Ordinary Council Meeting

11 September 2019

Minutes



Members of the public who attend Council meetings should not act immediately on anything they hear at the meetings, without first seeking clarification of Council's position. Persons are advised to wait for written advice from the Council prior to taking action on any matter that they may have before Council.

Agendas and Minutes are available on the City's website www.kwinana.wa.gov.au

Vision Statement

Kwinana 2030
Rich in spirit, alive with opportunities,surrounded by nature – it's all here!



Mission

Strengthen community spirit, lead exciting growth, respect the environment - create great places to live.

We will do this by –

- providing strong leadership in the community;
- promoting an innovative and integrated approach;
- being accountable and transparent in our actions;
- being efficient and effective with our resources;
- using industry leading methods and technology wherever possible;
- making informed decisions, after considering all available information; and
- providing the best possible customer service.

Values

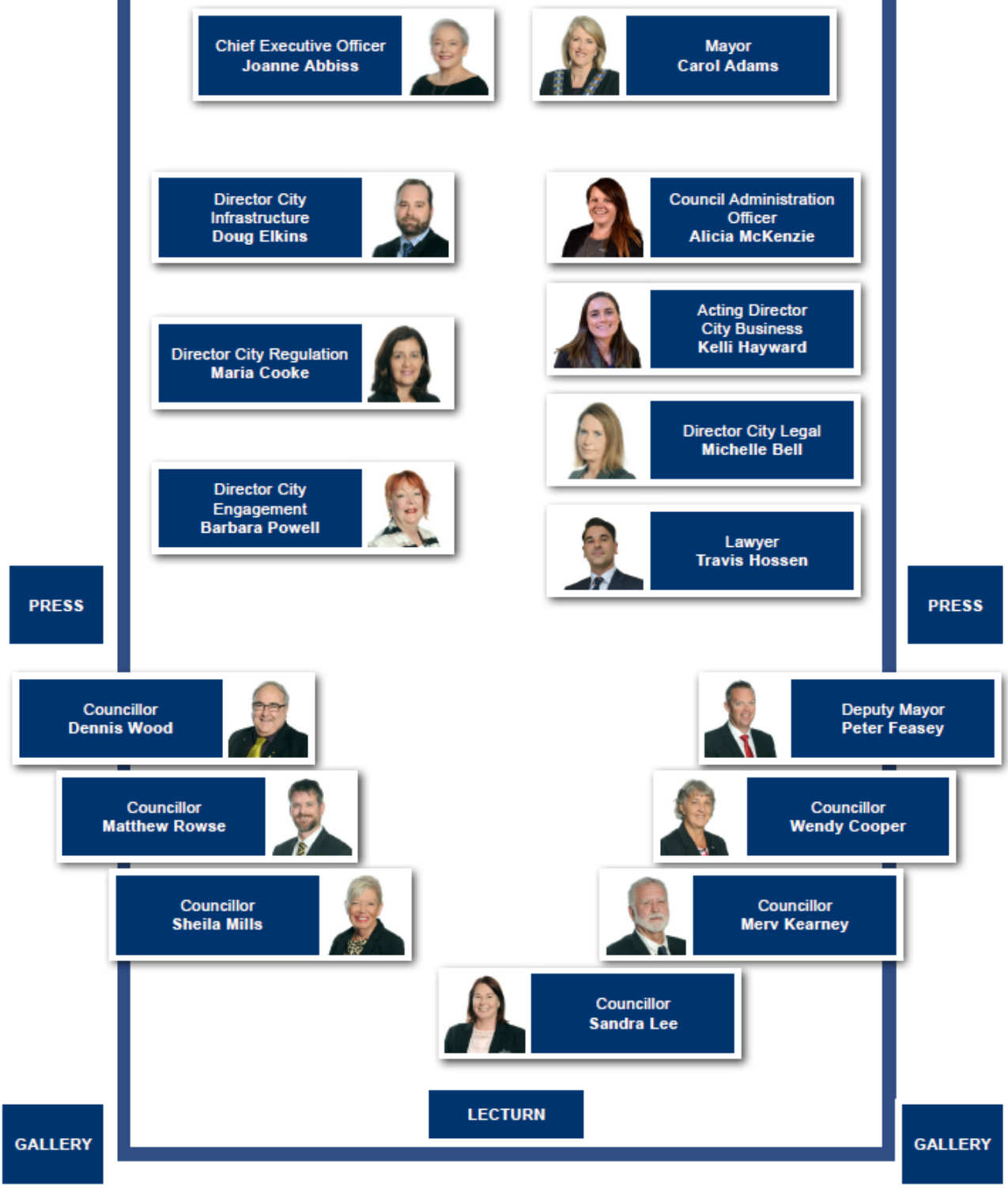
We will demonstrate and be defined by our core values, which are:

Lead from where you stand – *Leadership is within us all*. | Act with compassion – *Show that you care*. | Make it fun – *Seize the opportunity to have fun*. | Stand Strong, stand true – *Have the courage to do what is right*. | Trust and be trusted – *Value the message, value the messenger*. | Why not yes? – *Ideas can grow with a yes*.



Council Chambers

Seating Layout



EMERGENCY GUIDE

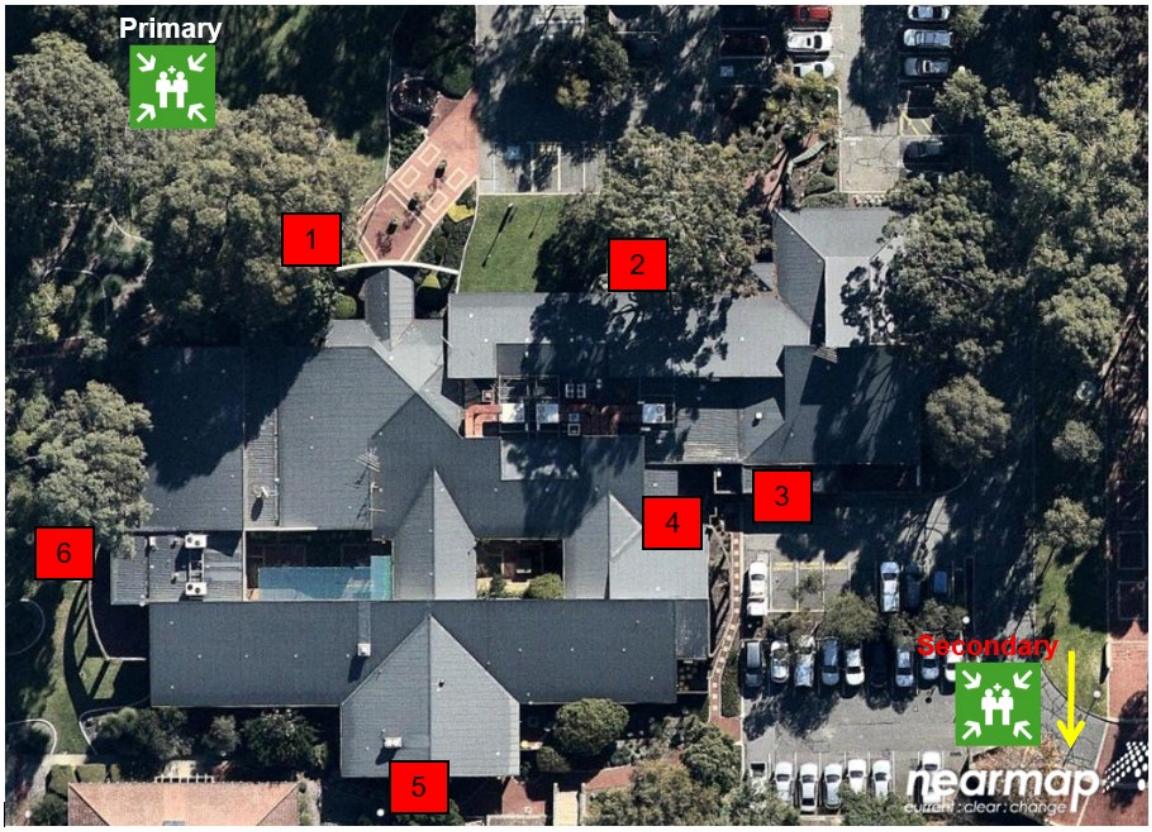
Council Chambers

The City of Kwinana values the health and safety of its employees, contractors and visitors. Please ensure you are familiar with the emergency procedures in place at the City of Kwinana to ensure your safe evacuation.

Fire Alarm

On hearing the fire alarm, if you are instructed to evacuate, all individuals must:

- remain calm;
- pay attention to the responsible officer (in charge);
- when instructed to evacuate, leave via the appropriate emergency exit as directed;
- assemble at the designated Muster Point; and
- await the arrival Emergency Services. You must not re-enter the building until the all clear has been given by Emergency Services.



Administration Centre – Access, Egress (Red) and Assembly Points (Green)

Assembly Points:

- Primary - North-west of the main entrance near Gilmore Avenue.
- Secondary - South-east of the facility on grass area near Koorliny Arts Centre.

TABLE OF CONTENTS

1 Declaration of Opening: 6
2 Prayer: 6
3 Apologies/Leave(s) of absence (previously approved) 6
4 Public Question Time: 7
5 Applications for Leave of Absence: 7
6 Declarations of Interest by Members and City Officers: 7
7 Community Submissions: 7
8 Minutes to be Confirmed: 14
8.1 Ordinary Meeting of Council held on 28 August 2019: 14
9 Referred Standing / Occasional / Management /Committee Meeting Reports: 15
10 Petitions: 15
11 Notices of Motion: 15
12 Reports - Community 15
13 Reports – Economic 15
14 Reports – Natural Environment 15
15 Reports – Built Infrastructure 16
15.1 Adoption of Amended Local Development Plan, Stage 2B Cassia Glades (Lot E26), Kwinana City Centre 16
15.2 Casuarina Central Local Structure Plan (multiple landholdings under separate ownership) – Consideration of submissions and recommendation to the Western Australian Planning Commission 23
16 Reports – Civic Leadership 71
16.1 Budget Variations 71
16.2 Review of Use of City of Kwinana Logos and Branding Policy 74
17 Urgent Business 77
18 Councillor Reports 77
19 Response to Previous Questions 77
20 Mayoral Announcements (without discussion) 78
21 Matters Behind Closed Doors 79
21.1 Acting Chief Executive Officer's selection and appointment 79
21.2 Appointment of a recruitment agency to undertake the recruitment activity for a new Chief Executive Officer 80
22 Meeting Closure 81

Present:

MAYOR CAROL ADAMS
DEPUTY MAYOR PETER FEASEY
CR W COOPER
CR M KEARNEY
CR S LEE
CR S MILLS
CR M ROWSE
CR D WOOD

MS J ABBISS	-	Chief Executive Officer
MRS M COOKE	-	Director City Regulation
MS K HAYWARD	-	Acting Director City Business
MR D ELKINS	-	Director City Infrastructure
MRS B POWELL	-	Director City Engagement
MS M BELL	-	Director City Legal
MRS S WILTSHIRE	-	Manager Human Resources
MR P NEILSON	-	Manager Planning and Development
MR T HOSSEN	-	Lawyer
MS A MCKENZIE	-	Council Administration Officer

Members of the Press	1
Members of the Public	5

1 Declaration of Opening:

Presiding Member declared the meeting open at 7:00pm and welcomed Councillors, City Officers and gallery in attendance and read the Welcome.

"IT GIVES ME GREAT PLEASURE TO WELCOME YOU ALL HERE AND BEFORE COMMENCING THE PROCEEDINGS, I WOULD LIKE TO ACKNOWLEDGE THAT WE COME TOGETHER TONIGHT ON THE TRADITIONAL LAND OF THE NOONGAR PEOPLE"

2 Prayer:

Councillor Dennis Wood read the Prayer

"OH LORD WE PRAY FOR GUIDANCE IN OUR MEETING. PLEASE GRANT US WISDOM AND TOLERANCE IN DEBATE THAT WE MAY WORK TO THE BEST INTERESTS OF OUR PEOPLE AND TO THY WILL. AMEN"

3 Apologies/Leave(s) of absence (previously approved)

Apologies

Nil

Leave(s) of Absence (previously approved):

Nil

4 Public Question Time:

Nil

5 Applications for Leave of Absence:

COUNCIL DECISION
540
MOVED CR S MILLS **SECONDED CR W COOPER**

Councillor Dennis Wood be granted a leave of absence from 12 September 2019 to 2 October 2019 inclusive.

Mayor Carol Adams be granted a leave of absence from 1 October 2019 to 5 October 2019 inclusive.

CARRIED
8/0

6 Declarations of Interest by Members and City Officers:

Deputy Mayor Peter Feasey declared an impartiality interest in item 15.1, Adoption of Amended Local Development Plan, Stage 2B Cassia Glades (Lot E26), Kwinana City Centre due to his supervisor also being the Minister for Housing and the item being a joint venture.

Deputy Mayor Peter Feasey declared an impartiality interest in item 15.2, Casuarina Central Local Structure Plan (multiple landholdings under separate ownership) – Consideration of submissions and recommendation to the Western Australian Planning Commission due to his supervisor also being the Minister for Housing and the item being a joint venture.

7 Community Submissions:

7.1 Mr Alf Lay on behalf of LWP Property Group regarding item 15.2, Casuarina Central Local Structure Plan (multiple landholdings under separate ownership) – Consideration of submissions and recommendation to the Western Australian Planning Commission:

Good evening Mayor, Chief Executive Officer and Councillors. My name is Alf Lay and I am the Group Manager, Development at LWP Property Group.

LWP has been working in partnership with the Housing Authority to undertake the planning and development of land within the Casuarina Central Precinct. The Housing Authority acquired the land from an LWP-related entity in June, 2019 with the clear intent to provide affordable housing options in the south west metropolitan area over coming years and has engaged LWP as its project manager.

7 COMMUNITY SUBMISSIONS

LWP is also the developer of Oakebella residential community in its own right, which is also located in the City of Kwinana and which has had positive development outcomes and has demonstrated LWP's strong working relationship with the City of Kwinana as well as its commitment to a collaborative approach in developing land.

For the Casuarina Precinct Structure Plan Project, LWP has procured an expert consultant team including environmental, engineering and planning professionals, to facilitate the best planning outcome on behalf of the Housing Authority.

LWP and its consultant team have all worked extensively with the City officers over the past two years to progress the Structure Plan for the Casuarina Central Precinct. Prior to lodgement of the Structure Plan with the City in December 2018, LWP undertook extensive consultation with the City to ensure a thorough understanding of the City's priorities, concerns and requirements for the Casuarina Central Precinct to appropriately inform the Structure Plan preparation and documentation. This collaborative approach with the City has continued throughout the City's assessment of the Structure Plan, and will continue to occur through the WA Planning Commission's consideration of the Structure Plan, and subsequent planning and development phases.

We are appreciative of the officer's recommendation for support of the Structure Plan, and acknowledge we will work with the City to resolve the outstanding issues through the WA Planning Commission's consideration of the Structure Plan.

Structure Plan Extent

The Housing Authority owns approximately 35% of the land within the Casuarina Central Precinct Structure Plan area. Although not formally required through the City's Local Planning Policy No. 6, LWP, through discussions with the City, has taken the responsibility to facilitate a single Structure Plan over the entire Casuarina Central Precinct to ensure orderly and proper planning is achieved for the entire locality, rather than progress the Structure Planning through a piece-meal approach. It is noted that this approach has not been committed to elsewhere in Casuarina.

This approach has meant LWP has committed to dealing with a range of constraints within the entire precinct, which it would not necessarily have to otherwise including wetlands, provision of a primary school site, provision of public open space , and retention of significant vegetation, to name a few.

The nature of preparing a Structure Plan over such an extensive area also means there are some limitations on the work which can be undertaken at this stage in the planning process. For example, LWP has not been able to access certain lots the Housing Authority does not own to undertake field assessments of flora and fauna. LWP acknowledges that additional work will be required on these lots prior to subdivision.

Department of Education Consultation

LWP appreciates the requirement to provide a Primary School near the intersection of Landgren and Orton Road, in accordance with the Jandakot District Structure Plan, the draft Eastern Residential Intensification Concept (ERIC) Plan and the City's Local Planning Policy No. 6. LWP has thoroughly considered the configuration and location of the proposed Primary School, in order to meet the Department of Education's Primary School site and design requirements. LWP has done this in consultation with the Department, and will continue to liaise with it to resolve its concerns raised in regards to the school site.

7 COMMUNITY SUBMISSIONS

LWP appreciates the City officer's support for the proposed location of the Primary School site.

Landscape Features and Tree Retention

LWP is committed to ensuring that appropriate measures are in place to incorporate, where appropriate, the retention of landscape features and significant trees in the planning for the urban development of this land. To this end, LWP has had particular regard to the City's Local Planning Policy (LPP 1) and has worked closely with the City's officers to design public open space areas to maximise tree retention.

In particular, the central Public Open Space was reconfigured and its area increased southwards to include a number of significant trees including two very large trees now located within the south west corner of the open space. We understand our Structure Plan has been the first to be assessed against the City's policy from the very inception of our proposal.

LWP has also lodged an Environmental Protection, Biodiversity and Conservation Act referral for its landholdings.

Costa Mushroom Farm

In relation to perceived odours from the Costa Mushroom Farm, LWP recognises and respects the importance of the Costa Mushroom Farm and its economic, employment, environmental and social investment to the region and in fact, the State of Western Australia.

LWP understands that perceived odour and noise impacts from the Costa Mushroom Farm must be appropriately considered and addressed through the Structure Planning process and has been aware of this consideration since initial liaison with the City, prior to the preparation of the Structure Plan.

LWP immediately acknowledged that sensitive development would need to be separated from the Mushroom Farm, and sourced the existing Envall reports which were prepared for Costa in 2015 from the City, to determine what the impacts, if any, of the Mushroom Farm are, and how this would have to be addressed in the Structure Plan.

LWP's consultants also liaised with the City's Environmental Health team on numerous occasions including as late as last Friday 6 September, who confirmed that there has been no complaints of odour from the Mushroom Farm since its three-stage $20m upgrade and modernisation of growing facilities and compost pasteurizing process has been undertaken.

City officers have confirmed the use and development of the Mushroom Farm has been operating in accordance with its Site Environmental Management Plan prepared in 2015 and that the Mushroom Farm can continue to co-exist with residential development.

Nevertheless, LWP chose to engage an odour expert, Dr Peter Forster from Strategen-JBSG to undertake further assessments which have confirmed the outcomes of the previous modelling undertaken to date. The methodology for that odour modelling was endorsed by the City of Kwinana and its independent expert in odour assessments of this nature.

7 COMMUNITY SUBMISSIONS

LWP adopted the recommendations provided by Strategen-JBSG in the Structure Plan by locating Service Commercial land and a Parks and Recreation reservation closest to the Mushroom Farm, and separating the residential development by some 200m.

LWP appreciates the City officers are recommending additional work to be undertaken "as a precautionary approach" to confirm the extent of the perceived odour and noise impacts generated by the Mushroom Farm, and whilst it disagrees with the officer's position, LWP is committed to resolving this issue in consultation with the Department of Water and Environmental Regulation, the City and the WA Planning Commission during the assessment period for the structure plan but within a shorter timeframe than what has been included in the officer's recommendation.

LWP is committed to enabling development in the Central Precinct to occur and co-exist with the Costa Mushroom Farm, and, through its team of expert environmental consultants has a high level of confidence this can be achieved.

In conclusion, LWP appreciates the City's consideration of the points outlined and looks forward to continuing to work closely with the City in relation to the finalisation of the Structure Plan through the WAPC's assessment.

7.2 Ms Rachel Chapman on behalf of LWP Property Group regarding item 15.2, Casuarina Central Local Structure Plan (multiple landholdings under separate ownership) – Consideration of submissions and recommendation to the Western Australian Planning Commission:

Good evening Mayor, Chief Executive, Councillors, staff and community. My name is Rachel Chapman and I am a Director at Taylor Burrell Barnett. TBB have been engaged by LWP as the planning consultants for the Casuarina Central Precinct Structure Plan project.

We have some comments to make in relation to the recommendations in the officer's report. These comments include an alternative recommendation as it relates to three of the recommended modifications to the structure plan. My comments and alternative recommendation specifically relate to the modifications to provide for:

1. An 'Investigation Area' within 500m of the closest buildings and ponds at the Mushroom Farm on Lot 45 Orton Road,
2. A Local Centre site south of the proposed Primary School site,
3. R5 density on the eastern boundary adjacent to the Rural zone.

I will also provide some comments in relation to DBCA's comments on a drainage basin in a wetland buffer and wetland surveys.

I will outline in detail my suggested alternative recommendation at the end of my deputation, following an explanation of the issues the request relates to.

Mushroom Farm

We appreciate the City requires additional work to confirm the odour impacts from the Costa Mushroom Farm, however it should be acknowledged that sufficient scientific modelling has already been undertaken and therefore we do not support the officer's recommendation to apply a 500m Investigation Area, with additional Field Odour Assessments (FOAs) over a 12 month period. There is no odour issue and this has not been disputed by the owners and operators of the Mushroom Farm, the City's planning and environmental health officers, the community, nor any of the experts.

7 COMMUNITY SUBMISSIONS

Modelling

Based on the odour reports prepared on behalf of the owners of the Costa Mushroom Farm, LWP engaged odour expert Dr Peter Forster from Strategen-JBSG to identify an Investigation Area where further work would be undertaken to confirm outcomes of the previous modelling undertaken to date. The Investigation Area was defined and methodology for additional Field Odour Assessments confirmed in April 2019 with the City and its independent expert, John Hurley from Talis, enabling advertising of the structure plan to commence, the additional Field Odour Assessments were then undertaken and City officers were briefed on the preliminary findings in June 2019 and it was confirmed that the additional field odour assessments were undertaken in accordance with the agreed methodology and within the defined Investigation Area, with the final report submitted end of June 2019.

Unfortunately, the City then engaged a different contractor to review the additional work undertaken (Terry Shultz from The Odour Unit), rather than the original peer-reviewer John Hurley at Talis; resulting in a third opinion and inconsistent approach to odour assessment. Despite The Odour Unit acknowledging that the Field Odour Assessments were conducted according to the agreed methodology, they have provided suggestions for additional work to be undertaken, beyond the scope of what was agreed to by the City, its odour expert at Talis, LWP and its odour expert at Strategen-JBSG. In our opinion, the City officer's have taken an overly cautious approach and adopted The Odour Unit's advice in their recommendation to Council.

Our expert, Dr Peter Forster has carefully considered The Odour Unit's and the City officer's recommendation that additional Field Odour FOA's are required for a period of 12 months across different wind and weather conditions so that the extent of adverse odour impacts can be assessed, with the suggestion that the worst-case weather conditions occur in Feb-April.

He has also liaised with DWER's odour specialist to seek advice regarding an appropriate methodology to resolve the odour assessment requirements. It is only necessary to undertake the FOA's during the wind and weather conditions which would result in the worst-case odour impacts. If the additional FOAs are carried out under the worst-case scenarios, there is no need to continue undertaking assessments for a 12-month period. The worst-case odour impacts will occur within the Structure Plan area when the wind is blowing in a NW-NNE direction at <1m/s. Dr Forster has reviewed when these conditions occur on the site, and confirmed, contrary to The Odour Unit's advise, that these wind conditions occur extremely infrequently (0.10% of the month) during the months of Feb-April, and therefore, monitoring is not necessary during these months.

Therefore, rather than stipulate the requirement for FOAs to be undertaken over 12 months, FOA's need only be undertaken so as to capture the worst-case wind conditions during the worst-case operating conditions (ie at the time of compost delivery). Once this evidence is obtained, there is no further requirement to continue undertaking FOAs.

Investigation Area

There is not sufficient policy nor scientific justification to apply a 500m Investigation Area, and this is considered to be extremely conservative given the existing scientific evidence that the impacts from the mushroom area are considered to be low risk and low frequency, and do not warrant a 500m Investigation Area being applied.

7 COMMUNITY SUBMISSIONS

As acknowledged in Costa's submission on the Casuarina Central Precinct Structure Plan, the 2015 EPA Draft Guidance Statement on Separation Distances suggest a 200-300m separation distances should be in place for mushroom farms without on-site compost manufacturing. These guidelines indicate EPA's understanding of the reduced odour risk for farms without composting on site. In accordance with City of Kwinana approvals and Site Environmental Plans prepared by Costa, the primary preparation of compost (Phase 1) is undertaken off-site and delivered once a week to the facility, meaning no on-site compost manufacture is allowed, nor is it taking place, at Lot 45 Orton Rd.

Furthermore, Dr Forster has confirmed Envall's reports do not support a 500m separation distance.

Costa Mushroom Farm Operations

The Envall 2015 reports identify that Costa Mushroom Farm had addressed previous issues with the conditions of their buildings, which was one of the factors which contributed to historical odour issues. Although an attempt to liaise with Costa was made in the work undertaken by LWP to date, further liaison with Costa is required, to determine if all the rectification works identified in the Envall reports have in fact been completed. Additionally, we need to gain a greater understanding of Costa's operation procedures, and if there are any further upgrades to the mushroom facility which are required to be undertaken, and any mitigation measures which may be able to be applied, which would impact the odour.

LWP are committed to undertaking further work to ensure any impacts from the Mushroom Farm are appropriately dealt with in the Structure Plan, and have considered a strategy for addressing this issue during the WAPC's consideration of the Structure Plan, based on the work undertaken to date. The land to the north of the Structure Plan will form the first stage of the development, and as such LWP will not delay undertaking the additional work required, and the perceived odour issue will be resolved prior to the WAPC's determination of the Structure Plan. LWP will continue to liaise with the City and DWER in resolving this matter to enable residential development to proceed.

Local Centre

The City Officer's recommendation includes a modification to show a Local Centre in the Structure Plan adjacent to Landgren Road, immediately south of the Primary School Site. Although we acknowledge there is a need for a Local Centre in the area for the residents to utilise, we do not support this suggested location, and it is important that the Local Centre is appropriately located so it is able to be sold, developed and can flourish as a centre to provide the greatest amenity to the community.

As identified in the Retail Needs Assessments prepared on behalf of LWP, a Local Centre would be better located in the northern precinct. We appreciate that the City engaged a peer reviewer, Shrapnel Urban Planning to assess the Retail Needs Assessment submitted. However, Shrapnel's scope was limited in that their report only considered where in the Casuarina Central Precinct a Local Centre should be located, rather than taking into consideration both the central and northern precincts.

7 COMMUNITY SUBMISSIONS

The City's Local Planning Policy No. 6 identifies the requirement for a Local Centre either in the North or Central Precinct, near the corner of Orton and Landgren Road. The proposed Structure Plan has taken into consideration the City's preference for the District Open Space and modified layout of Orton Road to be integrated with the Primary School and POS Site. As such there is no room for a Local Centre to be located within the central precinct, near the intersection of Orton and Landgren Road as required by the local planning policy. Therefore, as identified in the Retail Needs Assessment, the Local Centre would be more suitably located in the north precinct adjacent to the District Open Space, providing the greatest opportunity for a successful business. The landowners in the northern precinct acknowledged this and suggested the Local Centre be located in the north.

Rural Water Resource Zone Interface

We appreciate the City's requirement to provide an appropriate interface to the adjacent Rural Water Resource Zoned land on the eastern side of the subject site. However, we do not support the City officer's recommendation to provide an R5 coding, as this is considered to be unnecessary. The Structure Plan has been designed to provide an appropriate interface by:

- Locating roads along eastern edge of the Structure Plan boundary, as depicted on the Development Concept Plan.
- Locating areas of POS on the eastern edge of the Structure Plan boundary.
- Providing a R10-R20 density code range along the eastern sections of the Structure Plan.

The R10-R20 density coding also provides an appropriate transition between the adjacent R25-R40 lots proposed. We would also like to point out that the recently supported Anketell North LSP (Amendment 4B) to the north included R20 coded lots adjacent to the Rural zone which were supported by the City. We do not understand why a different approach is required for Casuarina.

Wetlands and Drainage

We acknowledge that the DBCA does not support the proposal for drainage basin B to be located within the buffer to the REW, with a suggestion that further assessment of the wetlands is required. We note that REWs are managed by the City, not DWER, with DWER being an advice agency only. The drainage basin proposed is to accommodate the 1:1 year drainage event only, and is located primarily on cleared land.

Less than 1% of Lot 31 is zoned urban and therefore there we consider it unreasonable to expect the landowner to fund the additional work required for a reclassification of the wetland. The majority of the REW is located outside the Structure Plan area and see no reason to reclassify this portion of the wetland. A small drainage event in the wetland buffer will not negatively impact the REW. We request the City make a pragmatic decision to accommodate the minor basin in this location.

Connection to Thomas Road

We would also like to reiterate the importance to secure a connection to Thomas Road. We have previously identified this to the City, mainly through our submission on the Casuarina North Precinct Structure Plan. We appreciate the City has requested the Concept Plan for the Casuarina North Precinct be updated to identify the DOS and the realignment of Orton Road, and we also request the plan identifies the requirement for Landgren Road to be extended to provide a connection for residential traffic to Thomas Road.

7 COMMUNITY SUBMISSIONS

Recommended modification to Council recommendation

We request that the officer's recommendation is amended as follows:

1. a) i. An investigation Area, 500m in radius (measured from the Phase 3 buildings and the wastewater pond), be shown on the CCLSP. The purpose of the Investigation Area would be to:ensure that extensive FOAs are conducted over a 12 month period (including late February to early April).

Be modified to:

1. a) i. Section 70A TLA Notifications on Titles for residential lots within 300m of the Phase 3 buildings and wastewater ponds on Lot 45 Orton Road (Mushroom Farm) are required advising of the existence of the Mushroom Farm and possibility of odour impacting the amenity of the area for future residents, unless it can be demonstrated, through comprehensive Field Odour Assessments (FOAs) that consider combined worst-case scenarios for both plant operating and meteorological conditions, that Notifications on Titles are not required.

1. a) iii Show a Local Centre (650m2 to 750m2) in the CCLSP adjacent to Landgren Road, immediately south of the Primary School site

Be modified to:

1. a) iii Show a Local Centre (650m2 to 750m2) in the southern portion of the Casuarina North Local Structure Plan, adjacent to the proposed District Open Space

1. a) v. Show the maximum residential density at the interface with the Rural zone along the eastern boundary of the CCLSP as R5 coding

Be deleted.

In conclusion, we appreciate the City's consideration of the points outlined we look forward to continuing to work closely with the City in relation to the finalisation of the Structure Plan through the WAPC's assessment.

Thank you for your time, are there any questions?

8 Minutes to be Confirmed:

8.1 Ordinary Meeting of Council held on 28 August 2019:

COUNCIL DECISION

541

MOVED CR S LEE **SECONDED CR S MILLS**

That the Minutes of the Ordinary Meeting of Council held on 28 August 2019 be confirmed as a true and correct record of the meeting.

CARRIED
8/0

9 Referred Standing / Occasional / Management /Committee Meeting Reports:

Nil

10 Petitions:

Nil

11 Notices of Motion:

Nil

12 Reports - Community

Nil

13 Reports – Economic

Nil

14 Reports – Natural Environment

Nil

15 Reports – Built Infrastructure

15.1 Adoption of Amended Local Development Plan, Stage 2B Cassia Glades (Lot E26), Kwinana City Centre

DECLARATION OF INTEREST:

Deputy Mayor Peter Feasey declared an impartiality interest due to his supervisor also being the Minister for Housing and the item being a joint venture.

SUMMARY:

A request to amend the Local Development Plan (LDP) for Stage 2B of the Cassia Glades Estate (Lot E26), Kwinana City Centre has been received for consideration under the City of Kwinana's Local Planning Scheme No.2 (LPS2) (refer Attachment B). The proposal seeks to amend the LDP that was initially adopted by Council at its Ordinary Council Meeting held on 15 October 2018 (refer Attachment C). The proposed amendment is to include Lot 400 (a Grouped Housing lot) and provisions relating to this site.

Subdivision (reference S155004) was approved by the WAPC on 31 July 2017 and a condition of approval required the development of a LDP for lots subject of the subdivision. Subsequently, the Stage 2B Cassia Glades LDP was approved by Council (refer Attachment C). This LDP only included R30 lots, however, and did not include the Grouped Housing R60 lot (Lot 400) now proposed for inclusion in the LDP. This was despite Lot 400 being part of the original subdivision. Subdivision clearance was subsequently issued for the R30 lots. The proponent now seeks to amend the current LDP for Stage 2B, to include Lot 400, to allow subdivision clearance to be issued for this lot.

The amended LDP includes specific provisions relating to this lot. In particular, a provision requiring mandatory two storey development has been included to ensure any proposed grouped dwellings will provide the scale of built form anticipated and consistent with the Kwinana City Centre Master Plan. Any proposed multiple dwellings will be required to meet the provisions of State Planning Policy 7.3 Volume 2 - Apartments (SPP7.3 Vol.2).

These provisions will help ensure future development on Lot 400 interfaces appropriately with the adjacent Public Open Space (POS) and includes design elements to help ensure a higher standard of built form addressing the streets. All other provisions and properties identified on the approved LDP remain unchanged.

The amended LDP (refer Attachment B) has been assessed and is supported by City Officers and is recommended for approval.

OFFICER RECOMMENDATION:

That Council approves the Amended Local Development Plan for Stage 2B Cassia Glades, Kwinana City Centre (as per Attachment B), pursuant to Clause 52(1)(a) of Schedule 2 – Deemed Provisions for *Local Planning Schemes of the Planning and Development (Local Planning Schemes) Regulations 2015*.

15.1 ADOPTION OF AMENDED LOCAL DEVELOPMENT PLAN, STAGE 2B CASSIA GLADES (LOT E26), KWINANA CITY CENTRE

DISCUSSION:

Land Status

Local Planning Scheme No. 2:	Residential R30 and R60
Metropolitan Region Scheme:	Urban

Background

A request to amend the LDP for Stage 2B of the Cassia Glades Estate, Kwinana City Centre has been received for consideration under LPS2. The proposal seeks to amend the adopted LDP (refer to Attachment C) and the proposal is to include Lot 400 (Grouped Housing lot) and provisions relating to this site (refer to Attachment B).

Subdivision (reference S155004) was approved by the WAPC on 31 July 2017 and a condition of approval required the development of a LDP for the subdivision. Subsequently, the Stage 2B Cassia Glades LDP was approved by Council, but only included the R30 lots and did not include the Grouped Housing R60 lot (Lot 400). Subdivision was subsequently issued for the R30 Lots. The proponent now seeks to amend the current LDP, to include Lot 400, which would then allow subdivision clearance to be issued for this lot.

The amended LDP includes specific provisions relating to this lot. In particular, a provision requiring mandatory two storey development has been included to ensure any proposed grouped dwellings will provide the scale of built form anticipated and consistent with its location near the Kwinana City Centre. Any proposed multiple dwellings will be required to meet the provisions of SPP 7.3 Vol.2.

These provisions will help ensure future development on Lot 400 interfaces appropriately with the adjacent POS and includes design elements to help ensure a higher standard of built form addressing the streets. All other provisions and properties identified on the approved LDP remain unchanged.

The amended LDP (refer Attachment B) has been assessed and is supported by City Officers and is recommended for approval.

Planning Assessment

The following policies were considered as part of the original LDP approval:

1. Local Planning Policy No. 1 – Landscape Feature and Tree Retention (LPP1);
2. Local Planning Policy No. 2 – Streetscapes (LPP2);
3. Local Planning Policy No. 7 – Uniform Fencing (LPP7); and
4. Local Planning Policy No. 8 – Designing Out Crime (LPP8).

All of the above policies, except LPP7, were addressed as part of the assessment of the original LDP. The following is a review with regard to Lot 400.

Local Planning Policy No. 1 – Landscape Feature and Tree Retention (LPP1)

Clearing and earthworks for Stage 2B was undertaken as part of subdivision approvals prior to the adoption of LPP1. As such, a Landscape Feature and Tree Retention Plan as required under LPP1 was not provided. However, some trees were retained as part of the previous subdivision approvals within the streets and POS areas.

15.1 ADOPTION OF AMENDED LOCAL DEVELOPMENT PLAN, STAGE 2B CASSIA GLADES (LOT E26), KWINANA CITY CENTRE

Local Planning Policy No. 2 – Streetscapes (LPP2)

With regard to LPP2, the City's Engineering Department reviewed and supported the engineering drawings for Stage 2B at the subdivision approval stage. The engineering drawings comply with LPP2 and the proposed street trees for the LDP are shown on the amended LDP as required. Additionally, along the northern and southern boundaries of Lot 400 street trees have been planted as part of the landscaping for Orange Street and Marlock Road and in the POS to the east (refer to Attachment D).

In keeping with the intent of LPP2, the provisions added for Lot 400 will help ensure a higher standard of built form addressing the street from this lot.

Local Planning Policy No.7 – Uniform Fencing (LPP7)

As per LPP7, the amended LDP has identified that Lot 400 is subject to uniform fencing requirements along the POS boundary and this is a condition of the subdivision approval. The fencing is to be visually permeable to provide passive surveillance of the POS and Provision No.25 of the amended LDP (refer to Attachment B) states:

"Visually permeable fencing (as defined by the R-Codes) shall be provided along the public open space boundary"

Local Planning Policy No. 8 – Designing Out Crime (LPP8)

LPP8 sets out design guidelines to be implemented during the design and assessment of LDPs. The amended LDP provisions require that all dwellings have a habitable room on both the ground and first floor overlooking the POS. The amended LDP still includes all other provisions requiring habitable rooms addressing both the primary and secondary street frontages to provide passive surveillance.

Additional Provisions

The amended LDP includes Lot 400 as part of the LDP and adds site specific provisions to read as follows:

The following shall apply to Lot 400 only:
Street Setbacks

22. A minimum and maximum primary setback of 2m and 4m respectively from Orange Street and Marlock Road (averaging not permitted).

Design Elements

23. Development within the Grouped Housing Site shall comprise of a minimum two storeys and provide articulation and visual interest in the façade through the use of:
23.1 Balconies;
23.2 Fenestration and awnings;
23.3 Varying façade treatments and textures; and/or,
23.4 Roof form (e.g. feature gables, parapet walls etc.).

15.1 ADOPTION OF AMENDED LOCAL DEVELOPMENT PLAN, STAGE 2B CASSIA GLADES (LOT E26), KWINANA CITY CENTRE

Public Open Space

24. Development shall be setback a minimum distance of 1m from Public Open Space boundary.
25. Visually permeable fencing (as defined in the R-codes) shall be provided along Public Open Space boundaries.
26. Development must provide surveillance to the Public Open Space through the location of a major opening from a habitable room on both ground and upper storey levels, facing the public open space.

State Planning Policy No.7.3: R-Codes Volume 2 - Apartments

With regard to Lot 400, it should be noted that SPP7.3 Vol.2, which includes specific requirements for Grouped Housing lots, became operational on 24 May 2019 and this document replaced State Planning Policy 3.1 Residential Design Codes (R-Codes) Part 6, which previously addressed these lot types.

SPP7.3 Vol.2 is relevant to the assessment of the amended LDP as Lot 400 is identified as a Grouped Housing site with an R-Code of R60. City Officers considered SPP7.3 Vol.2 and advise that no additional provisions are required for inclusion in the amended LDP. Future development applications for grouped or multiple dwellings will be assessed against the LDP and SPP7.3 Vol.2.

Conclusion

All current Local Planning Policies relevant to the amended LDP have been reflected in the provisions of the amended LDP. The proposed amendments to the LDP are consistent with the adopted Local Structure Plan and the approved subdivision. No changes are proposed to existing requirements of the LDP for Lots 148 – 156, and Lots 424 - 432. The inclusion of Lot 400 on the amended LDP will allow for the clearance of conditions on an approved subdivision, without requiring an additional LDP.

LEGAL/POLICY IMPLICATIONS:

For the purpose of Councillors considering a financial or impartiality interest only, the landowner is the Department of Communities. Satterley Property Group is developing the site and the applicant is CLE Town Planning & Design.

The following strategic and policy based documents were considered in assessing the application;

Legislation
Planning and Development (Local Planning Schemes) Regulations 2015

Schemes
Metropolitan Region Scheme; and
City of Kwinana Local Planning Scheme No.2.

15.1 ADOPTION OF AMENDED LOCAL DEVELOPMENT PLAN, STAGE 2B CASSIA GLADES (LOT E26), KWINANA CITY CENTRE

Local Planning Policies
Local Planning Policy No. 1 – Landscape Feature and Tree Retention;
Local Planning Policy No. 2 – Streetscapes;
Local Planning Policy No. 7 – Uniform Fencing; and
Local Planning Policy No. 8 – Designing Out Crime.

State Government Policies
State Planning Policy No. 7.3: R-Codes Volume 1 and 2
State Planning Policy No. 3.7: Planning in Bushfire Prone Areas; and
Liveable Neighbourhoods Operational Policy.

FINANCIAL/BUDGET IMPLICATIONS:

There are no financial or budget implications as a result of this application.

ASSET MANAGEMENT IMPLICATIONS:

There are no asset management implications as a result of this application.

ENVIRONMENTAL IMPLICATIONS:

The amended LDP encourages the use of passive solar urban design and identifies street trees required for compliance with LPP2. There are no street trees proposed for Lot 400 and this is consistent with the engineering drawing included as part of the subdivision approval. However, along the northern and southern boundaries of Lot 400, street trees have been planted as part of the landscaping for Orange Street and Marlock Road and as part of landscaping of the POS to the east of the property (refer to Attachment D).

STRATEGIC/SOCIAL IMPLICATIONS:

This proposal will support the achievement of the following outcome and objective detailed in the Strategic Community Plan.

Plan	Outcome	Objective
Strategic Community Plan	A well planned City.	4.4 Create diverse places and spaces where people can enjoy a variety of lifestyles with high levels of amenity.

COMMUNITY ENGAGEMENT:

Lot 400 has not yet been created (and remains in the ownership of the developer). The amended LDP was not advertised because the proposed amendments to the LDP are consistent with the adopted Local Structure Plan and approved subdivision and will have limited impact on landowners adjacent and within the LDP area.

15.1 ADOPTION OF AMENDED LOCAL DEVELOPMENT PLAN, STAGE 2B CASSIA GLADES (LOT E26), KWINANA CITY CENTRE

PUBLIC HEALTH IMPLICATIONS:

The proposal has the potential to contribute to improved neighbourhood amenity through the provision of higher standards in regard to built form.

RISK IMPLICATIONS:

The risk implications in relation to this proposal are as follows:

Risk Event	The Statutory process may not be met in respect to timeframes for the amendment and there may be an appeal to SAT of Council's decision on the proposed amended LDP.
Risk Theme	Failure to fulfil statutory regulations or compliance requirements.
Risk Effect/Impact	Reputation Compliance
Risk Assessment Context	Strategic
Consequence	Minor
Likelihood	Possible
Rating (before treatment)	Low
Response to risk treatment required/in place	Work instructions in place and checklists used when assessing the application. Consideration of the application within the statutory timeframes. Providing appropriate information in LDPs in accordance with legislative requirements. Compliance of the proposal with Local Planning Scheme No.2, R-Codes, Lots E26 Local Structure Plan, Bushfire Guidelines and relevant Policies. Liaising with the applicant throughout the application process.
Rating (after treatment)	Low

Risk Event	Bushfire risk to future landowners.
Risk Theme	Providing inaccurate advice/ insufficient information that may result in human danger or property damage.
Risk Effect/Impact	Reputation Health and Safety
Risk Assessment Context	Strategic
Consequence	Major

15.1 ADOPTION OF AMENDED LOCAL DEVELOPMENT PLAN, STAGE 2B CASSIA GLADES (LOT E26), KWINANA CITY CENTRE

Likelihood	Possible
Rating (before treatment)	Moderate
Response to risk treatment required/in place	Providing appropriate information in LDPs in accordance with legislative requirements. Compliance of the proposal with Local Planning Scheme No.2, *Building Act 2011*, Bushfire Guidelines and relevant Policies.
Rating (after treatment)	Low

COUNCIL DECISION

542

MOVED CR W COOPER **SECONDED CR M ROWSE**

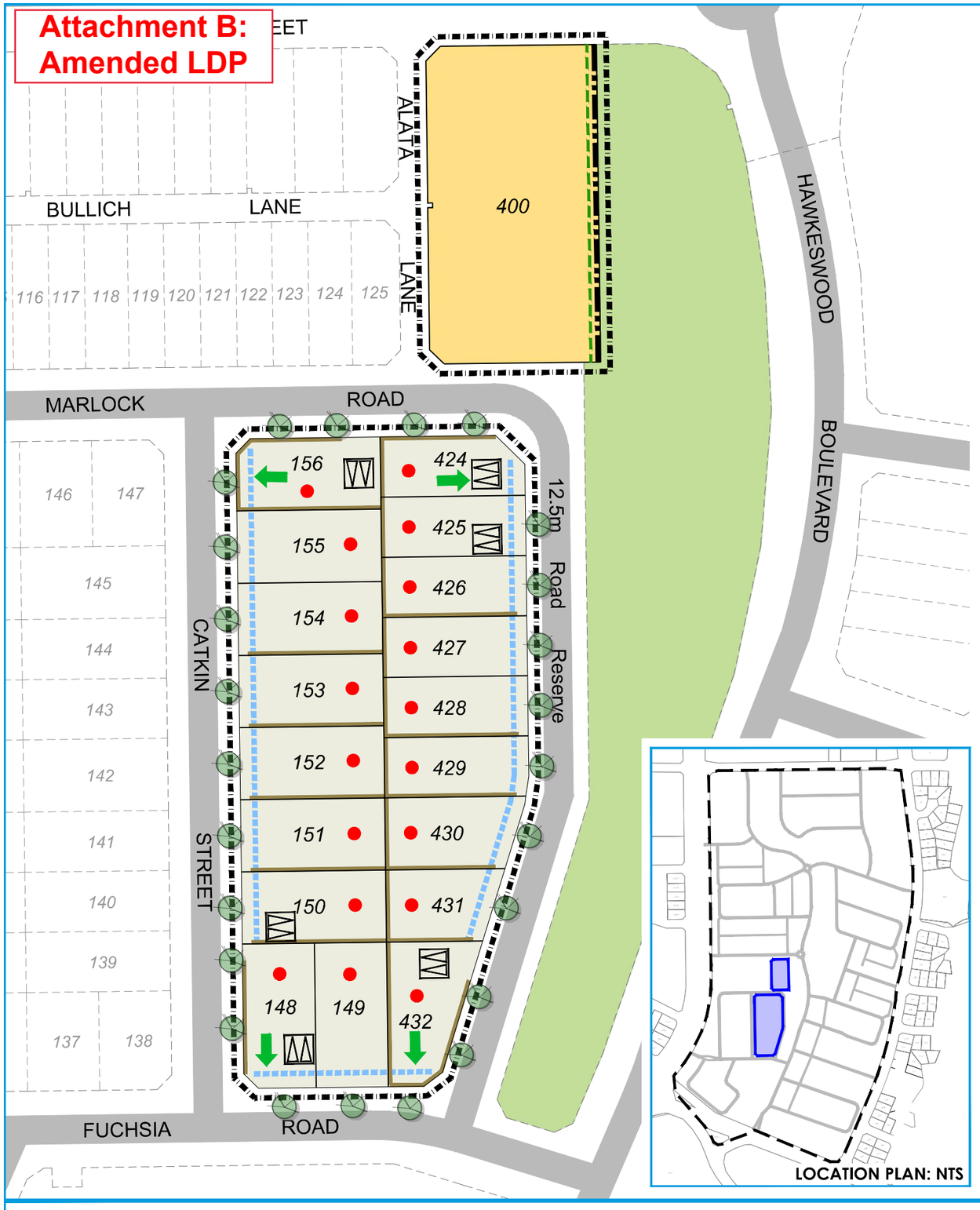
That Council approves the Amended Local Development Plan for Stage 2B Cassia Glades, Kwinana City Centre (as per Attachment B), pursuant to Clause 52(1)(a) of Schedule 2 – Deemed Provisions for *Local Planning Schemes of the Planning and Development (Local Planning Schemes) Regulations 2015*.

CARRIED
8/0

Attachment A: Location Plan



Attachment B: Amended LDP



PROVISIONS

General

1. This Local Development Plan (LDP) applies to all lots within Stage 2B of Cassia Glades Estate.
2. This LDP varies the provisions of the City of Kwinana Town Planning Scheme No.2 and State Planning Policy 3.1 *Residential Design Codes* (R-Codes).
3. The provisions of this LDP constitute 'Deemed-to-Comply' provisions of the R-Codes.
4. Development that complies with the LDP does not require consultation with surrounding landowners.
5. The City of Kwinana may vary the provisions of this LDP where considered appropriate to achieve a specfific design outcome.
6. This LDP is to be read in conjunction with the Estate's Residential Building Guidelines covenant.

The following shall apply to Single Lots only (Lots 148-156 & 424-432)

Street Setbacks

7. A 3.0m minimum and 5.0m maximum primary street setback is permitted for R30 coded lots as shown (averaging not permitted).

Boundary Setbacks

8. Boundary walls are permitted to the southernmost and westernmost boundary, behind the street setback line and to within 4m of the rear boundary, except where otherwise shown, or where this boundary abuts a road, recreation or drainage reserve.
9. Where boundary walls would be permitted and are not proposed, setbacks are to be in accordance with the R-Codes.

Garages

10. Garages shall be setback a Qminimum of 4.5m from the street.
11. Garages shall be located as shown on this LDP, where applicable.
12. All garages shall have doors to enclose them such that its contents are screened from public view.

Open Space and Outdoor Living

13. The minimum open space requirement (minimum % of the site) for R30 coded lots is 35%.
14. Outdoor Living Areas shall be located to maximise access to winter sunlight.

Dwelling Orientation and Streetscape for Corner Lots

15. Dwellings on corner lots shall address both primary and secondary streets by:
    - 15.1. providing articulation in the building facade along both boundaries;
    - 15.2. Incorporating similar materials, facade treatments, and fenestration along both boundaries; and,
    - 15.3. Incorporating similar roof forms along both boundaries (e.g. eaves, gables etc.).

Other Design Elements

16. Front fences within the primary street setback being visually permeable above 0.9m to a maximum height of 1.2m above natural ground level.
17. For secondary street boundaries, fencing shall be visually permeable above 1.2m behind the primary street setback, for a minimum length of 3m behind the truncation with a habitable room addressing the street.
18. Where sheds and outbuildings do not match the construction materials and finish of the primary dwelling, they are to be screened from public view.
19. All dwellings to provide an appropriate high quality interface with the surrounding streetscape, through the use of at least three of the following design features:
    - 19.1. Articulation in dwelling facade (i.e. varied wall setbacks);
    - 19.2. A minimum of two building materials, colours and/or finishes (e.g. render, brick, cladding));
    - 19.3. Major habitable room openings incorporating large windows to provide surveillance;
    - 19.4. Roof forms that incorporate gables;
    - 19.5. A balcony, portico, or verandah; or
    - 19.6. A built in planter box.

Bushfire Management

20. The land subject to this LDP is within a bushfire prone area, as designated by the Department of Fire and Emergency Services. Those lots identified on this LDP as being subject to a Bushfire Management Plan require a Bushfire Attack Level Assessment and certification prior to construction, in accordance with *Australian Standard 3959*.

Street Trees

21. In accordance with the City's Policy, a minimum of one street tree per lot and three street trees for corner lots is required. Street trees will be provided by the developer within the road verge, and maintained for a minimum of two years until established. Street trees are to be generally located as shown on this LDP, subject to detailed landscape design. Street trees are not be relocated or removed by landowners.

The following shall apply to Lot 400 only:

Street Setbacks

22. A minimum and maximum primary street setbacks of 2m and 4m respectively from Orange Street and Marlock Road (averaging not permitted).

Design Elements

23. Development within the Grouped Housing Site shall comprise a minimum of two storeys and provide articulation and visual interest in the façade through the use of:
    - 23.1. Balconies;
    - 23.2. Fenestration and awnings;
    - 23.3. Varying façade treatments and textures; and/or,
    - 23.4. Roof form (e.g feature gables, parapet walls etc).

Public Open Space

24. Development shall be set back a minimum distance of 1m from the public open space boundary
25. Visually permeable fencing (as defined by the R-Codes) shall be provided along the public open space boundary
26. Development must provide surveillance to the public open space through the location of a major opening from a habitable room on both ground and upper storey levels, facing the public open space.

LEGEND

- Local Development Plan Area
- Residential R30
- Residential R60
- Public Open Space
- Mandatory garage location
- 3.0m minimum 5.0m maximum primary street setback
- 1.0m minimum setback from public open space
- Visually permeable fencing
- Dwelling orientation
- Retained Trees
- Lots subject to a Bushfire Management Plan
- Approximate street tree location. *(Street trees are not to be removed or relocated by landowners.)*

APPROVED

..... Coordinator Statutory Planning, City of Kwinana

..... Date

LDP: ..... City of Kwinana Reference No.

NORTH

0 10 20 30 40 50m

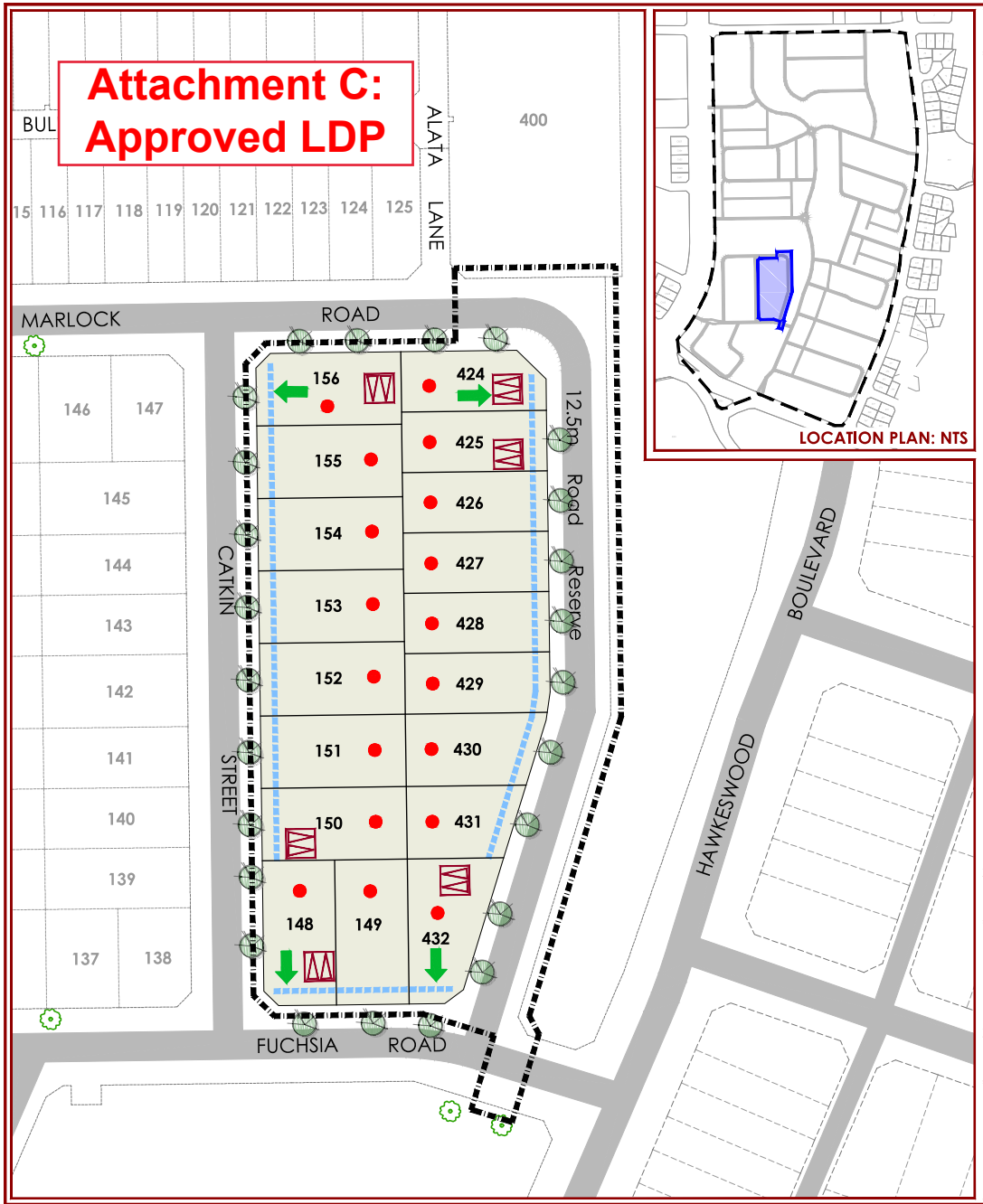
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LOCAL DEVELOPMENT PLAN
STAGE 2B, CASSIA GLADES ESTATE
KWINANA TOWN CENTRE

Plan No: 3163-18C-01
Date: 16.08.2019

CITY OF KWINANA

Attachment C: Approved LDP



PROVISIONS

General

1. This Local Development Plan (LDP) applies to all lots within Stage 2B of Cassia Glades Estate.
2. This LDP varies the provisions of the City of Kwinana Town Planning Scheme No.2 and State Planning Policy 3.1 *Residential Design Codes* (R-Codes).
3. The provisions of this LDP constitute 'Deemed-to-Comply' provisions of the R-Codes.
4. Development that complies with the LDP does not require consultation with surrounding landowners.
5. The City of Kwinana may vary the provisions of this LDP where considered appropriate to achieve a specific design outcome.
6. This LDP is to be read in conjunction with the Estate's Residential Building Guidelines covenant.

Street Setbacks

7. A 3.0m minimum and 5.0m maximum primary street setback is permitted for R30 coded lots as shown (averaging not permitted).

Boundary Setbacks

8. Boundary walls are permitted to the southernmost and westernmost boundary, behind the street setback line and to within 4m of the rear boundary, except where otherwise shown, or where this boundary abuts a road, recreation or drainage reserve.
9. Where boundary walls would be permitted and are not proposed, setbacks are to be in accordance with the R-Codes.

Garages

10. Garages shall be setback a minimum of 4.5m from the street.
11. Garages shall be located as shown on this LDP, where applicable.
12. All garages shall have doors to enclose them such that its contents are screened from public view.

Open Space and Outdoor Living

13. The minimum open space requirement (minimum % of the site) for R30 coded lots is 35%.
14. Outdoor Living Areas shall be located to maximise access to winter sunlight.

Dwelling Orientation and Streetscape for Corner Lots

15. Dwellings on corner lots shall address both primary and secondary streets by:
    - 15.1. providing articulation in the building facade along both boundaries;
    - 15.2. Incorporating similar materials, facade treatments, and fenestration along both boundaries; and,
    - 15.3. Incorporating similar roof forms along both boundaries (e.g. eaves, gables etc.).

Other Design Elements

16. Front fences within the primary street setback being visually permeable above 0.9m to a maximum height of 1.2m above natural ground level.
17. For secondary street boundaries, fencing shall be visually permeable above 1.2m behind the primary street setback, for a minimum length of 3m behind the truncation with a habitable room addressing the street.
18. Where sheds and outbuildings do not match the construction materials and finish of the primary dwelling, they are to be screened from public view.
19. All dwellings to provide an appropriate high quality interface with the surrounding streetscape, through the use of at least three of the following design features:
    - 19.1. Articulation in dwelling facade (i.e. varied wall setbacks);
    - 19.2. A minimum of two building materials, colours and/or finishes (e.g. render, brick, cladding));
    - 19.3. Major habitable room openings incorporating large windows to provide surveillance;
    - 19.4. Roof forms that incorporate gables;
    - 19.5. A balcony, portico, or verandah; or
    - 19.6. A built in planter box.

Bushfire Management

20. The land subject to this LDP is within a bushfire prone area, as designated by the Department of Fire and Emergency Services. Those lots identified on this LDP as being subject to a Bushfire Management Plan require a Bushfire Attack Level Assessment and certification prior to construction, in accordance with *Australian Standard 3959*.

Street Trees

21. In accordance with the City's Policy, a minimum of one street tree per lot and three street trees for corner lots is required. Street trees will be provided by the developer within the road verge, and maintained for a minimum of two years until established. Street trees are to be generally located as shown on this LDP, subject to detailed landscape design. Street trees are not be relocated or removed by landowners.

LEGEND

- Local Development Plan Area
- Residential R30
- Mandatory garage location
- 3.0m minimum 5.0m maximum primary street setback
- Dwelling orientation
- Approximate street tree location. Street trees are not to be removed or relocated by landowners.
- Retained Trees
- Lots subject to a Bushfire Management Plan

APPROVED

Coordinator Statutory Planning
City of Kwinana

15 October 2018
Date

LDP: 9202
City of Kwinana
Reference No.

All areas and dimensions are subject to survey, engineering and detailed design and may change without notice. © Copyright of Burgess Design Group.

NORTH
0 10 20 30 40 50m
SCALE 1:1000 (A3)

BURGESS DESIGN GROUP
TOWN PLANNING + URBAN DESIGN
All enquiries to be directed to the City of Kwinana on (08) 9439 0200

Plan No: SAT KWI 8-04a-01 Client: Satterley/Housing Authority
Date: 24.08.18 Planner: MB

LOCAL DEVELOPMENT PLAN
STAGE 2B, CASSIA GLADES ESTATE
KWINANA TOWN CENTRE
CITY OF KWINANA

Attachment D: Landscaping surrounding Lot 400



15.2 Casuarina Central Local Structure Plan (multiple landholdings under separate ownership) – Consideration of submissions and recommendation to the Western Australian Planning Commission

DECLARATION OF INTEREST:

Deputy Mayor Peter Feasey declared an impartiality interest due to his supervisor also being the Minister for Housing and the item being a joint venture.

SUMMARY:

A proposed Casuarina Central Local Structure Plan (CCLSP) has been lodged with the City of Kwinana (the City) in accordance with Schedule 2, Clause 29(1) of the *Planning and Development Regulations 2015* (P&D Regulations). The area the subject of the CCLSP is shown in Attachment A.

The CCLSP is situated within the Casuarina Urban Cell and encompasses approximately 96 hectares (ha) of land bounded by Orton Road to the north, Parks and Recreation Reserve to the east, Lugg Place to the south and Kwinana Freeway to the west (Attachment B). The CCLSP is in multiple landholdings under separate ownership.

The following land uses are proposed in the CCLSP:

a) Approximately 920-968 residential lots to accommodate a population of up to 2,700 residents;
b) A Service Commercial area located in the north western corner of the CCLSP area, adjacent to the Kwinana Freeway and Orton Road;
c) A Primary School and co-located Public Open Space (POS) for a senior sized oval located at the intersection of Landgren Road and Orton Road; and
d) Open space for recreation and to retain wetlands, significant vegetation and provide fauna corridors.

The City advertised the CCLSP between 19 April 2019 and 10 May 2019 and received fifteen submissions. The City's comments on each submission are provided in the Schedule of Submissions (Attachments C). The key points raised in the submissions are summarised in Table 1, below:

Table 1: Summary of issues raised in submissions

Submitters	Submitters Comments
Department of Biodiversity, Conservation and Attractions (DBCA)	The CCLSP should include provisions for the preparation and implementation of relevant management plans for proposed conservation areas and wetland rehabilitation requirements and interface treatments.
	Areas of open space intended for conservation purposes should be identified in the CCLSP.
	An additional targeted flora survey of all suitable habitat within the CCLSP is recommended to be undertaken at the appropriate time of the year, prior to the approval of the CCLSP.
	A wetland assessment of the CCLSP area is recommended to be undertaken prior to the approval of the CCLSP to accurately map, protect and manage the wetlands onsite.

15.2 CASUARINA CENTRAL LOCAL STRUCTURE PLAN (MULTIPLE LANDHOLDINGS UNDER SEPARATE OWNERSHIP) – CONSIDERATION OF SUBMISSIONS AND RECOMMENDATION TO THE WESTERN AUSTRALIAN PLANNING COMMISSION

	The DBCA has advised that it does not support the proposal to locate drainage Basin B within the buffer to the Resource Enhancement Wetland. Any drainage infrastructure should be located outside wetland buffers to minimise hydrological impacts in accordance with the Decision Process for Stormwater Management in WA (2005). This is particularly relevant if the subsequent wetland assessment undertaken results in an upgrade of the management category of this wetland to a Conservation Category Wetland
Main Roads	Any noise sensitive development that exceeds the noise target must implement the Quiet House Design measures.
Western Power	The CCLSP, future subdivision and development processes must protect the transmission line corridor and associated assets from encroachment, mitigating public safety or network reliability risks and ensure there is no impediment to routine and emergency land access to the network.
Department of Fire and Emergency Services (DFES)	It is not satisfied that the Bushfire Management Plan (BMP) has adequately considered how compliance can be achieved at subsequent planning stages and requires the BMP to be modified. However, DFES recommends that the structure plan proceed and the applicant be advised that these modifications be undertaken to support subsequent stages of the planning process.
Department of Education (DoE)	The requirement for schools in the area be reviewed to ensure that there is sufficient provision of public primary and secondary schools to meet the increased dwelling yield projection for the locality.
	The CCLSP is not supported because the proposed primary school site is constrained and does not facilitate a safe and efficient school design and does not comply with the design principles of Liveable Neighbourhoods.
Costa Mushroom Exchange	Additional protection of the mushroom farm operation is requested to ensure its long term viability into the future. A 500m buffer between the mushroom facility boundaries and any new sensitive development is requested, and, that an additional 500m be applied to create a conceptual buffer zone.
Owner of Lot 9000 Orton Road	Remove the 'Parks, Recreation and Drainage' Reserve at the north eastern corner of Lot 9000 and show the land as Residential.
	Remove the 'Parks, Recreation and Drainage' Reserve located between the wetland buffer and the power easement and show the land as Residential.

15.2 CASUARINA CENTRAL LOCAL STRUCTURE PLAN (MULTIPLE LANDHOLDINGS UNDER SEPARATE OWNERSHIP) – CONSIDERATION OF SUBMISSIONS AND RECOMMENDATION TO THE WESTERN AUSTRALIAN PLANNING COMMISSION

Owner of Lot 45 Orton Road	The CCLSP ought to be amended to show Lot 45 as the 'Local Centre'.
Owner of Lots 2, 24 and 25 Orton Road	The proposed CCLSP will set a precedent for the location of District Open Space on the property which is inconsistent with the proposed structure plan attached to their submission. The submitters plan includes a small local market centre on the corner of Landgren and Orton Roads providing fresh foods and small business as a local shopping centre for surrounding residential development.

In addition to the matters raised in the submissions, City Officers have also considered a number of other issues during the assessment of the CCLSP. For brevity and clarity these issues and the objective of the City's assessment in relation to each issue has been summarised in Table 2 below:

Table 2: Main issues raised during the assessment of the CCLSP

	ISSUES RAISED BY THE CCLSP	CITY'S OBJECTIVES IN RELATION THE ISSUES
1.	**Potential impact of odour and noise emissions from the mushroom farm on sensitive land uses**	Determine the extent of an appropriate investigation area to allow further odour and noise assessments to be undertaken. Ultimately the City's objective is to provide an appropriate separation distance between odour sensitive land uses and the mushroom farm.
2.	**Viability and location of the Local Centre**	Investigate the likely viability and location of a local centre within the CCLSP. Ultimately the City's objective is to ensure that future residents within the CCLSP have access to convenient retail.
3.	**Viability of the Service Commercial area as proposed in LPP6**	Investigate the likely viability of the Service Commercial area identified on the CCLSP, or, other land uses that could be located between the Kwinana Freeway, the high tension power lines and the mushroom farm.
4.	**Size and safety of the Primary School site as proposed in LPP6**	Investigate the size and safety of the Primary School site identified on the CCLSP. Ultimately the City's objective is to locate a Primary School site near the Orton Road / Landgren Road intersection and adjacent to the local sporting ground to maximise shared use of local facilities.

15.2 CASUARINA CENTRAL LOCAL STRUCTURE PLAN (MULTIPLE LANDHOLDINGS UNDER SEPARATE OWNERSHIP) – CONSIDERATION OF SUBMISSIONS AND RECOMMENDATION TO THE WESTERN AUSTRALIAN PLANNING COMMISSION

5.	**Closure of a portion of Orton Road**	Modify the Casuarina North Concept Plan to close a portion of Orton Road and provide a new road around the perimeter of the proposed District Open Space (DOS)(as shown in Figure 3) which will: • Facilitate integration of the DOS, Local Sporting Ground and Primary School to optimise the availability of these facilities for the community; and • Provide a road network that limits commercial traffic mixing with residential traffic.
6.	**Conservation of bushland, wetland and retention of significant trees**	Protect significant environmental values (including Conservation Category wetlands and Threatened Ecological Species) within open space areas within the CCLSP as far as practicable.
		Ensure that significant trees are retained in accordance with the City's LPP1 - Landscape Feature and Tree Retention.
7.	**Potential impact of Kwinana Freeway traffic noise on sensitive land uses**	Provide an appropriate separation distance between the Kwinana Freeway and noise sensitive land uses. Ensure that future noise sensitive land uses are designed to mitigate the potential impact of traffic noise emissions from the Kwinana Freeway.
8.	**Western Power easement**	Ensure that appropriate land uses are situated within and adjacent to the Western Power easement.
9.	**Future road access to Thomas Road**	Ensure the CCLSP is appropriately connected to Thomas Road as part of the future development of the Casuarina North precinct.
10.	**Interface with Rural zone along the eastern edge of the CCLSP**	Provide an adequate interface between the future residential areas within the CCLSP and the existing Rural zone to the east of the CCLSP to reduce the impact of residential development on the adjacent Rural zone.
11.	**Bushfire Management**	Ensure that the CCLSP incorporates appropriate Bushfire Management in accordance with State Planning Policy 3.7 Planning in Bushfire Prone Areas.
12.	**Designing out Crime**	Ensure that the CCLSP is designed in accordance with the City's LPP8 - Designing Out Crime.
13.	**Liveable Neighbourhoods**	Ensure that the CCLSP meets the requirements of Liveable Neighbourhoods.

