum:	GDA		Soil colour:	grey			
Easting:		387527	Soil comments:	dry			
Northing:		6481806	Outcrop:	n/a			
Topography	ls		Outcrop Type:				
Aspect	w		Litter cover (%)	Logs	Twigs	Leaves	
Slope	<5			3	1	3	
Fire (yrs)	>5		STRATA		Ht (cm)	% Cover	
Disturbance	HIGH			Upper	500	5	
Condition	CD			Mid	300	10	
Bare ground (%):		2		Lower	150	95	

Observations

Community Description grassland with fennel

Coll. No.	Species	% Cover
	Bromus diandrus	40
	Eragrostis curvula	40
	Ehrharta calycina	10
	Foeniculum vulgare	10
	Lupinis cosentinii	10
	Carpobrotus edulis	8
	Avena barbata	5
	Euphorbia terracina	5
	Olea europaea	5
	Ehrharta longiflora	3
	Hypochaeris glabra	1

Site:		6	Camera	SC			
Date:		17/10/09	Photo #	3090; 3091			
Initials:	sc		Direction	W: E			
Zone:		50	Soils	ls			
Datum:	GDA		Soil colour:	grey			
Easting:		387607	Soil comments:	wet			
Northing:		6481573	Outcrop:	n/a			
Topography	ls		Outcrop Type:				
Aspect	w		Litter cover (%)	Logs	Twigs	Leaves	
Slope	<5			0	0	0	
Fire (yrs)	>5		STRATA		Ht (cm)	% Cover	
Disturbance	HIGH			Upper	1000	5	
Condition	CD			Mid			
Bare ground (%):		0		Lower	150	100	
Observations							

Community Description	pennisetum clandestinum with emergent eucalyptus rudis

Coll. No.	Species	% Cover
	Arctotheca calendula	few
	Baumea articulata	few
	Brassica fruiticulosa	few
	Cyperus triangle	few
	Moraea flaccida	few
	Phalaris paradoxa	few
	Sonchus oleraceus	few
	Pennisetum clandestinum	40
	Avena barbata	25
	Cynodon dactylon	20
	Typha orientalis	20
	Ehrharta calycina	15
	Lupinis cosentinii	10
	Eucalyptus rudis	5
	Trifolium campestre	5
	Conyza bonoriensis	3
	Holcus lanatus	3
	Bromus diandrus	2
SC02	*Lolium rigidum*	2
	Trifolium subterraneum	2
	Hypochaeris glabra	1
SC06	*Juncus pallidus*	1

Appendix 4
Level 1 Fauna Assessment

Level 1 Fauna Assessment of Chianti Private Estate, Wanneroo Road, Woodvale

Prepared for: Cardno WA Pty Ltd
PO Box 155
Subiaco, WA, 6008

Prepared by: **Mike Bamford**

M.J. & A.R. BAMFORD
CONSULTING ECOLOGISTS
23 Plover Way
KINGSLEY WA 6026

11th April 2010

CONTENTS

1 Introduction 1
2 Description of the Project Area and proposed development 1
3 METHODS 2
3.1 Impact Assessment 2
3.2 Personnel 2
3.3 Licences and Permits 2
3.4 Nomenclature and Taxonomy 2
3.5 Sources of Information for Desktop Assessment 2
3.6 Interpretation of species lists 3
3.7 Site inspection 3
4 Results 3
4.1 Site description 3
4.2 Vertebrate fauna of the project area 5
4.2.1 Freshwater Fish 5
4.2.2 Frogs 6
4.2.3 Reptiles 7
4.2.4 Birds 8
4.2.5 Mammals 11
4.3 Fauna – species of conservation significance 13
4.3.1 Frogs 13
4.3.2 Reptiles 13
4.3.3 Birds 13
4.3.4 Mammals 15
4.3.5 Invertebrates 15
5 IMPACT ASSESSMENT 16
5.1 Habitat Types 18
5.2 Conservation Significant Fauna 18
5.3 Ecological Processes 21
5.3.1 Initial and ongoing mortality 21
5.3.2 Changes in amount of habitat affecting population survival 21
5.3.3 Changes in distribution of habitat affecting population movements and gene flow 21
5.3.4 Species interactions, including predators and other feral species 22
5.3.5 Hydroecology 22
5.3.6 Fire 22
5.3.7 Light, noise and disturbance 22
5.4 Patterns of Biodiversity 23
6 conclusions: fauna values, impacts and management 23
6.1 Values for fauna 23
6.2 Impacts upon fauna 24
6.3 Recommendations 25
7 References 26
8 APPENDIX 1. Impact Assessment 28

8.1 Background to Impact Assessment 28
8.1.1 Assessment of Conservation Significance 28
8.1.2 Ecological Processes and Impact Assessment 29
8.1.3 Increased mortality 29
8.1.4 Loss of habitat affecting population survival 30
8.1.5 Loss of habitat affecting population movements and gene flow 30
8.1.6 Species interactions, including predators and over-abundant native species 30
8.1.7 Hydroecology 30
8.1.8 Fire 30
8.1.9 Light and noise 30
8.2 Impact Assessment Methodology 31
9 APPENDIX 2 Categories used in conservation significance 32
10 APPENDIX 3 Species lists for the region 33

1 INTRODUCTION

Urban development for the Chianti Private Estate is proposed for a series of lots along Wanneroo Road in Woodvale, between Woodvale Drive and Whitfords Avenue. The site is mostly cleared, with extensive areas of weeds and very little of the original vegetation remaining, but it does lie alongside wetlands of Yellagonga Regional Park. Therefore, Cardno WA Pty Ltd is developing a Wetland Management Plan to ensure that the urban development is compatible with the conservation values of the adjacent wetland. Bamford Consulting Ecologists was commissioned to prepare a Level 1 fauna assessment to provide information to support the development of this plan, and to provide general information on fauna values and impacts. The objectives of this assessment are therefore to:

- review the list of fauna expected to occur on the site in the light of fauna habitats present, with a focus on significant species;
- identify significant or fragile fauna habitats within the study area;
- identify potential impacts upon fauna and propose recommendations to minimise impacts.

Note that the focus of this report is upon vertebrate fauna, on which most information is available, but invertebrate fauna is considered in the case of significant species or where potential impacts can be identified.

2 DESCRIPTION OF THE PROJECT AREA AND PROPOSED DEVELOPMENT

The project area lies south of Woodvale Drive and between Wanneroo Road and Yellagonga Regional Park, in Wanneroo. It lies to the east of the Regional Park and has an area of 25ha. The project area consists largely of cleared paddocks with some trees, and the adjacent Regional Park is mostly a shallow wetland covered with Bulrush *Typha* sp., but with some riparian trees. A more detailed site description appears in Section 4.

The development is an urban sub-division but includes a rehabilitation zone at the interface between the development and the Regional Park. This interface is to be developed as a buffer between the residential development and the Regional Park. Management of this interface will be important for fauna conservation.

3 METHODS

3.1 Impact Assessment

The general approach used by Bamford Consulting Ecologists to assess impacts of development projects is outlined in Appendix 1. This provides a framework for assessment for the current project.

Investigations carried out for this project constituted a Level 1 Fauna Assessment (*sensu.* Environmental Protection Authority 2002, 2004), which involves a reconnaissance survey, background research and low intensity fauna sampling. Where fauna and fauna habitats are well-known from existing studies, a Level 1 Assessment provides detailed information on the nature and requirements for management of impacts.

3.2 Personnel

Personnel involved in this project were:

- Dr Mike Bamford (B.Sc. Hons. Ph.D.) – field assessment and report preparation.

3.3 Licences and Permits

The site inspection involved no interaction with fauna other than passive observation and therefore on advice from the Wildlife Licencing branch of DEC no licence was issued.

3.4 Nomenclature and Taxonomy

As per the recommendations of EPA (2004), the nomenclature and taxonomic order presented in this report are generally based on the Western Australian Museum's *Checklist of the Vertebrates of Western Australia*. The authorities used for each vertebrate group are: amphibians and reptiles (Aplin and Smith, 2001), birds (Christidis and Boles, 2008), and mammals (How *et al.,* 2001).

Latin and (where available) English common names are given in the species tables. English names are used in the text where possible, with Latin names used where there is no English alternative.

3.5 Sources of Information for Desktop Assessment

The project area lies within the northern suburbs of Perth, less than five kilometres from the residence and office of Bamford Consulting, where fauna records in the adjacent Yellagonga Regional Park have been maintained for 21 years. This area of Yellagonga includes Lake Goollelal where there is more open water than in the study area, but otherwise the environment is similar with parkland cleared areas, some Flooded Gums and Paperbarks, and extensive areas of Bulrush. In addition, Bamford Consulting has done numerous studies in Yellagonga, Wangara, Gnangara, Whiteman Park (about 15km to the east) and Neerabup, and in coastal areas from Burns Beach to Two Rocks. Some of these studies have involves intensive trapping. As a result, Bamford Consulting has extensive fauna records for the area. Databases the DEC Naturemap database (URL - http//.naturemap.dec.wa.gov.au), the Birds Australia Atlas Database, DEC Threatened Fauna Database and EPBC Protected Matters Search Tool have been interrogated for

the northern suburbs areas for other studies, as recently as January 2010. Therefore, and in the light of personal records, these databases were not accessed for the present study.

3.6 Interpretation of species lists

Species lists generated from the review of sources of information are very generous as they include records from environments not represented in the project area. The overall species lists are presented in the appendices, but only species actually likely to rely upon the project area and/or the adjacent Regtional Park appear in tables presented in the body of the report. Species that may occur only in the adjacent Regional Park are included as they may be affected by activities in the project area.

3.7 Site inspection

The project area was visited by M. Bamford on 16th February 2010 for the site inspection. Weather conditions were typical for the time of year, being hot and dry. There had been no recent rain. Activities undertaken during the site inspection included:

1. Habitat descriptions;
2. Opportunistic observations, including recording conspicuous fauna and looking for evidence of fauna such as diggings, tracks and scats.

Most of the length of the study area was visited on foot, and parts of the adjacent Regional Park were also visited to provide context.

