APPENDIX 1
PRE-LODGEMENT CONSULTATION

Appendix 1: Pre-lodgement consultation

Agency	Date of Consultation	Method of Consultation	Summary of Outcome
Land owners within and adjacent to the structure plan area			
Relevant community groups in the area			
Local government			
Department of Planning			
Department of Water			
Department of Environment and Conservation			
Department of Education	26 July 2012	Discussion at DoE offices.	DoE approve of preliminary primary school site design and location.
Department of Indigenous Affairs			
Main Roads Western Australia			
Heritage Council			
Department of Transport			
Department of Health			
Public Transport Authority			
Environmental Protection Authority			
Western Power			
Alinta Gas			
Water Corporation			
Telstra			
Non-government school providers			
Department for Community Development			
Department of Sports and Recreation			
Department of Agriculture and Food Western Australia			
Fire and Emergency Services Authority			
Any other relevant government agency as Required			

APPENDIX 2
CERTIFICATE OF TITLE

REGISTER NUMBER	
50/DP67194	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
2	**25/1/2011**

WESTERN AUSTRALIA

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME **2752** FOLIO **408**

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 50 ON DEPOSITED PLAN 67194

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

PEET NO 88 PTY LTD OF LEVEL 7, 200 ST GEORGES TERRACE, PERTH
(AF L407053) REGISTERED 20 AUGUST 2010

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1. L527839 MORTGAGE TO ANZ FIDUCIARY SERVICES PTY LTD REGISTERED 11.1.2011.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

----------END OF CERTIFICATE OF TITLE----------

STATEMENTS:

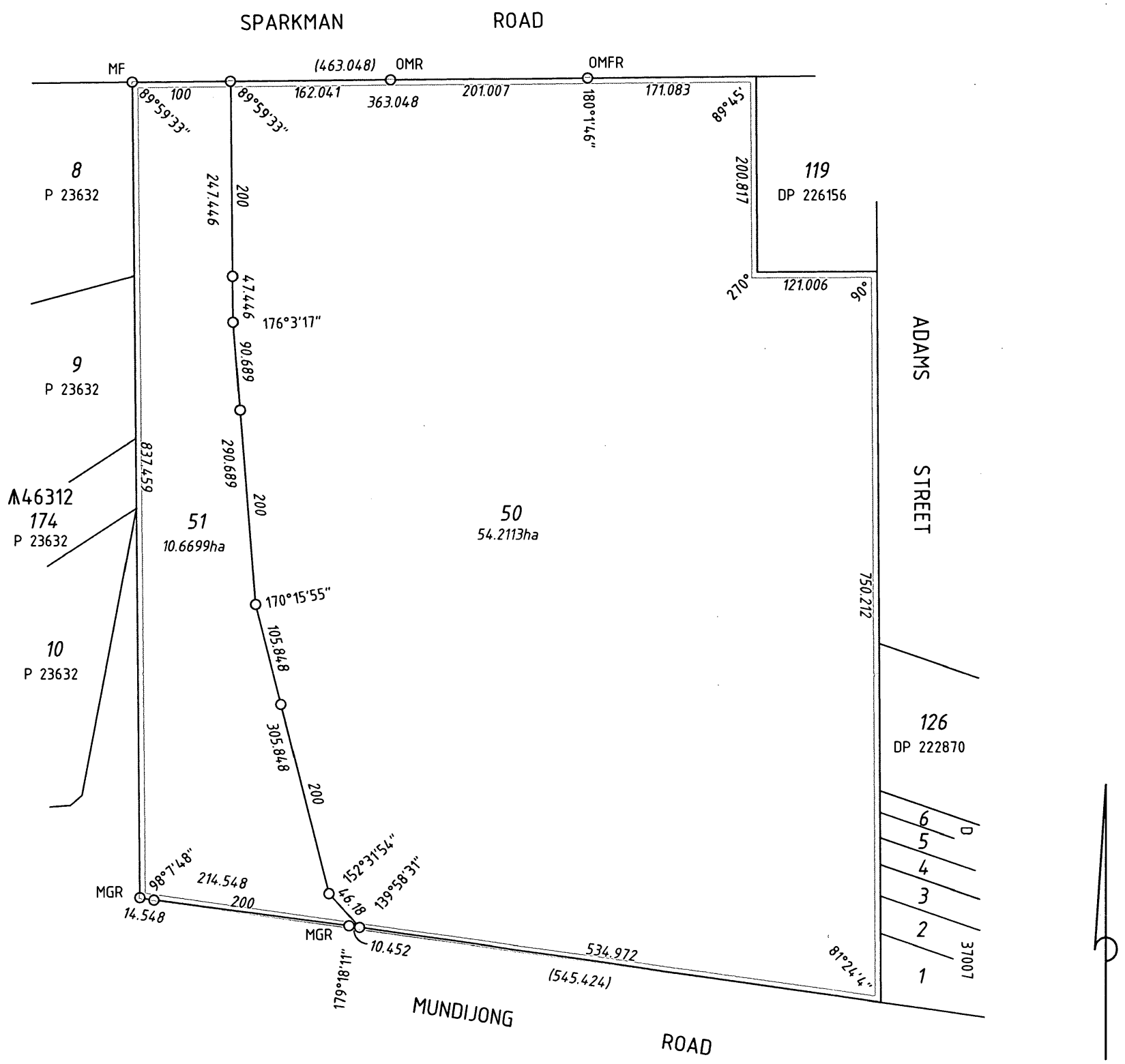
The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: DP67194 [SHEET 1].
PREVIOUS TITLE: 723-98.
PROPERTY STREET ADDRESS: 75 COCKRAM ST, MUNDIJONG.
LOCAL GOVERNMENT AREA: SHIRE OF SERPENTINE-JARRAHDALE.

LANDGATE COPY OF ORIGINAL NOT TO SCALE Mon Jul 23 16:02:04 2012 JOB 39651512

LANDGATE COPY OF ORIGINAL NOT TO SCALE Fri Oct 12 13:32:12 2012 JOB 40248166

VER	AMENDMENT	AUTHORISED BY	DATE
2	DP REPLACED, ADDED ACQUISITION NOTE	P.J. READ	28.4.2010
3	DP REPLACED, REMOVED ACQUISITION NOTE	P.J. READ	17.5.2010



SEE SHEET 2 FOR SURVEY INFORMATION

SURVEY CARRIED OUT UNDER REG 26A
SPECIAL SURVEY AREA GUIDELINES

SPECIAL SURVEY AREA SUBDIVISION

whelans

s:/projects/11/11395/carto/11395/11395dp2.dgn
ssa combined-dp2.acs FP-11395-003-VER 3.0

DP 67194 (01)

TYPE FREEHOLD

PURPOSE SUBDIVISION

PLAN OF

LOTS 50 & 51

SSA YES/~~NO~~

DISTRICT COCKBURN SOUND DPI FILE

TOWNSITE

LOCAL AUTHORITY SHIRE OF SERPENTINE-JARRAHDALE
LOCALITY MUNDIJONG

FORMER TENURE	ON	FIELD BOOK
LOT 46 DP 226156 C/T 723/98	INDEX BG33 (2) 20.26,20.27	113513 (SAM 4500)

100 0 100 200 300

SCALE: 1:5000 AT A3 SIZE

ALL DISTANCES ARE IN METRES

SURVEYOR'S CERTIFICATE - Reg 54

I PETER JAMES READ

hereby certify that this is accurate and is a correct representation of the

(a) *survey; and /or (b) *calculations from measurements

(*delete if inapplicable)

undertaken for the purposes of this plan and that it complies with the relevant written law(s) in relation to which it is lodged

Peter James Read 2010.05.17 06:23:00.Z

Licensed Surveyor Date

SURVEYOR'S CERTIFICATE - Compiled

I

hereby certify that this compiled plan

(a) is a correct and accurate representation of the survey(s) of the subject land ; and

(b) is in accordance with the relevant law in relation to which it is lodged.

Licensed Surveyor Date

SURVEYING & DRAFTING BY:

WHELANS (WA) PTY. LTD.
(08) 9443 1511 www.whelans.com.au

LODGED	TYPE OF VALIDATION
DATE 20-May-10	FULL AUDIT LEGAL COMPONENT MJR
FEE PAID $316.00	DOCKET PLAN/DIAG 00420-2010
ASSESS No. 6809804	CERTIFIED CORRECT 20/5/10 I.S.C. F.S.C.

APPROVED BY
WESTERN AUSTRALIAN PLANNING COMMISSION

FILE 807-2-29-44PV

Delegated Under S.16 P & D ACT 2005

DATE 25/5/2010

IN ORDER FOR DEALINGS

SUBJECT TO

26.5.10

FOR INSPECTOR OF PLANS & SURVEYS AUTHORIZED LAND OFFICER DATE

APPROVED REG 26A (4)

20.8.10

INSPECTOR OF PLANS & SURVEYS AUTHORIZED LAND OFFICER DATE

Landgate
Western Australian Land Information Authority

DEPOSITED PLAN

67194

ORIGINAL

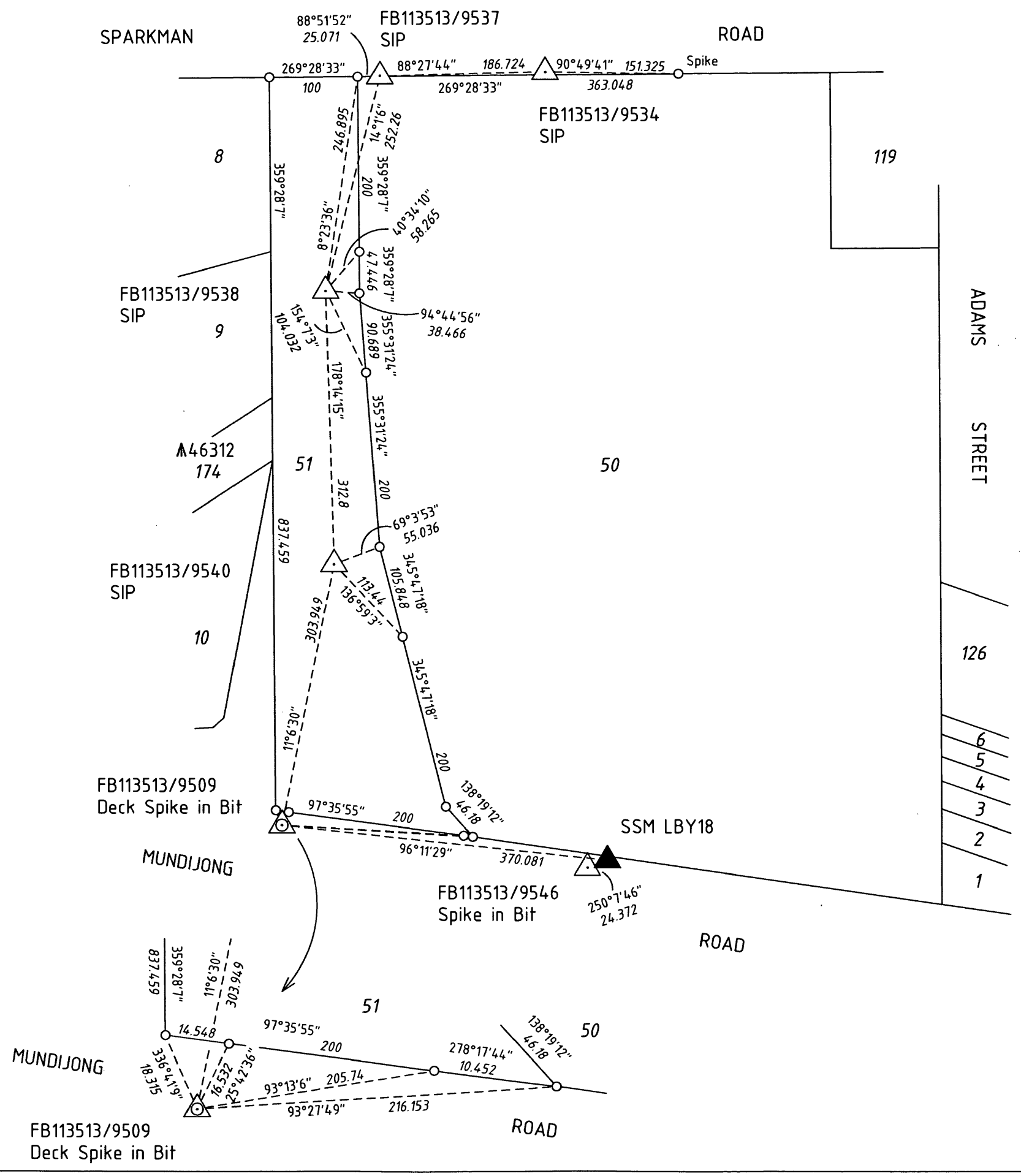
SHEET 1 OF 2

VERSION 3

LANDGATE COPY OF ORIGINAL NOT TO SCALE Fri Oct 12 13:32:12 2012 JOB 40248166

DP 67194 (02)

FOR HEADING SEE SHEET 1



SURVEY INFORMATION ONLY

FINAL SURVEY SHEET
SURVEY CARRIED OUT UNDER REG26A
SPECIAL SURVEY AREA GUIDELINES

- ▲ Denotes Standard Survey Mark
- Denotes Permanent Survey Mark
- Denotes Permanent Control Mark
- Denotes Temporary Control Mark
- o Denotes Peg
- × Spike

THIS SUBDIVISION CONTAINS RETAINING WALLS WHICH ARE ALL LOCATED WITHIN THE HIGH (OR LOW) LOT/S

PRIJECT GRID IS PCG 94

whelans

s:/projects/11/11395/carto/11395/11395dp2(sht2).dgn
ssa-dp2.acs FP-11395-003-VER 3.0

100 0 100 200 300

SCALE: 1:5000 AT A3 SIZE

ALL DISTANCES ARE IN METRES

SURVEYOR'S CERTIFICATE - Reg 54

I PETER JAMES READ

hereby certify that this is accurate and is a correct representation of the
(a) *survey; and /or
(b) *calculations from measurements
[*delete if inapplicable]
undertaken for the purposes of this plan and that it complies with the relevant written law(s) in relation to which it is lodged

Peter James Read
2010.05.17
06:23:03 Z

Licensed Surveyor Date

SHEET 2 OF 2

VERSION 3

Landgate
Western Australian Land Information Authority

DEPOSITED PLAN

67194

ORIGINAL

REGISTER NUMBER	
119/DP226156	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
N/A	**N/A**

WESTERN AUSTRALIA

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME **723** FOLIO **99**

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 119 ON DEPOSITED PLAN 226156

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

RAMSAY MACDONALD LIGHTBODY OF MUNDIJONG
(T T5200/1952) REGISTERED 27 MARCH 1952

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

----------END OF CERTIFICATE OF TITLE----------

STATEMENTS:

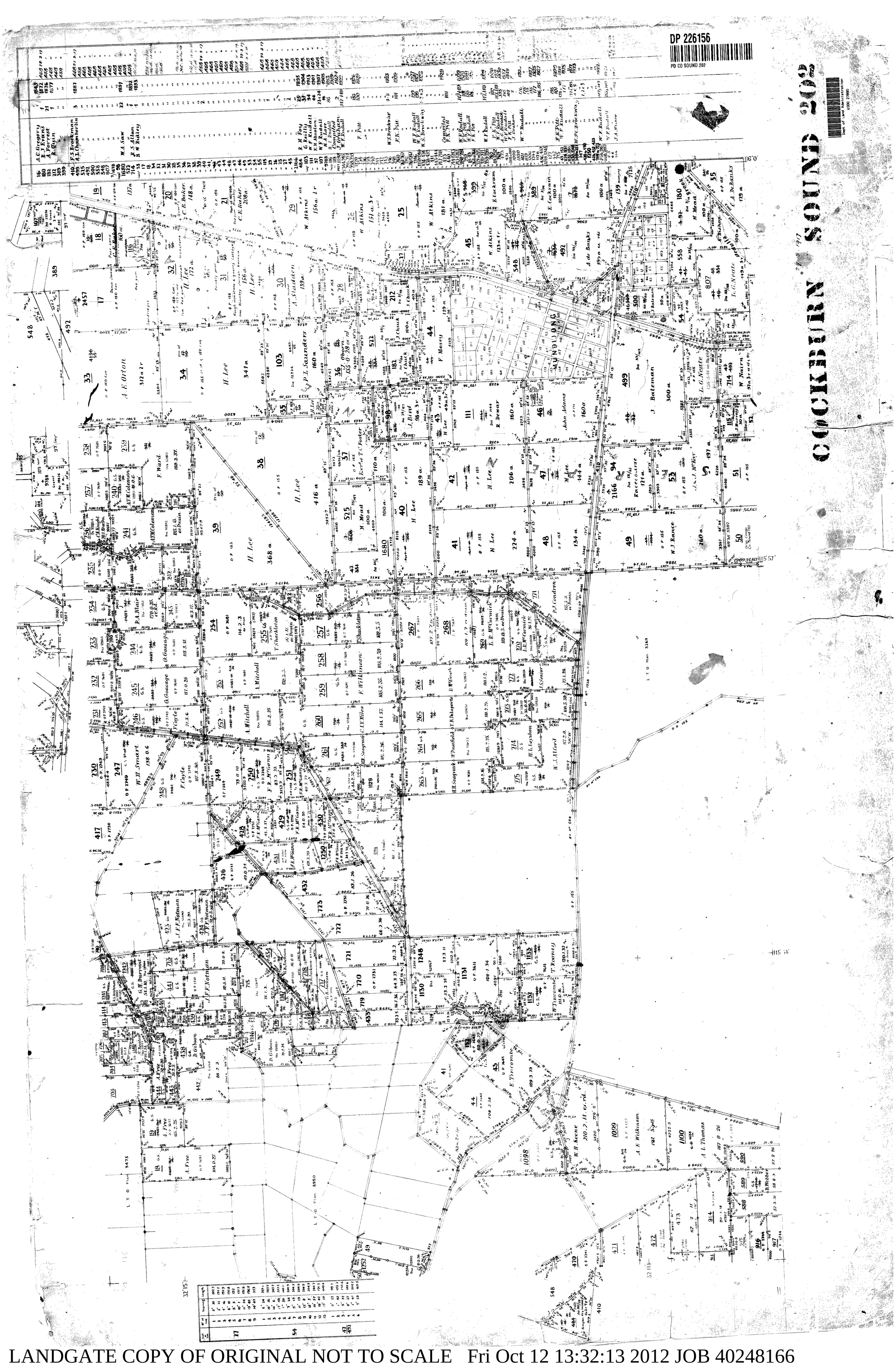
The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND:	723-99 (119/DP226156).
PREVIOUS TITLE:	This Title.
PROPERTY STREET ADDRESS:	LOT 119 SPARKMAN RD, MUNDIJONG.
LOCAL GOVERNMENT AREA:	SHIRE OF SERPENTINE-JARRAHDALE.

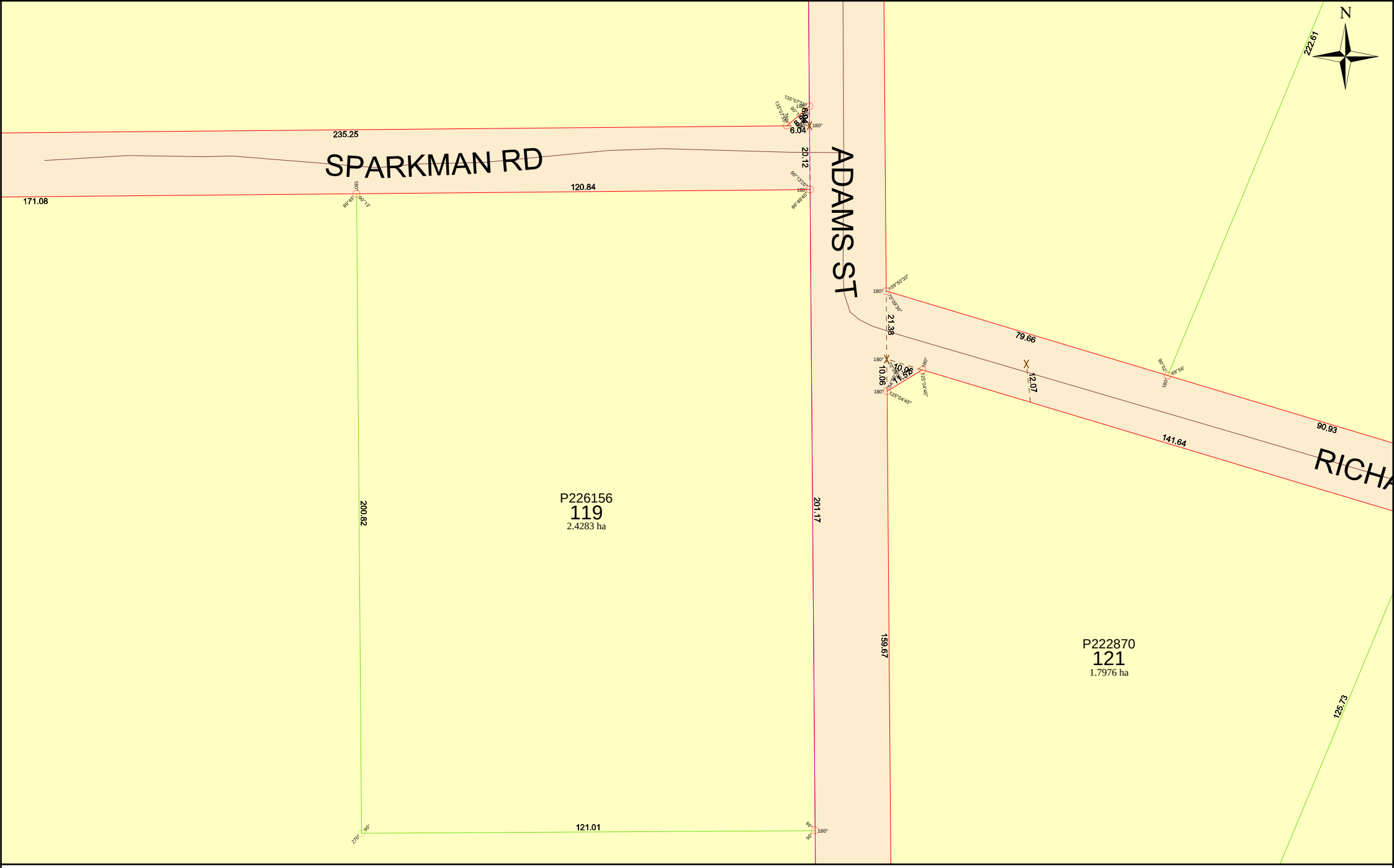
NOTE 1: A000001A LAND PARCEL IDENTIFIER OF SERPENTINE AGRICULTURAL AREA LOT 119 (OR THE PART THEREOF) ON SUPERSEDED PAPER CERTIFICATE OF TITLE CHANGED TO LOT 119 ON DEPOSITED PLAN 226156 ON 01-JUN-02 TO ENABLE ISSUE OF A DIGITAL CERTIFICATE OF TITLE.

NOTE 2: THE ABOVE NOTE MAY NOT BE SHOWN ON THE SUPERSEDED PAPER CERTIFICATE OF TITLE OR ON THE CURRENT EDITION OF DUPLICATE CERTIFICATE OF TITLE.

LANDGATE COPY OF ORIGINAL NOT TO SCALE Mon Jul 23 16:02:20 2012 JOB 39651512



LANDGATE COPY OF ORIGINAL NOT TO SCALE Fri Oct 12 13:32:13 2012 JOB 40248166



Scale : 1:1250 (Geographical)
MGA : SW=403473.5E,6426761.3N Zone 50 / NE=403842.2E,6427036.2N Zone 50
Lat/Long : 115°58'29.410", -32°17'30.386" / 115°58'43.605", -32°17'21.573" H 184mm by W 297mm

Printed : 15:27 Fri 12/Oct/2012
© Western Australian Land Information Authority 2012

This product is for information purposes only and is not guaranteed. The information may be out of date and should not be relied upon without further verification from the original documents. Where the information is being used for legal purposes then the original documents must be searched for all legal requirements.

APPENDIX 3
LPP24 SCHEDULE 1 (DESIGNING OUT CRIME TOOLBOX)

DESIGNING OUT CRIME TOOLBOX – SCHEDULE 1

Applicant: **Taylor Burrell Barnett**
Address: **187 Roberts Road, Subiaco**
Proposed Development: **LSP – Mundijong-Whitby Sub-Precinct E2**
Contact: **Sarah Davies**
Email: **sarah@tbbplanning.com.au**
Telephone number: **08 9382 2911**

Authorised Signature:

Date: 22-08-2013

	Item	Submission Developer Comments	Assessment Compliance	Assessment Comment
1.0	**Natural Surveillance** Objectives: • To encourage surveillance of spaces from surrounding buildings and land uses; and • To improve surveillance of spaces through increased legitimate uses			
1.1	Blind corners and problem areas • Avoid blind corners in pathways, stairways, corridors, hallways, near toilets and car parks • Avoid sudden changes of grade on pathways • Ensure through visibility in tunnels and underpasses • Consider the use of hardware such as mirrors to improve • existing situations • Avoid or minimise the effect of barriers on pathways	Road network will be designed to avoid blind corners. There will be no barriers on future pathways. Greatest density housing overlooking POS to maximise eyes on the park. The concept Masterplan has been design to minimise blind corners and problem areas. The future Plan of Subdivision and Landscape Plan will be designed to avoid blind corners		

	Item	Submission Developer Comments	Assessment Compliance	Assessment Comment
		and other related issues within streets and POS.		
1.2	Communal or public areas • Provide natural surveillance from activity land uses and activity rooms for communal and public areas • Establish community focal points at locations where surveillance is essential • Ensure public shelters do not impede surveillance • Co-locate movement systems to encourage surveillance in public areas • Encourage mixed uses to extend hours of surveillance, ensuring compatible uses and avoiding conflicting uses	POS will generally be surrounded by roads to provide opportunity for passive surveillance. The main central POS has significant frontage to the main proposed north/south neighbourhood connector and to the extension of Cockram Street providing good opportunity for passive surveillance. Dwellings surrounding POS will be oriented to overlook the POS. Primary school and shared use oval in central location with surveillance from surrounding properties.		
1.3	Entrances • Provide entries which are clearly visible.	Future building entries will be clearly visible.		
1.4	Fencing • Fence design should maximise natural surveillance from the street to the building, building to the street, and minimise opportunities for intruders to hide.	Detailed design will have regard to safe fence design.		
1.5	Landscaping • Avoid landscaping which obstructs surveillance, serves as a barrier to unimpeded views and allows intruders to hide.	Detailed design will have regard to using plant species which do not obstruct surveillance or views.		
2.0	**Urban structure** • To promote definition of use and ownership; • To promote attractive, legible and well orientated	The concept Masterplan shows a well defined urban structure including a legible street layout and a connected Public Open Space		

	Item	Submission Developer Comments	Assessment Compliance	Assessment Comment
	development; • To facilitate safe and efficient movement of vehicles, • cyclists and pedestrians; and • To facilitate safe and convenient locations for recreation, work and home.	network overlooked by dwellings.		
2.1	Local context • Scale, sighting, orientation and connections should take into account the local context of local topography, other land uses, actual and perceived crime risk and specific project requirements	Site topography, scale and connections to existing and future development and facilities have been key influences on the concept Masterplan design. Future subdivisional roads will be designed to provide for legible movement throughout the LSP area and will be overlooked by dwellings to encourage passive surveillance. Roads will provide connection to adjoining existing and future developments and local and district facilities beyond. Site topography has informed the road layout which allows for long views/vistas which assist with legibility and the sense of safety. Housed will be oriented to overlook public spaces to provide passive surveillance.		
2.2	Street layout and land division • Consider crime reduction measures in the early stages of design • Define ownership and use of space • Avoid ambiguous space and connections • Promote legibility and orientation • Buildings should be oriented towards the main street frontage and other areas of public realm • Street furniture should facilitate surveillance and	See previous comments. POS areas provide a mix of recreation, passive use and drainage functions. No cul-de-sacs proposed and street network is legible and well connected.		

	Item	Submission Developer Comments	Assessment Compliance	Assessment Comment
	discourage inappropriate use • Cul-de-sacs should be short and straight, allow visibility from one end to the other and not be joined by networks of footpaths that are irregularly used and likely to foster criminal activity • Avoid the establishment of small, unusable pockets of land and open space as they are difficult to maintain and do not facilitate recreation			
2.3	Movement network • Maximise surveillance of entry and exit points • Base upon primary routes and shared spaces • Minimise confusion about priorities of use on shared paths and access ways • Minimise underused and unnecessarily segregated streets and footpaths • Avoid routes which can become entrapment spots • Provide direct and clearly signed pedestrian, cycle andvehicular links to nearby destinations • Pathways and cycleways to facilitate surveillance • Maximise legibility, sightlines and comfort to encourage use	See previous comments. Concept masterplan movement network is legible and well connected. Road hierarchy is clearly identifiable. Street layout provides clear sightlines throughout the estate. The future landscape management plan will further develop the detail design of the pedestrian and cycle routes.		
2.4	Location of land uses • Minimise opportunities for conflict, especially in mixed use development • Provide active frontages of overlooked streets • Minimise blank walls and sides of buildings onto public open space and public realm	Minimal opportunity for land use conflict given primarily residential land use. Street layout provides for dwellings to address and overlook POS and public realm. Primary school (whist overlooked by residential dwellings) is separated from dwellings by roads and POS.		

	Item	Submission Developer Comments	Assessment Compliance	Assessment Comment
		Dwellings and the primary school will be oriented to overlook public spaces. It is likely future design criteria will require buildings with more than one road frontage to appropriately address both the primary and secondary streets.		
2.5	Regeneration and remodelling • Minimise dereliction, under- utilised and under maintained spaces and places • All open space should be well defined and purposeful • Vulnerable public spaces should become more liveable or be removed from public ownership	Central POS will be highly utilised with co-location of primary school and oval. Central active POS area defined by road network and will be designed to cater for a number of recreation uses (passive and active) to attract different users.		
3.0	**Land use mix** • To create a mix of uses, which promote extended surveillance and which are compatible with adjacent uses.			
3.1	Land use layout • Encourage mixes that promote activity, surveillance and legitimate contact between people • Avoid strict separation of compatible land uses that may result in isolation of buildings or spaces • Encourage mixes which are compatible in scale and neighbouring uses, particularly in isolated areas	Large, central park created as a focus for community life. LSP proposes a mix of residential densities and centrally located primary school. Uses are compatible with surrounding residential development.		
3.2	Access • Encourage pedestrian passage through or activity at ground level to promote surveillance	Streets will be provided with footpaths and the linear POS system will provide a pleasant walking environment to encourage pedestrian movement. Ensuring streets and POS are overlooked by dwellings will assist		

	Item	Submission Developer Comments	Assessment Compliance	Assessment Comment
		with passive surveillance.		
4.0	**Activity generators** • To promote surveillance; • To promote a wide range of legitimate activities; and • To promote community ownership and increased use of public spaces.			
4.1	Land use Layout • Locate around active edges or fringes of space to create surveillance opportunities	Dwellings and primary school will be oriented towards public spaces.		
4.2	Activity mix • Balance activities which may be crime generators such as bars, night time uses, restaurants and entertainment venues in terms of scale, size and local context	The LSP contemplates uses in accordance with the "Residential" zone including a primary school.		
4.3	Access • Encourage movement networks which provide surveillance without creating barriers	Most of the future roads within the LSP area will be local access streets which will provide a legible street network without creating barriers. The neighbourhood connector will provide for important movement through the site as well as providing access to the central POS and primary school. This road will be designed to allow for safe crossing. The neighbourhood connector is adjoined by POS and overlooked by smaller lot product – it is integrated within the urban structure, rather than being a barrier through the site.		
5.0	**Building design, including boundary definition** • To integrate public buildings into the wider public realm;			

	Item	Submission Developer Comments	Assessment Compliance	Assessment Comment
	• To use buildings to support surveillance of the public realm and public spaces; • To use construction materials which reduce temptations to vandalise and graffiti; and • To reduce the risk of public buildings contributing to crime and safety problems.			
5.1	Building entrances • Ensure entrances are oriented to face open or active spaces • Ensure entrances are clearly defined, distinguishable form public walkways, secure and well lit • Design lobbies to be visible from the exterior so that entry and exits spaces can be seen • Avoid creating entrapment spots or places where intruders may loiter or be concealed • Avoid locating ramped and elevator entrances and lifts in isolated locations • Secure non pedestrian entrances from illegal entry • Ensure staff entrances are well lit and allow maximumsurveillance and sightlines	The primary school will be integrated into the wider public realm with co-location with central POS area. We understand the Department of Education will design the future primary school to its specifications, ensuring a safe design. Entrances will be visible from public spaces.		
5.2	Building design • Consider crime reduction measures in the early stages of • esign • Minimise blank walls overlooking parks, car parks and other public areas • Minimise features or structures that can be used as natural ladders to gain access to higher levels, windows or doors • Optimise the variety of building design to create interesting built environments	Future development will be required to avoid blank walls overlooking parks and other public spaces.		

	Item	Submission Developer Comments	Assessment Compliance	Assessment Comment
	• Provide windows to overlook public areas			
5.3	Materials and fixtures • Avoid materials and exterior fixtures which might encourage crime • Use transparent and materials in doors and walls at major entry points	Materials and fixtures to be determined at detailed design stage and will have regard to not encouraging crime.		
5.4	Storage areas • Ensure surveillance and illumination of loading and storage areas • Locate delivery hatches, bins and other service facilities in a manner which does not create natural ladders or entrapment spaces	Storage area be considered at detailed design stage at the time of a specific development proposal.		
5.5	Retail commercial frontages • Promote after hours uses in frontage locations where public buildings front public spaces	No retail/commercial uses proposed.		
5.6	Sightlines • Provide clear sightlines	The indicative Masterplan allows for clear sightlines along public roads and between buildings and public spaces.		
5.7	Lighting • Illuminate entries so that access and egress visibility is maximised • Facilitate good interior to exterior surveillance through Illumination	To be considered at detailed design stage. Lighting will be designed to provide appropriate visibility and illumination.		
5.8	Employee car parking • Ensure safe and secure parking for employees near the building entry	Primary school parking areas will be designed by the Department of Education to its safety standards.		

	Item	Submission Developer Comments	Assessment Compliance	Assessment Comment
	• Provide surveillance of car parking			
5.9	Landscaping • Ensure landscape design will not provide concealment or entrapment areas • Optimise the variety of landscape to create interesting built environments	The indicative landscape concept plan illustrates the intent to provide interesting public open spaces that provide for a variety of recreational activities and contribute to the amenity of the urban area in terms of its visual appeal and safety. Future detailed landscaping design will have regard to safety and amenity and will be determined at the detailed design stage.		
5.10	Building security • Secure all windows, particularly at street level but ensure that security devices do not create a “fortress like” appearance.	To be considered at the building design stage of development.		
6.0	**Lighting** • To promote legitimate activity by users of public spaces after dark; • To encourage the use of appropriate lighting fixtures; and • To ensure the appropriate placement of lighting.	To be determined at detailed design. Lighting will be provided in public open spaces.		
6.1	Situational lighting • Ensure lighting is an early consideration in site planning and design • Select lighting appropriate to local context • Ensure inset spaces, access, egress and signage are well lit • Provide adequate lighting for directional signage	To be determined at detailed design. Will have regard to situational lighting.		

	Item	Submission Developer Comments	Assessment Compliance	Assessment Comment
6.2	Consistency of lighting • Maximise opportunities for natural light penetration • Provide consistent levels of lighting to reduce contrast and shadow • Ensure lighting supports visibility • Consider energy use	To be determined at detailed design. Will have regard to consistency of lighting.		
6.3	Placement of lighting • Select and light safe routes and spaces • Avoid placement in areas shielded by vegetation, awnings and other physical barriers • Avoid unshielded lighting at eye level • Consider light pollution • Ensure lighting falls upon the subject matter • Avoid lighting areas not intended for night time use • Consider lighting in terms of vulnerable groups, elderly, people with disabilities, children, women, night staff • Avoid creating natural ladders with lighting fixtures	To be determined at detailed design. Will have regard to appropriate lighting placement.		
6.4	Types of lighting • Install vandal resistant lighting • Avoid dependence on bollard lighting as the only light source • Combine lighting along footpaths with entrance lighting wherever possible	To be determined at detailed design, Will have regard to types of lighting that discourages vandalism.		
6.5	Maintenance • Ensure light fixtures are routinely and rapidly maintained • Consider public notices regarding maintenance contact details	Maintenance requirements to be considered at the detailed design stage.		

	Item	Submission Developer Comments	Assessment Compliance	Assessment Comment
7.0	**Landscape** • To balance the needs of the environment with those of user groups; • To support ease of maintenance; and • To support and reinforce principles such as surveillance, sightlines, legibility and orientation through compatible selection and placement of appropriate species and materials			
7.1	Footpath planting • Should improve amenity • Ensure shrubbery and planting is of low to medium level and does not impede sightlines, surveillance, security and way finding • Non concealing trees for selected locations should not encourage climbing and should be placed to avoid clumping • Avoid planting screening signage and lighting	The indicative landscaping concept included in Part 2 of the LSP intends to provide a safe functional and attractive environment through planting and landscape design. Specific landscaping will be determined at the detailed design stage.		
7.2	Wall planting • Grade planting with taller plants next to walls.	See comment above.		
7.3	Entrance planting • Avoid planting screening doorways, entrances and windows	See comment above.		
7.4	Maintenance • Carefully locate climbing plants to deter graffiti and vandalism • Specify high quality plants for long, low maintenance life	See comment above.		

	Item	Submission Developer Comments	Assessment Compliance	Assessment Comment
7.5	Hard landscaping • Select low maintenance, long life materials appropriate to the local context, level and type of use • Use details to identify public and private space and access ways for pedestrian, cycle and vehicular movement.	See comment above.		
8.0	**Management and Maintenance** • To discourage graffiti and vandalism by reducing blank canvases. • To facilitate prompt reporting of any damage; • To ensure prompt maintenance and repairs; and • To promote the perception of a well cared for area.			
8.1	Maintenance • Identify emergency contacts for maintenance in public locations • Promptly repair damage • Consider preventative maintenance			
8.2	Materials • Use secure and enclosed service points • Specify materials that can withstand normal hard use and be easily replaced • Provide protective heavy duty coatings in public areas and vulnerable hot spots • Avoid the use of highly vulnerable and flimsy materials and fittings which can be easily vandalised or removed in open locations • Avoid extensive and prolonged use of problem materials such as heavy duty mesh, cyclone fencing and grilles which may encourage wilful damage • Avoid long expanses of non permeable walls unless there	Materials and maintenance to be determined at detailed design stage. Will have regard to quality and durability of materials.		