15.2 CASUARINA CENTRAL LOCAL STRUCTURE PLAN (MULTIPLE LANDHOLDINGS UNDER SEPARATE OWNERSHIP) – CONSIDERATION OF SUBMISSIONS AND RECOMMENDATION TO THE WESTERN AUSTRALIAN PLANNING COMMISSION

Following the assessment of the CCLSP and the issues raised in the submissions, the City Officer recommendations are summarised in Table 3 as follows:

Table 3: Summary of City Officer recommendations

	ISSUES	CITY OFFICER RECOMMENDATIONS
1.	**Potential impact of odour emissions from the mushroom farm on sensitive land uses**	An Investigation Area, 500m in radius (measured from the nearest odour source being the Phase Three buildings and the wastewater pond), to be shown on the CCLSP. The purpose of the Investigation Area would be to: - Ensure that extensive Field Odour Assessments (FOA) are conducted over a 12 month period (including late February to early April); - Enable a comprehensive FOA data set to be collected across different wind and weather conditions so that the extent of adverse odour impacts can be assessed; and - Ensure that a precautionary approach is taken when considering potential odour impacts and determining separation distances between the mushroom farm and future sensitive land uses.
2.	**Potential impact of noise emissions from the mushroom farm on sensitive land uses**	An Investigation Area, 500m in radius (measured from the Phase Three buildings and the wastewater pond), to be shown on the CCLSP. The purpose of the Investigation Area would be to: - Ensure that noise assessments are conducted within the CCLSP area to determine the extent of noise emissions originating from the mushroom farm on the nearest proposed noise sensitive developments in accordance with regulation 8, 9 and 10 of the *Environmental Protection (Noise) Regulations 1997* relating to assigned noise levels, non – conforming uses and rural activities. - Ensure that a precautionary approach is taken when considering potential noise impacts and determining separation distances between the mushroom farm and future sensitive land uses.
3.	**Viability and location of the Local Centre**	A Local Centre of 650m^2 to 750m^2 to be provided on Landgren Road, south of the Primary School site is to be shown on the CCLSP.

15.2 CASUARINA CENTRAL LOCAL STRUCTURE PLAN (MULTIPLE LANDHOLDINGS UNDER SEPARATE OWNERSHIP) – CONSIDERATION OF SUBMISSIONS AND RECOMMENDATION TO THE WESTERN AUSTRALIAN PLANNING COMMISSION

4.	**Closure of portion of Orton Road**	Modify the Casuarina North Concept Plan to close a portion of Orton Road and provide a new road around the perimeter of the proposed DOS (as shown in Figure 3) which will: • Facilitate integration of the DOS, Local Sporting Ground and Primary School to optimise the availability of these facilities for the community; and • Provide a road network that limits commercial traffic mixing with residential traffic.
5.	**Primary school**	That the concerns raised by the Department of Education (DoE) about the future size and configuration of the Primary School be the subject of further consideration and discussions between the Department of Planning, Lands and Heritage (DPLH), DoE and the City prior to the final adoption of the CCLSP by the Western Australian Planning Commission (WAPC).
6.	**Conservation of bushland, wetland and retention of significant trees**	The proponent is to consult with the DBCA in relation to conducting an additional targeted flora survey within bushland where threatened flora species may occur, prior to the final adoption of the CCLSP by the WAPC.
		The proponent is to consult with the DBCA in relation to an additional assessment of the wetlands within the CCLSP area, prior to the approval of the CCLSP, to accurately map, protect and manage the wetlands within the CCLSP.
		A Wetland Management Plan should be prepared to the satisfaction of the DBCA in consultation with the City as a condition of subdivision to enable confirmation of mapping and management actions including rehabilitation requirements and interface treatments. Note: The DBCA has advised that it does not support the proposal to locate drainage Basin B within the buffer to the Resource Enhancement Wetland. Any drainage infrastructure should be located outside wetland buffers to minimise hydrological impacts in accordance with the Decision Process for Stormwater Management in WA (2005). This is particularly relevant if the subsequent wetland assessment undertaken results in an upgrade of the management category of this wetland to a Conservation Category Wetland.

		A Bushland Management Plan for bushland within Public Open Space (POS) in the CCLSP be prepared to the satisfaction of the DBCA in consultation with the City as a condition of subdivision.
		A Landscape Feature and Tree Retention Plan be prepared in accordance with Local Planning Policy 1 (LPP1) as a condition of subdivision, to ensure that the retention of significant trees is optimised as part of the civil design and earthworks.
		Identify on the CCLSP those areas of open space that are to be managed as conservation areas.
7.	**Potential impact of traffic noise from Kwinana Freeway on sensitive land uses.**	A condition on future subdivision applications requiring provision of Section 70A Notifications on all proposed lots that may be subject to excessive noise levels from Kwinana Freeway. The notifications would advise prospective purchasers that the lot situated in the vicinity of the Kwinana Freeway is currently affected and/or may in the future be affected by transport noise.
		Preparation of a Traffic Noise Assessment (TNA) assessing the impact of traffic noise from the Kwinana Freeway on residential areas including appropriate noise mitigation measures such as acoustic barriers and/or quiet house design requirements and an implementation plan to the satisfaction of the City of Kwinana. The TNA shall be prepared and adopted so as to inform subdivision design and/or any development approvals for the area the subject of the CCLSP.
8.	**Interface with Rural zone along the eastern edge of the CCLSP**	Show the maximum residential density at the interface with the Rural zone along the eastern boundary of the CCLSP as R5 coding. The purpose of the R5 coding is to ensure that there is sufficient space to provide landscaping on the R5 properties to reduce the potential impact of residential development on the Rural zoned properties to the east which are a minimum of 4ha in size.

15.2 CASUARINA CENTRAL LOCAL STRUCTURE PLAN (MULTIPLE LANDHOLDINGS UNDER SEPARATE OWNERSHIP) – CONSIDERATION OF SUBMISSIONS AND RECOMMENDATION TO THE WESTERN AUSTRALIAN PLANNING COMMISSION

9.	**Western Power easement**	Provision of Section 70A Notifications on all proposed lots adjoining the existing Western Power registered easement prior to subdivision clearance advising prospective purchasers that they are in close proximity to power infrastructure which will be maintained, upgraded and expanded on a regular basis.
10.	**Bushfire Management**	A Bushfire Management Plan should be prepared in accordance with State Planning Policy 3.7 Planning in Bushfire Prone Areas (SPP3.7) to the satisfaction of the Department of Fire and Emergency Services (DFES).
11.	**Urban Water Management**	An Urban Water Management Strategy should be prepared for the area the subject of CCLSP in consultation with the City and Department of Water and Environmental Regulation (DWER). The DBCA has advised that it does not support the proposal to locate drainage Basin B within the buffer to the Resource Enhancement Wetland. Any drainage infrastructure should be located outside wetlands buffers to minimise hydrological impacts in accordance with Decision Process for Stormwater Management in WA (2005). This is particularly relevant if the subsequent wetland assessment undertaken results in an upgrade of the management category of this wetland to a Conservation Category Wetland.

OFFICER RECOMMENDATION:

That Council makes the following recommendations to the Western Australian Planning Commission (WAPC) in respect to the proposed Casuarina Central Local Structure Plan (CCLSP):

1. Council advises the WAPC that it supports the CCLSP on the following basis:

    a) That the CCLSP be modified as follows:

        i. An Investigation Area, 500m in radius (measured from the Phase Three buildings and the wastewater pond), be shown on the CCLSP.

The purpose of the Investigation Area would be to:

- Ensure that extensive Field Odour Assessments (FOA) are conducted over a 12 month period (including late February to early April); and

- Enable a comprehensive FOA data set to be collected across different wind and weather conditions so that adverse odour impacts can be assessed.

- Ensure that noise assessments are conducted within the CCLSP area to determine the extent of noise emissions originating from the mushroom farm on the nearest proposed noise sensitive developments in accordance with the regulation 8, 9 and 10 of the *Environmental Protection (Noise) Regulations 1997* relating to assigned noise levels, non – conforming uses and rural activities.

- Ensure that a precautionary approach is taken when considering potential noise and odour impacts and determining separation distances between the mushroom farm and future sensitive land uses.

ii. Remove the Odour Investigation Area adjacent to the mushroom farm as shown in the advertised version of the CCLSP;

iii. Show a Local Centre (650m^2 to 750m^2) in the CCLSP adjacent to Landgren Road, immediately south of the Primary School site.

iv. Identify on the CCLSP those areas of open space that are required by the City of Kwinana and Department of Biodiversity Conservation and Attractions (DBCA) to be managed as conservation areas.

v. Show the maximum residential density at the interface with the Rural zone along the eastern boundary of the CCLSP as R5 coding.

b) Inclusion of the following in Part 1 of the CCLSP to the City's satisfaction:

i. Preparation of a Traffic Noise Assessment (TNA) assessing the impact of traffic noise from the Kwinana Freeway on the residential areas in the CCLSP. This assessment must include consideration of appropriate noise mitigation measures such as acoustic barriers and/or quiet house design requirements and an implementation plan to the satisfaction of Main Roads and the City of Kwinana. The TNA shall be prepared and adopted so as to inform subdivision design and/or any development approvals for the area the subject of the CCLSP.

ii. That a Local Water Management Strategy (LWMS) is to be prepared to the satisfaction of the Department of Water and Environmental Regulation (DWER) and the City of Kwinana.

The LWMS shall be prepared and adopted so as to inform subdivision design and/or any development approvals for the area of the CCLSP.

Note: The DBCA has advised that it does not support the proposal to locate drainage Basin B within the buffer to the Resource Enhancement Wetland. Any drainage infrastructure should be located outside wetland buffers to minimise hydrological impacts in accordance with Decision Process for Stormwater Management in WA (2005). This is particularly relevant if the subsequent wetland assessment undertaken results in an upgrade of the management category of this wetland to a Conservation Category Wetland.

iii. A Wetland Management Plan is to be prepared to the satisfaction of the DBCA in consultation with the City of Kwinana prior to subdivision to enable confirmation of mapping and management actions including rehabilitation requirements and interface treatments.

iv. A Bushland Management Plan for bushland within Public Open Space (POS) in the CCLSP is to be prepared to the satisfaction of the DBCA in consultation with the City of Kwinana prior to subdivision to enable confirmation of mapping and management actions including rehabilitation requirements and interface treatments.

v. A Landscape Feature and Tree Retention Strategy is to be prepared in accordance with City of Kwinana's Local Planning Policy No 1, to ensure that the retention of significant trees is optimised as part of the subdivision design, civil design and earthworks. The Landscape Feature and Tree Retention Strategy should be developed in consultation with the City of Kwinana to inform subdivision design and/or any development approvals for the area of the CCLSP.

vi. A Bushfire Management Plan should be prepared in accordance with State Planning Policy 3.7 Planning in Bushfire Prone Areas (SPP3.7) to the satisfaction of the Department of Fire and Emergency Services.

vii. All development shall be designed and constructed to protect Western Power infrastructure and interests from potential land use conflict. No development (including fill, fencing, storage or parking) will be permitted within Western Power registered easements without the prior written approval of Western Power or the relevant power line operator.

2. Request that the WAPC impose conditions on future subdivision applications within the area of CCLSP requiring:

   i. The provision of Section 70A Notifications on all proposed lots adjoining the existing Western Power registered easement advising prospective purchasers that they are in close proximity to power infrastructure which will be maintained, upgraded and expanded on a regular basis.

      All development shall be designed and constructed to protect Western Power infrastructure and interests from potential land use conflict.

      No development (including fill, fencing, storage or parking) will be permitted within Western Power registered easements without the prior written approval of Western Power or the relevant power line operator.

   ii. The provision of Section 70A Notifications on all proposed lots that may be subject to excessive noise levels from Kwinana Freeway advising prospective purchases that the lot is situated in the vicinity of Kwinana Freeway and is currently affected and/or may in the future be affected by transport noise.

   iii. Preparation of an Urban Water Management Plan for the area the subject of CCLSP in consultation with the City of Kwinana and DWER.

   iv. Preparation of a Bushland Management Plan for bushland within POS in the CCLSP to the satisfaction of the DBCA in consultation with the City of Kwinana.

   v. Preparation of a Landscape Feature and Tree Retention Plan in accordance with Local Planning Policy 1, to ensure that the retention of significant trees is optimised as part of the civil design and earthworks.

3. Recommend that the proponent consult with the DBCA in relation to conducting an:

   i. Additional targeted flora survey within bushland where threatened ecological species may occur within the CCLSP, prior to the final adoption of the CCLSP by the WAPC.

   ii. Assessment of the wetlands within the CCLSP area, prior to the approval of the CCLSP, to accurately map, protect and manage the wetlands within the CCLSP.

15.2 CASUARINA CENTRAL LOCAL STRUCTURE PLAN (MULTIPLE LANDHOLDINGS UNDER SEPARATE OWNERSHIP) – CONSIDERATION OF SUBMISSIONS AND RECOMMENDATION TO THE WESTERN AUSTRALIAN PLANNING COMMISSION

The City of Kwinana acknowledges that not all of the bushland on Lots 36 and 48 is included within open space as recommended by DBCA. The City also acknowledges that the DBCA has advised that further flora surveys and wetland assessments are required to enable an accurate assessment of environmental values on site to inform the structure plan design. However, City Officers are cognisant that 24% of the CCLSP area is identified as open space which is already in excess of the 10% Public Open Space (POS) contribution required under Liveable Neighbourhoods. City Officers are of the view that the configuration of open space shown in the CCLSP protects a significant area of Carnaby's Black Cockatoo habitat (including habitat bushland, and significant foraging and breeding trees) as shown in Confidential Attachment N in this report. Carnaby's Black Cockatoos are a Threatened Ecological Species and some of the areas of Carnaby's Black Cockatoo habitat are a Threatened Ecological Community under Commonwealth environmental legislation.

The City is responsible for ensuring that there is a balance between providing land for recreation, conservation of environmental values and retention of significant trees during the preparation of local structure plans for Urban zoned land. The City is satisfied that significant areas of bushland and wetlands within the CCLSP area, have been included within large consolidated areas of open space. City Officers recommend that these areas be identified in the CCLSP for conservation purposes.

4. Request that the concerns raised by the Department of Education (DoE) about the future size and configuration of the Primary School be the subject of further consideration and discussions between the Department of Planning, Lands and Heritage, DoE and the City of Kwinana prior to the final adoption of the CCLSP by the WAPC.

5. Endorse the Schedule of Submissions (Attachment C) pursuant to Schedule 2, Part 4, Clause 20(2) of the *Planning and Development Regulations 2015*.

6. Require the Casuarina North Concept Plan be amended to show the proposed closure of Orton Road and provision of a new road around the perimeter of the District Open Space (DOS) (Attachment D) which will:

   - Facilitate integration of the DOS, Local Sporting Ground and Primary School to optimise the availability of these facilities for the community; and
   - Provide a road network that limits commercial traffic mixing with residential traffic.

7. Council requests City Officers to review Local Planning Policy No. 6 Guidelines for Structure Planning in the Casuarina Cell to reflect the proposed closure of Orton Road and provision of a new road around the perimeter of the DOS.

8. Forward this Ordinary Council Meeting Report, Council's recommendations and the Schedules of Submissions for the CCLSP to the WAPC pursuant to Schedule 2, Clause 20 of the *Planning and Development Regulations 2015*.

15.2 CASUARINA CENTRAL LOCAL STRUCTURE PLAN (MULTIPLE LANDHOLDINGS UNDER SEPARATE OWNERSHIP) – CONSIDERATION OF SUBMISSIONS AND RECOMMENDATION TO THE WESTERN AUSTRALIAN PLANNING COMMISSION

BACKGROUND:

The area the subject of the proposed CCLSP is zoned Urban under the *Metropolitan Region Scheme* (MRS) and Development under *Local Planning Scheme No. 2* (LPS2).

The Casuarina Cell was rezoned from Rural to Urban Deferred in the MRS in November 2007 (MRS Amendment 1117/30). The Urban Deferred zoning was lifted by the WAPC on 18 October 2013 (MRS Amendment 1257/27). A concept plan for the Casuarina Cell (based on the Eastern Residential Intensification Concept) was prepared to support the lifting of urban deferment. LPS2 was amended concurrently with the lifting of urban deferment to rezone the Casuarina Cell from Rural to Development, pursuant to section 126(3) of the *Planning and Development Act 2005* (PD Act).

Local Planning Policy 6 – Guidelines for Structure Planning in the Casuarina Urban Cell

Local Planning Policy 6 (LPP6) (Attachment E) was adopted by Council in 2018 to provide a framework for local structure planning in the Casuarina Cell so that subdivision development can proceed in an orderly and proper manner.

Three local structure planning precincts are identified in LPP6, referred to as the North, Central and South precincts. City Officers are satisfied that the CCLSP meets the following criteria for a LSP as set out in LPP6:

a) The CCLSP provides for significant local and district land uses and facilities as identified in the policy;
b) The CCLSP can be considered in isolation to the wider planning considerations within the precinct in which it is located as its approval would not prejudice the optimum planning and design outcome of the precinct; and
c) The CCLSP applies to greater than a single lot and occupies an area of at least 30% of the precinct.

LPP6 states that a LSP in the Casuarina Central precinct should deal with the following district and local planning matters:

a) Demonstrate that the proposed sensitive land uses will not be exposed to unacceptable odour and noise emissions from the mushroom farm.
b) Potential land use compatibility matters should be taken into account and appropriately mitigated between Development and Rural zones.
c) A Primary School site located near the intersection of Landgren Road and Orton Road.
d) POS co-located with the Primary School to the satisfaction of the City and the Department of Education.
e) A maximum of 80% of the total POS requirement in the Central Precinct shall be provided within the precinct with the shortfall (maximum 20%) being provided as a cost contribution through the DCP.
f) Landgren Road as the main north-south road link through the Casuarina Cell.
g) Identify a site for a Local Centre (commercial and activity centre) (800m^2 retail floor space) provided at the intersection of Landgren Road and Orton Road, either in the Central Precinct or the North Precinct.

h) Provide Commercial uses and floor areas consistent with the City's Local Commercial and Activity Centres Strategy.
i) Ensure that vulnerable and high risk land uses are proposed in a manner in which the associated bushfire risk can be sufficiently mitigated.
j) Ensure that stormwater drainage is contained within each precinct, unless supported by a Local Water Management Strategy and an implementation process that enables drainage to be managed elsewhere.
k) *Residential densities are to comply with Liveable Neighbourhood principles with higher densities located near the activity centre or areas of higher amenity.*

The City Officers assessment of the CCLSP against the guidelines set out in LPP6, is outlined in the assessment sections of this report. In summary, the proponent has met the requirements of items b), c), d) and e) above in relation to the CCLSP. As discussed further in this report, the CCLSP should be modified to identify an investigation area concerning point a) and that a Local Centre be identified on the CCLSP in accordance with item g). Item c) cannot be satisfied due to the significant amount of open space required for conservation purposes within the CCLSP.

Casuarina North Local Structure Plan (partial)

The Casuarina North Local Structure Plan (CNLSP) (Attachment D) covers approximately 25.76 ha of land situated immediately north of Casuarina CCLSP. Council resolved to adopt the CNLSP on 14 November 2019. The WAPC adopted the CNLSP on 11 June 2019.

The purpose of the CNLSP is to provide the planning framework for a bulky goods retail and showroom precinct. The CNLSP identifies the land abutting the south side of Thomas Road as Service Commercial (13.95ha) and the land situated immediately north of the mushroom farm as Special Use (6.5ha).

Casuarina North Concept Plan

LPP6 requires the preparation of a concept plan for the balance of the Casuarina North precinct not included in the CNLSP. The Casuarina North Concept Plan (Attachment D) was prepared by the proponent of the CNLSP. The purpose of the concept plan is to address the key requirements set out in LPP6, including:

a) The location of a Main Roads WA controlled strategic four way intersection on Thomas Road;
b) A north-south road structure designed to tie in with the existing alignment of Landgren Road to the south in the adjacent Central Precinct; and
c) Location of District Open Space (DOS) on the Orton Road and Landgren Road intersection.

An outcome of the City Officer assessment of the CCLSP and its integration with future land uses on adjacent properties is a recommendation that the Casuarina North Concept Plan be modified to close a portion of Orton Road and provide a new road around the perimeter of the proposed DOS situated within the Casuarina North Concept Plan (as shown in Figure 3) which will:

a) Facilitate integration of the DOS, Local Sporting Ground and Primary School to optimise the availability of these facilities for the community; and
b) Provide a road network that limits commercial traffic mixing with residential traffic.

The road alignment around the DOS can then be explored in further detail as part of any future LSP for the area the subject of the Casuarina North Concept Plan.

It should be noted that whilst preliminary discussions have taken place with consultants in regards to aspects of the Casuarina North Concept Plan, an LSP for this area has not been lodged with the City for consideration.

SUMMARY AND CITY OFFICER RESPONSE TO ISSUES RAISED IN THE SUBMISSIONS

Fifteen submissions were received during the advertising period for the CCLSP, including nine from State Government agencies/service providers and six from landowners. The issues raised in the submissions and the City Officer comments are outlined in the Schedule of Submissions.

The main issues raised in the submissions and the City Officer comments are summarised in Table 4 below:

Table 4: The main issues raised in the submissions and City Officer comments

Submitters Comments	City Officer Comments
Department of Education	
DoE recommends that the requirement for schools in the area be reviewed to ensure that there is sufficient provision of public primary and secondary schools to meet the increased dwelling yield projection for the locality. DoE does not support the CCLSP because the proposed primary school site is constrained and does not facilitate a safe and efficient school design and does not comply with the design principles of Liveable Neighbourhoods.	To ensure this matter is resolved in a manner consistent with other greenfield sites within the metropolitan area, City Officers recommend that the concerns raised by the DoE about the future size and configuration of the Primary School be the subject of further consideration and discussions between the DPLH, DoE and the City prior to the final adoption of the CCLSP by the WAPC.

15.2 CASUARINA CENTRAL LOCAL STRUCTURE PLAN (MULTIPLE LANDHOLDINGS UNDER SEPARATE OWNERSHIP) – CONSIDERATION OF SUBMISSIONS AND RECOMMENDATION TO THE WESTERN AUSTRALIAN PLANNING COMMISSION

Department of Biodiversity, Conservation and Attractions	
The CCLSP should include provisions for the preparation and implementation of relevant management plans for proposed conservation areas and wetland rehabilitation requirements and interface treatments.	Support City Officers recommend that provisions requiring the preparation of the following management plans be included in the CCLSP and considered during the subdivision and development of the CCLSP area: -Wetland Management Plan -Bushland Management Plan -Landscape Feature and Tree Retention Plan
Areas of open space intended for conservation purposes should be identified on the CCLSP.	Support City Officers recommend that the CCLSP be modified by the proponent or the WAPC to identify those areas of open space that are required to be managed as conservation areas.
DBCA recommends an additional targeted flora survey of all suitable habitat within the CCLSP be undertaken at the appropriate time of the year, prior to the approval of the structure plan.	Support City Officers recommend that the proponent consults with the DBCA in relation to conducting additional targeted flora surveys where threatened species may occur within the CCLSP, prior to the final adoption of the CCLSP by the WAPC.
DBCA recommends that a wetland assessment of the CCLSP area is undertaken prior to the approval of the CCLSP to accurately map, protect and manage the wetlands onsite.	Support City Officers recommend that the proponent consults the DBCA in relation to an assessment of the wetlands within the CCLSP area, prior to the approval of the CCLSP to accurately map, protect and manage the wetlands onsite.

15.2 CASUARINA CENTRAL LOCAL STRUCTURE PLAN (MULTIPLE LANDHOLDINGS UNDER SEPARATE OWNERSHIP) – CONSIDERATION OF SUBMISSIONS AND RECOMMENDATION TO THE WESTERN AUSTRALIAN PLANNING COMMISSION

Main Roads	
Any noise sensitive development that exceeds the noise target must implement the mitigation measures specified in the Lloyd George Acoustics Noise Assessment Report.	Support City Officers recommend that the following provision be included in Part 1 of the CCLSP: Preparation of a Traffic Noise Assessment (TNA) assessing the impact of traffic noise from the Kwinana Freeway on residential areas including appropriate noise mitigation measures such as acoustic barriers and/or quiet house design requirements and the an implementation plan to the satisfaction of the City of Kwinana. City Officers will request the WAPC to impose the following condition on future subdivision applications: The provision of a notice on the title of all proposed lots that may be subject to excessive noise levels from the Kwinana Freeway advising prospective purchasers that the lot is situated in the vicinity of the Kwinana Freeway and is currently affected and/or may in the future be affected by transport noise.
Western Power	
Structure plan, future subdivision and development processes must protect the transmission line corridor and associated assets from encroachment, mitigating public safety or network reliability risks and ensuring there is no impediment to routine and emergency land access to the network.	Support City Officers recommend that the following provision be included in Part 1 of the CCLSP: All development shall be designed and constructed to protect Western Power infrastructure and interests from potential land use conflict. No development (including fill, fencing, storage or parking) will be permitted within Western Power registered easements without the prior written approval of Western Power or the relevant power line operator. City Officers will request the WAPC to impose the following condition on future subdivision applications: Provision of a notice on the title on all proposed lots adjoining the existing Western Power registered easement prior to subdivision clearance advising prospective purchasers that they are in close proximity to power infrastructure which will be maintained, upgraded and expanded on a regular basis.

15.2 CASUARINA CENTRAL LOCAL STRUCTURE PLAN (MULTIPLE LANDHOLDINGS UNDER SEPARATE OWNERSHIP) – CONSIDERATION OF SUBMISSIONS AND RECOMMENDATION TO THE WESTERN AUSTRALIAN PLANNING COMMISSION

Department of Fire and Emergency Services	
A number of modifications to the Bush Fire Management Plan will be required at subsequent stages of the planning process.	Support City Officers recommend that the following provision be included in Part 1 of the CCLSP: A Bushfire Management Plan should be prepared in accordance with State Planning Policy 3.7 Planning in Bushfire Prone Areas (SPP3.7) to the satisfaction of the Department of Fire and Emergency Services.
Costa Mushroom Exchange	
The owner of the mushroom farm requests additional protection of the mushroom farm operation to ensure its long term viability into the future. The mushroom farm owner states that a 500m buffer between the mushroom facility boundaries and any new sensitive development is required, and, that an additional 500m be applied to create a conceptual buffer zone.	City Officers recommend that an Investigation Area (500m radius measured from the nearest odour source being the Phase Three buildings and the wastewater pond) should be shown on the CCLSP. The purpose of the Investigation Area would be to: -Ensure that extensive FOAs are conducted over a 12 month period (including late February to early April);and -Enable a comprehensive FOA data set to be collected across different wind and weather conditions so that assessment of adverse odour impacts can be assessed. -Ensure that a precautionary approach is taken when considering potential noise and odour impacts and determining separation distances between the mushroom farm and future sensitive land uses. -Ensure that noise assessments are conducted within the CCLSP area to determine the extent of noise emissions originating from the mushroom farm on the nearest proposed noise sensitive developments in accordance with the regulation 8, 9 and 10 of the *Environmental Protection (Noise) Regulations 1997* relating to assigned noise levels, non – conforming uses and rural activities.

15.2 CASUARINA CENTRAL LOCAL STRUCTURE PLAN (MULTIPLE LANDHOLDINGS UNDER SEPARATE OWNERSHIP) – CONSIDERATION OF SUBMISSIONS AND RECOMMENDATION TO THE WESTERN AUSTRALIAN PLANNING COMMISSION

Owner of Lot 9000 Orton Road	
Remove the 'Parks, Recreation and Drainage' Reserve at the north eastern corner of Lot 9000 and show the land as Residential R25-40.	Not supported There are a number of significant stands of native trees located in this area. To ensure their protection the area is identified as POS in the CCLSP.
Remove the 'Parks, Recreation and Drainage' Reserve located between the wetland buffer and the power easement and show the land as Residential R25 - 40.	Not supported City Officers are of the view that the suggestion to provide approximately 5,000m^2 of residential land between the Western Power easement and the Conservation Category wetlands will result in poor planning outcomes, particularly in relation to the environment and residential amenity.
Owner of Lot 45 Orton Road	
The CCLSP ought to be amended to show Lot 45 as the 'Local Centre'.	Not supported City Officers are of the view that a Local Centre would not require all of Lot 45 (4.14ha) to be identified as Local Centre and the opportunity to co-locate District Open Space, a Local Sporting Ground and Primary School site will result in a preferable planning outcome. Alternative locations for the Primary School would not provide the same opportunity to locate the Primary School, Local Sporting Ground and District Open Space together.

15.2 CASUARINA CENTRAL LOCAL STRUCTURE PLAN (MULTIPLE LANDHOLDINGS UNDER SEPARATE OWNERSHIP) – CONSIDERATION OF SUBMISSIONS AND RECOMMENDATION TO THE WESTERN AUSTRALIAN PLANNING COMMISSION

Owner of Lots 2, 24 and 25 Orton Road	
The owners are concerned that the proposed CCLSP will set a precedent for the location of DOS on their property which is inconsistent with their proposed plan attached to their submission (Attachment C). The submitter's plan includes a small local market centre on the corner of Landgren and Orton Roads providing fresh foods and small business as a local shopping centre for housing.	Not supported It is recognised that the submitter has prepared a conceptual local structure plan across their three landholdings (as shown in the Schedule of Submissions) that shows a very different proposal to that shown in the Casuarina North Concept Plan. In particular, the location of the DOS under the Casuarina North Concept Plan significantly conflicts with their design intent. In consideration of this conflict, City Officers have focused on the best long term planning outcomes for the area and have concluded that the location of the DOS is the best for the community. The reason for this is that the co-location of the DOS with the primary school and the City's Local Sporting Ground provide a significant and unique opportunity to create a recreation facility of significant design and scale which maximises integration and will be of benefit for the community in the long term. Further, the primary school and oval are located on the CCLSP at the sites best suited to these uses given the constraints across the structure plan area so these tend to dictate the location of the DOS. Another advantage to the co-location of these facilities is that it allows for the closure of Orton Road and that will provide benefits for traffic movements throughout the locality and assist in separating service commercial traffic from residential traffic and land uses. Whilst conceptual at this stage, it is important to note that Orton Road is being closed and not being realigned around the DOS. That portion of the existing road reserve (20 metre width) within the DOS area would be re-vested for recreational purposes and this area can be incorporated into the area required for the DOS which would reduce the area of the DOS in Lots 2, 24 and 25. There would be a need for the delivery of a future subdivisional road around the DOS (needed to separate residential areas from the recreation reserve and provide on street parking).

15.2 CASUARINA CENTRAL LOCAL STRUCTURE PLAN (MULTIPLE LANDHOLDINGS UNDER SEPARATE OWNERSHIP) – CONSIDERATION OF SUBMISSIONS AND RECOMMENDATION TO THE WESTERN AUSTRALIAN PLANNING COMMISSION

CITY OFFICER ASSESSMENT OF STRATEGIC PLANNING ISSUES

To ensure that the area the subject of the CCLSP is developed in an orderly and proper manner and achieves the best possible long term planning outcomes, City Officers have assessed the CCLSP in relation to the following matters and the relevant planning strategies and policies:

Separation distance between the mushroom farm and noise/odour sensitive land uses

The mushroom farm is located adjacent to the north-west corner of the CCLSP.

LPP 6 requires that evidence obtained from onsite noise studies, odour studies and modelling will be required when sensitive land uses are proposed in the vicinity of the mushroom farm to demonstrate that sensitive land uses will not be exposed to unacceptable odour and noise emissions. The City will only support land uses in locations where it can be confident there will not be long-term land use conflicts.

The CCLSP proposes residential development approximately 200m from the main mushroom farm building. Residential development is classified as a sensitive land use in State Planning Policy 2.5 – Rural Planning (SPP2.5), which defines sensitive land uses as "Land uses that are residential or institutional in nature, where people live or regularly spend extended periods of time. These include dwellings, short stay accommodation, schools, hospitals, and childcare centres, and generally excludes commercial or industrial premises".

Discussion of odour assessment reports and recommendations
A series of reports have been prepared by the owners of the mushroom farm, the proponent and the City concerning the likelihood of odour emissions impacting on sensitive land uses within the CCLSP area and what distance these sensitive land uses should be separated from the mushroom farm. These reports are summarised in Table 5 below in chronological order.

Table 5: Mushroom farm odour assessment reports

	Date	Report title	Consultant & Client
1.	December 2013	Investigation of odour impacts from mushroom exchange	Envall Environmental Alliances (Client Costa Mushroom Farm)
2.	August 2015	Revision of predicted odour levels based on sampling of sterilisation building	Envall Environmental Alliances (Client – Costa Mushroom Farm)
3.	October 2015	Costa Mushroom Exchange Site Environmental Management Plan	Costa Mushroom Farm

15.2 CASUARINA CENTRAL LOCAL STRUCTURE PLAN (MULTIPLE LANDHOLDINGS UNDER SEPARATE OWNERSHIP) – CONSIDERATION OF SUBMISSIONS AND RECOMMENDATION TO THE WESTERN AUSTRALIAN PLANNING COMMISSION

4.	March 2019	Casuarina Central LSP – Odour Investigation Area (Attachment F)	Strategen Environmental (Client – LWP)
5.	July 2019	Casuarina Mushroom Farm Odour Assessment (Attachment G)	Strategen Environmental (Client – LWP)

Submission from the mushroom farm
The owner of the mushroom farm has lodged a submission in relation to the CCLSP which requests additional protection of the mushroom farm operation to ensure its long term viability into the future. The mushroom farm owner states that a 500m buffer is required, and, that an additional 500m be applied to create a conceptual buffer zone.

Summary of investigations and reports
Reports 1, 2 and 3 (Table 5 above) were prepared by the owners of the mushroom farm as part of the upgrade of the mushroom facility and preparation of environmental management plans.

Reports 1 and 2 were considered by the proponent of the CCLSP as the basis of their initial assessment of the separation distance required between the mushroom farm and residential areas and the identification of an Investigation Area on the CCLSP.

Prior to advertising the CCLSP, the City advised the proponent that it was not satisfied with the assessment of potential offsite impacts from the mushroom farm submitted with the CCLSP (Envall, August 2015). The City further advised that a more detailed odour study would be required which should include onsite verification of odour impacts to identify the required separation distance between the mushroom farm and sensitive land uses to avoid the occurrence of unacceptable odour levels in future residential areas.

The City also requested that the proponent demonstrate to the City how the CCLSP approval and planning may proceed while onsite testing is being undertaken, which could involve:

- Designating an area on the CCLSP as “Subject to Further Investigation” where sensitive land uses may be potentially affected by odour emissions from the mushroom farm; or
- Staging development within the CCLSP area.

In response, Strategen (Report 4 prepared on behalf of the proponent) identified a preliminary Investigation Area on the CCLSP and confirmed that further work would be undertaken during (and following) the advertising period to identify an Investigation Area.

The City engaged Talis consultants to independently review the methodology outlined by Strategen in Report 4. Talis also recommended a preferred methodology to be followed to identify potential emissions and an appropriate separation distance.

Strategen lodged Report 5 (on behalf of the proponent) which outlined a recommended separation distance based on field odour testing using the methodology outlined by Talis. Strategen concluded that odour levels were low and infrequent and did not necessitate an investigation area or buffer that would impinge on the CCLSP area.

15.2 CASUARINA CENTRAL LOCAL STRUCTURE PLAN (MULTIPLE LANDHOLDINGS UNDER SEPARATE OWNERSHIP) – CONSIDERATION OF SUBMISSIONS AND RECOMMENDATION TO THE WESTERN AUSTRALIAN PLANNING COMMISSION

The City then engaged Talis consultancy (which subcontracted The Odour Unit) to peer review the odour monitoring and assessment undertaken by Strategen in Report 5.

The Odour Unit peer review found the following:

- A small number (3) of FOAs were conducted over a short period (4 weeks) in May 2019;
- Only one of the FOAs was conducted during the delivery of compost, known to be the most odorous process on site;
- The projection of the findings from the May 2019 FOA assessments across a full year of wind and temperature conditions requires further justification. It is often the calm or near-calm wind conditions that result in adverse odour impacts in the near-field locations from an odour source. The Odour Unit recommended that the peak months for odour complaints are late-February to early-April; and
- The Envall reports (Reports 1 and 2) may not have included all significant odour sources at the mushroom farm. The 2013 report acknowledges that the odour emissions from the wastewater evaporation pond are seasonally variable and "higher during spring and summer". They were not sampled nor included as an odour source. In addition, the vents from the Phase 2 tunnels also appear not to have been included. The Odour Unit's experience is that these vent emissions have been found to be odorous during the first 24-36 hours from filling, and therefore these emissions need to be included in any odour assessment and the design of an odour control system. In general, the total odour emission rate from the plant, as used in the modelling, seems low for a plant of this size and layout.

The Odour Unit peer review concluded that findings and conclusions of the Strategen report (Report 5) could not be supported for the following reasons:

- The FOA assessments, though conducted according to an accepted methodology, were found to be insufficient in number and examined only the wind and temperature conditions prevailing during three days in May 2019. While the study did contain a wind frequency analysis as a means of redressing this limitation, it is considered that more ground truthing is required. If this approach is to be preferred over other methods, including odour dispersion modelling, a far more comprehensive FOA data set across different wind and weather conditions would be required, before any conclusive assessment of adverse odour impacts can be made.
- It is the peer reviewer's opinion that the Envall modelling studies (2013 and 2015) were carried out for reasons other than determining the extent to which odorous process emissions were impacting off-site. Use of the Envall Modelling Studies for accurately projecting odour movement from the site would require the model to be upgraded to include all odour sources at the mushroom farm, and to quantify these source emissions with a robust and comprehensive odour sampling program, assuming no such data set exists at present. Given that DWER recently issued Odour Guidelines, such a modelling-based approach may not meet with their endorsement, thus supporting the extended FAO approach favoured by this review.

15.2 CASUARINA CENTRAL LOCAL STRUCTURE PLAN (MULTIPLE LANDHOLDINGS UNDER SEPARATE OWNERSHIP) – CONSIDERATION OF SUBMISSIONS AND RECOMMENDATION TO THE WESTERN AUSTRALIAN PLANNING COMMISSION

City Officers comments

City officers are concerned that the FOAs conducted by Strategen were conducted over an insufficient number of days and examined only the wind and temperature conditions prevailing during three days in May 2019.

City Officers are also concerned that the FOA conducted on 29 May 2019 during the compost deliveries and easterly wind conditions was reported by Strategen as having been conducted on Holden Close (cul-de-sac - 160m and cars parked – 270m), on the other side of the Kwinana Freeway. Further, distance measurements appear to have been taken from the western border of the mushroom farm, as opposed to the location of the source of the odour at the north-east corner of the site. The location is a further 210m away from the south-west part of the property with the mushroom farm buildings mid path. This effectively means that the Holden Close location is around 480m from the source of the odour and could be detected despite the Kwinana Freeway traffic and mushroom farm buildings.

City Officers are therefore of the view that an Investigation Area 500m in radius (based on the EPA Guidance for the Assessment of Environmental Factors No. 3) (measured from the nearest odour source being the Phase Three buildings and the wastewater pond) should be shown on the CCLSP. The purpose of the Investigation Area would be to enable:

a) extensive FOAs to be conducted over a 12 month period across different wind and weather conditions during:
    - spring and summer to assess odour from the wastewater pond; and
    - February to early April when wind dispersion is limited.

b) Enable a comprehensive FOA data set to be collected across different wind and weather conditions so that the extent of adverse odour impacts can be assessed;

c) Ensure that noise assessments are conducted within the CCLSP area to determine the extent of noise emissions originating from the mushroom farm on the nearest proposed noise sensitive developments in accordance with the regulation 8, 9 and 10 of the Environmental Protection (Noise) Regulations 1997 relating to assigned noise levels, non – conforming uses and rural activities; and

d) Ensure that a precautionary approach is taken when considering potential noise and odour impacts and determining separation distances between the mushroom farm and future sensitive land uses.

The City will consider an amendment to the CCLSP to remove the 500m Investigation Area once the City is satisfied that points a) and b) above have been satisfied.

15.2 CASUARINA CENTRAL LOCAL STRUCTURE PLAN (MULTIPLE LANDHOLDINGS UNDER SEPARATE OWNERSHIP) – CONSIDERATION OF SUBMISSIONS AND RECOMMENDATION TO THE WESTERN AUSTRALIAN PLANNING COMMISSION

Viability and location of a Local Centre (in accordance with LPP6)

LPP 6 requires that a site for a Local Centre be provided near the intersection of Landgren Road and Orton Road, either in the Central Precinct or the Northern Precinct. This reflects the Local Commercial Activity Centres Strategy (LCACS) which identifies a Local Centre in the vicinity of the Landgren Road and Orton Road intersection. A Local Centre has not been shown on the CCLSP or the Casuarina North Concept Plan.

Three reports have been prepared concerning the potential viability and location of a Local Centre in the CCLSP. These are as follows:

a) Casuarina Central Local Structure Plan – Retail Needs Assessment and Mixed Business Assessment (Taktiks4, December 2018) prepared on behalf of LWP Property Group. (Attachment H)
b) Casuarina Central Precinct Structure Plan – Review of the Retail Needs Assessment (Shrapnel Urban Planning, June 2019) prepared on behalf of the City of Kwinana.
c) Casuarina Central Structure Plan – Response to Retail Needs Review (Sharpnell) (July, 2019) prepared by Taktiks4 on behalf of LWP Property Group. (Attachment I).

In summary, Taktics4 (December, 2018) advised the City on behalf of the proponent that the Casuarina Local Centre would capture 20% of the available spending capacity in Casuarina North and Casuarina Central and would not expect any spend from the catchments further north and south of the Casuarina Central precinct. Taktics4 concluded that the capture rate would support up to 115m^2 of retail floor space, enough to support a single shop. However, the proponent was of the view that it has proven unrealistic that a single shop is capable of being sustained in the current market and retail conditions. Taktics4 argued that very few single retail operations achieve sustainable success in a stand-alone situation.

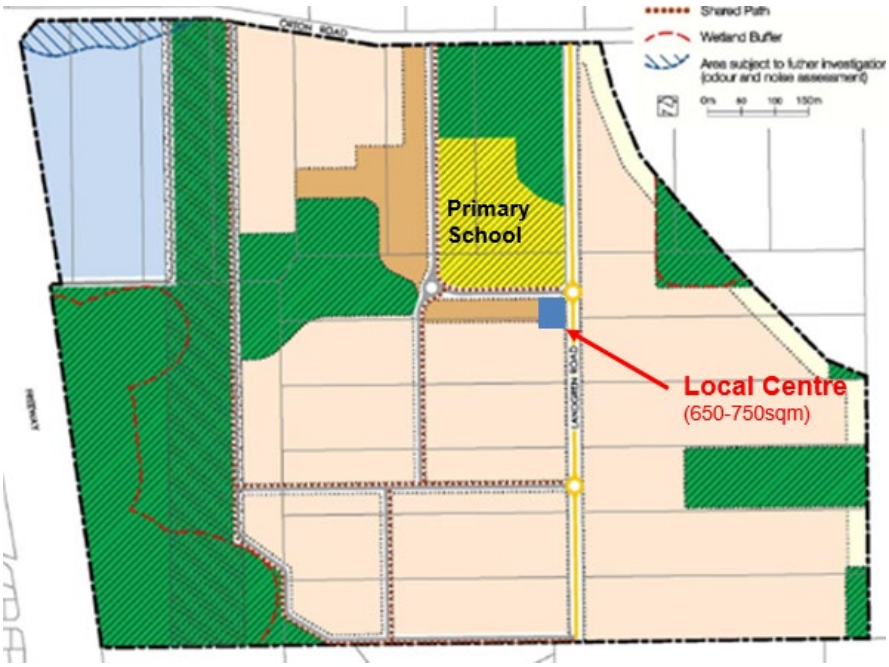
Taktics4 later advised (July, 2019) that the Casuarina Central community will have access to two supermarkets at two centres both north (Anketell South) and south (Casuarina South precinct). Taktics4 concluded that if a local centre is to be pursued for Casuarina, a location north of Orton Road is more ideally suited to maximise access to the catchment it is intended to serve.

The Taktics4 market analysis concluded that the community will not be able to sustain the existence of these two centres and a third Local Centre. The extent and limited nature of the catchment precludes this from being sustainable.

In contrast to the Taktics4 retail analysis, Shrapnel Urban Planning engaged by the City, advised that the most appropriate size for a Local Centre within Casuarina, based on current population projections, would be 650m^2 to 750m^2 by 2036. Shrapnel Urban Planning also advised that the Local Centre should be situated equidistant between Thomas Road and Mortimer Road immediately south of the proposed primary school site as shown in the plan below.

15.2 CASUARINA CENTRAL LOCAL STRUCTURE PLAN (MULTIPLE LANDHOLDINGS UNDER SEPARATE OWNERSHIP) – CONSIDERATION OF SUBMISSIONS AND RECOMMENDATION TO THE WESTERN AUSTRALIAN PLANNING COMMISSION

Figure 1: Recommended location for a Local Centre.



However, Shrapnel Urban Planning advised that this recommendation assumes that the majority of urban zoned land in Casuarina South is able to be developed and should this not occur, then the economic potential of a local activity centre in Casuarina should be reassessed.

City Officers comments

City Officers recommend that a Local Centre be shown on CCLSP immediately south of the primary school site as shown in Figure 1 above to allow the potential for a Local Centre to be developed and serve as a community focal point once the Casuarina Central precinct has been fully developed. This does not assume development of all of the urban zoned land in Casuarina South, but allows for the Local Centre to be identified now for future consideration and review, subject to changes within the catchment and the impact of other surrounding centres.

Viability of the proposed Service Commercial area

The CCLSP includes provision of a 7.1 ha Service Commercial precinct in the north-west corner of the CCLSP, situated between the Kwinana Freeway, the Western Power easement and south of the mushroom farm. Taktics4 (December, 2018) (on behalf of the proponent of the CCLSP) is of the view that this Service Commercial area should be reconsidered because:

a) The wider commercial precinct to the immediate north is much better placed to be viable than the southern portion within Casuarina Central;
b) The subject land does not have the exposure and accessibility to be viable; and
c) There is a risk of over-providing service commercial land in the area.

Shrapnel Urban Planning's advice to the City is consistent with Taktics4 and does not recommend Service Commercial this far south of Thomas Road.

15.2 CASUARINA CENTRAL LOCAL STRUCTURE PLAN (MULTIPLE LANDHOLDINGS UNDER SEPARATE OWNERSHIP) – CONSIDERATION OF SUBMISSIONS AND RECOMMENDATION TO THE WESTERN AUSTRALIAN PLANNING COMMISSION

City Officers comments
City Officers are of the view that when the disadvantages caused by the potential cumulative impacts on the amenity of the area (traffic noise from the Kwinana Freeway, potential odour emissions from the mushroom farm and visual impact of the high tension power lines) are considered against the advantages associated with the proximity of the Service Commercial area to the north and the commercial exposure provided by the Kwinana Freeway - that on balance the area is considered to be a suitable location for Service Commercial land uses in the long term.

Size and safety of the Primary School site

The CCLSP shows a primary school site co-located with a local sporting ground situated adjacent to the south west corner of the Landgren Road and Orton Road intersection. This location is in accordance with the guidelines in LPP6.

The total area of the proposed primary school and local sporting ground site is 7ha. A Resource Enhancement Wetland (REW) is positioned in the north-eastern corner of the Primary School site. The REW is proposed to be conserved in the CCLSP.

Comments from the Department of Education
As previously outlined the DoE has advised that it is concerned that future residential development in the Northern and Southern Casuarina Precincts would increase the dwelling yield such that more than one public primary school will be required to serve the future student population within the Northern, Central and Southern Casuarina precincts. DoE has advised that it may require additional public primary schools for future local structure planning in the Casuarina North and Casuarina South Precincts.

DoE recommends that the requirement for schools in the area be reviewed to ensure that there is sufficient provision of public primary and secondary schools to meet the increased dwelling yield projection for the locality.

DoE has also advised that the location of the drainage basin will pose safety issues and flooding risk to the school site and also encumbers the design of the school as it is now an irregular shape.

On this basis, the DoE does not support the CCLSP because the proposed primary school site is constrained and does not facilitate a safe and efficient school design and does not comply with the design principles of Liveable Neighbourhoods.

City Officers comments

Provision of primary school sites within Casuarina
In response to the DoE's concerns that there may be an insufficient number of primary school sites in the Casuarina area, City Officers note that current provision is in keeping with past planning for the locality over many years at the district planning level. It also appears to be in keeping with the approximate number and size of primary school sites required being one public primary school per 1,500-1,800 dwellings as recommended in the WAPC's Development Control (DC) Policy 2.4 – School Sites policy.

15.2 CASUARINA CENTRAL LOCAL STRUCTURE PLAN (MULTIPLE LANDHOLDINGS UNDER SEPARATE OWNERSHIP) – CONSIDERATION OF SUBMISSIONS AND RECOMMENDATION TO THE WESTERN AUSTRALIAN PLANNING COMMISSION

City Officers note that similar concerns of the DoE were expressed in response to the Anketell North Local Structure Plan. It does appear to reflect a broader policy shift at the DoE in regards to the numbers and sizes of schools relative to their population catchments.

Notwithstanding the desire on the City's part to ensure adequate schooling for this community, it is suggested that this concern of the DoE about the size of the school at this location be addressed in a similar fashion to the Anketell North Local Structure Plan.

In that case, Council resolved that the issue be considered further by both the DoE and DPLH prior to any final determination.

Location and design of the proposed primary school site
City Officers recommend that the proposed location of the primary school site be supported for the following reasons:

- The primary school site is 3.5ha and provides a rectangular core building area of 3ha (185m x 178m) (Figure 2 below). The adjoining local sporting ground is 3.1759ha, and provides sufficient room to accommodate a senior-sized oval (165m x 135m) and a pavilion.

- The REW wetland (0.615ha) situated adjacent to the school site is described in the DBCA's data set as a seasonally waterlogged dampland (UFI 6670). This type of wetland is where the basin is seasonally damp and water dependent plants species are able to access groundwater near the surface. In this instance the proponent's Local Water Management Strategy (LWMS) (hyd2o, 2018) indicates that the groundwater level is 0.5m below the surface. The wetland is not described as a wetland that becomes inundated and is not being engineered to function as a drain within the LWMS.

- Stormwater entering the wetland will drain to the east, away from the school site, via an existing culvert (Peel Sub1A drain) situated with the wetland.

Figure 2: Location and design of the proposed primary school site and Local Sporting Ground



15.2 CASUARINA CENTRAL LOCAL STRUCTURE PLAN (MULTIPLE LANDHOLDINGS UNDER SEPARATE OWNERSHIP) – CONSIDERATION OF SUBMISSIONS AND RECOMMENDATION TO THE WESTERN AUSTRALIAN PLANNING COMMISSION

Closure of a portion of Orton Road and provide a road around the proposed District Open Space within the Casuarina North Precinct

Orton Road runs along the northern boundary of the CCLSP through to Landgren Road and then continues eastwards. As part of its assessment of the CNLSP the City required a concept plan to be prepared for the balance of the land situated north of Orton Road (in accordance with LPP6). The Casuarina North Concept Plan shows DOS situated immediately north of Orton Road, adjacent to the local sporting ground.

The DOS is intended to provide a range of hardcourts (netball, basketball and tennis) and a clubroom. The local sporting ground is intended to cater for sports such as soccer, football and hockey.

To improve connectivity between the DOS and the local sporting ground, City Officers (including the City's Infrastructure Directorate) recommend that the Casuarina North Concept Plan be modified to close a portion of Orton Road and provide a new road around the perimeter of the proposed District Open Space (DOS) (as shown in Figure 3) which will:

- Facilitate integration of the DOS, Local Sporting Ground and Primary School to optimise the availability of these facilities for the community; and
- Provide a road network that limits commercial traffic mixing with residential traffic.

Figure 3: Recommended closure of Orton Road and provision of a road around the proposed District Open Space within the Casuarina North Concept Plan



A traffic assessment undertaken by the proponent advises that in the long term once all three precincts of the Casuarina urban cell have been developed, the forecast demand on Orton Road to the north of the future primary school is less than 600 vehicle movements per day. The proponent concludes that the importance of this east-west link is therefore very low and removal of this link to connect the DOS and Local Sporting Ground is practical.

15.2 CASUARINA CENTRAL LOCAL STRUCTURE PLAN (MULTIPLE LANDHOLDINGS UNDER SEPARATE OWNERSHIP) – CONSIDERATION OF SUBMISSIONS AND RECOMMENDATION TO THE WESTERN AUSTRALIAN PLANNING COMMISSION

Protection of significant environment values and retention of significant trees

Remnant vegetation & fauna habitat
Vegetation surveys conducted on behalf of the proponent (Environmental Assessment Report 2018) and advice provided by the DBCA confirm that there are occurrences of:

- Threatened Ecological Community 'Banksia Woodlands of the Swan Coastal Plain'; and
- Foraging and potential breeding habitats for Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) and Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) on site.

In addition to these confirmed environmental values, the DBCA has advised that significant areas of potential habitat for threatened orchid species were not subject to appropriately timed searches as part of the proponent's Environmental Assessment Report 2018.

DBCA has also advised that the environmental information presented in the Environmental Assessment Report indicates that not all of the CCLSP was surveyed due to the restricted access to some lots. Therefore, there is an absence of survey information for a number of lots situated within the CCLSP.

Due to the high likelihood of the occurrence of several threatened flora species on site and the gaps in the current environmental information collected, DBCA recommends an additional targeted flora survey of all suitable habitat within the CCLSP be undertaken at the appropriate time of the year, prior to the approval of the structure plan. Any additional survey report provided should include detailed information and maps related to the survey timing and extent in accordance with the Environmental Protection Authority's requirements.

City Officers recommend that as part of its assessment of the CCLSP the WAPC consult with the DBCA in relation to conducting additional targeted flora survey of all suitable habitat for threatened flora species within the CCLSP.

Wetlands
DBCA recommends that a wetland assessment of the CCLSP area be undertaken prior to the approval of the CCLSP to accurately map, protect and manage the wetlands onsite. DBCA's initial review of the wetland within the CCLSP indicate that portions of the currently mapped REW within Lots 45 and 47 Orton Road may be more commensurate with a CCW due to the intact remnant vegetation present.

DBCA has requested that wetland management plans be prepared prior to the subdivision to enable confirmation of management actions including rehabilitation requirements and interface treatments.

DBCA has advised that it does not support the proposal to locate a drainage basin within the buffer to the REW (on Lot 32 Orton Road). It argues that drainage infrastructure should be located outside wetland buffers to minimise hydrological impacts. This is particularly relevant if the subsequent wetland assessment undertaken results in an upgrade of the management category of this wetland to CCW. City Officers advise that the REW is not proposed to be used as a drainage basin in the LWMS lodged with the CCLSP.

15.2 CASUARINA CENTRAL LOCAL STRUCTURE PLAN (MULTIPLE LANDHOLDINGS UNDER SEPARATE OWNERSHIP) – CONSIDERATION OF SUBMISSIONS AND RECOMMENDATION TO THE WESTERN AUSTRALIAN PLANNING COMMISSION

City Officers recommend that:

a) As part of its assessment of the CCLSP that the WAPC consult with the DBCA in relation to an assessment of the wetlands within the CCLSP area, to accurately map, protect and manage the wetlands onsite;

b) A wetland management plan be prepared to the satisfaction of the DBCA, in consultation with the City, as a condition of subdivision, to enable confirmation of mapping and management actions including urban water management, rehabilitation requirements and interface treatments; and

c) The WAPC and the proponent be notified that the DBCA does not support the proposal to locate drainage Basin B within the buffer to the Resource Enhancement Wetland.

<u>Proposed conservation areas</u>
Areas with significant environmental values within the CCLSP area have been included within open space areas to protect environmental values. However, the DBCA has advised that:

a) Open space areas retained for conservation purposes should be clearly defined on the CCLSP.

City Officers agree with the DBCA advice and recommend that the CCLSP should be modified to identify those areas of open space that are to be managed as conservation areas; and Part 1 of the CCLSP include a provision requiring the preparation and implementation of relevant management plans for proposed conservation open space areas.

b) *The configuration of open space should be amended and designed to include and protect the excellent condition native vegetation and priority flora within Lot 48 Orton Road and Lot 36 Landgren Road* (refer to Figure 4 below).

Figure 4: Proposed open space on Lots 36 and 48



15.2 CASUARINA CENTRAL LOCAL STRUCTURE PLAN (MULTIPLE LANDHOLDINGS UNDER SEPARATE OWNERSHIP) – CONSIDERATION OF SUBMISSIONS AND RECOMMENDATION TO THE WESTERN AUSTRALIAN PLANNING COMMISSION

City Officers acknowledge that not all of the bushland on Lots 36 and 48 is included within open space as recommended by DBCA. The City also acknowledges that the DBCA has advised that further flora surveys and wetland assessments are required to enable an accurate assessment of environmental values on site to inform the structure plan design. However, City Officers are cognisant that 24% of the CCLSP area is identified as open space which is already in excess of the 10% POS contribution required under Liveable Neighbourhoods. City Officers are of the view that the configuration of open space shown in the CCLSP protects a number of bushland areas with regionally significant environmental values that are protected under the Environmental Protection and Biodiversity Conservation Act (EPBC Act) and Biodiversity Conservation Act (BC Act), including:

- consolidated areas of Banksia woodlands which are identified as an Endangered Threatened Ecological Community under the *Environmental Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act); and
- significant foraging and breeding trees for the Carnaby's Black Cockatoo (as shown in Confidential Attachment N) which is identified as an Endangered species under the EPBC Act and Specially Protected Fauna under the *Biodiversity Conservation Act 2016.* City Officers calculate that approximately 190 Carnaby's Black Cockatoo foraging and breeding habitat trees will be retained in open space areas in the CCLSP.

The City is responsible for ensuring that there is a balance between providing land for recreation, conservation of environmental values and retention of significant trees during the preparation of local structure plans for Urban zoned land. The City is satisfied that large areas of regionally significant bushland and wetlands (that have been identified under the EPBC Act and BC Act) have been included within consolidated areas of open space. City Officers recommend that these areas be identified in the CCLSP for conservation purposes.

It should also be noted that the proportion of POS provided with the CCLSP has exceeded the POS requirement specified in LPP6, which states that a maximum of 80% of the total POS requirement shall be provided in the Casuarina Central precinct with the shortfall (20%) being provided as a cost contribution through the DCP. Due to the extent of significant environmental values (wetlands, bushland and fauna habitats) present in the Central precinct more open space was required than anticipated.

c) *The CCLSP should include provisions for the preparation and implementation of relevant management plans for proposed conservation areas. Management plans should address the provision of adequate interface treatments, landscape plantings using endemic native species, a hard road edge and access control measures in addition to appropriate passive recreational facilities.*

City Officers agree and recommend that a Bushland Management Plan for bushland within public open space in the CCLSP be prepared to the satisfaction of the DBCA in consultation with the City as a condition of subdivision.

15.2 CASUARINA CENTRAL LOCAL STRUCTURE PLAN (MULTIPLE LANDHOLDINGS UNDER SEPARATE OWNERSHIP) – CONSIDERATION OF SUBMISSIONS AND RECOMMENDATION TO THE WESTERN AUSTRALIAN PLANNING COMMISSION

Retention of Significant Trees

The proponent conducted a significant tree survey over the CCLSP area and identified the significant trees (greater than 500mm diameter) worthy of retention in accordance with LPP1. The majority of the significant trees are Western Australian (45%) or Australian native species (40%).

City Officers note that a number of open space areas have been configured to maximise the retention of Significant Trees. Attachment L shows the location of the significant habitat trees situated within the CCLSP and the location of the open space areas. City Officers have calculated that approximately 110 significant habitat trees will be retained within the CCLSP area in open space areas and road reserves.

A number of the significant trees in the CCLSP area are especially large as shown in the photo below. Particular attention and effort should be made to ensure that as many significant trees are retained on site as practicable.

City Officers recommend that the WAPC be requested to impose a condition on future subdivision applications requiring the preparation of a Landscape Feature and Tree Retention Plan in accordance with LPP1. This will ensure that the retention of significant trees is optimised as part of the civil design and earthworks.

Figure 5: Large Marri trees situated in future open space in the Casuarina Central area



Separation distance between the Kwinana Freeway and noise sensitive land uses

The western boundary of the CCLSP abuts the Kwinana Freeway and the nearest residential area shown in the CCLSP is situated approximately 260m east of the Kwinana Freeway.

State Planning Policy - 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning (SPP5.4) (WAPC, 2009) aims to minimise the adverse impact of transport noise on noise sensitive residential development by achieving:

15.2 CASUARINA CENTRAL LOCAL STRUCTURE PLAN (MULTIPLE LANDHOLDINGS UNDER SEPARATE OWNERSHIP) – CONSIDERATION OF SUBMISSIONS AND RECOMMENDATION TO THE WESTERN AUSTRALIAN PLANNING COMMISSION

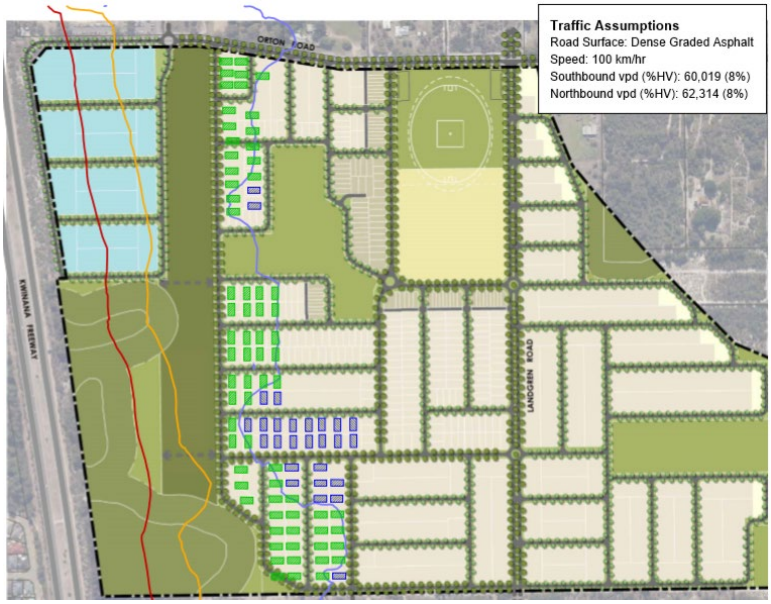
- acceptable indoor noise levels in noise sensitive areas [LAeq(Day) 40dB(A) in living areas and LAeq(Night)35dB(A) in bedrooms]; and
- a reasonable degree of acoustic amenity in at least one outdoor living area [LAeq(Day) 55dB(A) and LAeq(Night)50dB(A)].

The proponent has lodged a noise assessment for the CCLSP (Lloyd George Acoustics - Transportation Noise Assessment Casuarina Central Precinct, December 2019) (Attachment M) which concludes that noise limits are achieved at the ground floor of most future residential lots with the exception of those located in the south western corner of the CCLSP (Figure 6 shown in green) and at upper floor levels for a number of future residential lots (Figure 7 shown in green). The consultant advises that dwellings on these lots will require noise amelioration in the form of quiet house design.

Figure 6: Ground floor noise level contours (2031)



Figure 7: Upper floor noise level contours (2031)



Main Roads has advised that:

- Any noise sensitive development that exceeds the noise target must implement the mitigation measures specified in the Lloyd George Acoustics Noise Assessment Report.
- Quiet house design in the form of Package A is required for the proposed lots that exceed the noise target (above 55dB). All building treatment packages applied to the development are to comply with the requirements of the SPP 5.4 Implementation Guidelines to ensure that noise levels achieve the noise criteria where practicable.
- All affected lots (i.e. lots predicted to receive noise levels above the target) are to provide at least one outdoor living space that complies with the SPP 5.4 target, or if not practicable, the limit.
- Notification on titles are required for affected lots (i.e. lots predicted to receive noise levels above the target) and to be in accordance with SPP 5.4 Implementation Guidelines.
- Specialist acoustic advice should be sought for any two storey dwelling proposed.
- Any proposed non-residential sensitive land use (i.e. childcare centres, schools or places of worship) should be located furthest from the noise source and comply with SPP 5.4 Implementation Guidelines.

City Officers recommend that the WAPC be requested to impose a condition on future subdivision applications requiring provision of Section 70A Notifications on all proposed lots that may be subject to excessive noise levels from Kwinana Freeway. The notifications would advise prospective purchasers that the lots are currently affected and/or may in the future be affected by transport noise.

Management of land uses within the Western Power easement

The CCLSP is constrained by a Western Power easement that traverses the western side of the area the subject of the CCLSP. Western Power has not raised any fatal flaws in relation to the CCLSP and has advised that approval will be required before any development in accordance with the adopted CCLSP can occur within the power easement.

Western Power has advised that the structure plan, future subdivision and development processes must protect the transmission line corridor and associated assets from encroachment, mitigating public safety or network reliability risks and ensuring there is no impediment to routine and emergency land access to the network.

For this reason, City Officers are supportive of additional requirements on the proponent prior to the adoption of the CCLSP and at subdivision stage. The following provisions to be included on the CCLSP for consideration at the subdivision and development stages:

- Provision of Section 70A Notifications on all proposed lots adjoining the existing Western Power registered easement prior to subdivision clearance advising prospective purchasers that they are in close proximity to power infrastructure which will be maintained, upgraded and expanded on a regular basis.

- All development shall be designed and constructed to protect Western Power infrastructure and interests from potential land use conflict.
- No development (including fill, fencing, storage or parking) will be permitted within Western Power registered easements without the prior written approval of Western Power or the relevant power line operator.

Bushfire Management

State Planning Policy 3.7 Planning in Bushfire Prone Areas (SPP3.7) (WAPC, 2015) outlines how development and/or land uses should address bushfire risk in Western Australia and it applies to all land which has been designated as a Bushfire Prone Area.

A Bushfire Management Plan (BMP) has been prepared for CCLSP by an accredited assessor (Ecological, December 2018) in accordance with Clause 6.5 of SPP3.7.

DFES has advised that it is not satisfied that the BMP has adequately considered how compliance can be achieved at subsequent planning stages and requires the BMP to be modified. However, DFES recommends that the structure plan proceed and the applicant be advised that modifications be undertaken to support subsequent stages of the planning process.

City Officers recommend the provision of a BMP in Part 1 of the CCLSP to the satisfaction of the City and DWER.

Future road access to Thomas Road through the Casuarina Central precinct

Main Roads has advised that it objects to the CCLSP because it is based on modelling that assumes Bombay Boulevard will remain open, in addition to new road connections to Thomas Road. There is also no consideration of connectivity to Mortimer Road. Main Roads requires a properly considered ultimate scenario to provide full comment and possible support.

In response to Main Roads' comments, the proponent has advised that the traffic modelling undertaken during the preparation of the CCLSP took into account the future development of Casuarina and Casuarina South, to ensure future development impacts have been assessed on the internal road network. As part of the modelling, indicative road alignments to both Thomas Road and Mortimer Road were considered. As these connections are not within the CCLSP area and are not part of the landholding, the CCLSP cannot dictate how or when these future connections will be made.

City Officers note that long term planning will see Bombay Boulevard realigned to connect to a new north-south link within the northern precinct as shown in the Casuarina North Concept Plan.

The north-south neighbourhood connector through the CCLSP aligns with indicated future road alignments in the Casuarina North Concept Plan. These road alignments will ultimately negate the use of Bombay Boulevard.

Furthermore the City recommended that the CNLSP be amended to provide a north – south connector road to run alongside or potentially within the alignment of the High Voltage Transmission Line to Orton Road. The purpose of this road link is to ensure that traffic associated with the Mushroom Exchange and Service Commercial Zones to the north and potentially south of Orton Road have access/egress to Thomas Road without needing to move through future residential land uses. This road has been identified in the adopted CNLSP.

Interface treatment between the future residential areas and the existing Rural zone

The City's LPP6 requires that the CCLSP should take the following potential land use compatibility matters into account where the boundary of a proposed LSP, abuts the Rural zone:

a) The potential impact of future land uses within the Development zone on the visual amenity (light emissions, fencing and landscaping) and character of the Rural zone; and
b) The potential impact of land use activities (noise, dust and odour) within the Rural Water Resource zone on future sensitive land uses within the Development zone.

Where the CCLSP abuts the Rural Water Resource zone a low density R10-20 Residential Code is shown. City Officers consider that a low density residential frontage to the Rural zone will minimise adverse impacts from the CCLSP area on the amenity and character of the adjacent Rural properties. However, City Officers recommend that the CCLSP be modified to show that the maximum residential density at the interface is R5 (minimum site area 2,000m^2).

The purpose of the R5 coding is to ensure that there is sufficient space to provide landscaping onsite and reduce the potential impact of residential development on the Rural zoned properties to the east. City Officers do not consider that an R10-20 coding will allow a sufficient amount of landscaping to be provided to reduce the impact of residential development on the adjacent Rural zone.

Designing Out Crime

In accordance with Liveable Neighbourhoods, "The urban structure should create legible and well distributed POS networks to encourage walking and create a strong sense of place while responding to local character and environmental values. A variety of POS sizes can be utilised to create a multifunctional, integrated network which is responsive to community needs."