4 RESULTS

4.1 Site description

The project area is largely cleared and consists of fallow, weed-infested paddocks that slope down to wetlands dominated by Bulrush *Typha* sp. on the margin with Yellagonga Regional Park. The Bulrush extends into the project area in places. There are several houses along Wanneroo Road. There are some introduced trees within the project area and very few remnant native trees such as Flooded Gum *Eucalyptus rudis*. The adjacent Regional Park consists largely of a wetland with limited surface water in summer but that floods extensively in winter. The only surface water at the time of the site inspection was in a central drain within the Regional Park; this is probably the remnant of a canal used to transport produce along the chain of lakes from Joondalup to Goollelal. This wetland is covered with Bulrush (ie. there is effectively no open water) but with some riparian trees such as Flooded Gum and Freshwater Paperbark *Melaleuca rhaphiophylla.* There are also some exotic trees within the Regional Park, including Figs and some non-local eucalypts. Note that Yellagonga Regional Park is narrow but long, and extends from Hepburn Avenue in the south to Burns Beach Road in the north. The project area lies about one third of the length of the Regional Park, from the south. Most of the Regional Park is wetland but it includes some upland vegetation and is the major north-south wildlife corridor in Perth's northern suburbs. There is extensive but degraded upland native vegetation (mainly *Banksia* woodland) on the western side of the Regional Park, opposite the project area.

Overall, both the project area and the adjacent Regional Park are highly modified environments with high levels of weed invasion, but they are large areas of undeveloped land within the northern suburbs. Key features of the environment that provide habitat for fauna are:

- Cleared areas dominated by weeds; mostly within the project area (Figure 1);
- Isolated and occasional groups of non-native trees; within the project area and adjacent Regional Park (Figure 2);
- Rushbeds of Bulrush with seasonal water;(mostly within the Regional Park but extending into the project area in places (Figure 3); and
- Riparian woodland of Flooded Gum and Freshwater Paperbark; largely within the Regional Park (Figure 3).

Banksia woodland lies within Yellagonga Regional Park but outside the project area.

Figure 1. Cleared pasture dominated by weeds within project area.

Figure 2. Scattered, non-native trees over pasture.

Figure 3. Rushbed of Bulrush *Typha* sp. with adjacent riparian woodland of Flooded Gum and Freshwater Paperbark.

4.2 Vertebrate fauna of the project area

Fauna species known to occur in the general region of the northern suburbs based on the sources of information (see Section 3.5) are listed in Appendix 3 (vertebrate species only). The majority of these species are not likely to occur in the project area due to the lack of suitable habitat. Species that are or may be present are discussed below.

The desktop study identified a fauna assemblage that may occur in the project area consisting of: 4 fish, 6 frog, 19 reptile, 85 bird and 13 mammal species. Twenty-two of the species expected to occur in the project area are of conservation significance.

4.2.1 Freshwater Fish

All the freshwater fish listed in Appendix 3, the Swan River Goby, Goldfish, Carp and Mosquitofish, are present in Yellagonga Regional Park. They can therefore be expected to occur adjacent to the project area. Only the Swan River Goby is native.

4.2.2 Frogs

Only six of the frog species listed in Appendix 3 are likely to occur within the project area (Table 1). All are widespread species in the northern suburbs and the Motorbike Frog makes extensive use of garden ponds. The Moaning Frog and Pobblebonk are notable for being strictly terrestrial for much of the year and occur away from wetlands outside the breeding season (autumn/early winter and winter/spring respectively). There are anecdotal accounts of these two species being adversely affected by garden fencing, which interferes with their migration, and the Moaning Frog is reliant upon predictable water level rises in autumn in order to breed successfully.

Table 1. Frog species likely to occur in the project area.

Species	
Hylidae (tree-frogs)	
Slender Tree-Frog	*Litoria adelaidensis*
Motorbike Frog	*Litoria moorei*
Myobatrachidae (ground frogs)	
Clicking Froglet	*Crinia glauerti*
Sandplain Froglet	*Crinia insignifera*
Moaning Frog	*Heleioporus eyrei*
Pobblebonk	*Limnodynastes dorsalis*

4.2.3 Reptiles

Appendix 3 lists 50 reptile species as occurring in the northern suburbs of Perth; 19 of these may be present in the project area (Table 2). Of these 19, the Bobtail, Two-toed Skink, Dwarf Skink and Tiger Snake were recorded during the site inspection. Several of the reptile species expected to be present (eg. Long-necked Tortoise, Cool Skink and Tiger Snake) are aquatic or associated with vegetation round wetlands, while the remaining species are known to occur in disturbed and degraded environments around Perth. These do not necessarily require native vegetation and some can survive in urban gardens, but others require more continuous habitat. For example, the larger, mobile species (eg. Bearded Dragon and Gould's Sand Goanna) seem to persist around Lake Goollelal only because of large areas of degraded upland vegetation. Twelve of these species have been observed in a garden in Kingsley, just south of the project area, but several of these have been noted (M. Bamford pers. obs.) as sensitive to predation by domestic cats (Bearded Dragon, West Coast Ctenotus and probably Gould's Sand Goanna).

Table 2. Reptile species likely to occur in the project area.

Species	
Chelidae (side-necked tortoises)	
South-West Long-necked Tortoise	*Chelodina oblonga*
Gekkonidae (geckoes)	
Marbled Gecko	*Christinus marmoratus*
Spiny-tailed Gecko	*Strophurus spinigerus*
Pygopodidae (legless lizards)	
Sandplain Worm Lizard	*Aprasia repens*
Burton's Legless Lizard	*Lialis burtonis*
Agamidae (dragon lizards)	
Western Bearded Dragon	*Pogona minor*
Varanidae (monitors or goannas)	
Gould's Sand Goanna	*Varanus gouldii*
Scincidae (skink lizards)	
South-west Cool Skink	*Acritoscincus trilineatum*
Fence Skink	*Cryptoblepharus buchananii*
West Coast Ctenotus	*Ctenotus fallens*
Two-toed Skink	*Hemiergis quadrilineata*
Four-toed Lerista	*Lerista elegans*
Western Worm Lerista	*Lerista praepedita*
Dwarf Skink	*Menetia greyii*
Spotted Morethia	*Morethia lineoocellata*
Dusky Morethia	*Morethia obscura*
Bobtail	*Tiliqua rugosa*
Elapidae (front-fanged snakes)	
Tiger Snake	*Notechis scutatus*
Dugite	*Pseudonaja affinis*

4.2.4 Birds

Appendix 3 lists 181 bird species as occurring in the northern suburbs of Perth. This excludes marine species and probably some vagrants. Approximately half of these (85 species, see Table 3) may occur in the project area or in the adjacent Regional Park.

Many of the birds expected utilise degraded environments, including pasture, but there are also species that rely on the riparian vegetation and on remnant native vegetation. Some of the bird species are of conservation significance and this is indicated in Table 3. Significant species are discussed in Section 5.

Table 3. Bird species likely to occur in the project area. Species of conservation significance are noted, using categories as outlined in Appendix 1 (Section 5.1.1). [int] indicates introduced species. Species observed during the site inspection are indicated "X".

Species		Conservation Significance
Anatidae (ducks, geese and swans)		
Australian Shelduck	*Tadorna tadornoides*	
Pacific Black Duck	*Anas superciliosus*	
Grey Teal	*Anas gibberifrons*	
Australian Wood Duck	*Chenonetta jubata*	
Columbidae (pigeons and doves)		
Rock Dove (Domestic Pigeon)	*Columba livia*	
Laughing Dove	*Streptopelia senegalensis*	X
Spotted Dove	*Streptopelia chinensis*	
Crested Pigeon	*Ocyphaps lophotes*	
Podargidae (frogmouths)		
Tawny Frogmouth	*Podargus strigoides*	
Ardeidae (herons and egrets)		
Australasian Bittern	*Botaurus poiciloptilus*	CS1
Australian Little Bittern	*Ixobrychus dubius*	CS2
White-faced Heron	*Egretta novaehollandiae*	
White-necked Heron	*Ardea pacifica*	
Eastern Great Egret	*Ardea modesta (alba)*	CS1
Nankeen Night Heron	*Nycticorax caledonicus*	
Threskionithidae (ibis and spoonbills)		
Australian White Ibis	*Threskiornis molucca*	
Straw-necked Ibis	*Threskiornis spinicollis*	
Yellow-billed Spoonbill	*Platalea flavipes*	
Accipitridae (kites, hawks and eagles)		
Black-shouldered Kite	*Elanus axillaris*	
Whistling Kite	*Haliastur sphenurus*	

Species		Conservation Significance
Swamp Harrier	*Circus approximans*	
Brown Goshawk	*Accipiter fasciatus*	CS3
Collared Sparrowhawk	*Accipiter cirrhocephalus*	CS3
Falconidae (falcons)		
Peregrine Falcon	*Falco peregrinus*	CS1
Australian Hobby	*Falco longipennis*	
Nankeen Kestrel	*Falco cenchroides*	X
Rallidae (crakes and rails)		
Buff-banded Rail	*Rallus philippensis*	
Baillon's Crake	*Porzana pusilla*	
Australian Spotted Crake	*Porzana fluminea*	
Spotless Crake	*Porzana tabuensis*	
Dusky Moorhen	*Gallinula tenebrosa*	CS3
Purple Swamphen	*Porphyrio porphyrio*	
Eurasian Coot	*Fulica atra*	
Recurvirostridae (stilts and avocets)		
Black-winged Stilt	*Himantopus himantopus*	
Charadriidae (lapwings and plovers)		
Black-fronted Dotterel	*Elseyornis melanops*	
Red-kneed Dotterel	*Erythrogonys cinctus*	
Banded Lapwing	*Vanellus tricolor*	
Cacatuidae (cockatoos)		
Carnaby's Black-Cockatoo	*Calyptorhynchus latirostris*	CS1
Galah	*Cacatua roseicapilla*	X
Long-billed Corella [int]	*Cacatua tenuirostris*	
Little Corella	*Cacatua sanguinea*	
Psittacidae (lorikeets and parrots)		
Rainbow Lorikeet [int]	*Trichoglossus haematodus*	
Australian Ringneck	*Barnardius zonarius*	
Red-capped Parrot	*Purpureicephalus spurius*	
Elegant Parrot	*Neophema elegans*	
Cuculidae (cuckoos)		
Pallid Cuckoo	*Cuculus pallidus*	
Strigidae (hawk-owls)		
Southern Boobook	*Ninox novaeseelandiae*	
Tytonidae (barn owls)		
Barn Owl	*Tyto alba*	
Halcyonidae (forest kingfishers)		
Sacred Kingfisher	*Todiramphus sanctus*	