	Item	Submission Developer Comments	Assessment Compliance	Assessment Comment
	is extensive public surveillance			
8.3	Security education and coordination • Consider training programs and reporting systems in conjunction with the Police and Office of Crime Prevention			
9.0	**Sightlines and way finding** • To provide unimpeded sightlines, particularly along pedestrian pathways.			
9.1	Sightlines • Avoid the use of gradients or changes in direction which impede sightlines, especially on pathways, stairs or enclosed spaces • Avoid landscape materials acting as a screen or barrier to unimpeded views of pathways • Ensure that pedestrians have a clear view ahead • Improve the sightlines in established areas through a reconsideration of routes, times of access and additional hardware such as appropriate security mirrors	See previous comments. Pathways and road network layout will provide appropriate sightlines. Landscaping detail will have regard to view lines.		
9.2	Way finding • Signage should identify where assistance and key areas can be located such as taxi ranks, toilets, public transport and telephones • Signage should be visible, concise and easily maintained • Use environmental cues such as changes in footpath materials, levels of lighting and appropriate changes in grade or elevation	To be determined at detailed design. Directional signage will be provided as necessary and appropriately located.		

	Item	Submission Developer Comments	Assessment Compliance	Assessment Comment
	• Use appropriate physical barriers (permeable fences) and symbolic barriers (low vegetation) to define use and ownership			
10.0	**Signage** • To provide adequate, easily legible signage to assist all user groups, particularly young people, older people and people with disabilities to find their way safely; and to provide signage which indicates safe places and routes.	Signage to be determined at detailed design stage. Consideration will be given to sign legibility.		
10.1	Provision of signage • Prepare a signage plan focussing on safe routes, destinations, facilities and amenities en route • Ensure signage is easily legible at all hours • Locate signage strategically, at crossing points, junctions, activity places and other common areas • Indicate where to go for assistance • Provide maps in large public open spaces and orientate maps to be consistent with the viewers direction			
10.2	Maintenance • Ensure key public signage is not obscured by mature landscape, awnings, poor lighting, too many commercial signs and vandalism • Consider reporting contacts and the process for emergency maintenance	Detailed landscaping design will have regard to views of signage.		
11.0	**Predictable routes and spaces safe from entrapment** • To reduce the risk of attack by hidden persons; • To eliminate possible entrapment places; and • To ensure the location and design of facilities such as telephones and automatic teller machines do not create			

	Item	Submission Developer Comments	Assessment Compliance	Assessment Comment
	entrapment spaces.			
11.1	Entrapment spots adjacent to pedestrian and cycle routes • Avoid creating entrapment spots adjacent to a main pedestrian and or cycle route, a predictable and or unchangeable path or a private dead end alleyway In established areas consider additional facilities such as lighting, improved maintenance or uses such as a kiosk or vendors to make spaces safer • Consider appropriate target hardening of storage areas, loading docks or other potential entrapment spots after hours in order to limit access • Arrange for regular security or police patrols	Pedestrian and cycle routes will be legible and clearly defined. Paths will be part of an integrated network with no dead-ends or alley ways. Passive surveillance of paths will be facilitated through orientation of dwellings to overlook POS and location of roads along POS. Paths will travel through the central public open space.		
11.2	Location of facilities • Locate entrances to automatic teller machines and other facilities within direct view of pedestrian paths • Locate car parking away from potential entrapment spaces • Ensure signs do not create entrapment spots	Matter for consideration at detailed design stage.		
12.0	**Civic and Town Centres** • To ensure safe and easy movement between uses; • To balance the mix of uses with selective night time uses in safe and accessible locations; and • To encourage increased use and activity.	No civic or town centres proposed. See previous comments regarding activity, location and paths, public open spaces and design for safety.		
12.1	Street level activity • Encourage commercial uses with extended trading hours to open onto the street • Ensure outdoor public areas and parks are at street level,			

	Item	Submission Developer Comments	Assessment Compliance	Assessment Comment
	or encourage balconies			
12.2	Entrapment spaces • Ensure that alleyways and loading docks are well lit and secure after hours • Ensure that building set backs do not introduce dead zones and entrapment spaces			
12.3	Balancing land uses • Ensure pedestrian access between residential and activity precincts is well lit at all times • Encourage a range of activity times			
12.4	Safe access routes • Design safe access to activity zones, public transport and parking facilities • Provide direct pedestrian access to buildings from the front street rather than the side or rear			
12.5	Well located facilities • Locate public telephones, toilets, public transport and automatic teller machines in locations with good surveillance			
12.6	Maintenance • Ensure all outdoor public areas are well maintained			
13.0	**Shopping, commercial, health and education centres** • Provide a safe and attractive environment for staff and users; • Provide range of uses suitable for all members of the			

	Item	Submission Developer Comments	Assessment Compliance	Assessment Comment
	community; and • Ensure safe and easy access in and around the centre			
13.1	Design and use • Provide incentives to encourage footpath activities • Explore solutions which avoid the centre 'turning its back on the surrounding streets • Encourage spaces for young people to legitimately congregate • Encourage activities for diverse user groups • Provide secure storage spaces	Primary school centrally located with public open space with shared oval providing for primary school and wider community use. The POS will provide for diverse recreational activities for use by all age groups, including space for organised team sport, cycling, walking, kick around space as well as passive recreation (e.g. picnic space).		
13.2	Car parking • Design large car parks with good sightlines and clear signage • Avoid creating car parks that are too large to adequately manage and keep secure	Future detailed design of car parking will consider appropriate sightlines and security.		
13.4	Public transport • Locate bus and train stops at entrances of buildings rather than on edges of car parks	Future bus stop locations to be determined by PTA. Existing bus route travelling along eastern boundary of LSP area.		
13.5	Landscape • Consider using 'green screens' in areas with high potential for graffiti • Avoid creating entrapment spaces	For consideration at the detailed design stage.		
13.6	Maintenance • Remove obsolete and superfluous street furniture • Redevelop underused spaces	N/A site currently vacant.		

	Item	Submission Developer Comments	Assessment Compliance	Assessment Comment
13.7	Community participation • Involve the community in the design, construction, renewal and refurbishment of community facilities	Site vacant, no refurbishment proposed.		
14.0	**Parks and Public Open Space** • To encourage legitimate use by a wide range of users; • Ensure the design does not create unsafe or dead environments; and • Ensure appropriate plan selection, materials and lighting to reduce opportunities for crime			
14.1	Design and use • Locate where it can be surrounded by a mix of land use to generate activity over acceptable extended hours • Foster legibility, orientation and amenity • Consider water safety • Consider the relationship of users to adjacent private spaces for surveillance purposes and compatibility • Avoid over designing and limiting use and under designing and creating dead zones • Locate youth recreation areas so that they are visible and use access control measures as appropriate • Avoid below grade pathways • Ensure parks are visible from the street	Central public open space co-located with primary school and surrounding houses oriented towards POS.		
14.2	Lighting • Ensure adequate lighting of path ways, activity zones and signage	The future landscaping detailed design will provide for paths and POS to be adequately lighted.		
14.3	Maintenance • Ensure regular maintenance	Maintenance of parks and POS to be addressed at detailed design stage via the landscape management plan (or similar).		

	Item	Submission Developer Comments	Assessment Compliance	Assessment Comment
14.4	Community involvement • Promote community use and ownership	Community use of central park encouraged through co-location of primary school and oval.		
15.0	**Car parks, including grade and multi-storey** • To encourage car park design which assists all users to easily identify their vehicles; • To increase safety through optimising visibility and clear sightlines; • To encourage surveillance from surrounding land uses; and • To provide safe access to and from car parks.			
15.1	Car park size • Should be as small a size as possible or divided into smaller sections • Avoid large expanses of car parking which may act as barriers and create surveillance issues	Future car parking will be designed to be appropriately sized to meet safety requirements.		
15.2	Design • Integrate complementary and active land uses near car parks to prevent isolation • Clearly identify pedestrian routes in car parks	Future car parks will be related to the primary school use.		
15.3	Surveillance • Encourage surveillance of multi-storey or interior car parks through placement of windows and land uses to overlook • Exterior should be overlooked from the street	No interior or multi-storey car parks currently proposed.		
15.4	Access • Access points should be visible from every car parking space	Design of future car parks will ensure access points are clearly visible. Pedestrian accesses will be adequately		

	Item	Submission Developer Comments	Assessment Compliance	Assessment Comment
	• Ensure all paths to and from car parks have appropriate landscaping, lighting, signage and sightlines • Limit unauthorized entry points from the street • Ensure street level entry and exit points have maximum surveillance from adjacent uses during hours of operation • Where appropriate encourage on-street parking	lighted, landscaped and signed.		
15.5	Pedestrian routes • Pedestrian routes should be integrated into a walkway system • Safe routes make illegitimate use more obvious	Design of future car parks will include pedestrian pathways to provide access from car parks to building entrances and wider walkway network.		
15.6	Sightlines • Maximise sightlines • Limit support pillars which may obscure sightlines • Consider glazing and open design at access points, lifts and stairwells • Use vandal proof security mirrors as appropriate	Noted for future design of car parks.		
15.7	Lighting • Maximise consistent lighting for access, egress, orientation, surveillance and sightlines during all operational hours • Illuminate parking bays and circulation routes	Lighting to be determined at stage by detailed design. Access points will be adequately lighted during operational hours.		
15.8	Landscape • Consider landscape which provides the widest possible views from the street of access and egress points	Landscape detail to be determined during detailed design – will have regard to maintaining views from the street.		
15.9	Signage • Ensure adequate signage for orientation, emergency	Signage locations to be determined at detailed design stage.		

	Item	Submission Developer Comments	Assessment Compliance	Assessment Comment
	contacts and security			
15.10	Facilities • Locate facilities such as toilets, seating and telephones in safe locations where the opportunity to loiter is minimized	Location of facilities to be determined at stage of detailed design.		
15.11	Management • Consider regular security patrols or security personnel	Management of car parks to be considered at development stage.		
16.0	**Transit stations, including bus stops and taxi ranks** • To maximise the use of public transport by a wide range of people over extended operational hours; • To encourage all users to feel safe by increasing safety provisions; and • To promote surveillance.	To be determined at detailed design stage.		
16.1	Location • Avoid locating stations, interchanges and stops in isolated, derelict or underused locations including vacant land, car parks, alleys, wide set back zones and possible entrapment spots • Avoid locating entries and stops at different levels from the main activity zone to avoid isolation and reduced surveillance • Ensure short, safe routes to and from stations, interchanges and stops, especially near night time venues	To be determined at detailed design stage		
16.2	Access • Ensure access to and from public transport and other	To be determined at detailed design stage		

	Item	Submission Developer Comments	Assessment Compliance	Assessment Comment
	modes of transport and destinations is as direct, safe and universally accessible as possible			
16.3	Surveillance • Maximise surveillance opportunities • Consider risk assessment in established problem areas • Consider congestion as well as isolation factors	To be determined at detailed design stage		
16.4	Sightlines and visibility • Remove or ameliorate hard and soft structures which block sightlines or provide hiding places • Design attractive landscape at stations, interchanges and stops of an appropriate scale and robust, low maintenance quality	To be determined at detailed design stage		
16.5	Entrapment • Design and redevelop structures to reduce the risk of entrapment and to improve sightlines	To be determined at detailed design stage		
16.6	Signage • Provide adequate, easy to find, vandal proof signage for all user groups to assist orientation • Ensure signage provides up to date information including emergency contact details	To be determined at detailed design stage		
16.7	Design and maintenance • Ensure private, public and transition zones and uses are clearly understood • Design with graffiti resistant, vandal resistant materials wherever possible • Ensure well maintained public realm and facilities	To be determined at detailed design stage		

	Item	Submission Developer Comments	Assessment Compliance	Assessment Comment
16.8	Lighting • Ensure areas adjacent are appropriately illuminated (limit shadow and contrast) and protected from weather	To be determined at detailed design stage		
16.9	Other facilities • Ensure associated telephones, automatic teller machines, toilets and ticket machines are located near active frontages	To be determined at detailed design stage		
17.0	**Public toilets** • To ensure safety for all people using public toilets; • To maximise surveillance opportunities in the location of public facilities; and • To ensure prompt and effective maintenance.	To be determined at detailed design stage		
17.1	Location • Locate adjacent to high traffic and legitimate activity areas, rather than in isolation • Avoid designing in loitering opportunities such as seating, telephones, automatic teller machines which are too close or entrapment spaces such as storage, utility recesses or underused access ways • Consider relocating public toilets which are in established unsafe locations	To be determined at detailed design stage		
17.2	Surveillance • Ensure approaches and entrances to all toilets in all locations are highly visible so that people cannot loiter or enter without being seen • Ensure adequate lighting	To be determined at detailed design stage		

	Item	Submission Developer Comments	Assessment Compliance	Assessment Comment
17.3	Access • Ensure adequate signage • Ensure doors/windows can be secured only by legitimate key holder to reduce the danger of entrapment	To be determined at detailed design stage		
17.4	Maintenance • Ensure facilities are as vandal proof as possible, well maintained and promptly repaired	To be determined at detailed design stage		
18.0	**Pedestrian routes, laneways, alleyways and access ways** • Design to maximise safe pedestrian and cyclist linkages, especially at night; and • Design to encourage legitimate activity.			
18.1	Location • Locate to enhance other designing out crime initiatives • Locate as part of a collector system • Locate for views of activity as well as safety and security	Pedestrian and cycle linkages will be provided throughout the LSP area including POS areas.		
18.2	Design • Provide an attractive, convenient variety of options for diverse user groups • Avoid designing in areas where little pedestrian traffic is expected • Consider appropriate closure techniques and alternative uses to remove unsafe parts of an existing network • Avoid dead ends • Consider the needs of user groups sharing the movement network	Shared paths will be provided through the area as part of an integrated pathway network. The network will be designed to cater for recreational users as well as providing routes between destinations. There will be no paths leading to dead ends.		
18.3	Surveillance • Ensure routes do not violate privacy whilst providing	Pedestrian routes will be provided within roads overlooks by houses, paths through		

	Item	Submission Developer Comments	Assessment Compliance	Assessment Comment
	surveillance • Encourage appropriate surveillance especially in open space areas	POS will be adequately surveilled.		
18.4	Sightlines • Identify priorities for lighting	Location of lighting to be determined at stage of detailed design.		
18.5	Lighting • Align lighting and pathways • Align lighting and landscape	Location of lighting to be determined at stage of detailed design.		
18.6	Access • Provide direct access routes to and from destinations • Avoid designing in opportunities for short cuts • Provide a visible exit point • Provide secure cycle parking where appropriate • Ensure barrier free access • Provide clear edge definition	Paths will be designed to provide an integrated network for recreational users as well as providing routes between destinations, e.g. paths will provide direct routes between the surrounding residential area and the central park and primary school. All paths will be linked and without barriers. Bicycle parking will be considered at the detailed design stage in appropriate locations.		
18.7	Orientation • Design to enhance recognition of movement network during hours of use • Provide appropriate and vandal proof directional signage, maps and materials	Pedestrian paths will be provided along the road network. Directional signage to be determined at stage of detailed design.		
18.8	Maintenance • Ensure private, public and transition zones and uses are clearly understood • Design with graffiti resistant, vandal resistant materials wherever possible • Ensure well maintained public areas and facilities	Private and public zones to be clearly identified. Maintenance of public area and facilities to be determined at detailed design stage.		

	Item	Submission Developer Comments	Assessment Compliance	Assessment Comment
19.0	**Pedestrian overpasses and underpasses** • Balance the needs of road safety with community safety needs; and • Ensure design of underpasses and overpasses reduce opportunities for crime.	No overpasses or underpasses proposed		
19.1	Design • Avoid predictable or unchangeable routes • Avoid designing in claustrophobic spaces • Reduce opportunities for inappropriate activity • Design for easy and affordable maintenance • Maximise natural light and ventilation • Ensure direct sightlines • Avoid recesses • Maximise width and passing spaces	No overpasses or underpasses proposed		
19.2	Access • Avoid access to places closed at night	No overpasses or underpasses proposed		
19.3	Lighting • Ensure adequate, vandal proof lighting	No overpasses or underpasses proposed		
19.4	Maintenance • Ensure adequate drainage for maintenance • Maintain a safe and clean environment	No overpasses or underpasses proposed		

APPENDIX 4
ENVIRONMENTAL ASSESSMENT REPORT

LOT 50 MUNDIJONG ROAD MUNDIJONG

ENVIRONMENTAL ASSESSMENT REPORT

Prepared for:	Peet Mundijong Syndicate
Report Date:	16 October 2012
Version:	1
Report No.	2012-48

pgv ENVIRONMENTAL

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1 INTRODUCTION

1.1 Background

Peet Limited is proposing to develop Lot 50 Mundijong Road, Mundijong (the site) for urban purposes in accordance with its zoning. The Site is located in the Shire of Serpentine - Jarrahdale (the Shire) located 45km south east of the Perth Central Business District (Figure 1).

The Site is approximately 42ha in size and is bound by Mundijong Road to the south, the future Tonkin Highway to the west, Sparkman Road to the north and Adams Street to the east (Figure 2). The Bush Forever Site No. 360 occurs in the Mundijong Road reserve and abuts the southern boundary of Lot 50.

The Site is zoned "Urban" under the Metropolitan Region Scheme and "Urban Development" in the Shire Town Planning Scheme No. 2 (TPS 2).

1.2 Mundijong Whitby District Structure Plan

The Mundijong Whitby District Structure Plan (DSP) which guides the future development of the Mundijong – Whitby area including the site was approved by the Western Australian Planning Commission (WAPC) in April 2011. The Mundijong Whitby DSP was adopted by the Shire in August 2011 and to provide overall guidance to the structure, vision and objectives for the planning and development of Mundijong Whitby. The DSP contains a number of Precincts and defines a framework by which urban development can occur in a coordinated manner. The LSP is situated within Precinct E of the DSP

The DSP has been used as a guide in the preparation of the more detailed LSP. The DSP predominantly dealt with district level issues such as:

- Biodiversity;
- Landscape Protection;
- Appropriate management of water quality and maintenance of hydrology;
- Efficient use and re-use of water;
- Responsive built form outcomes, sense of place, and community identity and character;
- Providing for alternative modes of transport;
- Climate responsive design and energy efficiency;
- Economic prosperity ; and
- Community well-being.

SMEC (2009) prepared on behalf of the Shire an Environmental Study for the Mundijong Whitby DSP. The environmental study of the Mundijong Whitby area identified a series of potential environmental impacts associated with the proposed development of the area, as well as a series of broad management recommendations.

1.3 Scope of Work

A Local Structure Plan (LSP) is being prepared by Peet Limited to further guide the development of the site. This Environmental Assessment Report has been prepared to assist in the preparation of an environmentally responsible LSP in keeping with the owner's vision for the Site and the requirements of the DSP.

Much of the environmental work to date has been based on desktop assessment. The following more detailed work was undertaken to identify any site specific environmental issues to assist in the preparation of the LSP. The detailed work included the following:

- Level 2 Flora Survey;
    - Desktop search and review of DEC's Declared Rare and Priority Flora database;
    - Threatened Ecological Communities database;
    - Examination of recent aerial photography and contour maps to provisionally identify
    - vegetation types and condition;
    - Field survey in spring (September to October in this area) using plots or quadrats to record
    - native and introduced species as well as a thorough site walkover of any areas of native
    - vegetation;
    - Recording of any significant plant species using a hand-held GPS;
    - Description and mapping of vegetation types and vegetation condition;
    - Compilation of a flora list; and
    - Preparation of a stand-alone report,
- Level 1 Fauna Survey:
    - Desktop search and review of DEC's Threatened Fauna database and the Commonwealth;
    - EPBC Act Listed Fauna;
    - Field survey to identify fauna habitat types and quality;
    - Assessment of the potential habitat value for the three species of Black Cockatoo (Carnaby's,
    - Baudin's and Forest Red-tail). This will include searching for evidence of foraging, nesting
    - and measurement of individual large trees for their diameter;
    - Description and mapping of fauna habitat and potential Black Cockatoo habitat areas; and
    - Preparation of a report.

On completion of the field studies an Environmental Assessment Report (this Report) has been prepared to describe the environmental attributes, opportunities and constraints for the site and will assess the environmental impact of the LSP. Advice on the potential impact of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* is also included.

2 EXISTING ENVIRONMENT

2.1 Land Use

The Site has historically been cleared for agricultural purposes and does not contain any remnant native vegetation. There are a few isolated mature native trees over pasture and a pocket of cultivated C*asuarina obesa* on the northern boundary.

The Site is currently used for grazing with some farm infrastructure located on the central eastern boundary (Figure 4).

2.2 Topography

The Site gently slopes from east to west with elevations ranging from approximately 31m AHD to 26m AHD (Figure 4).

2.3 Landform and Soils

The site is located on the eastern side of the Swan Coastal Plain. The Swan Coastal Plain is generally flat and is approximately 20 to 30 kilometres wide, consisting of a series of geomorphic entities running parallel to the coastline.

The site is situated primarily in the Bassendean System, with the south east portion within the Pinjarra Plain System. The description of these systems and related sub-soil phases is provided in Table 1.

Table 1: Soil Landscape Systems Found Within the Site

Reference	Description
Bassendean Dune System	Very low relief, leached, grey siliceous Pleistocene sand dunes, intervening sandy and clayey swamps and gently undulating plains. These occur immediately west of, and partly overlie, the Pinjarra Plain. Topography becomes more subdued from west to east.
B1 Phase	Extremely low to very low relief dunes, undulating sandplain and discrete sand rises with deep bleached grey sands sometimes with a pale yellow B horizon or a weak iron-organic hardpan at depths generally greater than 2m; Banksia dominant.
B6 Phase	Imperfectly drained sandplain and broad extremely low rises. Deep or very deep grey siliceous sands.
Pinjarra Plain System	Broad low relief plain west of the foothills, comprising predominantly Pleistocene fluvial sediments and some Holocene alluvium associated with major current drainage systems. Major soils are naturally poorly drained and many swamps occur.

P1b Phase	Flat to very undulating plain with deep acidic mottled yellow duplex (or "effective duplex") soils comprising moderately deep pale sand to sandy loam over clay; imperfectly drained and moderately susceptible to salinity in limited areas.

2.4 Acid Sulphate Soils

Acid sulphate soils (ASS) are wetland soils and unconsolidated sediments that contain iron sulfides which, when exposed to atmospheric oxygen in the presence of water, form sulphuric acid. ASS form in protected low energy environments such as barrier estuaries and coastal lakes and commonly occurs in low-lying coastal lands such as Holocene marine muds and sands. When disturberd, these soils are prone to produce sulphuric acid and mobilise iron, aluminium, manganese and other heavy metals. The release of these reaction products can be detrimental to biota, human health and built infrastructure.

The site is mapped in the DEC *Acid Sulphate Risk Map for the Swan Coastal Plain* as having a low to moderate risk of ASS (Landgate, 2012).

2.5 Hydrology

2.5.1 Groundwater

Groundwater flows from east to west across the region, generally following the topography. The Perth Groundwater Atlas (DoW, online) shows a snapshot of groundwater levels as measured in May 2003 (which are an indication of low groundwater levels); showing groundwater levels at the site ranging from 27mAHD in the east to 23mAHD in the west.

Pre-development groundwater levels

Site-specific groundwater monitoring was carried out by Brown Geotechnical & Environmental and Emerson Stewart between September 2008 and August 2011 to obtain information on pre-development groundwater levels and water quality across the LSP area. The monitoring showed that groundwater levels were at their highest in August 2011, and were within 400mm of existing surface levels.

The groundwater tends to perch on the underlying clayey soils, causing large fluctuations of up to 3m between high and low groundwater levels. Towards the western end of the site where the clay materials are within 1m of natural surface, peak groundwater levels are very shallow (within 100mm of existing surface). The eastern end of the site has a greater depth of sand over the underlying clays, which results in a slightly larger natural separation between existing surface and peak groundwater levels (0.5-0.6m).

A comparison of the pre-development monitoring data to nearby long-term DoW monitoring bores showed that the maximum groundwater levels measured in August 2011 were slightly higher than the long-term (25-year) average maximum levels.

2.5.2 Surface water

The site is within the Serpentine River Catchment and lower Serpentine Water allocation sub –area. Surface water in the Shire of Serpentine-Jarrahdale drains to the Serpentine River and ultimately the Peel Harvey Estuary.

Surface runoff from the site is via overland flow from east to west, following the natural topography. There are some very shallow farm drains (approx 0.2 - 0.5m deep) across the site, which help to drain the site.

The Mundijong-Whitby DWMS (GHD, 2010) identified two flow paths which take runoff from upstream catchments east of Adams St through the site. The DWMS estimated the combined flow through the Precinct E1 site from upstream catchments to be approximately $12m^3/s$ under pre-development conditions (for the critical 100yr ARI event).

Pre-development surface water modelling

Surface runoff from a 390ha catchment discharges through Lot 50 Cockram Street and Lot 7 Adams Street, and due to the relatively flat nature of the site and very shallow existing drains, there is significant interaction between flow paths throughout the catchment. This interaction between several flow paths makes the calculation of pre-development flow rates particularly complex. A 2-dimensional surface water model was developed using XP Storm's 2D module, which allows a more accurate calculation of runoff than a traditional 1-dimensional model. The model showed that there are two main inflow locations to Lot 50, with a total flow rate of 6.9m3/s entering Lot 50 from upstream catchments in the critical 100yr ARI storm event, and the design of the open drains through the multiple use corridors will be designed to accommodate this inflow. The pre-development modelling also showed that 2.0m3/s is generated within the Lot 50 site in a 100yr ARI storm event.

2.6 Wetlands

A significant portion of the site is shown in the DEC *Geomorphic Wetlands of the Swan Coastal Plain* dataset as being a Multiple Use wetland (Figure 6). PGV Environmental confirmed in their vegetation and flora assessment in September 2011 that the site was completely degraded and did not exhibit any significant wetland values and it was correctly classified as Multiple Use.

The *Geomorphic Wetlands of the Swan Coastal Plain* dataset shows a Conservation Category wetland in the Mundijong Road reserve. The road reserve north of Mundijong Road adjacent to the site is very narrow and contains scattered trees over a weedy understorey and does not exhibit any wetland values as shown in Plates 1 and 2. The road reserve on the southern side of Mundijong Road is wider and contains vegetation in better condition and contains some ecological and wetland values.

The DEC Conservation Category wetland boundary within the Mundijong Road reserve has been mapped at a very broad scale and it is most likely that the spatial representation of the wetland is not accurate when considered at a finer scale.

Plate 1: Mundijong Road Looking East

Plate 2: Mundijong Road Looking East

2.6.1 Peel Harvey Estuary

The site is located within the catchment of the Peel-Harvey Estuary. The Peel-Harvey Estuarine system is a valuable water resource under stress from nutrients, particularly phosphorus, draining from the catchment area. Phosphorus is considered the critical nutrient for eutrophication causing algal blooms in the Peel-Harvey Estuary. Current average nutrients for the Peel-Harvey Inlet are estimated at a rate of 15kg of phosphorus/ha per annum and 150kg of nitrogen/ha per annum (Peel-Harvey WSUD Local Planning Policy, 2006). The Estuary has a long history of nutrient enrichment and algal blooms which are a major environmental concern in the region.

2.7 Vegetation and Flora

PGV Environmental undertook a Level 2 Flora survey of the site in October 2011. The Level 2 Flora survey was undertaken in accordance with Guidance Statement 51: *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia.*

The Level 2 Flora Survey included:

- Desktop search and review of Department of Environment and Conservation's Declared Rare and Priority Flora database and Threatened Ecological Communities database;
- Examination of recent aerial photography and contour maps to provisionally identify vegetation types and condition;
- A site walkover to ground truth the results of the desktop study; and
- Advice on the potential for significant species identified in the desktop searched to be present on the site.

As there was no native vegetation in the site, a separate Flora and Vegetation Report has not been produced. The results are provided below.

The vegetation on the site has been historically cleared for rural purposes. The site contains some scattered trees over pasture and weed species. The remaining native species include *Corymbia calophylla* (Marri), *Kingia australis* and *Eucalyptus* rudis (Flooded Gum).

A small triangular stand of planted Sheoaks *(Casuarina obesa)* is located on the northern boundary of the site. Other exotic trees on the site include *Eucalyptus camaldulensis* (River Red Gum) and *Eucalyptus sideroxylon* (Ironbark).

Plate 3: Mature Marri Over Pasture

Plate 4: *Kingia australis* over Pasture

2.7.1 Vegetation Condition

The condition of the vegetation was assessed according to the system devised by Keighery and described in Bush Forever (Government of Western Australia, 2000a). Keighery's condition rating scale ranges from Pristine where the vegetation exhibits no visible signs of disturbance to Completely Degraded where the vegetation structure in no longer intact and without native plant species (Table 2).

Table 2: Vegetation Condition Rating Scale.

Condition	Description
Pristine	Pristine or nearly so, no obvious signs of disturbance.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very Good	Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration

	but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

Source: Government of Western Australia, 2000.

The site has been cleared of native vegetation and used for grazing purposes. The site is considered Completely Degraded based on the Bush Forever vegetation condition rating scale.

The remnant mature trees have been assessed and a number have been identified to be retained where possible (Appendix 1).

2.7.2 Conservation Significant Flora

A search of the DEC Threatened Flora Database (DEFL), the WA Herbarium database (WAHerb), the Declared Rare and Priority Flora Species List and the Environment Protection Biodiversity Conservation Act 1999 (EPBC Act) Protected Matters Report indicates that a number of species that are listed as Endangered, Threatened or priority have been located within a 5km radius of the site the results from these database searches are shown in Table 3.

The significant flora species listed in Table 2 are would not occur on the site due to the Completely Degraded condition of the vegetation.

Table 3: Conservation Significant Flora known to occur in the Mundijong Area

Family	Taxa	Status Under Wildlife Conservation Act 1950	Status Under EPBC Act 1999
Apiaceae	*Eryngium pinnatifidum subsp. palustre-*	3	
Apocynaceae	*Parsonsia diaphanophleba*	4	
Aponogetonaceae	*Aponogeton hexatepalus*	4	
Asteraceae	*Millotia tenuifolia*	2	
Asteraceae	*Pithocarpa corymbulosa*	3	
Asteraceae	*Pithocarpa corymbulosa*	3	
Asteraceae	*Trichocline sp. Treeton*	2	
Centrolepidaceae	*Centrolepis caespitosa*	4	E
Cyperaceae	*Cyathochaeta teretifolia*	3	
Cyperaceae	*Schoenus pennisetis*	1	
Cyperaceae	*Tetraria australiensis*	T	

Droseraceae	*Drosera occidentalis*	4	
Ericaceae	*Andersonia audax ms*	T	
Ericaceae	*Andersonia gracilis*		E
Ericaceae	*Andersonia saxatilis ms*	1	
Fabaceae	*Acacia lasiocarpa var. bracteolata*	3	
Fabaceae	*Acacia oncinophylla subsp. oncinophylla*	3	
Fabaceae	*Dillwynia dillwynioides*	3	
Fabaceae	*Jacksonia gracillima*	2	
Goodeniaceae	*Anthotium sp.*	1	
Hemerocallidaceae	*Johnsonia pubescens subsp. cygnorum*	2	
Myrtaceae	*Baeckea sp. Perth Region*	3	
Myrtaceae	*Darwinia foetida*		CE
Myrtaceae	*Eucalyptus balanites*		V
Myrtaceae	*Eucalyptus rudis subsp. cratyantha*	4	
Myrtaceae	*Verticordia lindleyi*	4	
Myrtaceae	*Verticordia plumosa*	T	E
Orchidaceae	*Caladenia huegelii*	T	
Orchidaceae	*Diuris purdiei*	T	
Orchidaceae	*Drakaea elastica*	T	E
Orchidaceae	*Paracaleana gracilicordata*	1	
Orchidaceae	*Paracaleana granitica*	1	
Poaceae	*Austrostipa jacobsiana*	1	
Proteaceae	*Grevillea crowleyae*	2	
Proteaceae	*Grevillea curviloba subsp. incurva*		E
Proteaceae	*Grevillea manglesii subsp. ornithopoda*	2	
Proteaceae	*Synaphea odocoileops*	1	
Proteaceae	*Synaphea sp. Fairbridge Farm*		CE
Proteaceae	*Synaphea sp. Pinjarra Plain*	1	
Proteaceae	*Synaphea sp. Serpentine*	3	
Restionaceae	*Meeboldina decipiens subsp. decipiens*	3	
Stylidiaceae	*Stylidium ireneae*	4	
Stylidiaceae	*Stylidium longitubum*	3	

2.7.3 Conservation Significant Vegetation

A search of the DEC's Threatened (TEC) and Priority Ecological Communities (PEC) database and EPBC Protected Matters conducted for the site indicated that 5 TEC and 5 PECs are present within a 5km radius of the site (Table 4).

Due to the Completely Degraded structure and condition of the vegetation on the site, the TECs and PECs do not occur on the site.

Table 4: Threatened and Priority Ecological Communities known to occur in the Mundijong Area

Ecological Community	Description	Status under the Wildlife Conservation Act	Status under the EPBC Act
SCP20b	*Banksia attenuata* and/or *Eucalyptus marginata* woodlands of the eastern side of the Swan Coastal Plain	Endangered	
SCP3b	*Eucalyptus calophylla - Eucalyptus marginata* woodlands on sandy clay soils of the southern Swan Coastal Plain	Vulnerable	
SCP3a	*Eucalyptus calophylla - Kingia australis* woodlands on heavy soils, Swan Coastal Plain	Critically Endangered	Endangered
SCP3c	*Eucalyptus calophylla - Xanthorrhoea preissii* woodlands and shrublands, Swan Coastal Plain	Critically Endangered	Endangered
SCP08	Herb rich shrublands in clay pans	Vulnerable	Critically Endangered
SCP1a	*Eucalyptus haematoxylon - E. marginata* woodlands on Whicher foothills	Priority 3	
Casuarina obesa association	*Casuarina obesa* Association	Priority 1	
SCP21c	Low lying *Banksia attenuata* woodlands or shrublands	Priority 3	
SCP22	*Banksia ilicifolia* woodlands	Priority 2	
SCP24	Northern Spearwood shrublands and woodlands	Priority 3	

The Bush Forever Site No 360 "Mundijong Road and Watkins Road Bushland" is mapped as occurring in the Mundijong Road reserve adjacent to the southern boundary of the site. Bush Forever Site No. 360 contains plant communities representative of the eastern side of the Swan Coastal Plain that are considered to be regionally significant (WAPC, 2000).

The southern portion of the Mundijong Road reserve exhibits conservation values described in Bush Forever Site No. 360. However, the reserve to the northern portion of Mundijong Road reserve does not exhibit any conservation values. The northern portion of the Mundijong Road reserve contains scattered trees largely over a weedy understorey.

2.8 Fauna

Terrestrial Ecosystems was commissioned by PGV Environmental to undertake a Level 1 fauna risk assessment of the site. The purpose of the Level 1 fauna risk assessment was to provide information to assess the potential impact of vegetation clearing on the fauna assemblages located on the site.

The methodology broadly followed that described in the Environmental Protection Authority (EPA) *Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection* (EPA 2002), *Guidance Statement No. 56: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004) and the EPA/Department of Environment and Conservation (DEC) *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA/DEC 2010).

A Level 1 fauna risk assessment involves undertaking a desktop review and site inspection. The objectives of the fauna risk assessment were to:

- Provide an indication of the vertebrate fauna assemblage (reptiles, amphibians, small mammals and birds) on and in the vicinity of the project area;
- Identify the presence and/or potential risks of impacting on species of conservation significance that are present or likely to be present in the project area;
- Determine if any additional surveys are required to assess the potential impact on fauna assemblages in the project area, in particular, impacts on species of conservation significance; and
- Make recommendations that avoid, mitigate or minimise potential impacts on resident fauna.

The results of the Level 1 fauna risk assessment are summarised below and shown in full at Appendix 2.

2.8.1 Fauna Habitat

The site contains two habitat types (Plates 3 & 4):

- Fenced highly disturbed pasture with scattered mature native and planted trees: and
- Small patch of fenced densely planted *Allaocasuarina obesa* in the north west corner.

Plate 5: Tree over Pasture

Plate 6: *Casuarina obesa* Stand

2.8.2 Conservation Significant Fauna

Thirteen threatened species of fauna and 14 migratory species of birds identified under the *EPBC Act 1999* potentially occur in the vicinity of the site. There are 27 Schedule species listed under the WA *Wildlife Conservation Act 1950* and 10 species listed on the DEC's Priority Fauna List that potentially occur in the vicinity of the site. The following is an assessment of the likelihood of each of the species being found in the project area and Table 5 is a summary of this information.

Table 5: Conservation Significant Species that may occur in the Mundijong Area

Species	Status under the *Wildlife Conservation Act 1950*	Status under the *EPBC Act 1999*	Comment on potential impact that vegetation clearing will have on conservation significant species
Neopasiphae simplicior Native bee	Schedule 1	Critically Endangered	Unlikely to be found in the site. Low potential impact.
Phascogale calura Red-tailed Phascogale	Schedule 1	Endangered	Unlikely to be found in the site. Low potential impact.
Calyptorhynchus latirotris Carnaby's Black Cockatoo	Schedule 1	Endangered	Likely to be seen in the site. Low potential impact.
Botaurus poiciloptilus Australasian Bittern	Schedule 1	Endangered	Seen on the site. Low potential impact.
Calyptorhynchus banksii naso Forest Red-tailed Black Cockatoo	Schedule 1	Vulnerable	Likely to be seen in the site. Low potential impact.
Calyptorhynchus baudinii Baudin's Black Cockatoo	Schedule 1	Vulnerable	Likely to be seen in the site. Low potential impact.
Synemon gratiosa Graceful Sun-Moth	Schedule 1	Endangered	Unlikely to be found in the site. Low potential impact.
Sternula nereis nereis Fairy Term	Schedule 1	Endangered	Unlikely to be found in the site. Low potential impact.
Bettongia penicillata Woylie	Schedule 1	Endangered	Unlikely to be found in the site. Low potential impact.
Dasyurus geoffroii Chuditch	Schedule 1	Vulnerable	Unlikely to be found in the site. Low potential impact.
Myrmecobius fasciatus Numbat	Schedule 1	Vulnerable	Unlikely to be found in the site. Low potential impact.
Setonix brachyurus	Schedule 1	Vulnerable	Unlikely to be found in the

Quokka			site. Low potential impact.
Apus pacificus Fork-tailed Swift	Schedule 3	Migratory	May infrequently fly over the site. Low potential impact.
Haliaeetus leucogaster White-bellied Sea-eagle	Schedule 3	Migratory	May infrequently fly over the site. Low potential impact.
Merops ornatus Rainbow Bee-eater	Schedule 3	Migratory	May be found in the vicinity of the site. Low potential impact.
Calidris acuminata Sharp-tailed Sandpiper	Schedule 3	Migratory Wetland	Unlikely to be seen in the site. Low potential impact.
Calidris canutus Red Knot	Schedule 3	Migratory Wetland	Unlikely to be seen in the site. Low potential impact.
Calidris ferruginea Curlew Sandpiper	Schedule 3	Migratory Wetland	Unlikely to be seen in the site. Low potential impact.
Calidris ruficollis Red-necked Stint	Schedule 3	Migratory Wetland	Unlikely to be seen in the site. Low potential impact.
Ardea alba Great Egret	Schedule 3	Migratory Wetland	Unlikely to be seen in the site. Low potential impact.
Ardea ibis Cattle Egret	Schedule 3	Migratory Wetland	Unlikely to be seen in the site. Low potential impact.
Limosa lapponica Bar-tailed Godwit	Schedule 3	Migratory Wetland	Unlikely to be found in the site. Low potential impact.
Limosa limosa Black-tailed Godwit	Schedule 3	Migratory Wetland	Unlikely to be found in the site. Low potential impact.
Numenius minutus Little Curlew	Schedule 3	Migratory Wetland	Unlikely to be found in the site. Low potential impact.
Tringa glareola Wood Sandpiper	Schedule 3	Migratory Wetland	Unlikely to be seen in the site. Low potential impact.
Tringa stagnatilis Marsh Sandpiper	Schedule 3	Migratory Wetland	Unlikely to be seen in the site. Low potential impact.
Morelia spilota imbricata Carpet Python	Schedule 4		Unlikely to be found in the site. Low potential impact.
Falco peregrinus Peregrine Falcon	Schedule 4		May infrequently fly over the site. Low potential impact.