There are a variety of POS areas proposed within the CCLSP to ensure a balance of sizes, types, functions and locations for the future community. Both active and passive POS areas are proposed in a variety of different forms including Neighbourhood Parks, Local Parks, Playing Fields, wetland buffers and drainage swales. A large centrally located Neighbourhood Park is proposed in the CCLSP which incorporates a playground, shelter and picnic facilities as well as retained trees and vegetation. DOS is positioned to the north of Orton Road and the proposed Local Sporting Ground and Primary School site.

All POS areas within the CCLSP are easily accessible and within the walkable catchments of each residence. The permeable road network, shared paths and footpath networks, will link the POS areas. The effective lighting of public places as well as appropriate landscaping design (to be undertaken at the detailed subdivision stage) will also help to ensure the safe provision of POS throughout the CCLSP.

City Officers considered that the type and location of land uses, the local movement network and POS provision and distribution throughout the CCLSP addresses the general principles of the City's Local Planning Policy 8 – Designing Out Crime.

LIVEABLE NEIGHBOURHOODS ASSESSMENT

The WAPC requires LSPs to be prepared in accordance with objectives and requirements of Liveable Neighbourhoods (WAPC, 2009). The proposed CCLSP has been assessed by City Officers against the following elements of Liveable Neighbourhoods:

Lot Layout

The CCLSP proposes a variety of housing choices through the density ranges of R10-R20, R25-R40 and R40-60 density codings which are identified in the CCLSP.

The CCLSP will provide approximately 920–968 residential lots (yield may be dependent on the proximity that noise and odour sensitive uses can be located near the mushroom farm). The CCLSP achieves an average residential density of 26 dwellings per hectare of residential zoned land. This density is consistent with the minimum requirement of 26 dwellings per residential site hectare set out in Liveable Neighbourhoods.

Public Parkland

The CCLSP report states that a total of 17ha (24%) of POS has been provided in accordance with the calculation methodology set out in Liveable Neighbourhoods. City Officers are of the view that a number of the areas classified as unrestricted POS should not be attributed as unrestricted POS because they do not meet the criteria set out in Liveable Neighbourhoods. These areas are as follows and are identified in the POS Summary Plan in Attachment N.

- Area 3 – Impractical size and shape (1,745m^2) which abuts a CCW buffer which is described as restricted POS.
- Area 4 – The area is surrounded by Conservation Category Wetlands and a high voltage power easement causing it to be isolated from adjoining residential area (10,091m^2).
- Area 5 – Impractical size and shape (3,165m^2) which abuts a CCW buffer which is described as restricted POS.
- Area 7 – This area of open space (24,363m^2) is intended to conserve an intact area of remnant vegetation and will not be useable for recreational purposes.

However, even without these areas being included as unrestricted POS the amount of unrestricted POS alone would be 12.4% which is in excess of the 10% of the gross subdivisible area required under Liveable Neighbourhoods.

15.2 CASUARINA CENTRAL LOCAL STRUCTURE PLAN (MULTIPLE LANDHOLDINGS UNDER SEPARATE OWNERSHIP) – CONSIDERATION OF SUBMISSIONS AND RECOMMENDATION TO THE WESTERN AUSTRALIAN PLANNING COMMISSION

Table 6: Summary of POS required and provided in the CCLSP

	POS Required/ Permitted	Actual Open Space Provided	As calculated by City Officers as per Liveable Neighbourhoods
10% POS	69,306m^2	-	13,861m^2+72,578m^2 =86,439m^2 (12.4%) as per Liveable Neighbourhoods
Max restricted permitted (20%)	20%x69,306 m^2 =13,861m^2	59,391m^2 (59,391m^2-13,861m^2= 45,530m^2 overprovision)	13,861m^2
Min unrestricted permitted (80%)	80%x69,306 m^2=55,444m^2	111,851m^2	111,851m^2-39,364m^2 (not suitable as unrestricted) = 72,487m^2 unrestricted
Actual open space provided in CCLSP	**-**	59,391m^2+111,851m^2= 171,242m^2 171,242/693056 (24%)	-
Total credited POS As per Livebale Neighbourhoods (20% restricted & 80% unrestricted)	**-**	-	13,861m2+72,578m^2 =86,439m^2 (12.4%)

Urban Water Management

The following water management plans and strategies have been prepared for the area the subject of CCLSP. These strategies include:

- Jandakot Drainage and Water Management Plan - Peel Main Drain Catchment (Department of Water, 2009); and
- Casuarina Central Precinct Local Water Management Strategy - (hyd$_2$0 hydrology December, 2018).

These plans address water management within the CCLSP area providing a greater level of detail at each successive stage of the planning process. The system of stormwater management proposed for the area the subject of the CCLSP is consistent with the Better Urban Water Management guidelines and the Jandakot Drainage and Water Management Plan.

Utilities

The Engineering Infrastructure Report (Cossill & Webley, May 2019) prepared to support the CCLSP does not identify any major constraints to the provision of water, sewer, electricity, gas and telecommunications services. It is normal practice for the WAPC to impose subdivision conditions requiring that these services are provided to an urban standard.

15.2 CASUARINA CENTRAL LOCAL STRUCTURE PLAN (MULTIPLE LANDHOLDINGS UNDER SEPARATE OWNERSHIP) – CONSIDERATION OF SUBMISSIONS AND RECOMMENDATION TO THE WESTERN AUSTRALIAN PLANNING COMMISSION

The servicing agencies have not raised concerns with respect to the CCLSP.

LEGAL/POLICY IMPLICATIONS:

For the purpose of Councillors considering a financial or impartiality interest only, the proponent of the CCLSP is LWP on behalf of Anstey Road Developments and the Housing Authority.

Acts and Regulations

- *Planning and Development Act 2005*
- *Planning and Development (Local Planning Schemes) Regulations 2015*
- *Environmental Protection Act 1986*
- *Environmental Protection (Noise) Regulations 1997*
- *Environmental Protection and Biodiversity Conservation Act 1999 (Cwlth)*
- *Biodiversity Conservation Act 2016*

Schemes

- Metropolitan Region Scheme
- City of Kwinana Local Planning Scheme No. 2

State Government Policies

- Guidance for the Assessment of Environmental Factors No. 3 – Separation Distances between Industrial and Sensitive Land Uses (EPA, 2005)
- Environmental Protection Bulletin No 20 – Protection of naturally vegetated areas through planning and development
- South Metropolitan Peel Sub-regional Planning Framework (WAPC, 2018)
- Jandakot Drainage and Water Management Plan - Peel Main Drain Catchment
- Liveable Neighbourhoods 2009
- State Planning Policy 2.5 – Rural Planning
- State Planning Policy 3.0 – Urban Growth and Settlement (WAPC)
- State Planning Policy 3.1 – Residential Design Codes (WAPC)
- State Planning Policy 3.7 – Planning in Bushfire Prone Areas (WAPC)
- State Planning Policy 4.2 – Activity Centres for Perth and Peel (WAPC)
- State Planning Policy 5.4 - Road and Rail Transport Noise and Freight Considerations in Land Use Planning (WAPC)
- State Planning Policy 7.0 – Design of the Built Environment (WAPC)

Local Planning Policies

- Community Infrastructure Plan 2018
- Local Commercial and Activity Centres Strategy (LCACS)
- Local Planning Policy No. 1 - Landscape Feature and Tree Retention
- Local Planning Policy No. 2 - Streetscapes
- Local Planning Policy No. 6 – Guidelines for Structure Planning in the Casuarina Cell

15.2 CASUARINA CENTRAL LOCAL STRUCTURE PLAN (MULTIPLE LANDHOLDINGS UNDER SEPARATE OWNERSHIP) – CONSIDERATION OF SUBMISSIONS AND RECOMMENDATION TO THE WESTERN AUSTRALIAN PLANNING COMMISSION

- Local Planning Policy No. 7 - Uniform Fencing
- Local Planning Policy No. 8 - Designing out Crime

FINANCIAL / BUDGET IMPLICATIONS:

The cost of preparing the CCLSP has been borne by the applicant.

ASSET MANAGEMENT IMPLICATIONS:

The City will be financially responsible for maintaining open space, roads, verge trees and footpaths within the CCLSP once the area has been developed.

ENVIRONMENTAL IMPLICATIONS:

MRS Amendment 1117/33 to rezone Casuarina (including Casuarina Central precinct) from 'Rural' to 'Urban Deferred' was considered by the EPA under the *Environmental Protection Act 1986* (EP Act). The EPA determined that Amendment 1117/33 did not require formal environmental assessment under the EP Act and provided advice and recommendations.

In particular, the EPA advised that it had not assessed the following issues in its assessment of Amendment 1117/33 on the basis that these matters could be adequately resolved during subsequent stages of the planning process:

- Drainage
- Wetlands
- Remnant vegetation
- Fauna
- Peel Harvey catchment
- Contamination
- Air emissions
- Noise and Vibration

The EPA's decision acknowledges that parts of Casuarina have been cleared and can be developed without impacting on significant environmental values. If significant areas of vegetation and wetland are proposed to be developed as part of the planning process (structure planning and subdivision), then future subdivision and development can be referred to the EPA.

Vegetation surveys conducted on behalf of the proponent and advice provided by the DBCA confirm that there are occurrences of the threatened ecological community 'Banksia Woodlands of the Swan Coastal Plain' and also foraging and potential breeding habitat for Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) and Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) on site.

The proposed CCLSP has the potential to impact threatened species and communities listed under State and Federal legislation and the proponent should consider its obligations for assessment of the proposal in accordance with the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* and Western Australian *Environmental Protection Act 1986.*

15.2 CASUARINA CENTRAL LOCAL STRUCTURE PLAN (MULTIPLE LANDHOLDINGS UNDER SEPARATE OWNERSHIP) – CONSIDERATION OF SUBMISSIONS AND RECOMMENDATION TO THE WESTERN AUSTRALIAN PLANNING COMMISSION

The DBCA has requested that wetland management plans be prepared prior to subdivision to enable confirmation of management actions including rehabilitation requirements and interface treatments. Resolution of wetland management issues during subsequent planning stages can lead to unsatisfactory outcomes and potential inconsistencies with associated bushfire management plans and landscape concept plans.

City Officers support the DBCA's comments, and recommend that a wetland management plan be prepared to the satisfaction of the DBCA in consultation with the City as a condition of subdivision to enable confirmation of management actions including rehabilitation requirements and interface treatments.

STRATEGIC/SOCIAL IMPLICATIONS:

This proposal will support the achievement of the following outcome and objective detailed in the Strategic Community Plan.

Plan	Outcome	Objective
Strategic Community Plan 2019 -2029	A well planned City	4.4 Create diverse places and spaces where people can enjoy a variety of lifestyles with high levels of amenity.

COMMUNITY ENGAGEMENT:

The City advertised the CCLSP between 19 April 2019 and 10 May 2019 in accordance with Schedule 2, Clause 18 of the P&D Regulations.

Public advertising was carried out in the following manner:

- Nearby landowners and State Government agencies were notified of the proposal in writing and invited to comment;
- The proponent erected two signs within the area the subject of the CCLSP;
- A notice was placed in a local newspaper once over the course of the advertising period; and
- Copies of the proposed CCLSP and relevant documents were made available for inspection at the City's Administration Office and placed on the City's website.

The following State Government agencies were notified of the proposal in writing and invited to comment:

- Department of Education
- Department of Fire and Emergency Services
- Department of Health
- Department of Water and Environmental Regulation
- Western Power
- Water Corporation
- Main Roads

15.2 CASUARINA CENTRAL LOCAL STRUCTURE PLAN (MULTIPLE LANDHOLDINGS UNDER SEPARATE OWNERSHIP) – CONSIDERATION OF SUBMISSIONS AND RECOMMENDATION TO THE WESTERN AUSTRALIAN PLANNING COMMISSION

A total of thirteen submissions were received during the advertising period. The majority of the submissions were from landowners within the CCLSP area; and submissions were also received from State Government agencies listed above. The submissions, and City Officer comments on the submissions are provided in the Schedule of Submissions.

PUBLIC HEALTH IMPLICATIONS:

Impacts from potential noise and odour emissions from the mushroom farm situated to the north of the CCLSP requires careful consideration to ensure that appropriate separation distances are provided to sensitive cases so that future residents are not exposed to unacceptable odour or noise emissions.

Impacts from traffic noise from the Kwinana Freeway to the west of the CCLSP requires careful consideration of any noise attenuation measures to ensure that future residents are not exposed to unacceptable noise levels.

RISK IMPLICATIONS:

The risk implications in relation to this proposal are as follows:

Risk Event	Future development of the Casuarina Central area does not fully consider Council's policies resulting in incompatible land uses outcomes that impact the future community.
Risk Theme	Failure to fulfil statutory regulations or compliance requirements
Risk Effect/Impact	Compliance
Risk Assessment Context	Strategic
Consequence	Moderate
Likelihood	Possible
Rating (before treatment)	Moderate
Risk Treatment in place	The 60 day period in which the City is required to report to the WAPC, under Schedule 2 Clause 20 of the P&D Regulations, expired on the 9 July 2019 (60 days from close of advertising). The City will be reporting to the WAPC following the Council meeting on the 11 September 2019. The WAPC had approved an extension of time until the 6 September 2019. City Officers are seeking a further extension under clause 20(c) of the *Planning and Development Act* to provide sufficient time for the City to report to the WAPC.

15.2 CASUARINA CENTRAL LOCAL STRUCTURE PLAN (MULTIPLE LANDHOLDINGS UNDER SEPARATE OWNERSHIP) – CONSIDERATION OF SUBMISSIONS AND RECOMMENDATION TO THE WESTERN AUSTRALIAN PLANNING COMMISSION

Response to risk treatment required/in place	The City is requiring further investigation to be undertaken to ensure compatibility of land uses. The City is retaining key land uses within the CCLSP to ensure they are given due consideration in the long term planning and at each stage of the planning process. The City is to give due regard to the CCLSP when providing advice to the WAPC in relation to subdivision applications and making decisions in relation to development applications.
Rating (after treatment)	Moderate

COUNCIL DECISION

543

MOVED CR C ADAMS **SECONDED CR W COOPER**

That Council makes the following recommendations to the Western Australian Planning Commission (WAPC) in respect to the proposed Casuarina Central Local Structure Plan (CCLSP):

1. Council advises the WAPC that it supports the CCLSP on the following basis:

a) That the CCLSP be modified as follows:

i. An Investigation Area, 500m in radius (measured from the Phase Three buildings and the wastewater pond), be shown on the CCLSP.

The purpose of the Investigation Area would be to:

- **Ensure that extensive Field Odour Assessments (FOA) are conducted over a 12 month period (including late February to early April); and**

- **Enable a comprehensive FOA data set to be collected across different wind and weather conditions so that adverse odour impacts can be assessed.**

- **Ensure that noise assessments are conducted within the CCLSP area to determine the extent of noise emissions originating from the mushroom farm on the nearest proposed noise sensitive developments in accordance with the regulation 8, 9 and 10 of the *Environmental Protection (Noise) Regulations 1997* relating to assigned noise levels, non – conforming uses and rural activities.**

- **Ensure that a precautionary approach is taken when considering potential noise and odour impacts and determining separation distances between the mushroom farm and future sensitive land uses.**

ii. Remove the Odour Investigation Area adjacent to the mushroom farm as shown in the advertised version of the CCLSP;

iii. Show a Local Centre (650m^2 to 750m^2) in the CCLSP adjacent to Landgren Road, immediately south of the Primary School site.

iv. Identify on the CCLSP those areas of open space that are required by the City of Kwinana and Department of Biodiversity Conservation and Attractions (DBCA) to be managed as conservation areas.

v. Show the maximum residential density at the interface with the Rural zone along the eastern boundary of the CCLSP as R5 coding.

b) Inclusion of the following in Part 1 of the CCLSP to the City's satisfaction:

i. Preparation of a Traffic Noise Assessment (TNA) assessing the impact of traffic noise from the Kwinana Freeway on the residential areas in the CCLSP. This assessment must include consideration of appropriate noise mitigation measures such as acoustic barriers and/or quiet house design requirements and an implementation plan to the satisfaction of Main Roads and the City of Kwinana. The TNA shall be prepared and adopted so as to inform subdivision design and/or any development approvals for the area the subject of the CCLSP.

ii. That a Local Water Management Strategy (LWMS) is to be prepared to the satisfaction of the Department of Water and Environmental Regulation (DWER) and the City of Kwinana.

The LWMS shall be prepared and adopted so as to inform subdivision design and/or any development approvals for the area of the CCLSP.

Note: The DBCA has advised that it does not support the proposal to locate drainage Basin B within the buffer to the Resource Enhancement Wetland. Any drainage infrastructure should be located outside wetland buffers to minimise hydrological impacts in accordance with Decision Process for Stormwater Management in WA (2005). This is particularly relevant if the subsequent wetland assessment undertaken results in an upgrade of the management category of this wetland to a Conservation Category Wetland.

iii. A Wetland Management Plan is to be prepared to the satisfaction of the DBCA in consultation with the City of Kwinana prior to subdivision to enable confirmation of mapping and management actions including rehabilitation requirements and interface treatments.

iv. A Bushland Management Plan for bushland within Public Open Space (POS) in the CCLSP is to be prepared to the satisfaction of the DBCA in consultation with the City of Kwinana prior to subdivision to enable confirmation of mapping and management actions including rehabilitation requirements and interface treatments.

v. A Landscape Feature and Tree Retention Strategy is to be prepared in accordance with City of Kwinana's Local Planning Policy No 1, to ensure that the retention of significant trees is optimised as part of the subdivision design, civil design and earthworks. The Landscape Feature and Tree Retention Strategy should be developed in consultation with the City of Kwinana to inform subdivision design and/or any development approvals for the area of the CCLSP.

vi. A Bushfire Management Plan should be prepared in accordance with State Planning Policy 3.7 Planning in Bushfire Prone Areas (SPP3.7) to the satisfaction of the Department of Fire and Emergency Services.

vii. All development shall be designed and constructed to protect Western Power infrastructure and interests from potential land use conflict. No development (including fill, fencing, storage or parking) will be permitted within Western Power registered easements without the prior written approval of Western Power or the relevant power line operator.

2. Request that the WAPC impose conditions on future subdivision applications within the area of CCLSP requiring:

i. The provision of Section 70A Notifications on all proposed lots adjoining the existing Western Power registered easement advising prospective purchasers that they are in close proximity to power infrastructure which will be maintained, upgraded and expanded on a regular basis.

All development shall be designed and constructed to protect Western Power infrastructure and interests from potential land use conflict.

No development (including fill, fencing, storage or parking) will be permitted within Western Power registered easements without the prior written approval of Western Power or the relevant power line operator.

ii. The provision of Section 70A Notifications on all proposed lots that may be subject to excessive noise levels from Kwinana Freeway advising prospective purchases that the lot is situated in the vicinity of Kwinana Freeway and is currently affected and/or may in the future be affected by transport noise.

iii. Preparation of an Urban Water Management Plan for the area the subject of CCLSP in consultation with the City of Kwinana and DWER.

iv. Preparation of a Bushland Management Plan for bushland within POS in the CCLSP to the satisfaction of the DBCA in consultation with the City of Kwinana.

v. Preparation of a Landscape Feature and Tree Retention Plan in accordance with Local Planning Policy 1, to ensure that the retention of significant trees is optimised as part of the civil design and earthworks.

vi. The provision of Section 70A Notifications on all proposed lots within 500 metres of the Mushroom Farm on Lot 1 Orton Road (measured from the Phase Three buildings and the wastewater pond) that advises lot owners that they may be impacted by odour and noise resulting from the operations of the Mushroom Farm.

3. Recommend that the proponent consult with the DBCA in relation to conducting an:

i. Additional targeted flora survey within bushland where threatened ecological species may occur within the CCLSP, prior to the final adoption of the CCLSP by the WAPC.

ii. Assessment of the wetlands within the CCLSP area, prior to the approval of the CCLSP, to accurately map, protect and manage the wetlands within the CCLSP.

The City of Kwinana acknowledges that not all of the bushland on Lots 36 and 48 is included within open space as recommended by DBCA. The City also acknowledges that the DBCA has advised that further flora surveys and wetland assessments are required to enable an accurate assessment of environmental values on site to inform the structure plan design. However, City Officers are cognisant that 24% of the CCLSP area is identified as open space which is already in excess of the 10% Public Open Space (POS) contribution required under Liveable Neighbourhoods. City Officers are of the view that the configuration of open space shown in the CCLSP protects a significant area of Carnaby's Black Cockatoo habitat (including habitat bushland, and significant foraging and breeding trees) as shown in Confidential Attachment N in this report. Carnaby's Black Cockatoos are a Threatened Ecological Species and some of the areas of Carnaby's Black Cockatoo habitat are a Threatened Ecological Community under Commonwealth environmental legislation.

15.2 CASUARINA CENTRAL LOCAL STRUCTURE PLAN (MULTIPLE LANDHOLDINGS UNDER SEPARATE OWNERSHIP) – CONSIDERATION OF SUBMISSIONS AND RECOMMENDATION TO THE WESTERN AUSTRALIAN PLANNING COMMISSION

The City is responsible for ensuring that there is a balance between providing land for recreation, conservation of environmental values and retention of significant trees during the preparation of local structure plans for Urban zoned land. The City is satisfied that significant areas of bushland and wetlands within the CCLSP area, have been included within large consolidated areas of open space. City Officers recommend that these areas be identified in the CCLSP for conservation purposes.

4. **Request that the concerns raised by the Department of Education (DoE) about the future size and configuration of the Primary School be the subject of further consideration and discussions between the Department of Planning, Lands and Heritage, DoE and the City of Kwinana prior to the final adoption of the CCLSP by the WAPC.**

5. **Endorse the Schedule of Submissions (Attachment C) pursuant to Schedule 2, Part 4, Clause 20(2) of the *Planning and Development Regulations 2015*.**

6. **Require the Casuarina North Concept Plan be amended to show the proposed closure of Orton Road and provision of a new road around the perimeter of the District Open Space (DOS) (Attachment D) which will:**

    - **Facilitate integration of the DOS, Local Sporting Ground and Primary School to optimise the availability of these facilities for the community; and**
    - **Provide a road network that limits commercial traffic mixing with residential traffic.**

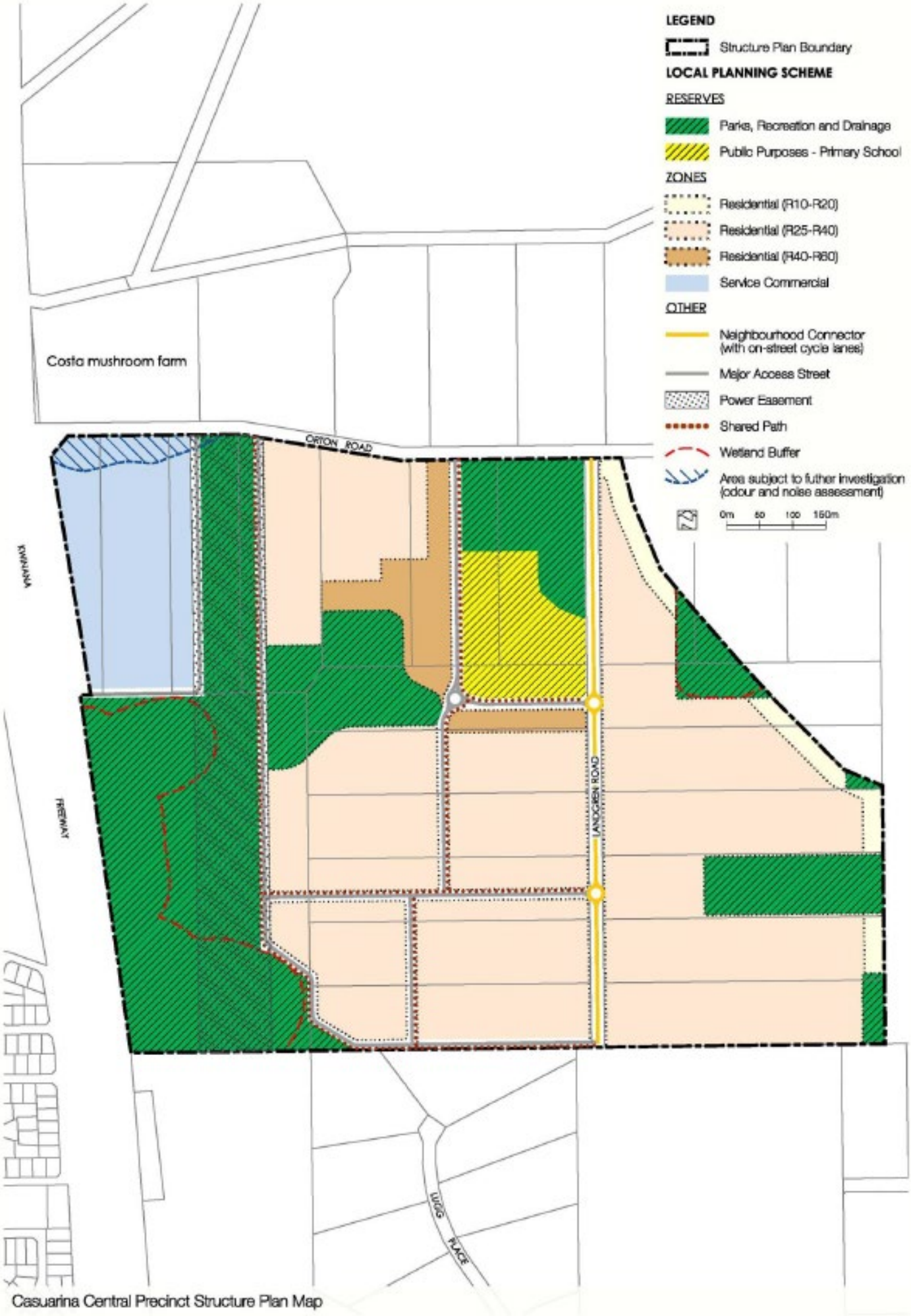
7. **Council requests City Officers to review Local Planning Policy No. 6 Guidelines for Structure Planning in the Casuarina Cell to reflect the proposed closure of Orton Road and provision of a new road around the perimeter of the DOS.**

8. **Forward this Ordinary Council Meeting Report, Council's recommendations and the Schedules of Submissions for the CCLSP to the WAPC pursuant to Schedule 2, Clause 20 of the *Planning and Development Regulations 2015*.**

CARRIED
8/0

NOTE – That the Officer Recommendation has been amended at point 2 to include point vi, so that notifications are on title for all lots within 500 metre radius of noise and odour sources of the Mushroom Farm.

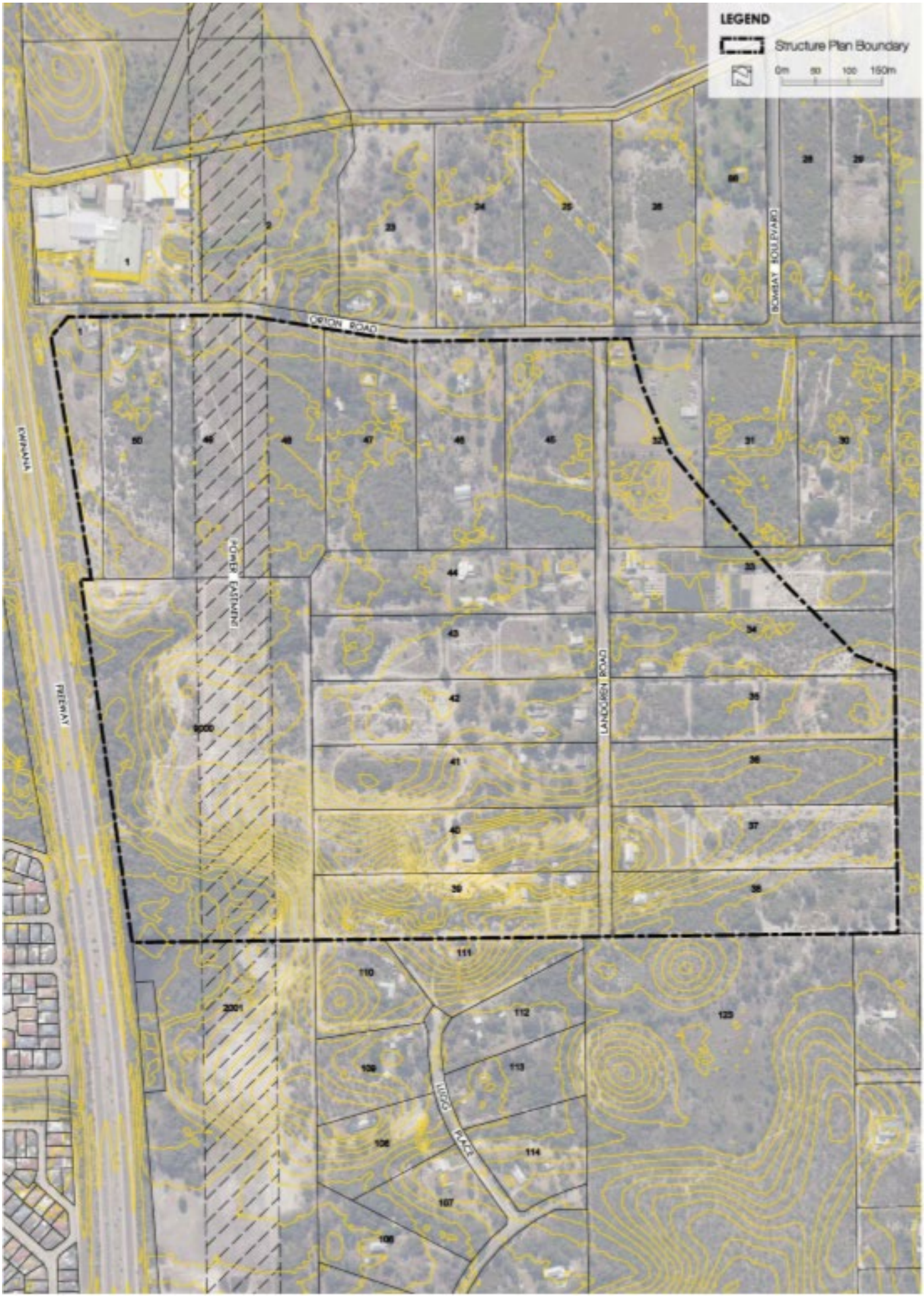
Attachment A



Casuarina Central Precinct Structure Plan Map

Locality Plan

Attachment B



Attachment C

SCHEDULE OF SUBMISSIONS
Casuarina Central Local Structure Plan

	Submitter and property affected by amendment (where applicable)	Overall object / support / neutral	Summary of Submission	City Response
1	**Department of Education**	Not supported	Provision of Public Schools The draft LSP Report indicates that the Central Precinct area would generate approximately 968 dwellings/lots. Notwithstanding that a future primary school site is identified within the draft LSP, the Department has concerns that future residential development in the Northern and Southern Precincts would increase the dwelling yield such that more than one (1) public primary school is required to serve the future student population within the Northern, Central and Southern Precincts. The Western Australian Planning Commission's Development Control (DC) Policy 2.4 - School Sites stipulates that one public primary school is to be provided for every 1500 - 1800 dwellings. In this regard, the Department may require additional public primary schools for future local structure planning in the Northern and Southern Precincts. Accordingly, the Department recommends that the Draft Eastern Residential Intensification Concept Plan (Figure 8 of the LSP Report) be reviewed to ensure that there is sufficient provision of public primary and secondary schools to meet the increased dwelling yield projection for the locality. Location of public primary school It is noted that the school site abuts a drainage basin on the north-eastern corner of the subject site. The Department was unaware of the presence of a drainage basin abutting the school site and this was not identified nor discussed	City Officers recommend that the concerns raised by the Department of Education (DoE) about the future size and configuration of the Primary School be the subject of further consideration and discussions between the Department of Planning, Lands and Heritage, DoE and the City of Kwinana prior to the final adoption of the CCLSP by the WAPC.

Attachment C

SCHEDULE OF SUBMISSIONS
Casuarina Central Local Structure Plan

Submitter and property affected by amendment (where applicable)	Overall object / support / neutral	Summary of Submission	City Response
		previously at any strategic planning phase. The location of the drainage basin will pose safety issues and flooding risk to the school site and also encumbers the design of the school as it is now an irregular shape. Table 9: Public Open Space Network, point 1 of the draft LSP Report indicates that the Public Open Space (POS) is co-located with the primary school site. Whilst shared use POS arrangement with the City of Kwinana is supported, this statement is in reference to an initial draft LSP, which was previously presented by the proponent to the Department for preliminary comments, where such arrangement could be considered subject to the school site achieving a regular shape. The incorporation of a drainage basin does not result in an efficient design of the school layout and adversely impact on the developability of the site. It is therefore considered that the location of the future public primary school site does not accord with the design principles of the Liveable Neighbourhoods (LN) as it presents undue site constraints and does not facilitate safe and efficient design of school site. In view of the above, the Department does not support the draft LSP in its current form owing to non-compliance with the relevant provisions of LN and DC Policy 2.4 - School Sites. The Department welcomes the opportunity to meet and discuss the above matter with the City of Kwinana including the planning for the interface of the oval with the school site.	

Attachment C

SCHEDULE OF SUBMISSIONS
Casuarina Central Local Structure Plan

Submitter and property affected by amendment (where applicable)		Overall object / support / neutral	Summary of Submission	City Response
2	**Department of Fire and Emergency Services**	Neutral	DFES is not satisfied that the BMP has adequately considered how compliance can be achieved at subsequent planning stages. As the modifications will not affect the structure plan, DFES recommends the structure plan proceed and the applicant be advised that these modifications be undertaken to support subsequent stages of the planning process (subdivision and development applications).	City Officers recommend that Part 1 of the CCLSP include the following provision: A Bushfire Management Plan should be prepared in accordance with State Planning Policy 3.7 Planning in Bushfire Prone Areas (SPP3.7) to the satisfaction of the Department of Fire and Emergency Services.
3	**Department of Health** Dr Michael Lindsay A/Executive Director Environmental Health Directorate	No objection	The Department of Health provided advice to assist in assessing the proposed LSP consistent with document 'Evidence supporting the creation of environments that encourage healthy active living'.	Noted
4	**Transperth** Rebecca Curry A/Network & System Planner Transperth Service Development Public Transport Centre, West Parade, Perth	Neutral	Transperth does not currently have any plans for a service to this area. The potential introduction of a service to the Casuarina Central Precinct will be dependent on significant residential development of the site and surrounding areas and suitability of the completed road network. As the location of the site is in an isolated pocket with the surrounding areas rural in nature representing a small passenger demand, the introduction of a bus service is unlikely to occur for a number of years.	Noted
5	**Watercorp** Charles Sabato		<u>Water Supply</u> The Corporation has noted the servicing report from the consultants and would add that the 220RC water main on Orton Road has no	City Officers recommend that Part 1 of the CCLSP include the following provision:

Attachment C

SCHEDULE OF SUBMISSIONS
Casuarina Central Local Structure Plan

	Submitter and property affected by amendment (where applicable)	Overall object / support / neutral	Summary of Submission	City Response
	Senior Planner Land Planning Development Services		additional capacity for the proposed development. A duplicate retic extension off the 300 main in Johnson Road may be an alternative way of serving initial staging to the site in conjunction with the construction of the 400 & 500 steel mains to follow at appropriate times. The Capital Investment Programme for these related assets are tentatively scheduled for 2023/24. The developer should liaise with the Corporation to refine the timing/delivery of these assets as development occurs. <u>Wastewater</u> The Corporation has noted the servicing report and agrees that any wastewater connections are dependent on the Construction of Pump Station "L". This asset is tentatively scheduled for 2023/24. The developer should continue to liaise with the Corporation to determine the construction schedule of this asset and final wastewater servicing outcomes for the total LSP area. <u>Drainage</u> Any future subdivision will require the approval of an Urban Water Management Plan to address related drainage issues.	• That a Local Water Management Strategy (LWMS) is to be prepared to the satisfaction of the Department of Water and Environmental Regulation and the City of Kwinana. The LWMS shall be prepared and adopted so as to inform subdivision design and/or any development approvals for the area of the CCLSP.
6	**Department of Water and Environmental Regulation** Brett Dunn Program Manager Urban Water Management Peel Region	Not supported	The DWER cannot support the local structure plan until the Department is satisfied with the revised LWMS. Accordingly, the proposed structure plan should not be finalised prior to the endorsement of a satisfactory LWMS by the DWER and the City of Kwinana. <u>Groundwater Quality</u>	City Officers recommend that Part 1 of the CCLSP include the following provision: • That a Local Water Management Strategy (LWMS) is to be prepared to the satisfaction of the Department of Water and

Attachment C

SCHEDULE OF SUBMISSIONS
Casuarina Central Local Structure Plan

Submitter and property affected by amendment (where applicable)	Overall object / support / neutral	Summary of Submission	City Response
		Given the nutrients levels in the groundwater are above the ANZECC guidelines for irrigation the section should confirm groundwater will be suitable for the long-term irrigation of public open space (POS) or indicate an alternative source. <u>Flood Protection (100 year ARI)</u> Section proposes stormwater runoff storage within the Western Power easement. Please include written confirmation of Western Power's support for this. <u>Ecological Protection (15 mm)</u> Please include conceptual cross-sections of the proposed bio-infiltration basins and flood storage areas. Please include top water levels (TWL) for all rainfall events, depth and phosphorous retention index (PRI) of amended soils, depth to maximum groundwater level (MGL) and slope gradients. <u>Contaminates Sites</u> DWER notes the proponent's commitment to site investigations and obligations required under the *Contaminated Sites Act 2003*.	Environmental Regulation and the City of Kwinana. The LWMS shall be prepared and adopted so as to inform subdivision design and/or any development approvals for the area of the CCLSP.
7	**Western Power** James Widenbar Network Team Leader Safety, Environment, Quality & Training Western Power	Neutral	The structure plan, future subdivision and development processes must protect the transmission line corridor and associated assets from encroachment, mitigating public safety and network reliability risks and ensuring there is no impediment to routine and emergency land access to the network.	City Officers recommend that the WAPC impose a condition on future subdivision applications within the area of CCLSP requiring: • The provision of Section 70A Notifications on all proposed lots adjoining the existing Western Power registered easement advising

Attachment C

SCHEDULE OF SUBMISSIONS
Casuarina Central Local Structure Plan

Submitter and property affected by amendment (where applicable)	Overall object / support / neutral	Summary of Submission	City Response
363 Wellington Street Perth		1. Prior to subdivision, Western Power will need to review, assess and provide prior written consent to any proposals below or within the registered easement, in accordance with the easement conditions, including: • Landscaping plans (including mature heights and location of species); • Ground level changes; • Permanent structures; • Drainage plans; • Conservation controls. 2. In respect to condition 1, the proponent must submit detailed design plans for the any development or change in land use proposed within the electricity infrastructure corridor to allow determination of its suitability in respect to public safety, routine and emergency land access and future network plans. Regarding public safety assessment, the requirements of the detailed study are summarised below and are required to form part of the servicing strategy: • Soil Resistivity Report outlining on-site measurement of the soil resistivity. • An Earth Potential Rise study to determine touch, step and transfer potentials, including documentation of all calculations.	prospective purchasers that they are in close proximity to power infrastructure which will be maintained, upgraded and expanded on a regular basis. All development shall be designed and constructed to protect Western Power infrastructure and interests from potential land use conflict. No development (including fill, fencing, storage or parking) will be permitted within Western Power registered easements without the prior written approval of Western Power or the relevant power line operator.

Attachment C

SCHEDULE OF SUBMISSIONS
Casuarina Central Local Structure Plan

Submitter and property affected by amendment (where applicable)	Overall object / support / neutral	Summary of Submission	City Response
		• A Low Frequency Induction study to investigate the effects of induced voltages from the power line for step, touch and transfer potentials, during both construction and operation of the site. • An Electrostatic Induction study to investigate the potential of hazardous charging of metallic objects in the vicinity of the line, such as fences, gates and other services. • An Electromagnetic Field Study to determine the impacts of Electric and Magnetic Fields as per ARPANSA guidelines. The studies should identify any mitigation required and be submitted to Western Power for review, record-keeping and to confirm the appropriateness of the proposal prior to subdivision. Please be advised that Western Power can provide data to assist in the preparation of the report, which will attract a fee. Costs will be estimated and funds must be received prior to assessment commencing. Generally assessments will take between three to five weeks, from receipt of funds. 3. Western Power requires the following additional provisions to be included on the Structure Plan for consideration at the subdivision and development stages: • Provision of Section 70A Notifications on all proposed lots adjoining the existing Western Power registered easement prior to subdivision clearance advising prospective	

Attachment C

SCHEDULE OF SUBMISSIONS
Casuarina Central Local Structure Plan

Submitter and property affected by amendment (where applicable)	Overall object / support / neutral	Summary of Submission	City Response
		purchasers that they are in close proximity to power infrastructure which will be maintained, upgraded and expanded on a regular basis. • All development shall be designed and constructed to protect Western Power infrastructure and interests from potential land use conflict. • No development (including fill, fencing, storage or parking) will be permitted within Western Power registered easements without the prior written approval of Western Power or the relevant power line operator. Note: The above advice should not be construed as Western Power's support or otherwise of the land use or development proposed in the existing electricity corridors and associated registered easements. Further detailed studies will be required to determine the suitability of subdivision and development within the easement corridors.	
	Department of Biodiversity Conservation and Attractions		The CCLSP should include provisions for the preparation and implementation of relevant management plans for proposed conservation areas and wetland rehabilitation requirements and interface treatments.	-A Wetland Management Plan should be prepared to the satisfaction of the Department of Biodiversity Conservation and Attractions (DBCA) in consultation with the City of Kwinana prior to subdivision to enable confirmation of mapping and management actions including rehabilitation requirements and interface treatments. -That a Local Water Management Strategy (LWMS) is to be prepared to the satisfaction of the

Attachment C

SCHEDULE OF SUBMISSIONS
Casuarina Central Local Structure Plan

Submitter and property affected by amendment (where applicable)	Overall object / support / neutral	Summary of Submission	City Response
			Department of Water and Environmental Regulation and the City of Kwinana.
		Areas of open space intended for conservation purposes should be identified on the CCLSP.	City Officers recommend that the CCLSP be modified as follows: -Identify on the CCLSP those areas of open space that are required by the City of Kwinana and DBCA to be managed as conservation areas.
		DBCA recommends an additional targeted flora survey of all suitable habitat within the CCLSP be undertaken at the appropriate time of the year, prior to the approval of the structure plan.	City Officers recommend that the proponent consult with the DBCA in relation to conducting an: -Additional targeted flora surveys within bushland where threatened ecological species may occur within the CCLSP, prior to the final adoption of the CCLSP by the WAPC.
		DBCA recommends that a wetland assessment of the CCLSP area is undertaken prior to the approval of the CCLSP to accurately map, protect and manage the wetlands onsite.	Recommend that the proponent consult with the DBCA in relation to conducting an: -Assessment of the wetlands within the CCLSP area, prior to the approval of the CCLSP, to accurately map, protect and manage the wetlands within the CCLSP.

SCHEDULE OF SUBMISSIONS
Casuarina Central Local Structure Plan

Submitter and property affected by amendment (where applicable)	Overall object / support / neutral	Summary of Submission	City Response
			City Officers recommend that Part 1 of the CCLSP include the following provision: -A Wetland Management Plan should be prepared to the satisfaction of the Department of Biodiversity Conservation and Attractions (DBCA) in consultation with the City of Kwinana prior to subdivision to enable confirmation of mapping and management actions including rehabilitation requirements and interface treatments. City Officers will request the WAPC to impose the following condition on future subdivision applications: -Preparation of a Bushland Management Plan for bushland within public open space in the CCLSP to the satisfaction of the Department of Biodiversity Conservation and Attractions in consultation with the City of Kwinana.
	Main Roads		Any noise sensitive development that exceeds the noise target must implement the mitigation measures specified in the Lloyd George Acoustics Noise Assessment Report.	City Officers recommend that the following provision be included in the CCLSP: Preparation of a Traffic Noise Assessment (TNA) assessing the impact of traffic noise from the Kwinana Freeway on residential areas including appropriate noise mitigation measures such as

Attachment C

SCHEDULE OF SUBMISSIONS
Casuarina Central Local Structure Plan

Submitter and property affected by amendment (where applicable)	Overall object / support / neutral	Summary of Submission	City Response
			acoustic barriers and/or quiet house design requirements and an implementation plan to the satisfaction of the City of Kwinana. City Officers will request the WAPC to impose the following condition on future subdivision applications: The provision of a notice on the title of all proposed lots that may be subject to excessive noise levels from Kwinana Freeway advising prospective purchases that the lot is situated in the vicinity of Kwinana Freeway and is currently affected and/or may in the future be affected by transport noise.
8 **Lot 9000 Orton Road, Casuarina** Creative Planning on behalf of Megajet Enterprises Pty Ltd		We seek modifications to the LSP as shown on the enclosed concept plan (Attachment 1) and as detailed below: - Remove the 'Parks, Recreation and Drainage' Reserve at the north eastern corner of Lot 9000 and show the land as Residential R25-40. - Remove the 'Parks, Recreation and Drainage' Reserve located between the wetland buffer and the power easement and show the land as Residential R25 - 40.	In the City's view the suggestion to provide approximately 5,000m2 of residential land between the Western Power easement and the Conservation Category wetlands will result in poor planning outcomes, particularly in relation to the environment and residential amenity.

Attachment C

SCHEDULE OF SUBMISSIONS
Casuarina Central Local Structure Plan

Submitter and property affected by amendment (where applicable)	Overall object / support / neutral	Summary of Submission	City Response
			

Attachment C

SCHEDULE OF SUBMISSIONS
Casuarina Central Local Structure Plan

Submitter and property affected by amendment (where applicable)	Overall object / support / neutral	Summary of Submission	City Response
9 **Costa Mushroom Farm**		While Local Planning Policy 6 and the proposed LSP together provide a level of support for Costa's mushroom facility, further strengthening of policy/direction is being sought. This would increase the level of certainty to Costa and enable consideration of possible further investment and expansion of the facility, with security and longevity of tenure. It is suggested this can be achieved by undertaking the policy directions discussed in Section 4 above, with the required buffer distance indicated on plans in the LSP. As part of taking a proactive precautionary approach, it is requested Council review its position on this matter. Such a notification approach is supported by wording in the State Planning Policy 4.1 State Industrial Buffer (Amended), which envisages Councils providing "mechanisms to ensure advice is provided to future landowners and residents informing them of the potential for off-site impact on amenity from nearby industrial uses or essential infrastructure (eg notification through memorials on property titles or signage)."	Council Officers recommend that the WAPC be advised that the City supports the CCLSP on the following basis: a) That the CCLSP be modified as follows: -An Investigation Area, 500m in radius (measured from the nearest odour source being the Phase Three buildings and the wastewater pond), should be shown on the CCLSP. The purpose of the Investigation Area would be to: -Ensure that extensive Field Odour Assessments (FOA) are conducted over a 12 month period (including late February to early April); and -Enable a comprehensive FOA data set to be collected across different wind and weather conditions so that assessment of adverse odour impacts can be assessed. -Ensure that noise assessments are conducted within the CCLSP area to determine the extent of noise emissions originating from the mushroom

Attachment C

SCHEDULE OF SUBMISSIONS
Casuarina Central Local Structure Plan

Submitter and property affected by amendment (where applicable)	Overall object / support / neutral	Summary of Submission	City Response
			farm on the nearest proposed noise sensitive developments in accordance with the regulation 8, 9 and 10 of the Environmental Protection (Noise) Regulations 1997 relating to assigned noise levels, non – conforming uses and rural activities. -Ensure that a precautionary approach is taken when considering potential noise and odour impacts and determining separation distances between the mushroom farm and future sensitive land uses. -Remove the Odour Investigation Area adjacent to the mushroom farm as shown in the advertised version of the CCLSP.
10 **Lot 45 Orton Road, Casuarina** Royale Australian Golf Club Pty Ltd Rowe Group		Our client is not supportive of the CCPLSP. Our Client is of the view that allocation of residential zoned land is inequitable, with little consideration given to the appropriate location of Public Open Space, the Primary School or the allocation of a Local Centre and will have a detrimental effect on other land holdings to an unequitable extent. Rowe Group is of the view that the CCLSP ought to be amended to show the site as 'Local Centre'. It would, in our view, provide a better outcome for the structure plan area as a whole to locate the Local Centre zone at the intersection of Orton Road and Landgren Road, instead of the proposed primary	In the City's view a Local Centre would not require all of Lot 45 to be identified as Local Centre and the opportunity to locate District Open Space, a Local Sporting Ground and Primary School site will result in a preferable planning outcome. Alternative locations for the primary school would not provide the same opportunity to locate the Primary School, Local Sporting Ground and District Open Space together.

Attachment C

SCHEDULE OF SUBMISSIONS
Casuarina Central Local Structure Plan

Submitter and property affected by amendment (where applicable)	Overall object / support / neutral	Summary of Submission	City Response
		school. Identification of the site as 'Local Centre' would set aside land for the daily convenience needs of the future residential population, which could be developed in the immediate future. It is foreseeable that the absence of the appropriate retail designation within the Structure Plan will limit the availability of residents to convenience services. It is our Client's concern that the identification of a prominent land parcel, to be use at some point in the future for a Primary School is a lost opportunity to create a high-quality entrance statement, adding to the sense of place. The provision of a local retail centre co-located with public open space and increased residential density at the site contributes to the viability of the central precinct. The identification of the site as a Local Centre is consistent with the objectives of the JDSP, which seek to generate an integrated townscape by establishing urban structure and high amenity in the area. The subject site contains existing environmental features (such as wetlands) which provide a good opportunity for a high quality entrance statement to the development area, and could be incorporated into a local centre, providing, for example, daily convenience, retail and child care uses to be co-located with higher density residential uses at an R60 density. This would result in a higher quality streetscape outcome with increased amenity contributing to a sense of place. Rowe Group is of the view that the relocation of the 'Primary School' reserve to the northern cell near the Orton Road and Landgren Road intersection (which does not yet have structure planning prepared) presents an opportunity to provide for the immediate development of	

Attachment C

SCHEDULE OF SUBMISSIONS
Casuarina Central Local Structure Plan

Submitter and property affected by amendment (where applicable)		Overall object / support / neutral	Summary of Submission	City Response
			the area, allowing a high quality urban outcome at a prominent entrance to the LSP area. Co-locating the proposed public open space at the site, with convenience uses and higher density residential uses will capitalise on the natural amenity of the locality. As an alternate, the Primary School could be moved south, consistent with the ERIC (see image below) and contained within a single lot. The CCPLSP in its current configuration contemplates the Primary School reserve over three lots. It is likely that there will be land management issues associated with showing the reserve over three lots, and this could jeopardise the capacity to provide a Primary School in the required timeframe. It would be more practical to identify the entire public school over one land holding in order to minimise the complexities associated with acquiring a considerable land parcel.	
11	**Lot 48 Orton Road, Casuarina**	No objection	- The owners are generally supportive of development in the area and the overall form of the Local Structure Plan. - It is important that a mechanism such as a Developer Contribution Scheme is in place to ensure landowners who provide large areas of Public Open Space, which benefit the general locality, are appropriately compensated. There does not appear to be any mention of compensation for landowners for excess Public Open Space provision in the Structure Plan document. - Any future substantive amendments to the proposed Structure Plan, in particular relating to the distribution and allocation of	Noted

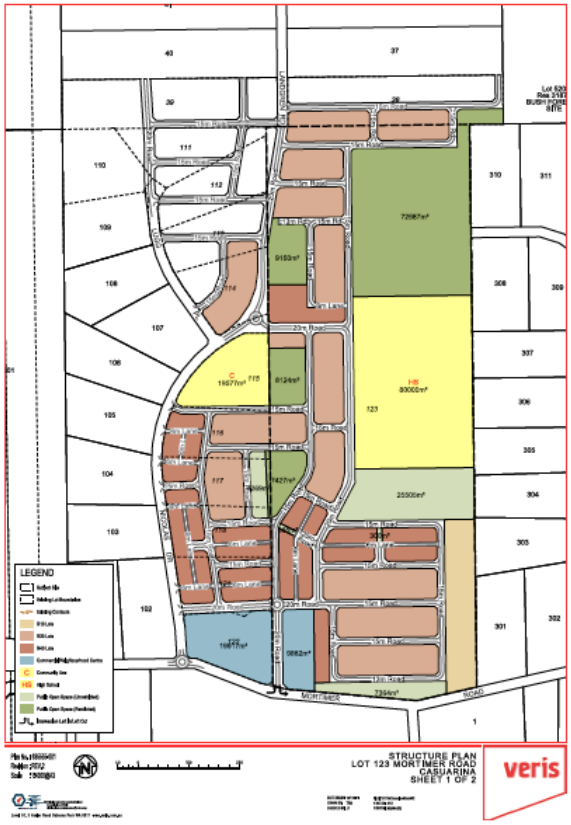
Attachment C

SCHEDULE OF SUBMISSIONS
Casuarina Central Local Structure Plan

Submitter and property affected by amendment (where applicable)	Overall object / support / neutral	Summary of Submission	City Response
		Public Open Space, should be subject to further consultation with affected landowners.	
12	**Lot 123 Mortimer Road, Casuarina** Elton Consulting	No objection	There is an interface issue with the draft structure plan for Lot 123 and the Proposed Development Concept Plan contained within the Proposed Casuarina Central Local Structure Plan report. We note that the Proposed Casuarina Central Local Structure Plan is flexible enough for this interface issue to be addressed at the subdivision stage.	Noted

Attachment C

SCHEDULE OF SUBMISSIONS
Casuarina Central Local Structure Plan

Submitter and property affected by amendment (where applicable)	Overall object / support / neutral	Summary of Submission	City Response
			

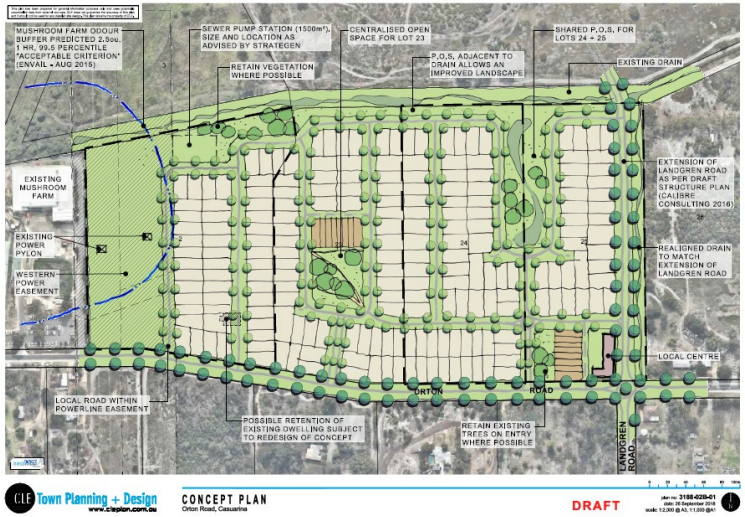
Attachment C

SCHEDULE OF SUBMISSIONS
Casuarina Central Local Structure Plan

	Submitter and property affected by amendment (where applicable)	Overall object / support / neutral	Summary of Submission	City Response
13	**Properties affected: Lots 2, 24 and 25 Orton Road, Casuarina** CLE consultants on behalf of Melanie Greensmith and Mark McEntee	Objection	We are concerned that the proposed CCLSP will set a precedent for the location of DOS on our property which is not consistent with our plan. Our plan includes a small local market centre on corner of Landgren and Orton providing fresh foods and small business as a local shopping centre for housing. Much more usable than open space. Also keeping trucks and cars off the road and making the area like a village not a bland setting like all the other small developments around us.	It is recognised that the submitter has prepared a conceptual local structure plan across their three landholdings (as shown in the Schedule of Submissions) that shows a very different proposal to that shown in the Casuarina North Concept Plan. In particular, the location of the DOS under the Casuarina North Concept Plan significantly conflicts with their design intent. In consideration of this conflict, City Officers have focused on the best long term planning outcomes for the area and have concluded that the location of the DOS is the best for the community. The reason for this is that the co-location of the DOS with the primary school and the City's Local Sporting Ground provide a significant and unique opportunity to create a recreation facility of significant design and scale which maximises integration and will be of benefit for the community in the long term. Further, the primary school and oval are located on the CCLSP at the sites best suited to these uses given the constraints across the structure pan area so these tend to dictate the location of the DOS. Another advantage to the co-location of these facilities is that it allows for the closure of Orton Road and that will provide benefits for traffic

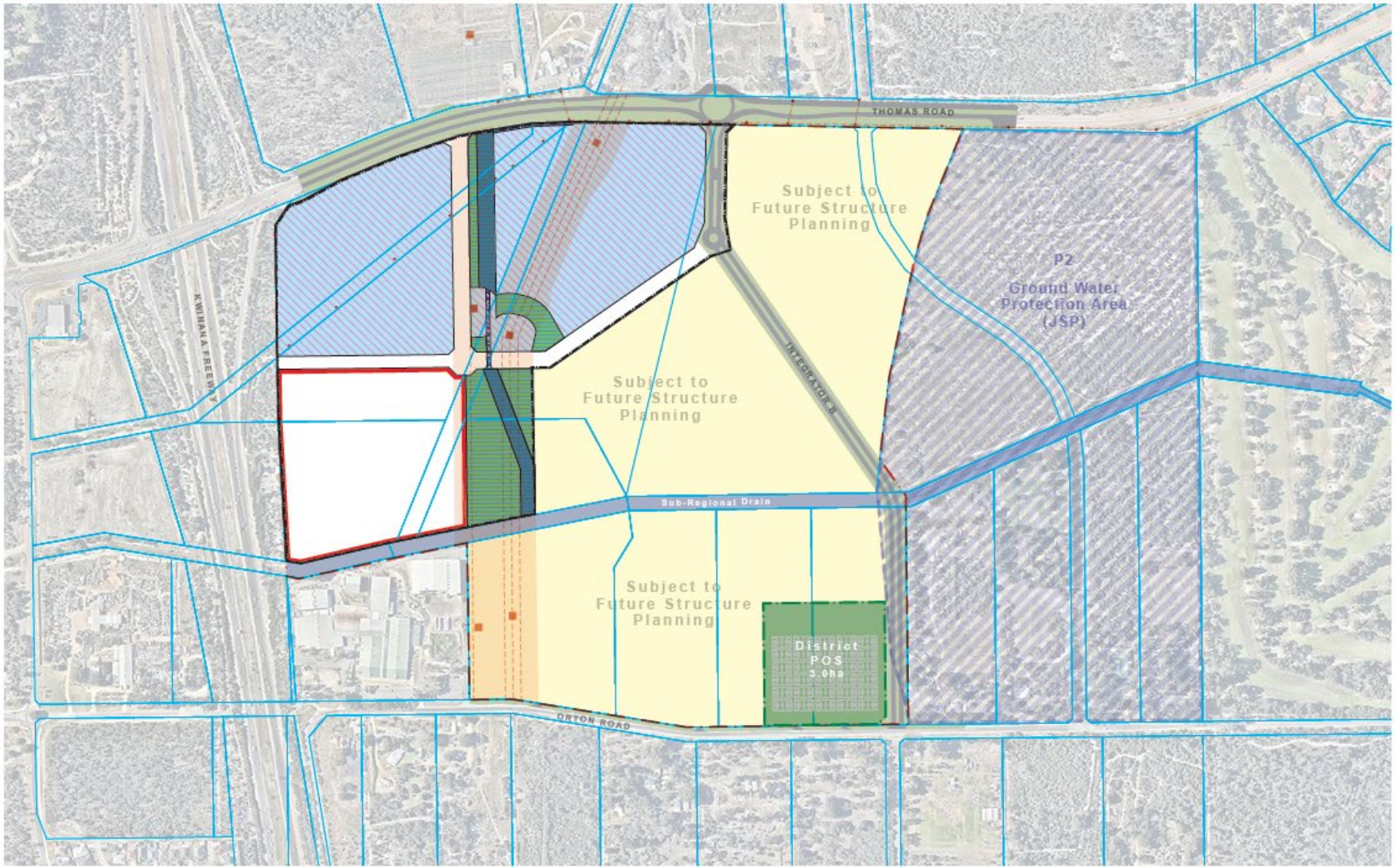
Attachment C

SCHEDULE OF SUBMISSIONS
Casuarina Central Local Structure Plan

Submitter and property affected by amendment (where applicable)	Overall object / support / neutral	Summary of Submission	City Response
			movements throughout the locality and assist in separating service commercial traffic from residential traffic and land uses. Whilst conceptual at this stage, it is important to note that Orton Road is being closed and not being realigned around the DOS. That portion of the existing road reserve (20 metre width) within the DOS area would be re-vested for recreational purposes and this area can be incorporated into the area required for the DOS which would reduce the area of the DOS in Lots 2, 24 and 25. This reduction would offset the need for the delivery of a future subdivisional road around the DOS (needed to separate residential areas from the recreation reserve and provide on street parking).

Casuarina North Concept Plan

Attachment D



Concept Plan

Lots 9011, 9012, 9013, 1199 & 3 Thomas Road, Casuarina

element.
the art and science of place

© NOTE: Initiatives shown on this plan are conceptual only and subject to detailed investigations including landowner consultation.

Attachment E

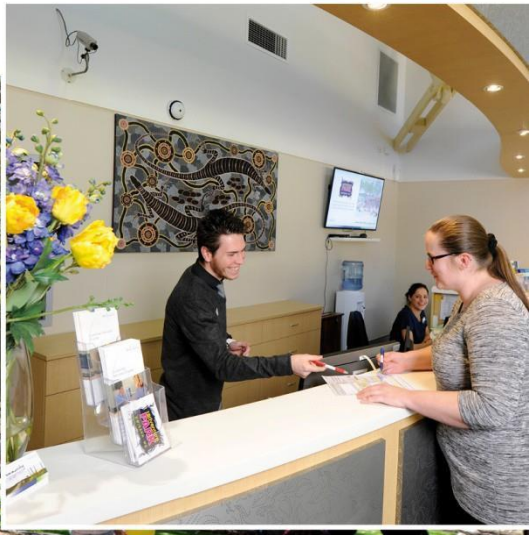
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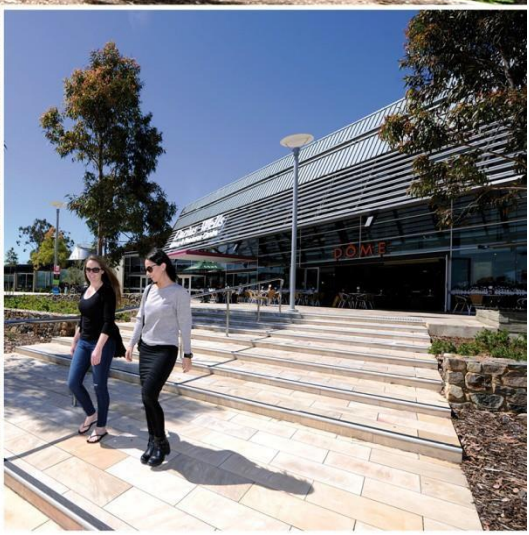


Local Planning Policy 6

Guidelines for Structure Planning In the Casuarina Cell







Local Planning Policy No. 6
Guidelines for Structure Planning in the Casuarina Cell

Adopted:	23 May 2018
Last Reviewed:	
Legal Authority:	*Planning and Development (Local Planning Schemes) Regulations 2015* Schedule 2 – Part 2 – Division 2

1. POLICY OBJECTIVE

To provide guidance on the district planning matters that should be considered during the preparation of Local Structure Plans (LSPs) within the Casuarina Urban Development zone (Casuarina Cell), to ensure that subdivision and/or development proceeds in an orderly and proper manner across the whole Cell.

2. POLICY APPLICATION

This policy has been informed by the *South Metropolitan Peel Sub-regional Planning Framework* (2018), *Jandakot Structure Plan* (2007) and *Eastern Residential Intensification Concept* (2005) in order to ensure integrated decision-making. This ensures that these regional planning documents are considered when preparing LSPs within the Casuarina Cell.

To ensure that subdivision and/or development proceed in an orderly and proper manner, LSPs prepared within the Casuarina Cell (pursuant to *Planning and Development Regulations 2015*) may only be supported by the City of Kwinana (the City) where they are prepared for one, or more, of the entire precincts as depicted in Figure 1 (Attachment A).

The City may consider a LSP for a portion of a precinct where the proponent has:

- Demonstrated that the LSP addresses and meets the objectives of LPP6 and the precinct guidelines in which it is located, such as the provision of significant local and district land uses and facilities as identified in the policy;

- Demonstrated that the LSP can be considered in isolation to the wider planning considerations within the precinct in which it is located, and, its approval would not prejudice the optimum planning and design outcome of the precinct as considered by Council;

- Demonstrated that the LSP applies to greater than a single lot and occupies an area of at least 30% of a precinct; and

- Prepared a concept plan for the remainder of the precinct which addresses the matters raised in the policy and has been the subject of consultation with other landowners in the precinct. The concept plan shall be submitted with the LSP documents and shall include but not limited to, details in relation to the outcomes of the consultation, total site area of the precinct, gross subdivisible area, distributor roads, POS schedule and POS distribution.

This policy should be read in conjunction with relevant State Government, Commonwealth Government and City legislation and policies, including but not limited to:

- *City of Kwinana Local Planning Scheme No. 2* (1992)
- *Community Infrastructure Plan* (as adopted by the City of Kwinana)
- *Development Contribution Plan 3* (POS) (City of Kwinana, 3 October 2017)
- *Development Contribution Plan 10* (Community facilities) (as adopted by the City of Kwinana)
- *Environmental Protection and Biodiversity Conservation Act 1999* (Cth)
- *Environmental Protection Act 1986* (WA)
- *Eastern Residential Intensification Concept (2006)*
- *Guidelines for Structure Plans* (WAPC, 2012)
- *Guidelines for Planning in Bushfire Prone Areas* (WAPC,2015)
- *Jandakot Structure Plan* (WAPC, 2007)
- *Liveable Neighbourhoods* (WAPC, 2009)
- *Local Commercial and Activity Centres Strategy* (City of Kwinana, 2013)
- *Planning and Development Regulations 2015* (WA Government)
- *South Metropolitan Peel Sub-regional Planning Framework* (2018)
- *State Planning Policy 1 – State Planning Framework* (WAPC, 2017)
- *State Planning Policy 2.3 – Jandakot Groundwater Protection* (WAPC, 2017)
- *State Planning Policy 3.7 – Planning in Bushfire Prone Areas* (WAPC, 2015)
- *State Planning Policy 4.2 – Activity Centres for Perth and Peel* (WAPC,2010)
- *State Planning Policy 5.4 - Road and Rail Transport Noise and Freight Considerations in Land Use Planning* (WAPC, 2009)
- *Strategic Community Plan 2017-2027* (City of Kwinana, January 2017)

3. DEFINITIONS

The terms used in this policy are defined below or as defined in adopted or amended versions of the *Local Planning Scheme No.2* (LPS2)*, Community Infrastructure Plan* or relevant *Developer Contribution Plan(s)*:

Developer Contribution Plan
The subject land is included in *Developer Contribution Plan 3* for public open space and *Developer Contribution Plan 10* for community facilities.

The principles and considerations that apply to development contributions are set out in *State Planning Policy 3.6 - Development Contributions for Infrastructure*.

District Community Centre
A large scale multi-purpose community centre that caters for the higher order social and community needs generated from surrounding local catchments. A District Community Centre provides a diverse range of universal activities and programs, including performance space.

A District Community Centre can also provide the base for the delivery of community services, such as child health clinics and can also accommodate office space for community organisations involved in the delivery of services or programs at the district level and visiting government services.

A District Community Centre can also provide the facilities for adult day care and other specialised functions and may resource and provide outreach programs, activities and services to Local Community Centres.

District Youth Centre
A multi-purpose community facility catering for young people (12 - 24 year olds) by providing a range of facilities, programs, services and activities that target their needs and interests.

Local Community Centre
A multi-purpose community building which provides a range of social, learning, personal development, health and lifestyle activities. A *Local Community Centre* incorporates a main hall area, activity area(s), meeting rooms, kitchen, wet activity areas, offices and storage areas.

Local Centre
An important local community focal point that helps to provide for the main daily to weekly household shopping and community needs.

District Sporting Ground
A multi-purpose sporting hub that is designed to have flexible capacity to cater for a diverse and changing range of field sports over time, while also integrating opportunities and infrastructure for passive recreation and physical activity.

Local Sporting Ground
A multi-purpose sports and recreation facility incorporating a grass active playing space with training level lighting that can accommodate a wide variety of sports. A Local Sporting Ground is typically shared by a minimum of two clubs and includes one to two multi-purpose hard courts and other facilities such as cricket practice nets. A Local Sporting Ground also provides for informal physical activity and passive recreation, such as jogging, walking, fitness programs and dog exercise and includes play equipment, seating, picnic table, BBQ, drinking fountain, toilets and shade at a minimum.

A facility building is situated alongside the playing field to provide toilets and some shade.

Local Park
A well designed open space with equipment and natural play opportunities for 0-12 year olds including active and passive elements.

4. GENERAL GUIDELINES

In addition to the requirements of the Western Australian Planning Commission (WAPC) and the City, there are a number of specific district planning matters that must be addressed as part of all LSPs prepared for the Casuarina Cell, as described below:

Bushfire Protection
This policy should be read in conjunction with *State Planning Policy 3.7 - Planning in Bushfire Prone Areas* (WAPC, 2015).

LSPs must take into account bushfire protection requirements. The City will not support LSPs where vulnerable and high risk land uses are proposed in a manner in which the associated risk cannot be sufficiently mitigated.

Compatible land uses in the vicinity of the mushroom farm
Evidence obtained from onsite noise studies, odour studies and modelling will be required when sensitive land uses are proposed in the vicinity of the mushroom farm on Lot 1 (45) Orton Road, Casuarina to demonstrate that the proposed land uses will not be exposed to unacceptable odour and noise emissions, to the satisfaction of the City.