Species		Conservation Significance
Laughing Kookaburra	*Dacelo novaeguineae*	
Meropidae (bee-eaters)		
Rainbow Bee-eater	*Merops ornatus*	CS1
Maluridae (fairy-wrens)		
Splendid Fairy-wren	*Malurus splendens*	CS3
Variegated Fairy-wren	*Malurus lamberti*	CS3
Pardalotidae (pardalotes)		
Striated Pardalote	*Pardalotus striatus*	
Spotted Pardalote	*Pardalotus punctatus*	
White-browed Scrubwren	*Sericornis frontalis*	CS3
Weebill	*Smicrornis brevirostris*	CS3
Western Gerygone	*Gerygone fusca*	
Inland Thornbill	*Acanthiza apicalis*	CS3
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	CS3
Meliphagidae (honeyeaters)		
Red Wattlebird	*Anthochaera carunculata*	X
Western Wattlebird	*Anthochaera lunulata*	CS3
Singing Honeyeater	*Lichenostomus virescens*	X
Brown Honeyeater	*Lichmera indistincta*	X
White-cheeked Honeyeater	*Phylidonyris nigra*	CS3
New Holland Honeyeater	*Phylidonyris novaehollandiae*	CS3
Acrocephalidae (reed-warblers)		
Australian Reed-Warbler	*Acrocephalus australis*	X
Megaluridae (grassbirds)		
Little Grassbird	*Megalurus gramineus*	
Zosteropidae (white-eyes)		
Silvereye	*Zosterops lateralis*	X
Pachycephalidae (whistlers)		
Rufous Whistler	*Pachycephala rufiventris*	
Dicruridae (flycatchers)		
Magpie-lark	*Grallina cyanoleuca*	
Grey Fantail	*Rhipidura fuliginosa*	
Willie Wagtail	*Rhipidura leucophrys*	X
Neosittidae (sittella)		
Varied Sittella	*Daphoenositta chrysoptera*	CS3
Campephagidae (cuckoo-shrikes)		
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	X
White-winged Triller	*Lalage sueurii*	
Artamidae (woodswallows)		

Species		Conservation Significance
Black-faced Woodswallow	*Artamus cinereus*	CS3
Grey Butcherbird	*Cracticus torquatus*	
Australian Magpie	*Gymnorhina tibicen*	X
Corvidae (ravens and crows)		
Australian Raven	*Corvus coronoides*	X
Motacillidae (pipits and true wagtails)		
Australian Pipit	*Anthus novaeseelandiae*	X
Dicaeidae (flower-peckers)		
Mistletoebird	*Dicaeum hirundinaceum*	
Hirundinidae (swallows)		
White-backed Swallow	*Cheramoeca leucosternus*	
Welcome Swallow	*Hirundo neoxena*	
Tree Martin	*Petrochelidon nigricans*	

4.2.5 Mammals

Appendix 3 lists 24 mammal species as occurring in the northern suburbs of Perth, of which 13 (Table 3) may occur in the project area or in the adjacent Regional Park. These 13 species include five introduced species, all of which are regularly observed around Lake Goollelal, so only eight native mammal species are likely to be present. Western Grey Kangaroos occur west of Yellagonga Regional Park, where a mob of about 30 animals is present (M. Bamford pers. obs.), and fresh scats were found in the project area, indicating some animals at least visit the area. The Rakali or Water-rat and Brush-tail Possum both occur around Lake Goollelal (M. Bamford pers. obs) and are therefore very likely to be present in the project area. The four bat species have also been recorded in the vicinity of the project area (M. Bamford pers. obs.), but the remaining native species, the Quenda, is not known from Lake Goollelal but is present at bushland reserves round wetlands to the east, such as Little Badgerup Swamp. It also occurs just to the north of Yellagonga Regional Park, so has the potential to colonise the project area.

The Rakali is aquatic and may occur where-ever there is surface water, probably moving into the area in winter and retreating to permanent water, such as at Lake Goollelal, for the rest of the year. The Quenda favours dense, low vegetation such as occurs around wetlands, and will inhabit dense weeds as well as dense native vegetation. The possum and bats rely on large, old trees for roosting, although both the White-striped and Gould's Wattled Bats have been found roosting in hollow metal cross-members of power poles in nearby Craigie (M. Bamford pers. obs.). The possum and bats will also use constructed nest-boxes. The Yellagonga mob of Kangaroos shelters in degraded banksia woodland and forages in degraded pasture north of Whitfords Avenue and just east of Duffy Terrace.

Some of the mammal species are of conservation significance and this is indicated in Table 3. Significant species are discussed in Section 4.

Table 4. Mammal species likely to occur in the project area. Species of conservation significance are noted, using categories as outlined in Appendix 1. [int] indicates introduced species. Species observed around Lake Goollelal and that are therefore very likely to occur in the project area are indicated "X".

Species		Status
Peramelidae (bandicoots)		
Quenda or Brown Bandicoot	*Isoodon obesulus*	CS2
Phalangeridae (brushtail possums)		
Brush-tailed Possum	*Trichosurus vulpecula*	X
Macropodidae (kangaroos and wallabies)		
Western Grey Kangaroo	*Macropus fuliginosus*	X
Mollosidae (mastiff bats)		
White-striped Bat	*Tadarida australis*	X
Vespertilionidae (vesper bats)		
King River Eptesicus	*Vespadelus (Eptesicus) regulus*	
Gould's Wattled Bat	*Chalinolobus gouldii*	X
Lesser Long-eared Bat	*Nyctophilus geoffroyi*	
Muridae (rats and mice)		
House Mouse [int]	*Mus musculus*	X
Rakali or Water-rat	*Hydromys chrysogaster*	CS2 X
Black Rat [int]	*Rattus rattus*	X
Leporidae (rabbits and hares)		
Rabbit [int]	*Oryctolagus cuniculus*	X
Canidae (foxes and dogs)		
European Red Fox [int]	*Vulpes vulpes*	X
Felidae (cats)		
Feral Cat [int]	*Felis catus*	X

4.3 Fauna – species of conservation significance

Details on species of conservation significance are discussed below. Impact upon these species are considered in Section 5.

4.3.1 Frogs

None of the frog species expected is of conservation significance.

4.3.2 Reptiles

None of the reptile species expected is of conservation significance. However, a number of the species do not occur in urban areas so their presence is of at least local interest. These include the Sandplain Worm-Lizard, Burton's Legless-Lizard, Western Bearded Dragon and Gould's Goanna.

4.3.3 Birds

The bird assemblage includes five species of CS1 (high conservation significance listed under legislation), one species of CS2 (listed as Priority by the DEC) and 13 species of CS3 (locally significant because they have declined in the Perth area). These species are briefly discussed below. The majority of the significant species are likely to be infrequent visitors in small numbers, and furthermore are likely to occur in Yellagonga Regional Park and particularly the remnant upland woodland rather than within the project area. Several of the significant species are waterbirds but they usually require some open water, although the Australasian and Little Bitterns occur in dense bulrush. The Rainbow Bee-eater is almost certainly present as a breeding migrant in spring/summer.

Conservation Significance Level 1.

Australasian Bittern (DEC Schedule 1)

The Australasian Bittern is listed as Vulnerable under the WA Wildlife Conservation Act. This species frequents reedbeds and dense vegetation in wetlands. The bulrush area within and adjacent to the project area are suitable habitat, but there are no recent records of the species around Perth, so it is very unlikely to be present.

Eastern Great Egret

The Eastern Great Egret is a large, Australian breeding waterbirds listed as Migratory under the EPBC Act and under Schedule 3 of the WA Wildlife Conservation Act. It is common and widespread in Australia, and is a regular sight on wetlands around Perth, including Lake Goollelal. However, riparian vegetation at the project area and adjacent Regional Park is so dense that the species probably only occurs as an occasional visitor, perhaps when flooding creates open water on grassland areas.

Peregrine Falcon (DEC Schedule 4)

The Peregrine Falcon is classified as "Specially Protected Fauna" under Schedule 4 of the Wildlife Conservation Act. It is a widespread species with several pairs living within Perth, where at least one pair nests on a ledge of a tall building in the CBD (natural nest sites are cliffs and very large trees). A pair is seen regularly in the Kingsley/Woodvale area and they probably

nest in a large hollow spout in a Tuart in Pinnaroo Valley (M. Bamford pers. obs.). There is no suitable nesting habitat in the project area nor are there large trees in the adjacent Regional Park, but the birds undoubtedly overfly and forage through the project area.

Carnaby's Black-Cockatoo (DEC Schedule 1)
Carnaby's Cockatoo is listed as Endangered under the EPBC Act, the Wildlife Conservation Act and according to Garnett and Crowley (2000). Carnaby's Cockatoo is dependent on large tree hollows (in Eucalypts) to breed. As a result of extensive clearance of woodlands in the Wheatbelt region, large hollow-bearing Eucalypts (and therefore breeding sites for the Carnaby's Cockatoo) are scarce, and this species has declined. The decline of Carnaby's Cockatoo has been exacerbated by the clearing of foraging habitat (typically *Banksia* woodland) along the west coast, partly due to urban expansion. Loss of such foraging habitat is recognised as a major threatening process by Garnett and Crowley (2000). There is little if any foraging habitat and no nesting habitat within the project area, but *Banksia* woodland is present in the adjacent Yellagonga Regional Park so the species is very likely to over-fly the project area.

Rainbow Bee-eater
The Rainbow Bee-eater is listed as Migratory under the EPBC Act and is a spring-summer migrant around Perth. It is common across much of Australia, occurs regularly around Lake Goollelal and constructs its nesting burrows in open ground in Yellagonga Regional Park. It almost certainly nests within the project area in the fallow paddocks in the October to January period.

Conservation Significance Level 2.
Little Bittern.
Listed as Priority 4 by DEC and occasionally recorded around Perth wetlands, generally in areas of dense rushbeds. The bulrush in the Regional Park adjacent to the project area is suitable habitat and the species has been recorded in the generally area in the past, and was recorded at Lake Goollelal during a recent (November 2009) survey by Birds Australia (R. Pickering pers.comm.).

Conservation Significance Level 3.
Fourteen bird species (see Table 3) are considered to be of local conservation significance. The majority of these are identified by the WA Department of Environmental Protection (DEP, 2000) as having declined in the Perth area due to impacts associated with urban development. A few of these are birds of prey, but the majority are small birds that rely on woodlands and shrublands where they are either residents (eg. fairy-wrens and thornbills) or seasonal visitors (honeyeaters). The fairy-wrens and thornbills are particularly sensitive to habitat loss and fragmentation, whereas the honeyeaters have a greater ability to access suitable habitat even when it is fragmented by urban development. One species, the Dusky Moorhen, is a waterbird that occurs on the fringes of rushbeds. The majority of the species listed by the DEP (2000) are also noted as having declined Australia-wide by more than 20% in the New Atlas of Australian Birds (Barrett *et al.* 2003). While these 14 species may be occasional visitors to the project area, the most suitable habitat for them is within the adjacent Regional Park.