Acanthorhynchus superciliosus Western Spinebill	Priority 4		May infrequently visit over the site. Low potential impact.
Ctenotus gemmula	Priority 3		Unlikely to be found in the site. Low potential impact.

The conservation significant species likely to be seen on the site are the Carnaby's Black Cockatoo, Baudin's Black Cockatoo and Forest Red-tailed Black Cockatoo.

The Western Spinebill and the Migratory Rainbow Bee-eater and the White Bellied Sea-Eagle may infrequently be seen in the site (Terrestrial Ecosystems, 2011).

Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) – Endangered under the *EPBC Act 1999* and Schedule 1 under the *Wildlife Conservation Act 1950*

Carnaby's Black Cockatoo inhabits the south-west of Western Australia (Garnett et al. 2011). Its preferred nesting trees include the smooth-barked Salmon Gum (*Eucalyptus salmonophloia*) and Wandoo (*E. wandoo*), which contain deep hollows. Nesting also occurs in Marri (*Corymbia calophylla*) and Tuart (*E. gomphocephala*). Its main foods are the seeds of Hakeas, Grevilleas, Banksias, Eucalypts and introduced pines.

The site contains some Marri (*Corymbia calophylla*) which are known feeding trees for Carnaby's Black Cockatoo (Higgins 1999). Carnaby's Black-Cockatoos were recorded during other fauna surveys in the general area. Carnaby's Black Cockatoo are likely to regularly feed in the native vegetation on the Mundijong Road verge on the southern boundary of the site (Terrestrial Ecosystems, 2011). There was no evidence of foraging or breeding seen on the site.

Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) – Vulnerable under the *EPBC Act 1999* and Schedule 1 under the *Wildlife Conservation Act 1950*

This species is most common in the far south-west of Western Australia. It is known to breed from the southern forests north to Collie and east to near Kojonup. Baudin's Black Cockatoo is typically found in vagrant flocks and utilises the taller, more open Jarrah and Marri woodlands, where it feeds mainly on Marri seeds and various Proteaceous species. While they are seasonally present on the Swan Coastal Plain, Baudin's Black Cockatoo are potentially seen in the vicinity of the site (Garnett et al. 2011).

Baudin's Black Cockatoo may infrequently feed in the site, but would more frequently be seen foraging in the native vegetation on the south side of Mundijong Road, which is on the other side of the southern boundary of the site (Terrestrial Ecosystems, 2011).

Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) – Vulnerable under the *EPBC Act 1999* and Schedule 1 under the *Wildlife Conservation Act 1950*

Forest Red-tailed Black Cockatoos frequent the humid to sub-humid south-west of Western Australia from Gingin in the north, to Albany in the south and west to Cape Leeuwin and Bunbury (Department of Sustainability Environment Water Population and Communities 2011). It nests in

tree hollows with a depth of 1-5m, that are predominately Marri (*C. calophylla*), Jarrah (*E. marginata*) and Karri (*E. diversicolor*) and it feeds primarily on the seeds of Marri.

Red-Tailed Black Cockatoos have been recorded during other fauna surveys in the general area and probably feed in the native trees on the south side of Mundijong Road outside of the site (Terrestrial Ecosystems, 2011). They may occasionally roost in the large trees on-site. There is no record to indicate that they breed in the vicinity of the site (Johnstone and Kirkby 2011).

Western Spinebill (*Acanthorhynchus superciliosus*) – Priority 4 with DEC

This species inhabits heath land, woodland, and open forest with healthy understorey and feed on banksias, eucalypts and numerous shrub species (Johnstone and Storr 2004). They also feed on insects. Their numbers have declined as a result of extensive habitat clearing and fires.

Western Spinebills have been recorded in other fauna surveys in the vicinity of the site. It may be seen occasionally in the Sheoak plantation area along the northern boundary (Terrestrial Ecosystems, 2011).

Rainbow Bee-eater (*Merops ornatus*) - Migratory under the *EPBC Act 1999* and Schedule 3 under the *Wildlife Conservation Act 1950*

Rainbow Bee-eaters are abundant in Australia, and found in many parts of Western Australia except the sandy deserts and dry arid interior. Johnstone and Storr (1998) described them as resident, breeding visitors and postnuptial nomads. They are generally migratory, moving south in late September and early October, having wintered from the Gascoyne to Indonesia.

Rainbow Bee-eaters are regularly seen across most of the wetter areas of Western Australia including around the site. Given their abundance and wide spread distribution, ground disturbance activities on a localised scale are unlikely to significantly impact on Rainbow Bee-eaters(Terrestrial Ecosystems, 2011) .

White-bellied Sea-Eagle (*Haliaeetus leucogaster*) – Migratory under the *EPBC Act 1999* and Schedule 3 under the *Wildlife Conservation Act 1950*

The White-bellied Sea-eagle is the second largest bird of prey found in Australia. This eagle has been seen in a variety of habitats and not always near the ocean, but they are more commonly seen in coastal areas. Birds form permanent pairs that inhabit territories throughout the year. These eagles are normally seen perched high in a tree, or soaring over waterways and adjacent land.

The White-bellied Sea-Eagle may infrequently be seen in the general area, but clearing the site is unlikely to significantly impact on this species (Terrestrial Ecosystems, 2011).

2.8.3 Biodiversity Value

The cleared pasture has almost no ecological value from a native fauna perspective. There are a few mature trees in the paddocks, some of which contain hollows which are currently providing nesting sites for Galahs and Australian Ringneck Parrots.

2.8.4 Ecological Linkages

There are four substantial areas set aside as Bush Forever sites nearby; Byford to Serpentine Rail/Road Reserves and adjacent bushland (BFS 350), Norman Road Bushland (BFS 354/361), Cardup Nature Reserve and adjacent bushland (BFE 352) and Roman Road Bushland (BFS 362). Avian fauna would regularly move through and between these areas.

The southern boundary of the site does not form part of an ecological linkage through the general area.

2.8.5 Conservation Significant Species

Conservation significant species that probably infrequently utilise the project area include Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*), Forest Red-tailed Black Cockatoo (*C. banksii naso*) and Baudin's Black Cockatoo (*C. baudinii*). The Western Spinebill (*A. superciliousus)* may infrequently be seen in the small triangular fenced area along the northern boundary. Migratory Rainbow Bee-eaters and the White-bellied Sea-eagle may infrequently be seen in the area, but will readily move when development commences and are unlikely to be significantly impacted.

All eucalypt trees on the site were inspected to determine whether any showed signs of use or had the potential to support a nesting hollow for a Black Cockatoo. Thirty five trees on the site had a trunk diameter of 50cm or greater at breast-height. The locations of these trees are shown on Figure 8. Three of these trees may have contained hollows.

Determining whether a tree contained a hollow can be difficult from the ground, as all you can see is the opening, but not inside the hollow. Three trees on the site may have contained hollows. Some of the trees that contained hollows contained nests of Australian Ringneck Parrots and Galahs. Johnstone and Kirkby (2011) indicated that there were no records of Carnaby's Black Cockatoos breeding in the vicinity of the site, and the closest nesting site was on the Darling Scarp to the east.

2.9 Heritage

2.9.1 Indigenous Heritage

A search of the Department of Indigenous Affairs Register of Aboriginal Sites revealed that there are no previously recorded ethnographic sites on the site (Landgate, 2012).

Ethnosciences undertook an Aboriginal Heritage Assessment of the site in 2011/2012. The assessment included a desktop search and ethnographic and archaeological field surveys. A separate report has been prepared to detail the findings of the assessment.

In summary, no ethnographic sites were reported on the land during the ethnographic survey which involved representatives of Bilya and Winjan Aboriginal Corporation who have long-standing associations with the region (Ethnosciences, 2012).

One archaeological site (MJ-06), an artefact scatter, was located on the site during the archaeological survey. MJ-06 is a small, medium-density, open quartz artefact scatter situated on a Bassendean sand dune above seasonally inundated wetlands. The site represents either the by-products of task specific activities or a short term or infrequently used occupation site. However, MJ-06 is assessed as currently being of low archaeological significance. No further recording of the surface assemblage of MJ-06 is required.

The consultants from the Bilya and Winjan Aboriginal Corporation groups were of the view that Site MJ-06 — the artefact scatter identified on Lot 50 during the archaeological survey — was of low cultural significance and did not oppose Peet Limited applying for Section 18 consent for the site. However, they differed in how the site should then be treated. The former wants the material left *in situ*; the latter wants the material salvaged and appropriately stored. At present, it is not possible to reconcile these opposing views.

2.9.2 Non Indigenous Heritage

A search of the following sources at federal, state and local government level was undertaken to determine the actual or potential presence of sites or features of non-indigenous heritage significance were within the site:

- World Heritage Sites.
- National Heritage Sites.
- Commonwealth Heritage Sites.
- Sites on the register of the National Estate.
- Sites listed in the Shire of Serpentine-Jarrahdale Municipal Heritage Inventory List.

This search revealed that there were no listed heritage sites occurring within the site.

2.10 Noise and Odour

The Mundijong Whitby DSP report identified a number of potential noise and odour emitting sources in the DSP area (Appendix 3).

2.10.1 Noise

There is one potential noise source that currently impacts on the southern boundary of the site, transport noise from Mundijong Road. The future Tonkin Highway alignment runs along the western boundary of the site and is likely to have transport noise impacts.

The final civil design for the development and proposed noise amelioration measures are required inputs for acoustic models to determine the level of impact. The final civil design will be completed as part of the future subdivision process. The Proponent will undertake an acoustic assessment as part of the planning process for subdivision.

2.10.2 Odour

The site is not impacted by any of the point odour sources or related buffers that were identified in the DSP.

3 LEGISLATION, POLICY AND GUIDELINES

The following legislation, policy and guidelines have been considered during this environmental assessment and will guide the required and expected management outcomes from Commonwealth, State and Local government agencies.

3.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act) is the Australian Government's central piece of environmental legislation.

The EPBC Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places — defined in the Act as matters of national environmental significance.

The seven matters of national environmental significance to which the EPBC Act applies are:

- world heritage sites
- national heritage places
- wetlands of international importance (often called 'Ramsar' wetlands after the international treaty under which such wetlands are listed)
- nationally threatened species and ecological communities
- migratory species
- Commonwealth marine areas
- nuclear actions.

Under the EPBC Act, a significant impact is determined by the sensitivity, value and quality of the environment which is to be impacted and the intensity, duration, magnitude and geographic extent of the impacts (DEWHA, 2008b). If a proposed action is deemed to have a significant impact, this action should be referred to the Minister.

The EPBC Act applies to 'actions' which:

- Have a 'significant impact' on 'matters of national environmental significance';
- Are undertaken by commonwealth government agencies and have a significant impact on the environment anywhere in the world; or
- Are undertaken by any person and have a significant impact on commonwealth land (even if the activity is not actually carried out on the commonwealth land).

The Matters of National Environmental Significance. Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999 (DSEWPaC, 2009) provides a guide for determining the significance of the impact which depends on the sensitivity, value and quality of the environment and the intensity, duration, magnitude and geographic extent of the impacts.

According to the Significant Impact Guidelines 1.1 an action is likely to have a significant impact on an endangered and vulnerable species if there is a possibility that it will trigger any one of nine criteria listed in Table 6 and 7.

Table 6: Significant Impact Criteria for Endangered Species

Criteria	Carnaby's Black Cockatoo
Lead to a long-term decrease in the size of a population	No
Reduce the area of occupancy of the species	No
Fragment an existing population into two or more populations	No
Adversely affect habitat critical to the survival of a species	No
Disrupt the breeding cycle of a population	No
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	No
Introduce disease that may cause the species to decline	No
Interfere with the recovery of the species	No

Table 7: Significant Impact Criteria for Vulnerable Species

Criteria	Baudin's Black Cockatoo	Forest Red-tail Black Cockatoo
Lead to a long-term decrease in the size of an important population of a species	No	No
Reduce the area of occupancy of an important population	No	No
Fragment an existing important population into two or more populations	No	No
Adversely affect habitat critical to the survival of a species	No	No

Disrupt the breeding cycle of an important population	No	No
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No	No
Result in invasive species that are harmful to a vulnerable species becoming established in the Vulnerable species' habitat	No	No
Introduce disease that may cause the species to decline	No	No
Interfere substantially with the recovery of the species.	No	No

The potential impacts of clearing the remnant trees on the site have been assessed against the criteria for the three species listed as Endangered and Vulnerable under the EPBC Act 1999 that could forage on the site.

Given that the site has been historically cleared of native vegetation and the above significant impact criteria are not triggered it is PGV Environmental's view that the proposed development will not significantly impact on Commonwealth listed conservation significant.

3.2 State Legislation

3.2.1 Environmental Protection Act 1999

The EPA considered the Draft South East Corridor Structure Plan, Metropolitan Scheme Amendment No. 966/33 and Stormwater Management Strategy and Plans for New Urban Development at Byford and Mundijong and provided advice in EPA Bulletin 795 (1995). This advice was provided as a Strategic Environmental Assessment which not a formal environmental impact assessment under Part IV of the EP Act.

The EPA concluded that the Draft South East Corridor Structure Plan, Metropolitan Scheme Amendment No. 966/33 and Stormwater Management Strategy and Plans for New Urban Development at Byford and Mundijong could be made environmentally acceptable. In reaching this conclusion the EPA identified the following main environmental objectives and the proposal should meet:

- Avoid and minimise environmental damage to wetlands of local and regional significance;
- Reserve land that has been identified in the System 6 Report as having conservation and recreation value;
- Prevent nutrient enrichment and degradation of the groundwater and the surface water systems from on-site eft1uent disposal;
- Protect remnant bushland communities identified in the system 6 review;
- Minimise the potential impact of noise, dust and odour from existing poultry farms and piggeries on proposed adjoining land uses;
- Ensure changes to land use within the catchment to the Peel Harvey estuarine system are controlled so as to avoid and minimise environmental damage particularly in terms of nutrient export; and

- Ensure suitable transport strategies have been adopted to ensure that air quality and greenhouse gas emissions in the South East Corridor meet health and environmental standards.

These environmental objectives were considered in the structural planning process for the Mundijong Whitby DSP.

Under the EP Act, clearing of native vegetation requires a permit from the DEC unless there is an exemption under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*. Proposals that have approval by means of a Ministerial Statement and which are implemented in accordance with that Statement are exempt from requiring a clearing permit to clear native vegetation. In addition clearing in accordance with an approved subdivision is also exempt.

It is likely that any clearing that will be required for the development will be considered at he subdivision stage by the DEC and is likely to be exempt from the requirements of a clearing permit.

3.2.2 Wildlife Conservation Act 1950

Under the *Wildlife Conservation Act 1950* (WC Act) all native species of fauna are protected unless otherwise declared, and cannot be captured or killed without a licence. In addition some fauna species are determined to require special protection, in which additional consideration is given for the protection and conservation of these species. The lists of species under the WC Act are regularly updated, with the DEC maintaining this list.

The WC Act protects all flora species, but specifically Declared Rare Flora (DRF) and it is an offence to take rare flora for any purpose on lands without written consent.

There are no DRF within the site and the only native species of fauna that may infrequently visit the site are the Carnaby's Black Cockatoo, Forest Red-tailed Black Cockatoo and Baudin's Black Cockatoo. Clearing of foraging and potential roosting habitat for Black Cockatoos does not need approval under the WA Act.

3.2.3 Aboriginal Heritage Act 1972

The *Aboriginal Heritage Act 1972* (AHA) protects all Aboriginal sites whether or not they are known and registered under the AHA. One new Aboriginal site was found within the site and management strategies for the site are addressed in the Indigenous Heritage Assessment Report for the site (Ethnoscience, 2012).

3.3 State Policy

3.3.1 State Planning Policy No. 2.1 Peel-Harvey Coastal Plain Catchment (SPP 2.1)

SPP 2.1 was developed to ensure that land use changes within the Peel-Harvey Estuary System that are likely to cause environmental damage are brought under planning control and are prevented (Department of Planning 2003). Generally the policy states that any development, including the construction of buildings should aim to:

- Reduce the nutrient load discharging into the Peel-Harvey Estuary catchment.
- Encourage the retention and rehabilitation of existing remnant vegetation.
- Subdivision maximises consumption and retention of drainage on site.

- Consider the treatment of soils within open space with nutrient retention soil amendment, particularly in areas where phosphorus retention is low.

The site is located within the Peel-Harvey Coastal Plain Catchment and as such the considerations and requirements of this policy have been considered as part of this strategy in Section 5.

3.3.2 State Planning Policy No. 2.8 Bushland Policy for the Perth Metropolitan Region

SPP 2.8 in conjunction with Bush Forever (Government of Western Australia 2000) seeks to ensure the protection of at least 10 per cent of the original extent of each vegetation complex within the Perth Metropolitan Region. SPP 2.8 was developed to ensure that bushland protection and management issues were appropriately addressed and integrated as a part of future land use. Bush Forever identified approximately 51,200 hectares of regionally significant vegetation for retention. The management of these areas include reservation and acquisition by the State government, negotiated planning solutions with owners who are seeking urban and/or industrial development and advice, assistance and incentive programs to support private conservation.

The Bush Forever Site No 360 Mundijong Road and Watkins Road Bushland is mapped as occurring in the Mundijong Road reserve adjacent to the southern boundary of the site. Bush Forever Site No. 360 contains plant communities representative of the eastern side of the Swan Coastal Plain that are considered to be regionally significant (WAPC, 2000).

The road reserve to the north of Mundijong Road does not exhibit any conservation values. The reserve contains scattered trees largely over a weedy understorey.

3.3.3 State Planning Policy No. 2.9 Water Resources

- SPP 2.9 aims to ensure the protection and appropriate management of water resources in line with state guidelines is included within the planning framework. The broad aims of this policy are to: Protect, conserve and enhance water resources.
- Assist in ensuring the availability of suitable water resources to maintain essential requirements for human and other biological life and to maintain or improve the quality and quantity of water resources.
- Promote and assist in the management and sustainable use of water resources.

As a part of implementing this policy, the Better Urban Water Management (WAPC 2008) framework was developed. This framework provides detail on how water resources should be considered at each stage of planning by identifying the various actions and investigations required with regard to regional and local planning strategies, town planning schemes, structure plans, subdivisions, strata subdivision and development applications (WAPC 2008).

3.3.4 State Planning Policy No. 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning

SPP 5.4 addresses transport noise from within major transport corridors, including freight routes, and its impact on noise sensitive land uses. The policy aims to:

- Protect people from unreasonable levels of transport noise by establishing a standardised set of criteria to be used in the assessment of proposals.

- Protect major transport corridors and freight operations from incompatible urban encroachment.
- Encourage best-practice design and construction standards for new development proposals and new or redeveloped transport infrastructure proposals.
- Facilitate the development and operation of an efficient freight network.
- Facilitate the strategic co-location of freight handling facilities.

Major transport (road) corridors are defined as:

- State roads and national highways;
- Urban primary distributors as described on the metropolitan functional road hierarchy (MRWA, local government) network;
- Other urban roads carrying more than 20,000 vehicles per day;
- Primary freight roads (Perth metropolitan region);
- Primary freight roads (South-West region); and
- Primary freight roads (State-wide).

Mundijong Road, located adjacent to the southern boundary of the site is described as a primary distributor within the metropolitan functional road hierarchy and as such the requirements of SPP 5.4 have been considered as part of this assessment. In addition, the future Tonkin Highway adjacent to the western boundary of the site will also be subject to this policy.

The noise criteria outlined in SPP 5.4 is applied to the outdoor areas of sensitive premises, and describes the level of noise which must be met. The noise criteria are provided below in Table 8. The noise target is the level of noise in which, when this target or lower is achieved, no further mitigation of noise is required. The noise limit represents an acceptable margin for compliance, in which a range of noise mitigation methods can be utilised to reach the noise target. In the policy it states that in greenfield developments there is an expectation that the design of the proposal will be consistent with achieving the target level.

Table 8: Noise Criteria

Time of Day Noise	Noise Target	Noise Limit
Day (6am – 10pm)	LAeq(Day) = 55dB (A)	LAeq(Day) = 60dB(A)
Night (10pm – 6am)	LAeq(Night) = 50dB(A)	LAeq(Day) = 55dB(A)

The noise criteria can be met through a variety of mitigation measures. An acoustic assessment at the subdivision stage of planning will be undertaken by the proponent.

3.3.5 Wetlands Conservation Policy for Western Australia

The Wetland Conservation Policy for Western Australia (Government of Western Australia 1997) outlines the State government's commitment to identify, maintain and manage the State's wetland resources which include lakes, swamps, marshes, springs, damplands, impoundments, intertidal flats and mangroves.

The objectives of the policy are to:

- Prevent further loss or degradation of valuable wetlands and wetland types.

- Include viable representation of all major wetland types within the conservation reserve.
- Maintain viable wild populations which include the species and genetic diversity of wetland dependant flora and fauna.
- Increase community awareness and appreciation for wetlands.

No wetlands of conservation significance are located within the site, with the Multiple Use Wetland identified retaining limited wetland values, given these areas are cleared paddocks.

A Conservation Category wetland is located in the reserve along Mundijong Road adjacent to the southern boundary of the site. The northern road reserve does not exhibit any values consistent with a Conservation Category wetland and it is likely that the broad spatial scale of the DEC mapping is not accurate.

The Local Water Management Strategy (Cardno 2010e) has provided for the management of these areas from a hydrological point of view.

3.3.6 Environmental Protection Authority Position Statement No. 4 Environmental Protection of Wetlands

EPA Position Statement No.4 Environmental Protection for Wetlands defines the important wetland values and functions of wetlands, and provides the EPA's position on protecting these values by establishing principles for wetland protection. The EPA recognises that the continued degradation and loss of wetland habitat in Western Australia, particularly on the Swan Coastal Plain, is a threat to conservation of wetlands and wetland biodiversity, maintaining that the remaining wetlands are important and require protection.

The key environmental values and functions of wetlands include:

- Primary production – provide nourishment for variety of organisms.
- Recreational and landscape amenity – provide a refuge for wildlife and humans and have an intrinsic natural beauty.
- Hydrological balance – provide important flood control and stormwater detention function.
- Water quality protection – remove pollutants such as sediments, nutrients, organic and inorganic matter and some pathogens.
- Wildlife habitat – provides a multitude of ecological niches and supports a variety of flora and fauna.

The principles the EPA will consider in determining potential impact on wetlands include:

- Protect, sustain and where possible restore biological diversity of wetland habitats.
- Protect the quality of wetlands through the application of ecological sustainable development and "wise-use". The term "wise-use" is taken from the Ramsar Convention and is taken to mean the sustainable utilisation for the benefit of humankind in a way compatible with the natural properties of the ecosystem, in which human use of wetland is undertaken in such a way that it may yield the greatest continual benefit for all.
- That there is no net loss of wetland values and functions (aspirational goal).

There is one wetland of conservation significance located to the south of the site and Mundijong Road and will need to be considered in terms of:

- Retention of wetlands;
- Management of wetlands to retain values and attributes; and
- Provision and management of buffers.

3.3.7 Environmental Protection Authority Guidance Statement No 33 Environmental Guidance for Planning and Development (EPA 2009)

The purpose of EPA Guidance Statement No.33 Environmental Guidance for Planning and Development is to outline the significance of environmental factors and provide the key definitions associated with the environmental factors. This document is primarily targeted at ensuring environmental factors are considered in line with the EPA's principals and objectives and within the planning framework. In particular, EPA Guidance Statement No.33 Environmental Guidance for Planning and Development aims to:

- Provide an overview to environmental protection processes and information;
- Describe the referral and environmental impact assessment process and process under Part IV of the EP Act; and
- Provide the EPA's position and advice on a range of environmental factors, outlining how to protect, conserve and enhance the environmental values.

3.4 Shire of Serpentine Jarrahdale

The Shire of Serpentine-Jarrahdale has a number of Local Planning Policies (LPP) which detail the Shire's expectations with regard to planning and development, and the factors that need to be considered throughout the planning process. Key LPPs applicable to the site and the environmental values within the site are outlined below:

- LPP 4 Revegetation Strategy;
- LPP 6 Water Sensitive Design;
- LPP 26 Biodiversity Planning; and
- LPP 22Water Sensitive Urban Design;

4 LOCAL STRUCTURE PLAN

4.1 Local Structure Plan

The LSP has been prepared for the site, utilising inputs of the project consultant team. The consultant team encompassed a range of technical disciplines, including environmental, civil engineering, urban design and town planning, traffic management, landscape architects and land-use economics.

A key consideration in the development of the LSP has been the Mundijong Whitby DSP which has been used to guide planning within the subject site. The Mundijong Whitby DSP was prepared by the Shire of Serpentine Jarrahdale to provide overall guidance on the structure, vision and objectives for the planning and development of Mundijong Whitby.

The LSP provides the next level of detailed planning which is based on the Mundijong Whitby DSP and provides general guidance for subdivision and detailed design. It is generally a spatial plan, with an inherent degree of flexibility in how it will be applied in the latter stages of planning, particularly as detailed site specific investigations are undertaken. The LSP is shown in Figure 3.

The environmental values of the site (outlined in Section 2) have been considered as a part of the design process through a variety of mechanisms. These include the retention of the environmental values, provision of public open space locations and road alignments to accommodate specific values and provide for the protection and management of these values.

The LSP is considered to be largely unconstrained from an environmental perspective. The most significant environmental values include:

- Location of the southern entry road to avoid TEC and CCW in Mundijong Road Reserve;
- Retention of healthy mature native trees where possible;
- Re-location of mature native species to POS;
- Location of POS to retain healthy paddock trees where possible;
- Location of larger lots along western boundary as a noise buffer adjacent to the future Tonkin Highway reserve and services corridor; and
- Stormwater drainage system that can be landscaped to increase the number of trees on the site and improve fauna habitat.

4.2 Landscape Masterplan

The Landscape Master Plan details the location of the particular types of public open space and is largely based on the environmental values present within the site and the desire to reflect the existing rural and 'leafy green' context that is evident in the existing Mundijong town site.

As with the LSP, this plan provides broad guidance on the development and management of the different open space opportunities. The Landscape Master Plan is provided in Appendix 4.

It outlines broad ‘typologies’ for the open space which are based on the size, type and function of the landscape treatment that is likely to be incorporated within the subject site as part of the LSP’s implementation.

5 OPPORTUNITIES AND CONSTRAINTS

5.1 Opportunities

The site has previously been cleared for agricultural purposes and is currently used for pasture crops and grazing. As the site contains no remnant vegetation apart from scattered paddock trees it is well placed for potential urban development.

5.1.1 Topography

The site is largely flat and will not require significant re-contouring for the proposed development.

5.1.2 Remnant Vegetation

The site does not contain any intact remnant vegetation and there is no ecologically significant vegetation. There are several isolated mature native trees in the paddocks which have some environmental and amenity value (Figure 8). Where possible the LSP has been designed around retaining the healthy mature trees.

The planted Sheoak stand is not of conservation significance and is not a constraint to development.

The completely degraded condition of the site is viewed as a benefit for future development as no clearing of native vegetation is required.

5.1.3 Conservation Significant Flora

None of the species listed as significant by DEC and DSEWPaC that have been previously recorded in the vicinity of the site was identified during the October 2011 flora survey.

Future development of the site will not result in loss of conservation significant flora.

5.1.4 Bush Forever Site No. 360

The Bush Forever site No. 360 is adjacent to the southern boundary of the LSP area in the Mundijong road reserve. The vegetation on the northern side of Mundijong Road is considered to be Completely Degraded and is not representative of plant communities of the eastern side of the Swan Coastal Plain. A large majority of the trees have been cultivated and the understorey consists of weed species and pasture.

The southern side of the road reserve however is representative of plant communities of the eastern side of the Swan Coastal Plain and the condition of the vegetation is considered to be Very Good.

The Bush Forever site on the northern side of Mundijong Road is not considered to be a constraint to the location of an entry road into the development.

5.1.5 Conservation Significant Fauna

The three species of Black Cockatoo (Carnaby's, Baudins and Forest Red-Tail) were identified as likely to be found infrequently on the site. These species are listed under the *Wildlife Conservation Act 1950* and the Commonwealth EPBC Act 1999.

Terrestrial Ecosystems (2011) identified 35 trees on the site that had a trunk diameter of 50cm or greater at breast height. Three of the trees appeared to have hollows but showed no evidence of use by Black Cockatoos for breeding purposes.

The migratory White-bellied Sea-eagle and Rainbow Bee-eater may on occasion fly over the site however they are not reliant on the site.

Future development of the site will result in a small loss of foraging habitat for the three species of Black Cockatoo. The impact is not considered significant according to the Significant Impact Guidelines 1.1. Retention of some of the mature trees on site will continue to provide habitat to ensure the Black Cockatoos continue to visit the site. Planting of Marri in POS and drainage reserves will lead to greater foraging habitat for Black Cockatoos on the site in the long term.

5.1.6 Surface Water Bodies/Wetlands

The site is mapped largely as a Multiple Use wetland which is not considered to contain significant environmental values.

The road reserve to the north of Mundijong Road (adjacent to the site) has been mapped as a Conservation Category Wetland in the *Geomorphic Wetlands of the Swan Coastal Plain* dataset (DEC, 2012). The mapping of the wetland follows the boundary of the Bush Forever site No. 360. The vegetation in the road reserve is largely cultivated and is not considered representative of wetland values (PGV, Environmental, 2012).

The mapped wetland on the northern side of Mundijong Road is not considered to be a constraint to development (see section 2).

Future development of the site will not result in loss of wetland values.

5.2 Constraints

The soils and groundwater characteristics within the site pose some limitations however these limitations can be mitigated and/or managed and are not considered being serious constraints to the future development of the site.

5.2.1 Drainage and Stormwater Runoff

Flooding is the temporary covering of land by water from overflowing streams and run-off from adjacent slopes. If a site is prone to flooding, which can be caused by inefficient drainage, then either the placement of fill or subsurface drainage should be considered as an integral component of engineering design.

Waterlogging is the condition of a soil which is saturated with water and in which most or all of the soil air has been displaced. Inundation occurs under severe waterlogging conditions when the land surface is covered by water.

The areas of the site that comprise of Bassendean Dune geomorphology generally have moderately well, to well-drained soils. Sandplain Plain systems in particular can be prone to swamp formations. The areas that would cause the most concern in terms of flooding would be the areas that have naturally poorly drained soils (i.e. Pinjarra Plain). Land capability assessment previously undertaken for the DSP area identified the site as being subject to seasonal waterlogging and inundation. The

Pinjarra P1b soil unit has a 95% risk of occurrence of water logging and the Bassendean B2 and B6 soil units have a 10% risk of occurrence of waterlogging (SMEC, 2009).

Appropriate management measures (refer to 6.1 Drainage and Stormwater Runoff) will be required to control runoff from roads, car parking areas, roofs of buildings and lawn/landscape areas.

5.2.2 Soils and Erosion

Nutrient retention ability refers to the ability of the soil profile to retain nutrients. Urban development is likely to increase the risk of phosphorous export from the MW Cell (Department of Agriculture and Food (DAF), 2000). Increased phosphorous export from the site is likely to contribute to the eutrophication of waterways and wetlands within the area and downstream watercourses, including the Peel-Harvey estuary.

The percentage risk of phosphorous export occurring within the site will only be increased by urbanisation. To reduce this risk any fill brought into the project area should maximise phosphorous retention time. This can be achieved by only importing soils with a low phosphorous export risk or by mixing high Phosphorous fixing materials (e.g. alkaloam) to soils with a high risk of phosphorous leaching.

The nutrient retention ability of soils can be demonstrated by the Phosphorus Retention Index (PRI) which measures how strongly P is adsorbed onto soil particles. SMEC (2009) identified that the Bassendean B2 and B6 have a high risk of occurrence (70% and 90% respectively) and the Pinjarra P1b has a low risk of occurrence (5%) of phosphorous export.

Wind erosion risk relates to the susceptibility of bare soil to be transported by wind. Severe wind erosion is generally limited to land which has been cleared, overstocked and grazed. Wind erosion can cause the loss of topsoil, leaving behind bleached/nutrient poor soils at the surface.

The Bassendean Dune System is subject to a high risk (35% occurrence) of wind erosion, due to lack of structure of the deep, grey, unvegetated sands which provide little resistance to wind when stripped of vegetation. In comparison, the Pinjarra land unit has a low risk (5% occurrence) wind erosion (SMEC, 2009).

5.2.3 Surface Water Flows

Water erosion can be caused by surface flow and take place in the form of sheet, rill, gully, stream bank or tunnel erosion which can cause soil loss and saltation as the result of poor planning or management. Erosion risk depends on climate, landform, soil factors and vegetation cover.

A very low risk of water erosion exists throughout the site due to the flat topography and the lack of significant watercourses.

5.2.4 Acid Sulphate Soils

The site has been classified as having a moderate to low risk of ASS occurring within 3m of the natural soil surface.

Whilst listed as a constraint, a preliminary ASS investigation will be required as part of the subdivision planning process to determine if ASS are present. Depending on the results of the investigation an ASS Management Plan may be required.

5.2.5 Noise

The site may be subject to transport noise constraints from Mundijong Road and the future Tonkin Highway to the west of the site.

Transport noise can be mitigated through a number of management strategies. Further investigation of potential noise impacts will be undertaken by the Proponent during the subdivision planning process.

6 ENVIRONMENTAL MANAGEMENT FOR FUTURE DEVELOPMENT

6.1 Vegetation

Mature trees to be retained or transplanted will be identified and marked appropriately prior to commencement of any pre-construction activities.

Five mature *Kingia australis* over pasture are located in the northern and southern end of the site. Where possible these will be retained or salvaged and replanted in POS.

No management practises are required for significant flora or TECs/PECs as none occur on the site.

6.2 Significant Fauna

The following management practices will be been made with respect to the three species of Black Cockatoo:

- Retention of the three significant trees from within the site identified by Terrestrial Ecosystems (2011) as having potential hollows;
- Where possible, the retention of mature native Eucalypt species will provide habitat for the three species of Black-Cockatoos; and
- Planting of Marri seedlings in POS and drainage reserves will occur.

6.3 Drainage and Stormwater Runoff

A Local Water Management Strategy (LWMS) has been prepared to support the LSP (Wave, 2012). Groundwater quality will be protected by the use of Water Sensitive Urban Design principles as outlined in the LWMS.

To ensure nutrient rich runoff (and other potential sources of contamination) does not directly enter the drainage channel the following management measures are proposed:

- In the vicinity of watercourses construct purpose built 'detention' basins that have the ability to trap sediments and nutrients. These basins will not be allowed to discharge directly to watercourses;
- Lawn areas (that require fertiliser, pesticide and/or herbicide application) will be minimised in areas of POS adjacent to watercourses; and
- During the subdivision of the site, the local community/new landowners will be provided with informative literature describing preventative methods they can implement themselves (i.e. reducing nutrient run-off) to reduce adverse impacts on the environment.

6.4 Soils and Erosion

To minimise potential for soil erosion to occur the following management measures are proposed:

- Ground disturbing activities will be kept to a minimum and carried out 'as required' (in stages) immediately prior to lots being released for sale as part of a 'staged' development of the site;
- Landscaping/stabilising/dust suppression of areas where ground disturbance has occurred will be scheduled to occur immediately after clearing/and or infrastructure construction has been completed; and
- Clearing activities have the potential to add clay 'fines' into the drainage channel creating turbid water downstream (drainage channel) and the installation of temporary drop-out basins to capture and aid in the settling of clay fines will be considered.

6.5 Acid Sulphate Soils

A preliminary site investigation will be undertaken at the subdivision planning stage to determine if ASS is present within the site.

If required an ASS and De-watering Management Plan will be prepared for the site in accordance with the DEC (2003) guidelines.

6.6 Noise

The Tonkin Highway alignment is adjacent to the western boundary of the LSP area. The LSP has been designed to have larger Lots backing onto the Tonkin Highway road reserve. Impacts of noise have not been assessed as the finished engineering levels and noise amelioration strategies proposed for the road reserve are not known.

An acoustic assessment at the subdivision stage is recommended to further detail the potential impacts of traffic noise from Mundijong Road and the future Tonkin Highway. The acoustic report will provide suitable noise mitigation and management strategies for the site.

6.7 Heritage Management

Indigenous Heritage issues and management are provided in a separate report (Ethnoscience, 2012) prepared to facilitate the LSP.

6.8 Fire Management

The site is predominantly cleared and is not situated within close proximity to any bushland with the exception of the narrow reserve to the south of the site and Mundijong Road.

7 CONCLUSIONS

The potential constraints and opportunities to the proposed development, in relation to the environmental attributes of the site outlined in Section 2 and 5. Appropriate management measures have been identified (Section 6) are recommendations made as to likely management practices to ameliorate the environmental constraints to the proposed development.

Based on the size and scope of the proposed development and the results of desktop and onsite assessments and mitigation measures identified, it is believed the potential for deleterious impacts on the biophysical environment as a result of the proposed development, are considered to be low with a high degree of confidence, and can be managed to minimise environmental harm.

Urban development of lot 50 Adams Road Mundijong is considered to be environmentally acceptable for the following reasons:

- The Site has largely been cleared of native vegetation and does not contain any conservation significant flora or vegetation;
- The site contains limited habitat for the three species of Black Cockatoo. Clearing trees will not cause a significant impact on the Black Cockatoos. Some habitat tress will be retained in the development. Planting of marri trees in POS and drainage reserves will lead to an increase in habitat in the long term;
- The site does not contain any significant wetlands;
- Access form Mundijong Road to the site can be achieved without impacting on the Threatened Ecological Community or Conservation Category Wetland in the Mundijong Road reserve;
- One Aboriginal heritage site is considered by the Aboriginal elders as not being a constraint to development;
- There are no European Heritage sites;
- Noise impacts from the future Tonkin Highway have been accommodated by large lots on the western side ; and
- A Local water Management Strategy has been prepared and incorporated intot he Local Structure Plan such that flooding on-site and downstream will be avoided and export of pollutants to the Peel Harvey Estuary will be minimised.