The City will only support land uses in locations where it can be confident there will not be long-term odour and noise conflicts.

Interface treatment between Development and Rural zones
In locations where the boundary of a proposed LSP, within the *Development* zone, abuts the *Rural Water Resource* zone (J*andakot Groundwater Protection Area*) the following potential land use compatibility matters should be taken into account and appropriately mitigated:

- The potential impact of future land uses within the *Development* zone on the visual amenity (light emissions, fencing and landscaping) and character of the *Rural* zone; and

- The potential impact of land use activities (noise, dust and odour) within the *Rural* zone on future sensitive land uses within the *Development* zone.

Local Water Management
Stormwater drainage should be contained within each precinct, unless supported by a *Local Water Management Strategy* and an implementation process that enables drainage to be managed elsewhere. Peel sub-drains should be upgraded to an appropriate urban standard with *Living Stream* treatment in accordance with the *Development Contribution Plan*.

Residential Densities
Residential densities should accord with *Liveable Neighbourhood* principles with higher densities located near the activity centre or areas of higher amenity, such as public open space (POS).

5. LOCAL STRUCTURE PLANNING GUIDELINES

In addition to the requirements of the WAPC and the City, there are a number of specific district and significant local planning matters that must be addressed as part of structure planning for each precinct identified in Figure 1 (Attachment A), as described below:

a) NORTH PRECINCT

The North Precinct should include the following:

i. *Bulky Goods* and *Showroom* uses should be located adjacent to Thomas Road and the Kwinana Freeway to make best use of the access and exposure provided by these roads. Supermarkets and small format shops are not permitted in this area. The balance of the precinct should be used for residential purposes.

ii. Primary access from Thomas Road should allow a four way intersection as approved in the *Anketell South Local Structure Plan* (2014). This access should become the primary north–south route through the broader Casuarina Cell and should link to existing Landgren Road in the adjacent Central Precinct.

iii. The City may support the use of the land within the power line easements for car parking associated with the adjacent commercial and recreation uses.

iv. Development of a *District Sporting Ground* located on land to be acquired by the *Development Contribution Plan* in accordance with the adopted *Community Infrastructure Plan* (or most recent version).

v. A maximum of 80% of the total POS requirement in the North Precinct shall be provided within the precinct with the shortfall (maximum 20%) being provided as a cost contribution through the DCP.

vi. The identification of a site for a *Local Centre* (commercial and activity centre) (800m^2 retail floor space) should be provided at the intersection of Landgren Road and Orton Road, either in the North Precinct or the Central Precinct.

vii. As part of the submittal of a LSP, the applicant shall consider and address the key land uses proposed in the Jandakot Structure Plan and Eastern Residential Intensification Concept for this Precinct area.

b) CENTRAL PRECINCT

The Central Precinct should include the following:

i. A *Primary School* site located near the intersection of Landgren Road and Orton Road.

ii. POS co-located with the Primary School to the satisfaction of the City and the Department of Education.

iii. A maximum of 80% of the total POS requirement in the Central Precinct shall be provided within the precinct with the shortfall (maximum 20%) being provided as a cost contribution through the DCP.

iv. Landgren Road as the main north-south road link through the Casuarina Cell.

v. The identification of a site for a *Local Centre* (commercial and activity centre) (800m^2 retail floor space) provided at the intersection of Landgren Road and Orton Road, either in the Central Precinct or the North Precinct.

vi. Commercial uses and floor areas should be consistent with the City's *Local Commercial and Activity Centres Strategy* (2013).

vii. As part of the submittal of a LSP, the applicant shall consider and address the key land uses proposed in the Jandakot Structure Plan and Eastern Residential Intensification Concept for this Precinct area.

c) SOUTH PRECINCT

The South Precinct should include the following:

i. A site for a *High School* provided in accordance with the design principles set out in *Liveable Neighbourhoods.*

ii. A *Local Sporting Groun*d (with a facility building and kiosk) to be co-located with the high school in accordance with the adopted *Community Infrastructure Plan* (or most recent version).

iii. Land for a *District Community Centre* (7,000m^2) to form part of the POS contribution for the Casuarina Cell.

iv. Land for a *District Youth Centre* (7,000m^2) to form part of the POS contribution for the Casuarina Cell. The *District Youth Centre* should be located adjacent to the *District Community Centre* within POS.

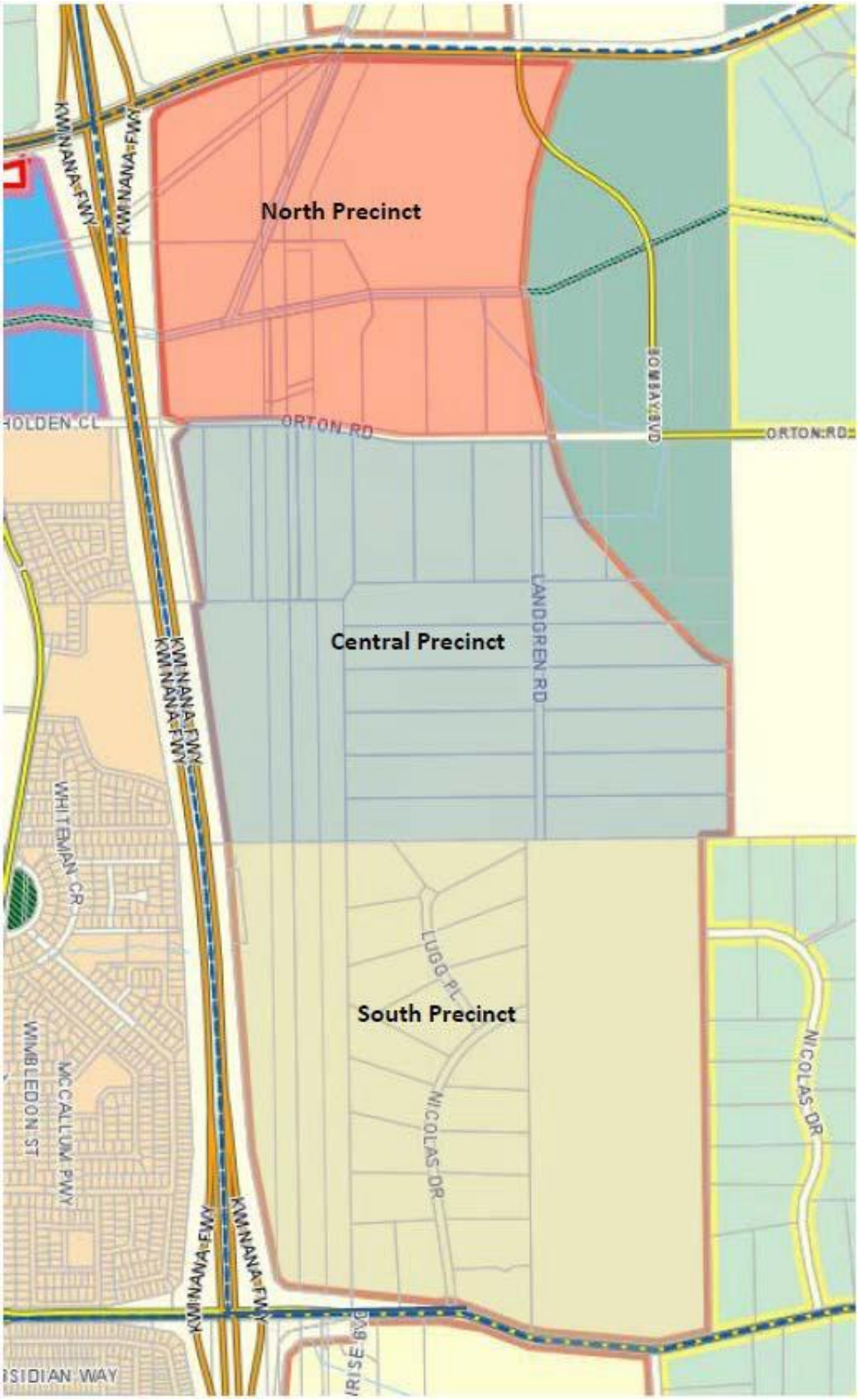
v. The identification of a site for a for a *Local Centre* (6,000m^2 retail floor space) be provided near the intersection of the north-south linkage (Landgren Road) and Mortimer Road.

vi. Landgren Road be extended to connect to and generally align with Nicholas Drive to provide a north-south linkage. The current intersection of Nicholas Drive and Mortimer Road may be used to align with local structure planning for the Wellard East Cell.

vii. The assessment of the environmental quality of the existing bushland within the Casuarina Cell and make recommendations for the preservation of areas of environmental value in accordance with the Western Australian *Environmental Protection Act 1986* and the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999*.

viii. The shortfall of POS in the North and Central Precincts may be used to purchase additional Restricted POS in the South Precinct through the DCP, for the purpose of maximising the preservation of environmentally significant native bushland.

Attachment A (Figure 1)



Attachment F

strategen
ENVIRONMENTAL

Chris Tanner
Coordinator - Environmental Health
City of Kwinana
PO Box 21
KWINANA WA 6966

Our reference: LWP19093.01

Dear Chris

CASUARINA CENTRAL LOCAL STRUCTURE PLAN - ODOUR INVESTIGATION AREA

LWP lodged a Local Structure Plan for the Casuarina Central Cell with the City on 12 December 2018.

Strategen has been engaged by LWP to assist on environmental aspects and on 20 February met with officers of the City to discuss the progress of the Structure Plan to advertising.

In these discussions, and subsequently via email, the City has identified the need to identify and substantiate the extent of an investigation area that will be subject to further monitoring and validation of odour emissions from the mushroom farm which is located north of the Structure Plan area.

The purpose of this correspondence is to identify the area proposed to be designated “subject to further investigation” prior to follow advertising of the Structure Plan.

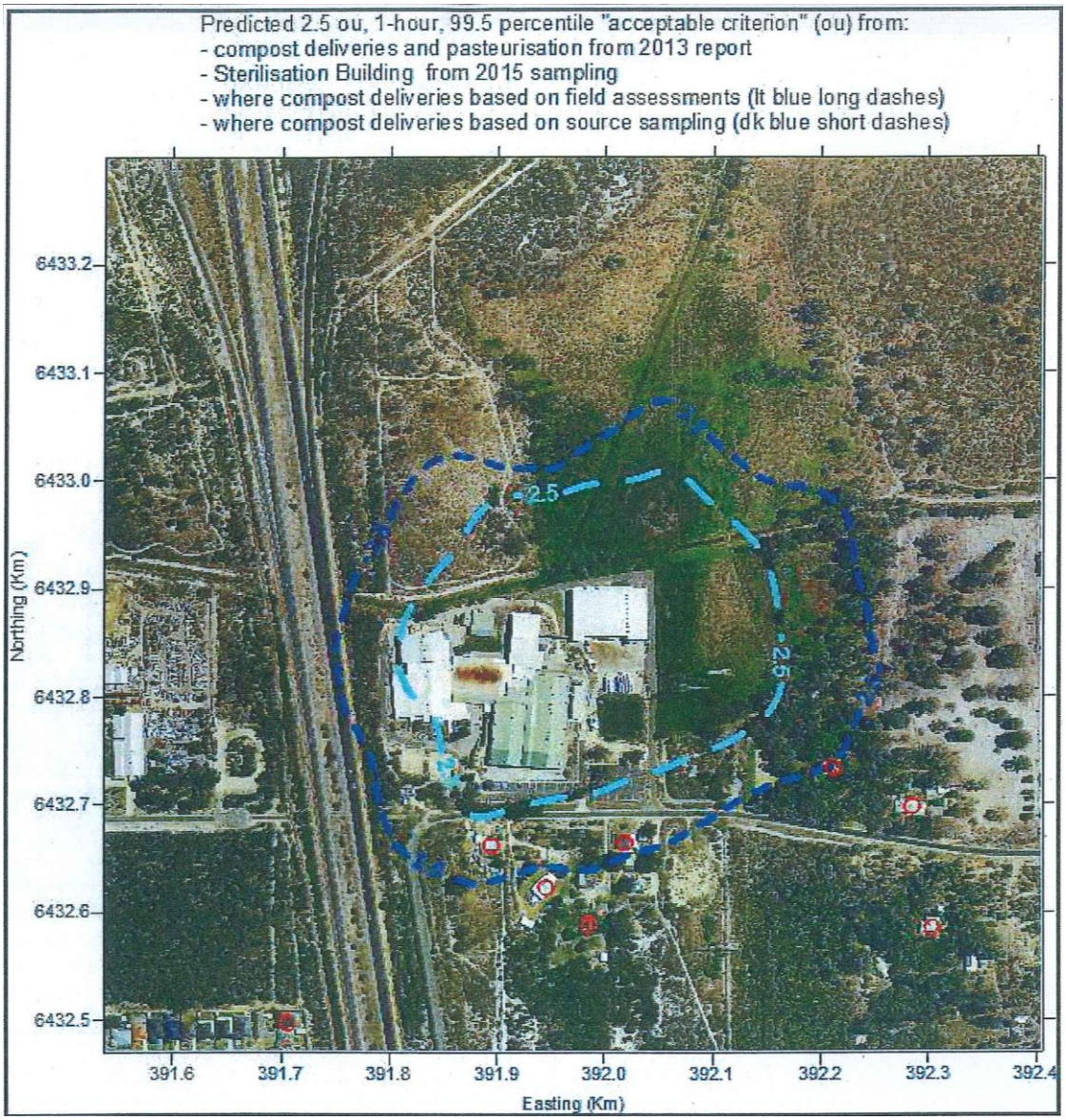
As you will be aware, the mushroom farm has been the subject of numerous odour studies and modelling exercises as well as detailed interaction between the City and Costa with respect to management of odour omissions from the facility.

This includes detailed modelling and validation exercises undertaken by Envall in 2013 and 2015 on behalf of Costa.

The August 2015 Envall report is considered to provide the most up to date and accurate assessment of the offsite impacts of the mushroom farm from odour. This work included odour modelling based on upgrades that had been made to the facility to reduce odour emissions from the key source area of the sterilisation building. The modelling undertaken in 2015 had the benefit of previously validated site-specific field odour measurements and assessments undertaken as part of a 2013 assessment. The odour emission levels used in the modelling in 2015 are therefore considered to be reliable.

The modelling is also considered to be highly conservative in that the 2013 odour assessment found that modelled concentration for odours from the facility were more than twice the field validated levels, meaning that the modelled odour concentrations are conservative and overstate actual levels.

The 2015 modelling of the then current odour emissions and footprint from the site, showed that the predicted acceptable odour contour only slightly impacted on the northernmost portion of the Casuarina Central Local Structure Plan as shown on the Figure overleaf which is an excerpt from the 2015 report.



It is understood that additional upgrades of the facility may have been undertaken subsequent to this work which would have further reduced emissions from the facility. Strategen understands that the City has not received any significant complaints from residents in the vicinity of the facility subsequent to the upgrades undertaken in 2015. It is also understood that the operation of the mushroom farm continues to be the subject of an Environmental Management Plan which is overseen by the City as part of planning approval conditions for the site.

Based on the above, it is considered that the area of the Structure Plan which is to be designated “subject to further investigation” is as shown on the attached version of the Structure Plan.

As agreed with the City at the 20 February meeting, LWP will undertake further field evaluation of actual odour emissions along with assessment of noise emissions from the operation from the facility during the advertising period for the Structure Plan.

The methodology to be used for field validation of current odour emissions is as follows.

The impact of odours can be assessed by field odour assessments (FOAs) carried out following a recognised methodology.

In January 2018, DWER released draft odour assessment guidelines which describe a methodology for conducting FOAs[1]. Although the draft guidelines are not intended for assessment of separation distances for planning matters, the assessment methodology can be considered for this study. The field odour assessments will follow the methodology used by Envall in 2013 (to ensure like-for-like comparison of findings) but would also follow the proposed DWER methodology (i.e. concurrent assessments will be undertaken).

The FOA methodology is based on German standard VDI 3940 Part 2 and European standard EN16841-2:2016. The assessors will track any odour plumes from the farm across the subject site by smelling the odours using a standard protocol. The protocol involves the assessors stopping approximately every 10-20 m and assessing the presence of the odour. Once the extent of the odour plume is established then detailed assessments will be carried out to determine the variability but rating the odours every 10 seconds using a numerical scale (Table 1) over a ten-minute period. A total of 60 observations are made for each odour survey location.

Table 1: Odour intensity scale

Intensity score	Descriptor	Intensity score	Descriptor
0	No odour	4	Strong
1	Very weak	5	Very strong
2	Weak	6	Extremely strong
3	Distinct		

A key component of the study will be to ensure the FOA is carried out during worst-case meteorological conditions for odour impacts. The general approach to the site-specific study is as follows:

- Strategen's odour specialists visit the subject site to carry out a formal FOA
- the FOA involves the odour specialists assessing the extent of odour plumes, then assessing the intensity and character of odours at locations between the odour sources and the subject site
- the assessments will be carried out at times of stable atmospheric conditions (light winds, overcast conditions, relatively cool temperatures) as these conditions provide the least amount of dispersion and dilution of odours from the sources, thereby providing worst-case conditions for assessment of potential odour impacts at the subject site.

The worst-case meteorological conditions typically occur in the very early morning, when light winds prevail and inversion events occur. Under these conditions, odour emissions tend to travel close to ground level with minimal dilution, providing the highest level of odour impacts. The location of the mushroom farm relative to the subject site suggests southerly to westerly winds will provide the greatest risk of odour impacts.

[1] Department of Water and Environmental Regulation 2018, *Draft odour guideline for prescribed premises,* Western Australia

The assessments will be repeated at several transects from the source and across the odour plume (if any) to characterise the spatial extent of odour impacts. The frequencies of each odour score at each location are calculated to determine the risk of unacceptable odour impacts. Details of wind direction and velocities are also recorded at each assessment location.

A key component of the risk of odour impacts is the frequency of light winds that would direct odours from the farm to the subject site with minimal dilution. Five years of wind speed and direction data from the Jandakot Airport Bureau of Meteorology weather station will be obtained and examined to determine the frequencies of winds. The overall risk is a function of the wind direction frequency, the odour emission concentration (or intensity) and the level of offensiveness of the odour at the subject site.

We would appreciate it if you could confirm that the proposed area designated as "subject to further investigation" is acceptable to allow for the Structure Plan to be advertised. We would also appreciate any comments which you have with regard to the proposed odour assessment methodology as it is intended this assessment occurs as soon as possible.

I would be happy to meet with you to discuss any aspect of the above correspondence in more detail.

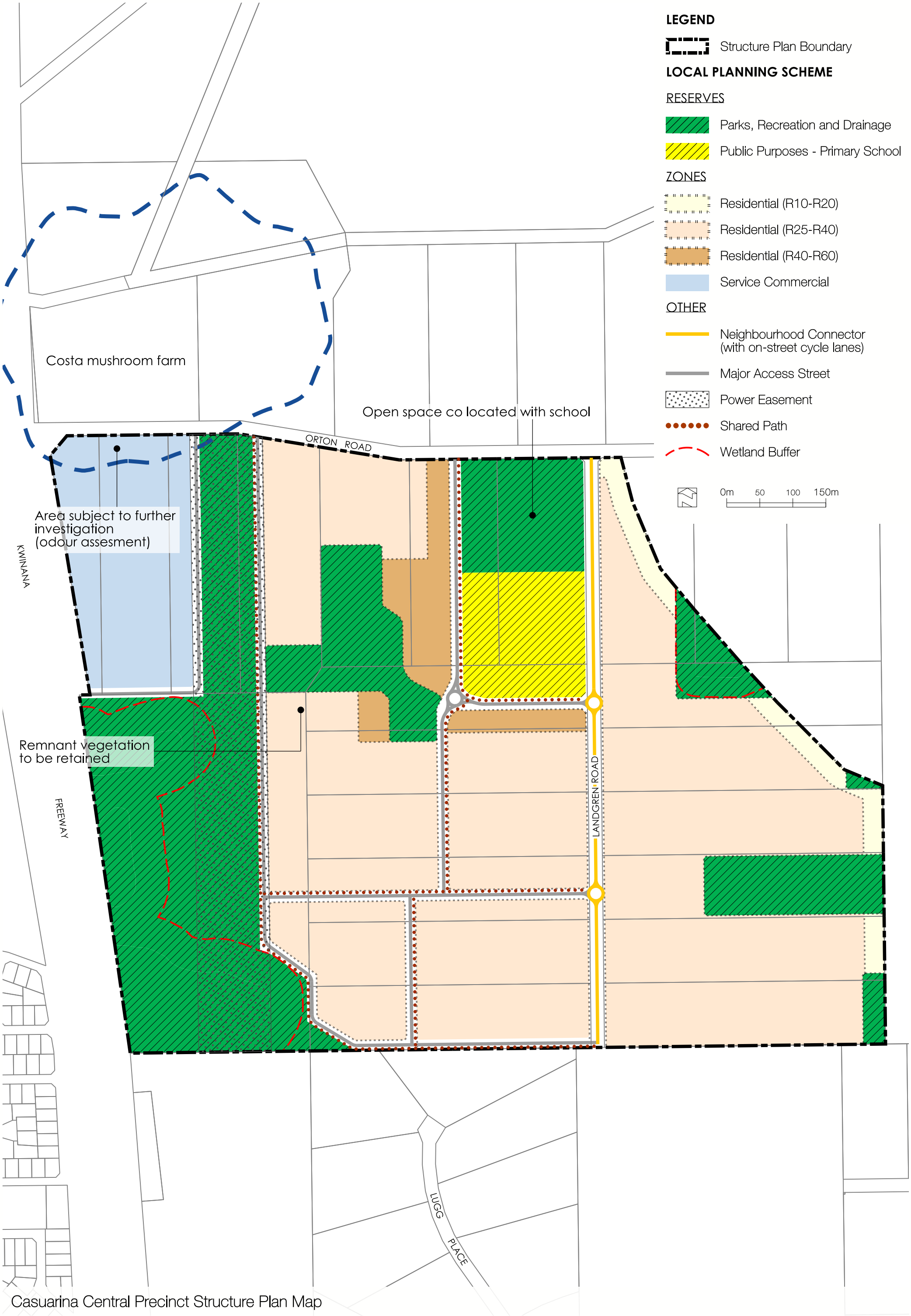
Yours sincerely



Darren Walsh
CHIEF EXECUTIVE OFFICER

11 March 2019

ATTACHMENT 1



Casuarina Central Precinct Structure Plan Map

Attachment G



intelligent outcomes | respected experience

Casuarina Mushroom Farm

Odour assessment

Prepared for
LWP Property
by Strategen

July 2019

strategen
ENVIRONMENTAL

Casuarina Mushroom Farm

Odour assessment

Strategen is a trading name of
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ACN: 056 190 419

July 2019

Limitations

Scope of services

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

Reliance on data

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

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

Environmental conclusions

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

Client: LWP Property

Report Version	Revision No.	Purpose	Strategen author/reviewer	Submitted to Client	
				Form	Date
Draft Report	A	Client review	P Forster / L Taylor	Electronic	25 June 2019
Draft Report	B	Client review	P Forster / L Taylor	Electronic	28 June 2019
Final Report	C	Client submission	P Forster / L Taylor	Electronic	2 July 2019

Filename: LWP19080.01 R001 Rev C - 2 July 2019

Table of contents

1. Background **1**

2. Scope of work **3**

3. Approach and methodology **4**

3.1 Odour assessment 4
3.2 Odour impact assessment criteria 5

4. Results of odour assessments **7**

4.1 Survey locations and weather conditions 7
4.2 Odour characteristics 8
4.3 Mushroom farm odours 10

5. Significance of odour observations **13**

5.1 Assessment against the SMRC criterion 13
5.2 Comparison with dispersion model predictions 13

6. Risks of future odour impacts **15**

6.1 Influence of prevailing winds 15
6.2 Implications of odour results – separation distances 18

7. Conclusions **21**

8. References **22**

List of tables

Table 1: Odour intensity scale 5
Table 2: Field odour assessment - summary details 7
Table 3: Odour characteristics observed during field odour assessments 8
Table 4: Odour survey results – mushroom farm odour 10

List of figures

Figure 1: Structure Plan and generic separation distance from mushroom farm 2
Figure 2: Field odour assessment locations 9
Figure 3: Odour dispersion modelling isopleths (from Envall 2015) 14
Figure 4: Wind rose from Jandakot BOM station 2012 15
Figure 5: Wind rose from Jandakot BOM station 2013 16
Figure 6: Wind rose from Jandakot BOM station 2014 16
Figure 7: Wind rose from Jandakot BOM station 2015 17
Figure 8: Wind rose from Jandakot BOM station 2016 17
Figure 9: Wind rose from Jandakot BOM station 2017 18
Figure 10: Local Structure Plan showing extent of odour impacts during compost deliveries (Wednesday each week) and at other times 19

Executive Summary

LWP Property has submitted a planning application to the City of Kwinana (City) to progress the Casuarina Central Structure Plan (Subject Site). The Costa Farms mushroom facility is adjacent to the northern boundary of the Subject Site and presents a potential source of odour at the Subject Site.

Environmental Protection Authority (EPA) separation distance guidance recommends a minimum generic separation distance from mushroom farms of 500 m to 1000 m depending on the size of the activity, to mitigate risks associated with odour (EPA 2005).

The Casuarina Central Structure Plan is shown in Figure 1, with a 500 m generic separation distance from the mushroom farm indicated.

Previous odour assessments were undertaken in 2013 (Envall 2013) and 2015 (Envall 2015) that included odour emissions measurements, dispersion modelling of odour emissions and field odour assessments (FOAs). FOAs verified the accuracy of the 2013 model predictions but were not carried out to verify the 2015 model predictions. Given this, Strategen assessed odours downwind from the existing farm operations to develop an understanding of the potential impacts from the mushroom farm.

This document describes the methodology and findings from an assessment of odour impacts from the mushroom farm at nearby locations, including locations within the Subject Site.

The field odour assessment were undertaken in May 2019 in accordance with the Department of Water and Environmental Regulation (DWER) draft odour assessment guidelines (DWER 2018) and the German VDI 3940 Part 2 methodology used by Envall in 2013 (to ensure like-for-like comparison of findings) . The assessment methodology was subject to peer review and the key recommendations arising from that review were also adopted.

Overall, the assessment indicates that odour impacts from the mushroom farm at the Subject Site are minimal and although some odour impacts may occur to the commercial and residential zoned land south-east of the farm, the impacts are likely to be very infrequent and relatively minor in terms of odour intensities. As such, the imposition of a separation buffer that impinges upon the Subject Site is not justified or necessary.

1. Background

LWP Property has submitted a planning application to the City of Kwinana (City) to progress the Casuarina Central Structure Plan (Subject Site).

The Costa Farms mushroom facility ('mushroom farm') is located at 45 Orton Road Casuarina. The southern boundary of the mushroom farm is immediately adjacent to the northern boundary of the Subject Site. The mushroom farm presents a potential source of odour that may impact upon persons residing or making use of commercial facilities at the Subject Site.

Environmental Protection Authority (EPA) separation distance guidance recommends a minimum generic separation distance from mushroom farms of 500 m to 1000 m depending on the size of the activity, to mitigate risks associated with odour (EPA 2005).

The Casuarina Central Structure Plan is shown in Figure 1, with a 500 m generic separation distance from the mushroom farm indicated to highlight the extent of potential impediment on proposed land uses should such a distance be applied as a buffer.

Previous odour assessments were undertaken in 2013 (Envall 2013) and 2015 (Envall 2015) that included odour emissions measurements, dispersion modelling of odour emissions and field odour assessments (FOAs). The 2015 modelling utilised revised (lower) emission rates from some sources and activities at the mushroom farm as compared with the 2013 modelling. Those lower rates reflected changes and improvements to operating practices implemented by Costa Farms.

FOAs verified the accuracy of the 2013 model predictions but were not carried out to verify the 2015 model predictions with the reduced odour emission rates. Although modelling and measurements carried out by Envall were consistent with most recent guidelines published by the regulator for modelling (DEC 2006) and for measurements/assessments (DEP 2002), the current view of Department of Water and Environmental Regulation (DWER) as described in draft revised odour assessment guidelines, is that modelling is not sufficiently reliable and field observations are the most appropriate way to assess impacts (DWER 2018). Field observations capture actual impacts at points in time that can greatly enhance the certainty around model predictions to inform odour impact risks at all times and locations.

Given this, Strategen assessed odours downwind from the existing farm operations to develop an understanding of the potential impacts from the mushroom farm.[1]

This document describes the methodology and findings from an assessment of odour impacts from the mushroom farm at nearby locations, including locations within the Structure Plan site.

[1] Note that the DWER draft odour guidelines are intended for assessment of odour impacts from prescribed premises and are not intended to inform planning matters (DWER 2018). Notwithstanding that intention, the methodologies described within the draft guidelines provide some guidance for assessment of odour impacts on future developments. A key issue with the draft guidelines is that criteria are not proposed to inform acceptable vs unacceptable odour impacts, using the various assessment tools (i.e. emissions measurements, modelling and field assessments). In the absence of regulatory criteria, this assessment has utilised criteria previously utilised in other published studies for assessment of odour impacts on residential areas.

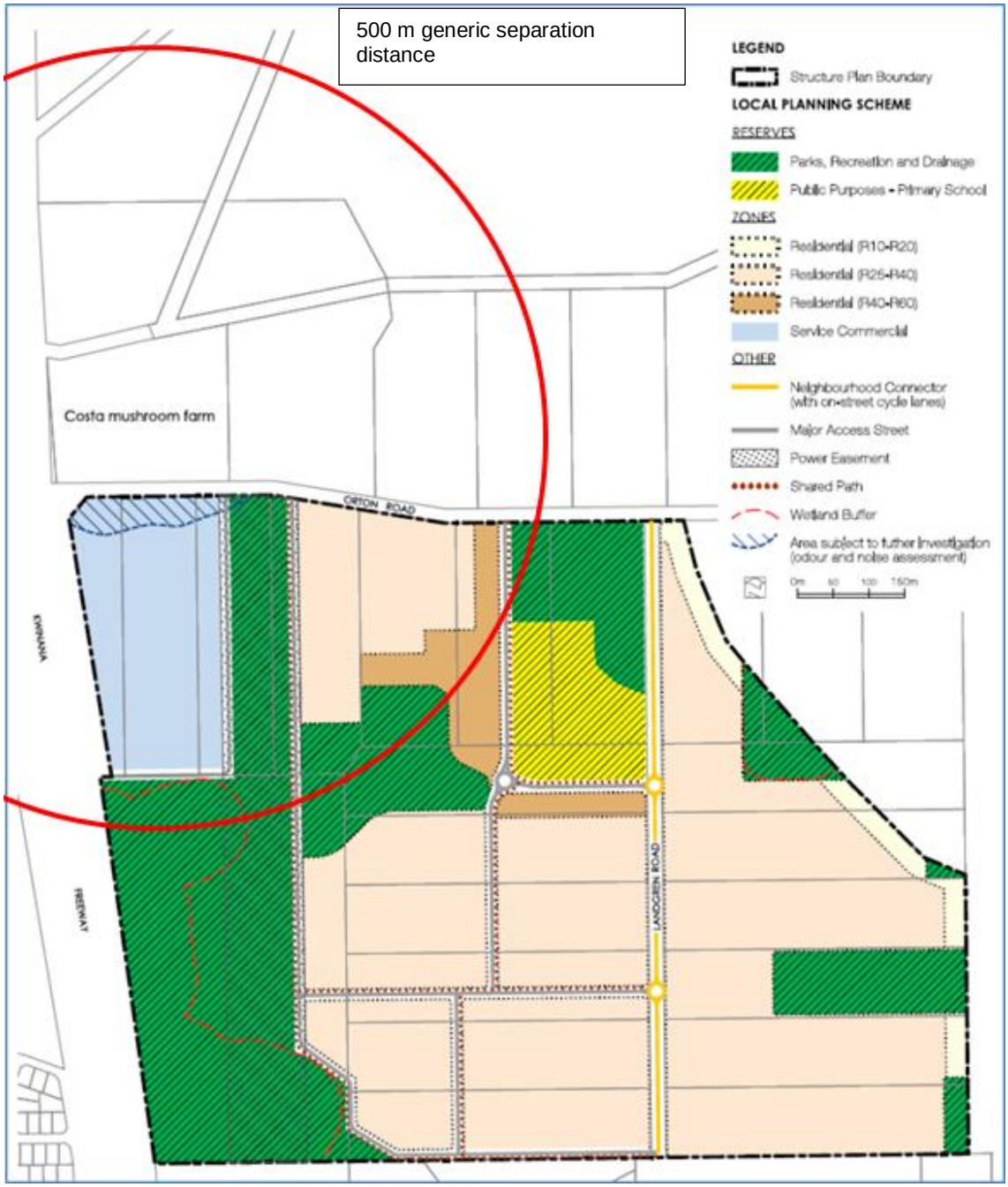


Figure 1: Structure Plan and generic separation distance from mushroom farm

2. Scope of work

The following investigations were carried out in respect of potential for odour impacts at the Subject Site:

- a site visit to identify the key odour emitting activities at the facility
- three FOAs
- examination of the odour findings in light of the generic separation distance guideline
- review of frequency of prevailing winds that would direct any odour emissions from the mushroom farm to the Subject Site.

3. Approach and methodology

3.1 Odour assessment

DWER draft odour assessment guidelines (DWER 2018) describe a methodology for conducting FOAs[2]. Although the draft guidelines are not intended for assessment of separation distances for planning matters, the assessment methodology can be considered for this study. The field odour assessments follow German VDI 3940 Part 2 methodology used by Envall in 2013 (to ensure like-for-like comparison of findings) but also considered the proposed DWER methodology which is based on EN16841-2 where relevant (CEN 2016). This approach is intended to address any concerns regarding the reliability of the assessment in respect of current DWER expectations.

The assessments were constructed to identify and track the odour intensities of odour plume(s) from the mushroom farm. As such, a key component of the study was to ensure the FOAs were carried out during worst-case meteorological conditions for odour impacts. The general approach to the site-specific study was taken as follows:

- odour assessors to visit the subject site to carry out formal FOAs
- the FOAs must involve the odour assessors assessing the extent of odour plumes, then assessing the intensity and character of odours at locations between the odour sources and the Subject Site
- the assessments must be carried out at times of stable atmospheric conditions (light winds, overcast conditions, relatively cool temperatures) as these conditions provide the least amount of dispersion and dilution of odours from the sources, thereby providing worst-case conditions for assessment of potential odour impacts at the Subject Site.

The worst-case meteorological conditions typically occur in the very early morning, when light winds prevail, and inversion events occur. Under these conditions, odour emissions tend to travel close to ground level with minimal dilution, providing the highest level of odour impacts. The location of the mushroom farm relative to the Subject Site suggested north east to northerly winds will provide the greatest risk of odour impacts at the Subject Site.

The initial FOA was conducted on Sunday 5 May 2019 by:

- Dr Peter Forster, Principal odour specialist
- Jonathan Bailes, Principal odour assessor
- Josip Knezevic, Consultant odour assessor.

Follow up odour survey were undertaken on 29 May 2019, which coincided with compost being delivered to the mushroom farm (every Wednesday). A third survey was undertaken on 31 May 2019, to determine if the compost odours had decreased some days after delivery. Both of these surveys were attended by Josip Knezevic and John Hurley (odour specialist from Environmental & Air Quality Consulting Pty Ltd). Assessors have been “calibrated” for odour assessments as per ASNZS4323.3:2001.[3]

The surveys involved initial plume tracking assessments as advocated by EN16841-2, followed by more detailed assessments using a rating of the intensity of the odour every 10 seconds for a period of 10 minutes to give 60 odour observations in each odour survey at each location within the plume or thereabouts.

The rating is based on a zero (0) to six (6) scale as shown in Table 1.

[2] At the time of writing, the guidelines have not been issued as final version for implementation by odour impact assessments.

[3] Copies of calibration certificates can be provided upon request.

Table 1: Odour intensity scale

Intensity score (I)	Definition	Meaning	Comments
0	No perceptible odour	Nil odour	High frequencies of Intensity scores 0 and 1 indicate insignificant odour impacts.
1	Very weak	Slight indication of odour but not possible to identify what type of odour	
2	Weak	Increase in odour but not able to identify the source with confidence	High frequencies of scores of 2 to 3 indicate an increased significance which may lead to unacceptable odour impacts.
3	Distinct	Clearly able to identify the type (character) of odour but odour is not offensive	
4	Strong	Odour intensity increases and begins to be offensive	Odour impacts of greater than 3 are considered to provide unacceptable odour impacts that would not be tolerated if occurring frequently.
5	Very strong	Odour intensity increases some more and is clearly offensive	
6	Extreme	Odour is very offensive and not tolerated	

The assessments were repeated at several transects from the source and across the odour plume (if any) to characterise the spatial extent of odour impacts. The frequencies of each odour score at each location were then calculated to determine the risk of unacceptable odour impacts. Details of wind direction and velocities were also recorded at each assessment location.

The overall risk is a function of the wind direction frequency, the odour emission concentration (or intensity) and the level of offensiveness of the odour at the subject site. Five years of wind speed and direction data was obtained from the Jandakot airport Bureau of Meteorology weather station and examined to determine the frequency of winds from the mushroom farm to the Subject Site to inform the risk of unacceptable odour impacts.

The odour survey methodology was also informed by the outcomes of discussions with the City of Kwinana and a peer review undertaken by Talis Consultants (2019). The key recommendations from the peer review were adopted in the odour survey methodology, with the exception that the assessments were conducted in line with the methodology of VDI3940 Part 2 to align with the methodology used by Envall (as previously discussed).

3.2 Odour impact assessment criteria

Odour impacts are characterised in terms of FIDOL factors, being ***frequency*** of occurrence, ***intensity*** (concentration) of odours, ***duration*** of impact, ***offensiveness*** of odour and ***location*** of the impacts. Odour impact benchmarks or criteria that consider these factors are not provided in the draft DWER guidelines.

The modelling conducted by Envall (2013 and 2015) referenced air quality criteria from Queensland EPA of 2.5 odour units (OU) for 1 hour average, 99.5th percentile, for assessment of predicted odour concentrations. Envall suggest that distinct odour intensities (score = 3) equate to odour concentrations of 4-10 OU. On that basis, the Queensland criterion of 2.5 OU most likely equates to an odour intensity score of 2-3.

The odour assessment criteria developed for odour assessments conducted at locations around the Southern Metropolitan Regional Council (SMRC) Canning Vale Regional Resource Recovery Centre (RRRC) provide a benchmark for comparison of the field observations at the Subject Site (SMRC 2012).

More specifically, the SMRC Methodology Statement for FOAs considers a frequency of odour intensity scores = 2 in a measurement cycle (i.e., the 60 observations made every 10 seconds for 10 minutes) of ≥20% as problematic in respect of odour impacts and a location is considered odour affected if that criterion is exceeded. The criterion is conservative in that it considers the intensity score of 1 to be the recognition threshold for a very weak odour and a score of 2 as being slightly greater odour significance, with an intensity score of 3 (distinct) suggesting higher levels of odour control should be implemented at the source.

The assignment of intensity score = 1 as the recognition threshold aligns with the DWER draft guidelines.

4. Results of odour assessments

4.1 Survey locations and weather conditions

A total of 43 odour surveys were carried out during the three site visits on 5, 29 and 31 May 2019. Details of weather conditions and the locations surveyed are summarised in Table 2.

Table 2: Field odour assessment - summary details

Date	Wind conditions	Locations surveyed	Number of odour surveys	Comments
5 May 2019	Light NNW to NE winds	Orton Rd, northern aspects of Subject Site to approximately 350 m south of Orton Rd	21	Odour plumes detected eastern side of mushroom farm (appears from roof top steam vent) and from western side of the farm (source not identified).
29 May 2019	Light NE to easterly to winds	West of mushroom farm and further to the west across the freeway	13	Survey conducted on day of compost deliveries. Winds were not blowing toward Subject Site. Surveys were conducted to the west of the farm to determine extent of odour plume. Odour plumes detected appeared to be emitted from eastern side of mushroom farm.
31 May 2019	Light NNW to NE winds	Orton Rd, northern aspects of Subject Site to approximately 450 m south of Orton Rd	9	Survey conducted two days after compost deliveries with northerly winds. Odour plumes detected from eastern side of mushroom farm.

The surveys on 5 May were carried out in the morning when winds were favourable in respect of direction to the Subject Site but of sufficiently light wind speeds to minimise dilution. As such, they provided a conservative assessment of the potential spatial extent and the significance of odour impacts at the Subject Site. Given the wind directions observed in May, assessments were not able to be undertaken within 500 m from the mushroom farm along the eastern portion of the Subject Site, i.e. winds from the NW did not occur to a significant frequency to facilitate surveys at those locations. The risk of odour impact at those locations is inferred on the basis of the extent of impacts observed at other locations and the frequency of light NW winds.

The survey on 29 May was also carried out in the morning on the day of the week (Wednesday) when compost is delivered to the mushroom farm. Winds at that time were from the east which directed any odour emissions to the west of the mushroom farm, not in the direction of the Subject Site. Nonetheless, the surveys identified the distances that compost odours travelled before being diluted below threshold levels. The observed distances can be applied to the Subject Site when northerly to NW winds of similar speeds occur, to identify the extent of potential impact at the Subject Site.

A third survey, conducted on 31 May, was intended to determine if the compost odours had decreased some days after delivery, as the compost is utilised within the farm operations. Winds at that time were from the north which allowed for direct assessment of odour impacts at the Subject Site.

The surveys were conducted at locations indicated in Figure 2 The locations were selected from the wind direction at the time of the assessments to maximise the potential to detect odours from the mushroom farm. It should be noted that locations outside the 500 m separation distance were visited during the site visits, but the mushroom farm odours were not detected at any of those locations and formal FOAs were not carried out as a consequence.

4.2 Odour characteristics

A number of types of odour are emitted from the mushroom farm (Envall 2013) and the current study was focussed on identifying the frequency and intensity of those odours (Table 3). Other odours from bushland, vegetation and eucalypt trees were detected during the surveys but were not recorded in the observations since the focus of the assessment was to determine the extent of impacts of compost and mushroom derived odours.

Table 3: Odour characteristics observed during field odour assessments

Odour character	Source	Comment
Compost	Compost deliveries Vents from growing rooms	Spent compost had very little odour and was not detected at odour survey locations
Earthy	Vents from growing rooms	
Mushroom	Vents from growing rooms	
Bush, vegetation, eucalyptus	Weeds, grasses, bushland, eucalyptus trees	Includes fragrances from flowering plants
Burnt caramel	Unknown	This odour was only detected from the western side of the mushroom farm on 5 May and on 31 May

An odour reminiscent of burnt caramel was detected at the western end of Orton Rd on 5 and 31 May surveys, which was attributed to an unknown source to the immediate north (based on the northerly winds at those times) and encompassed the buildings on the western side of the mushroom farm. The Envall reports did not describe such an odour and as such, the exact origin cannot be determined at this time. The burnt caramel odour persisted for approximately 100 m down the southern aspect of Orton Rd and was not detected at any other locations.

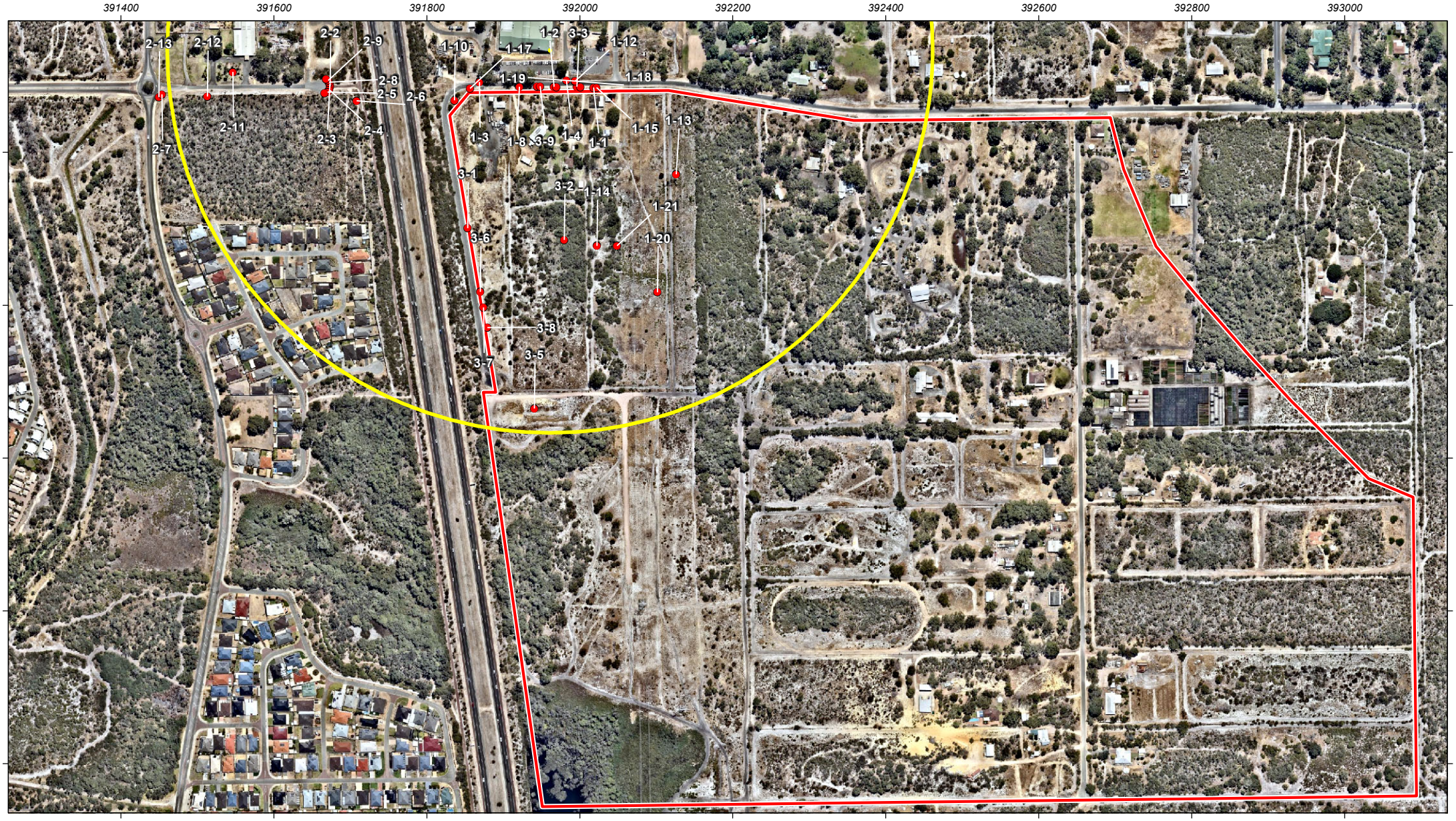


Figure 2: Location of sample sites

N

Scale 1:6,600 at A4

0 50 100 m

Coordinate System: GDA 1994 MGA Zone 50

Date: 10/06/2019

Legend

- Structure plan boundary
- 500m generic separation distance
- Survey points

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Data source: Nearmap: Aerial image, flown 05/2019. Landgate: Cadastre, 07/2018. LWP Property. Development layout, 05/2019. Created by: h.sullivan

4.3 Mushroom farm odours

The results of the odour surveys are summarised as frequencies of intensity scores for mushroom farm derived odours (Table 4). Odours with intensity scores of 4, 5 and 6 were not observed during the surveys and those results have therefore been omitted from the table. Distances are from the FOA location to the southern edge of the mushroom farm building nearest to Orton Rd.

Results for surveys with intensity scores of ≥2 occurring for 20% or more of the time are highlighted for discussion below.

Table 4: Odour survey results – mushroom farm odour

Date	Location reference	Location	Distance from mushroom farm	Wind conditions	I=0	I=1	I=2	I=3
05-05-19	1-1	Lot 60 Orton Road	70 m	North Light	30%	18%	35%	18%
05-05-19	1-2	Lot 54 Orton Road	45 m	North Light	88%	11%	2%	0%
05-05-19	1-3	Gate 3 Costa (Orton Road)	50 m	North Calm-light	77%	2%	12%	10%
05-05-19	1-4	Gate 2 Costa (Orton Road)	43 m	North Light	60%	18%	17%	5%
05-05-19	1-5	32° 14' 14" S. 115° 51' 13" E	55 m	North Light	75%	13%	12%	0%
05-05-19	1-6	32° 14' 23" S. 115° 51' 17" E	335 m	North Light	98%	2%	0%	0%
05-05-19	1-7	32° 14' 21" S. 115° 51' 15" E	260 m	North, sheltered location	92%	8%	0%	0%
05-05-19	1-8	Lot 50 Orton Road	48 m	North Light	63%	14%	22%	2%
05-05-19	1-9	Lot 54 Orton Road	45 m	North Light	86%	12%	2%	0%
05-05-19	1-10	West End Orton Road	87 m	Calm	100%	0%	0%	0%
05-05-19	1-11	Lot 52 Orton Road	46 m	North	91%	9%	0%	0%
05-05-19	1-12	32° 14' 14" S. 115° 51' 13" E	50 m	North Light	97%	3%	0%	0%
05-05-19	1-13	32° 14' 18" S. 115° 51' 18" E	225 m	North, North West	100%	0%	0%	0%
05-05-19	1-14	32° 14' 21" S. 115° 51' 13" E	255 m	North Calm-light	100%	0%	0%	0%
05-05-19	1-15	Lot 60 Orton Road	70 m	North Calm-light	66%	10%	19%	5%
05-05-19	1-16	Lot 54 Orton Road	45 m	North, NNW light	94%	2%	4%	0%
05-05-19	1-17	Western end Orton Road	62 m	Calm	100%	0%	0%	0%
05-05-19	1-18	32° 14' 14" S. 115° 51' 13" E	50 m	N, NNW/NNE, Light	95%	2%	2%	2%

Date	Location reference	Location	Distance from mushroom farm	Wind conditions	I=0	I=1	I=2	I=3
05-05-19	1-19	32° 14' 14" S. 115° 51' 13" E	50 m	North, Calm-light	100%	0%	0%	0%
05-05-19	1-20	32° 14' 23" S. 115° 51' 17" E	334 m	NNE, NNW, Light Winds	98%	0%	2%	0%
05-05-19	1-21	32° 14' 21" S. 115° 51' 15" E	263 m	North, light	81%	2%	14%	4%
29/05/2019	2-2	Holden Close Rd (Cul-de-sac end)	160 m	ESE, Calm-light	100%	0%	0%	0%
29/05/2019	2-3	Holden Close Rd (Cul-de-sac end)	160 m	ESE, Calm-light	100%	0%	0%	0%
29/05/2019	2-4	Holden Close Rd (Cul-de-sac end)	165 m	ESE, Calm-light	64%	27%	9%	0%
29/05/2019	2-5	Holden Close Rd (Cul-de-sac end)	168 m	ESE, Calm-light	100%	0%	0%	0%
29/05/2019	2-6	Southwest pathway of Holden Closed Rd	145 m	ESE, Calm-light	100%	0%	0%	0%
29/05/2019	2-7	Johnson Road/Sulphur Road	367 m	ESE, Calm-light	100%	0%	0%	0%
29/05/2019	2-8	Holden Close Rd (Cul-de-sac end)	160 m	ESE, Calm-light	100%	0%	0%	0%
29/05/2019	2-9	Holden Close Rd (Cul-de-sac)	160 m	ESE light	27%	53%	17%	3%
29/05/2019	2-10	Holden Close Rd (Cul-de-sac)	160 m	ESE light	12%	40%	30%	18%
29/05/2019	2-11	Holden Close Rd (Near Cars Parked)	270 m	ESE light	33%	45%	20%	2%
29/05/2019	2-12	South-Holden Close Road	310 m	ESE light	62%	35%	3%	0%
29/05/2019	2-13	Johnson Road/Sulphur Road	370 m	ESE light	57%	42%	2%	0%
29/05/2019	2-14	Holden Close Rd (Cul-de-sac)	170 m	ESE light	32%	57%	12%	0%
31/05/2019	3-1	Orton Road N/S	230 m	NNE-N light	80%	20%	0%	0%
31/05/2019	3-2	Bush (South of Site)	238 m	NNE-N light	100%	0%	0%	0%
31/05/2019	3-3	Orton Road	58 m	NNE-N light	83%	17%	0%	0%
31/05/2019	3-4	Orton Road	60 m	NNE-N calm to light	100%	0%	0%	0%
31/05/2019	3-5	Site Boundary	467 m	NNE-N light	78%	15%	7%	0%

Date	Location reference	Location	Distance from mushroom farm	Wind conditions	I=0	I=1	I=2	I=3
31/05/2019	3-6	South Orton Road	312 m	N-NE light	82%	18%	0%	0%
31/05/2019	3-7	South Orton Road	333 m	N-NE light	63%	37%	0%	0%
31/05/2019	3-8	South Orton Road	360 m	N-NE light	58%	42%	0%	0%
31/05/2019	3-9	Outside Facility	45 m	N-NE light	59%	41%	0%	0%

5. Significance of odour observations

5.1 Assessment against the SMRC criterion

As discussed in Section 3.2, the SMRC Methodology Statement for FOAs provides a criterion to assess the significance of the odours observed at the Subject Site. Five of the 21 surveys conducted along Orton Rd (43 to 70 m from the nearest building at the mushroom farm) on 5 May 2019 showed intensity score ≥ 2 for more than 20% of the time. As such, these locations are considered "odour affected" as per the SMRC methodology. Three surveys conducted at Holden Close Rd (160 and 270 m west of the farm) on 29 May 2019 showed intensity scores ≥ 2 for more than 20% of the time, indicating these locations were also odour affected.

The surveys conducted on 29 May 2019 were affected by higher levels of odour emissions from compost deliveries, and represent worst-case odour impacts.

Of note is that the odour impacts significantly decreased further to the west, with intensity score ≥ 2 of 3% at 310 m and 2% at 370 m from the farm. Neither of these locations are considered odour affected using the SMRC methodology.

The results suggest odour impacts from compost deliveries extend to approximately 270m from the mushroom farm, whereas impacts at other times are limited to approximately 70 m from the farm.

5.2 Comparison with dispersion model predictions

The 2015 Envall dispersion modelling report showed impacts largely isolated to the immediate vicinity of the mushroom farm (Figure 3). Two isopleths are shown: the light blue contour represents 2.5 odour units (OU), for 1-hour average, 99.5th percentile based on field odour assessments, and the dark blue contour represents the same odour concentration but from modelling of measured emission rates from the various sources within the farm. In effect, this shows the model is conservative and over-predicts impacts compared with field observations.

As indicated, a 2.5 OU concentration equate to intensity scores in the 2 to 3 range. A direct comparison of model predictions with field observations requires an assumption to be made that the odours could persist for an hour (to align with the model averaging). Odours at 2.5 OU (intensity score of 2-3) for an hour would indicate the location is odour affected as per the SMRC methodology. The model predicted impacts at approximately 260 m east of the farm which is consistent with the observations made on 29 May, where locations 160 and 270 m west of the farm were found to be odour affected from easterly winds blowing across the farm at times when compost deliveries occurred.

The greater extent of impacts predicted from modelling of source emission rates compared with field observations is not unexpected. Dispersion modelling assumes additivity of odour emission rates from multiple sources and can be inherently conservative as a consequence.

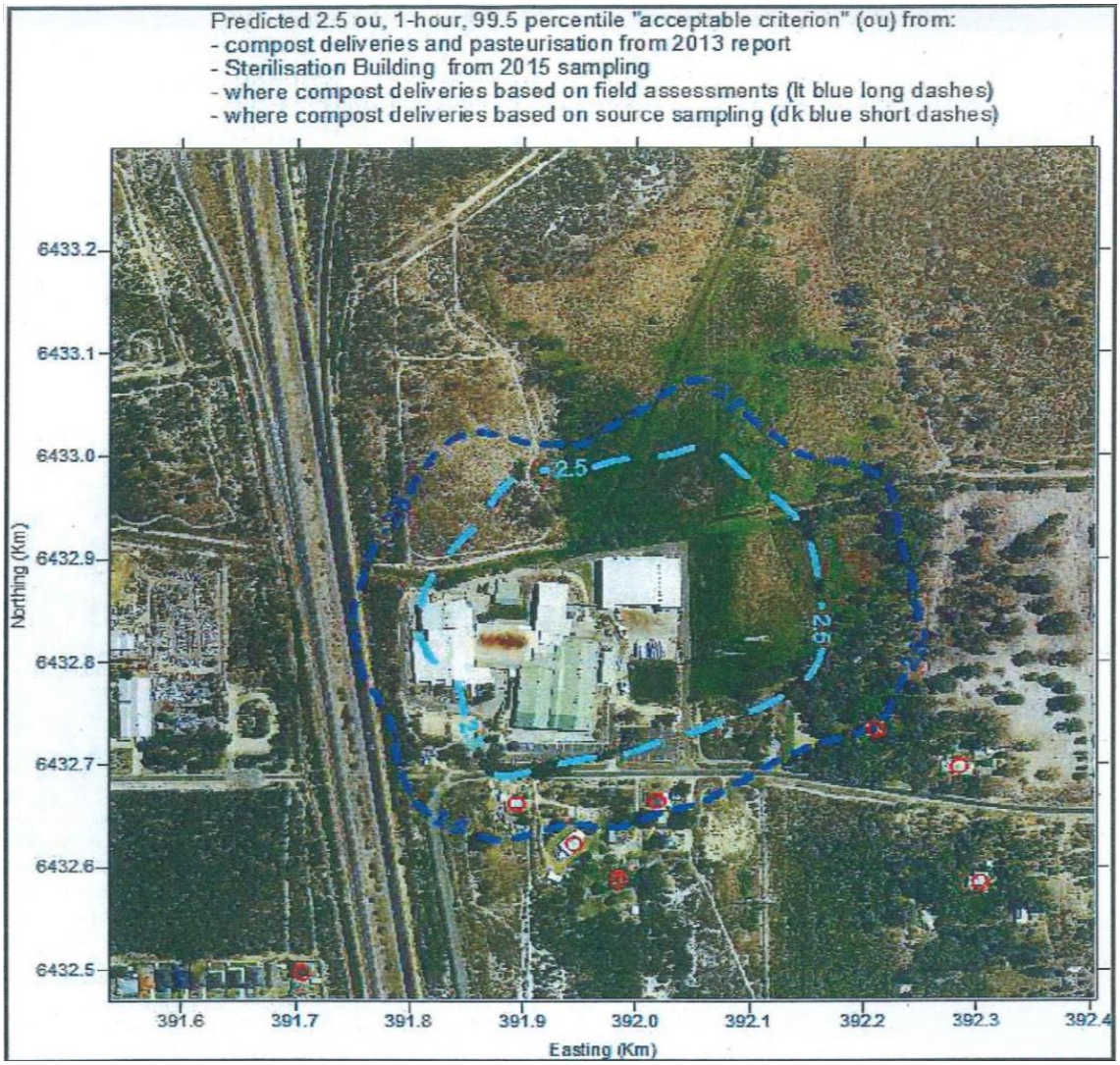


Figure 3: Odour dispersion modelling isopleths (from Envall 2015)

Note that the location of the isopleths (modelled odour contours) should not be considered as a threshold distance for acceptable versus unacceptable odour impacts. They describe the extent of predicted odour impacts at the 2.5 OU concentration for the 99.5th percentile, which is the 44th hour in the modelling year. The contours would extend further from the farm for the higher percentiles but the risks of odour impacts would decrease due to the lower probability of occurrence at those higher percentiles.

6. Risks of future odour impacts

6.1 Influence of prevailing winds

The potential for odour impacts at sensitive receptors in the Subject Site can be determined from the field odour assessment results and the frequency of winds that direct odour emissions from the mushroom farm to those receptors. Wind data from the Jandakot BOM station for a six year period (2012-2017 inclusive) have been examined to identify frequencies from the north to north west, as illustrated from wind roses shown in Figure 4 to Figure 9.

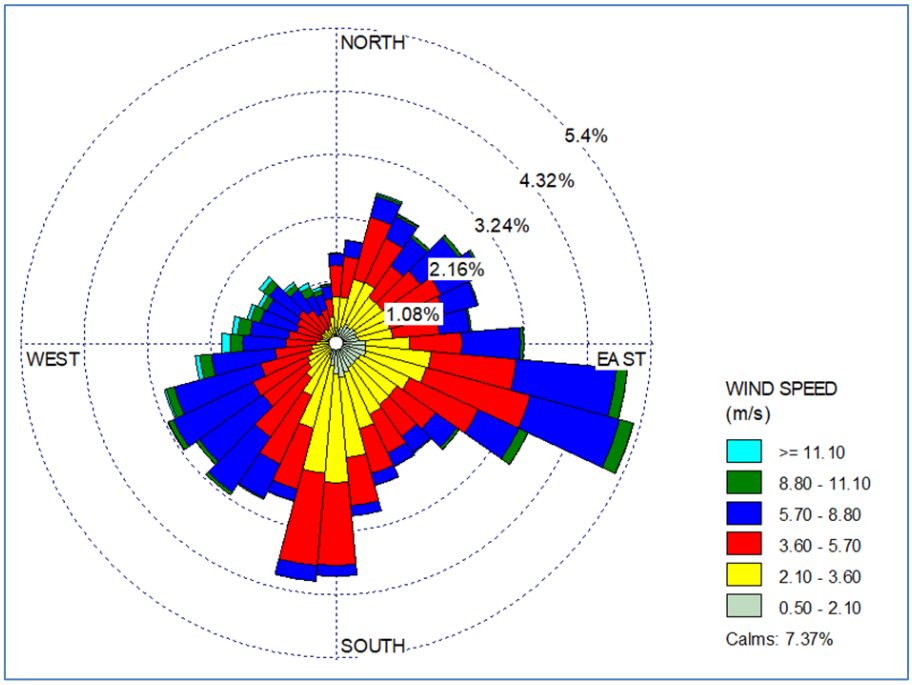


Figure 4: Wind rose from Jandakot BOM station 2012

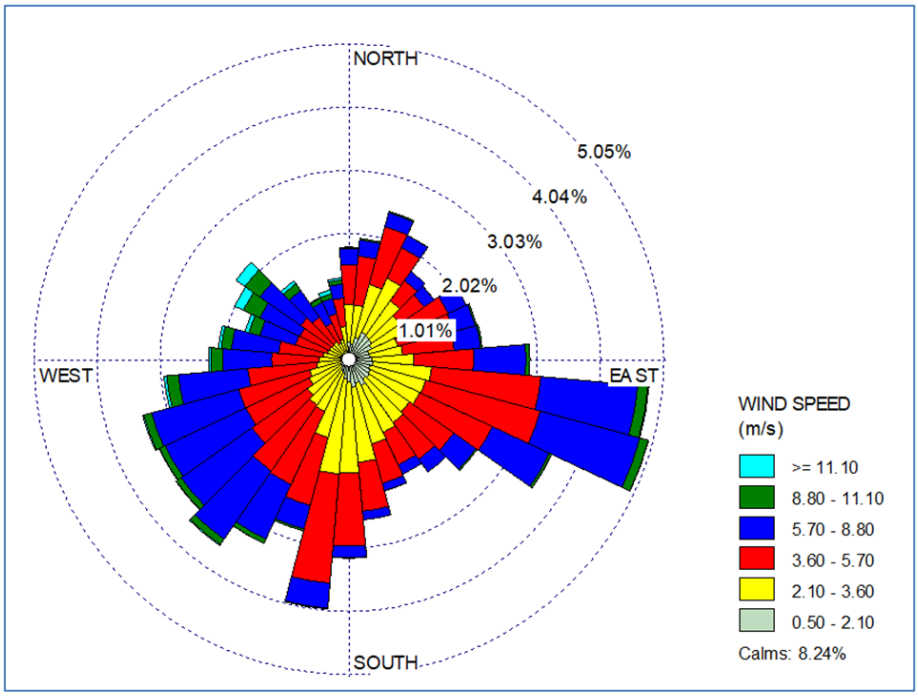


Figure 5: Wind rose from Jandakot BOM station 2013

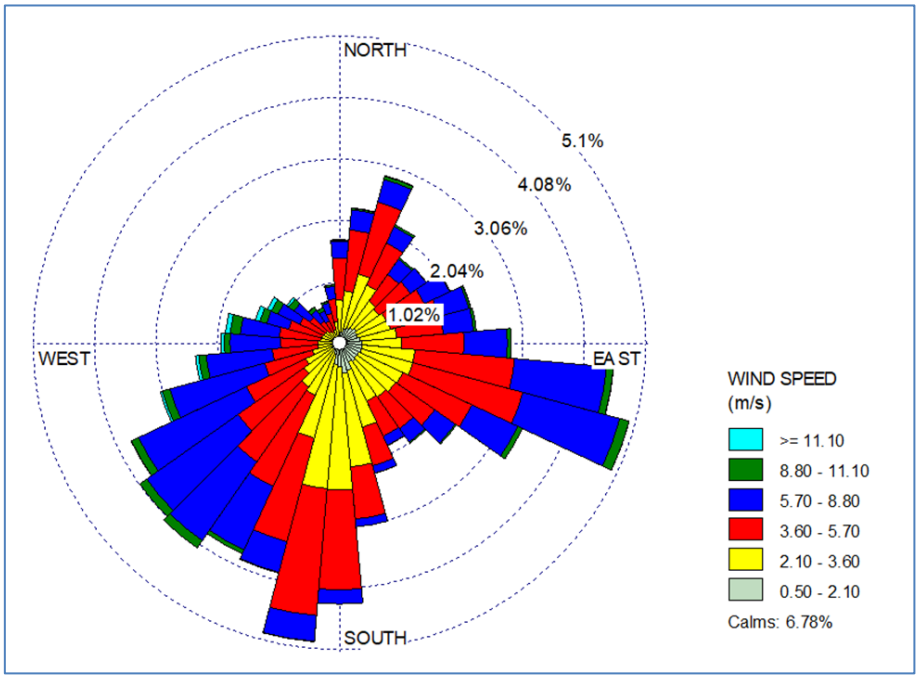


Figure 6: Wind rose from Jandakot BOM station 2014

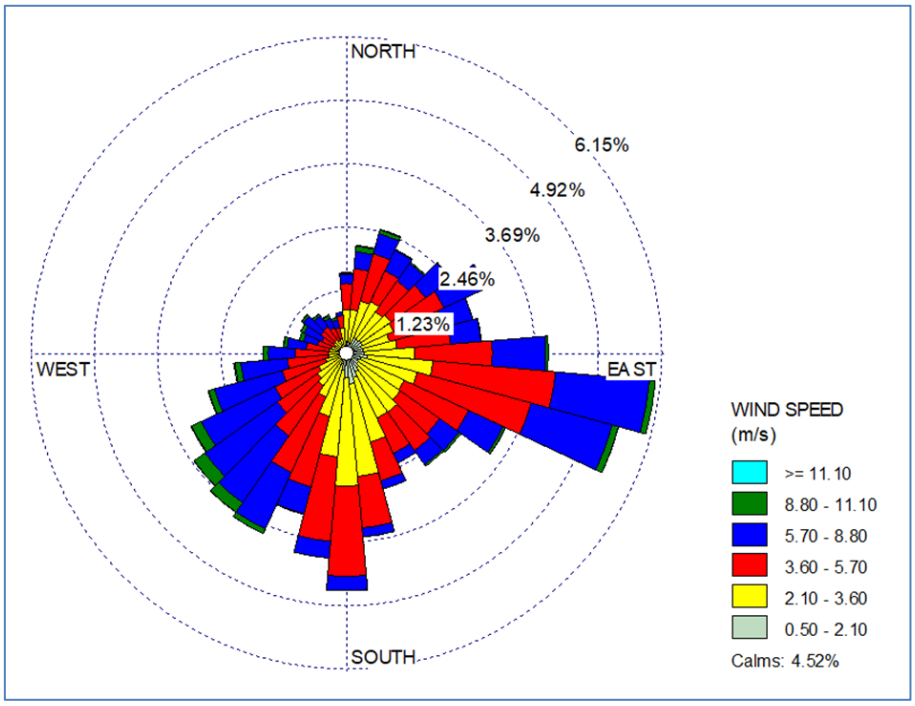


Figure 7: Wind rose from Jandakot BOM station 2015

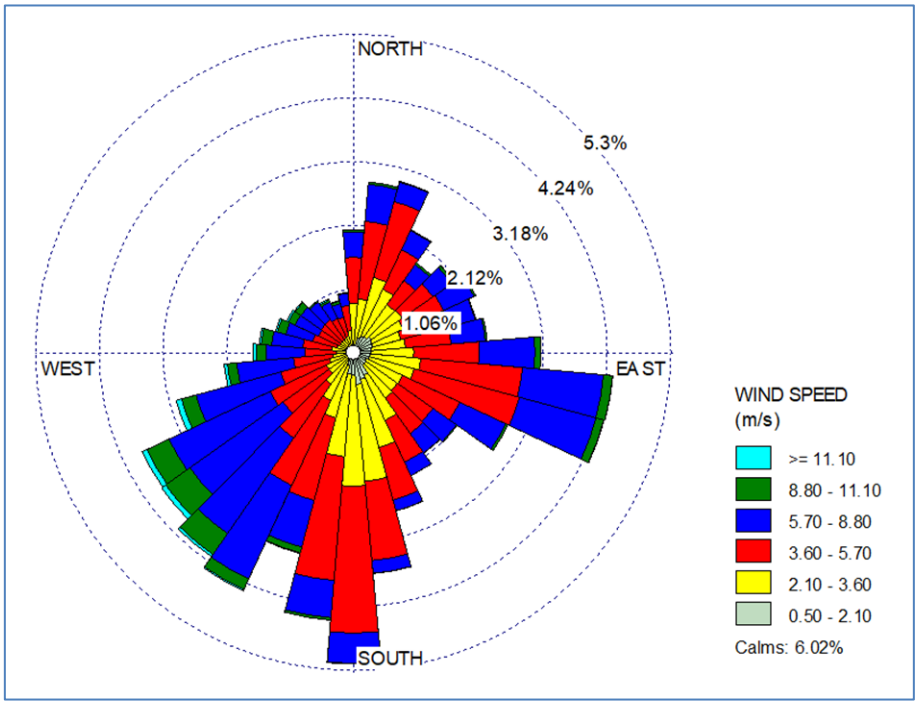


Figure 8: Wind rose from Jandakot BOM station 2016

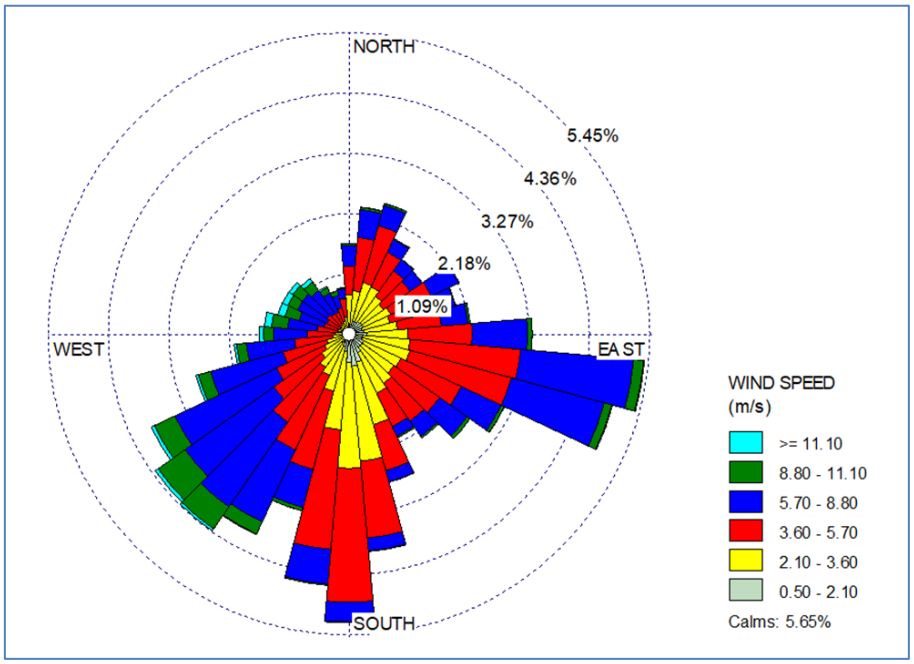


Figure 9: Wind rose from Jandakot BOM station 2017

Winds from the NE-N sector occur less than 2% of the time, with light winds that give rise to greatest potential for odour impacts as a consequence of low dilution rates occurring for < 0.5% of the time.