4.3.4 Mammals

The mammal assemblage includes two species of CS2 (listed as Priority by the DEC). These species are briefly discussed below. The other native species (several bats, the Grey Kangaroo and the Brush-tailed Possum) could be considered of local significance as they have generally declined around Perth, but all are common elsewhere. Note that several species of high conservation significance would have occurred in the area historically, but are now locally extinct.

Conservation Significance Level 2.

Quenda or Southern Brown Bandicoot

Listed as Priority 5 by DEC and present at several locations nearby, but not found in the project area and not recorded at Lake Goollelal. Despite this, the dense vegetation around the margins of the wetland, including dense weeds within the project area, are suitable habitat. With nearby populations, the project area could thus provide a corridor for movement of the species through the region.

Rakali or Water Rat

Listed as Priority 4 by DEC and is of concern because the species' population is in decline, particularly along rivers affected by salinity or degradation. The species appears to be common in Yellagonga Regional Park, with regular sightings around Lake Goollelal and several trapped at this lake in a low intensity trapping programme in 2009 (N. Huang pers. comm..). The Rakali is therefore almost certainly present in the Regional Park adjacent to the project area, and is probably a regular visitor in the project area, especially during winter when water levels are high.

4.3.5 Invertebrates

Less information on invertebrate species is available than is the case for vertebrate species, but a number of conservation significant invertebrate species are known from the northern suburbs region of Perth. These include the Graceful Sunmoth *Symenon grantiosa* (Castniidae), listed under the EPBC as Endangered and as Schedule 1 (Endangered) of the WA Wildlife Conservation Act, and three Priority 3 species: *Austrosaga spinifer* (a cricket), *Hyaleus globuliferus* and *Leioproctus contrarius* (both native bees). The Graceful Sun Moth has a very restricted distribution and is only known to occur in association with two species of Lomandra, *Lomandra hermaphrodita* and *Lomandra maritima.* Given the level of weed invasion in the project are, and the degradation of the *Banksia* woodland in the adjacent Regional Park, it is unlikely these plant species are present. The cricket and native bees are associated with heaths and/or banksia woodlands with healthy understorey and therefore it is unlikely that the habitats are suitable for them.

5 IMPACT ASSESSMENT

Developments such as that proposed for the Woodvale site can impact upon fauna in a number of ways. For example:

- Loss of habitat (clearing);
- Fragmentation of habitat;
- Obstructions (e.g. pipes on ground, roads) to the movements of terrestrial fauna;
- Impacts to surface and groundwater flows (through vegetation clearing, interception of the ground water table and dewatering);
- Introduction of permanent water storages;
- Death/injury of fauna during clearing, grading and impacts with vehicles/machinery;
- Disturbance of fauna in nearby areas from light, blasting vibrations, noise, dust and even people feeding selected species;
- Creation of new and sometimes novel habitats; and
- Changes in the abundance of feral species.

Some impacts upon fauna are unavoidable. Of concern are long-term, deleterious impacts upon biodiversity that are significant within the context of a site. Of interest are impacts that may be positive rather than negative. Impacts are re discussed below under the following categories:

- Habitats. Impacts may be significant if the habitat is rare, a large proportion of the habitat is affected and/or the habitat supports significant fauna.
- Significant fauna. Impacts may be significant if species of conservation importance are affected.
- Processes. Ecological processes are complex and can include hydrology, fire, predator/prey relationships and spatial distribution of a population (see discussion below). Impacts upon ecological processes may be significant if large numbers of species or large proportions of populations are affected.
- Patterns of biodiversity. Species are not distributed evenly across the landscape or even within one vegetation/landform type. There may be zones of high biodiversity such as particular habitats or ecotones (transitions between habitats).

Table 4 summarises impacts upon fauna according to criteria set out in the EPA Guidance Statement No. 56. This assessment recognises that the project area is of local importance because most of the surrounding areas are urbanised and the project area is adjacent to a Regional Park that acts as a wildlife corridor.

TABLE 4. The potential impacts to fauna of the proposal as assessed following the guidance of the EPA's Guidance Statement No. 56. (Terrestrial fauna surveys for environmental impact assessment in Western Australia, EPA 2004).

Factor	Impact and explanation
Degree of habitat degradation or clearing within the local area or region.	Low to Moderate (project lies within a region of fragmented and degraded ecosystems and the project area supports degraded ecosystems)
Size/scale of proposal/impact.	Low (small area of disturbance).
Rarity of vegetation and landforms.	Low to moderate (vegetation and landforms present in project area are poorly-represented regionally, but are of low value for fauna).
Refugia.	Low (project area does not have refugial habitats)
Fauna protected under international agreements or treaties, Specially Protected or Priority Fauna.	Low (very few species of high conservation significance present).
Size of remnant and condition/intactness of habitat and faunal assemblage.	Low to moderate (project area is small, degraded and with an incomplete fauna assemblage, but the assemblage is more complete than in surrounding urban areas so has some importance in a regional context).
Ecological linkage.	Moderate (The area is part of an ecological linkage at the regional or local scale.).
Heterogeneity or complexity of the habitat and faunal assemblage.	Moderate (The habitat and fauna assemblage of the project area are not complex, but they are distinctive in the context of the surrounding urban environment).

5.1 Habitat Types

The main habitat types are described is section 4.1 (above). The extent and impact on each habitat type can be summarised as follows:

Cleared areas dominated by weeds. These will be extensively impacted (directly) by the development but are of low value for fauna and are represented within Yellagonga Regional Park.

Isolated and occasional groups of non-native trees. These are mostly within the Regional Park so will not be directly impacted. Although not native, they are important, mostly for birds and some mammals. There will be an increase in plantings of non-native trees with urban development, so this habitat type will increase within the project area.

Rushbeds of Bulrush with seasonal water. These are mostly within the Regional Park so will not be directly impacted, except for possibly for some loss along the boundary of the Regional Park. They may, however, be indirectly affected through hydrological change, disturbance, etc. Such indirect, process-related impacts are discussed in section 5.3. There may also be some creation of rushbeds within public open space where swales a created to treat stormwater before it enters the Regional Park.

Riparian woodland of Flooded Gum and Freshwater Paperbark. These are mostly within the Regional Park and will not be directly impacted adversely, but will be positively impacted through plantings on public open space where the project area lies alongside the Regional Park.

Banksia woodland. This lies entirely within the Regional Park so will not be directly impacted. There may be some indirect, adverse impacts through disturbance and fire, which are discussed in section 5.3. There may also be some positive impacts on this vegetation type through use of native plants in gardens and public open space.

In summary, most impacts upon habitats affect the cleared areas dominated by weeds; this habitat is least important for fauna and is well-represented in the adjacent Regional Park. There are also potential positive impacts through the creation of habitat in public open space and gardens. Indirect impacts are discussed in section 5.3.

5.2 Conservation Significant Fauna

The desktop review found that 22 vertebrate species of conservation significance may occur in the project area, with four significant invertebrate species known from the region but unlikely to be present (see section 4.3). The status of the significant vertebrate fauna and predicted impacts of the proposed development upon them are presented in Table 5. Predicted impacts are drawn largely from personal experience with the species in urban landscapes. A range of impacts is expected:

- Negligible impacts (eight species).
- Some benefit through an increase in habitat (through revegetation of public open space and gardens) but may suffer an increase in predation from domestic pets (five species;

effect of domestic pets has been documented on the fairy-wrens at Lake Goolellal (Bamford 2008).

- Some benefit through an increase in habitat (seven species not expected to be affected by domestic pets. This includes the Quenda).
- Loss of habitat (two species; both well-represented elsewhere).

In summary, impacts upon significant species vary, with most species unaffected or potentially benefitting from the proposed development due to rehabilitation. There is, however, concern due to the impact of domestic pets, and two species (the Rainbow Bee-eater(CS1) and Black-faced Woodswallow (CS3)) will lose habitat. This loss is not expected to have a significanty impact on these species as both are widespread and there is suitable habitat nearby.

Table 5. Conservation significant vertebrate fauna that may occur in the project area; status and predicted impacts of the proposed development.

Species	Status in project area	predicted impacts
CS1		
Australasian Bittern	Possible very infrequent visitor	Negligible
Eastern Great Egret	Occasional visitor in small numbers	Negligible
Peregrine Falcon	Regular flyover	Negligible
Carnaby's Black-Cockatoo	Regular flyover	Negligible; possibility of creation of foraging habitat
Rainbow Bee-eater	Regular breeding visitor	Loss of nesting habitat but this is not limited in area
CS2		
Little Bittern	Present in general area and probably in Bulrush of adjacent Regional Park	Negligible
Quenda	Not present but potential to colonize	Improved connectivity through rehabilitation, but potential increase in predation
Rakali	Present in waterways	Negligible; they appear tolerant of urbanisation around Lake Goollelal
CS3		
Brown Goshawk	Resident or regular visitor	Negligible
Collared Sparrowhawk	Resident or regular visitor	Negligible
Dusky Moorhen	Infrequent visitor	Negligible
Splendid Fairy-wren	Probably resident or regular visitor (population around Lake Goollelal)	Increase in habitat but also potential increase in predation
Variegated Fairy-wren	Probably resident or regular visitor (population around Lake Joondalup)	Increase in habitat but also potential increase in predation
White-browed Scrubwren	Probably resident or regular visitor (population around Lake Joondalup)	Increase in habitat but also potential increase in predation
Weebill	Resident	Increase in foraging habitat
Yellow-rumped Thornbill	Probably resident or regular visitor (population around Lake Joondalup)	Increase in habitat but also potential increase in predation
Inland Thornbill	Probably resident or regular visitor (population around Lake Joondalup)	Increase in habitat but also potential increase in predation
Western Wattlebird	Regular visitor	Increase in foraging habitat
White-cheeked Honeyeater	Regular visitor	Increase in foraging habitat
New Holland Honeyeater	Regular visitor	Increase in foraging habitat
Varied Sittella	Probably resident or regular visitor (population around Lake Goollelal)	Increase in foraging habitat

Black-faced Woodswallow	Occasional visitor	Decline in open grassland habitat

5.3 Ecological Processes

Many of the potential impacts of proposed developments upon fauna can be related to ecological processes, and this is recognised under the EPBC Act, in which threatening processes are listed, and in the literature (see Appendix 1). A number of ecological processes can be related to the impacts upon fauna of the project, and these are discussed below. In general, impacts associated with ecological processes are likely to be low, with main impacts related to:

- Increase in abundance of introduced predators;
- Hydrological changes;
- Effects of light; and
- Increase in available habitat

These and other threatening processes are discussed below.