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FIGURES

PINPOINT CARTOGRAPHICS (08) 9562 7136 2012-048-f01.dgn

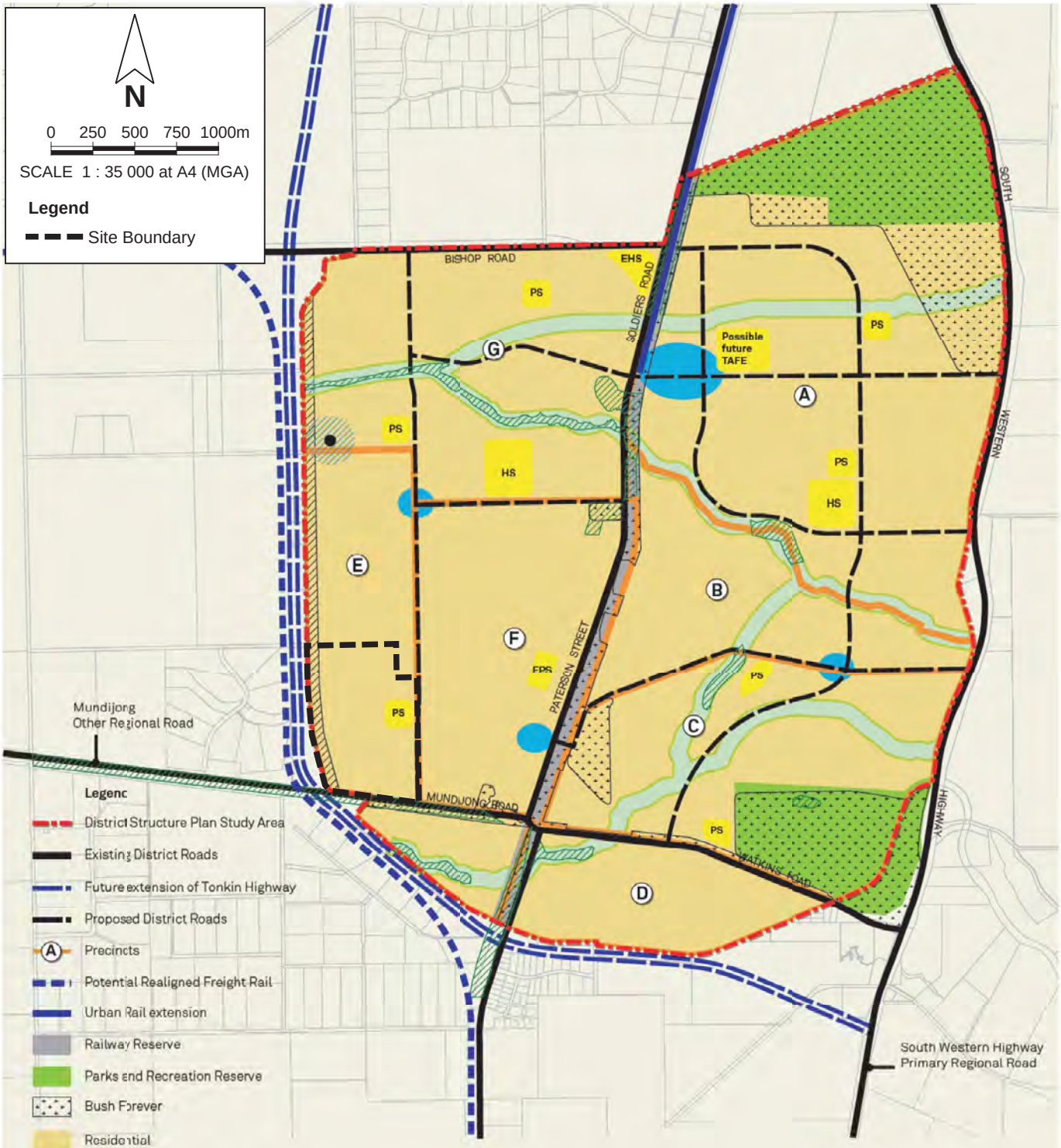
pgv ENVIRONMENTAL

Peet Limited
ENVIRONMENTAL ASSESSMENT REPORT
LOT 50 MUNDIJONG ROAD, MUNDIJONG

Drawn: B. Heath	Date: 27 Sep 2012
Job: 10054	Revision: A

SITE LOCATION

Figure 1



Legend

- District Structure Plan Study Area
- Existing District Roads
- Future extension of Tonkin Highway
- Proposed District Roads
- Precincts
- Potential Realigned Freight Rail
- Urban Rail extension
- Railway Reserve
- Parks and Recreation Reserve
- Bush Forever
- Residential
- Conservation Category Wetland
- Possible Wastewater Pump Station location and associated 150m radius odour buffer
- Multiple Use Corridor - location, size and dimension to be determined at LSP stage
- Possible Service Corridor
- Centre
- Schools: EPS - Existing Primary School; EHS - Existing High School; HS - High School; PS - Primary School; TAFE - Possible Future Tafe

'The District Structure plan has been prepared to provide overall guidance to the structure, vision and objectives identified for the planning and development of Mundijong/Whitby. It is designed to establish the overall development theme and address major district-wide issues in order to facilitate efficient and coordinated development in a manner that delivers the objectives and vision identified.

The District Structure Plan by its nature is not intended to address detailed planning and design matters but to provide the context for which these matters can be appropriately dealt with as part of further more detailed planning and design.'

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LOT 50 MUNDIJONG ROAD, MUNDIJONG

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Job: 10054	Revision: A

MUNDIJONG WHITBY DISTRICT STRUCTURE PLAN

Figure 2

PINPOINT CARTOGRAPHICS (08) 9562 7136 2012-048-f02.dgn

SOURCE: Taylor Burrell Barnett, Plan No. 08/039/020A, 06/08/2012.

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Job: 10054 | Revision: A

LOCAL STRUCTURE PLAN

Figure 3

BASE SOURCE: Taylor Burrell Barnett.
AERIAL PHOTOGRAPH SOURCE: Taylor Burrell Barnett.

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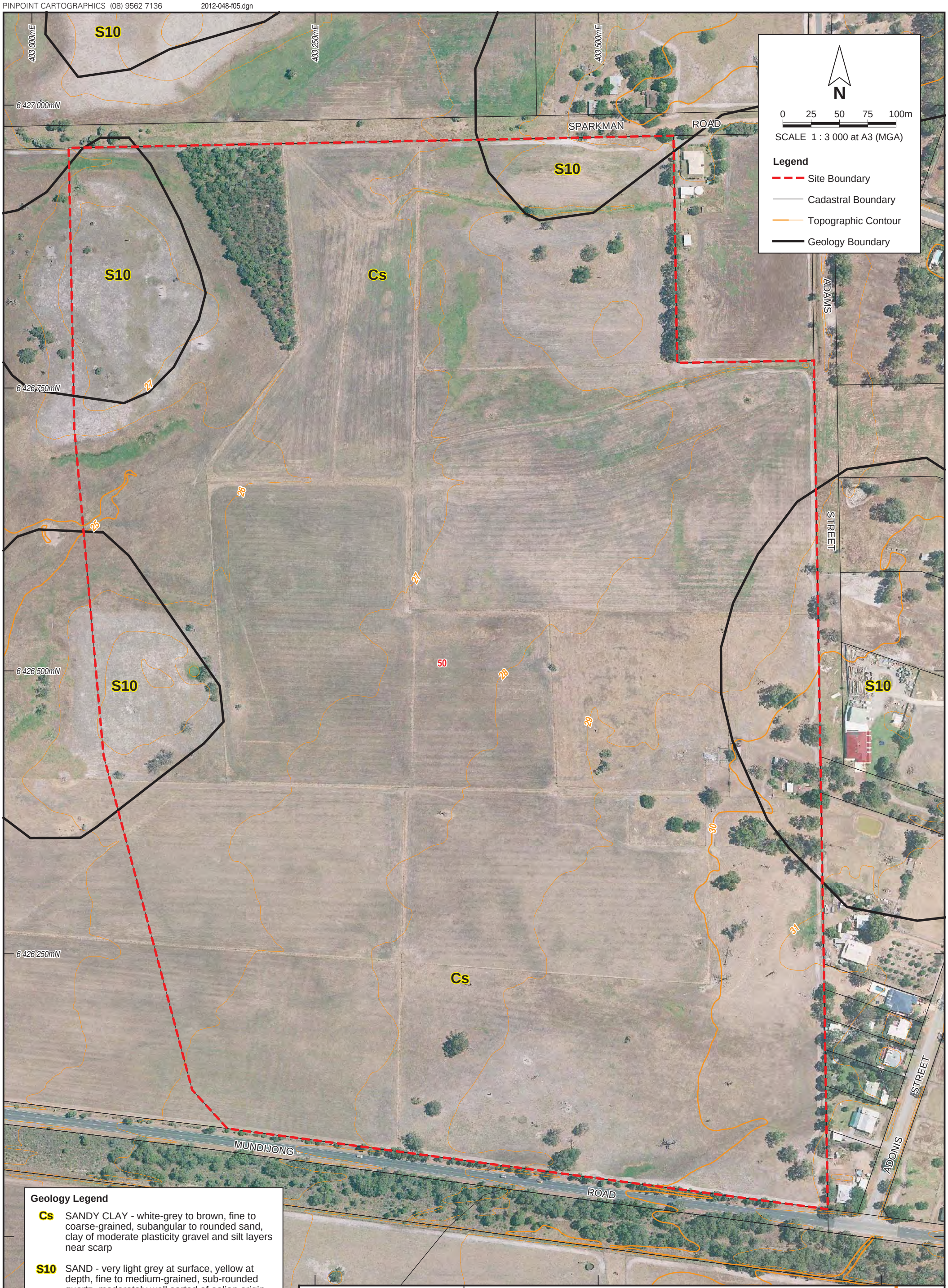
LOT 50 MUNDIJONG ROAD, MUNDIJONG

Drawn: B. Heath	Date: 27 Sep 2012
Job: 10054	Revision: A

CURRENT LAND USE AND TOPOGRAPHY

Figure 4



BASE SOURCE: Taylor Burrell Barnett.
AERIAL PHOTOGRAPH SOURCE: Taylor Burrell Barnett.
GEOLOGY SOURCE: Geological Survey of WA, 1:50 000 Environmental Geology Series.

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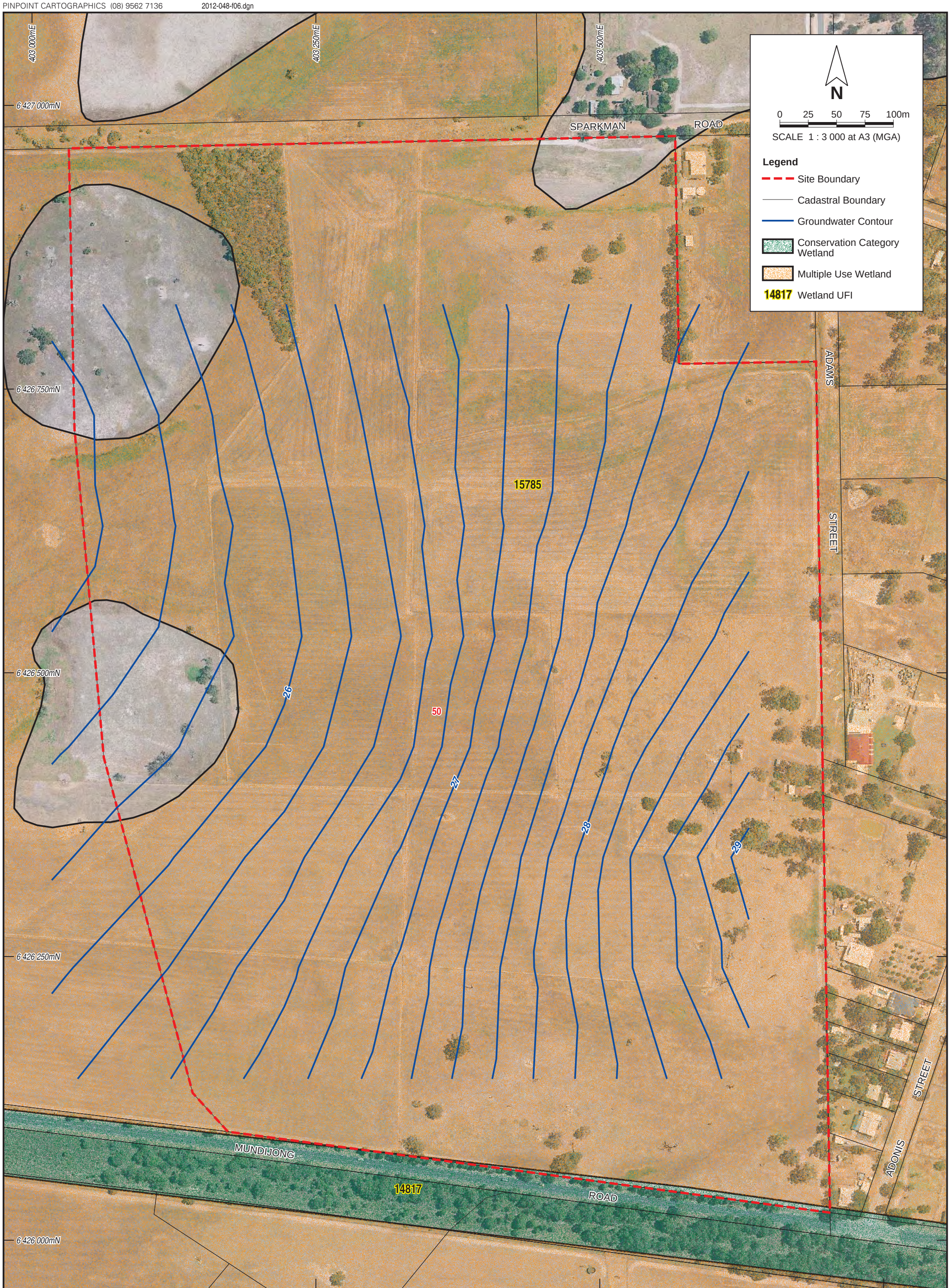
Job: 10054	Revision: A

GEOLOGY AND SOILS

Figure 5



BASE SOURCE: Taylor Burrell Barnett.
WETLAND SOURCE: DEC, October 2012.
AERIAL PHOTOGRAPH SOURCE: Taylor Burrell Barnett.

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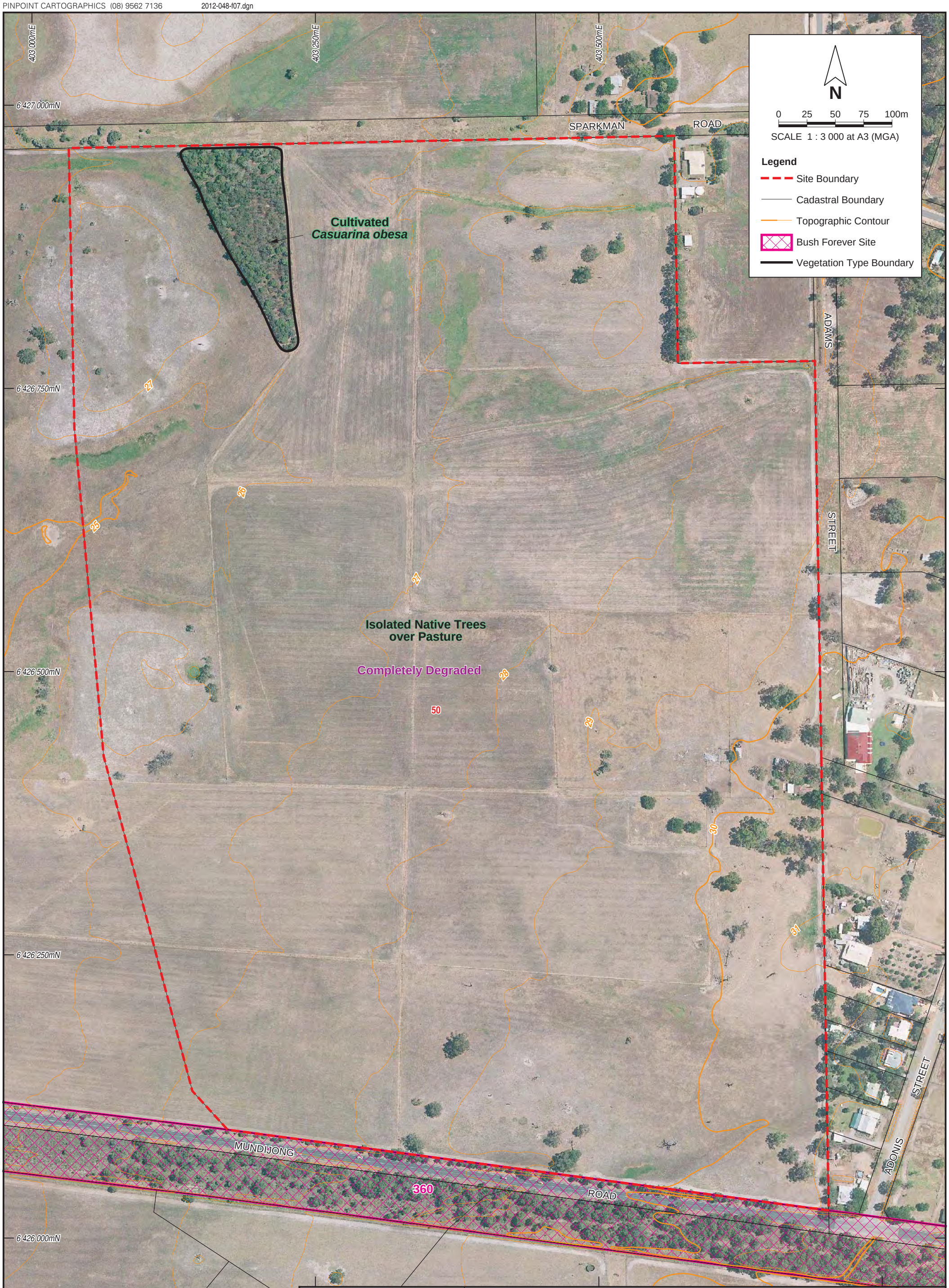
HYDROLOGY

Figure 6



BASE SOURCE: Taylor Burrell Barnett.
AERIAL PHOTOGRAPH SOURCE: Taylor Burrell Barnett.
BUSH FOREVER SOURCE: Department of Planning, 2007.

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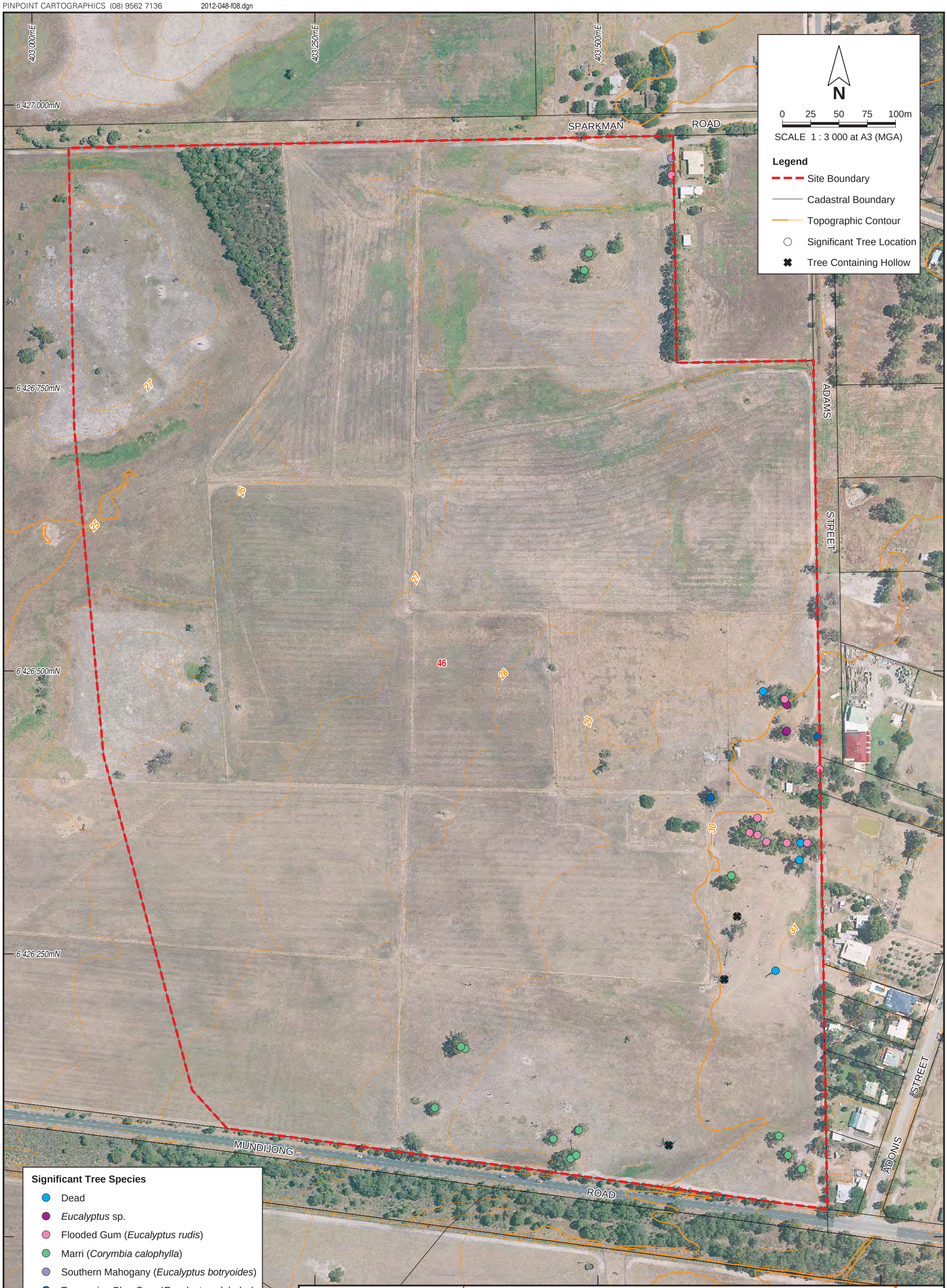
VEGETATION TYPES AND CONDITION

Figure 7



BASE SOURCE: Taylor Burrell Barnett.
AERIAL PHOTOGRAPH SOURCE: Taylor Burrell Barnett.
SIGNIFICANT TREES SOURCE: Terrestrial Ecosystems, Job No. 2011-040, 11 Nov 2011.

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LOT 50 MUNDIJONG ROAD, MUNDIJONG

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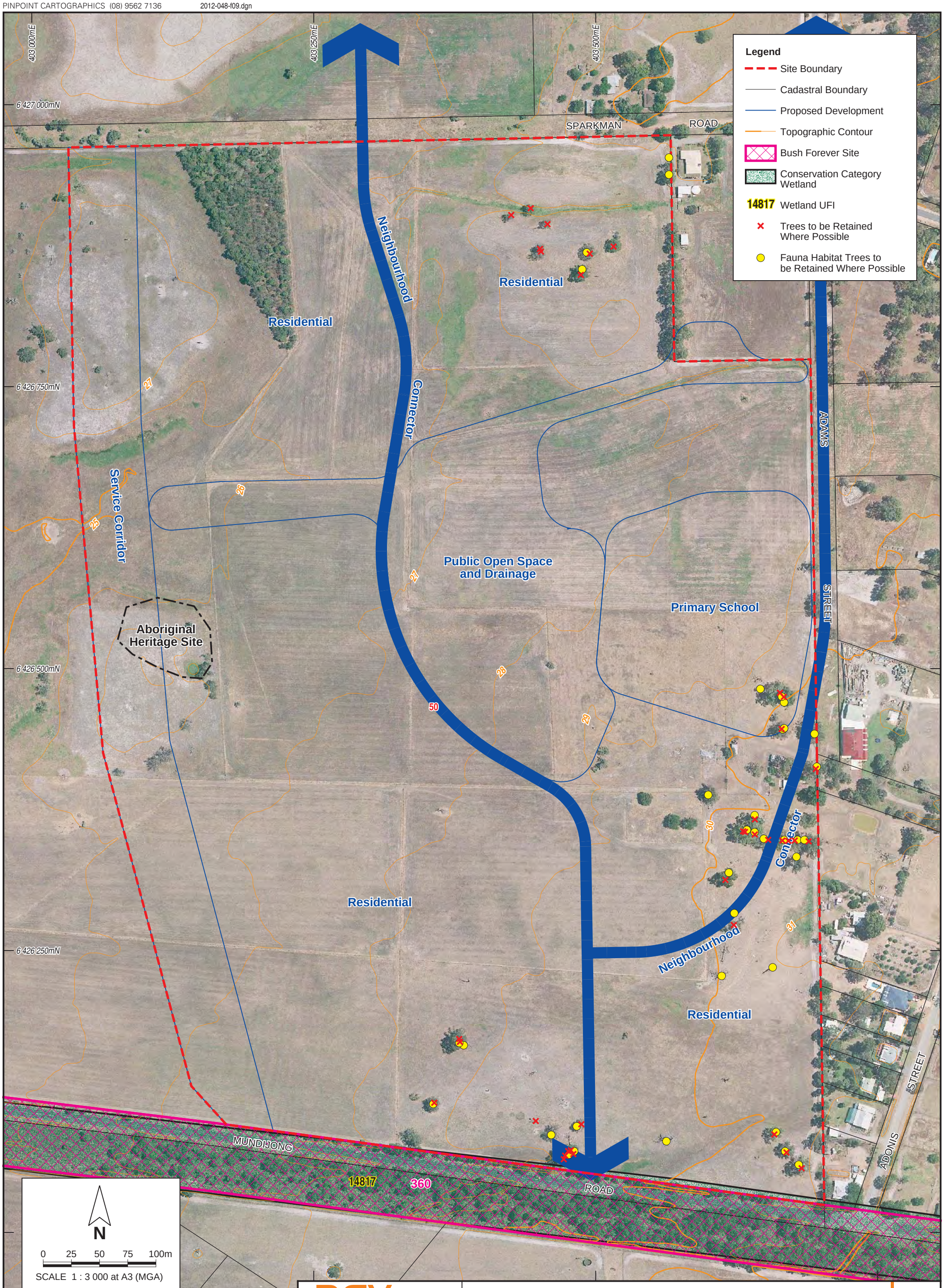
SIGNIFICANT TREES

Figure 8



BASE SOURCE: Taylor Burrell Barnett.
WETLAND SOURCE: DEC, October 2012.
AERIAL PHOTOGRAPH SOURCE: Taylor Burrell Barnett.
BUSH FOREVER SOURCE: Department of Planning, 2007.
PROPOSED DEVELOPMENT SOURCE: TBB, Plan No. 08/039/020A, 06/08/2012.

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ENVIRONMENTAL ASSESSMENT REPORT
LOT 50 MUNDIJONG ROAD, MUNDIJONG

Drawn: B. Heath	Date: 26 Oct 2012
Job: 10054	Revision: A

ENVIRONMENTAL ASSETS

Figure 9

APPENDIX 1

Mature Native Species Recommended for Retention

Trees for Consideration for Transplanting				Date: 30 July 2012		Observer: Paul van der Moezel			
Tree Number	**Species**	**Easting MGA zn50**	**Northing MGA zn50**	**Photo Number**	**Height**	**Diameter**	**Second Branch**	**Third Branch**	**Notes (hollows, bees etc.)**
58	Liquidambar	65116.46	225410.64						Transplant
55	Caesalpinia	65095.40	225425.78						Transplant
54	Lemon tree	65078.41	225433.14						Transplant
68	Erythrina (Coral Tree)	65001.88	225387.17						Transplant
69	Erythrina (Coral Tree)	64989.00	225387.15						Transplant
70	Pine	64964.60	225409.12						Transplant, Stunted pine but nice specimen

Trees for Consideration for Retaining				Date: 30 July 2012		Observer: Paul van der Moezel and Shane Caddy			
Tree Number	Species	Easting MGA zn50	Northing MGA zn50	Photo Number	Height	Diameter	Second Branch	Third Branch	Notes (hollows, bees etc.)
38	Marri	64941.97	225897.84						nice stunted tree
39	Marri	64920.79	225891.74						small but nice tree
40	Marri	64912.67	225873.05						needs pruning
41	Marri	64877.64	225894.14						small but nice tree
42	Marri	64876.89	225896.45						small but nice tree
43	Marri	64883.74	225918.38						small but nice tree
44	Marri	64868.95	225932.61						small but nice tree
45	Marri	64851.57	225926.87						small but nice tree
77	Marri	64774.66	225140.17						nice tree
78	Marri	64798.00	225193.94						large good tree next to 79
79	Marri	64797.43	225196.49						large good tree next to 78
80	Kingia x 3	64864.53	225122.98						tall specimens
82	Marri	64888.94	225088.80						nice clump of healthy trees
83	Marri	64890.23	225092.01						nice clump of healthy trees
84	Marri	64892.89	225095.95						nice clump of healthy trees
85	Marri	64895.25	225096.78						nice clump of healthy trees
86	Marri	64897.51	225093.37						nice clump of healthy trees
87	Marri	64904.91	225119.67						nice tree
88	Marri	65099.78	225078.49						nice clump of healthy trees 88-90
89	Marri	65086.53	225092.67						nice clump of healthy trees 88-90
90	Marri	65075.92	225108.76						nice clump of healthy trees 88-90
49	Eucalyptus camaldulensis (River Red Gum)	65085.24	225500.35						nice tree but only in POS as it drops limbs
50	Eucalypts species	65088.62	225496.70						nice tree but only in POS as it drops limbs
46	Eucalyptus sideroxylon (Ironbark)	65086.42	225468.24						nice tree
56	Euclayptus rudis (Flooded Gum)	65116.34	225432.49						nice specimen of a Flooded Gum
94	Marri	65035.01	225335.02						nice double trunk tree
93	Marri	65042.09	225294.91						contains hollows, breeding 28 parrots
61	Euclayptus rudis (Flooded Gum)	65109.28	225368.38						nice tree
62	Eucalyptus camaldulensis (River Red Gum)	65096.89	225369.18						keep but only in POS. Part of a line of River Red Gums
66	Eucalyptus camaldulensis (River Red Gum)	65061.68	225388.41						keep but only in POS. Part of a line of River Red Gums
95	Eucalyptus camaldulensis (River Red Gum)	65051.24	225377.91						keep but only in POS. Part of a line of River Red Gums
96	Eucalyptus camaldulensis (River Red Gum)	65052.88	225377.35						keep but only in POS. Part of a line of River Red Gums
97	Eucalyptus camaldulensis (River Red Gum)	65061.52	225374.97						keep but only in POS. Part of a line of River Red Gums
98	Eucalyptus camaldulensis (River Red Gum)	65073.37	225370.07						keep but only in POS. Part of a line of River Red Gums
99	Eucalyptus camaldulensis (River Red Gum)	65085.89	225369.36						keep but only in POS. Part of a line of River Red Gums
100	Eucalyptus camaldulensis (River Red Gum)	65091.36	225369.02						keep but only in POS. Part of a line of River Red Gums

APPENDIX 2

Level 1 Fauna Report

Level 1 Fauna Assessment of Precinct G, Southern Site

Version 2. November 2011

Prepared for:

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Front Cover: Galah (*Eolophus roseicapillus*)

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EXECUTIVE SUMMARY

Peet Ltd is proposing to develop the southern site of its Precinct G in Mundijong. The project area (~54ha) is approximately 40km south south-east of the Perth CBD, is fenced and is currently being used as pasture. The project area contains a small (~ 1ha) fenced and treed (*Acacia* sp.) triangular plot on the northern boundary and scattered mature trees that are mostly along the eastern and southern boandaries.

The project has a low ecological value other than the few mature trees scattered across the paddock and is not part of any important ecological linkage in the bioregion.

Mature trees provide an important ecological resource for birds and small arboreal mammals and as such, where practical, they should be preserved and protected. Even large dead trees that are safe (i.e. unlikely to pose a risk through dropping branches or falling over) should be protected as they provide roosting and nesting sites for a variety of birds. Within this context, the design of any residential development should endeavour to protect and preserve as many of the mature trees as possible. Some of these trees will end up in street verges, others in public open space and some will be in residential lots. Caveats and other restrictions can be added to property titles to protect important trees.

Recommendation 1. Mature, healthy and safe trees that are currently in the paddocks should be preserved and protected where this is feasible within the design for the development of the project area.

1 INTRODUCTION

1.1 Background

Peet Ltd is proposing to develop the southern site of its Precinct G in Mundijong. The project area (~54ha) is approximately 40km south south-east of the Perth CBD, is fenced and is currently being used as pasture (Figures 1 and 2). Most of the land has been cleared with the exception of a triangular treed area on the northern boundary that has been planted with *Acacia* sp. and scattered trees in the pasture (Figure 2).

1.2 Project objectives and scope of work

Terrestrial Ecosystems was commissioned by PGV Environmental on behalf of Peet Ltd to undertake a Level 1 fauna risk assessment of the southern site of Precinct G (project area). The purpose of this Level 1 fauna risk assessment was to provide information to enable the appropriate government regulators to assess the potential impact of vegetation clearing on the fauna assemblages in the project area. The methodology broadly followed that described in the Environmental Protection Authority (EPA) *Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection* (EPA 2002), *Guidance Statement No. 56: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004) and the EPA/Department of Environment and Conservation (DEC) *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA / DEC 2010).

A Level 1 fauna risk assessment involves undertaking a desktop review and site inspection. The objectives of this fauna risk assessment were to:

- provide an indication of the vertebrate fauna assemblage (reptiles, amphibians, small mammals and birds) on and in the vicinity of the project area;
- identify the presence and/or potential risks of impacting on species of conservation significance that are present or likely to be present in the project area;
- determine if any additional surveys are required to assess the potential impact on fauna assemblages in the project area, in particular, impacts on species of conservation significance; and
- make recommendations that avoid, mitigate or minimise potential impacts on resident fauna.

To achieve these objectives, Terrestrial Ecosystems has:

- reviewed Terrestrial Ecosystems fauna survey database [includes Western Australian Museum (WAM) and DEC records] to identify potential vertebrate fauna within the area;
- reviewed DEC listed Threatened and Priority species as recorded in NatureMap that are likely to be in the area;
- searched the Commonwealth government's on-line database to identify fauna species of national environmental significance that are protected under the *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act 1999*) potentially occurring in the area;
- reviewed previous fauna surveys conducted in the region;
- undertaken a site visit to identify available fauna habitat types and condition and to record all Eucalypt trees with a diameter of 50cm or greater at breast-height;
- undertaken an assessment of the potential risks to the fauna associated with clearing additional areas of native vegetation;
- provided a discussion of the likelihood of *EPBC Act 1999* and Western Australian (WA) *Wildlife Conservation Act 1950* listed species being present in the project area; and
- provided management recommendations to avoid, mitigate and minimise potential impacts on the fauna in the project area.

2 EXISTING ENVIRONMENT

2.1 Survey area

The project area (~ 54ha) is approximately 40km south south-east of the Perth CBD (Figure 1); it is fenced and used as pasture for cattle (Figure 2). Most of the land has been cleared with the exception of a triangular section on the northern boundary that is densely planted with young *Acacia* sp.. There are the remains of a building mid-way along the eastern boundary that is adjacent to cattle mustering yards. There is an abundance of rabbits in this area.

2.2 Climate

The Perth bioregion experiences a Mediterranean climate with hot summers from December to March and mild winters from May to August (Gentilli 1972). Chart 1 shows the average mean monthly maximum and minimum temperatures and rainfall for Jandakot airport (i.e. closest weather station). Temperatures are highest in January – February. Perth receives the majority of its annual rainfall in winter (Chart 1). This rain is usually the result of low pressure cells moving in a westerly direction which bring moisture bearing clouds over the south-west of Western Australia.

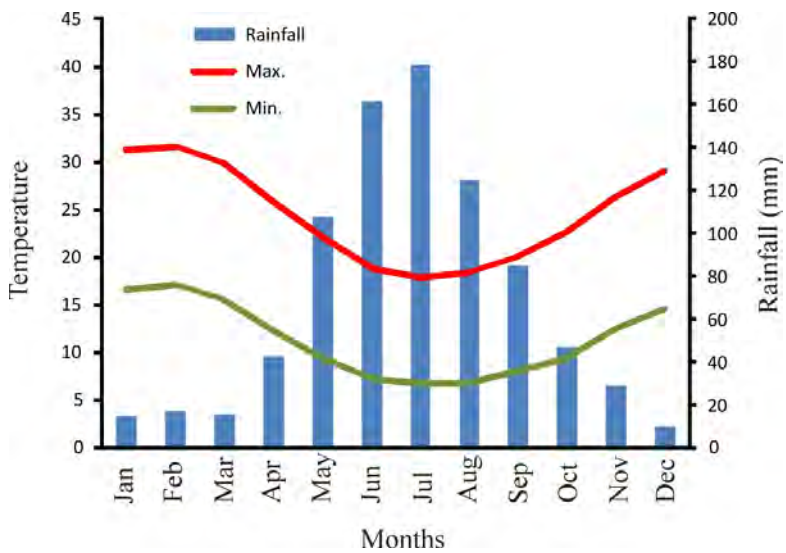

Chart 1. Mean monthly maximum and minimum temperatures and rainfall for Jandakot Airport (BOM July 2011; http://www.bom.gov.au/climate/averages/tables/cw_009172.shtml)

2.3 Land use

The predominant land use is pasture for cattle. Winter rains have resulted in low lying areas being wet under foot, and lush grass growth over most to the paddocks providing good pasture for cattle.

2.4 Biological context for the project area

The frogs, reptiles, mammals, birds and amphibians on the Swan Coastal Plain south of the Swan River have been surveyed on numerous occasions for a variety of purposes. Surveys in the vicinity of the project area which have been reviewed for this assessment include:

- 360 Environmental (2008) *Lot 9 Abernethy Road, Byford Spring Flora and Fauna Report*. Unpublished report for Australand Property Group, Perth.
- ATA Environmental (2006) *Vertebrate Fauna Assessment Brookdale Redevelopment Area*. Unpublished report for the Armadale Redevelopment Authority, Perth.
- Bamford Consulting Ecologists (2003) *Champion Lakes Master Plan; Fauna*. Unpublished report for Bowman Bishaw Gorham, Perth.
- Bamford Consulting Ecologists (2009) *Keane Road Strategic Link, Armadale Fauna Assessment*. Unpublished report for EnviroWorks Consulting, Perth.
- ENV Environment (2009) *Jandakot Airport Fauna Survey*. Unpublished report for Jandakot Airport Holdings Pty Ltd, Perth.
- Gole C.A. (2003) *Bird Survey in selected Perth Metropolitan Reserves. A Joint Biodiversity Conservation Project between Birds Australia WA and Perth Biodiversity Project*. Unpublished report Birds Australia and Perth Biodiversity Project, Perth.
- Harvey M.S., Dell J., How R.A. and Waldock J.M. (1997) *Ground Fauna of Bushland Remnants on the Ridge Hill Shelf and Pinjarra Plain Landforms Perth*. Unpublished report for the Australian Heritage Commission NEP Grant N95/49, Perth.
- How R.A. and Dell J. (2000) Ground vertebrate fauna of Perth's vegetation remnants: Impact of 170 years of urbanization. *Pacific Conservation Biology* 6, 198-217.
- How R.A., Harvey M.S., Dell J. and Waldock J.M. (1999) *Ground Fauna of Urban Bushland Remnants in Perth*. Unpublished report to the Australian Heritage Commission; NEP Grant N93/04, Perth.