The odour assessments have indicated the more significant odour impacts occur from compost deliveries, which are understood to only occur on Wednesday of each week, from nominal 7 am to 4 pm. The combined probability of light northerly winds occurring for the nine (9) hours on each Wednesday across a year when compost deliveries occur is approximately 0.03%.

The above considerations (low frequencies of prevailing winds and highest odour emissions for nine (9) hours on one day per week) suggest a low risk of odour impacts at the Subject Site.

6.2 Implications of odour results – separation distances

The extent of odour impacts as identified from the field assessments is limited to 270 m from the mushroom farm under light wind conditions during compost deliveries and 70 m at other times, with light winds providing worst-case (poor) conditions for odour dispersion.

The results do not support imposition of a 500 m separation distance on the proposed development at the Subject Site. In particular, the odour affected zone for times when compost deliveries occur (270 m) is considerably less than that afforded by a 500 m separation distance and further reduced (to 70 m) for operations at all other times (Figure 10).

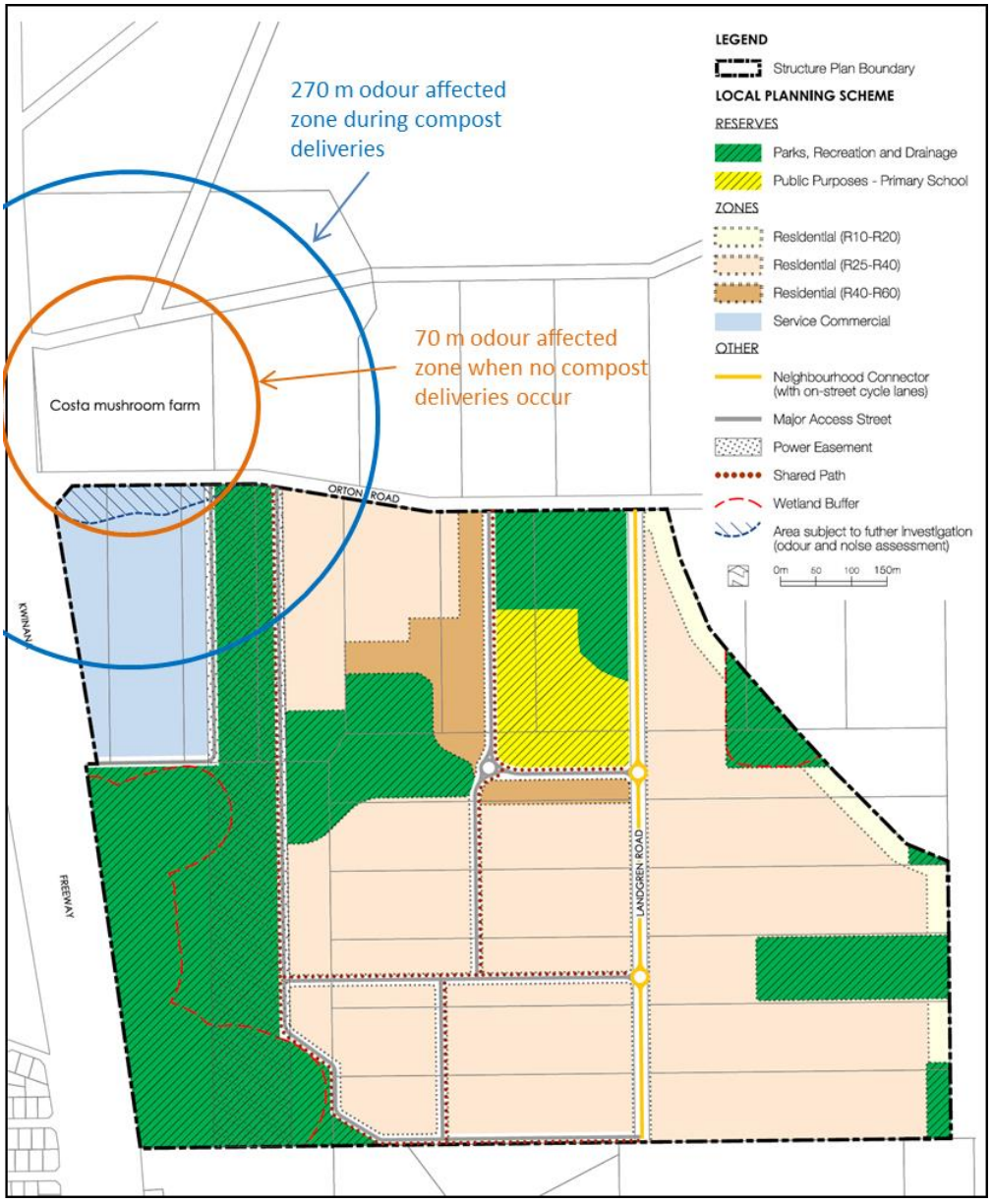


Figure 10: Local Structure Plan showing extent of odour impacts during compost deliveries (Wednesday each week) and at other times

The Structure Plan shows commercial development immediately south of the mushroom farm, which is inside the odour affected zone. Persons using those commercial premises may be impacted by compost, earthy and mushroom odours at times when light northerly winds prevail and compost deliveries occur. As previously discussed, the probability of coincident compost deliveries under such wind conditions is very low. At other times of operations, the impacts are limited to 30-40 m south of Orton Rd under those wind conditions.

The nearest of the R25-R40 residential properties to the SE of the farm may also experience some odour impacts, but again they will be limited by the low frequency of light NW winds. Strong NW winds would direct odours to those locations but the relatively high dilution afforded by the higher air flows would significantly reduce the odour concentrations and associated impacts.

The low risk of odour impacts suggests imposition of any separation distance to be unnecessary. The developer may consider memorials on titles to inform prospective purchasers of the very low risk of odour impacts.

The air conditioning systems at commercial premises can be designed to minimise odour ingress into buildings and garden beds could be planted around those buildings to provide some natural odour masking from flowing plants.

7. Conclusions

The following conclusions are made from consideration of the FOAs and wind conditions:

- odour impacts at the Subject Site are limited to within 270 m of the mushroom farm at times of compost deliveries (business hours every Wednesday) at other times, the impacts are largely isolated to within 40 m south of Orton Rd
- the risks from odour impacts at the Subject Site are dependent on frequencies of light winds from the NW to NNE, these winds occur for < 0.5% of the time, indicating a low risk of odour impacts
- even lower risks (0.03% of the time) are predicted for coincident light NW-NNE prevailing winds at the times of compost deliveries (for 9 hours during business hours every Wednesday)
- imposition of the EPA 500 m generic separation distance is not supported by these low risks
- furthermore, imposition of any other separation distance, for example at the extent of odour impacts (270 m) for compost deliveries, is also not supported by the low risks associated with coincident deliveries and unfavourable wind conditions
- some odour impacts may occur at the commercial premises located immediately south of the mushroom farm and the R25-R40 residential properties to the SE of the farm, these impacts are likely to be infrequent (from wind direction frequencies) and as such of low risk
- the design of the commercial buildings and landscaping can be optimised to minimise ingress of odours and to mask any odours using flowing plants, respectively.

Overall, the assessment indicates that odour impact is minimal and although some odour impacts may occur to the commercial and residential zoned land south-east of the farm, the impacts are likely to be infrequent and of low odour intensity. As such, imposition of a separation buffer that impinges on the Subject Site is not justified or necessary.

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Attachment H

Taktics4
Casuarina Central
Local Structure Plan

Retail Needs Assessment & Mixed Business Assessment

LWP Property Group
December 2018

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CONTENTS

1 EXECUTIVE SUMMARY 4
1.1 Retail Activity 4
1.2 Mixed Business/Service Centre Area 4

2 INTRODUCTION 5
2.1 Purpose 5
2.2 Location 5

3 POLICY CONTEXT 8
3.1 State Planning Policy – Activity Centres Perth and Peel 8
3.2 Jandakot Structure Plan 8
3.3 Draft District Structure Plan - Eastern Residential Intensification Concept 9
3.4 City of Kwinana – Local Commercial Activity Centres Strategy 11
3.5 Anketell South Local Structure Plan 12
3.6 Casuarina North Local Structure Plan 14
3.7 Casuarina Central Local Structure Plan 16
3.8 Policy Implications 17

4 RETAIL NEEDS ASSESSMENT 19
4.1 Casuarina Central Local Centre - Intended Catchment 19
4.2 Dwelling and Population Growth 19
4.3 Retail Spending Profile 20
4.4 Casuarina Central Local Centre Options 21
4.5 Implications for Policy 22
4.6 Implications for Community 23

5 MIXED BUSINESS / SERVICE COMMERCIAL ASSESSMENT 24
5.1 Employment Self Sufficiency 25
5.2 Location 25
5.3 Conclusions 26

1 EXECUTIVE SUMMARY

This Retail Needs Assessment outlines the demand for retail activity and service commercial / mixed business activity within the Casuarina Central Local Structure Plan. Broader regional and district planning initiatives for the area provide the following activity within the LSP.

- A single 800sqm local centre
- 7.5 Ha service commercial / mixed business precinct

The RNA conclusively finds:

1.1 Retail Activity

That the resident community created by the development of dwellings within the Casuarina Central LSP will not be capable of supporting the retail provision of a local centre of 800sqm currently allocated as part of the LCACS.

There is subsequently no market demand for the local centre to be developed within the LSP.

The community will be well served by future planned neighbourhood activity centres to the immediate north and south of the LSP.

The provision of a local centre in the LSP has the potential to detrimentally impact the performance of the Anketell South Neighbourhood Centre on Thomas Road. The removal of the local centre from the LSP would improve the viability of the Anketell South Neighbourhood Centre and improve the overall planning for retail activity in the area.

1.2 Mixed Business/Service Centre Area

The planned service commercial / mixed business area within the Casuarina Central LSP is intended to form part of a wider service commercial / mixed business area located north of the LSP.

Service commercial / mixed business activity is also located within Wandi District Centre and Casuarina North LSP. Both locations are better suited to the exposure and accessibility required for business activity in these areas to be viable.

The service commercial / mixed business precinct currently intended for the Casuarina Central LSP does not have the exposure and accessibility to be viable and should be reconsidered.

The over provision of this activity in the corridor may result in the detrimental impact of this activity in both Wandi District Centre and Casuarina North LSP.

2 INTRODUCTION

2.1 Purpose

Taktics4 was commissioned by LWP Property Group and Taylor Burrell Barnett – Town Planning and Design to provide detailed market and policy analysis and findings in relation to guiding the planning and design of retail and service commercial / mixed business activity within the Casuarina Central - Local Structure Plan (LSP). The findings in this report are incorporated within and should be read in conjunction with the Casuarina Central - Local Structure Plan report. Regional and district planning initiatives in the area currently incorporate the following non-residential land uses within the Casuarina Central LSP:

1. 800sqm local retail centre
2. 7.5 Ha service commercial / mixed business precinct

The report considers and analyses the implications of policy and market influences on the sustainability of retail and service commercial / mixed business activity specifically in relation to the Casuarina Central – Local Structure Plan (Casuarina Central LSP).

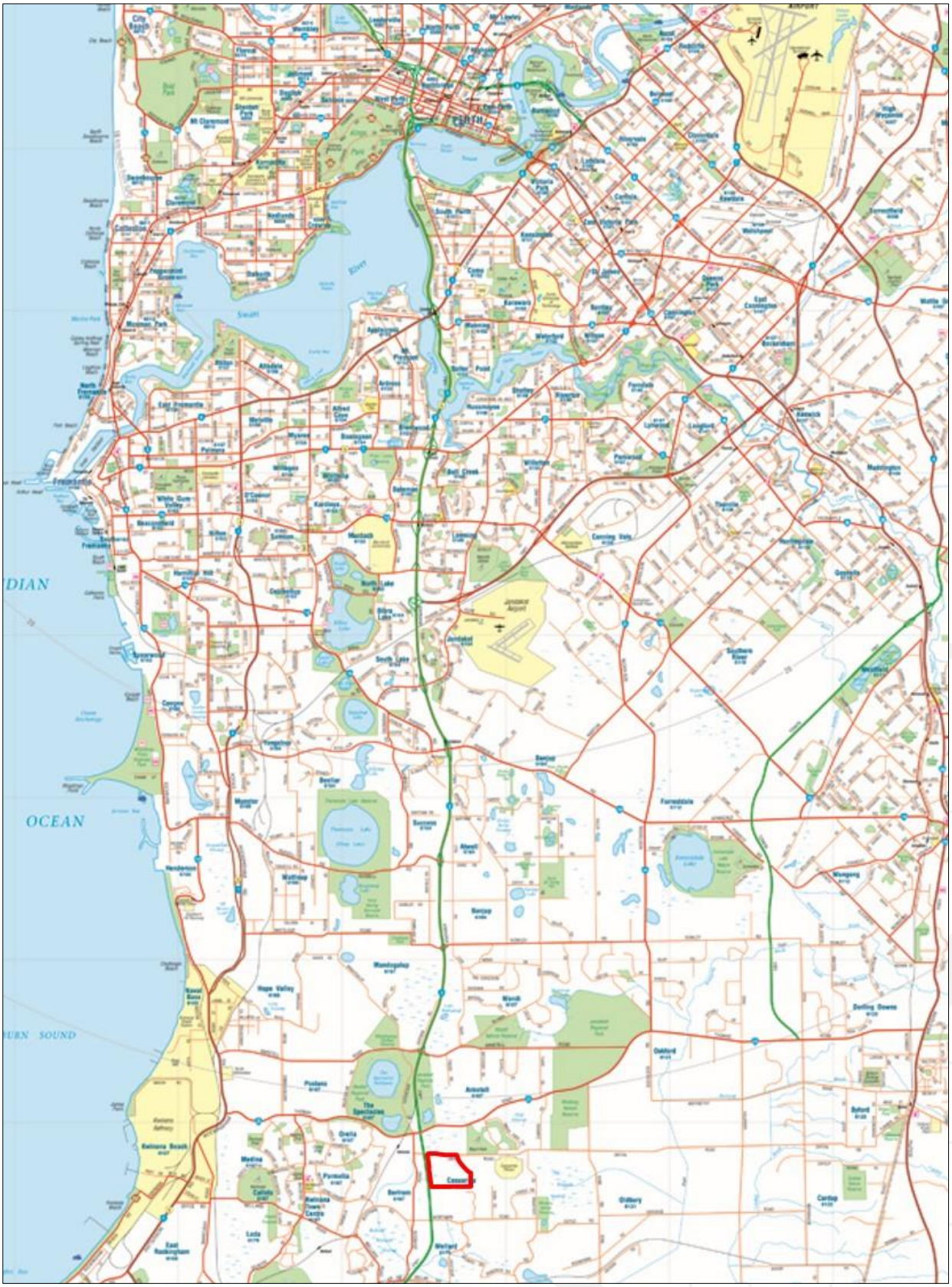
It subsequently assesses the market demand and implications for providing a local retail centre within the LSP and the market demand and implications of providing for an expansion to Precinct 23 mixed business area currently planned for in Casuarina North LSP immediately north of casuarina Central LSP.

The Retail Needs Assessment component of the paper has been prepared in accordance with the guidelines for preparing Retail Needs Assessments as outlined in State Planning Policy 4.2 – Activity Centres - Perth and Peel.

2.2 Location

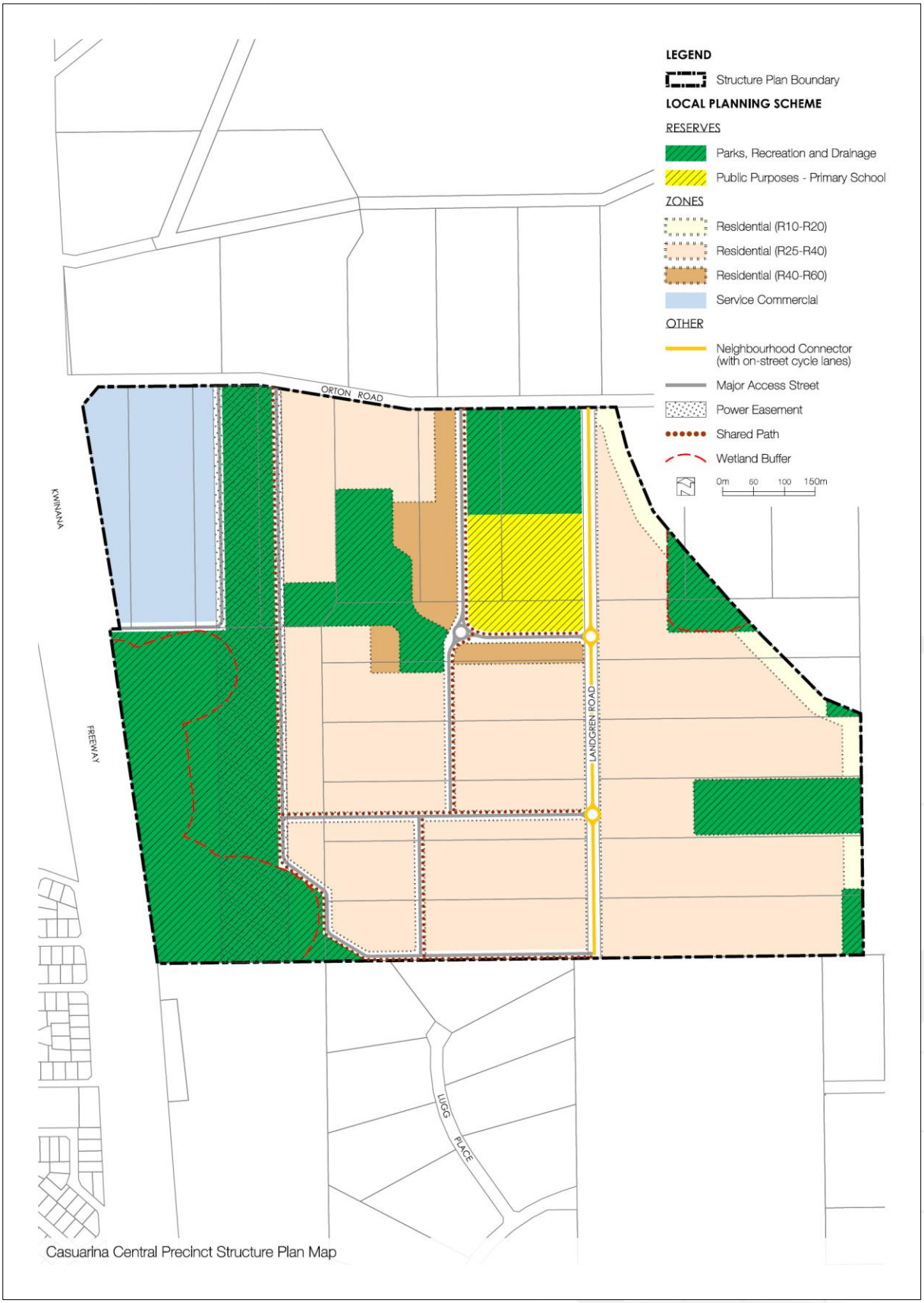
The Casuarina Central LSP is located approximately 30 km south of Perth. It incorporates land immediately south of Orton Road and East of the Kwinana Freeway in the City of Kwinana. The location and site are more definitively outlined in Figure 1 and Figure 2.

FIGURE 1 – LOCALITY PLAN



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FIGURE 2 - CASUARINA CENTRAL – LOCAL STRUCTURE PLAN



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3 POLICY CONTEXT

Planning, provision and design of retail activity and service commercial / mixed business land uses within the Casuarina Central LSP is guided by a range of state and local government policy initiatives.

3.1 State Planning Policy – Activity Centres Perth and Peel

State Planning Policy 4.2 - Activity Centres Perth and Peel (SPP4.2) was adopted by the WAPC in August 2010. It guides the planning for higher order centres in the retail and commercial network. It introduces the hierarchy for centres in Perth and Peel, including Strategic Metropolitan Centres, Secondary Centres and District Centres.

SPP4.2 allocates a District Centre (Wandi District Centre) in or around the Anketell Road and Kwinana Freeway interchange. SPP4.2 also acknowledges and substantiates the role and characteristics for neighbourhood and local centres within the hierarchy, however, it promotes the spatial planning and administration of these two lower centre types in the hierarchy to the responsible local authority.

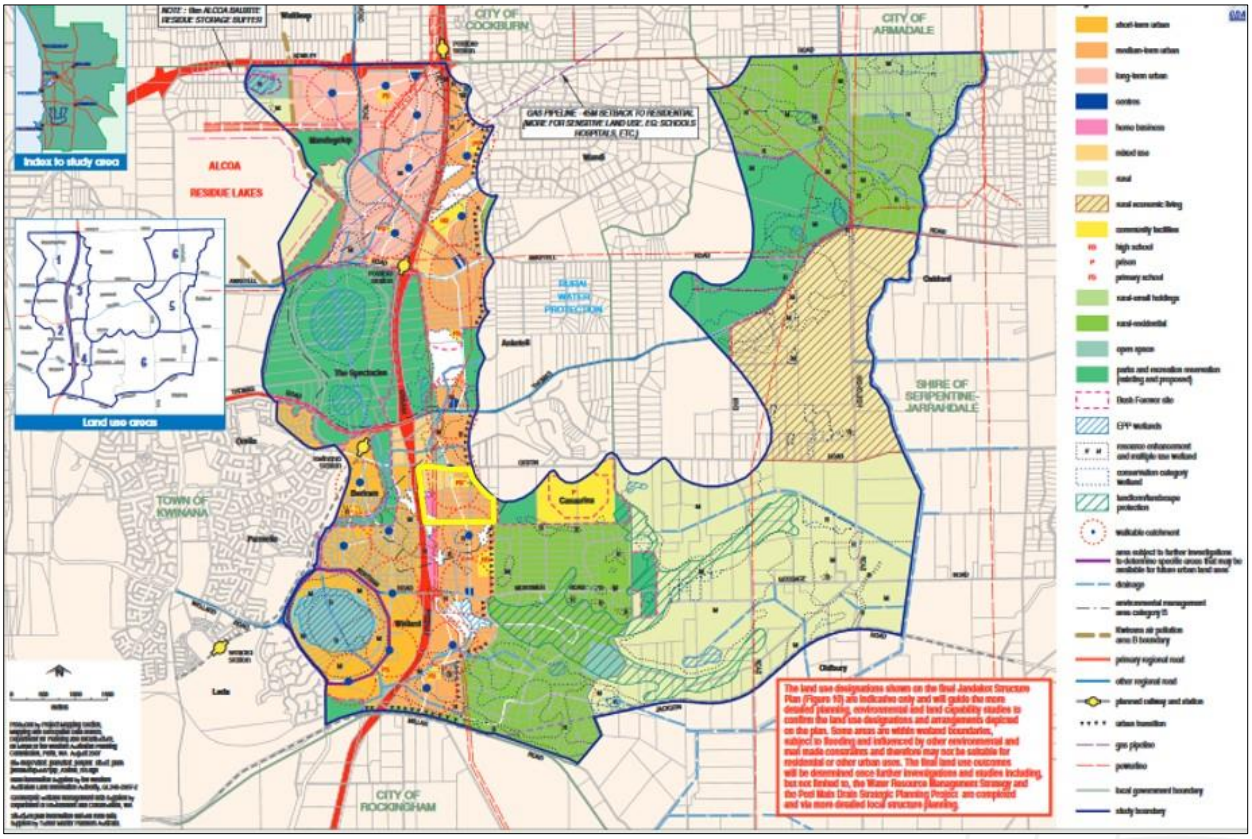
The spatial planning for retail and commercial activity in and around the Casuarina Central LSP beyond the Wandi District Centre is therefore founded on planning initiatives at a district and local level.

3.2 Jandakot Structure Plan

The Jandakot Structure Plan (JSP) was adopted in August 2007. The JSP sets the broad strategic planning framework for land generally surrounding the 'Jandakot Proclaimed Underground Water Pollution Control Area' which includes land in several different local governments. The JSP provides for a population projection of around 40,000 residents. In the City of Kwinana, it covers an area of land from Rowley Road to the north down to Mortimer Road in the south.

The JSP (Figure 3) outlines the general location of several centres, including 'Neighbourhood Centres' on Thomas Road and Mortimer Road and four local centres including a local centre on Orton Road within the Casuarina Central LSP. The JSP also provides for an area of 'mixed business' adjacent to the freeway extending south of Thomas Road to beyond Orton Road. The JSP does not allocate the role, function or size of the various centres and no formal justification or analysis has been completed to support the spatial planning for these centres and mixed business area. The land use designations shown on the final Jandakot Structure Plan are indicative only and are intended to guide the more detailed planning, environmental and land capability studies to confirm the land use designations and arrangements depicted on the plan. The final land use outcomes are intended to be determined via more detailed local structure planning.

FIGURE 3 – JANDAKOT STRUCTURE PLAN

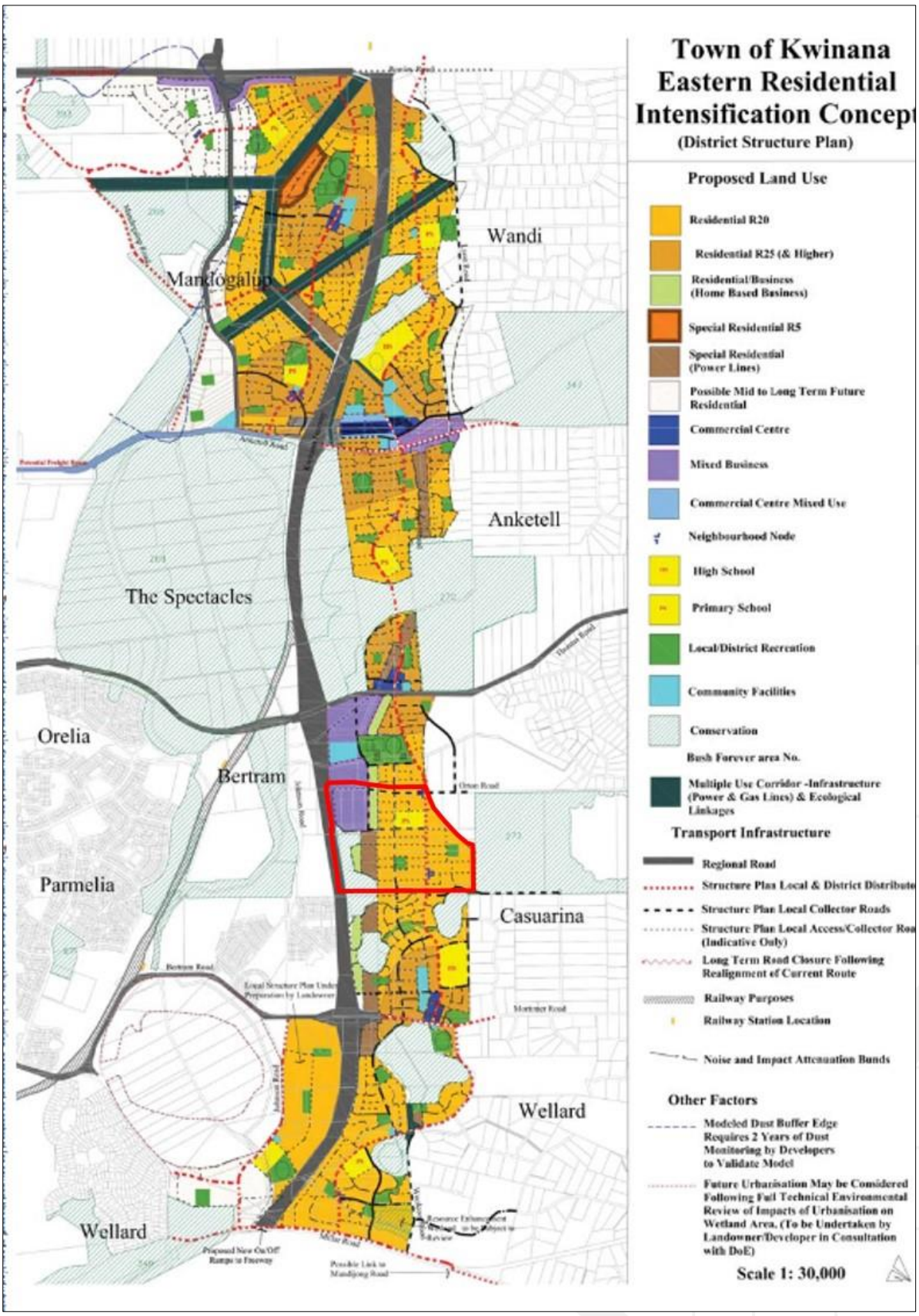


Jandakot Structure Plan WAPC

3.3 Draft District Structure Plan - Eastern Residential Intensification Concept

The Draft District Structure Plan - Eastern Residential Intensification Concept (ERIC) was prepared by the then Town of Kwinana in 2005. ERIC builds on the planning completed in the JSP. It broadly reconfirms the general location for commercial centres and mixed business areas previously adopted by the JSP, including the neighbourhood centres planned in Thomas Road and Mortimer Road and the smaller local centre in Orton Road. As per the JSP, ERIC (Figure 4) does not allocate roles or sizes to any of the centres and provides no evidence, justification or documentation to support the spatial planning and role for these centres and mixed business area.

FIGURE 4 – EASTERN RESIDENTIAL INTENSIFICATION CONCEPT



City of Kwinana

3.4 City of Kwinana – Local Commercial Activity Centres Strategy

The City of Kwinana Local Commercial Activity Centres Strategy (LCACS) was prepared for the City in September 2014. It more formally details the spatial distribution and role and function of the commercial centres and mixed business area. It specifically identifies the centres in the vicinity of the Casuarina Central LSP.

Retail Activity

TABLE 1 – ACTIVITY CENTRES IN LCACS

Centre Name	**Centre identification**	**Floor space allocation**
Wandi District Centre	Centre 2 – Anketell Road	20,000sqm Shop 10,000sqm Other Retail
Thomas Road Neighbourhood Centre	Centre 6 – Thomas Road	3,500sqm Shop 500sqm other retail
Mortimer Road Neighbourhood Centre	Centre 7 – Mortimer Road	5,500sqm shop 500sqm other retail
Orton Road Local Centre	Centre 14 – Casuarina 2	800sqm (2031)
Casuarina 3 - Local Centre	Centre 15 - Casuarina 3	800sqm (2031)

City of Kwinana – Local Commercial Activity Centres Strategy (Kwinana LCACS)

Mixed Business

TABLE 2 – BUSINESS PRECINCTS IN LCACS

Precinct Name	**Precinct identification**	**Floor space allocation**
Thomas/Holden Cl	Precinct 23	20,000sqm Other Retail
Orton Road	Precinct 24	15,000sqm Other Retail
Spectacles 01	Precinct 26	5,000sqm Other Retail
Combined	**Precincts 23,24,26**	**40,000 sqm Other Retail**

City of Kwinana – Local Commercial Activity Centres Strategy (Kwinana LCACS)

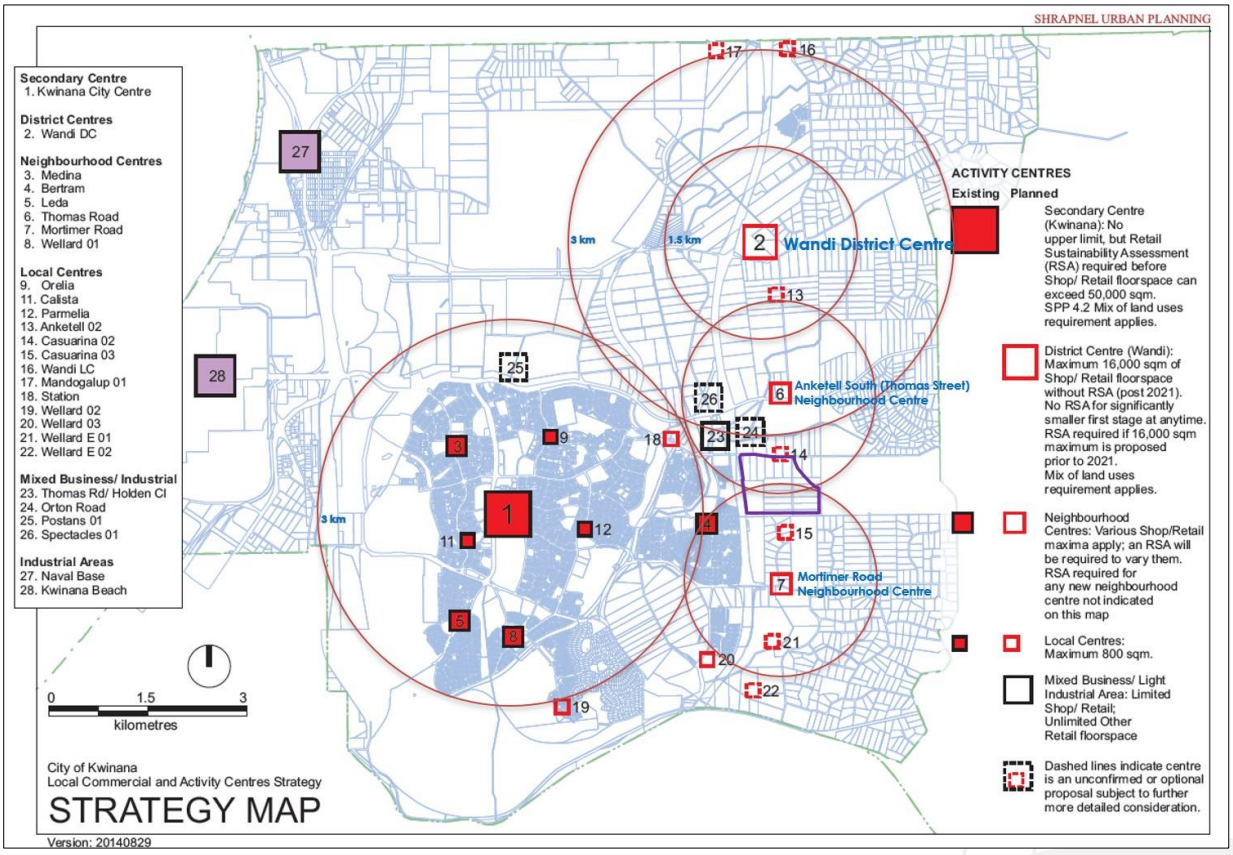
The tables and Figure 5 highlight that the Wandi DC is expected to generate enough floor space to comfortably deliver two full line supermarkets (3,500sqm each), a Discount Department Store (7,000sqm) and supporting specialty shops.

Despite a difference in floor space allocation, neighbourhood centres at Thomas (3,500sqm) and Mortimer (5,500sqm) are both expected to generate enough floor space to support a single full line supermarket (2,500sqm-3,500sqm) and supporting convenience shopping.

Local centres at Orton Road and Casuarina 03 are expected to generate 800sqm which is only capable of supporting a small number of convenience-based shops without an anchor supermarket.

The service commercial / mixed business area allocated within the LCACS are expected to capable of generating up to 40,000 sqm of other retail activity (along with non-retail uses). Most of this space is expected to be provided on the eastern side of the Kwinana freeway.

FIGURE 5 – LOCAL COMMERCIAL ACTIVITY CENTRES STRATEGY



City of Kwinana – Local Commercial Activity Centres Strategy (Kwinana LCACS)

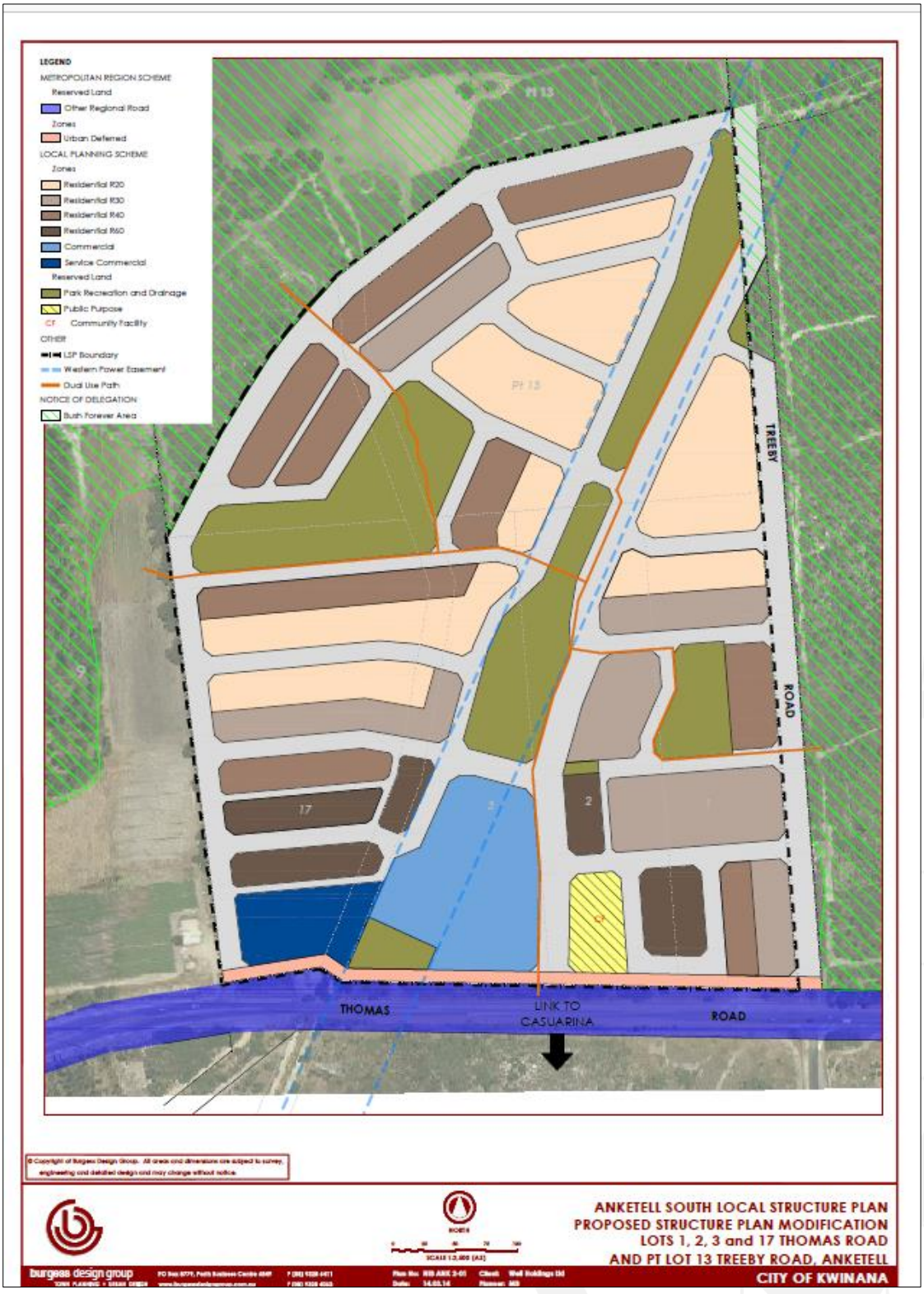
The commercial centres and mixed business areas are being planned in more detail on Local Structure Plans.

3.5 Anketell South Local Structure Plan

The Anketell South LSP details the land area allocated for commercial centre activity in accordance with the broader district and regional planning initiatives. The Anketell South LSP provides a land area of 1.35 Ha for the commercial activity site which is comfortably capable of physically accommodating the allocated 3,500sqm of retail floor space.

The Anketell South LSP yields about 420 dwellings capable of supporting a population of 1,300 residents. This centre therefore has a very limited catchment on the north of Thomas Road and will rely heavily on the catchment to the south of Thomas Road in order to be commercially sustainable.

FIGURE 6 – ANKETELL SOUTH LSP



BDG/WAPC

3.6 Casuarina North Local Structure Plan

The Casuarina North LSP has been prepared over the planned service commercial / mixed business area only. This area reflects precinct number 24 in the LCACS. Precinct 24 is expected to double the provision of mixed business area in the area planned by Precinct 23 on the western side of the Kwinana Freeway.

The Casuarina North LSP intends to generate 13.9Ha of service commercial area and 6.5Ha of Special Use. The service commercial zone is intended to primarily provide for showroom and bulky goods retail type uses. It is understood that this will typically fall under a 'showroom' land use definition under the City of Kwinana's LPS 2. Land use permissibly within the service commercial zone is to generally be in accordance with the zoning table and any associated provisions contained within LPS 2. It is noted that a 'Showroom' is a (P) permitted land use in the service commercial zone, consistent with the development intent for the precinct.

The special use zone falls under 'Division 11 – Special Use Zones': Land within a Special Use Zone may be used for the purposes specified on the Scheme Map and in the Third Schedule and for purposes incidental thereto and for no other purpose. The following uses are permitted (P) within the 'Special Use' zone:

- Bulky goods showroom
- Car park
- Consulting rooms
- Eating house
- Liquor store
- Motor repair station
- Petrol filling station
- Service station
- Warehouse

The following use is incidentally permitted (IP) within the 'Special Use' zone:

- Shop
- Fish shop

Potential employment opportunities for the northern part of precinct 23 are likely to be confined predominantly to the LSP area once fully developed and operational. It is estimated that the LSP area will have a maximum potential floorspace of approximately 127,750sqm. Due to the nature of showrooms and bulky goods retailing requiring a higher degree of car dependence, there is typically a need to dedicate around half the site for car parking. In this case an assumed plot ratio of 0.7 has been used to calculate potential floorspace, as a result of the likely need to offset a portion of the required car parking to be within the high voltage powerline easement. Accordingly, based on this developable site area and the assumed maximum plot ratio of 0.7 an estimated maximum employment figure of approximately 2,555 jobs will be accommodated within the LSP area.

The concept plan provided as part of the Casuarina North LSP includes a showroom floor space allocation closer to 63,000sqm – almost half of the 127,750sqm listed in the supporting documentation. Showroom activity typically generates an average floor space to employment ratio of 35 sqm per employee. The employment generated by the service commercial and special use will therefore be expected to be 1,800 employees instead of 2,550 employees.

FIGURE 7 – CASUARINA NORTH LSP

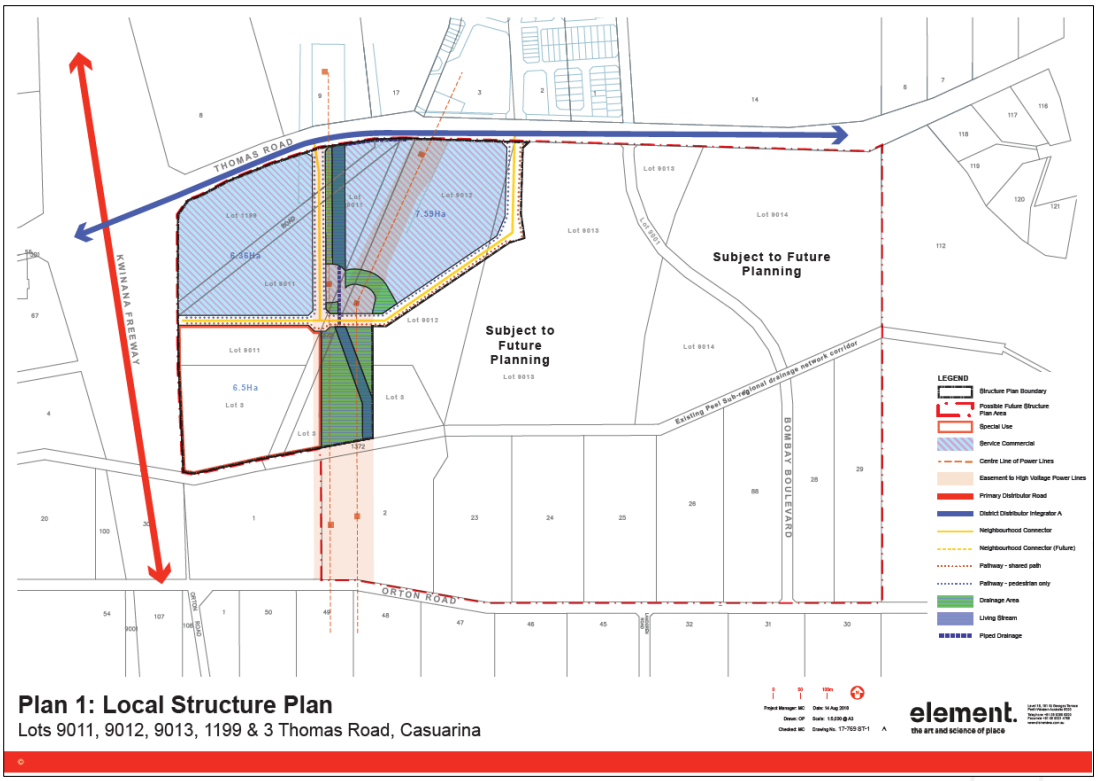


FIGURE 8 – CASUARINA NORTH INDICATIVE CONCEPT PLAN



3.7 Casuarina Central Local Structure Plan

The Casuarina Central LSP is the subject of this report. Based on the regional and district planning initiatives the LSP is currently expected to incorporate:

- local retail centre of 800sqm
- part of the mixed-use precinct 23

This report subsequently assesses the market demand and implications for providing a local retail centre within the LSP and the market demand and implications of providing for an expansion to Precinct 23 mixed business area currently planned for in Casuarina North LSP. The following chapters assess the market demand and implications of providing these uses and activities within the Casuarina Central LSP.

FIGURE 9 – CASUARINA CENTRAL – DEVELOPMENT CONCEPT



TBB

3.8 Policy Implications

The planning initiatives at a regional and district level have been consistent in the desire and intent for a retail centre and mixed business/service commercial area within the Casuarina Central LSP. However, there is very little documented supporting evidence within these initiatives that these uses are sustainable. Based on these policy initiatives, it is more than likely that the commercial market will respond in the following manner.

Wandi DC

The Wandi District Centre could initially be expected to develop as a single and possibly double supermarket-based neighbourhood centre in the short term as residential development occurs in its immediate catchment. Wandi's initial catchment would incorporate the residents within a 1.5km radius. This catchment includes the areas of Wandi to the north of Thomas Road and Anketell North to the south of Thomas Road.

It remains unclear as to whether the residential catchment for Wandi DC will ultimately be capable of attracting and sustaining a Discount Department Store to this location even when the residential catchment becomes fully developed. If Wandi DC catchment ultimately did support a DDS it would be capable of trading to a wider 3km catchment.

Anketell South NC

The Anketell South Neighbourhood Centre allocated to Thomas Road has a limited residential catchment to the north (420 dwellings) and south (large tracts of non-residential land). It is located only 2.5km south of Wandi DC and will subsequently be operating within the immediate trade shadow of the Wandi DC catchment. This may hinder the attraction of a supermarket operator to this location. The Anketell South NC would ultimately be expected to serve the Anketell South LSP community and the Casuarina North and Central LSP communities. The centre may subsequently only attract a smaller supermarket operator and may ultimately function as a small neighbourhood or local centre.

Mortimer Road NC

The Mortimer Road neighbourhood centre is ultimately expected to serve the Casuarina South LSP and the Wellard East LSP area. The NC is located approximately 3km south of the Anketell South NC, providing a dedicated 1.5km catchment for both centres. This Casuarina South to Wellard East SP area is yet to be fully planned and do not impact the findings in this RNA.

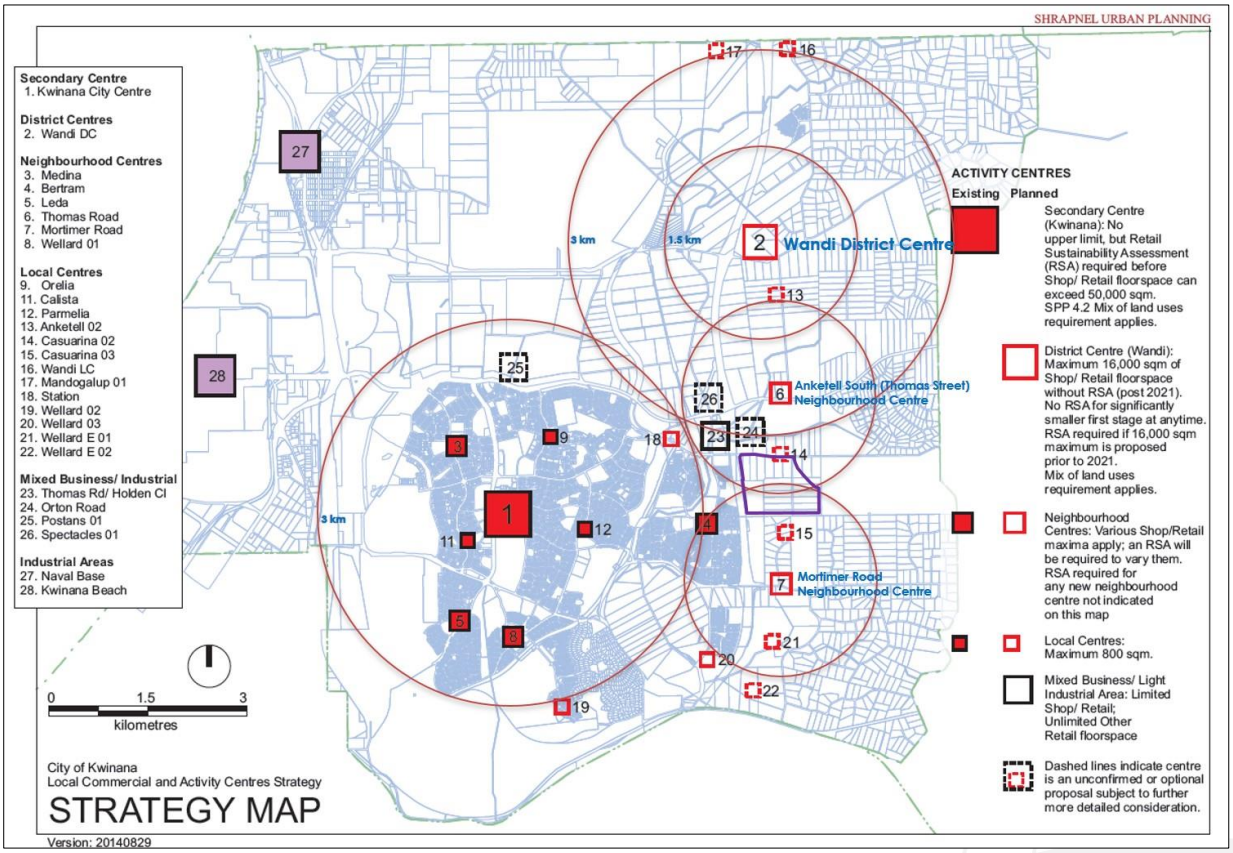
The narrow and elongated nature of the residential development area east of the Freeway promoted by ERIC and the Jandakot SP limits the size of the catchments available for the planned NC.

Local Centres

The local convenience centres allocated within ERIC and Jandakot SP are all located within 1km of higher order convenience-based neighbourhood or District centres. This proximity to larger convenience centres will hinder the local centres ability to capture sustainable amount of retail sales to be viable centres.

The community formed by the dwellings developed in Casuarina Central LSP will be served by both the Anketell South NC and the Mortimer Road NC.

FIGURE 10 – POTENTIAL CENTRE FUNCTION AND CATCHMENTS



City of Kwinana

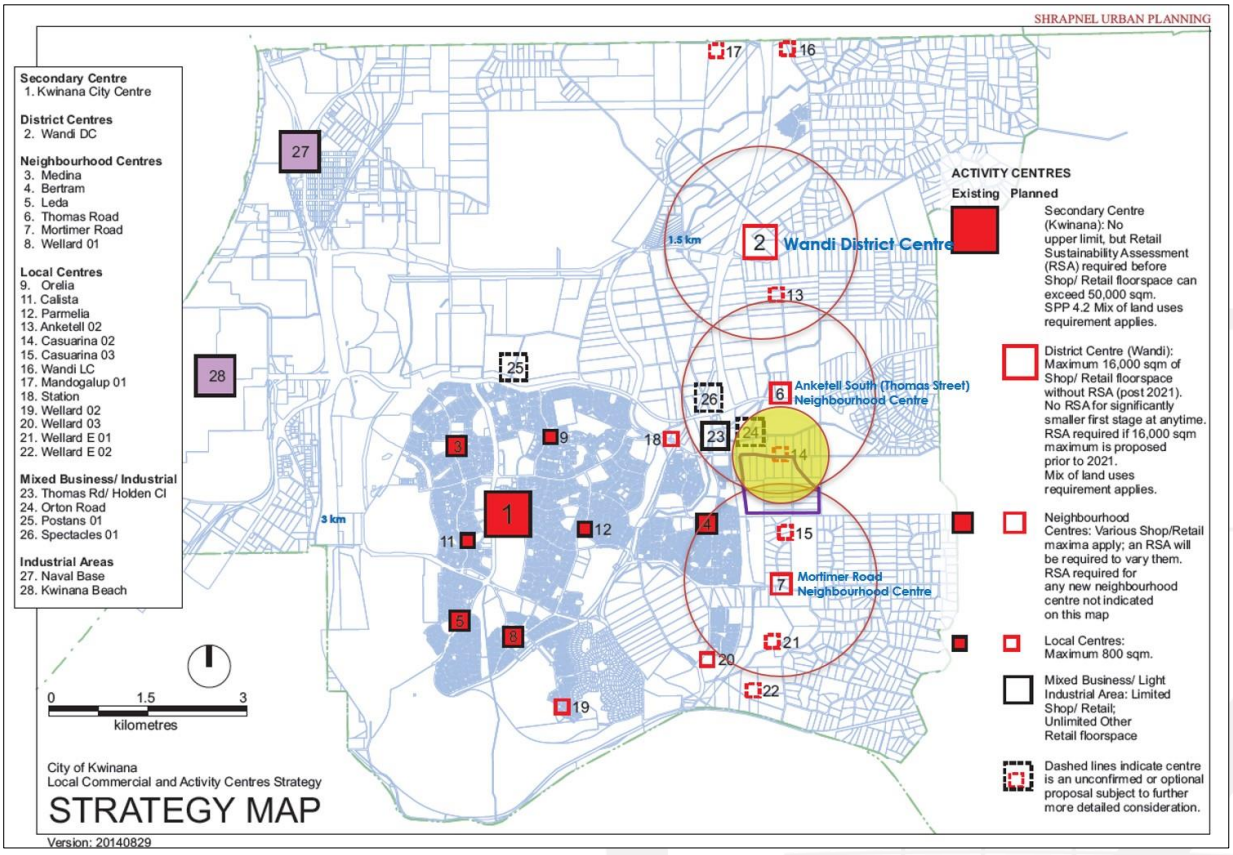
4 RETAIL NEEDS ASSESSMENT

The commercial sustainability of any retail centre will depend on its accessibility to a sufficient catchment and the impact of the competitive commercial environment also trading to the same catchment. The following sections will therefore assess the extent and nature of the planned catchments and the impact that these commercial centre function will have on the sustainability of any planned retail activity in the Casuarina Central LSP.

4.1 Casuarina Central Local Centre - Intended Catchment

The policy initiatives surrounding planned commercial centres in the vicinity of the Casuarina Central LSP will restrict the catchment of any local retail centre in the LSP to a walkable catchment of 400 metres. A local centre comprising 800sqm of floor space would usually represent about 6-8 shops without an anchor tenant (Figure 11).

FIGURE 11 – LOCAL CENTRE CATCHMENT



City of Kwinana (Taktics4)

4.2 Dwelling and Population Growth

The residential area formed by the ERIC and the Jandakot SP is expected to produce approximately 7,600 dwellings and accommodate approximately 22,800 residents. The breakdown for the region includes:

- 4,500 residents west of the freeway in Mandogalup
- 8,400 residents in Wandi and Anketell North (the catchment for the Wandi DC)

- 4,800 residents in Anketell South and Casuarina North and Central (the catchment for the Anketell South NC)
- 5,100 residents in Casuarina South to Wellard East (the catchment for the Mortimer Road NC)

TABLE 3 – POPULATION BY LSP (ERIC/JSP)

LSP	Dwellings	Population
Mandogalup (west of Kwinana Freeway)	1,500	4,500
Wandi (north of Anketell Road)	1,700	5,100
Anketell North LSP	1,100	3,300
Anketell South LSP	400	1,200
Casuarina North - Central	1,200	3,600
Casuarina South - Wellard East	1,700	5,100
Total ERIC Residential Area	**7,600**	**22,800**

Taktics4

A full line supermarket in a suburban environment would typically require a population of around 8,500 residents to be attracted to a site. As indicated the Wandi DC can therefore fully expect to attract a full line supermarket (3,500sqm) to its centre. The Anketell South NC and Mortimer NC catchments do not appear to achieve a catchment of 8,500 residents. These centres may subsequently attract smaller supermarkets (1,500sqm) rather than full line supermarkets.

4.3 Retail Spending Profile

To further place the potential level of market demand and sustainability into perspective it is possible to highlight the potential sales and trading performance for both supermarket-based NC in Anketell South (Thomas Road) and Mortimer Road. And the subsequent impact it has on a local centre at Orton Road.

The average residents spend approximately $6,000 per annum on supermarket and convenience-based retail goods and services. This spending profile generates a total supermarket and convenience retail spending capacity of $59.4 M p.a. across the catchments catering to the two NC and potential local Orton Road centre.

TABLE 4 – POPULATION by LSP

LSP	Population	Spending Capacity
Anketell South LSP	1,200	$ 7,200,000
Casuarina North - Central	3,600	$ 21,600,000
Casuarina South - Wellard East	5,100	$ 30,600,000
Combined	**9,900**	**$ 59,400,000**

Taktics4

The neighbourhood centres are expected to capture a total of 77% of this retail spending capacity – resulting in total sales of $45.6M p.a. ($17.5M for Anketell South NC and $28.1M p.a. for Mortimer Road NC).

The Mortimer Road NC is expected to have a larger market capture rate due to its larger catchment size and further proximity from Wandi and Kwinana Centres. These market capture rates and sales potential generate

A typical supermarket-based neighbourhood centre operating in an urban environment generally requires an average of $7,500/sqm p.a. in retail sales. This represents an industry average for sustainability of a supermarket-based centre. Using this sales productivity across both NC would result in a sustainable floor space of 2,350sqm for Anketell South NC and 3,750sqm for the Mortimer Road NC.

The balance of this supermarket and convenience retail spending capacity is typically captured by higher order centres, in this case likely to be Wandi DC and Kwinana Town Centre, as well as local centres.

The Wandi DC and Kwinana Town Centre may be expected to capture at least 60% of the remaining convenience-based retail spending due to the trip generation to these centres from the catchment for non-convenience-based activity. This leaves 40% of the balance of the supermarket and convenience-based retail spending to be captured by local centres in the catchment. There are currently three local centres allocated by policy to the catchments in question. Orton Road could expect to capture 20% of the remaining available spending capacity in Casuarina North and Central and would not expect any from the catchments further north and south.

This capture rate would be responsible for supporting up to 115sqm of retail floor space at the Orton Road local centre. A 115sqm of retail floor space is enough to sustain a single shop or café.

4.4 Casuarina Central Local Centre Options

Potential options for The Casuarina Central (Orton Road) Local Centre include:

Option 1 - Reduction of LC to a single tenant café/shop of 115 sqm

However, it has proven unrealistic that a single shop is capable of being sustained in the current market and retail conditions. Very few single retail operators achieve sustainable success in a stand-alone situation. This is due in most part to the nature of the retail industry, especially convenience-based retailing which is dominated by supermarket sector. Supermarkets capture 40% of total retail trade in Australia which equates to 80% of total convenience-based retail trade. This domination of the industry results in other small convenience-based tenants needing to locate near the supermarkets in order to benefit from their exposure and accessibility. The Casuarina Central Local Structure Plan identifies the need to close that section of Orton Road which would further hinder the development opportunity for any retail activity by limiting exposure and access to the already limited catchment. Subsequently any retail activity would be required to be relocated further north or further south to maintain the exposure and accessibility to the wider catchment. This would result in any retail activity relocating closer to the planned supermarket-based neighbourhood centres located north and south to cater for their respective communities/catchments.

Option 2 - Removal of the Casuarina Central Local Centre opportunity from the LSP.

This option would minimise the potential negative impact on potential retail sales on a seemingly economically vulnerable Anketell South NC and remove the perception and subsequent disappointment of the idea of a single café/shop to prospective communities/residents only for this to never eventuate.

Option 3 - Reallocation of the Local Centre at Orton Road to the mixed business service commercial area.

This option would better provide for the local café/convenience store needs for prospective employment within the service commercial / mixed business area. It would appear more to provide more flexibility in planning for the service commercial /mixed business activity and create a higher amenity for the area by providing convenience needs for the area's employees and visitors. This option would not preclude Casuarina Central and North residents accessing the store/centre for any local needs not met by the neighbourhood centre to the north and south.

4.5 Implications for Policy

SPP 4.2

The removal of the local centre from future planning initiatives would have no detrimental impact on SPP4.2. This policy supports the decision making in respect to local centres to be addressed at the more detailed local structure plan level. The analysis in this RNA has proved that a local centre cannot be sustained in the location specified due to the restricted catchment and the proximity to competing commercial activity. Similarly, relocation of the centre to a non-residential area in proximity to its original location would have no detrimental impact on the SPP4.2 principles and objectives.

LCACS

The relocation or removal of the Casuarina Central local centre would not have a detrimental impact on the findings and integrity of the LCACS. The LCACS findings and objectives have adequately allocate a range of centres as best it could, based on the information available during its preparation. It highlights and acknowledges that the retail floor space allocations for the various centres are not fixed and should be able to be altered to better reflect the more detailed planning of the specific areas. Subsequently, this analysis simply responds to the principles and objectives developed by the LCACS to respond to and facilitate changes to the allocated centres resulting from detailed analysis and planning of the area.

Casuarina North LSP

The residential areas within the Casuarina North LSP has not been formally planned. However, the planning for this area will not be impacted due to the knowledge that the future residential communities it ultimately creates will be well served by the planned Anketell South NC in Thomas Road immediate abutting the community. This would not preclude the opportunity for this LSP area to formally introduce a local centre should the land owners see an opportunity to do so.

Casuarina South LSP

The planning for the Casuarina South LSP is not affected by the options to relocate or remove the Casuarina Central (Orton Road) local centre. The Casuarina South LSP area is allocated a local centre of a similar size and nature as the Casuarina Central (Orton Road) local centre in the broader regional planning initiatives.

4.6 Implications for Community

None of the potential options for addressing the need, size and location of the Casuarina Central Local Centre have an impact on the ability of residents to access their day to day convenience-based retail goods and services. The Casuarina Central and North communities will continue to be serviced by direct access to supermarket-based centres less than 1.5 km north and south of their place of residence. Subsequently the Casuarina Central community will have even greater choice than most urban residents by having access to two supermarket-based centres equidistant from each other. The loss of a single shop (as it has been shown that the centre cannot sustain 800sqm) will not have a detrimental impact on this community's access to goods and services.

5 MIXED BUSINESS / SERVICE COMMERCIAL ASSESSMENT

As previously highlighted, broader regional planning initiatives for the area have incorporated a precinct for non-residential uses and activities that spans across the Casuarina North and Central LSP areas. It runs predominantly along the eastern edge of the Kwinana Freeway south from Thomas Road to beyond Orton Road. The planning for this precinct has been commenced through the Casuarina North LSP. The service commercial / mixed business area within the Casuarina North LSP area incorporates 20.4 Ha. Inclusive of 13.9 ha of service commercial zone and 6.5 Ha of special use zone. The Casuarina North LSP text includes the following passage:

Land Use Permissibility

a) The Local Structure Plan Map (Plan 1) outlines zones and reserves within the LSP area. Where applicable the intention of zones and land use permissibility within the LSP area shall be in accordance with the corresponding zone or reserve purpose
b) under the City of Kwinana Local Planning Scheme No. 2 (LPS 2).
c) Land use permissibility for the 'Service Commercial' zone shall be in accordance with the associated LPS 2 provisions.
d) The following uses are permitted (P) within the 'Special Use' zone:
- *Bulky goods showroom*
- *Car park*
- *Consulting rooms*
- *Eating house*
- *Liquor store*
- *Motor repair station*
- *Petrol filling station*
- *Service station*
- *Warehouse*

e) The following use is incidentally permitted (IP) within the 'Special Use' zone:
- *Shop*
- *Fish shop*

The mixed business/service commercial/special use zone in the Casuarina North LSP is shown to accommodate 127,000 sqm of floor space and create 2,500 employment opportunities in the region.

The basis for these figures is born from an assumed plot ratio of 70% on developable land and a floor space to employee ratio of 50 sqm per employee. However, it appears based on the concept plan attached to the LSP that this figure is meant to be closer to 30% plot ratio (which is more likely for this activity type) and subsequently is expected to generate 64,000sqm of floor space and produce 1,800 employment opportunities (based on 35 sqm for this activity type instead of 50sqm in the LSP).

The Casuarina Central LSP intended service commercial / mixed business area will form part of this broader service commercial / mixed business precinct to the north. It is expected to contain 7.5 Ha. Based on the same assumptions as the analysis provided in this RNA (not the assumptions formed by the Casuarina North LSP) the Casuarina Central LSP can accommodate 22,500sqm of floor space and create opportunities for 650 employees.

The overall area incorporating service commercial/mixed business zones in both the Casuarina North and Casuarina Central LSP's is therefore 28.7 Ha and capable of containing 86,000 sqm of floor space and generating 2,450 employees.

There is additional service commercial / mixed business activity planned to accommodate the same activity type in and around Wandi District Centre. This area is expected to generate up to 20,000sqm of other retail including showroom and mixed business activity.

This results in over 107,000sqm of mixed business /service commercial activity located in the ERIC and Jandakot SP area. Creating jobs for over 3,050 employees.

TABLE 5 – SERVICE COMMERCIAL / MIXED BUSINESS FLOOR SPACE

	Land Area (Ha)	Floor space (sqm)	Employment
Casuarina North LSP	21.2	63,510	1,815
Casuarina Central LSP	**7.5**	**22,500**	**643**
Casuarina North and South LSP	28.7	86,010	2,457
Anketell /Wandi	7	21,000	600
Total ERIC	**35.7**	**107,010**	**3,057**

Taktics4

5.1 Employment Self Sufficiency

The resident population east of the Kwinana Freeway is expected to grow from 8,050 in 2018 to 27,100 by 2036, an increase of 19,050 over the next 18 years at an average of 1,000 residents per annum.

The forecast resident population will produce a resident labourforce of 13,550 employees.

The employment generation of within the entire mixed business area will therefore contribute 23% of the broader employment needs of the community. The total employment self-sufficiency in the region is expected to be 44%, meaning that there are jobs for 44% of the total labourforce in this corridor. The service commercial area represents more than half of the total employment in the region. This appears to be an over representation for this activity type in the region.

The area allocated to service commercial / mixed business area will therefore contribute significantly to the levels of employment self-sufficiency in the region and provide opportunities for business activity to cater for this growing regional population corridor.