5.3.1 Initial and ongoing mortality

Increased mortality is inevitable during clearing operations and from ongoing activities, such as roadkill due to animals being struck by vehicles. The area to be developed is mostly poor quality habitat so direct mortality of fauna during clearing is expected to be low, but clearing during late spring could destroy active nests of the CS1 Rainbow Bee-eater. Roadkill during and after construction may adversely affect populations of species such as the Bobtail and Gould's goanna, which are probably small and therefore vulnerable to the loss of even a few animals.

5.3.2 Changes in amount of habitat affecting population survival

The proposed project is likely to result in an increase rather than a decrease of habitat due to revegetation of public open space and even development of gardens and verge plantings. This should benefit a number of bird and possibly mammal species. At Lake Goollelal, the Splendid Fairy-wren recolonised the area in about 2008, with the birds occupying shrubs planted as part of a revegetation programme in the 1990s (M. Bamford pers. obs.). Carnaby's Black-Cockatoos now forage in garden trees in suburbs established near Lake Goollelal in the early 1990s, while Weebills and Varied Sittellas have spread into the suburb from the Regional Park (M. Bamford pers. obs.). Swales designed to treat stormwater and prevent it from directly entering the Regional Park may provide seasonal open water that is currently a habitat not available in the area.

There will be a decline in grassland habitat used by species such as the Black-faced Woodswallow, Rainbow Bee-eater and Nankeen Kestrel, and local declines of these species were observed around Lake Goollelal following urban development in the late 1980s (M. Bamford pers. obs.). However, it is not anticipated that these local declines will affect the status of these species in the area, as there will remain extensive grasslands in Yellagonga Regional Park.

5.3.3 Changes in distribution of habitat affecting population movements and gene flow

The proposed development is situated adjacent to Yellagonga Regional Park, recognised as regionally significant fauna corridor. The project area to some extent supplements this role of

the Regional Park by increasing its width, but the habitat is generally poor. Rehabilitation of the public open space on the Regional Park side of the project area may have the effect of enhancing the linkage function of the Regional Park. Even gardens and verge plantings may have this effect, so the outcome of the proposed development may be enhanced linkage function. However, the development may introduce barriers to the movement of wildlife to and from the lake due to the construction of roads and fences. This may be a particular concern for frog species such as the Pobblebonk and Moaning Frogs, as these species effectively migrate between upland habitats where they spend most of their lives, and wetlands where they breed. There are anecdotal reports from residents of Kingsley that these species were initially common but declined as house and fences were established, with accounts of "large numbers" of frogs trapped against fences.

5.3.4 Species interactions, including predators and other feral species

Introduced species, including the Feral Cat, Fox and Rabbit, are present in the area and are probably having adverse impacts upon some native species. The cat population in particular may increase with the introduction of domestic cats into homes established in the area. The local extinction of fairy-wrens at Lake Goollelal correlated with the arrival of domestic cats in the area (Bamford 2008).

5.3.5 Hydroecology

The project area is adjacent to wetlands of Yellagonga Regional Park and these may be vulnerable to hydrological changes from increased runoff and reduced fringing vegetation. The proposed development has a drainage plan to manage stormwater via infiltration through swale wetlands, thus preventing major flood events that can carry sediment and chemicals from the roads into the main wetland. Such swales to manage stormwater have been created around Lake Goollelal. With this management, impacts associated with altered hydrology should be minimal.

5.3.6 Fire

The Bulrush areas are very prone to fire and regenerate rapidly, but the riparian woodland of Flooded Gums and Freshwater Paperbark is sensitive to fire, with bulrush suppressing trees if fires are too frequent. Development of a residential area adjacent to the Regional Park may increase the likelihood of fires being started, either accidentally or deliberately. A recent (December 2009) fire at Lake Goollelal started alongside a newly-established dual-use pathway that gave people access to riparian woodland at the lake.

5.3.7 Light, noise and disturbance

Light, noise and disturbance already occur around Yellagonga Regional Park and the project area, but the proposed development will reduce the distance between these and the Park. Rich and Longcore (2006) review the effects of lighting on biodiversity and include accounts of declines of insect populations in urban woodlands due to the mortality of adults at street lights. It is not known if such an effect is a concern at Yellagonga Regional Park. One effect of lights, however, is that non-biting midges are attracted into the suburbs, sometimes resulting in spraying programmes in the wetlands. Advice from the City of Joondalup and the DEC is that such spraying is benign if carried out correctly, but these agencies can also advise on how to minimise midge "problems". These include reducing nutrient-rich runoff into the lake, screen planting and minimising outside lighting.

The effect of noise is not likely to change due to the proposed development, as the location is already noisy with major roads nearby, but disturbance may increase with increased recreational use of the adjacent Regional Park by people.

5.4 Patterns of Biodiversity

The project area is generally of low value for biodiversity, with higher biodiversity values in the adjacent Regional Park. Even in this area the vertebrate fauna is depauperate, but it is significant because of the very low fauna values of the surrounding suburbs. Adverse impacts upon the biodiversity of the Regional Park are anticipated to be low, but some management needs to be considered (see below). There are also ways in which the proposed development could enhance the biodiversity of the Regional Park through the creation of additional fauna habitat.

6 CONCLUSIONS: FAUNA VALUES, IMPACTS AND MANAGEMENT

Sections 4 and 5 present information on the fauna assemblage of the project area (and the adjacent Regional Park) and how this assemblage may be affected by the proposed development. The identification of values and impacts provides guidance for management. Fauna values, impacts and recommendations for management are summarised below. Note that while it is the project area where development will occur, the juxtaposition with the Regional Park means that values, impacts and recommendations need to consider both the project area and the Regional Park.

6.1 Values for fauna

The fauna assemblage is poor because of the degraded nature of the site and degraded nature of adjacent Regional Park, but is still significant in the urban setting. Key values are:

- An incomplete but still substantial assemblage of vertebrate fauna compared with surrounding suburbs. For example, over a third of the reptiles present on the northern outskirts of Perth may occur within the project area and adjacent Regional Park, and almost half the bird species of the northern outskirts of Perth may be present at least occasionally. The population of Western Grey Kangaroos is valued by local residents. Despite the presence of wetlands, waterbirds are poorly represented beaue the wetlands are almost entirely covered with Bulrush, there being almost no open water.
- The fauna assemblage includes a few species of listed conservation significance, such as the Rakali or Water-rat, Carnaby's Black-Cockatoo and Rainbow Bee-eater.
- The fauna assemblage includes a number of species that are at least locally significant, such as some reptiles, mammals such as the Brush-tailed Possum and a suite of birds that has declined in urban areas (thornbills, fairy-wrens).
- Several species of high conservation significance could be present, but probably only as infrequent visitors (eg. Australasian and Little Bitterns may be present in the Bulrush areas of the regional park).
- The regional park is the major north-south corridor for wildlife movements through the local suburban area. This is probably very important for some birds and mammals. Most

of this function probably on the western side of the Regional Park where there is remnant (albiet degradede) upland woodland.
- While the vegetation in both the project area and adjacent Regional Park is degraded, it does provide habitat, and the extensive Bulrush areas probably act as a biological filter for water entering the Regional Park from nearby suburbs and light industrial areas.

6.2 Impacts upon fauna

There could be both positive and negative impacts upon fauna from the propsoed development.

Impacts: negative

- Loss of even upland habitats in the project area that currently support a few species, including breeding Rainbow Bee-eaters. However, the significance of this impact is thought to be low as there is extensive similar habitat within the Regional Park.
- Some loss of fringing Bulrush areas that provide habitat and may filter water entering the Regional Park. However, Bulrush is very extensive and there is no recent evidence of species of high conservation significance (bitterns) being present in ther area.
- Increased predation presure on reptiles and small birds, and possibly also mammals, from domestic cats. This may be a serious concern as local extinctions from such predation have been documented.
- Increased mortality of some reptiles due to roadkill. This could threaten the persistence of small populations.
- Increased disturbance of wildlife and potential for fires due to increased levels of human activity in the Regional Park.
- Disruption of fauna movement such as frogs travelling to and from the Regional Park, due to installation of roads and fences.
- Increased lighting close to the Regional Park may increase mortality of insects. Location of homes close to the Regional Park may result in an increase in demand for midge control by spraying in the Regional Park.
- Hydrological changes such as increased runoff into the Regional Park.

Impacts: positive

- Rehabilitation in public open space, development of gardens and verge plantings have the potential to increase habitat available for a range of bird and possibly mammal species.
- The increase in fauna habitats from rehabilitation and other plantings may improve the linkage function of the Regional Park. This effect likely to be especially important for birds that have declined in the urban area, and has already been documetned for the Splendid Fairy-wren at nearby Lake Goollelal.
- Swales in public open space may provide seasonal open water which is currently a habitat not available in the adjacent Regional Park.

6.3 Recommendations

A number of recommendations can be made to enhance the positive and manage the negative impacts. For example:

- Avoid clearing in grassland during the spring breeding season of the Rainbow Bee-eater.
- Encourage responsible pet ownership; particularly with respect to cats.
- Keep road speeds down to minimise roadkill.
- Liaise with the City of Jondalup and the DEC over the management of non-biting midges in the area.
- Encourage use of native plants in gardens and in verge plantings to enhance wildlife habitat.
- Ensure that swales designed for stormwater management are effective and provide habitat through plantings and, if possible, the creation of seasonal open water.
- Provide information to residents on living close to a Regional Park. This could include providing them with information on the impact of fences on tortoises and frogs, the impact of domestic cats on wildlife, awareness of snakes, the risk of bushfire and the value of native plants for wildlife.

7 REFERENCES

Aplin, K.P. and Smith, L.A. (2001). Checklist of the frogs and reptiles of Western Australia. Rec. WA Museum Suppl. No. 63: 51-74.

Bamford, M.J. (2008). Local Extinction of Fairy-wrens due to Cat Predation? Amytornis 1(1): 25-26.

Barrett, G., Silcocks, A., Barry, S., Cunningham, R. and Poulter, R. (2003). The New Atlas of Australian Birds. Royal Australasian Ornithologists Union, Melbourne.

Blakers, M., Davies, S.J.J.F. and Reilly, P.N. (1984). The Atlas of Australian Birds. Royal Australasian Ornithologists Union. Melbourne University Press.