The 360 Environmental (2008), ATA Environmental (2006) and Bamford Consulting Ecologists (2003, 2009) reports are for projects to the west and north of the project area but on the Swan Coastal Plain. The Western Australian Museum (Harvey et al. 1997, How et al. 1999, How and Dell 2000) and Gole (2003) reports are for fauna in remnant habitats in the region.

In addition to the above reports, Terrestrial Ecosystems fauna survey database contains records from NatureMap and the Western Australian Museum collection for this area. These records include the results of early surveys and incidental records that very often remain unreported. Many of the Western Australian Museum records are likely to be a subset of the NatureMap records, but there is no way of separating the data in NatureMap to isolate the records from the Museum.

3 METHODOLOGY

A review of the *EPBC Act 1999* list of protected species was undertaken to identify species of conservation interest to the Commonwealth Government. The search rectangle coordinates were 32.45°S, 115.88°E; 32.13 °S, 115.88 °E; 32.13 °S, 116.0 °E; 32.45 °S, 116.0 °E; 32.45 °S, 115.88 °E (Appendix A). In addition, a desktop search of the Terrestrial Ecosystems' fauna survey database was used to develop an appreciation of the vertebrate fauna assemblages in the relevant section of the bioregion in the vicinity of the project area. The DEC threatened and priority species database was searched via the records in NatureMap.

Other more general texts were also used to provide supplementary information on vertebrates in the bioregion, including Tyler *et al.* (2000) for frogs; Storr *et al.* (1983, 1990, 1999, 2002) for reptiles; Johnstone and Storr (1998, 2004) for birds; and Van Dyck and Strahan (2008) for mammals.

Because the project area is within the known distribution of Black-Cockatoos, a search was conducted to identify all trees with a trunk diameter at breast-height of 50cm or greater and those with hollows that could provide a nesting site for Black-Cockatoos. The site visit also looked for evidence of Black-Cockatoos feeding or actual birds foraging in the project area.

Collectively these sources of information were used to create lists of species expected to utilise the project area and broader bioregion. It should be noted that these lists will include species that have been recorded in the general region but are possibly vagrants and they will not generally be found in the project area due to a lack of suitable habitat (e.g. marine shore birds) and those found in the area before it was cleared but are no longer present. Vagrants can be recorded almost anywhere. Many of the bird, mammal, reptile and amphibian species have specific habitat requirements that may be present in the general area but not in the specific survey area. Also, the ecology of many of these species is often not well understood and it can sometimes be difficult to indicate those species whose specific habitat requirements are not present in the survey area. As a consequence many species will be included in the lists produced from database searches but will not be present in the actual project area.

3.1 Site visit

A site vist was undertaken on 20th September 2011 by Drs S and G Thompson. All sections of the project area were inspected. The location and type of all Eucalypt trees with a diameter of 50cm or greater at breast-height were recorded.

3.2 Limitations

This Level 1 fauna risk assessment is based on information contained in the Commonwealth Government database and other published and unpublished fauna survey data for the bioregion and a site visit. It is acknowledged that multiple surveys conducted in different seasons, repeated over several years are necessary to fully appreciate the fauna assemblage in the project area.

In addition, the project area is highly disturbed, with the consequence that it is unlikely to support a near-natural assemblage of the fauna that was present in the area before it was cleared. Determining whether a tree contained a hollow can be difficult from the ground, as all you can see is the opening, but not inside the hollow. It is therefore likely that many trees have been recorded as containing hollows, when on closer inspection that will not be the case, and even those that do contain hollows, only a few might be suitable as nesting sites for Black-Cockatoos.

The EPA *Guidance for Assessment of Environmental Factors: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56* (2004) suggested that fauna surveys may be limited by many variables. Limitations associated with each of these variables are assessed in Table 1.

Table 1. Fauna survey limitations and constraints

Possible limitations	Constraint (yes/no); significant, moderate or negligible	Comment
Competency and experience of the consultant carrying out this assessment	No	The environmental scientists that prepared this assessment are familiar with the vertebrate fauna of this bioregion.
Scope	No	All aspects of the scope of works have been addressed.
Proportion of fauna identified, recorded and/or collected	No	Not applicable.
Accuracy of previous survey work	Yes, negligible	Terrestrial Ecosystems has reported fauna survey data recorded by various authors, but is not in a position to vouch for the accuracy of this information. It is acknowledged that the taxonomy of Western Australian vertebrates is continually being revised and the nomenclature of some of the species listed in the appendices may have changed since publication by the authors.
Sources of information	Yes, negligible	Vertebrate fauna information was available from an on-line database and unpublished and published reports of surveys conducted in the bioregion in a variety of habitat types. Many of these surveys employed a low level of trapping effort which significantly impacts on the capacity of these data to represent the fauna assemblages in the areas surveyed.
Timing/weather/ season/ cycle	No	Weather was suitable for a site visit.
Disturbances which affected results of the survey	No	The project area is highly disturbed. This has been taken into account in this assessment.
Intensity of survey effort	N/A	Not applicable.
Resources	No	Adequate resources were available.
Remoteness and/or access problems	No	There were no problems with access to the project area.
Availability of contextual information on the region	No	Fauna survey data are available for the general area.

Negligible – less than 20%; moderate -20-60%; significant – greater than 80%

4 RESULTS

4.1 Fauna habitats and condition

Project area contains two habitat types:

- fenced highly disturbed pasture with scattered mature native and planted trees (Plates 1a, b); and
- a small patch of fenced densely planted *Acacia* sp..

Plate 1a. Pasture with scattered mature native and planted trees

Plate 1b. Pasture with scattered mature native and planted trees

4.2 Location of conservation significant trees

All eucalypt trees in the project area were inspected to determine whether any showed signs of use or had the potential to support a nesting hollow for a Black-Cockatoo. Thirty five trees had a trunk diameter of 50cm or greater at breast-height in project area. The locations of these trees are shown on Figure 2 and Appendix B.

4.3 Bioregional vertebrate fauna

Appendix C provides a summary of the fauna survey data that are available in the vicinity of the project area. There are appreciable differences in the recorded fauna assemblages within and among fauna surveys shown in Appendix C. These differences are partially due to the low survey effort often deployed and they also reflect variations in soils and vegetation as well as temporal variations in the fauna assemblages.

Tables 2-5 provide a list of vertebrate species potentially found in the vicinity of the project area that have been compiled based on the fauna survey report results shown in Appendix C and information contained in Tyler *et al.* (2000) for frogs, Storr *et al.* (1983, 1990, 1999, 2002) for reptiles, Johnstone and Storr (1998, 2004) for birds, and Van Dyck and Strahan (2008) for mammals.

These lists are a significant over estimate of the actual species list likely to be present as many of these species have specific habitat requirements that are not available in the project area and the project area has been significantly degraded. The highly degraded nature of the project area means that the site would not support a fauna assemblage that was typical of the area before vegetation clearing.

Table 2. Birds potentially found in the vicinity of the project area

Family	Species	Common Name
Accipitridae	*Elanus axillaris*	Black-shouldered Kite
	Haliastur sphenurus	Whistling Kite
	Accipiter fasciatus	Brown Goshawk
	Accipiter cirrocephalus	Collared Sparrowhawk
	Circus approximans	Swamp Harrier
	Aquila audax	Wedge-tailed Eagle
	Hieraaetus morphnoides	Little Eagle
Anatidae	*Biziura lobata*	Musk Duck
	Stictonetta naevosa	Freckled Duck
	Cygnus atratus	Black Swan
	Tadorna tadornoides	Australian Shelduck
	Chenonetta jubata	Australian Wood Duck
	Anas gracilis	Grey Teal
	Anas superciliosa	Pacific Black Duck
	Aythya australis	Hardhead
Aegothelidae	*Aegotheles cristatus*	Australian Owlet-nightjar
Podargidae	*Podargus strigoides*	Tawny Frogmouth
Charadriidae	*Vanellus tricolor*	Banded Lapwing
Recurvirostridae	*Recurvirostra novaehollandiae*	Red-necked Avocet
Scolopacidae	*Calidris subminuta*	Long-toed Stint
	Calidris acuminata	Sharp-tailed Sandpiper
Stercorariidae	*Stercorarius longicauda*	Long-tailed Jaeger
Turnicidae	*Turnix velox*	Little Button-quail
Ardeidae	*Ardea pacifica*	White-necked Heron
	Egretta novaehollandiae	White-faced Heron
	Nycticorax caledonicus	Nankeen Night Heron
Pelecanidae	*Pelecanus conspicillatus*	Australian Pelican
Threskiornithidae	*Threskiornis molucca*	Australian White Ibis
	Threskiornis spinicollis	Straw-necked Ibis
Columbidae	*Columba livia*	Rock Dove
	Streptopelia senegalensis	Laughing Dove
	Streptopelia chinensis	Spotted Dove
	Phaps chalcoptera	Common Bronzewing
	Ocyphaps lophotes	Crested Pigeon
Alcedinidae	*Dacelo novaeguineae*	Laughing Kookaburra
	Todiramphus sanctus	Sacred Kingfisher
Meropidae	*Merops ornatus*	Rainbow Bee-eater
Cuculidae	*Chalcites basalis*	Horsfield's Bronze-Cuckoo
	Chalcites lucidus	Shining Bronze-Cuckoo

Family	Species	Common Name
	Cacomantis pallidus	Pallid Cuckoo
	Cacomantis flabelliformis	Fan-tailed Cuckoo
Caprimulgidae	*Eurostopodus argus*	Spotted Nightjar
Falconidae	*Falco cenchroides*	Nankeen Kestrel
	Falco berigora	Brown Falcon
	Falco longipennis	Australian Hobby
	Falco subniger	Black Falcon
Phasianidae	*Coturnix ypsilophora*	Brown Quail
Rallidae	*Porphyrio porphyrio*	Purple Swamphen
	Gallirallus philippensis	Buff-banded Rail
	Porzana tabuensis	Spotless Crake
	Gallinula tenebrosa	Dusky Moorhen
	Fulica atra	Eurasian Coot
Acanthizidae	*Sericornis frontalis*	White-browed Scrubwren
	Smicrornis brevirostris	Weebill
	Gerygone fusca	Western Gerygone
	Acanthiza chrysorrhoa	Yellow-rumped Thornbill
	Acanthiza inornata	Western Thornbill
	Acanthiza apicalis	Inland Thornbill
Acrocephalidae	*Acrocephalus australis*	Australian Reed-Warbler
Artamidae	*Artamus cinereus*	Black-faced Woodswallow
	Artamus cyanopterus	Dusky Woodswallow
	Cracticus torquatus	Grey Butcherbird
	Cracticus tibicen	Australian Magpie
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-Shrike
	Lalage sueurii	White-winged Triller
Climacteridae	*Climacteris rufa*	Rufous Treecreeper
Corvidae	*Corvus coronoides*	Australian Raven
Estrildidae	*Stagonopleura oculata*	Red-eared Firetail
Hirundinidae	*Hirundo neoxena*	Welcome Swallow
	Petrochelidon nigricans	Tree Martin
	Petrochelidon ariel	Fairy Martin
Maluridae	*Malurus splendens*	Splendid Fairy-wren
	Malurus elegans	Red-winged Fairy-wren
Meliphagidae	*Acanthorhynchus superciliosus*	Western Spinebill
	Lichenostomus virescens	Singing Honeyeater
	Lichenostomus ornatus	Yellow-plumed Honeyeater
	Manorina flavigula	Yellow-throated Miner
	Anthochaera lunulata	Western Wattlebird

Family	Species	Common Name
	Anthochaera carunculata	Red Wattlebird
	Epthianura albifrons	White-fronted Chat
	Glyciphila melanops	Tawny-crowned Honeyeater
	Lichmera indistincta	Brown Honeyeater
	Phylidonyris novaehollandiae	New Holland Honeyeater
	Phylidonyris niger	White-cheeked Honeyeater
	Melithreptus brevirostris	Brown-headed Honeyeater
	Melithreptus lunatus	White-naped Honeyeater
Monarchidae	*Grallina cyanoleuca*	Magpie-Lark
	Anthus novaeseelandiae	Australasian Pipit
Nectariniidae	*Dicaeum hirundinaceum*	Mistletoebird
Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella
Pachycephalidae	*Pachycephala pectoralis*	Golden Whistler
	Pachycephala rufiventris	Rufous Whistler
	Colluricincla harmonica	Grey Shrike-thrush
Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote
	Pardalotus striatus	Striated Pardalote
Petroicidae	*Petroica multicolor*	Pacific Robin
	Petroica boodang	Scarlet Robin
	Petroica goodenovii	Red-capped Robin

Family	Species	Common Name
	Eopsaltria georgiana	White-breasted Robin
Rhipiduridae	*Rhipidura fuliginosa*	New Zealand Fantail
	Rhipidura albiscapa	Grey Fantail
	Rhipidura leucophrys	Willie Wagtail
Timaliidae	*Zosterops lateralis*	Silvereye
Cacatuidae	*Calyptorhynchus banksii naso*	Red-tailed Black-Cockatoo
	Calyptorhynchus latirostris	Carnaby's Black-Cockatoo
	Calyptorhynchus baudinii	Baudin's Black-Cockatoo
	Eolophus roseicapillus	Galah
	Cacatua sanguinea	Little Corella
Psittacidae	*Trichoglossus haematodus*	Rainbow Lorikeet
	Glossopsitta porphyrocephala	Purple-crowned Lorikeet
	Polytelis anthopeplus	Regent Parrot
	Platycercus icterotis	Western Rosella
	Barnardius zonarius	Australian Ringneck
	Purpureicephalus spurius	Red-capped Parrot
	Melopsittacus undulatus	Budgerigar
	Neophema elegans	Elegant Parrot
Strigidae	*Ninox novaeseelandiae*	Southern Boobook
Tytonidae	*Tyto alba*	Barn Owl

Table 3. Amphibians potentially found in the vicinity of the project area

Family	Species	Common Name
Hylidae	*Litoria adelaidensis*	Slender Tree Frog
	Litoria moorei	Motorbike Frog
Limnodynastidae	*Heleioporus eyrei*	Moaning Frog
	Heleioporus psammophilus	Sand Frog
	Limnodynastes dorsalis	Western Banjo Frog
Myobatrachidae	*Crinia georgiana*	Quacking Frog

Family	Species	Common Name
	Crinia glauerti	Clicking Frog
	Crinia insignifera	Squelching Froglet
	Crinia pseudinsignifera	Bleating Froglet
	Geocrinia leai	Ticking Frog
	Myobatrachus gouldii	Turtle Frog
	Pseudophryne guentheri	Crawling Toadlet

Table 4. Mammals potentially found in the vicinity of the project area

	Species	Common Name
Canidae	*Canis lupus*	Dog
	Vulpes vulpes	Red Fox
Felidae	*Felis catus*	House Cat
Molossidae	*Austronomus australis*	White-striped Freetail Bat
	Mormopterus species 4	Southern Freetail Bat
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat
	Nyctophilus geoffroyi	Lesser Longeared Bat
	Nyctophilus major	Western Longeared Bat
	Vespadelus regulus	Southern Forest Bat
Dasyuridae	*Antechinus flavipes*	Yellow-footed Antechinus
	Phascogale tapoatafa	Brush-tailed Phascogale
	Sminthopsis gilberti	Gilbert's Dunnart

	Species	Common Name
Burramyidae	*Cercartetus concinnus*	Southwestern Pygmy Possum
Macropodidae	*Macropus fuliginosus*	Western Grey Kangaroo
Phalangeridae	*Trichosurus vulpecula*	Common Brushtail Possum
Tarsipedidae	*Tarsipes rostratus*	Honey Possum
Leporidae	*Oryctolagus cuniculus*	European Rabbit
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna
Peramelidae	*Isoodon obesulus*	Southern Brown Bandicoot
Muridae	*Hydromys chrysogaster*	Water Rat
	Mus musculus	House Mouse
	Rattus fuscipes	Bush Rat
	Rattus rattus	Black Rat

Table 5. Reptiles potentially found in the vicinity of the project area

Family	Species
Agamidae	*Ctenophorus adelaidensis*
	Pogona minor
Boidae	*Morelia spilota imbricata*
Diplodactylidae	*Diplodactylus polyophthalmus*
	Strophurus spinigerus
Elapidae	*Acanthophis antarcticus*
	Brachyurophis fasciolata
	Brachyurophis semifasciata
	Demansia psammophis
	Echiopsis curta
	Elapognathus coronatus
	Neelaps bimaculatus
	Neelaps calonotos
	Notechis scutatus
	Parasuta gouldii
	Parasuta nigriceps
	Pseudonaja affinis
	Simoselaps bertholdi

Family	Species
Gekkonidae	*Christinus marmoratus*
Pygopodidae	*Aprasia pulchella*
	Aprasia repens
	Delma fraseri
	Delma grayii
	Lialis burtonis
	Pletholax gracilis
	Pygopus lepidopodus
Scincidae	*Acritoscincus trilineatum*
	Cryptoblepharus buchananii
	Ctenotus australis
	Ctenotus fallens
	Ctenotus gemmula
	Ctenotus impar
	Ctenotus labillardieri
	Egernia napoleonis
	Hemiergis initialis
	Hemiergis quadrilineata

Family	Species
	Lerista distinguenda
	Lerista elegans
	Lerista lineata
	Lerista lineopunctulata
	Menetia greyii
	Morethia lineoocellata
	Morethia obscura
	Tiliqua occipitalis
	Tiliqua rugosa
Typhlopidae	*Ramphotyphlops australis*
	Ramphotyphlops bituberculatus
	Ramphotyphlops pinguis
	Ramphotyphlops waitii
Varanidae	*Varanus gouldii*
	Varanus rosenbergi
	Varanus tristis
Chelidae	*Chelodina oblonga*

4.4 Conservation significant fauna

Conservation significant fauna are protected by the Commonwealth *EPBC Act 1999*, and this list includes species covered by international treaties such as the Japan-Australia Migratory Bird Agreement (JAMBA) and China-Australia Migratory Bird Agreement (CAMBA) and the Western Australia (WA) *Wildlife Conservation Act 1950*. The WA *Wildlife Conservation Act 1950* provided for the publishing of the *Wildlife Conservation (Specially Protected Fauna) Notice* that lists species under multiple categories. In addition, the DEC maintains a list of fauna that require monitoring under five priorities based on DEC's knowledge of their distribution, abundance and threatening processes. The *EPBC Act 1999* and *Wildlife Conservation Act 1950* imply legislative requirements for the management of anthropogenic impacts to minimise the effects of disturbances on species and their habitats. Priority species have no statutory protection, other than the DEC wishes to monitor potential impacts on these species. Environmental consultants and proponents of developments are encouraged to avoid and minimise impacts on these species. Definitions of the significant fauna under the *WA Wildlife Conservation Act* are provided in Appendix D.

Thirteen threatened species of fauna and 14 migratory species of birds identified under the *EPBC Act 1999* potentially occur in the project area. There are 27 Schedule species listed under the WA *Wildlife Conservation Act 1950* and 10 species listed on the DEC's Priority Fauna List that potentially occur in the project area. The following is an assessment of the likelihood of each of the species being found in the project area and Table 6 is a summary of this information.

The recently released Commonwealth government draft referral guidelines on Black-Cockatoos in Western Australia (Department of Sustainability Environment Water Population and Communities 2011) is also relevant as the project area potentially provides a foraging resource for Black-Cockatoos.

Table 6. Species that are potentially found in the vicinity of the project area and that are listed as being of conservation significance under state or commonwealth government legislation or with DEC

Species	**Status under the Wildlife Conservation Act / DEC**	**Status under the *EPBC Act***	**Comment on potential impact that vegetation clearing will have on conservation significant species**
Neopasiphae simplicior Native bee	Schedule 1	Critically Endangered	Unlikely to be found in the project area. Low potential impact.
Phascogale calura Red-tailed Phascogale	Schedule 1	Endangered	Unlikely to be found in the project area. Low potential impact.
Calyptorhynchus latirotris Carnaby's Black-Cockatoo	Schedule 1	Endangered	Likely to be seen the project area. Low potential impact.
Botaurus poiciloptilus Australasian Bittern	Schedule 1	Endangered	Seen in the project area. Low potential impact.
Synemon gratiosa Graceful Sun-Moth	Schedule 1	Endangered	No suitable habitat. Low potential impact.
Sternula nereis nereis Fairy Term	Schedule 1	Endangered	Unlikely to be found in the project area. Low potential impact.
Bettongia penicillata Woylie	Schedule 1	Endangered	Unlikely to be found in the project area. Low potential impact.
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo	Schedule 1	Vulnerable	Likely to be seen in the project area. Low potential impact.
Calyptorhynchus baudinii Baudin's Black-Cockatoo	Schedule 1	Vulnerable	Likely to be seen in the project area Low potential impact.
Dasyurus geoffroii Chuditch	Schedule 1	Vulnerable	Unlikely to be found in the project area. Low potential impact.
Myrmecobius fasciatus Numbat	Schedule 1	Vulnerable	Unlikely to be found in the project area. Low potential impact.
Setonix brachyurus Quokka	Schedule 1	Vulnerable	Unlikely to be found in the project area. Low potential impact.
Apus pacificus Fork-tailed Swift	Schedule 3	Migratory	May infrequently fly over the project area. Low potential impact.
Haliaeetus leucogaster White-bellied Sea-eagle	Schedule 3	Migratory	May infrequently fly over the project area. Low potential impact.
Merops ornatus Rainbow Bee-eater	Schedule 3	Migratory	May be found in the vicinity of the project area. Low potential impact.
Calidris acuminata Sharp-tailed Sandpiper	Schedule 3	Migratory Wetland	Unlikely to be seen in the project area. Low potential impact.
Calidris canutus Red Knot	Schedule 3	Migratory Wetland	Unlikely to be seen in the project area. Low potential impact.
Calidris ferruginea Curlew Sandpiper	Schedule 3	Migratory Wetland	Unlikely to be seen in the project area. Low potential impact.
Calidris ruficollis Red-necked Stint	Schedule 3	Migratory Wetland	Unlikely to be seen in the project area. Low potential impact.
Ardea alba Great Egret	Schedule 3	Migratory Wetland	Unlikely to be seen in the project area. Low potential impact.
Ardea ibis Cattle Egret	Schedule 3	Migratory Wetland	Unlikely to be seen in the project area. Low potential impact.
Limosa lapponica Bar-tailed Godwit	Schedule 3	Migratory Wetland	Unlikely to be found in the project area. Low potential impact.
Limosa limosa Black-tailed Godwit	Schedule 3	Migratory Wetland	Unlikely to be found in the project area. Low potential impact.
Numenius minutus Little Curlew	Schedule 3	Migratory Wetland	Unlikely to be found in the project area. Low potential impact.
Tringa glareola Wood Sandpiper	Schedule 3	Migratory Wetland	Unlikely to be seen in the project area. Low potential impact.
Tringa stagnatilis Marsh Sandpiper	Schedule 3	Migratory Wetland	Unlikely to be seen in the project area. Low potential impact.
Morelia spilota imbricata Carpet Python	Schedule 4		Unlikely to be found in the project area. Low potential impact.
Falco peregrinus Peregrine Falcon	Schedule 4		May infrequently fly over the project area. Low potential impact.
Ctenotus gemmula	Priority 3		Unlikely to be found in the project area. Low potential impact.

Species	Status under the Wildlife Conservation Act / DEC	Status under the *EPBC Act*	Comment on potential impact that vegetation clearing will have on conservation significant species
Neelaps calonotos Black-striped Snake	Priority 3		Unlikely to be found in the project area. Low potential impact.
Lerista lineata Lined Skink	Priority 3		Unlikely to be found in the project area. Low potential impact.
Macropus irma Western Brush Wallaby	Priority 4		Unlikely to be found in the project area. Low potential impact.
Hydromys chrysogaster Water Rat	Priority 4		Unlikely to be found in the project area. Low potential impact.
Numenius madagascariensis Eastern Curlew	Priority 4		Unlikely to be found in the project area. Low potential impact.
Falsistrellus mackenziei Western False Pipistrelle	Priority 4		Unlikely to be found in the project area. Low potential impact.
Acanthorhynchus superciliosus Western Spinebill	Priority 4		Maybe in the project area. Low potential impact.
Isoodon obesulus fusciventer Southern Brown Bandicoot	Priority 5		Unlikely to be found in the project area. Low potential impact.

Native Bee (*Neopasiphae simplicior*) – Critically Endangered under the *EPBC Act 1999* and Schedule 1 under the *Wildlife Conservation Act 1950*

The Department of Sustainability, Environment, Water, Population and Communities (http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=6682) indicated that this critically endangered bee has been found in a single location within the Forrestdale Lake Nature Reserve, and it is known to occupy an area of about 1km^2. It has been collected from the flowers of Thread-leaved Goodenia (*Goodenia filiformis*), Slender Lobelia (*Lobelia tenulor*), *Angianthus preissianus* and *Velleia* sp. (Houston 2000).

The Forrestdale Lake is about 15km to the north-west of the project area. Terrestrial Ecosystems' assessment is that the proposed vegetation clearing is unlikely to impact on this species, as it is outside the species known geographic distribution.

Red-tailed Phascogale (*Phascogale calura*) – Endangered under the *EPBC Act 1999* and Schedule 1 under the *Wildlife Conservation Act 1950*

This species was formerly widespread in woodland habitat through much of inland southern and central Australia. It is now restricted to remnants of mature Wandoo or Rock Oak woodland in the southern wheatbelt.

Terrestrial Ecosystems' assessment is that given the lack of recent records of this species in the vicinity of the project area and a lack of suitable habitat, the Red-tailed Phascogale is unlikely to occur within the project area.

Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*) – Endangered under the *EPBC Act 1999* and Schedule 1 under the *Wildlife Conservation Act 1950*

Carnaby's Black-Cockatoo inhabits the south-west of Western Australia (Garnett et al. 2011). Its preferred nesting trees include the smooth-barked Salmon Gum (*Eucalyptus salmonophloia*) and Wandoo (*E. wandoo*), which contain deep hollows. Nesting also occurs in Marri (*Corymbia calophylla*) and Tuart (*E. gomphocephala*). Its main foods are the seeds of Hakeas, Grevilleas, Banksias, Eucalypts and introduced pines.

The project area contains some Marri (*Corymbia calophylla*) which are known feeding trees for Carnaby's Black-Cockatoo (Higgins 1999). Carnaby's Black-Cockatoos were recorded during other fauna surveys in the general area. Carnaby's Black-Cockatoo are likely to regularly feed in the native vegetation on the Mundijong Road verge on the southern boundary of the project area.

Loss of breeding habitat in the form of suitable hollows and adequate feeding resources in the vicinity of nesting hollows to enable adults to feed chicks is a primary threat. Competition for nesting hollows by other cockatoos, Galahs and feral Honey Bees appears to also be a significant threat (Garnett et al. 2011).

All eucalypt trees in the project area were inspected to determine whether any showed signs of use or had the potential to support a nesting hollow for a Black-Cockatoo. Thirty five trees had a trunk diameter of 50cm or

greater at breast-height in project area. The locations of these trees are shown on Figure 2 and Appendix B. Most of the large trees in project area are along the eastern or southern boundaries.

Determining whether a tree contained a hollow can be difficult from the ground, as all you can see is the opening, but not inside the hollow. Three trees may have contained hollows in the project area. Some of the trees that contained hollows contained nests of Australian Ringneck Parrots and Galahs. Johnstone and Kirkby (2011) indicated that there were no records of Carnaby's Black-Cockatoos breeding in the vicinity of the project area, and the closest nesting site was on the Darling Scarp to the east.

Australasian Bittern (*Botaurus poiciloptilus*) – Endangered under the *EPBC Act 1999* and Schedule 1 under the *Wildlife Conservation Act 1950*

The Australasian Bitterns' preferred habitat is beds of tall dense *Typha*, *Baumea* and sedges in the shallows of freshwater swamps (Johnstone and Storr 1998). Johnstone and Storr (1998) reported its distribution from Moora east to Cape Arid and the south-west of Western Australia. Johnstone and Storr (1998) reported it as locally common in the wetter parts of the south-west. Garnett et al. (2011) more recently indicated that the sub-population in Western Australia is restricted to a few records away from the south coast and Lake Muir wetlands, with few confirmed records from the Swan Coastal Plain since 1992.

Threats include drainage of permanent and ephemeral swamps for agriculture and urban development (Garnett et al. 2011). It was recorded in an earlier fauna survey of Thomson's Lake. It is unlikely to be in the project area due to a lack of suitable habitat.

Graceful Sun-moth (*Synemon gratiosa*) – Endangered under the *EPBC Act 1999* and Schedule 1 under the *Wildlife Conservation Act 1950*

This species has brightly coloured orange hind-wings, and is similar in appearance to a butterfly. The breeding season is late February to early April, during which time adults are active during the day and they are thought to breed exclusively on *Lomandra* species, in particular *L. hermaphrodita* and *L. maritima*. Graceful Sun-moths occur along the Swan Coastal Plain between Moore River and Preston Beach and the species is under threat due to vegetation clearing and damage to the environment.

No *Lomandra hermaphrodita* was observed in the project area, nor was there any Banksia woodland; therefore, Terrestrial Ecosystems' believes that it is highly unlikely that the Graceful Sun-moth is in the project area.

Fairy Tern (*Sternula nereis nereis*) – Endangered under the *EPBC Act 1999*

Garnett et al. (2011) reported that the Fairy Tern occurs in on sheltered coasts and saline wetlands in southern Australia from the Pilbara in Western Australia around to Botany Bay in NSW, excluding the Great Australian Bight. Garnett et al. (2011) reported that it mostly nests on predator-free islands in Western Australia.

It is unlikely to be seen in the vicinity of the project area due to a lack of suitable habitat.

Woylie (*Bettongia penicillata ogilbyi)* – Endangered under the *EPBC Act 1999* and Schedule 1 under the *Wildlife Conservation Act 1950*

Woylie numbers have significantly reduced in recent years after it was removed from the conservation significant species lists. The Woylie was once abundant in the south-west forest areas. Fox and cat predation, along with habitat destruction were thought to have significantly reduced its numbers (De Tores and Start 2008) but it is still unclear why its number have recently declined. The Woylie diet consists of underground fungi, tubes, bulbs and seeds.

Woylies have not been recorded in the vicinity of the project area in recent years and as a consequence they are unlikely to be impacted by vegetation clearing in the project area.

Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*) – Vulnerable under the *EPBC Act 1999* and Schedule 1 under the *Wildlife Conservation Act 1950*

Forest Red-tailed Black-Cockatoos frequent the humid to sub-humid south-west of Western Australia from Gingin in the north, to Albany in the south and west to Cape Leeuwin and Bunbury (Department of Sustainability Environment Water Population and Communities 2011). It nests in tree hollows with a depth of 1-5m, that are predominately Marri (*C. calophylla*), Jarrah (*E. marginata*) and Karri (*E. diversicolor*) and it feeds primarily on the seeds of Marri.

Loss of breeding habitat in the form of suitable hollows and adequate feeding resources in the vicinity of nesting hollows to enable adults to feed chicks is a primary threat. Competition for nesting hollows by other cockatoos, Wood Ducks, Galahs and feral Honey Bees appears to also be a significant threat (Garnett et al. 2011).

All eucalypt trees in the project area were inspected to determine whether any showed signs of use or had the potential to support a nesting hollow for a Black-Cockatoo. Thirty five trees had a trunk diameter of 50cm or greater at breast-height in project area. The locations of these trees are shown on Figure 2 and Appendix B. Most of the large trees in project area are along the eastern or southern boundaries.

Red-Tailed Black-Cockatoos have been recorded during other fauna surveys in the general area and probably feed in the native trees on the south side of Mundijong Road outside the project area. They may occasionally roost in the large trees on-site. There is no record to indicate that they breed in the vicinity of the project area (Johnstone and Kirkby 2011).

Baudin's Black-Cockatoo (*Calyptorhynchus baudinii*) – Vulnerable under the *EPBC Act 1999* and Schedule 1 under the *Wildlife Conservation Act 1950*

This species is most common in the far south-west of Western Australia. It is known to breed from the southern forests north to Collie and east to near Kojonup. Baudin's Black-Cockatoo is typically found in vagrant flocks and utilises the taller, more open Jarrah and Marri woodlands, where it feeds mainly on Marri seeds and various Proteaceous species. While they are seasonally present on the Swan Coastal Plain, Baudin's Black-Cockatoo are potentially seen in the vicinity of the project area (Garnett et al. 2011).

Garnett et al. (2011) reported the primary threat to this species is a lack of suitable hollows. Competition for hollows also comes from other cockatoos, Galahs, Wood Ducks and feral Honey Bees.

Loss of breeding habitat in the form of suitable hollows and adequate feeding resources in the vicinity of nesting hollows to enable adults to feed chicks is a primary threat. Competition for nesting hollows by other cockatoos, Galahs and feral Honey Bees appears to also be a significant threat (Garnett et al. 2011).

All eucalypt trees in the project area were inspected to determine whether any showed signs of use or had the potential to support a nesting hollow for a Black-Cockatoo. Thirty five trees had a trunk diameter of 50cm or greater at breast-height in project area. The locations of these trees are shown on Figure 2 and Appendix B. Most of the large trees in project area are along the eastern or southern boundaries.

Baudin's Black-Cockatoo may infrequently feed in the project area, but would more frequenly be seen foraging in the native vegetation on the south side of Mundijong Road, which is on the other side of the southern boundary of the project area.

Chuditch, Western Quoll (*Dasyurus geoffroii*) – Vulnerable under the *EPBC Act 1999* and Schedule 1 under the *Wildlife Conservation Act 1950*

The Chuditch was originally found in over 70% of Australian woodlands; however, since European settlement its range has diminished to a patchy distribution throughout the Jarrah forest and mixed Karri-Marri-Jarrah forest of south-west WA. They have been known to occupy a wide range of habitats including woodlands, dry sclerophyll forests, riparian vegetation, beaches and deserts. The Chuditch creates dens in hollow logs or burrows and have also been recorded in tree hollows and cavities. They are opportunistic feeders and forage on the ground at night, feeding on invertebrates, small mammals, birds and reptiles.

Terrestrial Ecosystems' believes that it is unlikely the Chuditch occurs within the project area due to a lack of suitable habitat and there are no recent records in the vicinity.

Numbat (*Myrmecobius fasciatus*) – Vulnerable under the *EPBC Act 1999* and Schedule 1 under the *Wildlife Conservation Act 1950*

The Numbat was originally widespread across southern semi-arid and arid Australia, from western NSW through SA and southern NT to the south-west of WA (Maxwell et al. 1996). There are currently two remnant native populations at Dryandra and Perup, WA and several reintroduced populations including Boyagin Nature Reserve, Tutanning Nature Reserve, Batalling block and Karroun Hill Nature Reserve (Friend and Thomas 1995).

There are no recent records of this species in the general area and the available habitat is not suitable. Terrestrial Ecosystems' assessment is that the Numbat is unlikely to occur within the project area.

Quokka (*Setonix brachyurus*) – Vulnerable under the *EPBC Act 1999* and Schedule 1 under the *Wildlife Conservation Act 1950*

Quokkas were originally very common on the Swan Coastal Plain, however, their distribution is now limited to Rottnest Island and a few isolated areas in the south-west of WA. On the mainland, they prefer densely vegetated areas around wetlands and streams, whereas on Rottnest Island they inhabit low scrubby coastal vegetation where water is not readily available year-round. They are herbivorous, and feed on leaves, bark, succulent plants and grasses. There are no recent records of Quokka being found in the vicinity of the project area.

Terrestrial Ecosystems' believes that Quokkas are unlikely to occur within the project area due to lack of suitable habitat and the presence of introduced predators.

Fork-tailed Swift (*Apus pacificus*) - Migratory under the *EPBC Act 1999* and Schedule 3 under the *Wildlife Conservation Act 1950*

The Fork-tailed Swift breeds in north-east and mid-east Asia and winters in Australia and south New Guinea (Johnstone and Storr 1998). They arrive in the Kimberley in late September and in the Pilbara in November and the south-west in December, leaving late in April. Johnstone and Storr (1998) reported them as common in the Kimberley and uncommon to moderately common along the north-west, west and south-east coasts and scarce elsewhere. They are often seen in large flocks and can be attracted to thunderstorms or cyclonic events in the northern parts of the state.

As this is a migratory species, ground disturbance activities on a localised scale are unlikely to significantly impact on Fork-tailed Swifts. They could infrequently be seen flying over the project area.

White-bellied Sea-Eagle (*Haliaeetus leucogaster*) – Migratory under the *EPBC Act 1999* and Schedule 3 under the *Wildlife Conservation Act 1950*

The White-bellied Sea-eagle is the second largest bird of prey found in Australia. This eagle has been seen in a variety of habitats and not always near the ocean, but they are more commonly seen in coastal areas. Birds form permanent pairs that inhabit territories throughout the year. These eagles are normally seen perched high in a tree, or soaring over waterways and adjacent land.

Terrestrial Ecosystems' assessment is that the White-bellied Sea-Eagle may infrequently be seen in the general area, but clearing the project area is unlikely to significantly impact on this species.

Rainbow Bee-eater (*Merops ornatus*) - Migratory under the *EPBC Act 1999* and Schedule 3 under the *Wildlife Conservation Act 1950*

Rainbow Bee-eaters are abundant in Australia, and found in many parts of Western Australia except the sandy deserts and dry arid interior. Johnstone and Storr (1998) described them as resident, breeding visitors and postnuptial nomads. They are generally migratory, moving south in late September and early October, having wintered from the Gascoyne to Indonesia.

Rainbow Bee-eaters are regularly seen across most of the wetter areas of Western Australia including around the project area. Given their abundance and wide spread distribution, ground disturbance activities on a localised scale are unlikely to significantly impact on Rainbow Bee-eaters.

Sharp-tailed Sandpiper (*Calidris acuminata*) – Migratory under the *EPBC Act 1999* and Schedule 3 under the *Wildlife Conservation Act 1950*

This species is found in a variety of habitats including tidal sandbars, mudflats, estuaries, swamps, inland lakes and shorelines, but is essentially confined to areas around water.

Terrestrial Ecosystems' believes it is unlikely to be recorded in the project area due to a lack of suitable habitat.

Red Knot (*Calidris canutus*) - Migratory under the *EPBC Act 1999* and Schedule 3 under the *Wildlife Conservation Act 1950*

The Red Knot is mostly found around mud and sand flats in estuaries, along sheltered coast lines and edges of salt lakes. It breeds in the New Siberian Islands wintering in Australia and New Zealand (Garnett et al. 2011).

Terrestrial Ecosystems' believes it is unlikely to be recorded in the project area due to a lack of suitable habitat.