TABLE 6 – EMPLOYMENT SELF SUFFICIENCY

	Number	Employment Self sufficiency
Forecast Resident labourforce	**13,550**	
Service Commercial (Cas Nth and Central)	2,457	
Service Commercial (Anketell/Wandi)	600	
Service Commercial (All)	**3,057**	**23%**
Activity Centres	1,312	
Schools	200	
Home Business	903	
Sub Total	**5,473**	
Other 10%	547	
Total	**6,020**	**44%**

Taktics4

5.2 Location

Service commercial / mixed business activity is highly dependent on car-based trips. The value of the land within the location is heavily focused on exposure and access to passing trade. The service commercial / mixed business area in Wandi DC provides strong exposure and access for traffic along Anketell Road. Similarly, Casuarina North LSP service commercial / mixed business area has direct exposure and access from Thomas Road.

The value of the precinct to activity diminishes significantly the further activity is located from the high exposure locations. To this end, the service commercial / mixed business area in Casuarina Central LSP is located too far from Thomas Road to facilitate a viable and thriving service commercial / mixed business precinct.

5.3 Conclusions

This Retail Needs Assessment and employment analysis has highlighted that

The local centre currently planned for Casuarina central LSP is not required. That the Local centre could be provided for in several ways without jeopardising the integrity, objectives and principles of the planning initiatives developed for the broader region.

That the provision of the local centre is considered unnecessary and inefficient given the proximity of higher order convenience-based centres to the north and south

As well as the limited catchments available to these centres due to the narrow and elongated nature of the residential corridor.

The planning for the Casuarina Central LSP should therefore consider alternate ways to deal with the planned provision of a local centre in casuarina. Options may include:

- Removal of the local centre from the LSP
- Reduction of the LSP to a single café/shop
- Relocation of the local centre to the service commercial area in the Casuarina Central LSP
- Relocation of the local centre to the service commercial area in the Casuarina North LSP

Each of these options have merit and should be explored.

The service commercial / mixed business area planned in the ERIC corridor /Jandakot SP is located across three locations including the Wandi DC, Casuarina North and Casuarina Central LSP's. The amount of floor space allocated within these areas appears to be excessive for the population it is intended to serve. Planning for the Casuarina Central LSP should explore a reduction or removal of the service commercial area from the LSP.

Attachment I

Information Paper

To:	**Claire Boland**	**claire@tbbplanning.com.au**	
Cc:	**Alf Lay**	**ALay@lwpproperty.com.au**	
From:	**Greg Davis**	**g.davis@taktics4.com.au**	
Date	**Monday, 29 July 2019**	Pages	**4**
Subject	**Casuarina Central Structure Plan - Response to RNA Review**		

Taktics4 has been requested to address the issues and position presented in a review of the Retail Needs Assessment (RNA) for the Casuarina Central Precinct Structure Plan prepared by Shrapnel Urban planning dated June 2019 for the City of Kwinana (The Review).

Having reviewed the issues raised and position adopted by the Review, we maintain the position adopted in the RNA that a local centre is not supported in the Casuarina Central Precinct.

The position adopted in recommending the removal of the Local centre was not taken lightly. The findings were based on a robust assessment of the market conditions both current and forecast in the community that the local centre was intended to serve.

In response to the issues raised during the Review. We considered the broad categories raised by the review to include:

1. Suggested under assessment of the extent of the intended catchment
2. Suggested under reporting of spending capacity
3. Suggested misinterpretation of the removal of a previously planned local centre in Casuarina South precinct
4. Suggested potential need for a local centre to act as community hub regardless of sustainability
5. Suggested spatial allocation of a centre to be more central to the catchment.

Taktics4's response to these suggestions is addressed below:

Suggested under assessment of extent of intended catchment

The Review indicates that assessment of a local centre should reasonably include trade from all three of the entire Casuarina precincts. This position suggests that the local centre without any major supermarket drawcard would have the same catchment area as the supermarket-based centres planned north and south of the precincts.

By virtue of the competitive environment that a local centre would trade within, it was pertinent to assess the dwellings and population for the precincts north and south of the central precinct. However, we believe that any local centre would only be able to and expected to trade to a relatively small catchment within these precincts. This is supported by commercial and policy facts.

SPP 4.2 – Activity Centres identifies the catchment for a neighbourhood centre to be in the order of 1.5km and a local centre to be primarily concerned with serving a walkable catchment of 400m.

Commercially the distribution patterns of supermarket-based neighbourhood shopping centres confirm a dedicated average trade area of 1.5km.

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The likely future closure of Orton Road would appear to have the effect of further restricting access to a local centre from any catchment to the north of the central precinct.

Suggested under-reporting of retail spending capacity

Taktics4 subscribes to and utilises the MarketInfo MDS data in accordance with most reputable retail planning organisations. However, Taktics4 further translates that data to reflect spending potential by retailer type based on Australian Retail Sales data captured and published monthly by Australian Bureau of Statistics.

Most convenience-based retail spending occurs within supermarket-based neighbourhood centres. These centres – whether anchored by a full line or limited line supermarket can attract the chain brands and franchise operators together with a range of tenant types that simply would not consider locating in a local centre devoid of a supermarket. To apply a convenience-based spending profile of $10,000 per person for distribution amongst local centres implies that a local centre will also have access to spending by incorporating tenants such as newsagencies, pharmacies, butchers and bakers. The stark commercial reality (one that I like most planners express as unfortunate) is that these tenant types do not and will not locate in new local centres. Therefore, the retail spending profile available to the local centres includes food and grocery and takeaway and personal services such as nail and hair salons.

It is not commercially plausible or robust to apply a market capture of a larger spending profile for a tenant type that a local centre will not have access to. We therefore comfortably maintain our use of the reduced spending profile as being more consistent with the profile that should be used to assess the sales potential for a local centre tenant type.

The total convenience market spending profile includes spending on goods and services that the market says just cannot be considered at a local centre.

The review has supported the local centre by effectively doubling the catchment of the local centre and doubling the spending capacity within the centre without reducing or altering the market capacity of tenants within the local centre to be attracted to the resultant larger local centre. Whilst the mathematics associated with the findings are sound, the logic is not considered reflective of market trends and commercial reality.

Suggested misinterpretation of the removal of a previously planned local centre in Casuarina South precinct

The removal of a local centre from the Casuarina South Precinct in subsequent planning policy does not alter the catchment extent of the local centre trading conditions. It would still be operating within a trade shadow of two full line supermarket-based neighbourhood centres, which in themselves are operating within a very limited and difficult catchment.

The sales potential was derived from an assessment of the market capacity from a local centre to a small catchment within Casuarina Central.

The removal of a local centre in Casuarina South will be to the obvious benefit to the trading potential for the Casuarina South neighbourhood centre just as the removal of the Casuarina Central local centre will be to the benefit of the neighbourhood centre to the north. The logic remains the same. There was clearly a decision that the southern local centre was not able to be sustained in proximity to its competitive environment. Nor is the Central local centre.

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Suggested potential need for a local centre to act as community hub regardless of sustainability

Taktics4 fully supports the assertion by the Review that any local centre has the capacity to be a community hub for a local community. And as previously stated the recommendation to remove the local centre was not taken lightly. Taktics4 laments the market conditions which have reduced the effectiveness of local centres in this catchment type. However, retail planners must deal with the evidence before them and in this instance given the restrictive nature of the neighbourhood centre catchments caused by the freeway to the west and the non-urban land uses to the east. The planning for this area should have adopted a greater distance between the neighbourhood centres to accommodate a local centre.

To suggest that a local centre should be provided for regardless of the potential sustainability of the centre is not supported. The planning for a local centre does not make it a valued community hub. The allocation of a site does not make it a valued community hub. The delivery of a sustainable local centre makes it a valued community hub. Unfortunately, in this instance in these market conditions the delivery of local centre has been shown not be sustainable. To suggest that a local centre should be provided regardless of the findings from an RNA is to fundamentally reduce the need for and effectiveness of one of the key pillars of change that policy has introduced in SPP4.2.

The Review offered suggestions around the potential for a medical centre and childcare centres to be included as part of an expanded local centre offer. However, our experience indicates medical centres are more likely to be attracted to and planned for in or adjacent to neighbourhood centres, while childcare centres are more likely to be freestanding.

There have been a significant number of (full line and limited line) supermarket-based neighbourhood centres planned and developed in Perth Metropolitan Area over the past 15 years.

In that time there have been very few if any local centres which have been developed to 800sqm (6-8 shops). Let alone within similar market conditions including limited catchments and neighbouring centres. The local centre has appeared to take one of two forms over recent years. The local centre has taken the form of either a 150-250sqm café/deli or a 1,500sqm small (IGA) supermarket-based centre supporting a 1,000sqm supermarket and 5 shops.

Suggested spatial allocation of a centre to be more central to the catchment

Whilst the RNA confirms and this paper reaffirms that a local centre will not be viable in the central precinct, it is acknowledged that the City's LPP does state that a local centre is required in this area. The Review subsequently provides an alternate location for the local centre – south of the primary school site and equi-distant from both neighbourhood centres.

However, if a local centre is required to be provided for, then it would be best served in a location that gives it as much access to the population it is intended to serve. The proximity to a school or park and at the intersection to two major road alignments provides the best position to be exposed to the highest proportion of traffic volumes. To this end a location on the north side of Orton Road opposite the park, near the intersection with Landgren Road is a better solution for the site. This position is reinforced by the likely closure of Orton Road.

The restrictive catchment for the northern NC would suggest that a local centre closer to the northern precinct would be better suited than in the central area. Here it would only be competing with a smaller supermarket-based centre. Placing it further from the stronger southern NC with the full line supermarket would be more suitable.

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Information Paper

The approved Structure Plan for portion of the Casuarina North Precinct (referred to as Casuarina – East of Freeway) acknowledges that future structure planning for the remaining portion of the precinct should include a local centre in the north or central precinct and we submit that the north is the most suitable location, taking into consideration the catchment it will serve and the location of the proposed hard courts in the southern end of the northern precinct.

Summary

The community of Casuarina will have access to two full line supermarkets at two centres both north and south of the community. They will have all services provided for the day to day convenience nature of shopping experience met by not one but two centres, they will be spoilt for choice.

The market analysis concludes that the community simply cannot and will not be able to sustain the existence of these two centres and a third local centre. The extent and limited nature of the catchment simply precludes this from being sustainable.

The Review offers that the extent of the catchment may be even more severely restricted. Making the potential sustainability or the attraction of developers and tenants even more reluctant.

If provision for a local centre is to be pursued for the Precinct, a location north of Orton Road is more ideally suited to maximise access for the catchment it is intended to serve.

I trust that this assessment and response to the issues raised in the Review are useful in the continued planning and decision making on this matter. Taktics4 maintains the original position forwarded in the initial RNA that a local centre is not sustainable in this location and should be removed from the Structure Plan.

Regards
Taktics4

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Director
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Attachment J

LEGEND

- Maximum Retention Opportunity
- Potential Retention Opportunity
- Structure Plan Boundary
- Western Power Easement
- Public Open Space
- Unsurveyed Area
- Development Concept

Significant Trees with >500 mm Diameter at breast height

Species

- Jarrah (Eucalyptus marginata)
- Tuart (Eucalyptus gomphocephala)
- Marri (Corymbia callophylla)
- Coastal Blackbutt (Eucalyptus todtiana)

Source: Strategen (15/03/2019)

ORTON ROAD

BOMBAY BOULEVARD

KWINANA FREEWAY

LANDGREN ROAD

NOTES

1. **Maximum Retention Opportunity**
   Includes significant trees located within POS areas and within the CCW and CCW buffer west of the powerline easement.
   These trees are also located where there is no more than 1m of cut or fill based on the preliminary earthworks design.
   The POS area to the north has been specifically located and designed to include significant trees which have the opportunity to be retained based on the preliminary earthworks design, in addition to consideration of other landscape features such as retention and conservation of the Banksia Woodland TEC and the Carnaby's Black Cockatoo Potential Feeding Areas, as well as addressing drainage requirements and providing passive and active recreation opportunities.
   The POS area on the eastern edge of the site has also been designed to include significant trees which have the opportunity for retention, as well as providing a regional ecological linkage with the adjacent Bush Forever site. This POS has also been located and designed to retain and conserve Banksia Woodlands and Black Cockatoo Potential Breeding Trees.
   Retention of the significant trees is subject to detailed subdivision and engineering design, and in particular retention of the trees located near the perimeter of the POS is dependent on the final levels of the surrounding roads.
2. **Potential Retention Opportunity**
   Includes significant trees located outside of POS areas within road reserves, or adjacent to the proposed playing field, where there is potentially no more than 1m of cut or fill based on the preliminary earthworks design. There is the possibility that these trees may be retained, however they are subject to further investigation at the detailed subdivision and engineering design stage. Opportunities for retention include offset road carriageways, localised retaining to trees and use of other road design features to maximise opportunities for retention of significant trees.

TREE PROTECTION METHODS AND ONGOING MAINTENANCE MEASURES

- All trees identified for retention at the detailed subdivision and engineering design stage should be clearly marked and a tree protection zone (TPZ) prepared prior to the commencement of subdivision works.
- Construction management plans should be prepared in compliance with the tree protection plan.
- Protective fencing should be erected around tree protection zones for trees proposed to be retained.
- No building materials are to be stored or disposed of within the tree protection zone.
- Placement of fill should not be stored or built up around the trunk of retained trees.
- Preparation of chemicals, refuelling and washing down and cleaning equipment should not occur within tree protection zones.
- Use of vehicles / machinery including parking should be prohibited within the tree protection zone.
- Seek arborist advice for proposed level changes or excavation within the tree protection zones.
- Where roots within the tree protection zone are exposed by excavation, temporary root protection should be installed to prevent them drying out. It is not acceptable for roots within the tree protection zone to be pruned with machinery such as backhoes or excavators.
- Pruning wounds should not be treated with dressings or paints. Seek arborist advice prior to pruning.
- Seek arborist advice for remedial works for any tree damage that has occurred during the construction process.
- Maintain mulch to a depth of 50-100mm around base of tree. Where existing landscape within the tree protection zone remains unaltered mulch may not be required.
- Monitor soil moisture levels during and post construction works.
- Supplementary watering to retained trees may be required where works are in proximity of the trees.
- All weeds should be removed by hand or controlled with appropriate use of herbicide to minimise disturbance to soil.
- Continue to monitor tree health during maintenance period.

CASUARINA CENTRAL PRECINCT - SIGNIFICANT TREES - PROPOSED RETENTION AND REMOVAL

Various Lots, Orton Road & Landgren Road CASUARINA

0m 25 50 75m

s: 1:5,000@A3
d: 25/03/2019
p: 17/038/049B

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Attachment K

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Transportation Noise Assessment

Casuarina Central Precinct

Reference: 18054422-01 Rev 1.docx

Prepared for:
Taylor Burrell Barnett

Report: 18054422-01 Rev 1.docx

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Date:	Rev	Description	Prepared By	Verified
05-Nov-18	-	Issued to Client	Olivier Mallié	Terry George
03-Dec-18	1	Finalised Precinct Concept Plan	Olivier Mallié	-

Table of Contents

1 INTRODUCTION 1

2 CRITERIA 2

3 METHODOLOGY 3

3.1 Site Measurements 3

3.2 Noise Modelling 5

3.2.1 Ground Topography, Road Design & Cadastral Data 5

3.2.2 Traffic Data 6

3.2.3 Ground Attenuation 6

3.2.4 Parameter Conversion 7

4 RESULTS 7

4.1 Noise Monitoring 7

4.2 Noise Modelling 10

5 ASSESSMENT 13

6 CONCLUSION 17

List of Tables

Table 2-1 Outdoor Noise Criteria 3

Table 3-1 Noise Relationship Between Different Road Surfaces 6

Table 3-2 Kwinana Freeway Traffic Information Used in the Modelling 6

Table 4-1 Measured Average Noise Levels at Logger Location 7

List of Figures

Figure 1-1 Subject Site Location _____ 1

Figure 1-2 Casuarina Central Precinct Development Concept _____ 2

Figure 3-1 Noise Logger Location (Google Earth Aerial) _____ 4

Figure 4-1 Kwinana Freeway Noise Monitoring Results (Chart 1) _____ 8

Figure 4-2 Kwinana Freeway Noise Monitoring Results (Chart 2) _____ 9

Figure 4-3 Future (Year 2031) Ground Floor Noise Contour Plot, dB $L_{Aeq(Day)}$ _____ 11

Figure 4-4 Future (Year 2031) Upper Floor Noise Contour Plot, dB $L_{Aeq(Day)}$ _____ 12

Figure 5-1 Residential Lots Ground Floor Noise Control Requirements _____ 15

Figure 5-2 Residential Lots Upper Floor Noise Control Requirements _____ 16

Appendices

A Acceptable Treatment Packages

B Terminology

1 INTRODUCTION

It is proposed to subdivide the land south of Orton Road, and east and west of Landgren Road in Casuarina into residential and commercial lots. *Figure 1-1* shows the location of the site, while *Figure 1-2* shows a subdivision concept.

As the site is located close to the Kwinana Freeway, road traffic noise impacts were assessed against the requirements of the *State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning*.

This report presents the methodology and results of the noise monitoring and modelling undertaken, and the assessment of transport noise impacts.

Appendix B contains a description of some of the terminology used throughout this report.



Figure 1-1 Subject Site Location



Figure 1-2 Casuarina Central Precinct Development Concept

2 CRITERIA

The criteria relevant to this assessment is the *State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning* (hereafter referred to as the Policy) produced by the Western Australian Planning Commission (WAPC). The objectives in the Policy are 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 redevelopment transport infrastructure proposals;
- Facilitate the development and operation of an efficient freight network; and
- Facilitate the strategic co-location of freight handling facilities.

The Policy's outdoor noise criteria are shown below in *Table 2-1*. These criteria apply at any point 1-metre from a habitable façade of a noise sensitive premises and in one outdoor living area.

Table 2-1 Outdoor Noise Criteria

Period	Target	Limit
Day (6am to 10pm)	55 dB $L_{Aeq(Day)}$	60 dB $L_{Aeq(Day)}$
Night (10pm to 6am)	50 dB $L_{Aeq(Night)}$	55 dB $L_{Aeq(Night)}$

Note: The 5 dB difference between the target and limit is referred to as the margin.

In the application of these outdoor noise criteria to new noise sensitive developments, the objectives of this Policy is to achieve -

- acceptable indoor noise levels in noise-sensitive areas (e.g. bedrooms and living rooms of houses); and
- a 'reasonable' degree of acoustic amenity in at least one outdoor living area on each residential lot.

If a noise sensitive development takes place in an area where outdoor noise levels will meet the *target*, no further measures are required under this policy.

In areas where the *target* is exceeded, customised noise mitigation measures should be implemented with a view to achieving the *target* in at least one outdoor living area on each residential lot, or if this is not practicable, within the *margin*. Where indoor spaces are planned to be facing outdoor areas that are above the *target*, mitigation measures should be implemented to achieve acceptable indoor noise levels in those spaces.

For residential buildings, "acceptable indoor noise levels" are taken to be 40 dB $L_{Aeq(Day)}$ in living areas and 35 dB $L_{Aeq(Night)}$ in bedrooms.

3 METHODOLOGY

Noise measurements and modelling have been undertaken in accordance with the requirements of the Policy as described below in *Sections 3.1* and *3.2*.

3.1 Site Measurements

Noise monitoring was undertaken at one location in order to:

- Quantify the existing noise levels;
- Determine the differences between different acoustic parameters ($L_{A10,18hour}$, $L_{Aeq(Day)}$ and $L_{Aeq(Night)}$); and
- Calibrate the noise model for existing conditions.

The instrument used was an ARL type Ngara noise data logger (S/N 8780F6), located approximately 30 metres from the edge of the freeway (refer *Figure 3-1*). The microphone was approximately 1.4 metres above ground level.

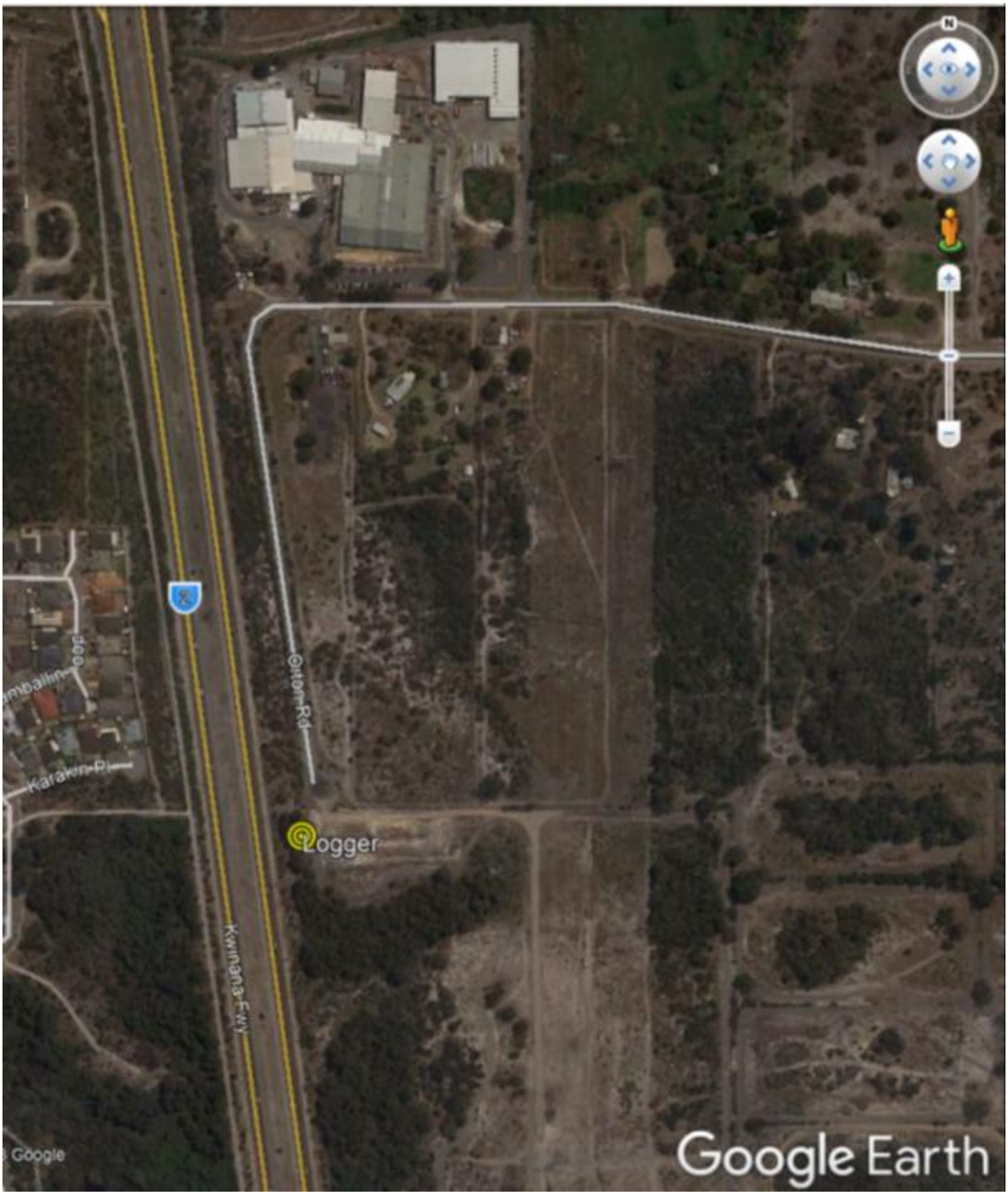


Figure 3-1 Noise Logger Location (Google Earth Aerial)

The logger was programmed to record hourly L_{A1}, L_{A10}, L_{A90}, and L_{Aeq} levels. This instrument complies with the instrumentation requirements of *Australian Standard 2702-1984 Acoustics – Methods for the Measurement of Road Traffic Noise*. The logger was field calibrated before and after the measurement session and found to be accurate to within +/- 1 dB. Lloyd George Acoustics also holds current laboratory calibration certificate for the loggers.

The noise data collected was verified by inspection and professional judgement and where hourly data was considered atypical, an estimated value was inserted.

The weather conditions during the measurement period were obtained from the Bureau of Meteorology's Perth station. This data was compared against the Main Roads Western Australia (MRWA) specifications for measurement conditions and data recorded under unacceptable conditions was not considered in the analysis.

3.2 Noise Modelling

The computer programme *SoundPLAN 8.0* was utilised incorporating the *Calculation of Road Traffic Noise* (CoRTN) algorithms, modified to reflect Australian conditions. The modifications included the following:

- Vehicles were separated into heavy (Austroads Class 3 upwards) and non-heavy (Austroads Classes 1 & 2) with non-heavy vehicles having a source height of 0.5 metres above road level and heavy vehicles having two sources, at heights of 1.5 metres and 3.6 metres above road level, to represent the engine and exhaust respectively. By splitting the noise source into three, allows for less barrier attenuation for high level sources where barriers are to be considered.
- Note that corrections are applied to the exhaust of –8.0 dB (based on Transportation Noise Reference Book, Paul Nelson, 1987) and to the engine source of –0.8 dB, so as to provide consistent results with the CoRTN algorithms for the no barrier scenario;
- Adjustments of -0.7 dB and -1.7 dB have been applied to the predicted $L_{A10,18hour}$ levels for the 'free-field' and 'at facade' cases respectively, based on the findings of *An Evaluation of the U.K. DoE Traffic Noise Prediction*; Australian Road Research Board, Report 122 ARRB – NAASRA Planning Group (March 1983).

Predictions are made at heights of 1.4 metres above ground floor level and at 1.0 metre from an assumed building façade (resulting in a + 2.5 dB correction due to reflected noise).

Various input data are included in the modelling such as ground topography, road design, traffic volumes etc. These model inputs are discussed below.

3.2.1 Ground Topography, Road Design & Cadastral Data

Topographical and road design data for this project was taken from publicly available data e.g. Google Earth. At this stage information on subdivision levels are unknown and therefore the modelling uses the existing topography.

Based on Main Roads ROM24 modelling data for the future scenario, the freeway would be widened from the existing 2 lanes to 3 lanes in both directions and this has been included in the model.

3.2.2 Traffic Data

Traffic data for this assessment include:

- Road Surface – The noise relationship between different road surface types is shown below in *Table 3-1*.

Table 3-1 Noise Relationship Between Different Road Surfaces

Road Surfaces						
Chip Seal			Asphalt			
14mm	10mm	5mm	Dense Graded	Novachip	Stone Mastic	Open Graded
+3.5 dB	+2.5 dB	+1.5 dB	0.0 dB	-0.2 dB	-1.0 dB	-2.5 dB

The existing and future road surface was assumed to be dense graded asphalt.

- Vehicle Speed – The existing posted speed is 100 km/hr and assumed to remain the same in the future.
- Traffic Volumes – Information used in the modelling is provided in *Table 3-2*.

Table 3-2 Kwinana Freeway Traffic Information Used in the Modelling

Parameter	Kwinana Freeway			
	Existing (2018)[1]		Future (2031)	
	Northbound	Southbound	Northbound	Southbound
24 Hour Volume	38,777	40,079	62,314[2]	60,019[2]
18 Hour Volume[3]	33,840	38,389	54,381	57,488
% Heavy	10	13	8	8

Notes:

1. From Main Roads WA online hourly data at sites 8212 and 8213, year 2017/18.
2. ROM24 24 hrs AAWT model data from Main Roads WA and adjusted based on predicted/observed data for year 2016. That is, the predicted 24 hrs traffic volumes for year 2031 were calibrated against the 2016 observations. The calibration factor was then applied to the predicted volumes for year 2031. MRWA job reference (#40925).
3. Based on the hourly data recorded in 2017/18 at sites 8212 and 8213.

3.2.3 Ground Attenuation

The ground attenuation has been assumed to be 0.0 (0 %) for the road and 1.0 (100 %) for the current land and public open space. A ground attenuation factor of 0.5 (50 %) was used for the future subdivision. Note 0.0 represents hard reflective surfaces such as water and 1.0 represents absorptive surfaces such as grass.

3.2.4 Parameter Conversion

The CoRTN algorithms used in the *SoundPlan* modelling package were originally developed to calculate the $L_{A10,18hour}$ noise level. The WAPC Policy however uses $L_{Aeq(Day)}$ and $L_{Aeq(Night)}$. The relationship between the parameters varies depending on the composition of traffic on the road (volumes in each period and percentage heavy vehicles).

As noise monitoring was undertaken, the relationship between the parameters is based on the results of the monitoring – refer *Section 4.1*.

4 RESULTS

4.1 Noise Monitoring

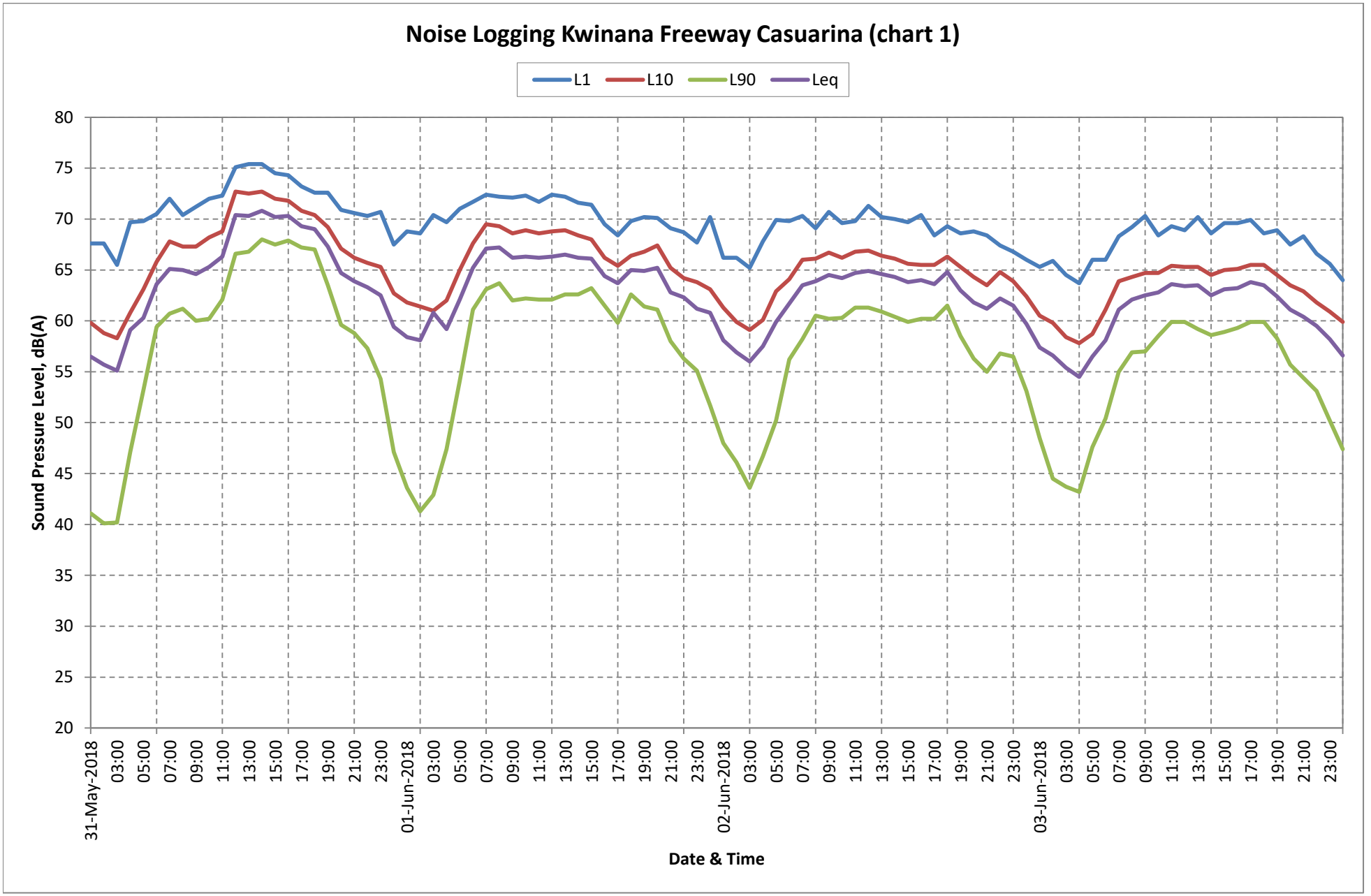
The results of the noise monitoring are summarised below in *Table 4-1* and shown graphically in *Figures 4-1* and *4-2*.

Table 4-1 Measured Average Noise Levels at Logger Location

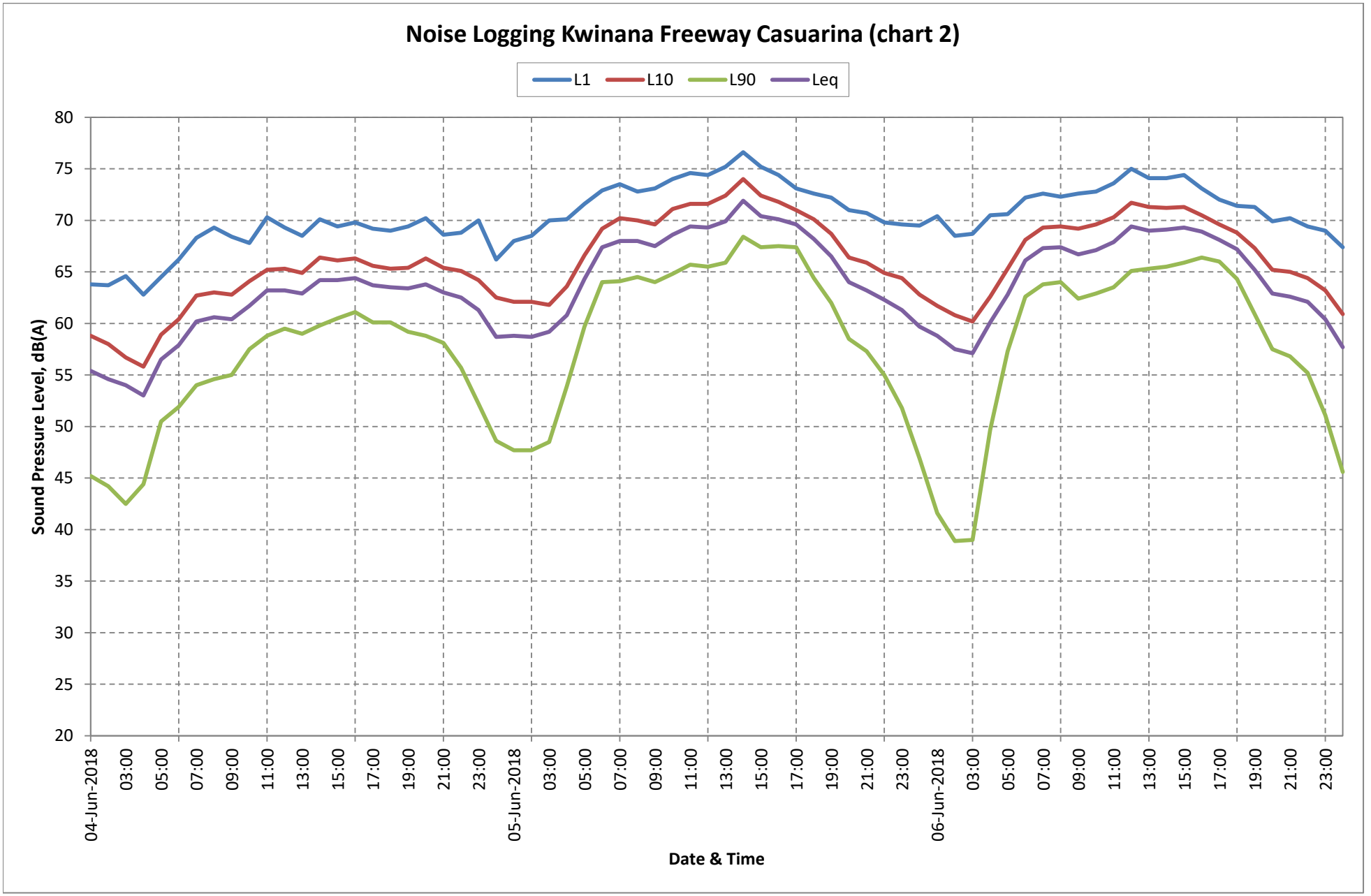
Date	Average Weekday Noise Level, dB			
	$L_{A10,18hour}$	$L_{Aeq,24hour}$	$L_{Aeq\ (Day)}$	$L_{Aeq\ (Night)}$
Thursday, 31 May 2018	*68.8*	*66.6*	*68.0*	*60.0*
Friday, 1 June 2018	67.1	64.6	65.6	61.3
Saturday, 2 June 2018	*65.5*	*62.8*	*63.8*	*59.4*
Sunday, 3 June 2018	*64.0*	*61.3*	*62.6*	*56.8*
Monday, 4 June 2018	*64.8*	*61.8*	*63.0*	*57.2*
Tuesday, 5 June 2018	*69.4*	*67.3*	*68.6*	*62.4*
Wednesday, 6 June 2018	68.2	66.1	67.4	61.2
Weekday Average	**67.7**	**65.4**	**66.5**	**61.3**

It is noted that weather conditions over the survey period were generally fine except for 31 May and 05 June (provided in *italics*), and data recorded on those dates were not included in the weekday average. Data recorded on the 04 June (also in *italics*) were also not included as it was a public holiday.

From the above, it can be seen that the average differences between the weekday $L_{A10,18hour}$ and $L_{Aeq(Day)}$ is 1.2 dB. This conversion has been used in the modelling for the future scenario. The average differences between the weekday $L_{Aeq(Day)}$ and $L_{Aeq(Night)}$ is 5.2 dB and therefore the daytime noise levels dictate compliance since the night-time levels are more than 5 dB over the daytime levels.



Reference: 18054422-01


Noise Logging Kwinana Freeway Casuarina (chart 2)
L1
L10
L90
Leq
Sound Pressure Level, dB(A)
80
75
70
65
60
55
50
45
40
35
30
25
20
04-Jun-2018
03:00
05:00
07:00
09:00
11:00
13:00
15:00
17:00
19:00
21:00
23:00
05-Jun-2018
03:00
05:00
07:00
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21:00
23:00
06-Jun-2018
03:00
05:00
07:00
09:00
11:00
13:00
15:00
17:00
19:00
21:00
23:00
Date & Time

4.2 Noise Modelling

The model was first calibrated against the survey results presented in *Table 4-1*.

For the future noise levels, an adjustment of -1.7 dB is applied to the predicted levels in accordance to the NAASRA report (refer *Section 3-2*) and a +2.5 dB facade adjustment is applied to account for facade reflection when assessed at houses.

The noise modelling is provided in *Figures 4-3* and *4-4* as a $L_{Aeq(Day)}$ noise level contour plot (including the +2.5 dB facade correction) for the future traffic conditions (year 2031) and for ground floor and upper floor levels respectively.

It can be seen that noise levels across the site are predicted to be below the *target*, with the exception of the lots west of the easement and a few lots in the south-west corner of the development. However, it is noted the modelling also shows that noise levels at an upper storey would be over the *target* for those future residential lots east of the easement.

In relation to the development area located west of the easement, it is understood these lots are marked as 'non residential uses' and therefore noise mitigation measures would not be required. However, it is noted that child care centres, educational buildings (schools) and places of worship are considered a sensitive use under the Policy although they are 'non-residential' and would therefore warrant noise mitigation.

Casuarina Central Precinct Development

$L_{Aeq(Day)}$ Noise Level Contours for Future Conditions (Year 2031) at Ground Floor Level

Figure 4-3



Traffic Assumptions
Road Surface: Dense Graded Asphalt
Speed: 100 km/hr
Southbound vpd (%HV): 60,019 (8%)
Northbound vpd (%HV): 62,314 (8%)

Noise levels
$L_{Aeq(Day)}$, dB

< 55
55 <= < 60
60 <= < 63
63 <=

N

Signs and symbols
Road
Area

03-Dec-18

Length Scale 1:6500
0 30 60 120 180 240 m

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Figure 4-4

Casuarina Central Precinct Development

$L_{Aeq(Day)}$ Noise Level Contours for Future Conditions (Year 2031) at Upper Floor Level



Traffic Assumptions
Road Surface: Dense Graded Asphalt
Speed: 100 km/hr
Southbound vpd (%HV): 60,019 (8%)
Northbound vpd (%HV): 62,314 (8%)

Noise levels
$L_{Aeq(Day)}$, dB

< 55
55 <= < 60
60 <= < 63
63 <=

N

Signs and symbols
Road

03-Dec-18

Length Scale 1:6500
0 30 60 120 180 240 m

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5 ASSESSMENT

The objectives of the criteria are for noise at all houses to be no more than the *limit* and preferably no more than the *target*. Where the *target* is achieved, no further controls are required. Where the *target* is exceeded, further controls are necessary.

It is noted that while the Policy mainly deals with residential uses, other uses such as child care centres, educational buildings (schools) and places of worship are also considered a sensitive use under the Policy, therefore requiring some degree of protection. In the case of child care centres, it is expected for at least one outdoor area which complies with the *target* to also be provided, therefore matching the requirements of residential buildings. For other sensitive uses such as a place of worship, only the internal noise level criteria are to be met.

With no noise control, road traffic noise levels to most of the land west of the easement will be above the daytime *target* of 55 dB $L_{Aeq(Day)}$, as well as a few lots in the south-western part of the development. It is noted that noise levels at future upper storeys were also predicted to exceed the *target* for those future residential lots east of the easement.

The *target* is achieved at the ground floor of most future residential lots with the exception of those located in the south western corner. A local noise wall to the west of the access road could be incorporated however, it would need to be in excess of 4.5 metres to achieve the *target* at those few lots. For those future lots in the south-west corner that are above the *target* of 55 dB $L_{Aeq(Day)}$, the following would be required:

- Where residences are predicted to experience future noise levels above *target* of 55 dB $L_{Aeq(Day)}$, (refer *Figure 5-1*) Package A (refer *Appendix A*) is to be incorporated, and
- All affected lots are to have notifications on lot titles as per the Policy requirements – refer *Appendix A*.
- The above requirement is shown on *Figure 5-1*.

Noise levels over the *target* are also predicted at upper floor levels for a number of future residential lots, however all future residential lots are below the *limit* of 60 dB $L_{Aeq(Day)}$. Since elevated receivers do not receive the same level of attenuation provided by walls, fences or other dwellings, architectural packages would be required only to the upper storey as follows:

- Where an upper storey is predicted to experience future noise levels above the *target* of 55 dB $L_{Aeq(Day)}$, Package A (refer *Appendix A*) is to be incorporated, and
- All affected lots are to have notifications on lot titles as per the Policy requirements (refer *Appendix A*) to advise prospective purchasers that additional noise mitigation requirements are required if a double storey dwelling be constructed.
- The above requirement is shown on *Figure 5-2.*

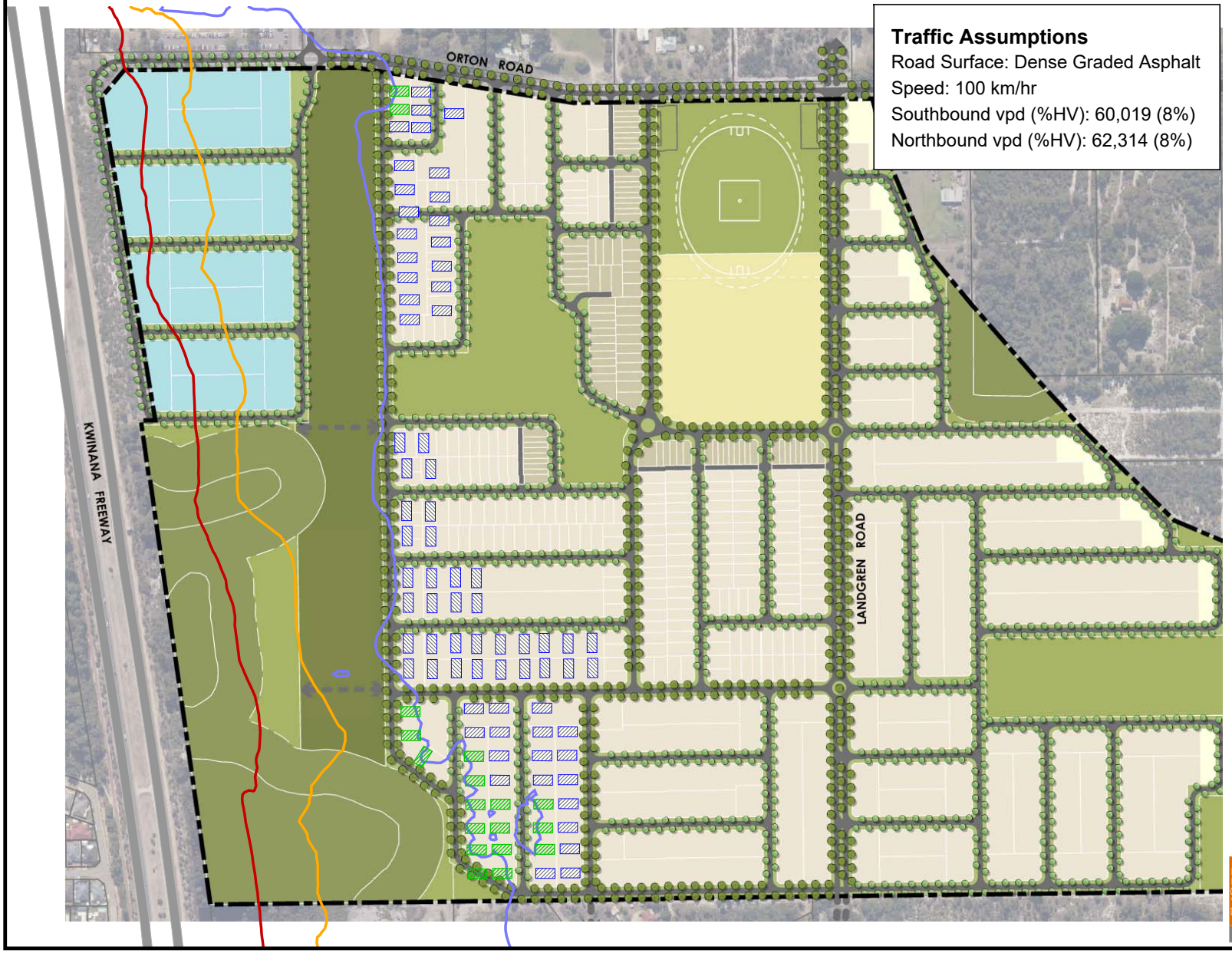
Alternative constructions to the Package A may be acceptable if supported by a report undertaken by a suitably qualified acoustical consultant once the lots specific building plans are available.

With regard to the lots west of the easement, these are marked for non-residential uses and therefore no noise mitigation is required. However, as noted above, child care centres, schools, places of worship and the like are considered sensitive uses and therefore some form of noise mitigation may still be required e.g. noise wall or architectural treatments. The requirements for mitigation measures will also depend on which lot the non-residential sensitive use would be built-on, and the height and orientation of adjacent buildings. At this stage, it is recommended for these lots to also have some form of notification on lot titles to advise of the Policy requirements in relation to non-residential sensitive use.

Figure 5-1

Casuarina Central Precinct Development

Ground Floor Package A Requirements and $L_{Aeq(Day)}$ Ground Floor Noise Level Contours for Future Conditions (Year 2031)



Traffic Assumptions
Road Surface: Dense Graded Asphalt
Speed: 100 km/hr
Southbound vpd (%HV): 60,019 (8%)
Northbound vpd (%HV): 62,314 (8%)

Noise levels
$L_{Aeq(Day)}$, dB

< 55
55 <= < 60
60 <= < 63
63 <=

N

Signs and symbols
Road
Package A

03-Dec-18

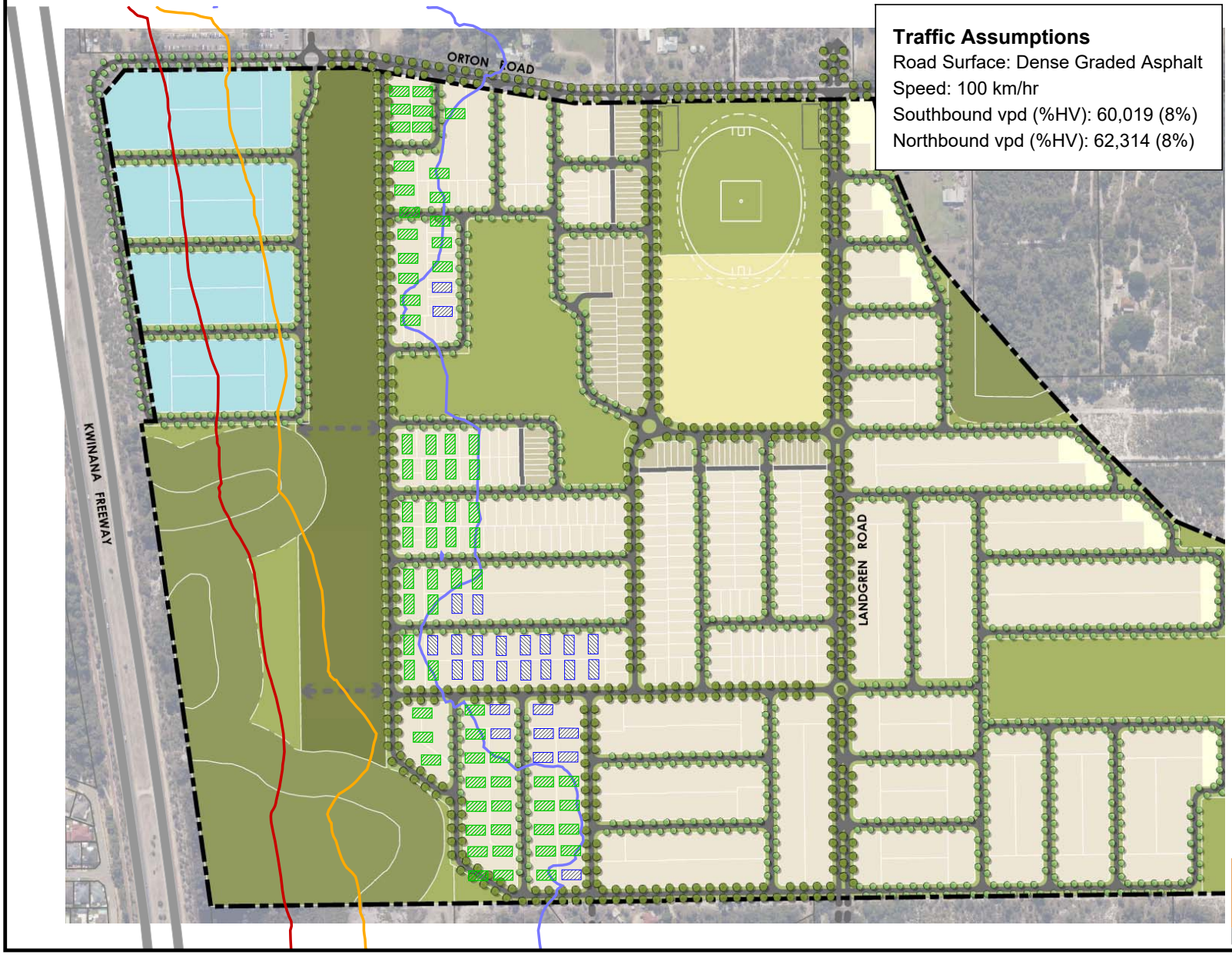
Length Scale 1:6500
0 30 60 120 180 240 m

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Figure 5-2

Casuarina Central Precinct Development

Upper Floor Package A Requirements and $L_{Aeq(Day)}$ Upper Floor Noise Level Contours for Future Conditions (Year 2031)



Traffic Assumptions
Road Surface: Dense Graded Asphalt
Speed: 100 km/hr
Southbound vpd (%HV): 60,019 (8%)
Northbound vpd (%HV): 62,314 (8%)

Noise levels
$L_{Aeq(Day)}$, dB

	< 55
55 <=	< 60
60 <=	< 63
63 <=	

N

Signs and symbols
- Road
- Package A

03-Dec-18

Length Scale 1:6500

0 30 60 120 180 240 m

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6 CONCLUSION

To satisfy the requirements of the *State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning*, the following is required:

- Implement noise mitigation as shown on either *Figures 5-1* and *Figure 5-2*,
- Encourage non-noise sensitive uses on the western most lots,
- Locate non-residential sensitive uses on the western lots (e.g. child care) behind other buildings. Alternatively, localised noise walls to be incorporated,
- For dwellings / floor level requiring Package A, alternative treatment to the deemed to satisfy can be accepted if supported by a report by a suitable qualified acoustical engineer (member firm of the Association of Australasian Acoustical Consultants), and
- All residential affected lots are to have notifications on lot titles as per the Policy requirements – refer *Appendix A*. Non-residential lots to also have some form of notification to advise of the Policy requirements in relation to non-residential sensitive use.

Appendix A

ACCEPTABLE TREATMENT PACKAGES

The packages and information provided on the following pages are taken from *Implementation Guidelines for State Planning Policy 5.4 Road and Rail Transport Noise and freight Considerations in Land Use Planning*; December 2014.

Where outdoor noise levels are above the ***target*** level, excluding the effect of any boundary fences, the Guidelines propose acceptable treatment packages that may be implemented without requiring detailed review. The packages are also intended for residential development only. At higher noise levels or for other building usages, specialist acoustic advice will be needed.

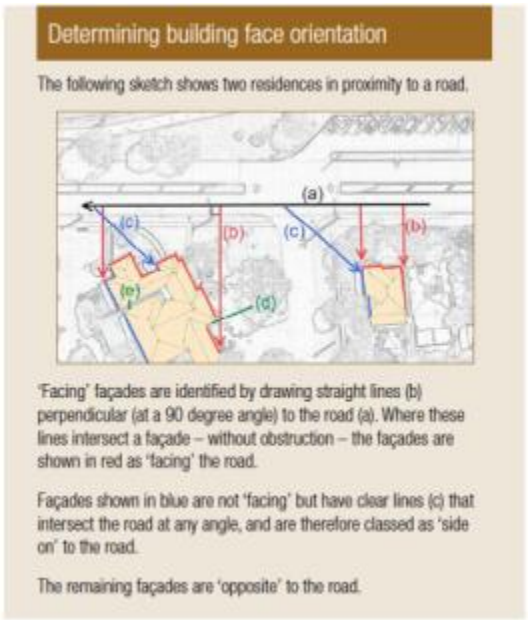
The acceptable treatment packages are intended to simplify compliance with the noise criteria, and the relevant package should be required as a condition of development in lieu of a detailed assessment.

Transition between each package should be made on the basis of the highest incident $L_{Aeq(Day)}$ or $L_{Aeq(Night)}$ value to the nearest whole number determined for the building development under assessment.

Any departures from the acceptable treatment specifications need to be supported by professional advice from a competent person that the proposal will achieve the requirements of the Policy.

With regards to the packages, the following definitions are provided:

- **Facing** the transport corridor: Any part of a building façade is 'facing' the transport corridor if any straight line drawn perpendicular to its nearest road lane or railway line intersects that part of the façade without obstruction (ignoring any fence).
- **Side-on** to transport corridor: Any part of a building façade that is not 'facing' is 'side-on' to the transport corridor if any straight line can be drawn from it to intersect the nearest road lane or railway line without obstruction (ignoring any fence).
- **Opposite** to transport corridor: Neither 'side on' nor 'facing', as defined above.



Package A

Area	Orientation to Road or Rail Corridor	Package A (up to 60 dB $L_{Aeq(Day)}$ and 55 dB $L_{Aeq(Night)}$)
Bedrooms	Facing	• Windows systems: Glazing up to 40% of floor area (minimum $R_w + C_{tr}$ 28) – 6mm thick glass (monolithic, toughened or laminated) in fixed sash, awning or casement opening with seals to openings.
	Side	• Windows systems: As above.
	Opposite	No requirements
Other Habitable Rooms Including Kitchens	Facing	• Windows and external door systems: Glazing up to 60% of floor area (minimum $R_w + C_{tr}$ 28) – 6mm thick glass (monolithic, toughened or laminated) in fixed sash, awning or casement opening with seals to openings. Doors to be either 35mm thick solid timber core door with full perimeter acoustic seals. Glazed inserts to match the above. Sliding glass doors to be same performance including brush seals.
	Side	• Windows and external door systems: As above.
	Opposite	No requirements
General	Any	• Walls (minimum $R_w + C_{tr}$ 45) – Two leaves of 90mm thick brick with minimum 50mm cavity • Roof and ceiling (minimum $R_w + C_{tr}$ 35) – Standard roof construction with 10mm plasterboard ceiling and minimum R2.5 insulation between ceiling joists. • Eaves to be closed using 4mm compressed fibre cement sheet. • Mechanical ventilation – Refer following pages.
Outdoor Living Area		• Locate on the side of the building that is opposite to the corridor if practicable; or • Locate within alcove area so that the house shields it from corridor if practicable.

Note: Any penetrations in a part of the building envelope must be acoustically treated so as to not downgrade the performance of the building elements affected. Most penetrations in external walls such as pipes, cables or ducts can be sealed through caulking gaps with non-hardening mastic or suitable mortar.

Mechanical Ventilation requirements

It is noted that natural ventilation must be provided in accordance with F4.6 and F4.7 of Volume One and 3.8.5.2 of Volume Two of the National Construction Code. Where the noise *limit* is likely to be exceeded, a mechanical ventilation system is usually required. Mechanical ventilation systems will need to comply with AS 1668.2 – *The use of mechanical ventilation and air-conditioning in buildings*.

In implementing the acceptable treatment packages, the following must be observed:

- Evaporative air conditioning systems will meet the requirements for Packages A and B provided attenuated air vents are provided in the ceiling space and designed so that windows do not need to be opened.
- Refrigerant based air conditioning systems need to be designed to achieve fresh air ventilation requirements.
- External openings (e.g. air inlets, vents) need to be positioned facing away from the transport corridor where practicable.
- Ductwork needs to be provided with adequate silencing to prevent noise intrusion.

Notification

Notifications on certificates of title and advice to prospective purchasers warning of the potential for noise impacts from major transport corridors help with managing expectations.

The area of land for which notification is required should be identified in the noise management plan and contain a description of major noise sources nearby (e.g. 24-hour freight rail).

Notification should be provided to prospective purchasers, and required as a condition of subdivision (including strata subdivision) for the purposes of noise sensitive development or planning approval involving noise sensitive development, where external noise levels are forecast or estimated to exceed the 'target' criteria as defined by the Policy.

In the case of subdivision and development, conditions of approval should include a requirement for registration of a notice on title, which is provided for under Section 165 of the Planning and Development Act 2005 and Section 70A of the Transfer of Land Act 1893. An example of a suitable notice is:

Notice: This lot is situated in the vicinity of a transport corridor and is currently affected, or may in the future be affected, by transport noise. Transportation noise controls and Quiet House design strategies at potential cost to the owner may be required to achieve an acceptable level of noise reduction. Further information is available on request from the relevant local government offices.

Appendix B

Terminology

The following is an explanation of the terminology used throughout this report.

Decibel (dB)
The decibel is the unit that describes the sound pressure and sound power levels of a noise source. It is a logarithmic scale referenced to the threshold of hearing.

A-Weighting
An A-weighted noise level has been filtered in such a way as to represent the way in which the human ear perceives sound. This weighting reflects the fact that the human ear is not as sensitive to lower frequencies as it is to higher frequencies. An A-weighted sound level is described as L_A dB.

L_1
An L_1 level is the noise level which is exceeded for 1 per cent of the measurement period and is considered to represent the average of the maximum noise levels measured.

L_{10}
An L_{10} level is the noise level which is exceeded for 10 per cent of the measurement period and is considered to represent the "*intrusive*" noise level.

L_{90}
An L_{90} level is the noise level which is exceeded for 90 per cent of the measurement period and is considered to represent the "*background*" noise level.

L_{eq}
The L_{eq} level represents the average noise energy during a measurement period.

$L_{A10,18hour}$
The $L_{A10,18\ hour}$ level is the arithmetic average of the hourly L_{A10} levels between 6.00 am and midnight. The *CoRTN* algorithms were developed to calculate this parameter.

$L_{Aeq,24hour}$
The $L_{Aeq,24\ hour}$ level is the logarithmic average of the hourly L_{Aeq} levels for a full day (from midnight to midnight).

$L_{Aeq,8hour}$ / $L_{Aeq\ (Night)}$
The $L_{Aeq\ (Night)}$ level is the logarithmic average of the hourly L_{Aeq} levels from 10.00 pm to 6.00 am on the same day.

$L_{Aeq,16hour}$ / $L_{Aeq\ (Day)}$
The $L_{Aeq\ (Day)}$ level is the logarithmic average of the hourly L_{Aeq} levels from 6.00 am to 10.00 pm on the same day. This value is typically 1-3 dB less than the $L_{A10,18hour}$.

R_w

This is the weighted sound reduction index and is similar to the previously used STC (Sound Transmission Class) value. It is a single number rating determined by moving a grading curve in integral steps against the laboratory measured transmission loss until the sum of the deficiencies at each one-third-octave band, between 100 Hz and 3.15 kHz, does not exceed 32 dB. The higher the R_w value, the better the acoustic performance.

C_{tr}

This is a spectrum adaptation term for airborne noise and provides a correction to the R_w value to suit source sounds with significant low frequency content such as road traffic or home theatre systems. A wall that provides a relatively high level of low frequency attenuation (i.e. masonry) may have a value in the order of –4 dB, whilst a wall with relatively poor attenuation at low frequencies (i.e. stud wall) may have a value in the order of -14 dB.

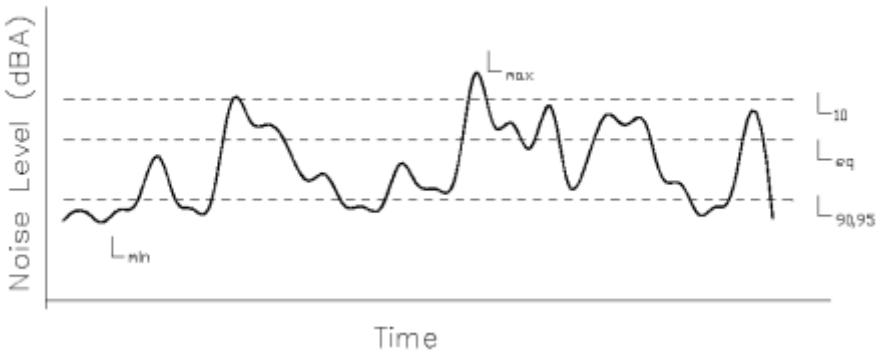
Satisfactory Design Sound Level

The level of noise that has been found to be acceptable by most people for the environment in question and also to be not intrusive.

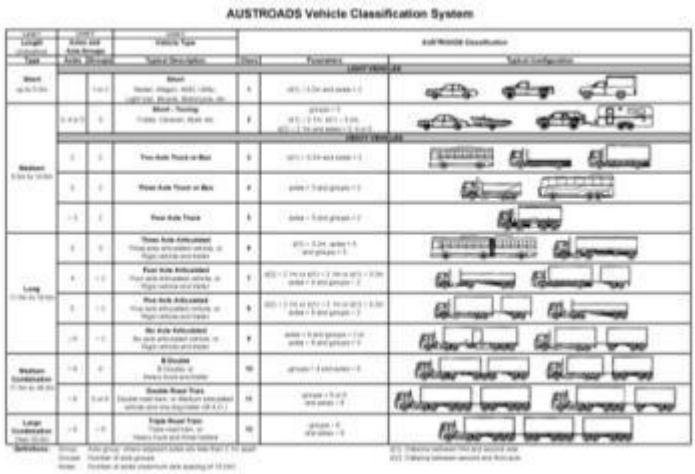
Maximum Design Sound Level

The level of noise above which most people occupying the space start to become dissatisfied with the level of noise.

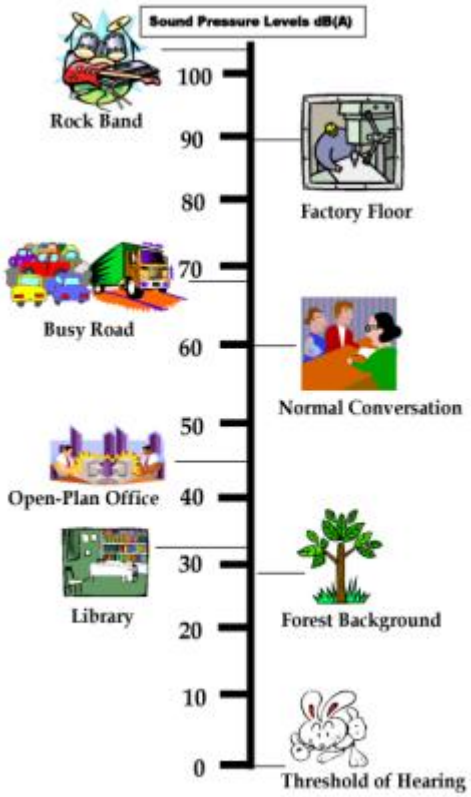
Chart of Noise Level Descriptors



Austroads Vehicle Class



Typical Noise Levels



POS Provision Summary Attachment L



POS PROVISION SUMMARY

①	Neighbourhood Park (Active Play Area)	3.1759 ha
②	Neighbourhood Park (Tree Retention/Active and Passive)	3.9989 ha
③	Local Park	0.1745 ha
④	Park Neighbourhood	1.0091 ha
⑤	Local Park	0.3165 ha
⑥	Local Park	0.3600 ha
⑦	Neighbourhood Park	2.4363 ha
⑧	Local Park	0.0904 ha
⑩	Wetland Buffer (CCW)	4.9217 ha
⑪	Wetland Core (REW)	0.4288 ha

DEDUCTIONS

D1	Drainage Swale (1:1 year event)	0.0450 ha
D2	Drainage Swale (1:1 year event)	0.1750 ha
D3	Drainage Swale (1:1 year event)	0.0074 ha
D4	Drainage Swale (1:1 year event)	0.1970 ha
D5	Drainage Swale (1:1 year event)	0.0675 ha
D6	Drainage Swale (1:1 year event)	0.0800 ha
D7	Wetland Core (CCW)	3.9362 ha

Figure 17 Public Open Space

Attachment M

Taylor Burrell Barnett

Casuarina Central Precinct

STRUCTURE PLAN



Prepared for **CDN No. 1 Pty Ltd managed by LWP Property Group**
Prepared by **Taylor Burrell Barnett**

LWP bringing communities to life

DOCUMENT HISTORY AND STATUS

Casuarina Central Precinct Structure Plan – 17/038

Revision	Reviewer	Date Issued
Rev 0	LM	Dec 2018
Rev 1	RC	April 2019

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ENDORSEMENT

This Structure Plan is prepared under the provisions of the **City of Kwinana Local Planning Scheme No. 2.**

IT IS CERTIFIED THAT THIS STRUCTURE PLAN WAS APPROVED BY RESOLUTION OF THE WESTERN AUSTRALIAN PLANNING COMMISSION ON:

_____ Date

Signed for and on behalf of the Western Australian Planning Commission

_____

an officer of the Commission duly authorised by the Commission pursuant to section 16 of the Planning and Development Act 2005 for that purpose, in the presence of:

_____ Witness

_____ Date

_____ Date of Expiry

TABLE OF AMENDMENTS

Each time the Structure Plan is amended, the amendment is to be recorded in the table of amendments at the front of the Structure Plan, including the amendment type (minor or major).

AMENDMENT NO.	SUMMARY OF THE AMENDMENT	AMENDMENT TYPE	DATE APPROVED BY WAPC

TABLE OF DENSITY PLANS

Each time a density plan is approved, the plan is to be recorded in the table of density plans at the front of the Structure Plan.

DENSITY PLAN NO.	AREA OF DENSITY PLAN APPLICATION	DATE ENDORSED BY WAPC

EXECUTIVE SUMMARY

This Structure Plan is prepared to guide the subdivision and development of the area referred to be the City of Kwinana's Local Planning Policy No. 6 as the Casuarina Central Precinct. This area includes the part of the Casuarina Urban Cell which extends east of the Kwinana Freeway to the western edge of the Jandakot Groundwater Projection area, from the southern side of Orton Road to the northern boundary of the lots located at the northern end of Lugg Place. Hereafter referred to as the 'structure plan area', 'subject site' or 'site'.

The subject site is located:

- within the municipality of the City of Kwinana; and
- approximately 38 km south of the Perth CBD.

The subject site's natural features include existing stands of vegetation; wetlands; and an undulating topography.

The Structure Plan has been prepared to accommodate development of the land for:

- 'Residential' purposes comprising a mix of medium residential densities;
- Public Open Space (POS) and drainage;
- 'Service Commercial';
- a Primary School; and
- the Movement Networks consisting of a Neighbourhood Connector, Major Access streets and Access streets.

The design principles in which the Structure Plan is based, include:

- a careful response to the site's natural features requiring protection including wetlands and associated buffers, landform and vegetation;
- appropriately responding to other existing features on and surrounding the site including the power easement, mushroom farm and existing road network;
- provision of a robust Public Open Space design;
- incorporating the requirement for a Primary School and co-located Public Open Space;
- provisions of an interconnected pedestrian network, integrating with the open space network, Primary School and future district open space; and
- orientating local road directions for efficient earthworks and drainage flows.