Burbidge, A.A. and McKenzie, N.L. (1989). Patterns in the Modern Decline of Western Australia's Vertebrate Fauna; Causes and Conservation Implications. Biol. Cons. 50: 143-198.

Christidis, L. and Boles, W.E. (2008). Systematics and Taxonomy of Australian Birds. CSIRO Publishing, Collingwood.

Clevenger, A. P. and Waltho, N. (2000). Factors Influencing the Effectiveness of Wildlife Underpasses in Banff National Park, Alberta, Canada. *Conservation Biology* **14**: 1-11

Cogger, H.G.,Cameron, E.E., Sadlier, R.A. and Eggler, P. (1993). The Action Plan for Australian Reptiles. Environment Australia, Canberra

Department of Environmental Protection (2000). Bush Forever Volume 2. Government of Western Australia, Perth.

Dufty, A.C. (1989). Some Population characteristics of *Perameles gunnii* in Victoria. Wildlife Research: **18** (3) 355 – 365.

Duncan, A., Baker, G.B. and Montgomery, N. (1999). The Action Plan for Australian Bats. Environment Australia, Canberra.

Environmental Protection Authority. (2002). Terrestrial Biological Surveys as an Element of Biodiversity Protection. Position Statement No. 3. Environmental Protection Authority, Perth, Western Australia.

Environmental Protection Authority. (2004). Guidance for the assessment of environmental factors: Terrestrial fauna surveys for environmental impact assessment in Western Australia. No. 56. Environmental Protection Authority, Perth, Western Australia.

Garnett, S.T. and Crowley, G.M. (2000). The Action Plan for Australian Birds 2000. Environment Australia, Canberra.

How, R.A., Cooper, N.K. and Bannister, J.L. (2001). Checklist of the mammals of Western Australia. Rec. WA Museum Suppl. No. 63: 91-98.

Jackson, S. D. and Griffin, C. R. (2000). A Strategy for Mitigating Highway Impacts on Wildlife. Pp. 143 – 159, In Messmer, T. A and B. West, (eds) Wildlife and Highways: Seeking Solutions to an Ecological and Socio – economic Dilemma. The Wildlife Society.

Jones, M.E. (2000). Road upgrade, road mortality and remedial measures: impacts on a population of eastern quolls and Tasmanian devils. *Wildlife Research* **27**: 289 – 296.

Lee, A.K. (1995). The Action Plan for Australian Rodents. Environment Australia, Canberra.

Mace, G. and Stuart, S. (1994). Draft IUCN Red List Categories, Version 2.2. Species; Newsletter of the Species Survival Commission. IUCN - The World Conservation Union. No. 21-22: 13-24.

Maxwell, S., Burbidge, A.A. and Morris, K. (1996). Action Plan for Australian Marsupials and Monotremes. Environment Australia, Canberra.

Rich, C. and Longcore, T. (2006). *Ecological Consequences of Artificial Night Lighting*. Island Press.

Scheick, B.K. and Jones, M.D. (1999). Locating Wildlife Underpasses Prior To The Expansion Of Highway 64, In North Carolina. In Proceedings of the International Conference on Wildlife 1999.

8 APPENDIX 1. IMPACT ASSESSMENT

8.1 Background to Impact Assessment

Development of the project area may adversely impact upon fauna in a number of ways and some impacts upon fauna are unavoidable. Of concern are long-term, deleterious impacts upon biodiversity. These can be considered under the following categories:

- "Habitats" – "Habitats", which are really associations of vegetation type, soil and landform, can be important for biodiversity if they are rare and support unusual species assemblages, or if they support naturally high levels of biodiversity. Impacts may therefore be significant if the impacted "habitat" is rare or biodiverse. Thus, "habitats" considers both the diversity of the environments in a project area and the pasterns of distribution of fauna across those environments.
- Fauna of Conservation Significance - Impacts may be significant if species of conservation importance are affected. The assessment of conservation significance is discussed below.
- Ecological Processes - Ecological processes are complex and can include hydrology, fire, predator/prey relationships and spatial distribution of a population. Impacts upon ecological processes may be significant if large numbers of species or large proportions of populations are affected. Ecological processes that may be important in the assessment of impacts are discussed below and in Appendix 2.

8.1.1 Assessment of Conservation Significance

The conservation status of fauna species is assessed under Commonwealth and State Acts such as the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the Western Australian *Wildlife Conservation Act 1950*. The EPBC Act also provides protection for threatened ecological communities. The significance levels for fauna used in the EPBC Act are those recommended by the International Union for the Conservation of Nature and Natural Resources (IUCN) and reviewed by Mace and Stuart (1994). The Wildlife Conservation Act uses a set of Schedules but also classifies species using some of the IUCN categories. These categories and Schedules are described in Appendix 1.

The EPBC Act also has lists of migratory species that are recognised under international treaties such as the China Australia Migratory Bird Agreement (CAMBA), the Japan Australia Migratory Bird Agreement (JAMBA), the Republic of Korea Australia Migratory Bird Agreement (ROKAMBA) and the Bonn Convention (The Convention on the Conservation of Migratory Species of Wild Animals). In addition, the federal Department of Environment, Water, Heritage and the Arts (DEWHA, formerly Environment Australia) has supported the publication of reports on the conservation status of most vertebrate fauna species e.g. reptiles (Cogger *et al.* 1993), birds (Garnett and Crowley 2000), monotremes and marsupials (Maxwell *et al.* 1996), rodents (Lee 1995) and bats (Duncan *et al.* 1999) These publications also use the IUCN categories, although those used by Cogger *et al.* (1993) differ in some respects as these reports pre-date Mace and Stuart's review (1994).

In Western Australia, the Department of Environment and Conservation (DEC) has produced a

supplementary list of Priority Fauna, being species that are not considered Threatened under the *Wildlife Conservation Act* but for which the DEC feels there is cause for concern. Some Priority species, however, are also assigned to the IUCN Conservation Dependent category. Levels of Priority are described in Appendix 1.

Fauna species included under conservation acts and/or agreements are formally protected under state or federal legislation. Species listed only as Priority by DEC, or that are included in publications such as Garnett and Crowley (2000) and Cogger *et al.* (1993), but not in State or Commonwealth Acts, are also of recognised conservation significance but are not formally protected under legislation. In addition, species that are at the limit of their distribution, those that have a very restricted range and those that occur in breeding colonies, such as some waterbirds, can be considered of conservation significance, although this level of significance has no legislative or published recognition and is based on interpretation of distribution information. The then Department of Environmental Protection (2000, now DEC) used this sort of interpretation to identify significant bird species in the Perth metropolitan area as part of Perth Bushplan (DEP, 2000).

On the basis of the above comments, three levels of conservation significance are recognised in this report:

3. ***Conservation Significance (CS) 1***: Species listed under State and/or Commonwealth Acts.
4. ***Conservation Significance (CS) 2***: Species not listed under State or Commonwealth Acts, but listed in publications on threatened fauna or as Priority species by the DEC.
5. ***Conservation Significance (CS) 3***: Species not listed under Acts or in publications, but considered of at least local significance because of their pattern of distribution. This level may have links to preserving biodiversity at the genetic level (EPA 2002). For example, if a population is isolated but a subset of a widespread (common) species, then it may not be recognised as threatened, but may have unique genetic characteristics. Species on the edge of their range, or that are sensitive to impacts such as habitat fragmentation, may also be classed as CS3.

In addition to these conservation levels, species that have been introduced (INT) are indicated.

8.1.2 Ecological Processes and Impact Assessment

Many of the potential impacts of proposed developments upon fauna can be related to ecological processes. This is recognised under the EPBC Act, in which threatening processes are listed, and in the literature (see Appendix 2). A number of ecological processes are relevant to the proposal and can be related to the potential impacts of the project upon fauna. These are discussed below.

8.1.3 Increased mortality

Direct mortality of common species during clearing is unavoidable but can be minimised. Direct mortality of rare species, and ongoing mortality such as due to roadkill, may have a significant impact. Fragmentation of habitat can severely affect wildlife and lead to mortality through collision with vehicles (Jackson and Griffen 2000; Scheik and Jones 1999; Clevenger and Waltho 2000). Dufty (1989) suggested that the greatest cause of adult mortality in populations of

Eastern Barred Bandicoots (*Peremeles gunni*) was due to collisions with vehicles. Jones (2000) documented the sudden decline in a population of Eastern Quolls (*Dasyurus viverrinus*) and Tasmanian Devils (*Sarcophilus harrisii*) directly attributed to increased road mortality following the upgrade of a local road. Direct and ongoing mortality (in particular from road collisions) may be a concern for the viability of species that occur at low population densities in areas adjacent to the Project area.

8.1.4 Loss of habitat affecting population survival

Some loss of habitat in the Project area is inevitable but can be minimised through controls during clearing. Excessive loss of habitat can reduce the size of a population to the point where it is unsustainable or more vulnerable to other impacts.

8.1.5 Loss of habitat affecting population movements and gene flow

Loss of habitat can affect population survival through fragmentation particularly if the affected habitat is linear and distinctive. This can occur in agricultural landscapes where remnant habitat is often linear, such as along roads, but also in substantially intact landscapes where there are distinctive habitats along watercourses or associated with geological features.

8.1.6 Species interactions, including predators and over-abundant native species

Introduced species, including the feral Cat, Fox and Rabbit may have adverse impacts upon native species, and the abundance of these species can alter during development projects. In particular, some mammal species are very sensitive to introduced predators and the decline of many mammals in Australia has been linked to predation by the Fox, and to a lesser extent the cat (Burbidge and McKenzie 1989). Introduced grazing species, such as the rabbit and domestic livestock, can also degrade habitats. Changes in the abundance of some native species can also be a concern, such as the increase in abundance of some birds, at the expense of others, due to the provision of watering points.

8.1.7 Hydroecology

Interruptions of hydroecological processes can have massive effects because they underpin primary production in ecosystems and there are specific, generally rare habitats that are hydrology-dependent. Development may alter both surface and sub-surface hydrology.

8.1.8 Fire

Fire is a natural feature of the environment but frequent, extensive fires may adversely impact some fauna, particularly mammals and short-range endemic species. Long-unburnt habitats are important for fauna, but regeneration after fire can also be significant for some species.

8.1.9 Light and noise

Impacts of light and noise upon fauna are difficult to predict. As such, it is best to take a precautionary approach. The death of very large numbers of insects has been reported around some remote mine sites and attracts other fauna (including introduced predators), as well as presumably reducing the populations of insects in surrounding habitats. Some studies have demonstrated a decline in the abundance of some insects due to mortality around lights, although

this is in fragmented landscapes where populations are already under stress (Rich and Longcore 2006). Light is also a concern for nestling turtles. Impacts of noise on wildlife are less certain.