Curlew Sandpiper (*Calidris ferruginea*) – Migratory under the *EPBC Act 1999* and Schedule 3 under the *Wildlife Conservation Act 1950*

This species breeds in north Siberia and winters from western Africa to Australia (Garnett et al. 2011). It occurs around the whole of the Australian coast line. It is mostly found in coastal brackish lagoons, tidal mud and sand flats, estuaries, salt marshes and occasionally on inland waterways.

Terrestrial Ecosystems' believes it is unlikely to be recorded in the project area due to a lack of suitable habitat.

Red-necked Stint (*Calidris ruficollis*) – Migratory under the *EPBC Act 1999* and Schedule 3 under the *Wildlife Conservation Act 1950*

The Red-necked Stint is a wader that prefers saline sand bars or tidal mudflats along the coast.

Terrestrial Ecosystems' believes it is unlikely to be recorded in the project area due to a lack of suitable habitat.

Great Egret (*Ardea alba*) - Migratory under the *EPBC Act 1999* and Schedule 3 under the *Wildlife Conservation Act 1950*

Herons and egrets all depend to some extent upon surface water for hunting. The Great Egret is the largest of the Australian egrets, and is an elegant, white wader dependent upon floodwaters, rivers, shallow wetlands and intertidal mudflats. Its diet consists of a range of small, aquatic invertebrates and small vertebrates (Firth 1976).

Terrestrial Ecosystems' believes it is unlikely to be recorded in the project area due to a lack of suitable habitat.

Cattle Egret (*Ardea ibis*) - Migratory under the *EPBC Act 1999* and Schedule 3 under the *Wildlife Conservation Act 1950*

The smallest of the Australian egrets, this species has undertaken an invasion of Australia from the north, where it was originally more common in the Indonesian archipelago than Australia (Simpson and Day 2004). This invasion may have been assisted by the opening up of farming land and irrigation schemes, providing the pasturelands and shallow wetlands in which it prefers to forage. Johnstone and Storr (1998) noted the species distribution in Western Australia as being confined to the irrigation areas surrounding Kununurra, however, its migratory nature and current invasive tendencies suggest that it may occur elsewhere in the state, and may still be expanding its distribution.

Terrestrial Ecosystems' believes it is unlikely to be recorded in the project area due to a lack of suitable habitat.

Bar-tailed Godwit (*Limosa lapponica*) – Migratory under the *EPBC Act 1999* and Schedule 3 under the *Wildlife Conservation Act 1950*

This species breeds in north-east Siberia and north-east Alaska and is found along the coasts of Australia (Garnett et al. 2011). It is a wader which is found along muddy coastlines, estuaries, inlets, mangrove fringed lagoons and sheltered bays.

Terrestrial Ecosystems' believes it is unlikely to be recorded in the project area due to a lack of suitable habitat.

Black-tailed Godwit (*Limosa limosa*) – Migratory under the *EPBC Act 1999* and Schedule 3 under the *Wildlife Conservation Act 1950*

The Black-tailed Godwit breeds in China, Mongolia and Russia and winters among other places along the Australian coast (Garnett et al. 2011). It is found in sheltered bays, estuaries and lagoons and near coastal wetlands (Garnett et al. 2011). It is most common in northern Australia and scattered down south in coastal areas.

Terrestrial Ecosystems' believes it is unlikely to be recorded in the project area due to a lack of suitable habitat.

Little Curlew (*Numenius minutes*) - – Migratory under the *EPBC Act 1999* and Schedule 3 under the *Wildlife Conservation Act 1950*

The Little Curlew is found on northern coastal plains and near coastal riverine plains south to Shark Bay and occasionally on the Swan Coastal Plain. Its preferred habitat is short grass plains, including sorghum, stubble, dry riverbeds and tidal mud flats (Johnstone and Storr 1998).

Terrestrial Ecosystems' believes it is unlikely to be recorded in the project area.

Wood Sandpiper (*Tringa glareola*) – Migratory under the *EPBC Act 1999* and Schedule 3 under the *Wildlife Conservation Act 1950*

The Wood Sandpiper prefers well watered coastal swamps, lagoons, waterways and dams is occasionally seen around brackish wetlands (Johnstone and Storr 1998).

Terrestrial Ecosystems' believes it is unlikely to be recorded in the project area due to a lack of suitable habitat.

Marsh Sandpiper (*Tringa stagnatilis*) – Migratory under the *EPBC Act 1999* and Schedule 3 under the *Wildlife Conservation Act 1950*

The Marsh Sandpiper is a distinctive wader with very long legs, a fine long bill and small body. This species prefers shallow fresh and brackish swamps, waterways and sewage ponds and is occasionally seen in estuaries and rarely along the coast (Johnstone and Storr 1998).

Terrestrial Ecosystems' believes it is unlikely to be recorded in the project area due to a lack of suitable habitat.

Carpet Python (*Morelia spilota imbricata*) – Schedule 4 under the *Wildlife Conservation Act 1950*

This species is a large python found across the south west of Western Australia, north to Geraldton and Yalgoo, and east to Kalgoorlie, Fraser Range and Eyre. Carpet Pythons inhabit forest, heath, or wetland areas and shelter in the hollows of large trees. They occur in relatively high abundance on Garden Island and have been caught in the Rockingham area. This species is widespread within the south-west, but is not in high density across its distribution. Carpet Pythons are rarely found on the coastal plain south of the Swan River, and there are no recent records in the vicinity of the project area, however, there are some old records on the Swan Coastal Plain west of the Darling Range scarp, so they may still be found in relatively undisturbed woodlands.

Terrestrial Ecosystems' believes it is unlikely to be recorded in the project area due to a lack of suitable habitat.

Peregrine Falcon (*Falco peregrinus*) - Schedule 4 under the *WA Wildlife Conservation Act 1950*

Johnstone and Storr (1998) reported the Peregrine Falcon as being widespread including on some off-shore islands, but was absent from most deserts. They went on to suggest it was mainly seen about cliffs along coasts, rivers and ranges and wooded watercourses and lakes, but Terrestrial Ecosystems has seen them in a variety of other habitats. Peregrine Falcons are rarely seen in the Perth metropolitan area.

Terrestrial Ecosystems' believes it is unlikely to be recorded in the project area due to a lack of suitable habitat.

Ctenotus gemmula – Priority 3 with DEC

There are three geographic populations for this small skink. One is on the sand plain north of Perth, one is on the sand plain around the greater metropolitan area and the largest geographic distribution is along the south coast of Western Australia. Storr et al. (1999) reported its habitat as white sandplains, mainly in semi-arid and subhumid zones. There is a single record in Terrestrial Ecosystems' fauna survey database for a *C. gemmula* about 10km west of the project area.

Terrestrial Ecosystems' assessment is that *Ctenotus gemmula* is unlikely to have been found in the project area before it was disturbed and less likely now, given the level of disturbance.

Black-striped Snake (*Neelaps calonotos*) – Priority 3 with DEC

This species occurs on dunes and sand-plains vegetated with heaths and eucalypt/banksia woodlands. It feeds largely on skinks and its distribution is restricted and threatened by urban development. The project area does not provide suitable habitat for the Black-striped snake and it has not been recorded in the vicinity of the project area.

Terrestrial Ecosystems' assessment is that it is unlikely to be found in the project because of a lack of suitable habitat.

Lined Skink (*Lerista lineata*) – Priority 3 with DEC

This species is found in coastal heaths and shrub lands on the lower west coast between Perth and Mandurah, including Rottnest Island, with isolated populations on the mid-west coast and Busselton. It has been caught on the sand plain south of the Swan River. It has not been caught within the vicinity of the project area.

Terrestrial Ecosystems' assessment is that it is highly unlikely to be found in the project because of a lack of suitable habitat.

Western Brush Wallaby (*Macropus irma*) – Priority 4 with DEC

This species was very common in the early days of settlement, however, its range has been seriously reduced and fragmented due to clearing for agriculture and there is a significant decline in abundance within most remaining habitat. It is now distributed across the south-west of WA from north of Kalbarri to Cape Arid. The optimum habitat is open forest or woodland, particularly favouring open, seasonally wet flats with low grasses and open scrubby thickets.

It was not seen during the site visit and Terrestrial Ecosystems' believes that it is unlikely to be found in the area because of a lack of suitable habitat.

Water Rat (*Hydromys chrysogaster*) – Priority 4 with DEC

The Water Rat is found mainly near permanent bodies of freshwater, occasionally at temporary waterholes. It is also found in the streams, wetland, lakes and estuaries on the Swan Coastal Plain. There are no records for Water Rats in Terrestrial Ecosystems database in the vicinity of the project area.

Terrestrial Ecosystems' believes it is unlikely to be recorded in the project area due to a lack of suitable habitat.

Eastern Curlew (*Numenius madagascariensis*) – Priority 4 with DEC

This species breeds on open mossy or transitional bogs, moss-lichen bogs and wet meadows, and on the swampy shores of small lakes. In the non-breeding season it is essentially coastal, occurring at estuaries, mangrove swamps, salt marshes and intertidal flats, particularly those with extensive seagrass meadows.

Terrestrial Ecosystems' believes that given the lack of suitable habitat it is unlikely to be seen in the project area.

Western False Pipistrelle (*Falsistrellus mackenziei*) – Priority 4 with DEC

This insectivorous species is the largest vespertilinoid in WA and is confined to south-west WA, south of Perth and east to the wheatbelt (Churchill 1998). It is known to utilise the mature Karri forests but has also been recorded in Jarrah and Tuart woodland on the Swan Coastal Plain. Terrestrial Ecosystems has a record of this species being heard just south of Serpentine, so it may be present in areas providing suitable habitat, but is unlikely to be present in an area that is largely cleared and used for pasture.

Terrestrial Ecosystems' believes that given the lack of suitable habitat it is unlikely to be seen in the project area.

Western Spinebill (*Acanthorhynchus superciliosus*) – Priority 4 with DEC

This species inhabits heath land, woodland, and open forest with healthy understorey and feed on banksias, eucalypts and numerous shrub species (Johnstone and Storr 2004). They also feed on insects. Their numbers have declined as a result of extensive habitat clearing and fires.

Western Spinebills have been recorded in other fauna surveys in the vicinity of the project area. It may be seen occasionally in the treed triangular area along the northern boundary.

Quenda or Southern Brown Bandicoot (*Isoodon obesulus fusciventer*) – Priority 5 with DEC

Quenda prefer dense scrub (up to one metre high), with swampy vegetation. They will often feed in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and crop land lying close to dense cover. This species has been recorded in the general area on multiple occasions in densely vegetated habitat.

Terrestrial Ecosystems' believes it is unlikely to be recorded in the project area due to a lack of suitable habitat.

4.5 Risk assessment

Fauna surveys to support Environmental Impact Assessments (EIA) are part of the environmental risk assessment undertaken to consider what potential impacts a development might have on the biodiversity in a particular area and region. Potential impacts on fauna from the proposed development are identified and briefly described above. The risk assessment is provisional as the proposed development has not been finalised and as such, a precautionary approach has been taken when conducting the risk assessment. Tables 7, 8 and 9 provide a summary of the risk assessment associated with this project.

The assessment contained in Table 9 is supported by more detailed discussion in sections above and the management recommendations below.

Table 7. Fauna impact risk assessment descriptors

Any risk assessment is a product of the likelihood of an impact occurring and the consequences of that impact. Likelihood and consequences are categorised and described below. These criteria do not fit all circumstances (e.g. adequacy of fauna survey data); however, they are useful in providing the reader with an appreciation of the level of likelihood and consequences of an event. The assessed risk level (likelihood x consequences) is then calculated as the overall risk for the development. This is followed by an assessment of the acceptability of the risk associated with each of the events or impacts. Disturbances and vegetation clearing have an impact on the fauna at multiple scales – site, local, landscape and regional. Each of these is considered in the risk assessment. This assessment should be considered in the context of the summary in Table 9.

Likelihood		
Level	Description	Criteria
A	Rare	The environmental event may occur or one or more conservation significant species may be present in exceptional circumstances.
B	Unlikely	The environmental event could occur or one or more conservation significant species could be present at sometime.
C	Moderate	The environmental event should occur or one or more conservation significant species should be present at sometime.
D	Likely	The environmental event will probably occur or one or more conservation significant species will be present in most circumstances.
E	Almost certain	The environmental event is expected to occur or one or more conservation significant species is expected be present in most circumstances.
Consequences		
Level	Description	Criteria
1	Insignificant	Insignificant impact on fauna of conservation significance or regional biodiversity, and the loss of individuals will be insignificant in the context of the availability of similar fauna or fauna assemblages in the area.
2	Minor	Impact on fauna localised and no significant impact on species of conservation significance in the project area. Loss of species at the local scale.
3	Moderate	An appreciable loss of fauna in a regional context or a limited impact on species of conservation significance in the project area.
4	Major	Significant impact on conservation significant fauna or their habitat in the project area and/or regional biodiversity and/or a significant loss in the biodiversity at the landscape scale.
5	Catastrophic	Loss of species at the regional scale and/or a significant loss of species categorised as 'vulnerable' or 'endangered' under the *EPBC Act (1999)* at a regional scale.

Acceptability of Risk	
Level of risk	Management of risk
Low	No action required.
Moderate	Avoid if possible, routine management with internal audit and review of monitoring results annually.
High	Externally approved management plan to reduce risks, monitor major risks annually with external audit and review of management plan outcomes annually. Will require a referral to the Commonwealth under the *EPBC Act 1999*.
Extreme	Unacceptable, project should be redesigned or not proceed.

Table 8. Levels of acceptable risk

		Likelihood				
		Rare or very low (A)	Unlikely or low (B)	Moderate (C)	Likely (D)	Almost certain (E)
Consequences	Insignificant (1)	Low	Low	Low	Low	Low
	Minor (2)	Low	Low	Low	Moderate	Moderate
	Moderate (3)	Low	Moderate	Moderate	High	High
	Major (4)	Moderate	Moderate	High	High	Extreme
	Catastrophic (5)	Moderate	High	High	Extreme	Extreme

Table 9. Risk assessment

		Before Management				With Management		
Factor	Potential Impact	Inherent Risk			Risk Controls / Management	Residual Risk		
		Likelihood	Consequence	Significance		Likelihood	Consequence	Significance
Inadequate fauna survey data.	Unknown loss of fauna, fauna of conservation significance, fauna assemblage(s) in development site.	B	2	Low				
Inadequate knowledge of potential impacts.	Unknown or poorly assessed impact(s) on fauna assemblage and conservation significant species.	B	2	Low				
Inadequate bioregional data for contextual purposes.	Incomplete analysis of data and appreciation of impacts on biodiversity values in a regional context.	B	2	Low				
Removal of habitat – site scale.	Almost complete loss of terrestrial fauna in cleared areas, severe impact on local fauna assemblage.	E	2	Low				
Significant reduction of habitats – local scale.	Loss of fauna and fauna habitat and impacts on local fauna assemblage (excluding conservation significant species).	B	2	Low				
Significant reduction of habitats – landscape scale.	Loss of fauna and fauna habitat and impacts on fauna in a landscape context (excluding conservation significant species).	A	1	Lowe				
Significant reduction of habitats – regional scale.	Loss of fauna and fauna habitat and impacts on fauna in a bioregional context (excluding conservation significant species).	A	1	Low				

		Before Management				With Management		
Factor	Potential Impact	Inherent Risk			Risk Controls / Management	Residual Risk		
		Likelihood	Consequence	Significance		Likelihood	Consequence	Significance
Impact on resident or visiting conservation significant terrestrial species.	Loss of a localised population or a few individuals – *Calyptorhynchus banksii naso.*	A	3	Low				
	Loss of a localised population or a few individuals – *Calyptorhynchus latirotris.*	A	4	Low				
	Loss of a localised population or a few individuals – *Calyptorhynchus baudinii.*	A	3	Low				
	Loss of a localised population or a few individuals – *Haliaeetus leucogaster.*	A	2	Low				
	Loss of a localised population or a few individuals – *Merops ornatus.*	A	2	Low				
	Loss of a localised population or a few individuals – *Hydromys chrysogaster.*	A	2	Low				
	Loss of a localised population or a few individuals – *Isoodon obesulus fusciventer.*	A	2	Low				
	Loss of a localised population or a few individuals – *Acanthorhynchus superciliosus.*	A	2	Low				

5 DISCUSSIONADEQUACY OF AVAILABLE VERTEBRATE FAUNA DATA

The EPA *Terrestrial Biological Surveys as an Element of Biodiversity Protection:* Position Statement No. 3 (EPA 2002), *Guidance Statement for Assessment of Environmental Factors: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia No. 56* (EPA 2004) and the *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA / DEC 2010) are the three relevant documents to assess the adequacy of the available information and reporting for vertebrate fauna surveys in Western Australia.

Reports by 360 Environmental (2008), ATA Environmental (2006), Bamford Consulting Ecologists (2003, 2009), Harvey et al. (1997), How et al. (1999), How and Dell (2000) and Gole (2003) provide an indication of the vertebrate species that could have been present in the project area before it was cleared and used to graze cattle. These data are supported by records contained in NatureMap and the Western Australian Museum records.

Had the area supported relatively undisturbed native vegetation, then a more comprehensive survey of the project area would have been required (EPA 2004, EPA / DEC 2010). The level of disturbance has meant little of the original fauna would now be present in the area. The data available are adequate to assess potential impacts on fauna.

5.1 Biodiversity values of the site

5.1.1 Condition of fauna habitat and extent of habitat degradation

The cleared pasture has almost no ecological value from a native fauna perspective. There are a few mature trees in the paddocks, some of which contain hollows which are currently providing nesting sites for Galahs and Australian Ringneck Parrots.

5.1.2 Ecological linkages

There are four substantial areas set aside as Bush Forever sites nearby; Byford to Serpentine Rail/Road Reserves and adjacent bushland (BFS 350), Norman Road Bushland (BFS 354/361), Cardup Nature Reserve and adjacent bushland (BFE 352) and Roman Road Bushland (BFS 362). Avian fauna would regularly move through and between these areas. The southern site of Precinct G does not form part of an ecological linkage through the general area.

5.1.3 Size and scale of the proposed disturbance and potential impacts

The project area is approximately 54ha and contains a small (~1ha) fenced triangular section on the northern boundary that is planted with *Acacia* sp.. It is a relatively large area but its highly degraded condition means that any subsequent development of the site is unlikely to have a significant impact on native vertebrate fauna.

5.1.4 Conservation significant species

Conservation significant species that probably infrequently utilise the project area include Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*), Forest Red-tailed Black-Cockatoo (*C. banksii naso*) and Baudin's Black-Cockatoo (*C. baudinii*). The Western Spinebill (*A. superciliousus*) may infrequently be seen in the small triangular fenced area along the northern boundary. Migratory Rainbow Bee-eaters and the White-bellied Sea-eagle may infrequently be seen in the area, but will readily move when development commences and are unlikely to be significantly impacted.

5.2 Potential environmental impacts

Clearing of vegetation and developing the project area will potentially affect vertebrate fauna in a number of ways, including:

- death/injury of fauna during vegetation clearing and development;

- loss of habitat; and
- further fragmentation of fauna habitat.

Given the project area has been cleared for pasture, contains a small number of mature native and planted trees, vegetation clearing impacts would be low.

5.2.1 Black-Cockatoos

Carnaby's Black-Cockatoo, Baudin's Black-Cockatoo and the Forest Red-tailed Black-Cockatoo will probably infrequently forage in the project area. The project area contains a small number of Eucalypt trees with a trunk diameter greater than 50cm at breast-height and a few of these appear to contain hollows. None of the trees showed evidence of use by Black-Cockatoos for breeding purposes. The Johnstone and Kirkby (2011) report on Black-Cockatoo foraging and breeding locations on the Swan Coastal Plain provided no indication that Black-Cockatoos bred or are likely to breed in the vicinity of the project area.

The previous Commonwealth Department of Environment and Heritage (2009) indicated what was a significant impact for critically endangered, endangered and vulnerable species. An action is likely to have a significant impact on an endangered and vulnerable species if there is a possibility that it will trigger any one of nine criteria listed in Table 10. The potential impacts of clearing the vegetation in the project area have been assessed against the criteria for the three species listed as endangered and vulnerable under the *EPBC Act 1999* that could forage in the project area.

Table 10. Criteria to determine whether an action will have a significant impact on an endangered species

Criteria	Carnaby's Black-Cockatoo	Baudin's Black-Cockatoo	Forest Red-tail Black-Cockatoo
Lead to a long-term decrease in the size of a population	No	No	No
Reduce the area of occupancy of the species	No	No	No
Fragment an existing population into two or more populations	No	No	No
Adversely affect habitat critical to the survival of a species	No	No	No
Disrupt the breeding cycle of a population	No	No	No
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No	No	No
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	No	No	No
Introduce disease that may cause the species to decline	No	No	No
Interfere with the recovery of the species	No	No	No

The recently released Commonwealth government referral guideline on Black-Cockatoos (Department of Sustainability Environment Water Population and Communities 2011) provided a referral decision making tree and criteria for deciding whether a project should be referred to the Commonwealth minister responsible for the environment (Appendix E). Although this guideline has not been formally approved, it is understood that the Commonwealth department officers are using this in their assessment of potential impacts. The project area contains less than 1ha of quality foraging habitat and would not trigger any of the criterion if it was developed. A referral under the *EPBC Act 1999* is therefore not recommended.

5.2.2 Impacts on the fauna assemblage and fauna habitat

Level 1 fauna assessments are, in essence, an assessment of the risks associated with the proposed disturbance on the fauna either known or potentially in the area. Table 11 is a summary of that risk assessment for clearing vegetation and developing the southern site of Precinct G in Mundijong. The level of alteration to the natural habitat is generally high.

Table 11. A summary of the assessed risk of impact on the fauna and fauna habitat it the project area

Issues	**Assessment**				
Formal conservation status for the area:	No			Yes	
Specifically for fauna	X				
Level of alteration to the original faunal habitat	Very High 1	2	3	4	Very Low 5
surface soil		X			
vegetation	X				
by salinity					X
by non-farmed exotic species				X	
by farmed species	X				
level of habitat fragmentation	X				
Knowledge of:	Very High 1	2	3	4	Very Low 5
species in each biotope				X	
assemblage structure per biotope				X	
presence of rare and protected species		~~X~~	X		
presence of range restricted species			X		
presence of short range endemic invertebrates					X
presence of stygofauna					X
ecosystem values	X				
regional species and regional assemblages			X		
regional ecosystems			X		
Capacity to assess biodiversity values for each biotope at:	Very High 1	2	3	4	Very Low 5
species level	X				
ecosystem levels	X				
ecological functional values	X				
regional significance of faunal assemblage	X				
Consequences of the proposed disturbance in the context of the:	Very High 1	2	3	4	Very Low 5
level of existing disturbance					X
size of area to be disturbed				X	
scale of the disturbance					X
significance of fauna habitat in a regional context					X
extent to which the area is a refuge for fauna				X	
extent to which the disturbance will impact on rare or protected fauna					X
extent to which the fauna habitat is an ecologically important remnant					X
extent to which the habitat provides an ecological linkage(s) or corridor(s)					X
heterogeneity of habitat					X
abundance of the habitat in the bioregion	X				

5.2.3 Native vegetation clearing principles

The *Environmental Protection Act* (*1986*) provides criteria to judge the potential impact of a development on clearing native vegetation. These criteria have been listed in Table 12 with a response to indicate how clearing of the vegetation in the project area might be judged against these principles.

Table 12. Assessment of impact on fauna using the Native Vegetation Clearing Principles

Principle	Response
It comprises a high level of biological diversity.	Clearing vegetation will not compromise a high level of biodiversity.
It comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.	Clearing the vegetation is unlikely to result in the significant loss of habitat for Carnaby's Black-Cockatoos, Forest Red-tailed Black-Cockatoos and Baudin's Black-Cockatoos.
It includes, or is necessary for the continued existence or, rare flora.	Not applicable.
It comprises the whole or a part of, or is necessary for the maintenance of, a threatened ecological community.	The area does not contain a threatened ecological fauna community, but could support a few individuals from a conservation significant species.
It is significant as a remnant of native vegetation in an area that has been extensively cleared.	The project area does not contain remnant bushland.
It is growing in, or in association with, an environment associated with a watercourses or wetland.	The project area does not contain a water course or wetland.
The clearing of the vegetation is likely to cause appreciable land degradation.	Not applicable.
The clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.	Clearing of vegetation is unlikely to impact on the environmental values of nearby conservation areas.
The clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.	Not applicable.
The clearing of the vegetation is likely to cause, or exacerbate the incidence of flooding.	Not applicable.

6 SUMMARY, CONCLUSIONS AND MANAGEMENT RECOMMENDATIONS

Peet Ltd is seeking to develop the southern site in Precinct G near Mundijong. The project area has been substantially cleared and is currently used as pasture for cattle. The project area contains a small (~ 1ha) fenced and triangular plot planted with *Acacia* sp. on the northern boundary and scattered mature trees that are mostly along the eastern and southern boandaries. The project has a low ecological value other than the few mature trees scattered across the paddock and is not part of any important ecological linkages in the bioregion.

Mature trees provide an important ecological resource for birds and small arboreal mammals and as such, where practical, they should be preserved and protected. Even large dead trees that are safe (i.e. unlikely to pose a risk through dropping branches or falling over) should be protected as they provide roosting and nesting sites for a variety of birds. Within this context, the design of any residential development should endeavour to protect and preserve as many of the mature trees as possible. Some of these trees will end up in street verges, others in public open space and some will be in residential lots. Caveats and other restrictions can be added to property titles to protect important trees.

Recommendation 1. Mature, healthy and safe trees that are currently in the paddocks should be preserved and protected where this is feasible within the design for the development of the project area.

7 REFERENCES

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PGV Environmental
PRECINCT G SOUTHERN SITE
MUNDIJONG

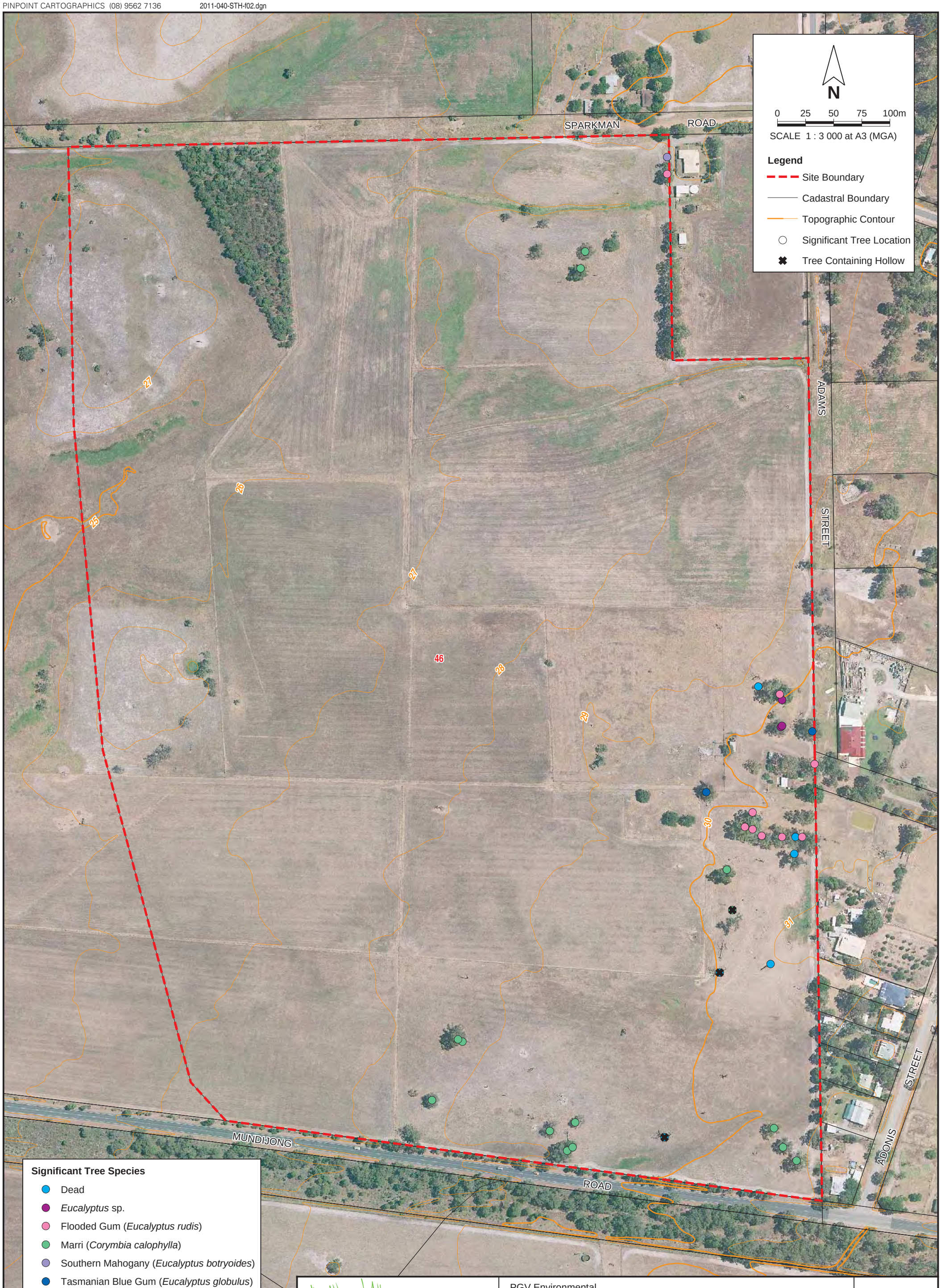
Figure 1

TERRESTRIAL ECOSYSTEMS

REGIONAL LOCATION

Drawn: G. Thompson | Date: 18 Oct 2011 | Job: 2011-040

PINPOINT CARTOGRAPHICS (08) 9562 7136 2011-040-STH-f01.dgn



BASE SOURCE: Taylor Burrell Barnett.
WETLANDS SOURCE: DEC, March 2011.
AERIAL PHOTOGRAPH SOURCE: Taylor Burrell Barnett.

TERRESTRIAL ECOSYSTEMS

Drawn: G. Thompson

Date: 11 Nov 2011

PGV Environmental
PRECINCT G SOUTHERN SITE
MUNDIJONG

SIGNIFICANT TREE LOCATIONS

Figure 2

Job: 2011-040

Appendix A

Search Results from the *EPBC Act* (1999) On-line Database

Level 1 Vertebrate Fauna Assessment – Southern Site Precinct G

TERRESTRIAL ECOSYSTEMS

Australian Government

Department of Sustainability, Environment, Water, Population and Communities

EPBC Act Protected Matters Report: Coordinates

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

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

Information about the EPBC Act including significance guidelines, forms and application process details can be found at http://www.environment.gov.au/epbc/assessmentsapprovals/index.html

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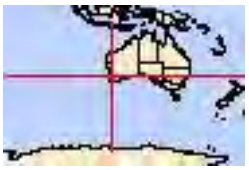


Summary

Details

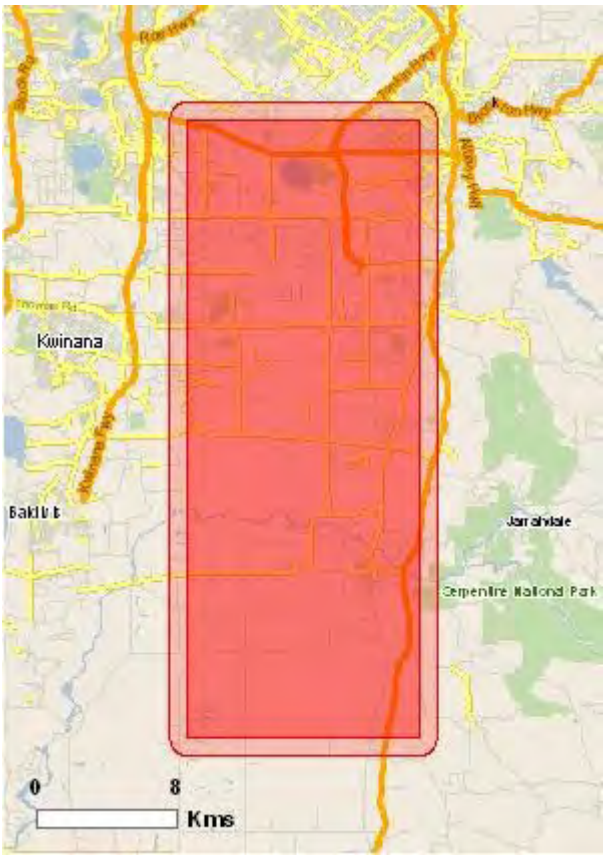
Matters of NES

Other matters protected by the EPBC Act

Extra Information

Caveat

Acknowledgements



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates

Buffer: 1.0Km

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance - see http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Significance (Ramsar Wetlands):	3
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Threatened Ecological Communitites:	2
Threatened Species:	25
Migratory Species:	16

Other Matters Protected by the EPBC Act

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

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage/index.html

Please note that the current dataset on Commonwealth land is not complete. Further information on Commonwealth land would need to be obtained from relevant sources including Commonwealth agencies, local agencies, and land tenure maps.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at http://www.environment.gov.au/epbc/permits/index.html.

Commonwealth Lands:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	24
Whales and Other Cetaceans:	None

Critical Habitats:	None
Commonwealth Reserves:	None

Report Summary for Extra Information

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

Place on the RNE:	15
State and Territory Reserves:	14
Regional Forest Agreements:	1
Invasive Species:	18
Nationally Important Wetlands:	2

Details

Matters of National Environmental Significance

Wetlands of International Significance (RAMSAR Sites) [Resource Information]

Name	Proximity
Forrestdale & thomsons lakes	Within Ramsar site
Peel-yalgorup system	Upstream from Ramsar site
Becher point wetlands	Upstream from Ramsar site

Threatened Ecological Communities [Resource Information]

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

Name	Status	Type of Presence
Corymbia calophylla - Kingia australis woodlands on heavy soils of the Swan Coastal Plain	Endangered	Community known to occur within area
Corymbia calophylla - Xanthorrhoea preissii woodlands and shrublands of the Swan Coastal Plain	Endangered	Community known to occur within area

Threatened Species [Resource Information]

Name	Status	Type of Presence
BIRDS		
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo [67034]	Vulnerable	Species or species habitat may occur within area
Calyptorhynchus baudinii Baudin's Black-Cockatoo, Long-billed Black-Cockatoo [769]	Vulnerable	Roosting known to occur within area

Calyptorhynchus latirostris Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Breeding likely to occur within area
Sternula nereis nereis Fairy Tern (Australian) [82950]	Vulnerable	Species or species habitat may occur within area
INSECTS		
Neopasiphae simplicior A native bee [66821]	Critically Endangered	Species or species habitat likely to occur within area
Synemon gratiosa Graceful Sun Moth [66757]	Endangered	Species or species habitat may occur within area
MAMMALS		
Bettongia penicillata ogilbyi Woylie [66844]	Endangered	Species or species habitat may occur within area
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area
Phascogale calura Red-tailed Phascogale [316]	Endangered	Species or species habitat may occur within area
Setonix brachyurus Quokka [229]	Vulnerable	Species or species habitat may occur within area
PLANTS		
Andersonia gracilis Slender Andersonia [14470]	Endangered	Species or species habitat may occur within area
Caladenia huegelii King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat likely to occur within area
Centrolepis caespitosa [6393]	Endangered	Species or species habitat likely to occur within area
Darwinia foetida Muchea Bell [83190]	Critically Endangered	Species or species habitat likely to occur within area
Drakaea elastica Glossy-leaved Hammer-orchid, Praying Virgin [16753]	Endangered	Species or species habitat likely to occur within area
Drakaea micrantha Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus balanites Cadda Road Mallee, Cadda Mallee [24264]	Endangered	Species or species habitat known to occur within area
Grevillea curviloba subsp. incurva Narrow curved-leaf Grevillea [64909]	Endangered	Species or species habitat may occur within area
Lasiopetalum pterocarpum Wing-fruited Lasiopetalum [64922]	Endangered	Species or species habitat likely to occur within area
Lepidosperma rostratum Beaked Lepidosperma [14152]	Endangered	Species or species habitat likely to occur within area

Synaphea sp. Fairbridge Farm (D.Papenfus 696)		
Selena's Synaphea [82881]	Critically Endangered	Species or species habitat known to occur within area
Synaphea stenoloba		
Dwellingup Synaphea [66311]	Endangered	Species or species habitat may occur within area
Thelymitra stellata		
Star Sun-orchid [7060]	Endangered	Species or species habitat likely to occur within area
Verticordia plumosa var. pleiobotrya		
Narrow-petalled Featherflower [55803]	Endangered	Species or species habitat likely to occur within area

Migratory Species

[Resource Information]

Name	Status	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat may occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Migratory Terrestrial Species		
Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area
Migratory Wetlands Species		
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris canutus		
Red Knot, Knot [855]		Roosting known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]		Roosting known to occur within area
Calidris ruficollis		
Red-necked Stint [860]		Roosting known to occur within area
Limosa lapponica		
Bar-tailed Godwit [844]		Roosting known to occur within area
Limosa limosa		
Black-tailed Godwit [845]		Roosting known to occur within area
Numenius minutus		
Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area
Tringa glareola		
Wood Sandpiper [829]		Roosting known to occur within area

Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]	Roosting known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Commonwealth Land -

Listed Marine Species [Resource Information]

Name	Status	Type of Presence
Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat may occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]		Roosting known to occur within area
Calidris ferruginea Curlew Sandpiper [856]		Roosting known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Roosting known to occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris subminuta Long-toed Stint [861]		Roosting known to occur within area
Charadrius dubius Little Ringed Plover [896]		Roosting known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Roosting known to occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Himantopus himantopus Black-winged Stilt [870]		Roosting known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Roosting known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Merops ornatus		

Rainbow Bee-eater [670]	Species or species habitat may occur within area
Numenius minutus	
Little Curlew, Little Whimbrel [848]	Roosting likely to occur within area
Philomachus pugnax	
Ruff (Reeve) [850]	Roosting known to occur within area
Recurvirostra novaehollandiae	
Red-necked Avocet [871]	Roosting known to occur within area
Thinornis rubricollis	
Hooded Plover [59510]	Roosting known to occur within area
Tringa glareola	
Wood Sandpiper [829]	Roosting known to occur within area
Tringa stagnatilis	
Marsh Sandpiper, Little Greenshank [833]	Roosting known to occur within area

Extra Information

Places on the RNE [Resource Information]

Note that not all Indigenous sites may be listed.