STRUCTURE PLAN SUMMARY

ITEM	DATA	STRUCTURE PLAN REF (SECTION NO.)
Total area covered by the Structure Plan	96.1223 hectares	1.2
Area of each proposed Land Use Zones • Residential • Service Commercial Reserves • Road Reserve • Public Purpose – Primary School • Public Open Space	 49.7197 hectares 7.1018 hectares 7.7305 hectares 3.5000 hectares 28.0703 hectares* *includes drainage	3.3, & 3.4
Estimated Lot and Dwelling Yield	968 lots or dwellings	3.3 Development Concept – Figure 13
Estimated Residential Density • Dwellings per site hectare (as per Liveable Neighbourhoods)	26 dwellings per site hectare	3.3
Estimated Population	2,710 people @ 2.8 people/household in single residential dwellings	3.3
Amount of Public Open Space: • Amount of credited Public Open Space: (As per Liveable Neighbourhoods) • Amount of restricted Public Open Space: (As per Liveable Neighbourhoods)	12.5712 hectares / 18.14% Creditable POS 5.9391 (1.3861 hectares creditable)	3.4 Table 9: POS Schedule / Figure 17
Composition of Public Open Space: • Neighbourhood • Local Parks	10.6202 hectares (86%)* 1.7254 hectares (14%)* *includes drainage	3.4 Table 9: POS Schedule / Figure 17

TABLE OF CONTENTS

CASUARINA CENTRAL PRECINCT 1
1 STRUCTURE PLAN AREA 2
2 OPERATION 2
3 STAGING 2
4 SUBDIVISION AND DEVELOPMENT REQUIREMENTS 2
5 LOCAL DEVELOPMENT PLAN 4
6 OTHER REQUIREMENTS 4
PART TWO EXPLANATORY INFORMATION 6
1 PLANNING BACKGROUND 7
1.1 INTRODUCTION AND PURPOSE 7
1.2 LAND DESCRIPTION 8
1.3 PLANNING FRAMEWORK 10
1.4 PLANNING STRATEGIES 16
1.5 RELEVANT PLANNING POLICIES 19
2 SITE CONDITIONS AND CONSTRAINTS 27
2.1 ENVIRONMENTAL CONSIDERATIONS 27
2.2 BUSHFIRE HAZARD 30
2.3 HERITAGE 31
2.4 MOVEMENT NETWORKS 31
2.5 SERVICE INFRASTRUCTURE 32
2.6 SITE CONTEXT 34
3 STRUCTURE PLAN 36
3.1 DESIGN PRINCIPLES 37
3.2 DEVELOPMENT CONCEPT PLAN 41
3.3 LAND USE 44
3.4 OPEN SPACE 49
3.5 WATER MANAGEMENT 56
3.6 MOVEMENT NETWORK 57
3.7 TRANSPORTATION NOISE ASSESSMENT 62
4 IMPLEMENTATION AND STAGING 63
4.1 STRUCTURE PLAN 63
4.2 MANAGEMENT PLANS 63
4.3 STAGING 63
APPENDIX A PRE-LODGEMENT CONSULTATION 64
APPENDIX B ENVIRONMENTAL ASSESSMENT REPORT 65
APPENDIX C BUSHFIRE MANAGEMENT PLAN 66
APPENDIX D TRANSPORTATION NOISE ASSESSMENT 67
APPENDIX E ENGINEERING SERVICES REPORT 68
APPENDIX F LOCAL WATER MANAGEMENT STRATEGY 69
APPENDIX G TRAFFIC ASSESSMENT 70
APPENDIX H RETAIL NEEDS ASSESSMENT 71
APPENDIX I LANDSCAPE STRATEGY 72
APPENDIX J LOCAL LANDSCAPE FEATURE AND TREE RETENTION STRATEGY 73

PART ONE
IMPLEMENTATION

1 STRUCTURE PLAN AREA

This Structure Plan applies to the land contained within the inner edge of the line denoting the Structure Plan boundary on the Structure Plan Map.

2 OPERATION

The Structure Plan commences operation on the date it is approved by the Western Australian Planning Commission (WAPC).

3 STAGING

Subdivision will be undertaken in 40-60 lot stages depending on market conditions at the time. Subdivision will extend from the north via Orton Road to the south through the central portions of the structure plan area, then extending east and west.

4 SUBDIVISION AND DEVELOPMENT REQUIREMENTS

a) The Structure Plan Map defines the broad residential density ranges that apply to different areas within the Structure Plan. Lot specific residential densities, generally in accordance with the defined residential density ranges, are to be assigned in accordance with a Residential Density Code Plan determined by the WAPC.

b) A Residential Density Code Plan is to be submitted at the time of application for subdivision approval to the WAPC and shall indicate the residential density code applicable to each lot within the proposed subdivision. The Residential Density Code Plan shall be generally consistent with the residential density ranges identified in the Structure Plan.

c) The Residential Density Code Plan is to include a summary of the dwelling yield of the proposed subdivision.

d) Determination of the Residential Density Code Plan shall be undertaken at the time of determination of a subdivision application by the WAPC. An approved Residential Density Code Plan shall then form part of the Structure Plan and be used for the determination of future development applications and building permit applications.

e) Variations to the Residential Density Code Plan will require the approval of the WAPC. A revised Residential Density Code Plan shall generally be consistent with the approved plan of subdivision issued by the WAPC. The revised Residential Density Code Plan shall be consistent with residential density ranges identified on the Structure Plan Map.

f) A revised Residential Density Code Plan, consistent with clause (e) above will replace, wholly or partially, the previously approved Residential Density Code Plan, and shall form part of the Structure Plan as outlined in clause (d) above.

g) A Residential Density Code Plan is not required if the WAPC considers that subdivision is for one or more of the following:

   i. the amalgamation of lots;

   ii. consideration of land for 'super lot' purposes to facilitate land assembly for future development;

iii. the purposes of facilitating the provision of access, services or infrastructure; or

iv. land which by virtue of its zoning or reservation under the Structure Plan cannot be developed for residential purposes.

h) The residential density code ranges are:

i. R10 – R20

ii. R25 – R40

iii. R40 – R60

i) Where density code ranges are depicted on the Structure Plan Map, the designation of R-Codes shall be in accordance with the criteria outlined below:

i. R10 – R20 provides for larger lot types along the eastern edge of the subject site to provide an appropriate interface with the adjacent Rural – Water Projection zone. Accommodates single detached dwellings.

ii. R25 – R40 provides the main density code range to accommodate a variety of traditional and smaller sized lots with front access. Accommodate appropriate subdivision design and a range of opportunities for future homeowners by incorporating residential densities which offer flexibility for traditional homes which are likely to be built by project home builders.

iii. R40 – R60 provides for a variety of lot types to achieve single, grouped and multiple dwellings with front or rear access adjacent to areas of amenity including POS and the Primary School. Detached, semi-detached and attached housing (terrace) can be provided for within this density code range.

j) Land use permissibility within the Structure Plan area shall accord with the corresponding land use classification in the City of Kwinana Local Planning Scheme No. 2 (as amended).

k) Public Open Space is to be provided in accordance with the Structure Plan Map.

l) This Structure Plan is supported by a Bushfire Management Plan (BMP), Bushfire Management Plan – Casuarina Central Precinct (December 2018) prepared by Eco Logical Australia. Any land falling within 100 metres of a bushfire hazard identified in the BMP is designated as a Bushfire Prone Area for the purpose of the Building Code of Australia.

m) This Structure Plan is supported by a Transportation Noise Assessment, Transportation Noise Assessment – Casuarina Central Precinct (December 2018) prepared by Lloyd George Acoustics. Any land with a noise level in excess of 55dB is subject to the Transportation Noise Assessment.

n) Notifications on Title

The Council shall recommend to the WAPC that a condition be imposed on the grant of subdivision approval for a notification to be placed on the Certificate of Title to suitably respond to the following:

i. That a lot with a Bushfire Attack Level (BAL) rating of 12.5 or higher is subject to a *Bushfire Management Plan*.

ii. That a lot with a noise level of 55dB or higher is subject the *Transportation Noise Assessment*.

o) Management plans

The Council shall recommend to the WAPC that a condition be imposed on the grant of subdivision approval to respond to the following as identified by the Structure Plan:

i. Landscape Plan for POS areas.

ii. Wetland management plan providing for the protection of the conservation category and resource enhancement wetlands.

iii. Urban Water Management Plan/s.

5 LOCAL DEVELOPMENT PLAN

Local Development Plan(s) are to be prepared for lots with one or more of the following attributes:

a) smaller than 260m²;

b) rear vehicle access;

c) with frontages of less than 10.5 metres; and

d) abutting POS.

6 OTHER REQUIREMENTS

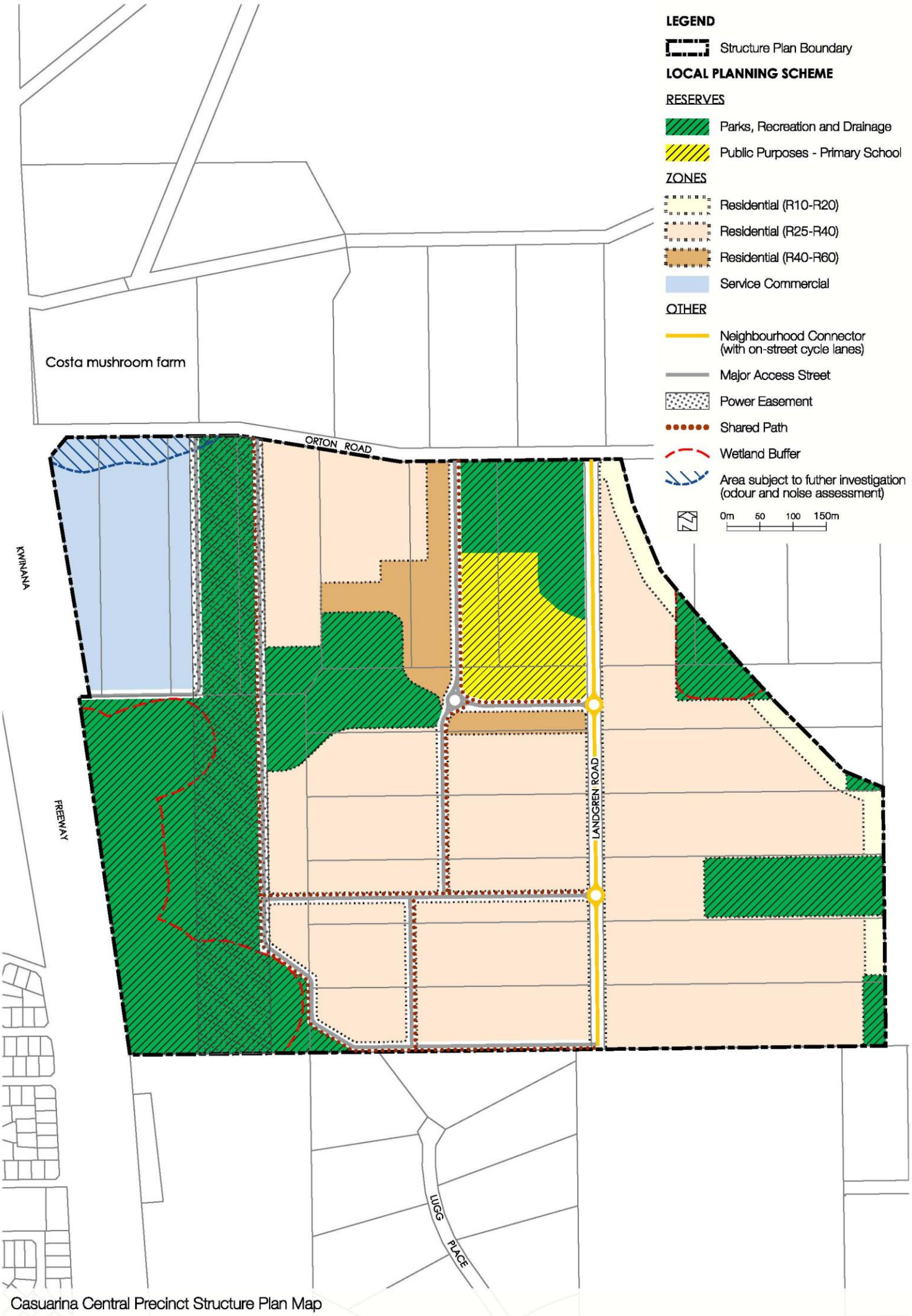
a) an amendment to the City of Kwinana Town Planning Scheme No. 2 will be required to include an additional infrastructure item in the Development Contribution Plan No. 3, comprising the upgrade and extension of Landgren Road to connect into Thomas Road. The amendment can run in parallel to the assessment and implementation of Structure Plan.

b) Costa Mushroom Farm

i) Prior to subdivision and development of sensitive land uses in the area depicted on the Structure Plan map 'subject to further investigation (odour and noise)', validation of the modelling included in the following reports is required, in relation to the Costa Mushroom Farm:

1) Environmental Alliances Pty Ltd (Environmental Alliances) 2015, (Costa) Mushroom Exchange, Casuarina – Revision of Predicted Odour Levels Based on Sampling of Sterilisation Building Emissions; and

2) Herring Storer Acoustics 2015, Mushroom Exchange, 45 Orton Road, Casuarina – Noise Assessment.



Casuarina Central Precinct Structure Plan Map

PART TWO
EXPLANATORY INFORMATION

1 PLANNING BACKGROUND

1.1 INTRODUCTION AND PURPOSE

This Structure Plan has been prepared on behalf of CDN No. 1 Pty Ltd, a development company managed by LWP Property Group (LWP), for Casuarina Central Precinct area, which includes the part of the Casuarina Urban Cell which extends east of the Kwinana Freeway to the western edge of the Jandakot Groundwater Projection area, from the southern side of Orton Road to the northern boundary of the lots located at the northern end of Lugg Place. CDN No. 1 Pty Ltd is a majority landowner with the structure plan area and has taken the responsibility of preparing this Structure Plan over the entire Casuarina Central Precinct to meet the requirements of the City of Kwinana Local Planning Policy No. 6 – Guidelines for Structure Planning in the Casuarina Cell.

The Structure Plan will accommodate the future subdivision and development of the site for predominantly residential purposes, service commercial purposes, a Primary School, Public Open Space (POS) and the movement network.

The Structure Plan has been prepared to address the requirements of the City of Kwinana Local Planning Scheme No. 2 and the Planning and Development (Local Planning Schemes) Regulations 2015. The Structure Plan and report have been prepared in accordance with the WAPC's Structure Plan Framework August 2015.

The Structure Plan will guide future subdivision and development of the site with the determining authorities having due regard for it in the assessment of development and subdivision applications.

The following information and technical documentation have been prepared in support of this town planning report:

Consultation Schedule (refer **Appendix A**)
Environmental Assessment Report (refer **Appendix B**)
Bushfire Management Plan (refer **Appendix C**);
Transportation Noise Assessment (**Appendix D**);
Engineering Services Report (refer **Appendix E**);
Local Water Management Plan (refer **Appendix F**);
Traffic Assessment (**Appendix G**)
Retail Needs Assessment (**Appendix H**);
Landscape Strategy (Refer **Appendix I**); and
Local Landscape Feature and Tree Retention Strategy (**Appendix J**).

The Project Team responsible for preparing the information contained within this report, (in consultation with the City of Kwinana, DPLH, and relevant Service Authorities) include those detailed in **Table 1.**

TABLE 1: PROJECT TEAM AND ROLE

PROJECT ROLE	CONSULTANT
Town Planning and Urban Design	Taylor Burrell Barnett
Civil Engineering	Cossill & Webley
Environment	Strategen and 360 Environmental
Hydrology	Hyd2o
Bushfire Hazard Assessment and Management	Eco Logical Australia
Landscape	Emerge
Traffic / Transport Assessment	Riley Consulting
Transportation Noise Assessment	Lloyd George Associates

1.2 LAND DESCRIPTION

LOCATION

The subject site is located within the suburb of Casuarina, situated within the City of Kwinana **(refer Figure 2)**.

The subject site is located:

- south of Orton Road, a mushroom farm, and land subject to the draft 'Casuarina North Structure Plan' currently under consideration;
- east of the Kwinana Freeway;
- west of Bush Forever Site No. 273 and a Resource Enhancement Wetland;
- north of existing rural residential lots contained within the 'Casuarina South Precinct', which is subject to future structure planning;
- approximately 7km east of the Kwinana town centre; and
- approximately 38km south of the Perth CBD.

Land surrounding the subject site generally consists of developed and vacant rural and rural residential land, east of the Kwinana Freeway.

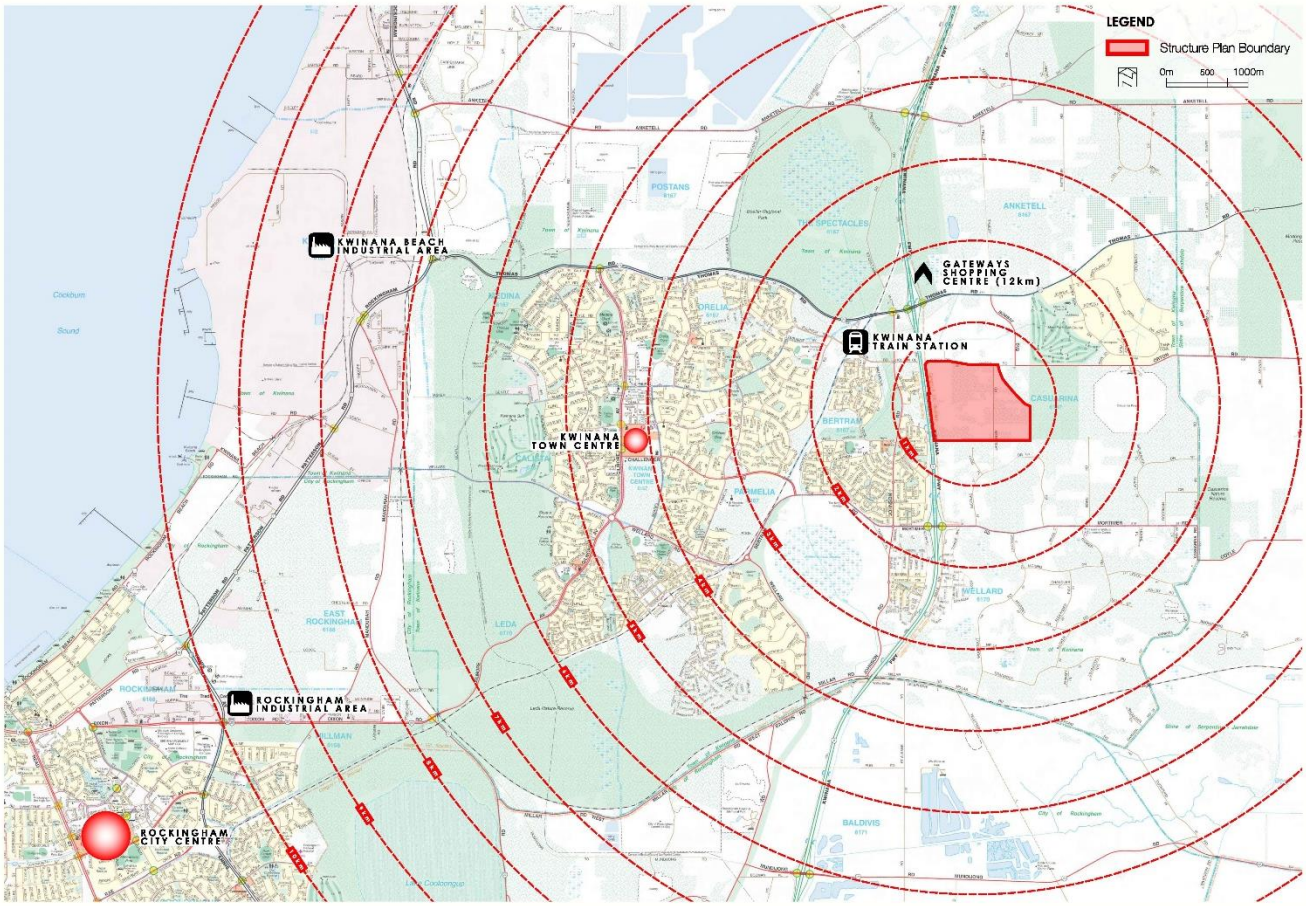


Figure 2 Location Plan

AREA AND LAND USE

The subject site consists of 22 lots, and is approximately 96.1223 hectares (refer **Table 2** for lot areas). The site has several exiting dwellings located throughout it. A Western Power transmission line protected by an easement (power easement) is located within the western portion of the site (refer **Figure 3**).

LEGAL DESCRIPTION AND OWNERSHIP

The property details and ownership of the subject site are detailed in **Table 2.**

TABLE 2: PROPERTY DETAILS

LOT NO.	VOLUME	FOLIO	DEPOSITED PLAN	OWNER	AREA
Lot 44 Landgren Road	1706	221	8390	CDN No. 1 Pty Ltd^	4.0855
Lot 43 Landgren Road	1308	447	8390	CDN No. 1 Pty Ltd^	4.1140
Lot 42 Landgren Road	1308	446	8390	CDN No. 1 Pty Ltd^	4.1127
Lot 41 Landgren Road	1823	778	8390	CDN No. 1 Pty Ltd^	4.1113
Lot 39 Landgren Road	1308	443	8390	CDN No. 1 Pty Ltd	4.1457
Lot 34 Landgren Road (Part Lot)	1932	827	8390	CDN No. 1 Pty Ltd	4.1084
Lot 37 Landgren Road	8390	1308	441	CDN No. 1 Pty Ltd	4.1086
Lot 47 Orton Road	1369	146	8390	CDN No. 1 Pty Ltd	4.3667
Lot 40 Landgren Road	1308	444	8390	Abbott, David Antony Abbott, Debbie*	4.1097
Lot 1 Orton Road	2597	695	45805	Commissioner of Main Roads	1.8559
Lot 50 Orton Road	1391	271	8390	Sharp, David Sharp, Wayne	4.1045
Lot 49 Orton Road	1873	818	8390	Scilio, Antoinette Marie Scilio, Alexandro John	4.1181
Lot 48 Orton Road	1375	289	8390	Wong, Swee ChunWong, Kook Moon	4.6763
Lot 46 Orton Road	1323	709	8390	Williams, Water Desmond	4.1451
Lot 45 Orton Road	1346	120	8390	Royale Australian Golf Club Pty Ltd	4.1430
Lot 32 Orton Road (Part Lot)	1411	394	8390	Harvey, Maureen Patricia Harvey, Douglas William	4.4940
Lot 31 Orton Road (Part Lot)	171	65A	8390	Muscara, Nicola	4.4016
Lot 9000 Orton Road	2608	892	48382	Megajet Enterprises Pty Ltd	16.7116
Lot 33 Landgren Road (Part Lot)	1308	437	8390	Pearson, Steven Arnold	4.1084
Lot 35 Landgren Road	1308	439	8390	Byford West Pty Ltd	4.1084
Lot 36 Landgren Road	1308	440	8390	Grubisin, Mary Grubisin, Steven Vinko	4.1085
Lot 38 Landgren Road	1308	442	8390	Harvey, Wayne Douglas Parker, Lisa Maree	4.1259

*Lot contracted by CDN No.1 Pty Ltd

^ Subject to settlement.

1.3 PLANNING FRAMEWORK

ZONING AND RESERVATIONS

METROPOLITAN REGION SCHEME

The subject site is zoned 'Urban' under the Metropolitan Region Scheme (MRS) (refer **Figure 4**). Land abutting the subject site to the north and south is also zoned 'Urban'. The Kwinana Freeway, to the west of the subject site is reserved as a 'Primary Regional Road'. The site is abutting a 'Parks and Recreation' reserve to the east, a portion of which is located within Bush Forever Site no. 273. The land to the north is zoned 'Rural – Water Protection' and is part of the Groundwater Protection – Jandakot Groundwater Mound.

CITY OF KWINANA LOCAL PLANNING SCHEME NO. 2

The subject site is zoned 'Development' under the City of Kwinana Town Planning Scheme No. 2 (TPS 2) (refer **Figure 5**), which corresponds with the 'Urban' zone under the MRS. The adjacent land to the north-east is zoned 'Rural Water Resource' under TPS 2, corresponding with the 'Rural – Water Protection' zone under the MRS.

The 'Development' zone requires future subdivision and development of the land to be coordinated by a Structure Plan, in accordance with Clause 6.15.3 of TPS 2.

The subject site is contained within Development Contribution Areas 3 and 10 as depicted on the TPS 2 Map.

CITY OF KWINANA DEVELOPER CONTRIBUTIONS

The subject site is included in two Development Contribution Plan areas (DCPs).

Development Contribution Area 3 (DCA 3) addresses Traditional Infrastructure in the Casuarina Precinct. DCA 3 was included in Amendment 100A to the TPS 2, which was gazetted on 3 October 2017. The current rate to be paid by subdividers is based on Gross Subdivisible Area for some items and Development Area for others.

The infrastructure items included in the DCA 3 include:

- Roads – Mortimer Road and Thomas Road upgrades.
- Drainage – Peel Sub Drains upgrades.
- Public Open Space – in accordance with the Structure Plan or Public Open Space Strategy.
- District Sporting Ground – located within Casuarina.
- Community Facilities – land for a library located within the Wandi District Centre.

DCA 10 addresses with Community Infrastructure in the Casuarina Precinct and is included in Amendment 145 to TPS 2 which is still to be finalised. Amendment 145 was advertised for public comment in November 2015, and public submissions are currently being reviewed.

Contribution amounts and payment by the subdivider will be addresses at the subdivision stage.

Given the importance of the upgrade and extension of Landgren Road through the Casuarina North Cell (as discussed in **Section 3.7**) it is recommended that the City include the Landgren Road extension and upgrade as a DCP item.

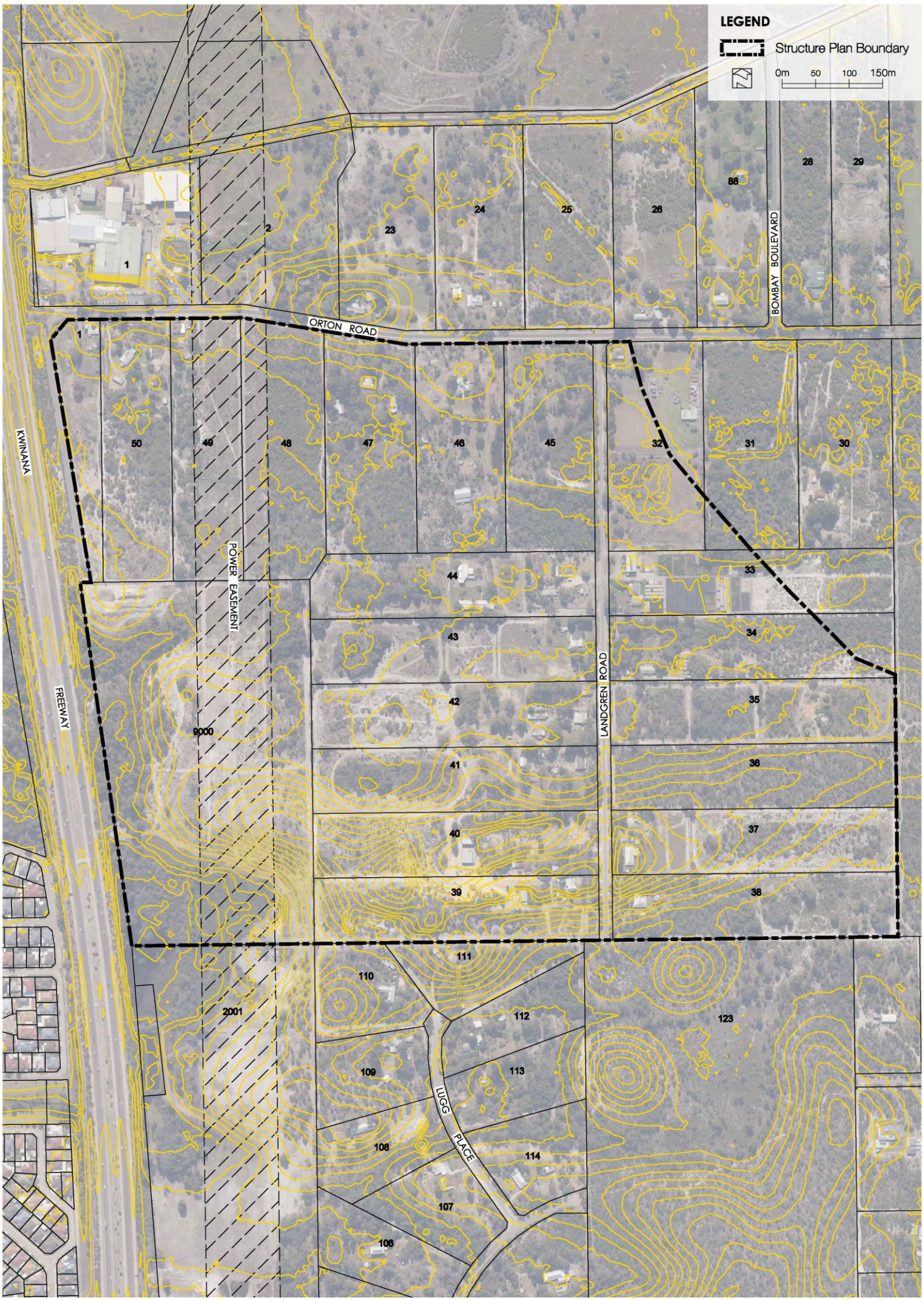


Figure 3 Subject Site

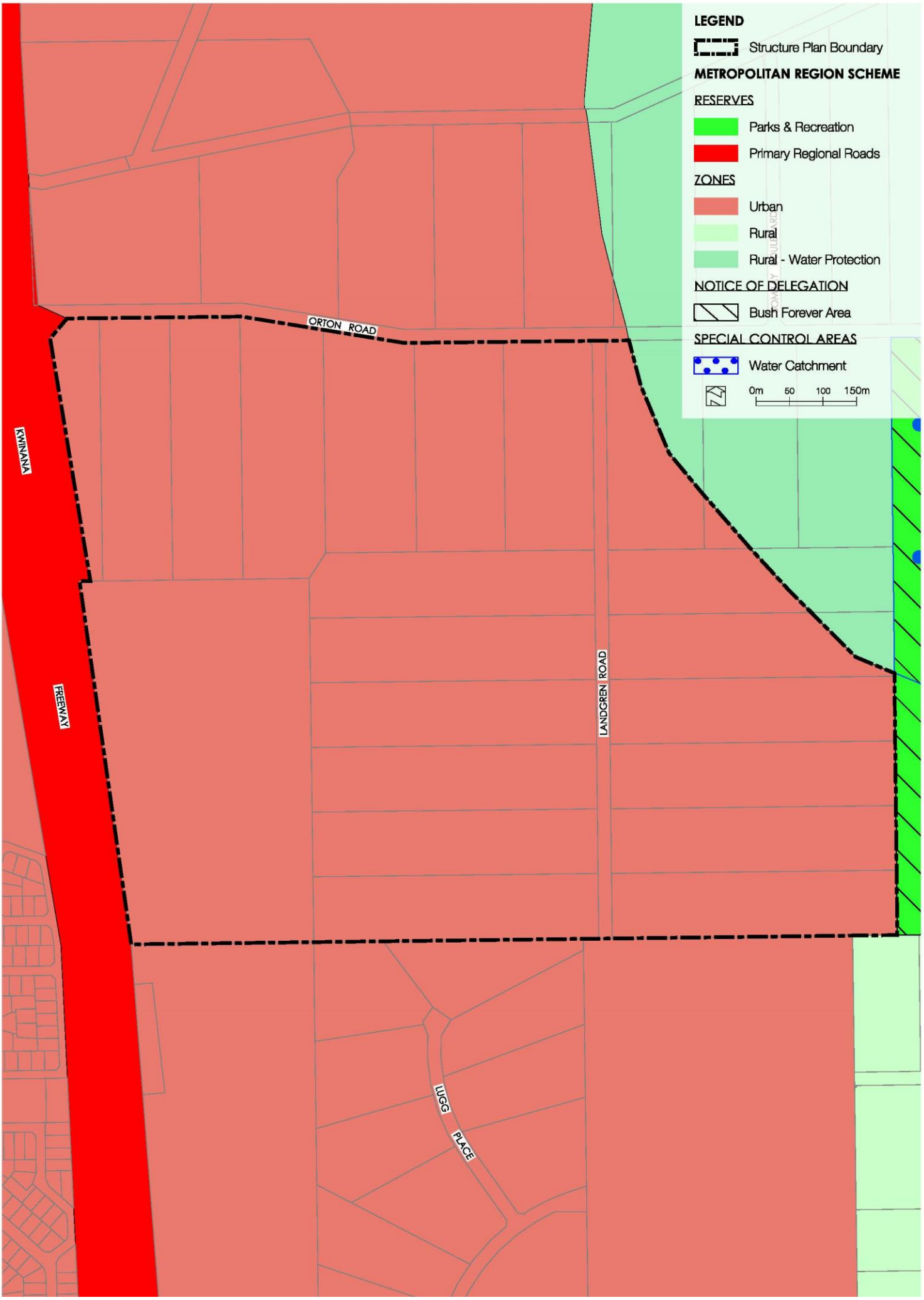


Figure 4 Metropolitan Region Scheme

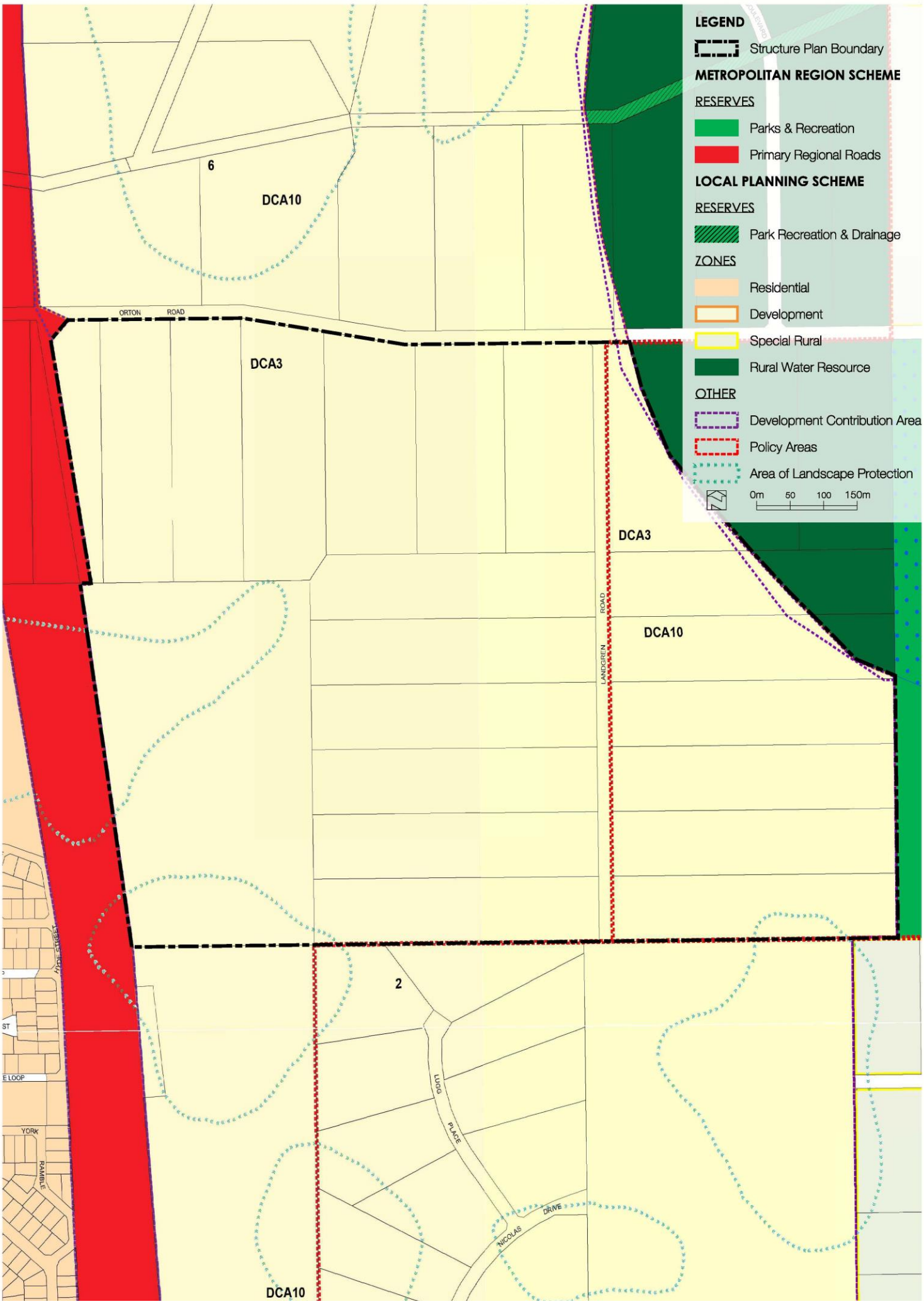


Figure 5 City of Kwinana Local Planning Scheme No. 2

PLANNING AND DEVELOPMENT (LOCAL PLANNING SCHEMES) REGULATIONS 2015

The assessment and approval of this Structure Plan will be considered under the Planning and Development (Local Planning Schemes) Regulations 2015 as detailed under Schedule 2 Part 4.

JANDAKOT DISTRICT STRUCTURE PLAN

The subject site is included within the Jandakot District Structure Plan (JDSP), which was adopted in 2007 and outlines the physical framework for the future development of the land immediately surrounding the Jandakot Underground Water Pollution Control Area, generally comprising the localities of Oakford, Mandogalup, Casuarina, Wellard, Anketell and The Spectacles.

The majority of the subject site is identified as 'Medium-Term Urban', and a 'Primary School' is identified in the northern portion of the site (refer **Figure 6**).

The JDSP also identifies an area of 'Mixed Use' and 'Home Business' adjacent to the Freeway extending south of Thomas Road to beyond Orton Road, within the subject site.

SURROUNDING LOCAL STRUCTURE PLANNING

The land to the north of the subject site between Orton Road and Thomas Road, is referred as the Casuarina North Precinct in the City of Kwinana Local Planning Policy No. 6 – Guidelines for Structure Planning in the Casuarina Cell (LPP 6). The Casuarina North Structure Plan prepared by Element was advertised for public comment in September 2018 and is currently under consideration by the WAPC. The advertised Structure Plan identifies an area of Service Commercial land in the north-eastern corner of the precinct adjacent to Thomas Road and the Kwinana Freeway, and a preliminary road layout connecting into Thomas Road and only covers approximately one third of the Casuarina North Precinct. The balance of the precinct is identified as subject to further planning; however, there is some contextual planning provided for this area within the Structure Plan documentation.

The land to the south of the subject site, referred to as the Casuarina South Precinct in LPP 6, is also zoned 'Development' in the City of Kwinana TPS 2, and is subject to the preparation and approval of a separate structure plan. Structure planning in this precinct is yet to commence.

The land north of Thomas road is covered by various existing Structure Plans including the Anketell North Structure Plan, Wandi North Structure Plan, Mandogalup East Structure Plan and Mandogalup West Structure Plan.

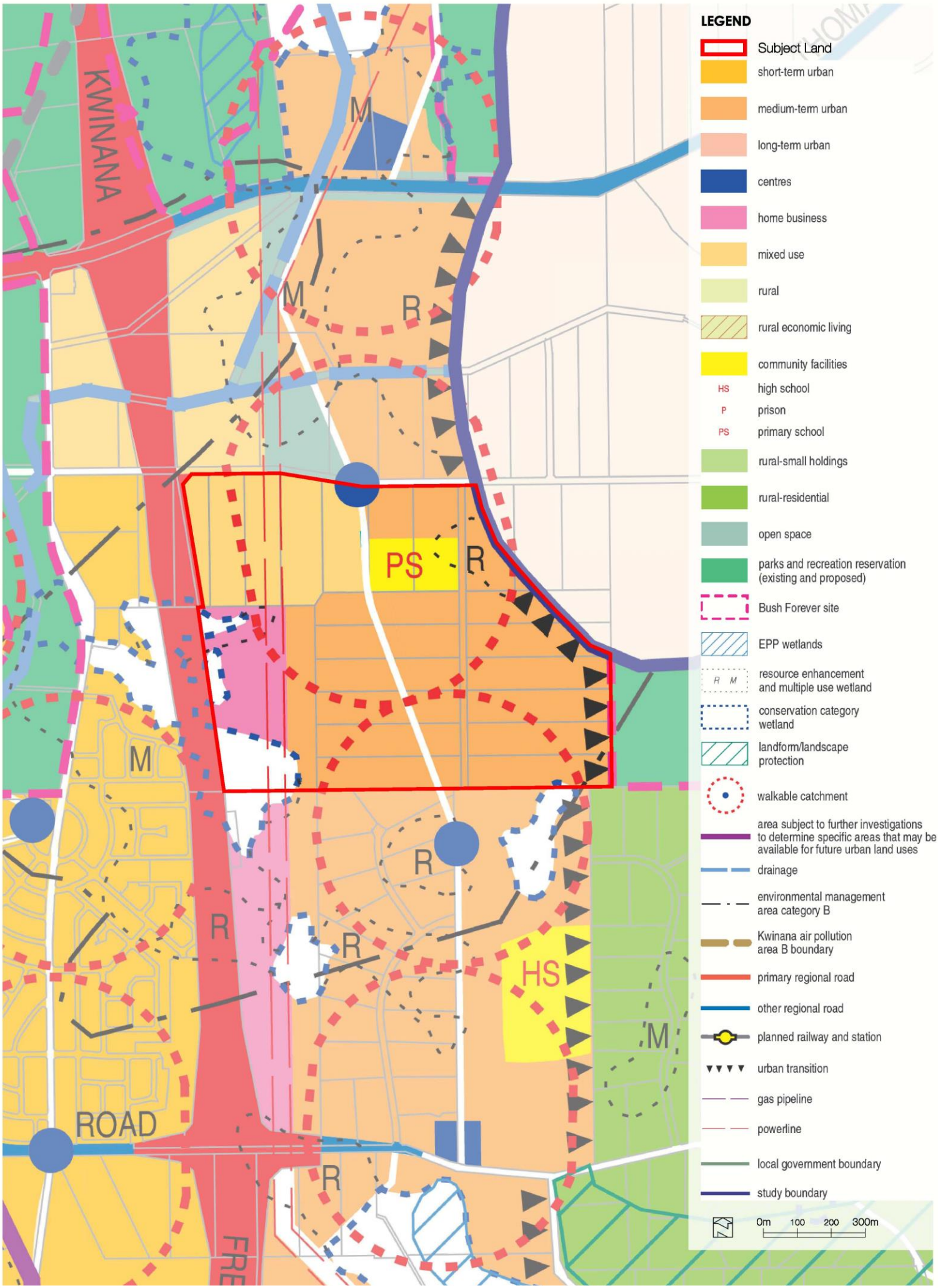


Figure 6 Jandakot District Structure Plan

1.4 PLANNING STRATEGIES

PERTH AND PEEL @ 3.5 MILLION

Perth and Peel @ 3.5 Million is a suite of documents released by the WAPC in 2018 for the Perth and Peel metropolitan regions to identify:

- where future homes and jobs should be located;
- how to protect important environmental assets;
- how to best utilise existing and proposed infrastructure; and
- appropriate areas for greater infill development and residential density.

As part of this documentation, sub-regional planning frameworks were released in March 2018 to guide future development. The subject site is included within the South Metropolitan Peel Sub-regional Planning Framework (Sub-regional Planning Framework) and is identified as Urban with a 'Short term' implementation staging timeframe (refer **Figure 7**).

The minimum urban infill dwelling targets identified for the City of Kwinana are 1,370 dwellings, to accommodate an estimated population of 3,010 by 2050. This Structure Plan will assist in achieving the infill dwelling targets for the City of Kwinana by providing appropriate residential densities given the site's context as demonstrated in this Report.

DRAFT EASTERN RESIDENTIAL INTENSIFICATION CONCEPT PLAN (ERIC)

The City released the draft Eastern Residential Intensification Concept (ERIC) plan for comment in November 2005. It remains a draft as it was never formally adopted by the WAPC. ERIC is considered by the City as an effective strategic plan, used by the City to guide the preparation and consideration of district and local structure planning, providing an additional layer of detail to the JDSP. ERIC aims to define the planning framework by which urban subdivision and development can occur in the most coordinated manner, recognising the strategic importance of the land contained within the study area, as acknowledged by the City of Kwinana.

The ERIC identifies structure planning across the subject site with land uses including Residential R20, Primary School, Local/District Recreation and Commercial Centre (refer **Figure 8**).

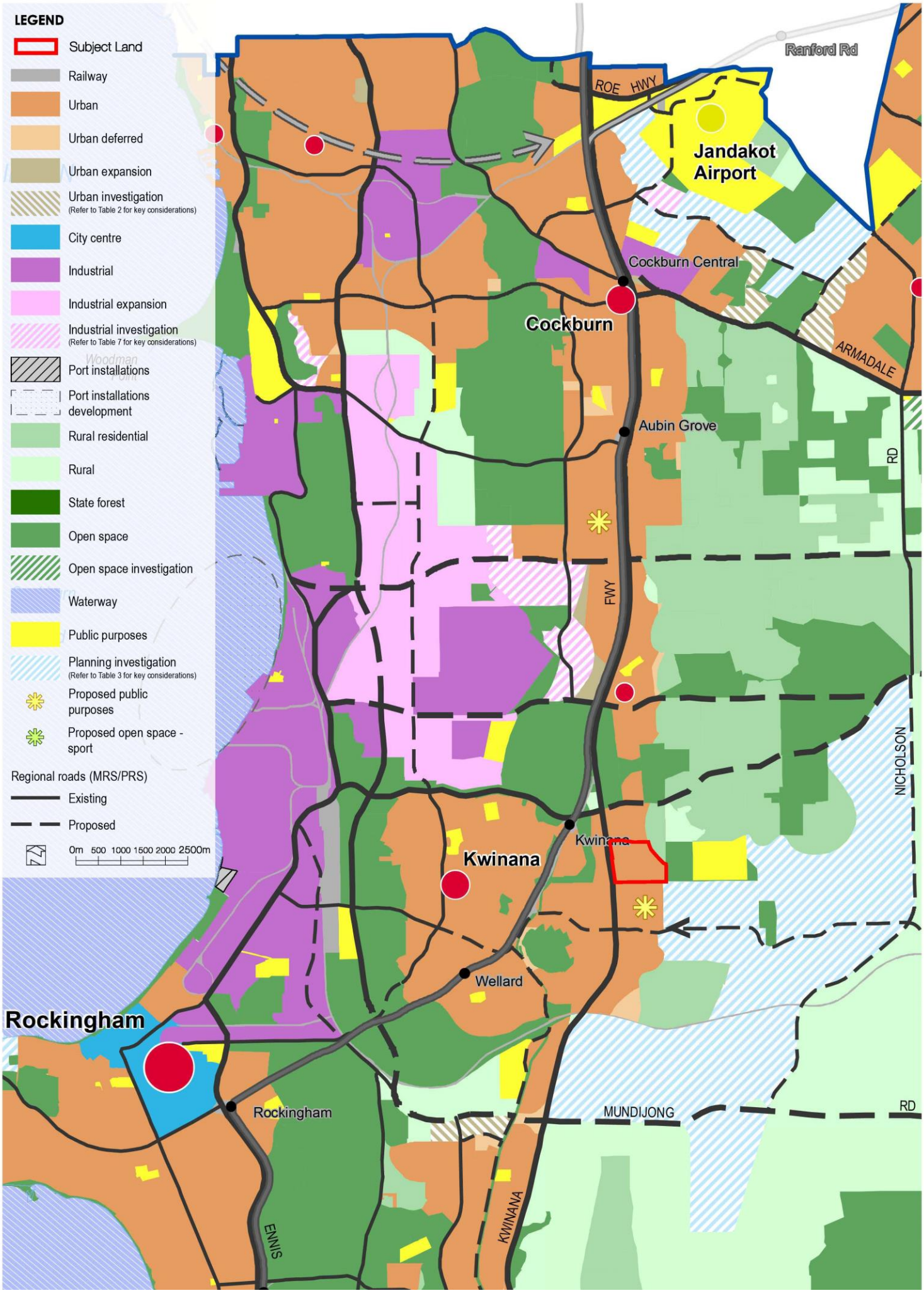


Figure 7 South Metropolitan Peel Sub-regional Planning Framework

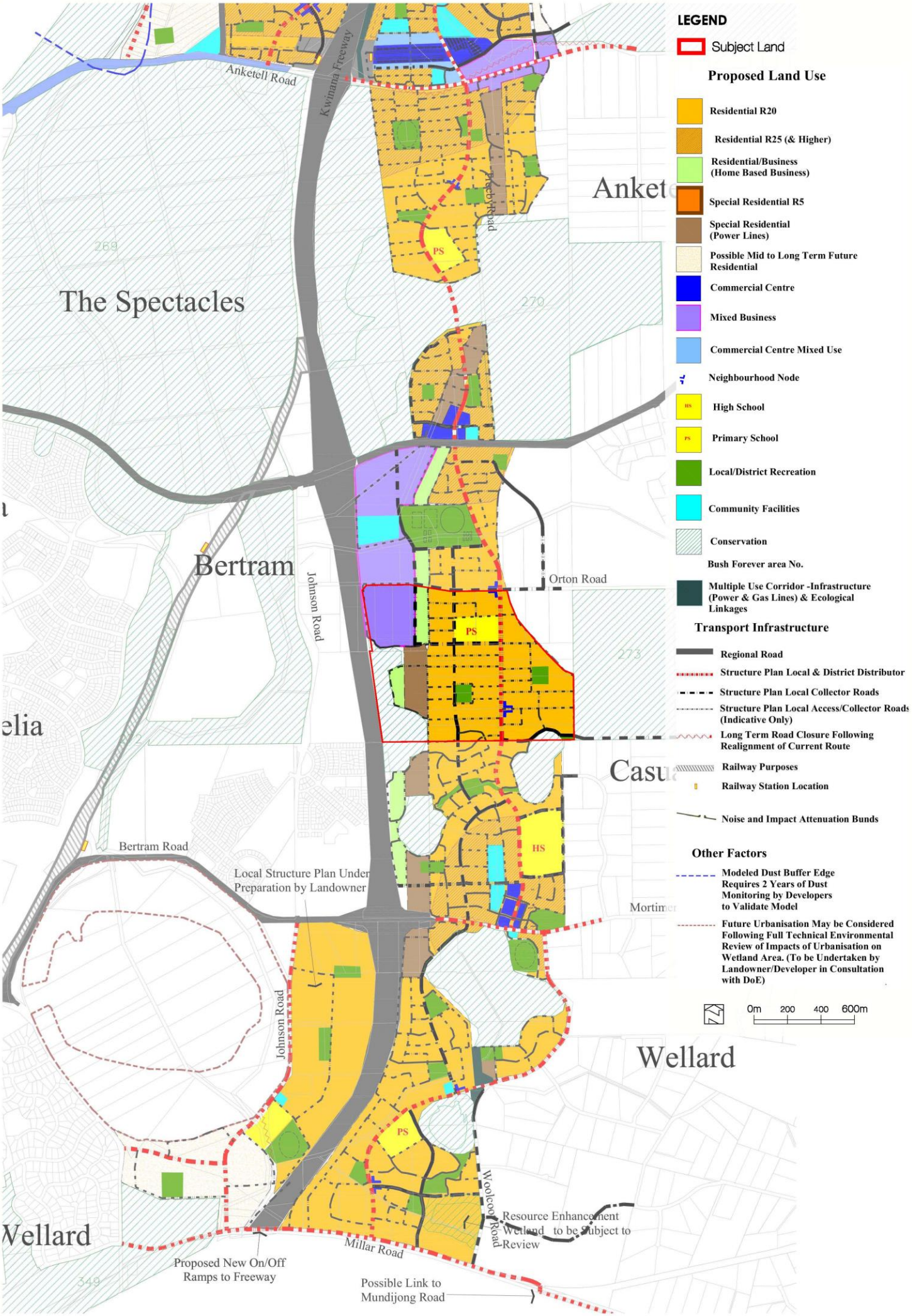


Figure 8 Eastern Residential Intensification Concept

1.5 RELEVANT PLANNING POLICIES

STATE PLANNING POLICIES

OPERATIONAL POLICY – LIVEABLE NEIGHBOURHOODS

Liveable Neighbourhoods (LN) is the WAPC's operational policy guiding the design and approval of structure plans for green field sites. The objective of LN is the delivery of new developments that provide high quality living, working and recreational environments, thereby contributing to the successful implementation of the State Planning and State Sustainability Strategies. The Structure Plan meets the aspirational requirements of LN, with a particular focus on the following key aims:

- an urban structure based on interconnected, safe and walkable neighbourhoods;
- creating a sense of community, identity and a sense of place;
- providing a variety of lot sizes and housing types to cater for the diverse housing needs of the community at a density that can support local services and public transport; and
- maximising land efficiency wherever possible.

STATE PLANNING POLICY 3.7 PLANNING IN BUSHFIRE PRONE AREAS – BUSHFIRE POLICY FRAMEWORK

State Planning Policy 3.7 Planning in Bushfire Prone Areas (SPP 3.7) forms the foundation for land use planning to address bushfire risk management in Western Australia. SPP 3.7 is used to inform and guide decision makers, referral authorities and proponents on achieving acceptable fire protection outcomes on planning proposals in bushfire prone areas.

In support of SPP 3.7 and pursuant to 'State Planning Policy 3.4 – Natural Hazards and Disasters', the Guidelines for Planning in Bushfire Prone Areas sets out a range of matters that need to be addressed at various stages of the planning process, to provide an appropriate level of protection to life and property from bushfires, and to avoid inappropriately located or designed land use, subdivision and development on land where a bushfire risk is identified.

Bushfire considerations form an integral part of the structure plan design, as outlined in **Section 2.2** of this report and the Bush Fire Hazard Assessment and Management Plan attached at **Appendix C.**

STATE PLANNING POLICY 3 URBAN GROWTH AND SETTLEMENT

State Planning Policy 3 Urban Growth and Settlement (SPP 3) establishes the broad principles and considerations which apply to planning for urban growth and settlements in Western Australia. As a result of the existing undeveloped nature of the site, SPP 3 is required to be taken into consideration as part of the structure planning process. This Structure Plan complies with the following objectives off SPP 3:

- To promote a sustainable and well-planned pattern of settlement across the State, with sufficient and suitable land to provide for a wide variety of housing, employment, recreation facilities and open space.
- To build on existing communities with established local and regional economies, concentrate investment in the improvement of services and infrastructure and enhance the quality of life in those communities.
- To manage the growth and development of urban areas in response to the social and economic needs of the community and in recognition of relevant climatic, environmental, heritage and community values and constraints.

- To promote the development of a sustainable and liveable neighbourhood form which reduces energy, water and travel demand whilst ensuring safe and convenient access to employment and services by all modes, provides choice and affordability of housing and creates an identifiable sense of place for each community.
- To coordinate new development with the efficient, economic and timely provision of infrastructure and services.

STATE PLANNING POLICY 5.4 – ROAD AND RAIL TRANSPORT NOISE AND FREIGHT CONSIDERATIONS IN LAND USE PLANNING

The WAPC's State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning (SPP 5.4) aims to promote a system in which sustainable land use and transport are mutually compatible. The policy and associated guidelines apply to proposals for new noise-sensitive developments and is applicable given the proximity of the site to the Kwinana Freeway.

A Transportation Noise Assessment has been undertaken to address the requirements of SPP 5.4 (**Appendix D**) and is discussed in **Section 3.8**.

LOCAL PLANNING POLICIES

LOCAL PLANNING POLICY NO. 1 LANDSCAPE FEATURE AND TREE RETENTION

The City of Kwinana's Local Planning Policy No. 1 (LPP 1) objectives are to ensure that an appropriate level of information concerning significant trees and landscape features is provided at each stage of the planning framework, and to ensure that retention of significant trees and landscape features are optimised through the strategic and statutory planning framework to retain the character of the area.

LPP 1 requires a Local Landscape Feature and Tree Retention Strategy to be submitted to the City of Kwinana at the Local Structure Planning stage. An initial assessment of the significant trees and landscape features on the subject site has been undertaken, which has informed the Landscape Feature and Tree Retention Strategy included in **Appendix J.** As per the requirements of LPP 1, the Local Landscape Feature and Tree Retention Strategy comprises the following plans:

1. Existing Landscape Features on Site
2. Landscape Features to be Retained
3. Existing Significant Trees on Site
4. Significant Trees Proposed to be Retained and Removed

The Strategy also includes the Tree Survey Data included in a spreadsheet which identifies the location, species and size of the significant trees on site.

The Significant Trees Proposed to be Retained and Removed Plan identifies the protection methods and ongoing maintenance measures for trees proposed to be retained, as follows:

- All trees identified for retention at the detailed subdivision and engineering design stage should be clearly marked and a tree protection zone (TPZ) prepared prior to the commencement of subdivision works.
- Construction management plans should be prepared in compliance with the tree protection plan.
- Protective fencing should be erected around tree protection zones for trees proposed to be retained.
- No building materials are to be stored or disposed of within the tree protection zone.
- Placement of fill should not be stored or built up around the trunk of retained trees.
- Preparation of chemicals, refuelling and washing down and cleaning equipment should not occur within tree protection zones.

- Use of vehicles / machinery including parking should be prohibited within the tree protection zone.
- Seek arborist advice for proposed level changes or excavation within the tree protection zones.
- Where roots within the tree protection zone are exposed by excavation, temporary root protection should be installed to prevent them drying out. It is not acceptable for roots within the tree protection zone to be pruned with machinery such as backhoes or excavators.
- Pruning wounds should not be treated with dressings or paints. Seek arborist advice prior to pruning.
- Seek arborist advice for remedial works for any tree damage that has occurred during the construction process.
- Maintain mulch to a depth of 50-100mm around base of tree. Where existing landscape within the tree protection zone remains unaltered mulch may not be required.
- Monitor soil moisture levels during and post construction works.
- Supplementary watering to retained trees may be required where works are in proximity of the trees.
- All weeds should be removed by hand or controlled with appropriate use of herbicide to minimise disturbance to soil.
- Continue to monitor tree health during maintenance period.

The findings of the Landscape Feature and Tree Retention Strategy have been considered in the Development Concept Plan (**Figure 13**), and discussed in **Section 3.2.**

It is noted that the Local Landscape Feature and Tree Retention Strategy will be updated as the Development Concept Plan is refined, including an assessment of the structural health of all Significant Trees.

LOCAL PLANNING POLICY NO. 6 GUIDELINES FOR STRUCTURE PLANNING IN THE CASUARINA CELL

The City of Kwinana's *Local Planning Policy No. 6 – Guidelines for Structure Planning in the Casuarina Cell* (LPP 6) provides guidance on the district planning matters that should be considered during the preparation of Local Structure Plans within the Casuarina Urban Development zone, to ensure subdivision and / or development proceeds in an orderly and proper manner across the Casuarina Cell. The Casuarina Cell comprises three precincts; the Northern Precinct; Central Precinct in which the subject site is located; and the Southern Precinct (refer **Figure 9**).

LPP 6 identifies matters structure plans should address in the Casuarina Cell with specific requirements for each precinct. **Tables 3 and 4** identify how this Structure Plan addresses these requirements.

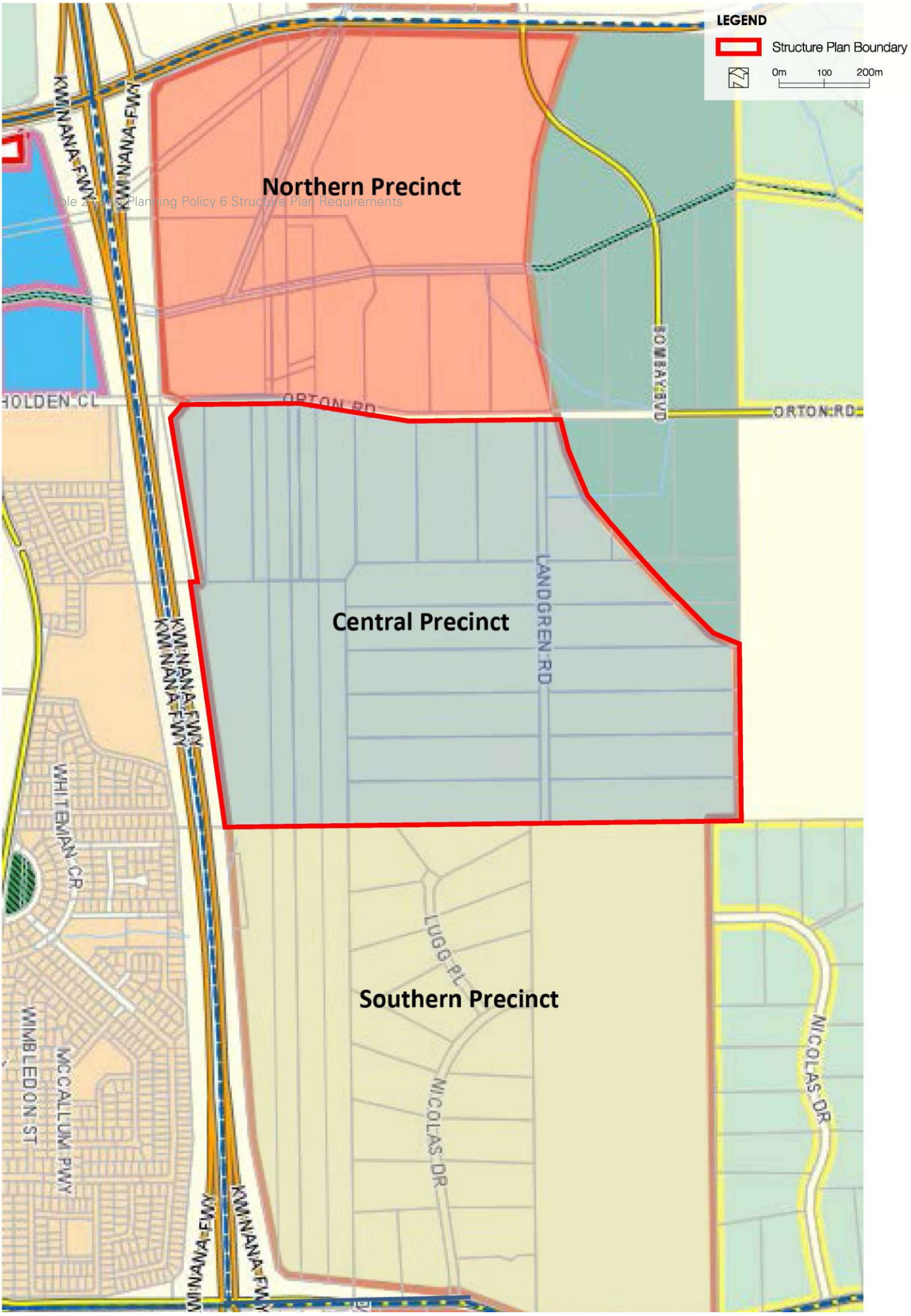


Figure 9 Local Planning Policy No. 6 – Guidelines for Structure Planning in the Casuarina Cell

TABLE 3 LOCAL PLANNING POLICY 6 STRUCTURE PLAN REQUIREMENTS - CASUARINA

CASUARINA CELL STRUCTURE PLAN - GENERAL REQUIREMENTS	ADDRESSED IN STRUCTURE PLAN
Bushfire Protection – structure plans must consider bushfire protection requirements. The City will not support structure plans where vulnerable and high-risk land uses are proposed in a manner in which the associated risk cannot be sufficiently mitigated.	A Bushfire Management Plan has been prepared to address the requirements of SPP 3.7 as discussed in **Section 2.2** and included in **Appendix C**, which will ensure compliance with this requirement.
Compatible land uses in the vicinity of the mushroom farm – evidence obtained from onsite noise studies, odour studies and modelling will be required where sensitive land uses are proposed in the vicinity of the mushroom farm on Lot 1 (45) Orton Road Casuarina to demonstrate that proposed land uses will not be exposed to unacceptable odour and noise emissions, to the satisfaction of the City.	Onsite noise and odour assessments have been undertaken as discussed in **Section 2.1** and in **Appendix B – Environmental Assessment Report.** The Structure Plan has been designed to ensure sensitive land uses will not be impacted by the mushroom farm through appropriate separation by locating the Service Commercial land use area opposite it, in the north-western corner of the site. In addition, Orton Road and the power easement will provide suitable separation to residential development.
Interface treatment between Development and Rural zones - in locations where the boundary of a Structure Plan, within the Development zone, abuts the Rural Water Resource zone, the following potential land use compatibility matters should be taken into account and appropriately mitigated: • The potential impact of future land uses within the Development zone on the visual amenity (light emissions, fencing and landscaping) and character of the Rural zone; and • The potential impact of land use activities (noise, dust and odour) within the Rural zone on future sensitive land uses within the Development zone.	The Structure Plan design has considered the interface of the subject site with the abutting Rural Water Resource zone by: • Providing a R10-R20 density code range along the eastern sections of the Structure Plan area. • Locating POS on the eastern edge of the Structure Plan boundary. • As depicted on the Development Concept Plan locating roads along eastern edge of the Structure Plan boundary. • Limiting residential land use along the edge of the Structure Plan boundary. • Balance lots created within the Rural Water Resource zone adjacent to the Structure Plan area will be of a size consistent with rural lifestyle lots, which will provide a transition to larger lots to the east. These lots, which there are three, are unlikely to be used for extensive rural uses given their site.
Local Water Management – stormwater drainage should be contained within each precinct, and peel sub-drains should be upgraded to an appropriate standard in accordance within the DCP.	A Local Water Management Strategy has been prepared as discussed in **Section 3.6** and included in **Appendix F**, which addresses these requirements.
Residential Densities should accord with Liveable Neighbourhood principles with higher densities located near the activity centre or areas of higher amenity, such as POS.	The residential densities depicted on the Structure Plan have been are in accordance with Liveable Neighbourhood principles, as discussed in **Section 3.3**.

TABLE 4 LOCAL PLANNING POLICY 6 STRUCTURE PLAN REQUIREMENTS - CASUARINA CENTRAL PRECINCT

CENTRAL CELL STRUCTURE PLAN REQUIREMENTS	ADDRESSED IN STRUCTURE PLAN	REFERENCE IN STRUCTURE PLAN REPORT
i) A Primary School site located near the intersection of Landgren Road and Orton Road.	A Primary School is located near the intersection of Landgren Road and Orton Road, as depicted on the Structure Plan Map. This location is also generally consistent with the JDSP and ERIC, which are key strategic planning documents for precinct.	**Structure Plan Map**
ii) POS co-located with the Primary School to the satisfaction of the City and the Department of Education.	POS is co-located with the Primary School, which provides sufficient room to accommodate a senior-sized oval and pavilions. Liaison with the Department of Education has been undertaken to confirm the location and design of the POS, which satisfies the Department's requirements.	**Section 3.4**
iii) A maximum of 80% of the total POS requirement in the Central Precinct shall be provided within the precinct with the shortfall (maximum 20%) being provided as a cost contribution through the DCP.	As discussed in Section 3.4 the allocation and distribution of POS on the Structure Plan has been based on several key criteria as listed below: • A senior-sized oval being co-located with the Primary School. • The protection of TEC vegetation. • The protection of Geomorphic Wetlands and the provision of their buffers. • The protection of significant trees. • Drainage. Consequently, these factors combined result in a maximum of 8% POS provision being exceeded within the Structure Plan area.	**Section 3.4**
iv) Landgren Road as the main north-south road link through the Casuarina Cell.	Landgren Road is identified as the main north-south road link through the Casuarina Cell, providing a connection to Orton Road to the north through to the Casuarina South precinct. Landgren Road will be upgraded to the requisite urban standard to include footpaths, kerbing and piped drainage. Landgren Road will operate as a Neighbourhood Connector, and is anticipated to carry less than 5,000 vehicles per day at its full capacity.	**Section 3.7**
v) The identification of a site for a Local Centre (commercial and activity centre) (800m2 retail floor space) provided at the intersection of Landgren Road and Orton Road, either in the Central Precinct or the North Precinct. – need discussion	The structure planning process though the Retail Needs Assessment prepared by Taktics4 has determined that locating a Local Centre at the intersection of Landgren and Orton Road would prove to be commercially unviable and would exceed the retail floorspace requirement in the Casuarina Urban Cell. As discussed in detail in **Section 3.3** and **Appendix H**, it is considered there is no market demand for a local centre within the Structure Plan area, and the provision of a local centre has the potential to detrimentally impact the performance of the adjacent Anketell South Neighbourhood Centre.	**Section 3.3**

vi) Commercial uses and floor areas should be consistent with the City's Local Commercial and Activity Centres Strategy (2013).	A Service Commercial land use area is located in the north-western corner of the subject site on the western side of the powerline easement, consistent with the City's Local Commercial and Activity Centres Strategy, as well as other key strategic planning documents including the JDSP and ERIC. As discussed in **Section 3.3** and **Appendix H**, the extent of the commercial area may need to be reduced at an appropriate time in the future to respond the poor accessibility, and the over provision of commercial / mixed business areas within proximity to the subject site.	**Section 3.3**
vii) As part of the submittal of a structure plan, the applicant shall consider and address the key land uses proposed in the Jandakot Structure Plan and Eastern Residential Intensification Concept for this Precinct area.	The land use distribution and allocation depicted on the Structure Plan is consistent with the land uses identified on the JDSP and ERIC as referenced throughout this report.	**Structure Plan Map**

LOCAL PLANNING POLICY PLANNING FOR BUSHFIRE PROTECTION GUIDELINES

The objective of Local Planning Policy Planning for Bushfire Protection Guidelines, is to provide for an appropriate level of protection to life and property from bush fires and avoid inappropriately located or designed land uses, subdivision and development on land where a bush fire risk is identified.