8.2 Impact Assessment Methodology

An assessment of the potential impacts of the project on fauna and habitat was conducted based on the results of the field surveys, desktop surveys and the past experience of the authors. The severity of impacts was quantified on the basis of predicted population change as outlined in Table A. Population change can be the result of direct habitat loss and/or impacts upon ecological processes as discussed above.

Table A. Assessment Criteria for Impacts upon fauna

Severity of impact	Observed Impact
Minimal	No population decline
Low	Short-term population decline (recovery after end of project) within project area, no change in viability of conservation status of population
Moderate	Permanent population decline, no change in viability of conservation status of population
High	Permanent population decline resulting in change in viability or conservation status of population
Extreme	Taxon extinction

9 APPENDIX 2

Categories used in the assessment of conservation status.
IUCN categories (based on review by Mace and Stuart 1994**) as used for the Environmental Protection and Biodiversity Conservation (EPBC) Act and the WA Wildlife Conservation Act**.

Extinct. Taxa not definitely located in the wild during the past 50 years.

Extinct in the Wild. Taxa known to survive only in captivity.

Critically Endangered. Taxa facing an extremely high risk of extinction in the wild in the immediate future.

Endangered. Taxa facing a very high risk of extinction in the wild in the near future.

Vulnerable. Taxa facing a high risk of extinction in the wild in the medium-term future.

Near Threatened. Taxa that risk becoming Vulnerable in the wild.

Conservation Dependent. Taxa whose survival depends upon ongoing conservation measures. Without these measures, a conservation dependent taxon would be classed as Vulnerable or more severely threatened.

Data Deficient (Insufficiently Known). Taxa suspected of being Rare, Vulnerable or Endangered, but whose true status cannot be determined without more information.

Least Concern. Taxa that are not Threatened.

Schedules used in the WA Wildlife Conservation Act.

Schedule 1. Rare and Likely to become Extinct.

Schedule 2. Extinct.

Schedule 3. Migratory species listed under international treaties.

Schedule 4. Other Specially Protected Fauna.

WA Department of Conservation and Land Management Priority species (species not listed under the Conservation Act, but for which there is some concern).

Priority 1. Taxa with few, poorly known populations on threatened lands.

Priority 2. Taxa with few, poorly known populations on conservation lands; or taxa with several, poorly known populations not on conservation lands.

Priority 3. Taxa with several, poorly known populations, some on conservation lands.

Priority 4. Taxa in need of monitoring. Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could be if present circumstances change.

Priority 5. Taxa in need of monitoring. Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years (IUCN Conservation Dependent).

10 APPENDIX 3. SPECIES LISTS FOR THE REGION

Freshwater fish the northern suburbs of Perth, generally west of Wanneroo Road and south of Yanchep.

Species	
Gobidae (gobies)	
Swan River Goby	*Pseudogobius olorum*
Cyprinidae (goldfish, carp and allies)	
Goldfish [int]	*Carassius auratus*
Common Carp [int]	*Cyprinus carpio*
Poeciliidae (livebearers)	
Mosquitofish	*Gambusia holbrooki*

Frogs of the northern suburbs of Perth, generally west of Wanneroo Road and south of Yanchep.

Species	
Hylidae (tree-frogs)	
Slender Tree-Frog	*Litoria adelaidensis*
Motorbike Frog	*Litoria moorei*
Myobatrachidae (ground frogs)	
Clicking Froglet	*Crinia glauerti*
Sandplain Froglet	*Crinia insignifera*
Moaning Frog	*Heleioporus eyrei*
Pobblebonk	*Limnodynastes dorsalis*
Turtle Frog	*Myobatrachus gouldii*
Guenther's Toadlet	*Pseudophryne guentheri*

Reptiles of the northern suburbs of Perth, generally west of Wanneroo Road and south of Yanchep.

Species	
Chelidae (side-necked tortoises)	
South-West Long-necked Tortoise	*Chelodina oblonga*
Gekkonidae (geckoes)	
Marbled Gecko	*Christinus marmoratus*
Clawless Gecko	*Crenadactylus ocellatus*
White-spotted Gecko	*Diplodactylus alboguttatus*
Spotted Gecko	*Diplodactylus polyophthalmus*
Spiny-tailed Gecko	*Strophurus spinigerus*
Barking Gecko	*Underwoodisaurus milii*
Pygopodidae (legless lizards)	
Javelin Legless Lizard	*Delma concinna*
Sandplain Worm Lizard	*Aprasia repens*
Fraser's Legless Lizard	*Delma fraseri*
Gray's Legless Lizard	*Delma grayii*
Burton's Legless Lizard	*Lialis burtonis*
Keeled Legless Lizard	*Pletholax gracilis*
Common Scaleyfoot	*Pygopus lepidopodus*
Agamidae (dragon lizards)	
Western Bearded Dragon	*Pogona minor*
Sandhill Dragon	*Rankinia adelaidensis*
Varanidae (monitors or goannas)	
Gould's Sand Goanna	*Varanus gouldii*
Black-tailed Tree Goanna	*Varanus tristis*
Scincidae (skink lizards)	
South-west Cool Skink	*Acritoscincus trilineatum*
Fence Skink	*Cryptoblepharus buchananii*
Limestone Ctenotus	*Ctenotus australis*
West Coast Ctenotus	*Ctenotus fallens*
Jewelled Ctenotus	*Ctenotus gemmula*
Odd-striped Ctenotus	*Ctenotus impar*
Western Slender-bluetongue	*Cyclodomorphus celatus*
King's Skink	*Egernia kingii*
Mourning Skink	*Egernia luctuosa*
Salmon-bellied Skink	*Egernia napoleonis*
Two-toed Skink	*Hemiergis quadrilineata*
Four-toed Lerista	*Lerista elegans*
Line-spotted Lerista	*Lerista lineopunctulata*
Western Worm Lerista	*Lerista praepedita*
Dwarf Skink	*Menetia greyii*
Spotted Morethia	*Morethia lineoocellata*
Dusky Morethia	*Morethia obscura*

Species	
Western Bluetongue	*Tiliqua occipitalis*
Bobtail	*Tiliqua rugosa*
Typhlopidae (blind snakes)	
Southern Blind Snake	*Ramphotyphlops australis*
Fat Blind Snake	*Ramphotyphlops pinguis*
Boidae (pythons)	
Carpet Python	*Morelia spilota imbricata*
Elapidae (front-fanged snakes)	
Half-ringed Snake	*Brachyurophis semifasciata*
Narrow Banded Snake	*Brachyurophis fasciolata*
Yellow-faced Whip-Snake	*Demansia psammophis*
Bardick	*Echiopsis curtus*
Black-naped Snake	*Neelaps bimaculatus*
Black-striped Snake	*Neelaps calonotos*
Tiger Snake	*Notechus scutatus*
Dugite	*Pseudonaja affinis*
Gould's Snake	*Parasuta gouldii*
Jan's Bandy-Bandy	*Simoselaps bertholdi*

Birds of the northern suburbs of Perth, generally west of Wanneroo Road and south of Yanchep (excluding strictly marine species). [int] indicates introduced species.

Species	
Dromaiidae (emus)	
Emu	*Dromaius novaehollandiae*
Phasianidae (pheasants and quails)	
Stubble Quail	*Coturnix pectoralis*
Anatidae (ducks, geese and swans)	
Freckled Duck	*Stictonetta naevosa*
Domestic Goose [int]	*Anser anser*
Black Swan	*Cygnus atratus*
Australian Shelduck	*Tadorna tadornoides*
Muscovy Duck [int]	*Cairina moschata*
Mallard [int]	*Anas platyrhynchos*
Muscovy/Mallard hybrid [int]	NA
Pacific Black Duck	*Anas superciliosus*
Grey Teal	*Anas gibberifrons*
Chestnut Teal	*Anas castanea*
Australasian Shoveler	*Anas rhynchotis*

Species	
Pink-eared Duck	*Malacorhynchus membranaceus*
Hardhead (White-eyed Duck)	*Aythya australis*
Australian Wood Duck	*Chenonetta jubata*
Musk Duck	*Biziura lobata*
Blue-billed Duck	*Oxyura australis*
Podicepididae (grebes)	
Great Crested Grebe	*Podiceps cristatus*
Hoary-headed Grebe	*Poliocephalus poliocephalus*
Australasian Grebe	*Tachybaptus novaehollandiae*
Columbidae (pigeons and doves)	
Rock Dove (Domestic Pigeon)	*Columba livia*
Laughing Dove	*Streptopelia senegalensis*
Spotted Dove	*Streptopelia chinensis*
Common Bronzewing	*Phaps chalcoptera*
Brush Bronzewing	*Phaps elegans*
Crested Pigeon	*Ocyphaps lophotes*
Podargidae (frogmouths)	
Tawny Frogmouth	*Podargus strigoides*
Caprimulgidae (nightjars)	
Spotted Nightjar	*Eurostopodus argus*
Aegothelidae (owlet-nightjars)	
Australian Owlet-nightjar	*Aegotheles cristatus*
Apodidae (swifts)	
Fork-tailed Swift	*Apus pacificus*
Anhingidae (darters)	
Darter	*Anhinga melanogaster*
Phalacrocoracidae (cormorants)	
Great Cormorant	*Phalacrocorax carbo*
Pied Cormorant	*Phalacrocorax varius*
Little Black Cormorant	*Phalacrocorax sulcirostris*
Little Pied Cormorant	*Phalacrocorax melanoleucos*
Pelecanoididae (pelicans)	
Australian Pelican	*Pelecanus conspicillatus*
Ardeidae (herons and egrets)	
Australasian Bittern	*Botaurus poiciloptilus*
Australian Little Bittern	*Ixobrychus dubius*
White-faced Heron	*Egretta novaehollandiae*
White-necked Heron	*Ardea pacifica*
Eastern Great Egret	*Ardea modesta (alba)*