Name	Status
Natural	
Forrestdale Lake & Adjacent Wetlands WA	Indicative Place
Gibbs Road Wetland System WA	Indicative Place
Modong Nature Reserve WA	Indicative Place
Banksia Road Nature Reserve WA	Registered
Brickwood Bushland WA	Registered
Cardup Bushland WA	Registered
Forrestdale Lake WA	Registered
Karnet Nature Reserve WA	Registered
Lowlands and Riverlea Bushland WA	Registered
Reserve 23012 WA	Registered
Serpentine National Park WA	Registered
Wandi Nature Reserve WA	Registered
Historic	
Keysbrook Farmhouse WA	Indicative Place
Turner Cottage WA	Indicative Place
Lowlands WA	Registered

State and Territory Reserves [Resource Information]

Gibbs Road, WA
Cardup, WA
Piara, WA
Wandi, WA
Lambkin, WA
Unnamed WA42044, WA
Banksia, WA
Karnet, WA
Modong, WA
Watkins Road, WA
Serpentine, WA
Unnamed WA46587, WA

Forrestdale Lake, WA
Unnamed WA46818, WA

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

South West WA RFA, Western Australia

Invasive Species [Resource Information]

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

Name	Status	Type of Presence
Mammals		
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat may occur within area

Olea europaea	
Olive, Common Olive [9160]	Species or species habitat may occur within area
Pinus radiata	
Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]	Species or species habitat may occur within area
Rubus fruticosus aggregate	
Blackberry, European Blackberry [68406]	Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtiji	
Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]	Species or species habitat likely to occur within area
Salvinia molesta	
Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]	Species or species habitat likely to occur within area
Tamarix aphylla	
Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]	Species or species habitat likely to occur within area

Nationally Important Wetlands **[Resource Information]**

Gibbs Road Swamp System, WA

Forrestdale Lake, WA

Caveat

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

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

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

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

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

Only selected species covered by the following provisions of the EPBC Act have been mapped:
- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:
- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:
- non-threatened seabirds which have only been mapped for recorded breeding sites;
- seals which have only been mapped for breeding sites near the Australian continent.

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

Coordinates

-32.45 115.88,-32.13 115.88,-32.13 116.0,-32.45 116.0,-32.45 115.88

Acknowledgements

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

-Department of Environment, Climate Change and Water, New South Wales
-Department of Sustainability and Environment, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment and Natural Resources, South Australia
-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts
-Environmental and Resource Management, Queensland
-Department of Environment and Conservation, Western Australia
-Department of the Environment, Climate Change, Energy and Water
-Birds Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-SA Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System

-Australian Government, Department of Defence
-State Forests of NSW
-Other groups and individuals

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

Please feel free to provide feedback via the Contact Us page.

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| Australian Government |

Appendix B
Location of Conservation Significant Trees

Level 1 Vertebrate Fauna Assessment – Southern Site Precinct G

TERRESTRIAL ECOSYSTEMS

Appendix B. Location of conservation significant trees

UTM Zone	UTM Easting	UTM Northing	Tree type
50	403570	6426083	Dead
50	403619	6426234	Dead
50	403657	6426235	Dead
50	403678	6426333	Dead
50	403679	6426348	Dead
50	403646	6426482	Dead
50	403666	6426446	*Eucalyptus* sp.
50	403667	6426447	*Eucalyptus* sp.
50	403667	6426470	*Eucalyptus* sp.
50	403667	6426348	Flooded Gum (*Eucalyptus rudis*)
50	403649	6426349	Flooded Gum (*Eucalyptus rudis*)
50	403641	6426355	Flooded Gum (*Eucalyptus rudis*)
50	403634	6426357	Flooded Gum (*Eucalyptus rudis*)
50	403641	6426370	Flooded Gum (*Eucalyptus rudis*)
50	403665	6426475	Flooded Gum (*Eucalyptus rudis*)
50	403565	6426938	Flooded Gum (*Eucalyptus rudis*)
50	403685	6426348	Flooded Gum (*Eucalyptus rudis*)
50	403696	6426413	Flooded Gum (*Eucalyptus rudis*)
50	403680	6426060	Marri (*Corymbia calophylla*)
50	403476	6426069	Marri (*Corymbia calophylla*)
50	403668	6426072	Marri (*Corymbia calophylla*)
50	403481	6426072	Marri (*Corymbia calophylla*)
50	403468	6426085	Marri (*Corymbia calophylla*)
50	403660	6426089	Marri (*Corymbia calophylla*)
50	403492	6426089	Marri (*Corymbia calophylla*)
50	403356	6426114	Marri (*Corymbia calophylla*)
50	403383	6426166	Marri (*Corymbia calophylla*)
50	403379	6426168	Marri (*Corymbia calophylla*)
50	403623	6426283	Marri (*Corymbia calophylla*)
50	403618	6426319	Marri (*Corymbia calophylla*)
50	403488	6426854	Marri (*Corymbia calophylla*)
50	403492	6426869	Marri (*Corymbia calophylla*)
50	403565	6426953	Southern Mahogany (*Eucalyptus botryoides*)
50	403610	6426391	Tasmanian Blue Gum (*Eucalyptus globulus*)
50	403694	6426442	Tasmanian Blue Gum (*Eucalyptus globulus*)

Appendix C
Fauna Surveys in the Vicinity of the Project Area

Level 1 Vertebrate Fauna Assessment – Southern Site Precinct G

TERRESTRIAL ECOSYSTEMS

Appendix C(1). Fauna survey data in the vicinity of the project area

		Surveys	A	B				C						D	E	
Family	**Species**	**Common Name**	**Abernethy Rd Byford**	**Site 1**	**Site 2**	**Site 3**	**Opportunistic**	**Site 1**	**Site 2**	**Site 3**	**Site 4**	**Site 6**	**Opportunistic**	**Keane Rd**	**Jandakot Airport 1**	**Jandakot Airport 2**
Birds																
Accipitridae	*Elanus axillaris*	Black-shouldered Kite											X			
	Haliastur sphenurus	Whistling Kite					2									
	Accipiter fasciatus	Brown Goshawk													1	2
	Accipiter cirrocephalus	Collared Sparrowhawk											X			
	Hieraaetus morphnoides	Little Eagle											X			7
	Pandion haliaetus	Osprey														
Anatidae	*Biziura lobata*	Musk Duck														
	Stictonetta naevosa	Freckled Duck														
	Cygnus atratus	Black Swan					1									
	Tadorna tadornoides	Australian Shelduck					25							X		
	Chenonetta jubata	Australian Wood Duck					59							X		
	Anas gracilis	Grey Teal					8									
	Anas castanea	Chestnut Teal														
	Anas superciliosa	Pacific Black Duck					26						X	X		
	Oxyura australis	Blue-billed Duck														
Podargidae	*Podargus strigoides*	Tawny Frogmouth					1									
Charadriidae	*Charadrius ruficapillus*	Red-capped Plover														
	Elseyornis melanops	Black-fronted Dotterel														
	Erythrogonys cinctus	Red-kneed Dotterel														
	Vanellus tricolor	Banded Lapwing											X			
Laridae	*Chlidonias hybridus*	Whiskered Tern														
	Chroicocephalus novaehollandiae	Silver Gull														
Recurvirostridae	*Himantopus himantopus*	Black-winged Stilt														
	Recurvirostra novaehollandiae	Red-necked Avocet														
	Cladorhynchus leucocephalus	Banded Stilt														
Scolopacidae	*Actitis hypoleucos*	Common Sandpiper														
	Tringa stagnatilis	Marsh Sandpiper														
	Calidris subminuta	Long-toed Stint														
	Calidris acuminata	Sharp-tailed Sandpiper														
Stercorariidae	*Stercorarius longicauda*	Long-tailed Jaeger														
Turnicidae	*Turnix varius*	Painted Button-quail														
	Turnix velox	Little Button-quail														

		Surveys	A	B				C						D	E	
Family	**Species**	**Common Name**	**Abernethy Rd Byford**	**Site 1**	**Site 2**	**Site 3**	**Opportunistic**	**Site 1**	**Site 2**	**Site 3**	**Site 4**	**Site 6**	**Opportunistic**	**Keane Rd**	**Jandakot Airport 1**	**Jandakot Airport 2**
Ardeidae	*Ardea alba*	Great Egret														
Ardeidae	*Ardea pacifica*	White-necked Heron					3									
	Egretta novaehollandiae	White-faced Heron					31									
	Nycticorax caledonicus	Nankeen Night Heron					1									
Pelecanidae	*Pelecanus conspicillatus*	Australian Pelican					1									
Threskiornithidae	*Plegadis falcinellus*	Glossy Ibis														
	Threskiornis molucca	Australian White Ibis					28						X			
	Threskiornis spinicollis	Straw-necked Ibis					238							X		
	Platalea flavipes	Yellow-billed Spoonbill														
Columbidae	*Columba livia*	Rock Dove														
	Streptopelia senegalensis	Laughing Dove					24						X	X	14	
	Streptopelia chinensis	Spotted Dove					7						X			
	Phaps chalcoptera	Common Bronzewing					15						X	X		
	Ocyphaps lophotes	Crested Pigeon					8						X	X		
Alcedinidae	*Dacelo novaeguineae*	Laughing Kookaburra					6									
	Todiramphus sanctus	Sacred Kingfisher					7								2	
Meropidae	*Merops ornatus*	Rainbow Bee-eater					34								3	1
Cuculidae	*Chalcites basalis*	Horsfield's Bronze-Cuckoo					1						X	X		
	Chalcites lucidus	Shining Bronze-Cuckoo					11						X	X		
	Cacomantis pallidus	Pallid Cuckoo												X		
	Cacomantis flabelliformis	Fan-tailed Cuckoo					1						X			
Caprimulgidae	*Eurostopodus argus*	Spotted Nightjar														
Falconidae	*Falco cenchroides*	Nankeen Kestrel					21						X	X		
	Falco berigora	Brown Falcon					1									
	Falco longipennis	Australian Hobby											X			
	Falco subniger	Black Falcon														
Phasianidae	*Coturnix ypsilophora*	Brown Quail					1						X			
Rallidae	*Porphyrio porphyrio*	Purple Swamphen					9									
	Gallirallus philippensis	Buff-banded Rail														
	Porzana pusilla	Baillon's Crake														
	Porzana fluminea	Australian Spotted Crake														
	Porzana tabuensis	Spotless Crake														
	Tribonyx ventralis	Black-tailed Native-hen														
	Gallinula tenebrosa	Dusky Moorhen														
	Fulica atra	Eurasian Coot					20									

TERRESTRIAL ECOSYSTEMS

		Surveys	A	B				C						D	E	
Family	**Species**	**Common Name**	**Abernethy Rd Byford**	**Site 1**	**Site 2**	**Site 3**	**Opportunistic**	**Site 1**	**Site 2**	**Site 3**	**Site 4**	**Site 6**	**Opportunistic**	**Keane Rd**	**Jandakot Airport 1**	**Jandakot Airport 2**
Acanthizidae	*Sericornis frontalis*	White-browed Scrubwren					3							X		
	Smicrornis brevirostris	Weebill					3							X		
	Gerygone fusca	Western Gerygone					42						X	X	2	7
	Acanthiza chrysorrhoa	Yellow-rumped Thornbill					169						X	X		
	Acanthiza inornata	Western Thornbill														
	Acanthiza apicalis	Inland Thornbill					14							X		
Acrocephalidae	*Acrocephalus australis*	Australian Reed-Warbler														
	Cincloramphus mathewsi	Rufous Songlark														
Artamidae	*Artamus cinereus*	Black-faced Woodswallow														
	Artamus cyanopterus	Dusky Woodswallow														
	Cracticus torquatus	Grey Butcherbird					21						X	X	1	2
	Cracticus tibicen	Australian Magpie					155						X	X	13	6
	Strepera versicolor	Grey Currawong														
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-Shrike					29						X	X	3	2
	Lalage sueurii	White-winged Triller					4									
Climacteridae	*Climacteris rufa*	Rufous Treecreeper														
Corvidae	*Corvus coronoides*	Australian Raven					198						X	X	42	26
	Corvus splendens	House Crow														
Estrildidae	*Stagonopleura oculata*	Red-eared Firetail														
Hirundinidae	*Cheramoeca leucosterna*	White-backed Swallow														
	Hirundo neoxena	Welcome Swallow					26								4	1
	Petrochelidon nigricans	Tree Martin					25						X	X	42	9
	Petrochelidon ariel	Fairy Martin														
Maluridae	*Malurus splendens*	Splendid Fairy-wren					173						X	X	9	9
	Malurus elegans	Red-winged Fairy-wren														
Meliphagidae	*Acanthorhynchus superciliosus*	Western Spinebill											X	X	15	3
	Lichenostomus virescens	Singing Honeyeater					29						X	X	36	23
	Manorina flavigula	Yellow-throated Miner														
	Anthochaera lunulata	Western Wattlebird					3						X	X		
	Anthochaera chrysoptera	Little Wattlebird													2	
	Anthochaera carunculata	Red Wattlebird					70						X	X	35	3
	Epthianura albifrons	White-fronted Chat														
	Glyciphila melanops	Tawny-crowned Honeyeater												X		
	Lichmera indistincta	Brown Honeyeater					120						X	X	43	35
	Phylidonyris novaehollandiae	New Holland Honeyeater					63						X	X	35	10

TERRESTRIAL ECOSYSTEMS

		Surveys	A	B				C						D	E	
Family	**Species**	**Common Name**	**Abernethy Rd Byford**	**Site 1**	**Site 2**	**Site 3**	**Opportunistic**	**Site 1**	**Site 2**	**Site 3**	**Site 4**	**Site 6**	**Opportunistic**	**Keane Rd**	**Jandakot Airport 1**	**Jandakot Airport 2**
	Phylidonyris niger	White-cheeked Honeyeater											X	X	11	1
	Melithreptus brevirostris	Brown-headed Honeyeater														
	Melithreptus lunatus	White-naped Honeyeater														
Monarchidae	*Grallina cyanoleuca*	Magpie-Lark					94						X	X	8	
Motacilidae	*Anthus novaeseelandiae*	Australasian Pipit					16							X		
Nectariniidae	*Dicaeum hirundinaceum*	Mistletoebird					1									
Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella													2	2
Pachycephalidae	*Pachycephala pectoralis*	Golden Whistler											X	X		
	Pachycephala rufiventris	Rufous Whistler					32						X	X	28	27
	Colluricincla harmonica	Grey Shrike-thrush					8						X	X		6
Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote														
	Pardalotus striatus	Striated Pardalote					11						X		10	4
Petroicidae	*Petroica multicolor*	Pacific Robin					2									
	Petroica goodenovii	Red-capped Robin												X		
	Eopsaltria georgiana	White-breasted Robin														
Rhipiduridae	*Rhipidura fuliginosa*	New Zealand Fantail					67								7	
	Rhipidura albiscapa	Grey Fantail												X		
	Rhipidura leucophrys	Willie Wagtail					53						X	X	24	1
Timaliidae	*Zosterops lateralis*	Silvereye					293						X	X	7	3
Phalacrocoracidae	*Microcarbo melanoleucos*	Little Pied Cormorant					5									
	Phalacrocorax carbo	Great Cormorant														
	Phalacrocorax sulcirostris	Little Black Cormorant					2									
	Phalacrocorax varius	Pied Cormorant														
Podicipedidae	*Tachybaptus novaehollandiae*	Australasian Grebe					2									
	Podiceps cristatus	Great Crested Grebe														
Procellariidae	*Daption capense*	Cape Petrel														
	Pachyptila desolata	Antarctic Prion														
	Pterodroma macroptera	Great-winged Petrel														
Cacatuidae	*Calyptorhynchus banksii naso*	Red-tailed Black-Cockatoo	20				26						X			
	Calyptorhynchus latirostris	Carnaby's Black-Cockatoo	4				2						X			
	Calyptorhynchus baudinii	Baudin's Black-Cockatoo														
	Eolophus roseicapillus	Galah					85						X	X		
	Cacatua pastinator	Western Corella											X			
	Cacatua sanguinea	Little Corella					6									
Psittacidae	*Trichoglossus haematodus*	Rainbow Lorikeet					56						X	X		

TERRESTRIAL ECOSYSTEMS

		Surveys	A	B				C						D	E	
Family	**Species**	**Common Name**	**Abernethy Rd Byford**	**Site 1**	**Site 2**	**Site 3**	**Opportunistic**	**Site 1**	**Site 2**	**Site 3**	**Site 4**	**Site 6**	**Opportunistic**	**Keane Rd**	**Jandakot Airport 1**	**Jandakot Airport 2**
	Polytelis anthopeplus	Regent Parrot					14									
	Platycercus icterotis	Western Rosella														
	Barnardius zonarius	Australian Ringneck					60						X	X	1	
	Purpureicephalus spurius	Red-capped Parrot					52						X	X	4	1
	Neophema elegans	Elegant Parrot					6									
Strigidae	*Ninox novaeseelandiae*	Southern Boobook					2									
Tytonidae	*Tyto alba*	Barn Owl					1									
Mammals																
Suidae	*Sus scrofa*	Pig														
Canidae	*Canis lupus*	Dog												X		
	Vulpes vulpes	Red Fox	1	1	1									X		
Felidae	*Felis catus*	House Cat		1	1									X		
Molossidae	*Austronomus australis*	White-striped Freetail Bat											X			
Pteropodidae	*Pteropus scapulatus*	Little Red Flying Fox														
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat		1									X			
	Nyctophilus geoffroyi	Lesser Longeared Bat														
	Nyctophilus major	Western Longeared Bat														
	Vespadelus regulus	Southern Forest Bat											X			
Dasyuridae	*Antechinus flavipes*	Yellow-footed Antechinus														
	Phascogale tapoatafa	Brush-tailed Phascogale														
Macropodidae	*Macropus fuliginosus*	Western Grey Kangaroo												X		
Phalangeridae	*Trichosurus vulpecula*	Common Brushtail Possum		18												
Tarsipedidae	*Tarsipes rostratus*	Honey Possum														
Leporidae	*Oryctolagus cuniculus*	European Rabbit			4									X		
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna														
Peramelidae	*Isoodon obesulus*	Southern Brown Bandicoot			25			4	3	7				X		
Muridae	*Mus musculus*	House Mouse		26	23					1		2				
	Rattus fuscipes	Bush Rat		1												
	Rattus rattus	Black Rat			5			2								
Amphibians																
Hylidae	*Litoria adelaidensis*	Slender Tree Frog		7	4	10								X		
	Litoria moorei	Motorbike Frog		8	36	9										
Limnodynastidae	*Heleioporus eyrei*	Moaning Frog		518	81											2
	Heleioporus psammophilus	Sand Frog						4								
	Limnodynastes dorsalis	Western Banjo Frog		1	2				1	1				X	6	1

TERRESTRIAL ECOSYSTEMS

		Surveys	A	B				C						D	E	
Family	**Species**	**Common Name**	**Abernethy Rd Byford**	**Site 1**	**Site 2**	**Site 3**	**Opportunistic**	**Site 1**	**Site 2**	**Site 3**	**Site 4**	**Site 6**	**Opportunistic**	**Keane Rd**	**Jandakot Airport 1**	**Jandakot Airport 2**
Myobatrachidae	*Crinia georgiana*	Quacking Frog		158												
	Crinia glauerti	Clicking Frog		11	1	4										
	Crinia insignifera	Squelching Froglet		X										X	X	
Myobatrachidae	*Myobatrachus gouldii*	Turtle Frog														1
	Pseudophryne guentheri	Crawling Toadlet														
Reptiles																
Agamidae	*Ctenophorus adelaidensis*	Southern Heath Dragon														
	Pogona minor	Bearded Dragon						1							2	
Diplodactylidae	*Diplodactylus polyophthalmus*															
	Strophurus spinigerus															
Elapidae	*Brachyurophis fasciolata*															
	Brachyurophis semifasciata															
	Demansia psammophis							1	2	2						
	Echiopsis curta	Bardick														
	Elapognathus coronatus	Crowned Snake														
	Neelaps bimaculatus	Black-naped Snake														
	Notechis scutatus	Tiger Snake		3	2											
	Parasuta gouldii															1
	Parasuta nigriceps															
	Pseudechis australis	Mulga Snake														
	Pseudonaja affinis	Dugite		2	1											1
	Pseudonaja mengdeni	Gwardar														
	Simoselaps bertholdi	Jan's Banded Snake														
	Simoselaps littoralis	West Coast Banded Snake														
Gekkonidae	*Christinus marmoratus*	Marbled Gecko		1												
Pygopodidae	*Aprasia pulchella*															
	Aprasia repens			2												
	Delma fraseri									1					2	3
	Delma grayii															
	Lialis burtonis			5												2
	Pletholax gracilis	Keeled Legless Lizard														2
	Pygopus lepidopodus	Common Scaly Foot						1	2		1					
Scincidae	*Acritoscincus trilineatum*			30	2						1					
	Cryptoblepharus buchananii			36	3	9					1				2	5
	Ctenotus australis				13										1	4

TERRESTRIAL ECOSYSTEMS

		Surveys	A	B				C						D	E	
Family	**Species**	**Common Name**	**Abernethy Rd Byford**	**Site 1**	**Site 2**	**Site 3**	**Opportunistic**	**Site 1**	**Site 2**	**Site 3**	**Site 4**	**Site 6**	**Opportunistic**	**Keane Rd**	**Jandakot Airport 1**	**Jandakot Airport 2**
	Ctenotus fallens															
	Ctenotus gemmula	(Swan Coastal plain)														
	Ctenotus impar															
	Ctenotus labillardieri															
	Egernia napoleonis															
	Hemiergis initialis															
	Hemiergis quadrilineata									1	1					
	Lerista distinguenda															
	Lerista elegans			11	9					1					12	14
	Lerista lineata														1	8
	Lerista lineopunctulata															
	Menetia greyii			14	3	1			1	1	1				12	28
	Morethia lineoocellata				1											
	Morethia obscura			4												
	Tiliqua occipitalis	Western Bluetongue														
	Tiliqua rugosa			3	3				1	1				X	2	3
Typhlopidae	*Ramphotyphlops australis*			2											1	
Varanidae	*Varanus gouldii*	Bungarra or Sand Monitor			3									X		
	Varanus rosenbergi	Heath Monitor		1												
	Varanus tristis	Racehorse Monitor														
Chelidae	*Chelodina oblonga*	Oblong Turtle														

A 360 Environmental (2008) *Lot 9 Abernethy Road, Byford Spring Flora and Fauna Report*. Unpublished report for Australand Property Group, Perth.
B ATA Environmental (2006) *Vertebrate Fauna Assessment Brookdale Redevelopment Area*. Unpublished report for the Armadale Redevelopment Authority Perth.
C Env (2009) *Jandakot Airport Fauna Survey*. Unpublished report for Jandakot Airport Holdings Pty Ltd, Perth.
D Bamford Consulting Ecologists (2009) *Keane Road Strategic Link, Armadale Fauna Assessment*. Unpublished report for EnviroWorks Consulting, Perth.
E How R.A., Harvey M.S., Dell J. and Waldock J.M. (1999) *Ground Fauna of Urban Bushland Remnants in Perth*. Unpublished report to the Australian Heritage Commission; NEP Grant N93/04; Perth.
X Presence only

Appendix C(2). Fauna survey records in the vicinity of the project area

		Surveys	A	B			C							D	E
Family	**Species**	**Common Name**	**Wright Lake**	**Ken Hurst Park**	**Manjedal Brook**	**Shreeve Road Wetland**	**Brickwood Reserve 2**	**Brickwood Reserve 3**	**Cardup Reserve 1**	**Cardup Reserve 2**	**Cardup Reserve 3**	**Norman Road 1**	**Norman Road 2**		
Birds															
Accipitridae	*Elanus axillaris*	Black-shouldered Kite				X								5	
	Accipiter fasciatus	Brown Goshawk		X	X			7	3	1				10	
	Accipiter cirrocephalus	Collared Sparrowhawk			X							1	1	15	
	Circus assimilis	Spotted Harrier												5	
	Circus approximans	Swamp Harrier												5	
	Aquila audax	Wedge-tailed Eagle	X											10	
	Hieraaetus morphnoides	Little Eagle					1	1	1		5				
	Pandion haliaetus	Osprey		X											
Anatidae	*Dendrocygna arcuata*	Wandering Whistling-Duck	1												
	Biziura lobata	Musk Duck												20	
	Stictonetta naevosa	Freckled Duck												5	
	Cygnus atratus	Black Swan	11												
	Tadorna tadornoides	Australian Shelduck	29			X									
	Chenonetta jubata	Australian Wood Duck			X	X				1					
	Malacorhynchus membranaceus	Pink-eared Duck	1												
	Anas rhynchotis	Australasian Shoveler	6												
	Anas gracilis	Grey Teal	480			X								10	
	Anas superciliosa	Pacific Black Duck	192		X	X								15	
Aegothelidae	*Aegotheles cristatus*	Australian Owlet-nightjar												5	
Podargidae	*Podargus strigoides*	Tawny Frogmouth												3	
Charadriidae	*Charadrius ruficapillus*	Red-capped Plover	1												
	Elseyornis melanops	Black-fronted Dotterel	15			X									
	Vanellus tricolor	Banded Lapwing												1	
Laridae	*Chroicocephalus novaehollandiae*	Silver Gull	2												
Recurvirostridae	*Himantopus himantopus*	Black-winged Stilt				X									
	Recurvirostra novaehollandiae	Red-necked Avocet												1	
Scolopacidae	*Calidris subminuta*	Long-toed Stint												15	
	Calidris acuminata	Sharp-tailed Sandpiper												15	
Stercorariidae	*Stercorarius longicauda*	Long-tailed Jaeger												1	
Turnicidae	*Turnix varius*	Painted Button-quail												1	
Ardeidae	*Ardea alba*	Great Egret	1			X									
	Ardea pacifica	White-necked Heron			X										

		Surveys	A	B			C							D	E
Family	**Species**	**Common Name**	**Wright Lake**	**Ken Hurst Park**	**Manjedal Brook**	**Shreeve Road Wetland**	**Brickwood Reserve 2**	**Brickwood Reserve 3**	**Cardup Reserve 1**	**Cardup Reserve 2**	**Cardup Reserve 3**	**Norman Road 1**	**Norman Road 2**		
	Egretta novaehollandiae	White-faced Heron	5		X	X									
	Nycticorax caledonicus	Nankeen Night Heron												1	
Threskiornithidae	*Threskiornis molucca*	Australian White Ibis	1			X									
	Threskiornis spinicollis	Straw-necked Ibis				X									
Columbidae	*Columba livia*	Rock Dove	X	X	X		1				1				
	Streptopelia senegalensis	Laughing Dove	X	X	X			1						4	
	Streptopelia chinensis	Spotted Dove	X	X											
	Phaps chalcoptera	Common Bronzewing	X	X	X	X				1					
	Ocyphaps lophotes	Crested Pigeon	X												
Alcedinidae	*Dacelo novaeguineae*	Laughing Kookaburra	X		X	X	2	2	13	1	2	2			
	Todiramphus sanctus	Sacred Kingfisher			X		5	4	12	3	2	5	1	1	
Meropidae	*Merops ornatus*	Rainbow Bee-eater		X	X				3	1	1	1	1	10	
Cuculidae	*Chalcites basalis*	Horsfield's Bronze-Cuckoo			X										
	Chalcites lucidus	Shining Bronze-Cuckoo			X						2				
	Cacomantis pallidus	Pallid Cuckoo					1				1			5	
	Cacomantis flabelliformis	Fan-tailed Cuckoo												5	
Caprimulgidae	*Eurostopodus argus*	Spotted Nightjar												5	
Falconidae	*Falco cenchroides*	Nankeen Kestrel	X											5	
	Falco longipennis	Australian Hobby		X					1					5	
	Falco subniger	Black Falcon												5	
Phasianidae	*Coturnix ypsilophora*	Brown Quail												5	
Rallidae	*Porphyrio porphyrio*	Purple Swamphen	2			X									
	Gallirallus philippensis	Buff-banded Rail												5	
	Porzana pusilla	Baillon's Crake												1	
	Porzana fluminea	Australian Spotted Crake				X									
	Porzana tabuensis	Spotless Crake												1	
	Gallinula tenebrosa	Dusky Moorhen				X								5	
	Fulica atra	Eurasian Coot	48			X									
Acanthizidae	*Sericornis frontalis*	White-browed Scrubwren			X	X								1	
	Smicrornis brevirostris	Weebill			X						1	X	9	3	
	Gerygone fusca	Western Gerygone		X	X	X	23	6	44	15	36	26	34	20	
	Acanthiza chrysorrhoa	Yellow-rumped Thornbill	X		X	X			3	1	3	5	5	15	
	Acanthiza inornata	Western Thornbill			X							X		35	
	Acanthiza apicalis	Inland Thornbill	X		X	X								25	
Acrocephalidae	*Acrocephalus australis*	Australian Reed-Warbler				X								25	

TERRESTRIAL ECOSYSTEMS

		Surveys	A	B			C							D	E
Family	**Species**	**Common Name**	**Wright Lake**	**Ken Hurst Park**	**Manjedal Brook**	**Shreeve Road Wetland**	**Brickwood Reserve 2**	**Brickwood Reserve 3**	**Cardup Reserve 1**	**Cardup Reserve 2**	**Cardup Reserve 3**	**Norman Road 1**	**Norman Road 2**		
Artamidae	*Artamus cinereus*	Black-faced Woodswallow	X			X	2							10	
	Artamus cyanopterus	Dusky Woodswallow			X		1		2	2	17				
	Cracticus torquatus	Grey Butcherbird	X	X	X				1	1	X	1			
	Cracticus tibicen	Australian Magpie	X	X	X	X	2	1	5	2	6	4	2	50	
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-Shrike	X	X	X	X	8	7	3	3	6	3	2	5	
	Lalage sueurii	White-winged Triller			X						1				
Climacteridae	*Climacteris rufa*	Rufous Treecreeper												5	
Corvidae	*Corvus coronoides*	Australian Raven	X	X	X	X	6	7	16	6	6	7	11	35	
	Corvus splendens	House Crow												5	
Estrildidae	*Stagonopleura oculata*	Red-eared Firetail												1	
Hirundinidae	*Hirundo neoxena*	Welcome Swallow		X	X	X									
	Petrochelidon nigricans	Tree Martin			X	X	12	21	12	35	1				
	Petrochelidon ariel	Fairy Martin												5	
Maluridae	*Malurus splendens*	Splendid Fairy-wren	X	X	X	X			16	8	22	1		15	
	Malurus elegans	Red-winged Fairy-wren												35	
Meliphagidae	*Acanthorhynchus superciliosus*	Western Spinebill		X			1	3	2	17	13	9	21	40	
	Lichenostomus virescens	Singing Honeyeater		X	X	X									
	Lichenostomus ornatus	Yellow-plumed Honeyeater			X										
	Manorina flavigula	Yellow-throated Miner												15	
	Anthochaera lunulata	Western Wattlebird												10	
	Anthochaera chrysoptera	Little Wattlebird		X											
	Anthochaera carunculata	Red Wattlebird	X	X	X	X	1		11	7	1	1		20	
	Epthianura albifrons	White-fronted Chat						1						5	
	Glyciphila melanops	Tawny-crowned Honeyeater												1	
	Lichmera indistincta	Brown Honeyeater	X	X	X	X	32	26	30	37	34	35	21		
	Phylidonyris novaehollandiae	New Holland Honeyeater		X	X	X								8	
	Phylidonyris niger	White-cheeked Honeyeater		X	X									2	
	Melithreptus brevirostris	Brown-headed Honeyeater												5	
	Melithreptus lunatus	White-naped Honeyeater			X									15	
Monarchidae	*Grallina cyanoleuca*	Magpie-Lark	X	X	X	X		1						5	
Motacilidae	*Anthus novaeseelandiae*	Australasian Pipit	X											5	
Nectariniidae	*Dicaeum hirundinaceum*	Mistletoebird			X		1	1	2		1				
Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella		X	X		2	14			7				
Pachycephalidae	*Pachycephala pectoralis*	Golden Whistler			X										
	Pachycephala rufiventris	Rufous Whistler		X	X	X	22	19	36	27	31	18	20	4	

TERRESTRIAL ECOSYSTEMS

		Surveys	A	B			C							D	E
Family	**Species**	**Common Name**	**Wright Lake**	**Ken Hurst Park**	**Manjedal Brook**	**Shreeve Road Wetland**	**Brickwood Reserve 2**	**Brickwood Reserve 3**	**Cardup Reserve 1**	**Cardup Reserve 2**	**Cardup Reserve 3**	**Norman Road 1**	**Norman Road 2**		
	Colluricincla harmonica	Grey Shrike-thrush		X					3		7			5	
Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote			X									4	
	Pardalotus striatus	Striated Pardalote		X	X	X	4	16	35	28	20	10	4	3	
Petroicidae	*Petroica multicolor*	Pacific Robin		X	X									7	
	Petroica boodang	Scarlet Robin										2			
	Petroica goodenovii	Red-capped Robin			X										
	Eopsaltria georgiana	White-breasted Robin												10	
Rhipiduridae	*Rhipidura fuliginosa*	New Zealand Fantail												1	
	Rhipidura albiscapa	Grey Fantail	X	X	X	X		8	10	1	17				
	Rhipidura leucophrys	Willie Wagtail	X	X	X	X	2							1	
Timaliidae	*Zosterops lateralis*	Silvereye		X	X	X	4	2	4	3	9	3	2	8	
Anhingidae	*Anhinga melanogaster*	Australasian Darter												5	
Phalacrocoracidae	*Microcarbo melanoleucos*	Little Pied Cormorant	8			X									
	Phalacrocorax sulcirostris	Little Black Cormorant				X									
Podicipedidae	*Tachybaptus novaehollandiae*	Australasian Grebe	8			X								1	
	Poliocephalus poliocephalus	Hoary-headed Grebe	6												
	Podiceps cristatus	Great Crested Grebe												2	
	Pachyptila desolata	Antarctic Prion												2	
	Lugensa brevirostris	Kerguelen Petrel												2	
	Pterodroma lessonii	White-headed Petrel												2	
Cacatuidae	*Calyptorhynchus banksii naso*	Red-tailed Black-Cockatoo			X				1		2				
	Calyptorhynchus latirostris	Carnaby's Black-Cockatoo		X	X										
	Calyptorhynchus baudinii	Baudin's Black-Cockatoo					1					1			
	Eolophus roseicapillus	Galah	X	X	X	X	1				2				
	Cacatua sanguinea	Little Corella			X										
Psittacidae	*Trichoglossus haematodus*	Rainbow Lorikeet	X	X											
	Glossopsitta porphyrocephala	Purple-crowned Lorikeet												5	
	Polytelis anthopeplus	Regent Parrot			X										
	Platycercus icterotis	Western Rosella						1	31					1	
	Barnardius zonarius	Australian Ringneck	X	X	X	X	2	5	9	3	9	1		2	
	Purpureicephalus spurius	Red-capped Parrot		X	X	X	3	1	32	10	22	5	2	6	
	Melopsittacus undulatus	Budgerigar												55	
	Neophema elegans	Elegant Parrot					1		2	1	2				
Strigidae	*Ninox novaeseelandiae*	Southern Boobook												4	
Tytonidae	*Tyto alba*	Barn Owl												3	

TERRESTRIAL ECOSYSTEMS

		Surveys	A	B			C							D	E
Family	**Species**	**Common Name**	**Wright Lake**	**Ken Hurst Park**	**Manjedal Brook**	**Shreeve Road Wetland**	**Brickwood Reserve 2**	**Brickwood Reserve 3**	**Cardup Reserve 1**	**Cardup Reserve 2**	**Cardup Reserve 3**	**Norman Road 1**	**Norman Road 2**		
Mammals															
Suidae	*Vulpes vulpes*	Red Fox	X						X	X	X			2	1
Felidae	*Felis catus*	House Cat	X											10	
Molossidae	*Austronomus australis*	White-striped Freetail Bat	X												
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat	X											5	1
	Falsistrellus mackenziei	Western Falsistrelle													1
	Nyctophilus geoffroyi	Lesser Longeared Bat	X											1	1
	Nyctophilus major	Western Longeared Bat	X												
Dasyuridae	*Antechinus flavipes*	Yellow-footed Antechinus										1		20	2
	Dasyurus geoffroii	Western Quoll													6
	Phascogale tapoatafa	Brush-tailed Phascogale												10	10
	Sminthopsis gilberti	Gilbert's Dunnart												1	1
Myrmecobiidae	*Myrmecobius fasciatus*	Numbat													2
Burramyidae	*Cercartetus concinnus*	Southwestern Pygmy Possum										1		5	
Macropodidae	*Macropus fuliginosus*	Western Grey Kangaroo					X	X				X	X		
	Macropus irma	Western Brush Wallaby													2
	Setonix brachyurus	Quokka													7
Petauridae	*Petaurus breviceps*	Sugar Glider												1	
Phalangeridae	*Trichosurus vulpecula*	Common Brushtail Possum												15	13
Potoroidae	*Bettongia lesueur*	Burrowing Bettong												5	
Tarsipedidae	*Tarsipes rostratus*	Honey Possum												11	11
Leporidae	*Oryctolagus cuniculus*	European Rabbit	X				X	X	X	X	X	X	X	2	2
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna												1	1
Peramelidae	*Isoodon obesulus*	Southern Brown Bandicoot	X				X	X	X						31
Muridae	*Hydromys chrysogaster*	Water Rat													1
	Mus musculus	House Mouse					15	7	9	20	7	21	35	20	5
	Rattus fuscipes	Bush Rat													
	Rattus rattus	Black Rat												9	8
Amphibians															
Hylidae	*Litoria adelaidensis*	Slender Tree Frog												5	1
	Litoria moorei	Motorbike Frog												40	6
Limnodynastidae	*Heleioporus eyrei*	Moaning Frog					78	34	6	11	1	8	3	425	87
	Heleioporus psammophilus	Sand Frog												10	3
	Limnodynastes dorsalis	Western Banjo Frog										4	7	15	4
	Neobatrachus pelobatoides	Humming Frog												5	1

TERRESTRIAL ECOSYSTEMS

		Surveys	A	B			C							D	E
Family	**Species**	**Common Name**	**Wright Lake**	**Ken Hurst Park**	**Manjedal Brook**	**Shreeve Road Wetland**	**Brickwood Reserve 2**	**Brickwood Reserve 3**	**Cardup Reserve 1**	**Cardup Reserve 2**	**Cardup Reserve 3**	**Norman Road 1**	**Norman Road 2**		
Myobatrachidae	*Crinia georgiana*	Quacking Frog					5	8	2			2	X	265	54
	Crinia glauerti	Clicking Frog						2	1					75	19
	Crinia insignifera	Squelching Froglet					24	4	22	30	9	2	3	440	90
	Crinia pseudinsignifera	Bleating Froglet												20	4
	Geocrinia leai	Ticking Frog												15	3
	Myobatrachus gouldii	Turtle Frog												15	3
	Pseudophryne guentheri	Crawling Toadlet					2							6	6
Reptiles															
Agamidae	*Ctenophorus ornatus*	Ornate Crevice Dragon												10	2
	Pogona minor	Bearded Dragon					10		1	4	3	5	10	7	9
Boidae	*Morelia spilota imbricata*	Carpet Python													4
Carphodactylidae	*Underwoodisaurus milii*	Barking Gecko												5	3
Diplodactylidae	*Diplodactylus granariensis*													5	1
	Diplodactylus polyophthalmus													35	8
Elapidae	*Acanthophis antarcticus*	Southern Death Adder													7
	Brachyurophis semifasciata													25	5
	Demansia psammophis													5	1
	Echiopsis curta	Bardick						1					X	5	1
	Elapognathus coronatus	Crowned Snake												15	3
	Neelaps bimaculatus	Black-naped Snake												15	3
	Notechis scutatus	Tiger Snake												27	28
	Parasuta gouldii						1				3			11	11
	Pseudonaja affinis	Dugite						1					X	55	57
	Pseudonaja mengdeni	Gwardar												2	2
	Simoselaps bertholdi	Jan's Banded Snake												1	1
Gekkonidae	*Christinus marmoratus*	Marbled Gecko												15	3
Pygopodidae	*Aprasia pulchella*													10	2
	Aprasia repens						2	4	1	3	5	10	4	45	9
	Delma fraseri													45	9
	Delma grayii													15	3
	Lialis burtonis								1					85	18
	Pygopus lepidopodus	Common Scaly Foot												3	3
Scincidae	*Acritoscincus trilineatum*						4	4	2	4	2			85	14
	Cryptoblepharus buchananii						4	2	2	2	1	1	5	65	14
	Ctenotus australis													40	7

TERRESTRIAL ECOSYSTEMS

		Surveys	A	B			C							D	E
Family	**Species**	**Common Name**	**Wright Lake**	**Ken Hurst Park**	**Manjedal Brook**	**Shreeve Road Wetland**	**Brickwood Reserve 2**	**Brickwood Reserve 3**	**Cardup Reserve 1**	**Cardup Reserve 2**	**Cardup Reserve 3**	**Norman Road 1**	**Norman Road 2**		
	Ctenotus delli														1
	Ctenotus fallens								1			4	4	15	3
	Ctenotus impar						5	X	1	5	1	1		135	28
	Ctenotus labillardieri													30	6
	Egernia kingii	King's Skink												15	3
	Egernia napoleonis													5	1
	Hemiergis initialis													35	7
	Hemiergis quadrilineata													5	1
	Lerista distinguenda													25	5
	Lerista elegans						1	13	10	7	17	9	6	150	31
	Lerista lineata														2
	Menetia greyii						2		23	11	5	2	9	115	23
	Morethia lineoocellata													5	1
	Morethia obscura						8	5		1	10	6	16	30	7
	Tiliqua occipitalis	Western Bluetongue												2	2
	Tiliqua rugosa						3	2	7	2		X	2	3	1
Typhlopidae	*Ramphotyphlops australis*						6	1	4	1	3	1	2	14	14
	Ramphotyphlops bituberculatus													1	1
	Ramphotyphlops pinguis													1	1
	Ramphotyphlops waitii													3	3
Varanidae	*Varanus gouldii*	Bungarra or Sand Monitor							1	2	1	1		2	2
	Varanus rosenbergi	Heath Monitor												1	1
	Varanus tristis	Racehorse Monitor					X	4						2	2
Chelidae	*Chelodina oblonga*	Oblong Turtle												5	1

A Bamford Consulting Ecologists (2003) *Champion Lakes Master Plan; Fauna*. Unpublished report for Bowman Bishaw Gorham, Perth.