Species	
Cattle Egret	*Ardea ibis*
Little Egret	*Egretta garzetta*
Eastern Reef Egret	*Egretta sacra*
Nankeen Night Heron	*Nycticorax caledonicus*
Threskionithidae (ibis and spoonbills)	
Glossy Ibis	*Plegadis falcinellus*
Australian White Ibis	*Threskiornis molucca*
Straw-necked Ibis	*Threskiornis spinicollis*
Yellow-billed Spoonbill	*Platalea flavipes*
Accipitridae (kites, hawks and eagles)	
Eastern Osprey	*Pandion cristatus*
Black-shouldered Kite	*Elanus axillaris*
Square-tailed Kite	*Lophoictinia isura*
Whistling Kite	*Haliastur sphenurus*
White-bellied Sea-Eagle	*Haliaeetus leucogaster*
Spotted Harrier	*Circus assimilis*
Swamp Harrier	*Circus approximans*
Brown Goshawk	*Accipiter fasciatus*
Collared Sparrowhawk	*Accipiter cirrhocephalus*
Wedge-tailed Eagle	*Aquila audax*
Little Eagle	*Hieraaetus morphnoides*
Falconidae (falcons)	
Peregrine Falcon	*Falco peregrinus*
Australian Hobby	*Falco longipennis*
Brown Falcon	*Falco berigora*
Nankeen Kestrel	*Falco cenchroides*
Rallidae (crakes and rails)	
Buff-banded Rail	*Rallus philippensis*
Baillon's Crake	*Porzana pusilla*
Australian Spotted Crake	*Porzana fluminea*
Spotless Crake	*Porzana tabuensis*
Dusky Moorhen	*Gallinula tenebrosa*
Purple Swamphen	*Porphyrio porphyrio*
Eurasian Coot	*Fulica atra*
Otididae (bustards)	
Australian Bustard	*Ardeotis australis*
Haematopodidae (oystercatchers)	
Australian Pied Oystercatcher	*Haematopus longirostris*
Sooty Oystercatcher	*Haematopus fuliginosus*

Species	
Recurvirostridae (stilts and avocets)	
Black-winged Stilt	*Himantopus himantopus*
Banded Stilt	*Cladorhynchus leucocephalus*
Red-necked Avocet	*Recurvirostra novaehollandiae*
Charadriidae (lapwings and plovers)	
Grey Plover	*Pluvialis squatarola*
Lesser Sand Plover	*Charadrius mongolus*
Red-capped Plover	*Charadrius ruficapillus*
Black-fronted Dotterel	*Elseyornis melanops*
Red-kneed Dotterel	*Erythrogonys cinctus*
Hooded Plover	*Thinornis rubricollis*
Banded Lapwing	*Vanellus tricolor*
Scolopacidae (sandpipers and stints)	
Bar-tailed Godwit	*Limosa lapponica*
Marsh Sandpiper	*Tringa stagnatalis*
Common Greenshank	*Tringa nebularia*
Wood Sandpiper	*Tringa glareola*
Common Sandpiper	*Tringa hypoleucos*
Ruddy Turnstone	*Arenaria interpres*
Sanderling	*Calidris alba*
Red-necked Stint	*Calidris ruficollis*
Long-toed Stint	*Calidris subminuta*
Sharp-tailed Sandpiper	*Calidris acuminata*
Curlew Sandpiper	*Calidris ferruginea*
Turnicidae (button-quails)	
Painted Button-quail	*Turnix varia*
Laridae (gulls and terns)	
Fairy Tern	*Sternula nereis*
Caspian Tern	*Sterna caspia*
Whiskered Tern	*Chlidonias hybrida*
Crested Tern	*Sterna bergii*
Pacific Gull	*Larus pacificus*
Silver Gull	*Larus novaehollandiae*
Cacatuidae (cockatoos)	
Carnaby's Black-Cockatoo	*Calyptorhynchus latirostris*
Forest Red-tailed Black-Cockatoo	*Calyptorhynchus banksii naso*
Galah	*Cacatua roseicapilla*
Long-billed Corella[i]	*Cacatua tenuirostris*
Western Corella	*Cacatua pastinator*

Species	
Little Corella	*Cacatua sanguinea*
Sulphur-crested Cockatoo [int]	*Cacatua galarita*
Psittacidae (lorikeets and parrots)	
Rainbow Lorikeet [int]	*Trichoglossus haematodus*
Purple-crowned Lorikeet	*Glossopsitta porphyrocephala*
Regent Parrot	*Polytelis anthopeplus*
Western Rosella	*Platycercus icterotis*
Australian Ringneck	*Barnardius zonarius*
Red-capped Parrot	*Purpureicephalus spurius*
Rock Parrot	*Neophema petrophila*
Elegant Parrot	*Neophema elegans*
Cuculidae (cuckoos)	
Fan-tailed Cuckoo	*Cacomantis flabelliformis*
Pallid Cuckoo	*Cuculus pallidus*
Horsfield's Bronze-Cuckoo	*Chrysococcyx basalis*
Shining Bronze-Cuckoo	*Chrysococcyx lucidus*
Strigidae (hawk-owls)	
Southern Boobook	*Ninox novaeseelandiae*
Tytonidae (barn owls)	
Barn Owl	*Tyto alba*
Halcyonidae (forest kingfishers)	
Sacred Kingfisher	*Todiramphus sanctus*
Laughing Kookaburra	*Dacelo novaeguineae*
Meropidae (bee-eaters)	
Rainbow Bee-eater	*Merops ornatus*
Maluridae (fairy-wrens)	
Splendid Fairy-wren	*Malurus splendens*
Variegated Fairy-wren	*Malurus lamberti*
White-winged Fairy-wren	*Malurus leucopterus*
Southern Emu-wren	*Stipiturus malachurus*
Pardalotidae (pardalotes)	
Striated Pardalote	*Pardalotus striatus*
Spotted Pardalote	*Pardalotus punctatus*
White-browed Scrubwren	*Sericornis frontalis*
Weebill	*Smicrornis brevirostris*
Western Gerygone	*Gerygone fusca*
Inland Thornbill	*Acanthiza apicalis*
Western Thornbill	*Acanthiza inornata*
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*

Species	
Meliphagidae (honeyeaters)	
Red Wattlebird	*Anthochaera carunculata*
Western Wattlebird	*Anthochaera lunulata*
Yellow-throated Minor	*Manorina flavigula*
Singing Honeyeater	*Lichenostomus virescens*
Brown Honeyeater	*Lichmera indistincta*
White-naped honeyeater	*Melithreptus lunatus*
White-cheeked Honeyeater	*Phylidonyris nigra*
New Holland Honeyeater	*Phylidonyris novaehollandiae*
Tawny-crowned Honeyeater	*Phylidonyris melanops*
Western Spinebill	*Acanthorhynchus superciliosus*
White-fronted Chat	*Epthianura albifrons*
Petroicidae (Australian robins)	
Scarlet Robin	*Petroica multicolor*
Red-capped Robin	*Petroica goodenovii*
Hooded Robin	*Melanodryas cucullata*
White-breasted Robin	*Eopsaltria georgiana*
Acrocephalidae (reed-warblers)	
Australian Reed-Warbler	*Acrocephalus australis*
Megaluridae (grassbirds)	
Little Grassbird	*Megalurus gramineus*
Rufous Songlark	*Cincloramphus mathewsi*
Brown Songlark	*Cincloramphus cruralis*
Zosteropidae (white-eyes)	
Silvereye	*Zosterops lateralis*
Pachycephalidae (whistlers)	
Golden Whistler	*Pachycephala pectoralis*
Rufous Whistler	*Pachycephala rufiventris*
Grey Shrike-thrush	*Colluricincla harmonica*
Crested Bellbird	*Oreioca gutturalis*
Dicruridae (flycatchers)	
Magpie-lark	*Grallina cyanoleuca*
Grey Fantail	*Rhipidura fuliginosa*
Willie Wagtail	*Rhipidura leucophrys*
Neosittidae (sittella)	
Varied Sittella	*Daphoenositta chrysoptera*
Campephagidae (cuckoo-shrikes)	
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*
White-winged Triller	*Lalage sueurii*

Species	
Artamidae (woodswallows)	
Black-faced Woodswallow	*Artamus cinereus*
Dusky Woodswallow	*Artamus cyanopterus*
Grey Butcherbird	*Cracticus torquatus*
Australian Magpie	*Gymnorhina tibicen*
Corvidae (ravens and crows)	
Australian Raven	*Corvus coronoides*
Motacillidae (pipits and true wagtails)	
Australian Pipit	*Anthus novaeseelandiae*
Dicaeidae (flower-peckers)	
Mistletoebird	*Dicaeum hirundinaceum*
Hirundinidae (swallows)	
White-backed Swallow	*Cheramoeca leucosternus*
Welcome Swallow	*Hirundo neoxena*
Fairy Martin	*Petrochelidon ariel*
Tree Martin	*Petrochelidon nigricans*

Mammals of the northern suburbs of Perth, generally west of Wanneroo Road and south of Yanchep (excluding strictly marine species). ^{int} indicates introduced species.

Species	
Tachyglossidae (echidnas)	
Echidna	*Tachyglossus aculeatus*
Dasyuridae	
Chuditch	*Dasyurus geoffroii*
White-tailed Dunnart	*Sminthopsis granulipes*
Grey-bellied Dunnart	*Sminthopsis griseoventer*
Peramelidae (bandicoots)	
Quenda or Brown Bandicoot	*Isoodon obesulus*
Phalangeridae (brushtail possums)	
Brush-tailed Possum	*Trichosurus vulpecula*
Tarsipedidae (honey possum)	
Honey Possum	*Tarsipes rostratus*
Macropodidae (kangaroos and wallabies)	
Western Grey Kangaroo	*Macropus fuliginosus*
Brush or Black-gloved Wallaby	*Macropus irma*
Mollosidae (mastiff bats)	
White-striped Bat	*Tadarida australis*
Western Freetail Bat	*Mormopterus planiceps*

Species	
Vespertilionidae (vesper bats)	
King River Eptesicus	*Vespadelus (Eptesicus) regulus*
Gould's Wattled Bat	*Chalinolobus gouldii*
Chocolate Wattled Bat	*Chalinolobus morio*
Lesser Long-eared Bat	*Nyctophilus geoffroyi*
Greater Long-eared Bat	*Nyctophilus major*
Muridae (rats and mice)	
House Mouse [int]	*Mus musculus*
Rakali or Water-rat	*Hydromys chrysogaster*
Noodji or Ashy-grey Mouse	*Pseudomys albocinereus*
Moodit or Bush-Rat	*Rattus fuscipes*
Black Rat [int]	*Rattus rattus*
Leporidae (rabbits and hares)	
Rabbit [int]	*Oryctolagus cuniculus*
Canidae (foxes and dogs)	
European Red Fox [int]	*Vulpes vulpes*
Felidae (cats)	
Feral Cat [int]	*Felis catus*