B Gole C.A. (2003) *Bird Survey in selected Perth Metropolitan Reserve*s. A Joint Biodiversity Conservation Project between Birds Australia WA and Perth Biodiversity Project. Unpublished report Birds Australia and Perth.

C Harvey M.S., Dell J., How R.A. and Waldock J.M. (1997) *Ground Fauna of Bushland Remnants on the Ridge Hill Shelf and Pinjarra Plain Landforms Perth*. Unpublished report for the Australian Heritage Commission NEP Grant.

D NatureMap records

E Western Australian Museum records

X Presence only

Appendix D
Definitions of Significant Fauna under the WA *Wildlife Conservation Act 1950*

Level 1 Vertebrate Fauna Assessment – Southern Site Precinct G

TERRESTRIAL ECOSYSTEMS

APPENDIX D
DEFINITIONS OF SIGNIFICANT FAUNA UNDER THE WESTERN AUSTRALIAN *WILDLIFE CONSERVATION ACT 1950*

In Western Australia, all native fauna species are protected under the Western Australian *Wildlife Conservation Act 1950-1979*. Fauna species that are considered rare, threatened with extinction or have a high conservation value are specially protected under the Act. In addition, some species of fauna are covered under the 1991 ANZECC convention, while certain birds are listed under the Japan and Australian Migratory Bird Agreement (JAMBA) and the China and Australian Migratory Bird Agreement (CAMBA).

Classification of rare and endangered fauna under the *Wildlife Conservation (Specially Protected Fauna) Notice 2010* recognises four schedules of taxa. These are:

Schedule 1 – fauna which are rare or likely to become extinct and are declared to be fauna in need of special protection;

Schedule 2 – fauna which are presumed to be extinct and are declared to be fauna in need of special protection;

Schedule 3 – birds which are subject to an agreement between the governments of Australia and Japan relating to the protection of migratory birds and birds in danger of extinction which are declared to be fauna in need of special protection; and

Schedule 4 – fauna that are in need of special protection, for reasons other than mentioned in Schedules 1, 2 or 3.

In addition to the above classifications, DEC also classifies fauna under five different Priority codes:

Priority one – ***Taxa with few, poorly known populations on threatened lands*.** Taxa which are known from few specimens or sight records from one or a few localities on lands not managed for conservation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

Priority two – *Taxa with few, poorly known populations on conservation lands, or taxa with several, poorly known populations not on conservation lands.* Taxa which are known from few specimens or sight records from one or a few localities on lands not under immediate threat from habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

Priority three – *Taxa with several, poorly known populations, some on conservation lands*. Taxa which are known from few specimens or sight records from several localities, some of which are on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

Priority four – *Taxa in need of monitoring*. Taxa which are considered to have been adequately surveyed or for which sufficient knowledge is available and which are not considered currently threatened or in need of special protection, but could if present circumstances change. These taxa are usually represented on conservation lands. Taxa which are declining significantly but are not yet threatened.

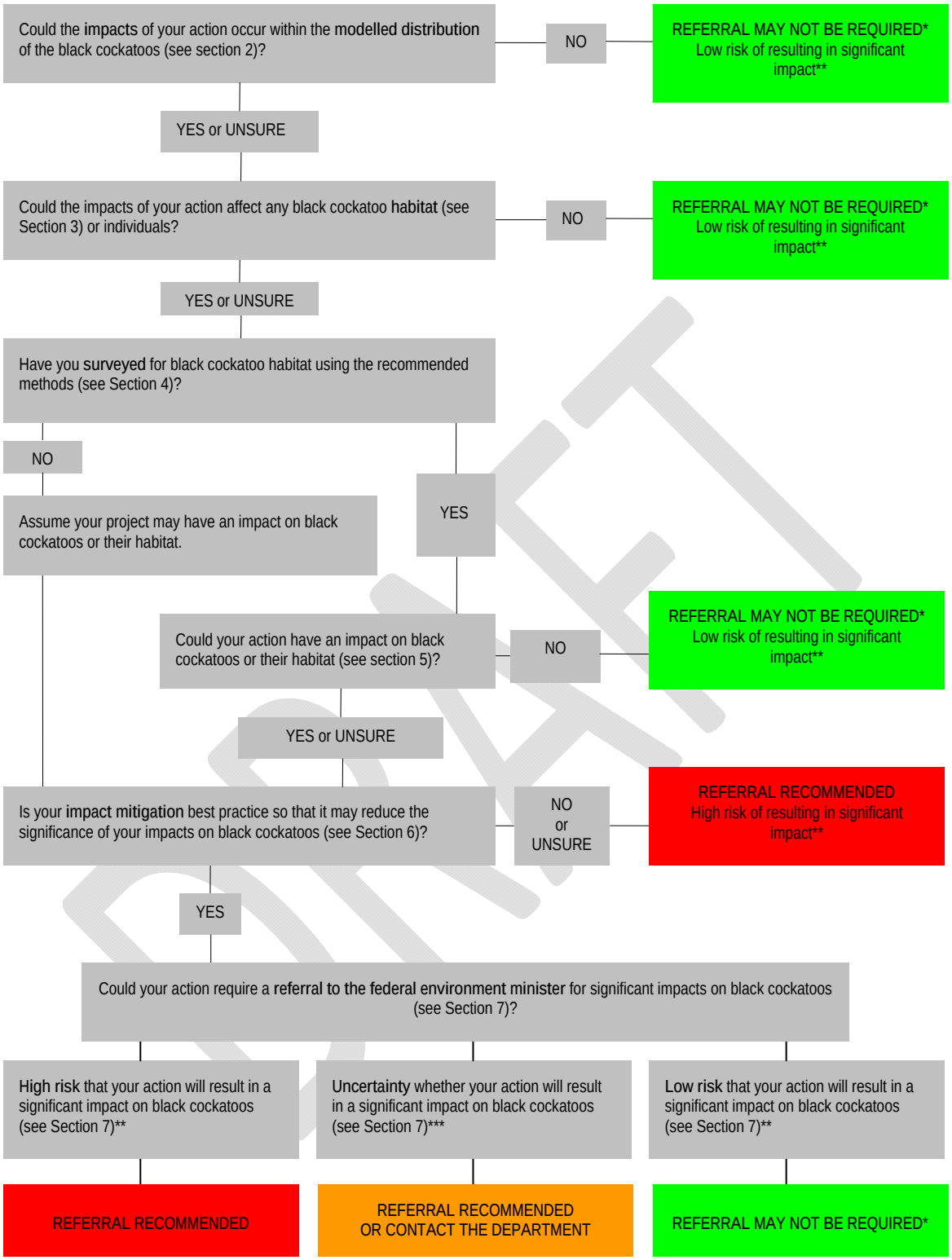
Priority five – *Taxa in need of monitoring.* Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

Appendix E
Referral Decision Tree for Black Cockatoos (Department of Sustainability Environment Water Population and Communities 2011)

Level 1 Vertebrate Fauna Assessment – Southern Site Precinct G

TERRESTRIAL ECOSYSTEMS

Figure 1: Decision making



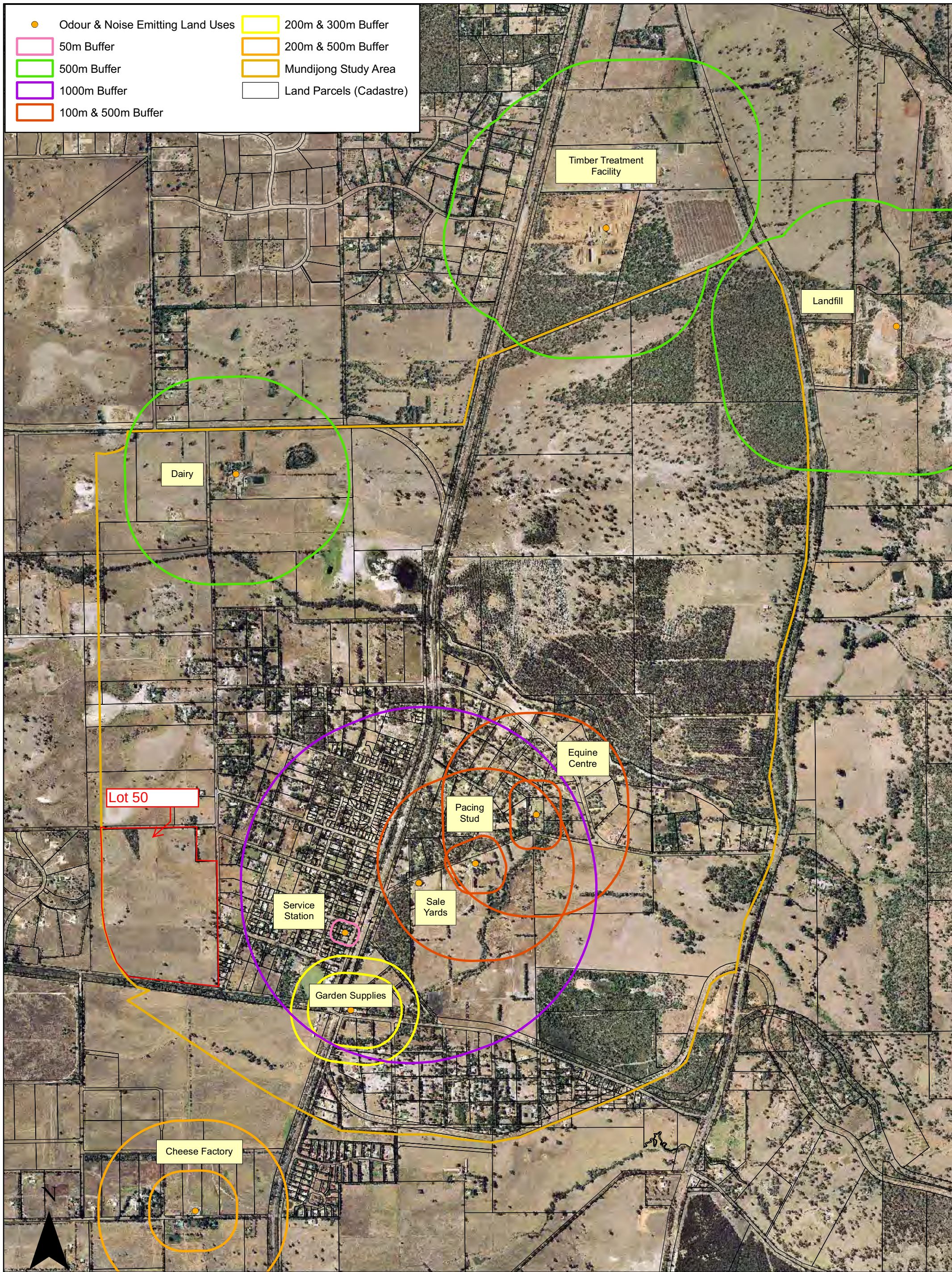
* Although it would appear a referral may not be required, you may still refer your proposed action if unsure, or if you think the proposal would not have significant impacts on matters of national environmental significance, but would like legal certainty. An example may be when other matters of national environmental significance, in addition to black cockatoos, are potentially affected.

** Risk is the chance of something happening that will have a [significant] impact on objectives [for example, protecting matters of national environmental significance] (adapted from Australian / New Zealand Risk Management Standard 4360: 2004).

*** If you are uncertain about the need to refer then you may also contact the federal environment department to discuss your action by emailing epbc.referrals@environment.gov.au

APPENDIX 3

DSP Odour and Noise Sources



JOB TITLE	Environmental Study - Mundijong/Whitby District Structure Plan				
FIGURE TITLE	Noise & Odour Emitting Land Uses	REFERENCE	Shire of Serpentine Jarrahdale	AUTHOR	J Levett
FIGURE No.	Figure 22	SCALE	1 : 20 000		
DATE	19/06/2008	PROJECT No.	3006110	0 125 250 500 750 1,000 Meters	

SMEC

APPENDIX 4

Landscape Master Plan

September 2012

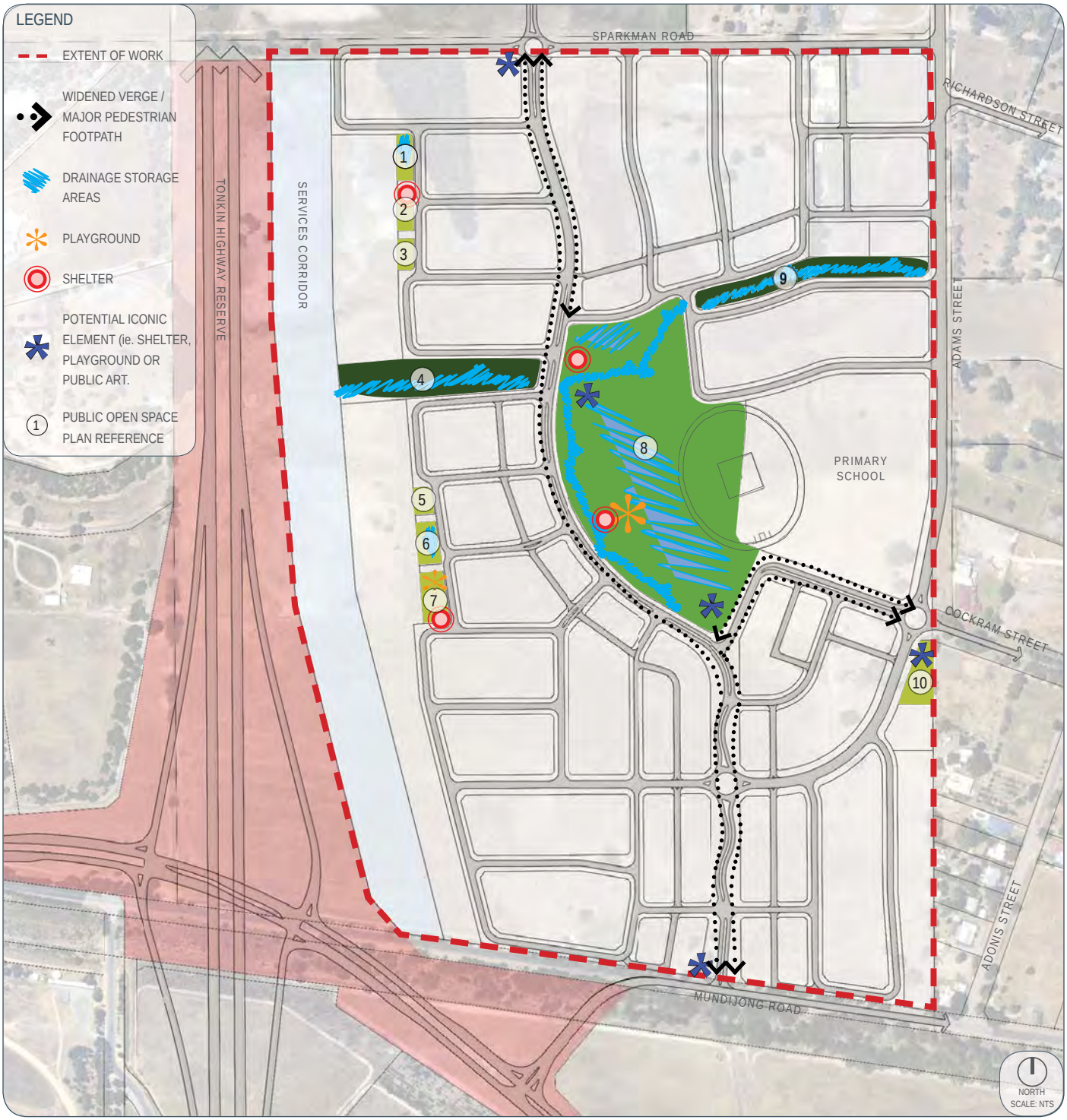
Lot 50 Cockram St, Mundijong

Local Structure Plan - Landscape Strategy

emerge ASSOCIATES

Integrated Science & Design

LANDSCAPE STRATEGY PLAN



PUBLIC OPEN SPACE SUMMARY

LOCAL PARK (POS 1, 2, 3, 5, 6, 7 & 10)

- Predominantly native planted areas with pockets of turf.
- Retention of existing significant trees where possible.
- Small gathering nodes and basic picnic facilities with shade structures.
- Path network which links into the greater development.
- Primary focus on passive recreation.
- Fully irrigated.

LINEAR POS / DRAINAGE SWALE (POS 4 & 9)

- Predominantly native planted areas with pockets of turf.
- Retention of existing significant trees where possible.
- Drainage retention and conveyance through a vegetated and stabilised swale.
- Pedestrian bridge crossings over landscaped drainage swales.
- Informal active recreation uses on open grassed areas.
- Small gathering nodes with picnic / BBQ facilities.
- Path network which links into the greater development.
- Manicured landscape areas fully irrigated.

NEIGHBOURHOOD PARK (POS 8)

- Centrally located and easily accessible to the greater community.
- Predominantly native planted areas with pockets of turf.
- Retention of existing significant trees where possible.
- Drainage retention and conveyance through vegetated and stabilised swales.
- Formal active recreation uses through shared oval with School site.
- Informal active recreation used on open grassed areas.
- Playground with informal seating.
- Large gathering nodes with picnic / BBQ facilities and shade structures.
- Path network which links into the greater development.
- Manicured landscape areas fully irrigated.

THIS DRAWING IS INDICATIVE ONLY AND MAY NOT REPRESENT THE FINAL SCOPE OF LANDSCAPE WORKS

LANDSCAPE MASTER PLAN

CONSIDERED

HOMELY

COMFORTABLE

INTERACTIVE

TEXTURAL

CONNECTED

LOT 50 COCKRAM ST, MUNDIJONG - STRUCTURE PLAN

LANDSCAPE JOB NUMBER : MG01 : SEPTEMBER 2012 : REV A

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THIS DRAWING IS INDICATIVE ONLY AND MAY NOT REPRESENT THE FINAL SCOPE OF LANDSCAPE WORKS

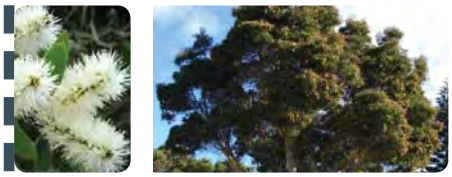
STREET TREE MASTER PLAN

Liquidambar styraciflua - Red Gum

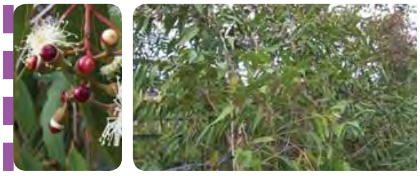
Eucalyptus sideroxylon - Red Ironbark

Eucalyptus nicholii - Narrow Leaved Paperbark

Agonis flexuosa - WA Peppermint



Melaluca quinquinervia - Paperbark



Corymbia maculata - Spotted Gum

LOT 50 COCKRAM ST, MUNDIJONG - STRUCTURE PLAN

LANDSCAPE JOB NUMBER : MG01 : SEPTEMBER 2012 : REV A

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THIS DRAWING IS INDICATIVE ONLY AND MAY NOT REPRESENT THE FINAL SCOPE OF LANDSCAPE WORKS

POS TREE PLANTING PALETTE

Agonis flexuosa

Liquidambar styraciflua

Kingia Australis

Corymbia maculata

Casuarina cunninghamiana

Corymbia calophylla

Corymbia ficifolia

Eucalyptus nicholii

Eucalyptus rudis

Eucalyptus wandoo

Eucalyptus sideroxylon

Eucalyptus camaldulensis

Eucalyptus marginata

Melaleuca quinquernervia

Xanthorrrhoea preissii

LOT 50 COCKRAM ST, MUNDIJONG - STRUCTURE PLAN

LANDSCAPE JOB NUMBER : MG01 : SEPTEMBER 2012 : REV A

emerge ASSOCIATES Integrated Science & Design

THIS DRAWING IS INDICATIVE ONLY AND MAY NOT REPRESENT THE FINAL SCOPE OF LANDSCAPE WORKS

POS 8 CONCEPT

POS TYPOLOGY

- Neighbourhood Park.

SIZE

- 43,910m2 + 3,390m2 verge.

CONCEPT

- Provide an active recreation POS with a large flat grassed oval for formal recreation in a shared arrangement with the proposed school site (primary school sized oval).
- Drainage retention and conveyance through vegetated and stabilised swales.
- Grassed amphitheatre for viewing sporting activities.
- Possible small community building (by others) to provide public facilities such as a toilets / changerooms / meeting rooms in conjunction with oval uses.
- Large gathering nodes with picnic / BBQ facilities and shade structures.
- Large adventure playground with informal seating opportunities co-located with picnic / BBQ facilities.
- Path network to disability codes which links into the greater development.

FUNCTIONS / MATERIALS

- Provide for stormwater retention and conveyance through vegetated and rock stabilised swales and streams.
- Provide for formal active recreation uses on a large grassed area in a shared arrangement with the proposed school.
- Provide for a large adventure playground with informal seating.

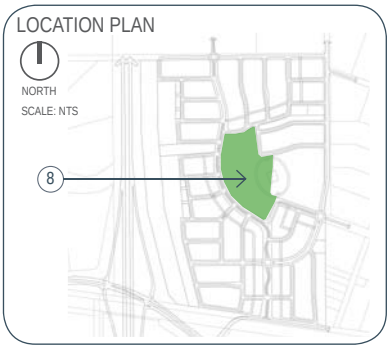
ENVIRONMENTAL CONSIDERATIONS

- Retention and polish of stormwater runoff
- Waterwise Plant Strategy.
- Hydrozoning of plant species.
- Controlled fertiliser application to landscape areas.
- Retain existing trees (where possible).

DRAINAGE CONSIDERATIONS

Swale A	1:1yr Storm Volume = 810m2
	1:5yr Storm Volume = 2,400m2
	1:100yr Storm Volume = 3,900m2
Swale B	1:1yr Storm Volume = 3,680m2
	1:5yr Storm Volume = 11,900m2
	1:100yr Storm Volume = 14,500m2
Drain A	1:5yr Flood Width = 9m
	1:100yr Flood Width = 10m
Drain B	1:5yr Flood Width = 7m
	1:100yr Flood Width = 10m

LOCATION PLAN



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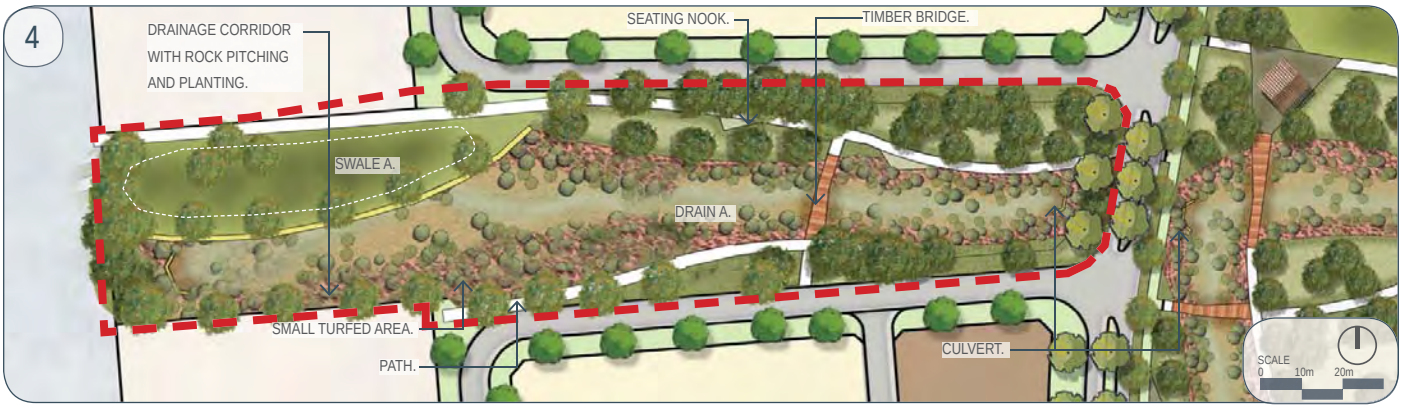
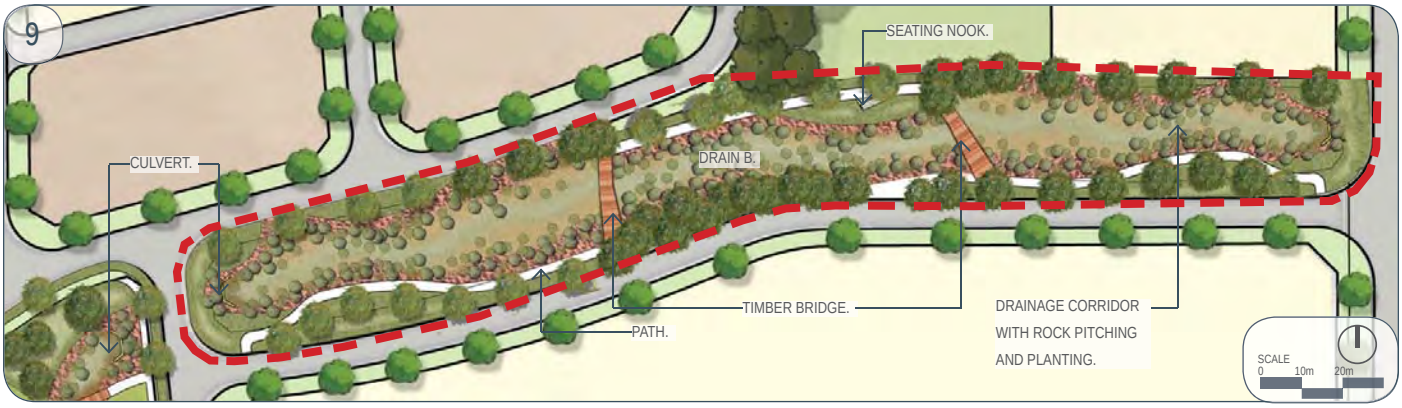
POS 4 & 9 CONCEPT





POS TYPOLOGY

- Linear POS / Drainage Swale

SIZE

- **POS 4** - 7,154m2 + 1,210m2 verge.
- **POS 9** - 4,663m2 + 1,761m2 verge.

CONCEPT

- Provide a POS which caters for drainage retention and conveyance through a vegetated and stabilised swale.
- Path network to disability codes which links into the greater development.
- Shaded seating nooks along path network.

FUNCTIONS / MATERIALS

- Provide for stormwater retention and conveyance through vegetated and rock stabilised swales and streams.
- Provide for informal recreation uses with small gathering nodes with picnic / BBQ facilities.

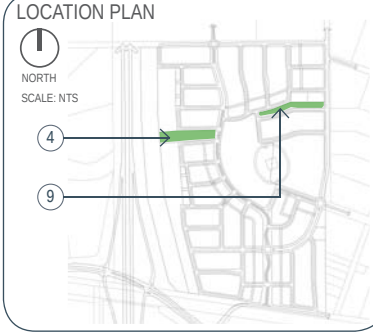
ENVIRONMENTAL CONSIDERATIONS

- Retention and polish of stormwater runoff
- Waterwise Plant Strategy.
- Hydrozoning of plant species.
- Controlled fertiliser application to landscape areas.
- Retain existing trees (where possible).

DRAINAGE CONSIDERATIONS

Swale A	1:1yr Storm Volume = 410m2
	1:5yr Storm Volume = 1,200m2
	1:100yr Storm Volume = 2,600m2
Drain A	1:5yr Flood Width = 12m
	1:100yr Flood Width = 15m
Drain B	1:5yr Flood Width = 8m
	1:100yr Flood Width = 11m

LOCATION PLAN



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POS 1-3 & 5-7 CONCEPT

POS TYPOLOGY

- Local Parks

SIZE

- **POS 1** - 734m2
- **POS 2** - 672m2
- **POS 3** - 490m2
- **POS 5** - 486m2
- **POS 6** - 887m2
- **POS 7** - 1,265m2

CONCEPT

- Provide a series of POS' primarily focussed on passive receration with pockets of turf and feature nodes. on key axis'.
- Feature shelters with picnic and BBQ facilities.
- Provide seating nooks along path network.
- Predominantly native planted garden beds.
- Small playground with informal seating.

FUNCTIONS / MATERIALS

- Provide for stormwater retention in turf and vegetated swales.
- Provide for informal recreation uses with small gathering nodes with picnic / BBQ facilities.

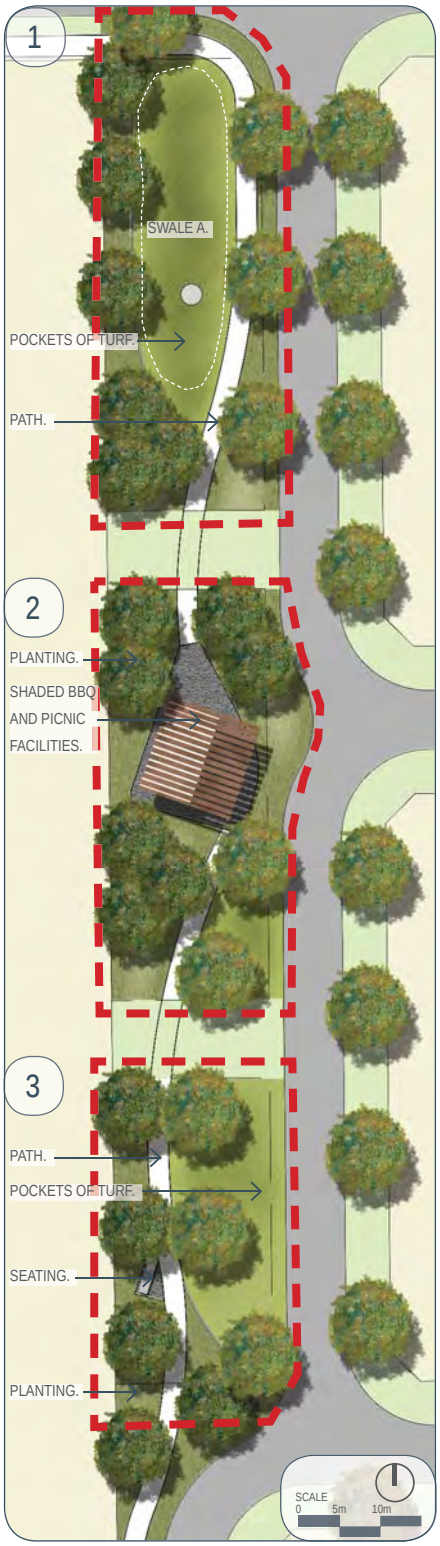
ENVIRONMENTAL CONSIDERATIONS

- Waterwise Plant Strategy.
- Hydrozoning of plant species.
- Controlled fertiliser application to landscape areas.
- Retain existing trees (where possible).

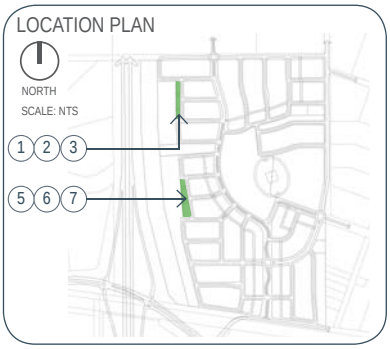
DRAINAGE CONSIDERATIONS

Swale A
1:1yr Storm Volume = 420m2
1:5yr Storm Volume = 1,000m2
1:100yr Storm Volume = 1,100m2

Swale B
1:1yr Storm Volume = 1,080m2
1:5yr Storm Volume = 2,100m2
1:100yr Storm Volume = 2,600m2



LOCATION PLAN



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POS 10 CONCEPT

POS TYPOLOGY
- Local Park

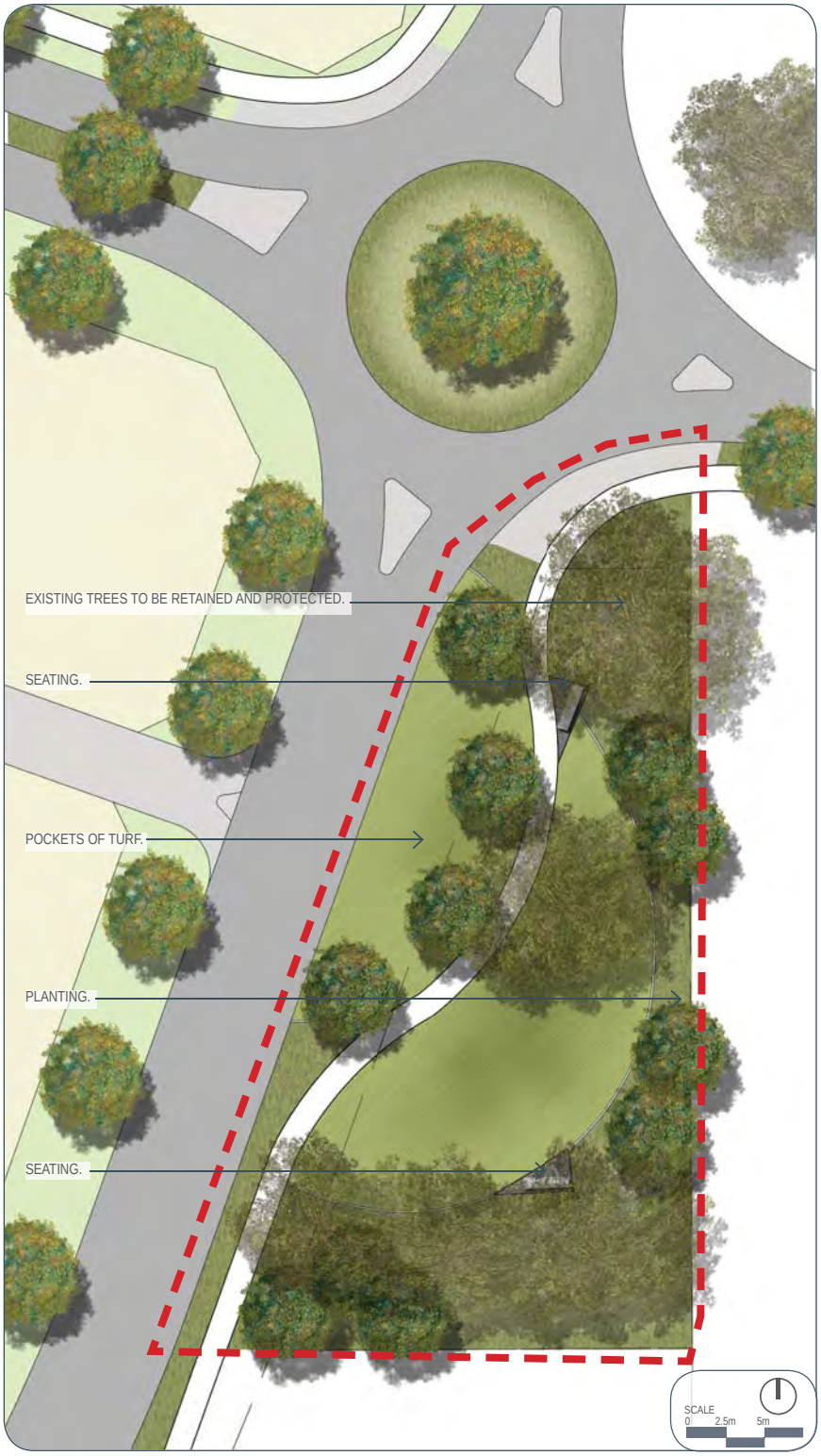
SIZE
- 1,437m2 + 623m2 verge.

CONCEPT
- Provide a POS primarily focussed on passive receration with pockets of turf and seating nooks.
- Predominantly native planted garden beds.
- Retention of existing trees.

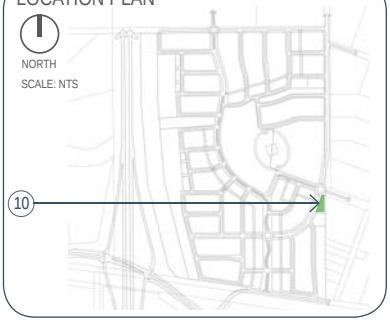
FUNCTIONS / MATERIALS
- Provide for informal recreation uses with small gathering nodes.

ENVIRONMENTAL CONSIDERATIONS
- Waterwise Plant Strategy.
- Hydrozoning of plant species.
- Controlled fertiliser application to landscape areas.
- Retain existing trees (where possible).

DRAINAGE CONSIDERATIONS
N/A



LOCATION PLAN



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