The Policy states that the City of Kwinana adopts the WAPC's Planning for Bush Fire Protection Guidelines as a Local Planning Policy. The WAPC's SPP 3.7 and Guidelines have been discussed in **Section 1.5**, and addressed in the Bushfire Management Plan in **Appendix C.**

LOCAL PLANNING POLICY PUBLIC OPEN SPACE

The City of Kwinana's Local Planning Policy on Public Open Space requires structure plans to identify areas of regional and district open space, in accordance with the City of Kwinana's Community Infrastructure Plan, and include notional locations of local open space areas in addition to other land use elements.

The Policy sets out location requirements for where POS shall be provided, and landform requirements for the design of the POS. The Policy also includes provisions regarding POS credits for drainage facilities and wetlands. A POS plan and POS calculation have been prepared to address the requirements of this Policy, included in **Section 3.4.**

LOCAL PLANNING POLICY NO.2 STREETSCAPES

The City of Kwinana's Local Planning Policy No.2 Streetscapes (LPP 2) objectives are to enhance the character of local streets through the delivery of an urban street canopy; and encourage attractive streetscapes and enhance neighbourhood amenity. LPP 2 requires structure plans to include a Landscape Masterplan, to generally include:

- Indicative areas of irrigated and dry garden bed and turf proposed to be handed over to the City.
- Indicate number and locations of bores.
- Indicative proposed planning palettes.
- Indicative number, location and species of all proposed trees.
- Indicative existing trees to be retained.
- Indicative locations of footpaths and service alignments and setbacks between street tree planting locations and footpaths/services.

A Landscape Strategy is included in **Appendix I,** which addresses the requirements of LPP 2, noting that additional detail will be provided at the subdivision stage.

LOCAL PLANNING POLICY NO. 7 UNIFORM FENCING

Local Planning Policy No. 7 Uniform Fencing (LPP 7), recognises the importance for appropriately managed, uniform fencing to provide for good quality visual and aesthetic outcomes where it adjoins the public domain including roads and areas of Public Open Space.

The policy requirements and criteria will be addressed as a condition of subdivision / development requiring the construction of uniform fencing in key areas.

LOCAL PLANNING POLICY NO. 8 DESIGNING OUT CRIME

Local Planning Policy No. 8 Design Out Crime (LPP 8) sets out design guidelines to reduce the likelihood of crime and anti-social behaviour in the City of Kwinana. The objectives of LPP 8 are to encourage urban development within the City to incorporate 'designing out crime principles'; provide guidance in relation to built form outcomes that support in actual and perceived crime and anti-social behaviour; and guidance on design and assessment of planning proposals.

The principles of LPP 8 for designing out crime have been addressed in the Structure Plan map and Concept Plan (**Figure 13**), in the type and location of land uses, the local movement network, and through the location of POS, which have been designed to encourage natural surveillance and provide clear sight lines to public realm areas from adjacent buildings. Additional principles have been applied, as demonstrated in the Landscape Strategy in **Appendix I,** including effective lighting of public places, and appropriate landscaping design.

2 SITE CONDITIONS AND CONSTRAINTS

2.1 ENVIRONMENTAL CONSIDERATIONS

An Environment Assessment Report has been prepared by Strategen Environmental to support the Structure Plan (refer **Appendix B**).

The assessment included analysis of previous flora and fauna surveys undertaken by 360 Environmental on the site, as well as a target spring flora survey and follow up fauna assessment to confirm aspects of the flora and fauna. Due to limited site access the target spring flora survey was undertaken over CDN landholdings only.

Due to the presence of Matters of National Environmental Significance (MNES) within the subject site, a referral under the requirements of EPBC Act will be undertaken.

ENVIRONMENTAL ASSETS AND CONSTRAINTS

VEGETATION AND FLORA

Regional vegetation association mapping identifies the Heddle vegetation complex and Bassendean Complex Central South is mapped within the subject site. Historically, a significant portion of the subject site has been cleared of remnant vegetation on site and has been fragmented through semi-rural land development and clearing. There are some remaining areas of vegetation on several lots.

No species listed as Threatened under the EPBC Act or Threatened under the Wildlife Conservation Act 1950 (WC Act) were recorded in the survey area.

A total of three Priority flora species were observed within the subject site: Cyathochaeta teretifolia (P3), Jacksonia gracillima (P3) and Tetraria sp. Chandala (P2).

In the target spring flora survey, no new conservation significant species or locations were observed in the survey area. Suitable habitat was observed for Drakaea elastica. It is noted the area identified as suitable habitat was is located within the central POS area on the Structure Plan and; therefore, will be retained.

The vegetation condition through the subject site ranged from Excellent to Completely Degraded and is primarily in a Completely Degraded state.

Two sub-communities of the Federally listed Threatened Ecological Communities (TEC) Banksia woodlands of the Swan Coastal Plain under the EPBC Act were determined to occur within the subject site: Central Banksia attenuata – Eucalyptus marginate woodlands, and Central Banksia attenuata – Banksia menziesii woodlands. Based on the approved Conservation advice on Banksia woodlands of the Swan Coastal Plain, due to the varying densities and condition of the species identified, only 11 remnants, equating to 9.21ha are considered to be representative of Banksia woodlands of the Swan Coastal Plain (refer Banksia Woodland TEC Plan in **Appendix B**). Further flora and vegetation surveys will be required across the lots that have not been surveyed.

The western portion of the subject site is mapped as an Environmentally Sensitive Area (ESA), associated with the CCW and its designated 50m wetland buffer.

FAUNA

The fauna assessment observed three different Black Cockatoo foraging habitats totalling 26.39ha on the subject site.

The fauna assessment identified a total of 56 trees to contain hollows greater than 120mm. No evidence of breeding or roosting was recorded during the survey. A follow-up Black cockatoo hollow assessment was undertaken to assess the trees containing hollows and determine their suitability for Black Cockatoo nesting. Due to access restrictions this was undertaken on the CDN No. Pty Ltd landholdings only. The assessment found that of the 31 trees identified with hollows greater then 120mm, 28 were unsuitable for nesting. 3 trees had potential to be suitable for nesting; however, require closer inspection of each hollow.

WETLAND, BUFFERS AND RECLASSIFICATION

Regional geomorphic mapping indicates that four wetlands categorised as either Resource Enhancement Wetland (REW) or Conservation Category Wetland (CCW).

All three CCWs are located within the south western corner of the subject site, adjacent to the Kwinana Freeway.

The REW is located within the north eastern corner of the subject site and extends further east of the site. Within the subject site (Lot 32), the REW has been cleared and is now a grassed paddock. Lot 45 contains the western most tip of the wetland and the vegetation is still intact, whereas Lot 31 contains the majority of the REW, and the vegetation is also still intact.

MUSHROOM FARM

A mushroom farm is located to the north of the subject site within the Casuarina North Structure Plan area (Costa Mushroom Farm). As a result of the mushroom farm leakages from odour sources, an odour assessment has been undertaken on the mushroom farm (Environmental Alliances 2015) and is included in the **Appendix B**. In the absence of any formal guidance, the 2.5ou, 1 hour, 99.5 Percentile contour is used a criterion for acceptable odour impacts.

The 2.5ou, 1-hour contour was modelled for a number of scenarios/sources, and based on the 2.5ou, 1-hour contours that were modelled, only the northern most portion of Lots 1, 50 and 49 were impacted under some scenarios and at worst, extending only 50 m into the subject site.

A noise assessment was undertaken (Herring Storer Acoustics 2015) to determine acoustic impacts of the mushroom farm, which determined noise exceedances may impact the north western corner of the subject site.

To accommodate any sensitive land uses within the area depicted as 'subject to further investigation (odour and noise)' on the Structure Plan map, validation of the odour and noise modelling undertaken by Environmental Alliances 2015 and Herring Storer Acoustics 2015 is required.

LANDFORM AND SOILS

LANDSCAPE AND TOPOGRAPHY

The pre-development topography of the site is reasonably flat across the northern half, ranging between RL 17m – RL 19m AHD. The south-eastern portion of the site is relatively low-lying with a low point of approximately RL 11m AHD associated with a wetland.

There is a sand dune in the southern portion of the site with a peak elevation of RL 32m AHD. It is anticipated this sand will be cut to create fill for use elsewhere in the site due to the significant height differential with the surrounding area.

SOILS

The subject site is characterised as Bassendean Sand, with the soil type generally pale to grey sands at the surface with yellow sands at depth (refer **Appendix E– Engineering Servicing Report** for Geotechnical Mapping). It is free draining and well suited to urban development. There are some isolated pockets containing silty, clayey sands and sandy silt, which are generally associated with wetland areas.

ACID SULFATE SOILS

The Department of Environment and Conservation's Acid Sulfate Soils (ASS) risk mapping shows the majority of the site as having "*moderate to low risk of acid sulphate soils within 3 metres of the natural soil surface*" (refer **Appendix E – Engineering Servicing Report** for ASS Mapping). Small sections in the southern, south-western and north-eastern portions of the site are identified as having *"high to moderate risk of ASS occurring within 3 metres of natural soil surface".* An ASS investigation will be conducted across the subject site to advise appropriate management measures prior to subdivision.

CONTAMINATION

A search of the Department of Water and Environmental Regulation (DWER) Contaminated Sites Database did not identify any contaminated sites present within the subject site. There is currently no identified contaminated material; however, uncontrolled fill has been observed within the subject site which may have introduced hydrocarbons or Asbestos contaminated material.

Land uses such as agriculture and horticulture are likely to have previously occurred on portions of the subject site. Practices associated with these activities may have introduced fertilisers and pesticides to the subject site.

A Preliminary Site Investigation will be required prior to subdivision to determine if a Detailed Site Investigation is required.

GROUNDWATER AND SURFACE WATER

GROUNDWATER

The Perth Groundwater Atlas indicates the superficial aquifer base at the site is approximately -15m AHD.

FLOWS AND LEVELS

Groundwater levels in the Atlas are representative of typical end of summer groundwater levels and estimate groundwater levels ranging from 11m AHD to 16m AHD across the site, with groundwater flow in a westerly direction.

Eleven groundwater monitoring wells installed across the subject site observed the depth to groundwater varies from at surface to 15m below surface in elevated areas.

QUALITY

A total of four groundwater quality sampling occasions were undertaken. Results of the groundwater quality sampling are included in the LWMS. Whilst the TN and TP concentrations within the groundwater are above the concentrations in the relevant guidelines, they represent typical groundwater nutrient values for the Swan Coastal Plan for land that has been historically used for farming purposes.

SURFACE WATER

The subject site is located within the Peel-Harvey Coastal Catchment. No natural surface water flows occur within the subject site.

The site has four topographic surface water catchments. In three of the catchments, runoff travels as diffuse overland flow towards topographic low points. On one catchment, runoff is directed towards the Peel Sub P1A drain located in the north eastern area of the subject site.

MODELLING

A local arterial drainage strategy is presented in the Jandakot Drainage and Water Management Plan, which provides allowable discharges from each catchment post-development. The post-development catchments are completely contained within the subject site area and contribute to the Peel Sub1A drainage.

Surface water modelling shows that the 1 in 100 year ARI top water level in the drain upstream of Landgren Road is 16.35m AHD.

2.2 BUSHFIRE HAZARD

The majority of the subject site is designated as bushfire prone on the WA Map of Bushfire Prone Areas (DFES 2018). A Bushfire Management Plan (BMP) has been prepared by Eco Logical Australia in support of the Structure Plan (refer **Appendix C**). The BMP is a strategic level plan which identifies the bushfire protection measures to be applied to development on the subject site to accommodate compliance with:

- State Planning Policy 3.7 Planning in Bushfire Prone Areas (SPP 3.7);
- Guidelines for Planning in Bushfire Prone Areas; and
- Australian Standard for the construction of buildings in bushfire-prone areas (AS3959-2009).

The purpose of the BMP is to:

- Provide guidance on how to plan for and manage the bushfire risk to future life and property assets of the project area through implementation of a range of bushfire management measures;
- outline how future on-site assets can be protected during the summer months when the threat from bushfire is at its peak, particularly when existing fire appliances in the area may be unable to offer an immediate emergency suppression response and therefore, development planning and design should aim to provide mitigation strategies that protect future life and property from bushfire as a priority; and
- achieve consistency with the objectives and requirements of the current bushfire risk management planning regulations, policy and guidelines.

IDENTIFICATION OF BUSHFIRE HAZARD ISSUES

The on-site vegetation extent is proposed to be cleared to enable development of a significant urban built footprint amongst areas of landscaped / managed POS and various easements. Therefore, the current on-site vegetation extent is not considered to be a bushfire hazard issue post-development, as these hazards can be managed through a staged clearing process, adequate separation of future built assets from classified vegetation, and ongoing fuel management.

On this basis the bushfire hazards within and adjacent to the subject site are readily manageable through standard management responses and compliance with acceptable solutions outlined in the Guidelines and AS 3959-2009. These management measures will be factored into the development design as early as possible to ensure a suitable, compliant and effective bushfire management outcome is achieved to ensure protection of future life and property assets.

Demonstration of compliance with the relevant requirements of SPP 3.7, the Guidelines and AS 3959-2009 at future planning stages will also depend on the developer's ability to coordinate the timing and staging of clearing and development works within the subject site with those developments proposed on adjacent landholdings in the aim of avoiding bushfire impacts from temporary retained vegetation.

Updated BMPs will be prepared to support subsequent planning applications where relevant and will contain re-assessments of bushfire risk including Bushfire Attack Level assessments.

2.3 HERITAGE

ABORIGINAL

A search of the Department of Planning, Lands and Heritage Aboriginal Heritage Inquiry System confirmed there are no registered Aboriginal Sites in or immediately adjacent to the subject site.

EUROPEAN

The State Heritage Office's inherit database did not identify any Federal, State or Local heritage places or listings within the subject site.

2.4 MOVEMENT NETWORKS

REGIONAL ROADS

The road network surrounding the site is legible and well defined, providing the site with good levels of connectivity at a local and regional level to locations in all directions. The subject site is connected to the regional road network via Bombay Boulevard to the north which provides a connection to Thomas Road and the Kwinana Freeway.

DISTRICT AND LOCAL ROADS

LANDGREN ROAD

Landgren Road runs which in a north-south direction through the subject site, is classified as an access street under Main Roads WA's Functional Road Hierarchy. Landgren Road is subject to the residential speed limit of 50kph. No traffic data is currently available for Landgren Road.

Landgren Road is constructed with a single pavement of approximately 6.0 metres wide. It is constructed to the southern boundary of the subject site. Landgren Road is expected to be extended to connect through to Thomas Road and to Mortimer Road (via Nicolas Drive), forming the major link between Thomas Road and Mortimer Road.

ORTON ROAD

Orton Road which runs along the northern boundary of the subject site, is classified as an access street under Main Roads WA's Functional Road Hierarchy between Bombay Boulevard and the Kwinana Freeway. East of Bombay Boulevard it is classified as a local distributor road. It is constructed with a single pavement of approximately 7.0 metres wide, and is subject to a 70 kph speed limit west of Bombay Boulevard. The portion of Orton Road adjacent to the subject site has a total traffic volume of 533 vehicles per day in both directions.

BOMBAY BOULEVARD

Bombay Boulevard is located north of the subject site. It is classified as an access street in the Main Roads WA's Functional Road Hierarchy and is constructed with a single rural standard pavement of approximately 7.0 metres wide. Bombay Boulevard currently carries 1,446 vehicles per day, with the capacity to carry up to 13,500 vehicles per day.

Bombay Boulevard currently provides access from Orton Road to Thomas Road, although only the southern portion of Bombay Boulevard is a gazetted road. The northern portion of Bombay Boulevard is in private ownership, meaning there is no legal access to Thomas Road. Formal access to Thomas Road is an essential requirement as Thomas Road provides the only connection to the Kwinana Freeway and the Kwinana Town Centre from the Casuarina Central Precinct. This section of Bombay Boulevard or an appropriate alternative must be secured as part of the adoption of the Casuarina North Structure Plan.

The ongoing use of Bombay Boulevard is appropriate and will assist with traffic distribution. A future connection to the Landgren Road extension through the Casuarina North Precinct will rationalise intersections to Thomas Road.

MORTIMER ROAD

Mortimer Road runs in an east-west direction along the southern boundary of the Casuarina South Precinct, providing a connection to the Kwinana Freeway. It is classified as a regional distributor in Main Roads WA's Functional Road Hierarchy. It is constructed with a single pavement of approximately 8.5 metres wide. It carries 4,913 vehicles per day with capacity to carry up to 13,500 vehicles per day.

THOMAS ROAD

Thomas Road is located along the norther boundary of the Casuarina North Precinct, and runs in an east-west direction, providing a regional link between Armadale in the east to Kwinana in the west. It is constructed with a single pavement of approximately 7.5 metres wide. Traffic data indicates a daily traffic demand of 17,622 vehicles per day, with capacity to carry up to 22,000 vehicles per day.

KWINANA FREEWAY

The Kwinana Freeway located along the western edge of the Structure Plan area, although without direct access, is a Primary Regional Road under the control of Main Roads WA. It provides a regional link between Perth and the South West of the State. It is constructed with four lanes adjacent to Casuarina and carries 75,851 vehicles per day between Thomas Road and Mortimer Road.

PUBLIC TRANSPORT

There are currently no existing public transport services within the subject site. The subject site is approximately 1.6km from the Kwinana railway station as the crow flies, and just over 3km by public road.

CYCLING

There are currently no cycle facilities within the subject site, however the Western Australian Bicycle Network Plan (2014 -2031) sets out to provide a principal shared route along Orton Road to connect to Byford / Mundijong to Rockingham.

2.5 SERVICE INFRASTRUCTURE

An Engineering Services Report has been prepared by Cossill and Webley in support of the Structure Plan (refer **Appendix E – Engineering Services Report**). The objective of the Services Report is to identify the matters to be addressed as part of the subdivision stage and to confirm that the site is capable of being developed for residential purposes. The Engineering Services Report suggests the site is capable of the development as accommodated by the Structure Plan with the logical, progressive extension of infrastructure and base capacity.

WATER RETICULATION

An existing 220mm water reticulation main is located in Orton Road. The Water Corporation advised that no water reticulation planning has been undertaken for the subject site. Notwithstanding, no water servicing issues are anticipated.

Water Corporation planning advice indicates a large steel water main may need to be constructed through the structure plan area from the south, travelling along Landgren Road, then headlining west at Orton Road and extending beneath Kwinana Freeway. It is anticipated due to the size of these mains that they would be pre-funded by the Water Corporation at a later date.

SEWERAGE RETICULATION

The existing sewerage reticulation near the subject site comprises a pressure main in Orton Road. There is insufficient existing sewer network in the vicinity to service the subject site.

Water Corporation wastewater planning information identifies the subject site as falling within two sewer catchments. The majority of the site will be serviced with conventional gravity reticulation that grades towards a pump station located north of Orton Road. Coordination with adjoining landowners north of Orton Road has occurred by CND No. Pty Ltd with an agreement reached to ensure the development of the subject site has access to the pump station location.

A small section of the southern portion of the subject site falls within a sewer catchment which grades southwards.

POWER

The Western Power Network Capacity Mapping Tool indicates the electricity network will have more than 20,000kVa remaining capacity in the future. This is adequate capacity to supply the future residential development in the subject site. This will be formally confirmed with Western Power during the detailed planning and design phase of development.

There are two existing 330kV overhead transmission lines located parallel to the western boundary of the subject site, which are protected via an easement.

There are also co-located overhead high and low voltage distribution lines along Orton Road and Landgren Road, which will need to be reconstructed as underground power as part of the development.

All future power infrastructure within the proposed development will be underground and fed from existing infrastructure in the adjacent areas. It is not anticipated any off-site headwork upgrades will be required.

TELECOMMUNICATIONS

The subject site is within the fibre footprint of the National Broadband Network (NBN), and development can be serviced with optic fibre under their roll-out scheme for greenfield developments.

The subdivider will be required to provide pit and pipe service infrastructure within the subject site, which will be handed over to NBN Co upon completion.

GAS

ATCO Gas has advised there will be sufficient capacity in the surrounding network to service the proposed development. ATCO Gas has advised the preferred option is to extend a main from Thomas Road along Bombay Boulevard to the subject site, however, this relies on a pressure main being constructed in Thomas Road by the time development commences. If this has not occurred, ATCO Gas will consider alternative arrangements.

STORMWATER MANAGEMENT

The stormwater management will be undertaken consistent with the DWER water sensitive design practices. The system will consist of lot soakwells, piped road drainage system, biofiltration areas, and stormwater storage detention and infiltration areas.

2.6 SITE CONTEXT

A Structure Plan Context Plan has been prepared to illustrate the likely road layout and land use distribution in the Casuarina North and Casuarina South precincts in relation to the subject site (refer **Figure 10**).

The Structure Plan Context Plan includes the Development Concept which was prepared in support of the Casuarina North Precinct Plan. The Development Concept in the Casuarina North Precinct depicts District Open Space on Orton Road, adjacent to the senior-sized oval within the subject site. If the District Open Space is developed, the potential future reconfiguration of Orton Road will assist the final merger of additional recreation facilities north of Orton Road in the form of District Open Space within the Northern Precinct.

A Structure Plan is yet to be prepared for the Casuarina South precinct and the location of land uses is still to be determined, however based on the requirements of LPP 6 and the City of Kwinana Draft Community Infrastructure Plan, the likely land uses within the southern precinct have been identified, including:

- High School;
- Local Sporting Ground (with a facility building and kiosk) – multipurpose sports and recreation facility incorporating a grass active playing space with training level lighting that can accommodate a wide variety of sports (ideally collocated with the high school);
- District Community Centre (7,000m²) – largescale multipurpose community centres, caters for higher order social and community needs;
- District Youth Centre (7,000m²) – caters for both indoor and outdoor activities; and
- Local Centre (6,000m²).

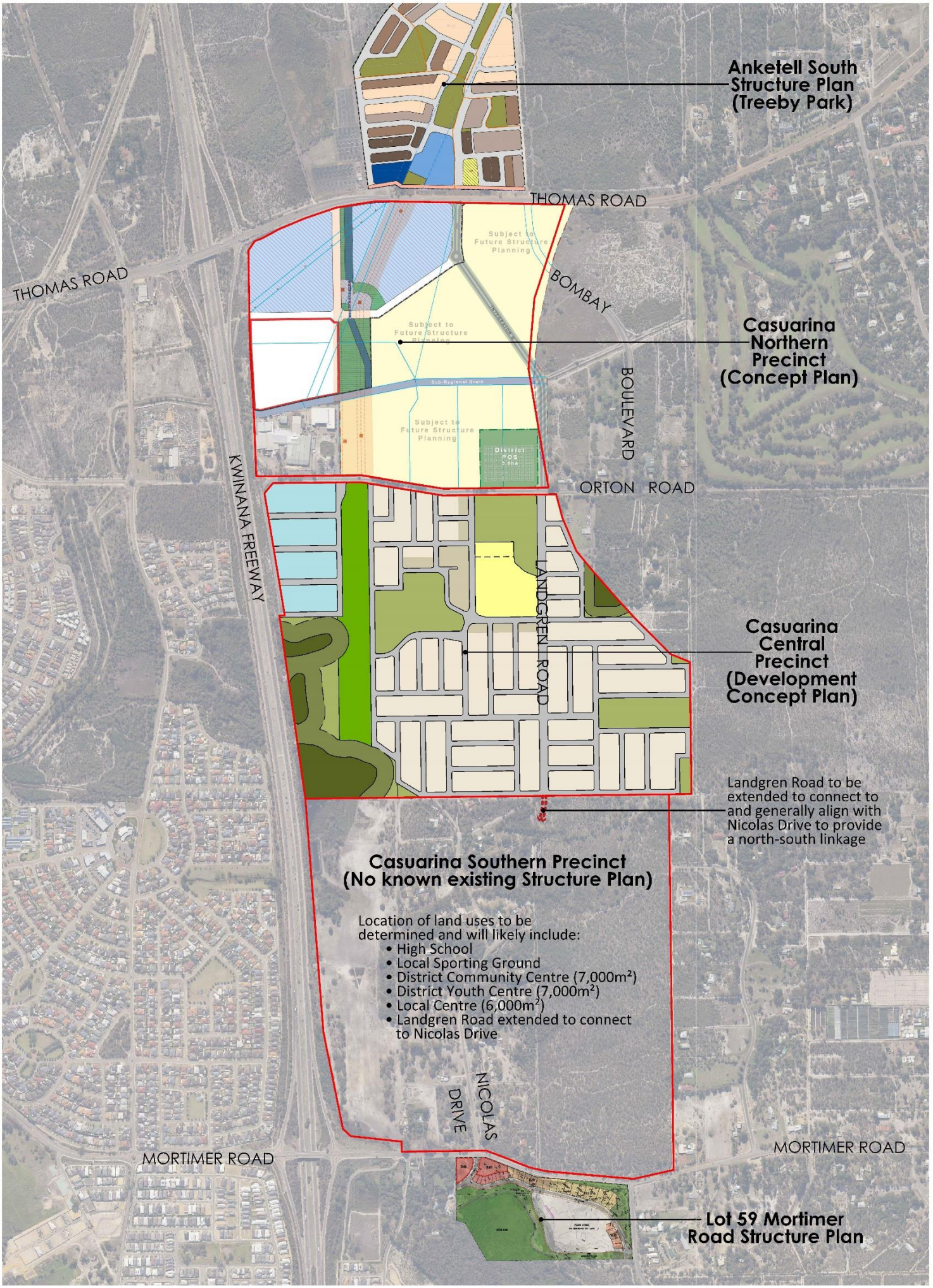


Figure 10 Structure Plan Context

3 STRUCTURE PLAN

The Casuarina Central Structure Plan provides for a diverse range of housing choices through of the application of R-Code density ranges including R10-R20, R25-R40 and R40-R60, which are identified on the Structure Plan Map. A Service Commercial area is located in the north-western corner of the site, adjacent to the Kwinana Freeway and Orton Road. A Primary School and co-located POS for a senior-sized oval is located at the intersection of Landgren Road and Orton Road. The Structure Plan also depicts the areas of POS and drainage areas, informed through urban design and hydrological modelling, as well as the Neighbourhood Connector (Landgren Road) and Major Access Streets informed through urban design and traffic modelling.

3.1 DESIGN PRINCIPLES

STRUCTURE PLAN RESPONSE TO PHYSICAL ASSETS AND CONSTRAINTS

SITE ANALYSIS

An Opportunities and Constraints exercise was undertaken to inform the design considerations over the site. As detailed in Section 2 of this report, the subject site contains some environmental and physical constraints requiring addressing including existing wetlands and associated buffers, landform, vegetation, and existing road network. All of these were contributing factors for the design response. The principle considerations are identified on the Issues and Considerations Plan in **Figure 11** and Site Opportunities at **Figure 12**, along with appropriate design responses in **Table 5**.

TABLE 5 DESIGN RESPONSE TO SITE ANALYSIS

OPPORTUNITIES	
ANALYSIS ITEM	**RESPONSE**
Existing Natural Landform	Create a development pattern that responds to the existing natural landform. Sand will be cut from the existing high point in the southern portion of the site to create fill for use else in the structure plan area due to a significant height differential with the surrounding area. This will contribute to a more efficient, cost effective and sustainable development outcome significant reducing the amount of imported fill required.
Land Use Diversity	Consider opportunities for non-residential development, to provide an appropriate interface with the Kwinana Freeway and the Mushroom Farm, and to diversify the land uses on offer. This will also assist with the employment offering. However, as will be detailed in **Section 3.3**, concerns are raised with the extent of the Service Commercial area provided adjacent to the Freeway.
Response to existing vegetation	Interrogate vegetation condition and opportunities for retention of Banksia Woodland of Swan Coastal Plain to provide high-quality POS and to ensure appropriate assessment under the EPBC Act.
Existing Infrastructure	Utilising existing Power Transmission Corridor to locate local subdivision roads and drainage within the power easement for development efficiencies. Some recreation opportunities may also be supported in this area.
POS amenity and wetland responses	Provide for CCW and REW protection including buffers and appropriate interfaces for robust POS design.
Precinct Structure and Accessibility	Promote extension and upgrade of Landgren Road to form main north-south connection through the subject site.
Fauna permeability	Consider locating proposed vegetation retention to achieve continuous connection to the adjacent Bush Forever site.
Community infrastructure	Incorporate the requirement for Primary School and co-located Oval Open Space. Consider the long-term accessibility of this infrastructure in the final subdivision design.
Pedestrian network	Provide interconnected pedestrian network via key network integrating open space with the Primary School and future district open space.
Landform response	Orientate local road directions for efficient earthworks and drainage flows.
CONSTRAINTS	
Land Use allocation	Consider appropriate interface response to the Kwinana Freeway in terms of noise and vibration implications. Potential for non-residential in this location.
Power Easement visual amenity	Existing Power Transmission Corridor (Easement) acts as a development constraint and potential visual impact. Consider appropriate landscape opportunities.
Landuse interface - Mushroom	Mushroom farm may incur limited noise and odour issues, consider compatibility of surrounding land uses.
Fire Management and vegetation retention considerations	Consider bushfire management solutions for development in proximity to Bush Forever reserve and Rural – Water Protection zone.
Landuse interface – Water Resource Zone	Provide an appropriate interface treatment to the adjacent Rural Water Resource zone, considering visual amenity and the character of the Rural zone.
Existing natural landform	Consider natural low points for drainage conveyance in roads and open space networks and consideration of earthworks required to natural ridgeline.
Resource Enhancement classified Wetlands	Investigate wetland integrity, quality and opportunity for development.

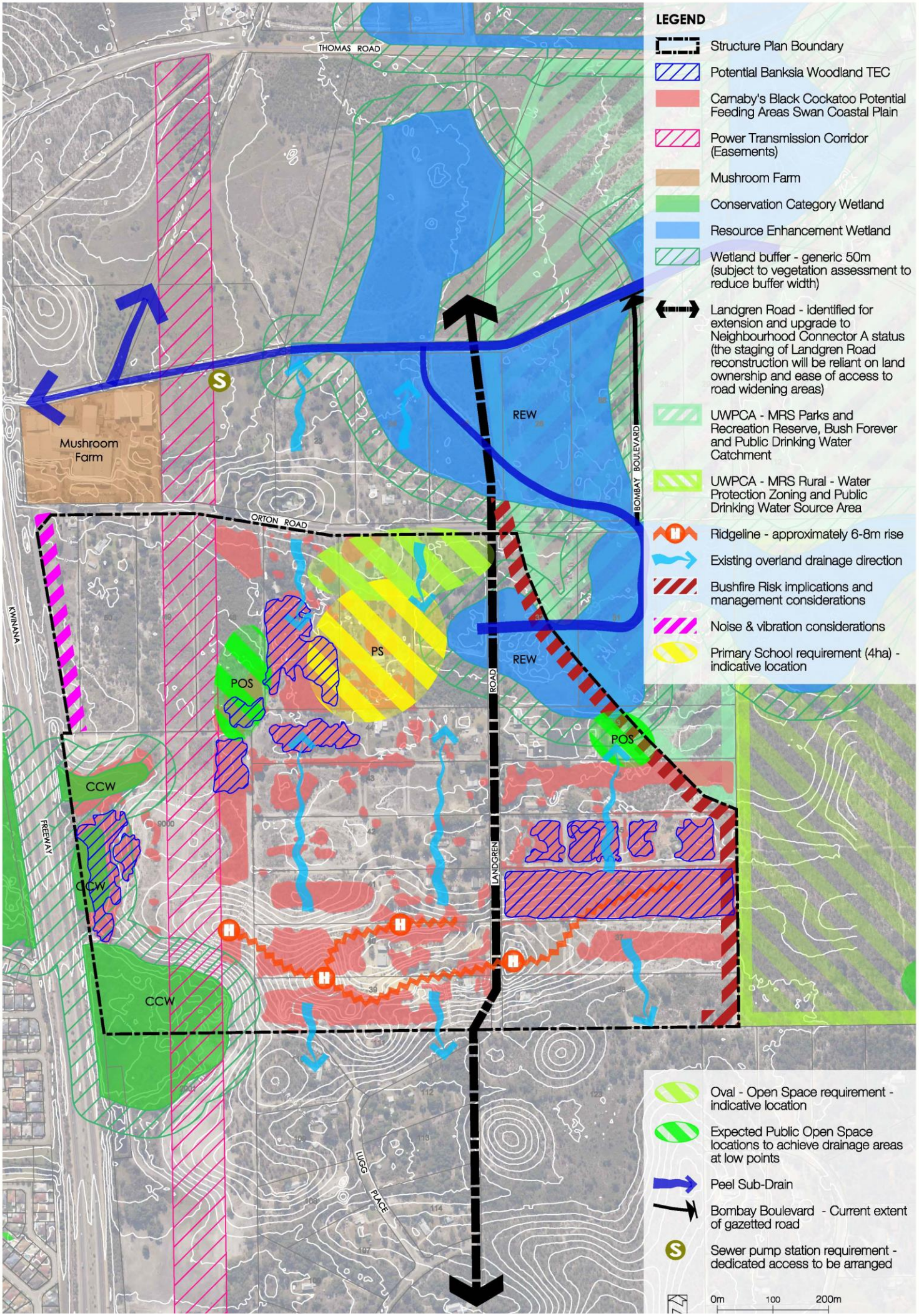


Figure 11 Issues and Considerations

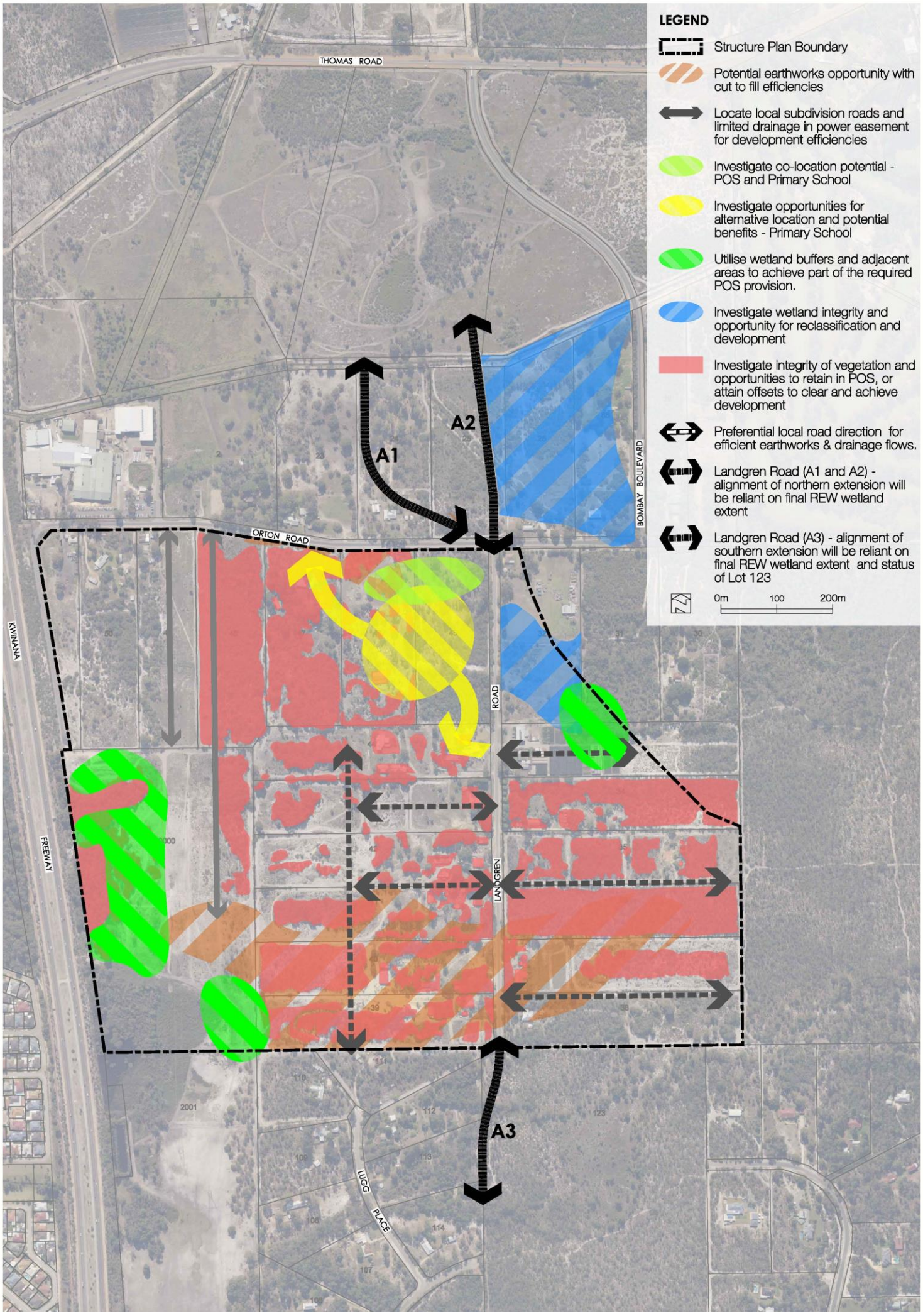


Figure 12 Site Opportunities

CONCEPT CHARACTERISTICS

In response to the Opportunities and Constraints analysis, specific design characteristics were prioritised in preparing the Development Concept Plan (**Figure 13**). These primary considerations are identified in **Table 6.**

TABLE 6 KEY DESIGN CHARACTERISTICS

CHARACTERISTIC	COMMENT
Drainage Requirement	Orient local roads and position POS to support drainage direction and minimise earthworks.
Development Interface	Design appropriate development interfaces to achieve an engaging development edge to the precinct features and perimeter.
Diverse Housing Choices	Provide the ability for a wide diversity of housing choices, with areas of higher density adjacent to areas of amenity and the school.
View Corridors	Subdivision road direction should enhance view line potential of the open space and conservation opportunities, enhancing the sense of place.
Public Open Space	Position POS in response to existing site characteristics and significant vegetation. Interlink POS elements with a robust pedestrian pathway network. Accommodate local wetlands in POS network in order to enhance their amenity and accessibility. Provide for recreation opportunities through provisions of a co-located senior sized oval with the Primary School. Ensure convenient and easy access to future District Open Space to be located with the Norther Precinct.
Service Commercial Node	A Service Commercial Activity Node has been integrated to provide a suitable interface to Kwinana Freeway and Mushroom Farm activities. The street network surrounding the Activity Node will be directed to provide direct access to it.
Environmental Sustainability	Create a development that embraces environmental sustainability through water sensitive urban design, vegetation retention and integration of wetlands.
Relationship with natural surrounds	Enhance and maximise the relationship between development and the natural surrounds including adjacent bushland, Rural - Water Protection zone.
Surveillance	Provide surveillance and activation adjacent high amenity open space focal areas to maximise safety and use of these community assets.
Aesthetic Streetscapes	Promote a high amenity and highly aesthetic streetscape network, by incorporating pedestrian paths and street tree planting along key connectors.
Access	Provide a hierarchy of highly connected streets ensuring a permeable, legible and robust vehicle and pedestrian network.

3.2 DEVELOPMENT CONCEPT PLAN

The Development Concept Plan in Figure 13 has been prepared to support the Structure Plan by providing an illustration of the development intent. This illustration is indicative only; however, it assists in understanding and guiding residential subdivision responses, density locations and movement network recommendations Importantly, the Development Concept Plan establishes the key design themes in which the subdivision and development will be guided. Key elements / Development Concept Plan notes include:

1. **Landgren Road:** Opportunity for this neighbourhood connector to be configured as a character tree-lined boulevard to provide improved amenity for the structure plan area. This road configuration will also aid lot accessibility and road functionality.

2. **Recreation Oval:** Senior-sized oval specifically located to respond to the District Open Space facility in the Casuarina Northern Precinct, providing the potential to form a consolidated POS area. The potential future reconfiguration of Orton Road will assist the final merger of additional recreation facilities north of Orton Road in the form of District Open Space within the Northern Precinct. The oval has also been oriented to retain existing vegetation along the eastern edge adjacent to Landgren Road.

3. **Primary School:** Primary School specifically located to share the recreation opportunities of the oval space and achieve an efficient land area outcome. Primary School pedestrian and vehicle access has been achieved through a highly permeable road network. Primary School located generally in accordance with JDSP and ERIC. The Primary School has been positioned to retain existing vegetation where the REW is currently located. Refer to **Section 3.4** for further detail in this regard.

4. **Road Network:** Achieve an interconnected and hierarchical street network that provides legible accessibility to the range of community assets.

5. **Public Open Space:** Situated in specific locations to achieve vegetation retention, drainage functionality and the following benefits:

    - estate entry view-line focal point/node;
    - landscaped to accommodate key active play area(s);
    - fauna corridor opportunities to the adjacent Bushland;
    - drainage within landscaped swales;
    - easily accessible and within walking distance for all residents;
    - retention of Banksia Woodland TEC areas;
    - retention of significant vegetation;
    - pedestrian linkages; and
    - placemaking benefits through character retention.

6. **Land Use Diversity:** Opportunity for local employment benefits through Service Commercial development. This proposal addresses interface issues of Kwinana Freeway and Mushroom Farm activities. These uses located in accordance with recommendations of JDSP and ERIC although the ongoing viability of these uses in this location is questioned as detailed in **Section 3.3.**

7. **Lot Diversity - Traditional Lots:** Main lot type, front vehicle access and solar efficiencies for buildings through cardinal oriented road network. A diverse lot size range is achievable in the structure with a variety of lot depths and frontage widths.

8. **Terrace Lots:** Medium density, rear accessed lots to enhance key points of estate amenity and achieve a specific streetscape appearance. These lot types have the flexibility to achieve alternative and affordable housing within the development.

9. **Wetland Protection:** Development outcome promotes retention of REW and CCW wetlands and their buffers in these locations given their integral local environmental functionality and amenity benefits.

10. **Power Easements:** Promote local road interfaces to the existing power easements, with the ability for local drainage to enter the power easement for the benefits of sustaining appropriate landscaping as an amenity enhancer.

11. **Pedestrian Access:** Resident access to public amenity areas has been prioritised with the recommendation of formalised pedestrian links across power easement.

12. **Bushfire Mitigation:** Perimeter roads located to moderate fire impact and promote asset protection to adjoining dwellings.



Figure 13 Development Concept Plan

3.3 LAND USE

The primary land use within the Structure Plan area is residential, supplemented by a Primary School, service commercial area, with open space and an associated internal road network. A summary of the land uses and their areas are provided in **Table 6**.

RESIDENTIAL

The Structure Plan will provide for a variety of housing choices through the designation of a range of residential R-Codes (through the application of the RMD codes). The density codes and their applicable lot typology are detailed in **Table 7**. The density code ranges are outlined on the Structure Plan. The allocation of residential densities shall be identified at the subdivision stage through the provision of a Residential Density Code Plan.

The density code ranges applied on the Structure Plan are consistent with those recommended by the WAPC's Structure Plan Framework August 2015. A description of the density code ranges and their intent are outlined below:

a) Residential R10 - R20: This density code range will apply to the land on the eastern edge of the land to provide larger sized lots to accommodate an appropriate interface to the adjacent Rural Water Resource zone. This range will accommodate single detached dwellings (refer **Figure 14** for extract Development Concept Plan depicting R10-R20 density code range).

b) Residential R25 – R40: This density code range will apply to the majority of land within the Structure Plan, maximising flexibility for the design to respond to market conditions and demand. It will provide for front accessed lots and traditional housing with a range of lots sizes intended. This range will also ensure that individual development stages can provide a range of lot and housing types without any particular stage being oversupplied with a particular lot type. Based on the developer's intent and in response to market conditions, it is expected that the majority of housing will be in the R25-R30 range, with medium density housing of an approximate R40 density code applying closer to key access roads and public amenity (refer Figure 15 for extract Development Concept Plan depicting R10-R20 density code range).

c) Residential R40 – R60: This density code range will apply to the land adjacent to the Neighbourhood Parks and the Primary School in the central and northern portion of the Structure Plan area. This density range provides the necessary flexibility to accommodate lots of a smaller and more affordable size to complement the predominately traditional and small traditional sized lots throughout the Structure Plan area. Lot vehicle access will be achieved through a mix of rear laneway and front accessed lots (refer **Figure 16** for extract Development Concept Plan depicting R10-R20 density code range).

d) It will provide an opportunity for attached terrace housing outcomes, which have been deliberately located adjacent areas of high amenity to overlook and interact with POS. Possible two-storey development in these areas will provide a desirable streetscape character and framing to the POS experiences. This coding provides the potential to diversify the lifestyle opportunities for the Structure Plan area.

TABLE 7: STRUCTURE PLAN LAND USE SUMMARY

STRUCTURE PLAN ZONE / RESERVE	AREA (HA)
Residential	49.7197
Service Commercial	7.1018
Roads	7.7305
Public Open Space (including drainage)	28.0703
Public Purpose – Primary School	3.5000
Total	96.1223



Figure 14 Development Concept Extract - Residential R10 - R20 density code range (along the eastern edge of the site).

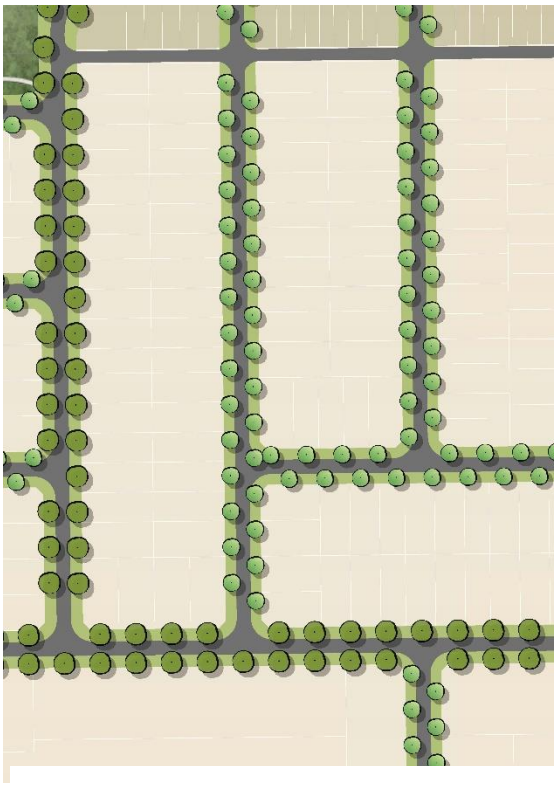


Figure 15 Development Concept Extract - Residential R25 – R40 density code range along.



Figure 16 Development Concept Extract - Residential R40 - - R60 density code range.

TABLE 8: DENSITY CODE RANGES AND LOT AND HOUSING TYPOLOGY

DENSITY CODE RANGE	TYPICAL LOT/DWELLING TYPE AND SIZE
Residential R10 – R20	Traditional, front accessed lots: 15.0m x 30.0m – 450m^2 17.0m x 30.0m – 510m^2 20.0m x 30.0m – 600m^2 15.0m x 35.0m – 525m^2 17.0m x 35.0m – 595m^2 20.0m x 35.0m – 700m^2
Residential R25 – R40	Narrow, front accessed lots: 7.5m x 30.0m – 225m^2 8.5m x 30.0m – 255m^2 Traditional, front accessed lots: 10.5m x 25.0m – 262m^2 12.5m x 25.0m – 312m^2 15.0m x 25.0m – 375m^2 10.5m x 30.0m – 315m^2 12.5m x 30.0m – 375m^2 15.0m x 30.0m – 450m^2 Squat, front accessed lots: 15.0m x 20.0m – 300m^2 12.5m x 25.0m – 312.5m^2 15.0m x 25.0m – 375m^2
Residential R40 – R60	Narrow, front accessed lots: 8.5m x 20.0m – 170m^2 8.5m x 25.0m – 212m^2 7.5m x 30.0m – 225m^2 Squat, front accessed lots: 10.5m x 20.0m – 210m^2 12.5m x 20.0m – 250m^2 10.5m x 25.0m – 262m^2 12.0m x 15.0m – 180m^2 Terrace, rear accessed lots: 6.0m x 25.0m – 150m^2 7.5m x 25m – 187m^2 6.0m x 28.0m – 168m^2 7.5m x 28.0m – 210m^2

DENSITY TARGETS

Liveable Neighbourhoods (LN) recommends that in new urban areas, densities of at least 15 dwellings per urban hectare, and an average of 22 dwellings per site hectare (encompassing land purely zoned for residential purposes) should be provided.

The applicable density targets under the Structure Plan, as measured in accordance with LN is 26 lots per net site hectare; based on 968 dwellings.

The density codes applied and the resultant lot typology will accommodate maximum flexibility for the Central Precinct, whilst addressing the needs of the local residential housing market. There are a variety of different lot types which will provide ample opportunities for purchasers to select their lot and a project home to meet their needs.

The Development Concept Plan suggests a potential yield of between 920 - 968 lots. This could accommodate a total population of up to 2,576 - 2,710 persons, based on 2.8 people per household in single residential dwellings.

RETAIL AND MIXED BUSINESS

A Retail Needs Assessment (RNA) was undertaken by Taktics4 to determine the market demand and implications for providing a retail centre and service commercial / mixed business area within the Structure Plan area (refer **Appendix H**). Particularly, the RNA assesses the recommendations within the planning framework (i.e. recommendations of LPP 6, JDSP and ERIC) to accommodate the following uses within the subject site:

- A Local Retail Centre of 800m^2; and
- A service commercial / mixed business area as an expansion of the mixed business area planning for in the Casuarina North Structure Plan area.

The provision and design of retail activity and service commercial / mixed business land uses within and in proximity to the Structure Plan area are guided by a range of state and local government policies, as follows:

- **SPP 4.2 – Activity Centre Perth and Peel –** allocates a District Centre (Wandi District Centre) in or around the Anketell Road and Kwinana Freeway interchange. It also promotes the spatial planning of neighbourhood and local centres to the responsible local authority.
- **Jandakot District Structure Plan –** allocates the general location of several centres, including Neighbourhood Centres on Thomas Road and Mortimer Road and a local centre on Orton Road within the subject site. It does not allocate the role, function or size of the centres and no formal justification or analysis has been completed to support the spatial planning for these centres and mixed business area. The land use designations shown on the JDSP are indicative only and are intended to guide the more detailed planning, environmental and land capability studies to confirm the land use designations and arrangements depicted on the plan. The final land use outcomes are intended to be determined via more detailed local structure planning.
- **Draft Eastern Residential Intensification Concept –** broadly reconfirms the general location for commercial centres and mixed business areas previously adopted by the JDSP, including the neighbourhood centres in Thomas Road and Mortimer Road, and the smaller local centre in Orton Road. ERIC does not allocate roles or sizes to any of the centres and does not provide evidence or justification to support the spatial planning and role of the centres and mixed business area.
- **City of Kwinana – Local Commercial Activity Centres Strategy (LCACS) –** identifies a range of other activity centres and mixed business precincts in the vicinity of the Structure Plan area. This includes a Local Centre on Orton Road in the subject site, expected to generate 800m^2, which is only capable of supporting a small number of convenience-based shops without an anchor supermarket.

  The LCACS also identifies a total of 40,000m^2 of other retail floor space allocation within commercial mixed business areas.

- **Anketell South Local Structure Plan -** provides a 1.35ha area for a commercial activity site, which is capable of accommodating 3,500m^2 of retail floor space. The Structure Plan yields about 420 dwellings, capable of supporting a population of 1,300 residents. The commercial activity centre therefore has a very limited catchment to the north of Thomas Road and will rely heavily on the catchment to the south of Thomas Road to be commercially sustainable.

- **Draft Casuarina North Local Structure Plan –** intends to generate 13.9ha of service commercial area and 6.5ha of Special use. The service commercial zone is intended to primarily provide for showroom and bulky goods retail type uses. Based on the concept plan included in the advertised Casuarina North Local Structure Plan, it is estimated approximately 1,800 jobs will be generated by the service and commercial and special uses in this locality

As such, despite the intent of the planning framework for a retail centre and mixed business / service commercial centre to be provided in the subject site, there is very little documented supporting evidence that these uses are sustainable. It is more likely the commercial market will respond in the following matter:

- **Wandi District Centre** – initially expected to develop as a single and possible double supermarket-based district centre. It remains unclear if a discount department store would be capable here.

- **Anketell South Neighbourhood Centre** – limited residential catchment, servicing the Anketell South Structure Plan community and the Casuarina North and Central Structure Plan communities. May only attract a smaller supermarket operator and ultimately function as a small neighbourhood or local centre.

- **Mortimer Road Neighbourhood Centre** – limited catchment, expected to service the Casuarina south and Wellard East Structure Plan communities.

- **Local Centres** – The local convenience centres allocated within JDSP and ERIC are all within 1km of higher order convenience-based neighbourhood or district centres, hindering the ability of local centres to capture sustainable amount of retail sales to be viable centres.

The Structure Plan has responded to the recommendations of the RNA as outlined below.

LOCAL RETAIL CENTRE

As the RNA has demonstrated there is no market demand for the local centre to be developed within the Central Precinct, it has been excluded from the Structure Plan to minimise the potential negative impact on retail sales in Anketell South Neighbourhood Centre and improve the overall planning for retail activity in the area. This will also assist achieving a responsible structure planning outcome where land uses are not committed too which may otherwise be unviable.

The community will be well served by future planned neighbourhood activity centres to the immediate north and south of the subject site, as well as extensive service commercial offerings.

Removal of the Local Centre will not have any detrimental impact on SPP 4.2, as this policy supports the decision making in respect to local centres to be addressed at the more detailed structure plan level. Furthermore, the removal of the Local Centre will not have a detrimental impact on the findings and integrity of the LCACS, as the LCACS acknowledges that retail floor space allocations should be altered to reflect more detailed planning of specific areas.

MIXED BUSINESS / SERVICE COMMERCIAL AREA

As highlighted, the planning framework incorporates a precinct for non-residential uses and activities that span across the Casuarina North and Central Structure Plan areas.

The Casuarina Central Structure Plan intended service commercial / mixed business area will form part of the broader service commercial / mixed business area to

the north. The area is 7.5ha and is anticipated to accommodate 22,500m^2 of floor space and create opportunities for 650 employees.

The overall area incorporating service commercial / mixed business zones in both the Casuarina North and Casuarina Central Precincts is therefore 28.7ha, capable of containing 86,000m^2 of floor space and generating 2,450 employees.

The RNA considers the amount of floor space within this area to be excessive for the population it is intended to serve, and in the context of the additional service commercial / mixed business in the Wandi District Centre. Additionally, the location of the service commercial / mixed business precinct has compromised exposure and accessibility within the Structure Plan area.

Despite this consideration, the service commercial / mixed business area has been included in the Structure Plan to address the requirements of the policy framework including the JDSP and ERIC. It is acknowledged the extent of the service / commercial area may be need to be scaled back to reflect the conditions of the market or alternatively be removed all together when development area matures. The extent of the service commercial / mixed business area can be modified at an appropriate time, either through a Structure Plan amendment, or alternatively in 10 years' time when the Structure Plan expires. Surrounding development and market conditions are likely to have changed during this period regardless.

As recognised in the policy framework, provision of the service commercial / mixed business area in this location is twofold, and importantly can act as an appropriate buffer to the mushroom farm to the north, and will assist sensitive land uses not being impacted by unacceptable noise and odour emissions identified in **Section 2.1**.

3.4 OPEN SPACE

The location and purposes of each POS has addressed site constraints generally associated with the CCWs on the western edge of the site, the TEC Banksia Woodland of the Swan Coastal Plain in various localities across the site, significant trees as defined in the City's LPP 1, the power easement, natural contours and drainage requirements of the site.

The Structure Plan has consolidated the existing fragmented environmental areas to retain and conserve viable significant CCWs, TEC and fauna habitat, and the highest quality vegetation, and thereby, creating an outcome which will ensure long-term protection and management of the proposed POS areas for conservation.

The open space has also considered regional ecological linkages, with the POS areas providing an east west ecological link across the site.

The POS provisions satisfy Council's requirements identified in LPP 6 to co-locate an oval with a Primary School near the intersection of Landgren Road and Orton Road.

The POS design has also been developed to satisfy Council's requirements in LPP 1, to retain significant trees and landscape features where viable.

The POS areas are located within the walkable catchments of each residence; providing only a short walking distance for all residents to at least passive recreation areas. The POS will be linked by the permeable road, shared path and footpath networks.

PUBLIC OPEN SPACE

A POS Calculation has been prepared in accordance with Liveable Neighbourhoods, as detailed in **Table 9.** A total of 12.5712 ha of Open Space is provided on the Structure Plan of differing forms and functions, including active open space, passive open space and wetland buffers, as detailed on **Figure 17** and **Table 8.**

A total of 18.14% POS is provided, identifying a surplus of POS in comparison to the minimum 10% requirement under State Government Planning Policy. The total POS provided will be refined at subdivision stage to ensure the obligations of State Planning Policy are meet by the Structure Plan.

The POS will be provided in accordance with the Structure Plan and POS Schedule and will be landscaped by the developer to a standard commensurate to, or above LN requirements and to the satisfaction of the City of Kwinana.

The total POS provision is suitable to the proposed development and composition of land uses. The Landscape Masterplan (**Appendix I**) provides a graphical representation of the public realm vision for the ultimate development of the site.

TABLE 9: PUBLIC OPEN SPACE NETWORK

OPEN SPACE REFERENCE	PURPOSE
1. Neighbourhood Park (Active Play Area)	The POS co-located with the Primary School will be used by residents and the Primary School providing a senior-sized oval. It provides sufficient space to accommodate an oval and pavilions, while still retaining existing trees which are located on the western side of Landgren Road. Liaison with the Department of Education has been undertaken to confirm the location and design of the POS is satisfactory to the Department's requirements. A drainage basin will also be accommodated in the north-eastern corner of the POS.
2. Neighbourhood Park (Tree Retention / Active and Passive)	The POS area retains and conserves high quality vegetation including viable significant Banksia Woodlands of the Swan Coastal Plain and Black Cockatoo Potential Breeding Trees, and suitable habitat for the *Drakeaea elastica*, and thereby, creating an outcome which will ensure long-term protection and management of the proposed POS areas for conservation. The POS also contains a large number of significant trees in accordance with the requirements of LPP 1. The POS will also provide active and passive recreation opportunities, featuring a shelter and picnic facilities, an adventure playground and irrigated native planting and turf. Pedestrian links will also provide connections to adjacent residential areas and POS.
3. Local Park	Local Park which contains a drainage swale, and forms a linkage with the adjacent CCW and CCW buffer. The park will incorporate pedestrian connections to the adjoining CCW buffer tracks, and will feature non-irrigated native planting.
4. Neighbourhood Park	Neighbourhood park forming a connection with the CCW and CCW buffer, and located on the western side of the power easement. The park will provide pedestrian connections from adjacent residential areas through the power easement. The POS will feature irrigated native planting and turf areas.
5. Local Park	Local park providing drainage function. Features native, non-irrigated planting.
6. Local Park	Local park providing drainage function and ecological linkage with adjacent bush forever site. Features pedestrian links to adjacent residential lots and irrigated native planting and turf.
7. Neighbourhood Park	A neighbourhood park which has been designed in the context of the adjacent Bush Forever site, positioned to provide a continued connection of vegetation, forming a regional ecological linkage. The park will retain and conserve Banksia Woodlands of the Swan Coastal Plain and Black Cockatoo Potential Breeding Trees. Weed eradication and revegetation will be provided where appropriate. The park will feature limestone firebreaks.
8. Local Park	A local park with no drainage function, providing an interface to the adjacent rural water resource area. The POS will feature irrigated native planting.
9. Local Park (incorporates REW buffer)	A local park which incorporates the 30m REW buffer, ensuring protecting of the REW whilst also providing an appropriate interface to the rural water resource area. Existing trees to be retained. Weed eradication and revegetation will be provided as required. A 1-year drainage basin is located in the 30m wide REW buffer.
10. Conservation Category Wetland	The CCW will be preserved, and minimal landscape works are to take place, involving weed eradication and revegetation as required.
11. Conservation Category Wetland Buffer	The CCW buffer will feature limestone footbaths, which will have a dual functionality as firebreaks. Weed eradication and native non-irrigated planting and revegetation will be provided as required.
12. Power Easement	The power easement will incorporate the 1:100 drainage basin. Features an irrigated turf area connection to the adjacent POS 4 (subject to Western Power / City of Kwinana approval). Limestone access tracks to Western Power Towers will also be provided. Non-irrigated native planting and revegetation will be provided, with trees and planting limited to typically 1m in height.



POS PROVISION SUMMARY

(1)	Neighbourhood Park (Active Play Area)	3.1759 ha
(2)	Neighbourhood Park (Tree Retention/Active and Passive)	3.9989 ha
(3)	Local Park	0.1745 ha
(4)	Park Neighbourhood	1.0091 ha
(5)	Local Park	0.3165 ha
(6)	Local Park	0.3600 ha
(7)	Neighbourhood Park	2.4363 ha
(8)	Local Park	0.0904 ha
(10)	Wetland Buffer (CCW)	4.9217 ha
(11)	Wetland Core (REW)	0.4288 ha

DEDUCTIONS

(D1)	Drainage Swale (1:1 year event)	0.0450 ha
(D2)	Drainage Swale (1:1 year event)	0.1750 ha
(D3)	Drainage Swale (1:1 year event)	0.0074 ha
(D4)	Drainage Swale (1:1 year event)	0.1970 ha
(D5)	Drainage Swale (1:1 year event)	0.0675 ha
(D6)	Drainage Swale (1:1 year event)	0.0800 ha
(D7)	Wetland Core (CCW)	3.9362 ha

Figure 17 Public Open Space

TABLE 10 PUBLIC OPEN SPACE SCHEDULE

	HECTARES	
Total Structure Plan Area[1]		94.3238
Deductions		
Primary School	3.5000	
Service Commercial	6.0898	
CCW Core	3.9362	
Drainage (1:1)	0.5719	
Powerline Easement	6.3674	
Surplus Restricted Public Open Space	4.5530	
Total Deductions	25.0183	
Gross Subdivisible Area		69.3056
Required Public Open Space (10%)		6.9306
PUBLIC OPEN SPACE REQUIREMENTS		
Unrestricted public open space (minimum 80% total)	5.5444	
Restricted public open space (maximum 20% total)	1.3861	
PUBLIC OPEN SPACE PROVISION		
Unrestricted Public Open Space		
POS 1	3.1617	
POS 2	3.8019	
POS 3	0.0945	
POS 4	1.0091	
POS 5	0.2490	
POS 6	0.2152	
POS 7	2.4363	
POS 8	0.0904	
POS 9 (incorporates REW Wetland Buffer)	0.1270	
Total Unrestricted Public Open Space		**11.1851**
Restricted Public Open Space		
CCW Buffer	4.9217	
REW Core	0.4288	
Drainage (1:5)	0.5886	
Total Restricted Public Open Space		**5.9391**
Total Credited Restricted Public Open Space		**1.3861**
TOTAL CREDITED PUBLIC OPEN SPACE		**12.5712**
Percentage of Public Open Space Provided (Unrestricted and Restricted POS Contribution)		**18.14%**

[1] Land area excludes Landgren Road (1.7985 hectares)

WETLANDS AND BUFFERS

CONSERVATION CATEGORY WETLANDS

All three CCWs in the south west corner of the subject site have been prioritised for retention. Implementation of the Structure Plan will lead to long-term conservation of the wetland and subsequent enhancement of their buffer, which is currently completely degraded, providing greater protection for the riparian vegetation within the CCWs.

In relation to the wetland mapping for the largest CCW located within the south western portion of the site, the mapped wetland boundary does not align with the area of intact wetland vegetation that has been mapped by 360 Environmental (2018). The completely degraded state of the western portion of the mapped CCW has been considered in the Structure Plan design, and a 50m buffer has been defined by following the area of intact wetland vegetation.

As part of the future development and prior to subdivision, a detailed wetland assessment will be undertaken to evaluate the wetland's values and accurately map the CCW boundary.

RESOURCE ENHANCEMENT WETLANDS

Consistent with the policy framework, the Primary School and co-located oval is located within the north eastern portion of the subject site, which falls across the western most tip of the REW. Aerial imagery identifies the same REW has been dissected by a road, and has been cleared within Lot 32. This has resulted in a small pocket of REW within Lot 45 becoming isolated from the remainder of the wetland located further to the east within Lot 31.

As a result, retention and management of this small area of the REW is in the long-term is unviable and not a high priority for retention, where balanced against the State and Federal significant environmental attributes within the subject site. Therefore, approximately 0.64 ha of the REW in Lot 45 will be removed,

Despite the REW being removed, the Primary School and the oval have been oriented to retain the vegetation in this location.

The remaining REW within Lot 31, which is part of the larger intact wetland vegetation that extends further east into the adjacent Bush Forever site 273 is proposed to be retained, along with the provision of a 30m wetland buffer.

LANDSCAPE DESIGN

A Landscape Masterplan has been prepared by Emerge Associates in order to inform open space development, the LWMP and Bushfire Hazard Assessment (refer **Appendix I**). The Landscape Strategy is indicative only and subject to detailed design at the subdivision stages.

The landscape treatments for the development will occur over a series of distinct areas as outlined below. The project theming, detailing and material selection will inform a cohesive open space network. Refer **Figure 13** which includes the Landscape Concept over the main area of POS.

STREETSCAPES

The streetscapes consist of a variety of treatments from typical residential streets with street trees on standard alignments to wider verges in major access streets which accommodate landscape planting and drainage within adjacent POS areas where necessary.

Street tree planting will be provided along access streets and avenue tree planting will be provided along the Structure Plan area's major access streets. Footpaths will be located in accordance with LN and will be integrated throughout the Structure Plan area.

POS FUNCTIONALITY

The POS is intended to contain public facilities deemed suitable for the intended local population. POS will include a playground area, picnic node with park furniture, expansive open turf areas and swales for local drainage purposes. The CCW and CCW buffers will be revegetated as required to ensure the environmental qualities are preserved. A series of pedestrian paths are provided throughout the POS areas and across the power easement to ensure maximum pedestrian accessibility to and throughout the POS. POS areas will contain a variety of materials that meet the City's long-term maintenance needs. The location of landscape elements within the POS have been arranged for maximum accessibility by all future residents and meeting CPTED and good urban design principles.

3.5 WATER MANAGEMENT

LOCAL WATER MANAGEMENT STRATEGY

A Local Water Management Strategy (LWMS) has been prepared by Hyd2o in support of the Structure Plan (refer **Appendix F**). The LWMS has been developed to establish the concepts and broad level design measures for flood mitigation and stormwater management for the Structure Plan area. The intention of the LWMS is to guide the general stormwater management principles and to guide the preparation of the Urban Water Management Plan(s) (UWMP) that will be prepared at the subdivision stage.

The LWMS has been prepared to:

- provide the conceptual stormwater management framework for urban development;
- describe the proposed design measure and Best Management Practices (BMP) to be incorporated in the stormwater management system;
- minimise development construction costs and ongoing operation and maintenance costs for landowners and the City of Kwinana; and
- to obtain the Department of Water and City of Kwinana's support for the stormwater management strategy.

Key elements of the system which are reflected in the Structure Plan include:

- maintenance of existing CCWs within the site with all stormwater infrastructure located outside of the wetland buffers;
- promotion of infiltration through the soil profile; and
- discharge of the 1 in 100-year events consistent with the Jandakot District Water Management Plan (DoW, 2009).

The stormwater management concept and post development mapping for the site is included in the LWMS. Six main stormwater catchments have been identified in consultation with the project engineers Cossill & Webley, five of which are catchments which infiltrate and one which discharges towards the Peel Sub 1A drain.

Development levels in the site will be largely dominated by fill requirements to achieve adequate separation to groundwater, given the proximity of groundwater levels to natural surface. Whilst it is not envisaged that subsoil drainage will be required within the development, should localised subsoil drainage be required to manage groundwater within the stormwater storage areas this will be investigated at detailed design stage.

Finished lot levels and fill requirements are a detailed design issue to be addressed during the preparation of detailed engineering design drawings and preparation of the UWMP.

3.6 MOVEMENT NETWORK

A Traffic Assessment was completed by Riley Consulting for the Structure Plan and based on the detailed design elements contained on the Development Concept Plan (**Appendix G**). The Structure Plan and supporting Development Concept Plan have been designed based on the recommendations of Liveable Neighbourhoods relating to the movement network. The Movement Network / Road Hierarchy Plan in **Figure 21** describes and supports this approach.

EXTERNAL ROAD NETWORK

The Structure Plan will accommodate a highly permeable grid movement network influenced by the existing road network as depicted on the Development Concept Plan.

As previously discussed, the areas to the north and south of the subject site also require structure plans prior to development. The structure plan which was advertised for the Northern Precinct proposes new road connections to Thomas Road. This will be important connections to the south to enable the Central Precinct development to access Thomas Road in the future.

The traffic modelling undertaken to determine the traffic generated by the structure plan includes the development to the north and south to ensure the future development impacts are assessed on the internal road network and an appropriate road hierarchy is provided for. As discussed in **Section 2.4**, Bombay Boulevard provides a critical link between Orton Road and Thomas Road. It is necessary that Bombay Boulevard remains open until at least the Landgren Road extension is constructed through to Thomas Road. It is preferable for consideration to be given to Bombay Boulevard's ongoing use and possible connection to the Landgren Road extension when in operation, and disconnection from Thomas Road occurs. It is necessary for the State and Local Government to ensure the ongoing use of Bombay Boulevard through necessary acquisition or securing of an appropriate public easement for the section which is with private freehold ownership.

The modelling shows traffic generated by the three land areas accessing Thomas Road and Mortimer Road, and the internal road traffic demands based on Liveable Neighbourhood thresholds.

Depending on the final design of the structure plan in the northern precinct, Orton Road may be diverted to enable a continuous area of District and Local Open Space between the Central and the Northern Precincts as understood to be the preferred open space structure by the City of Kwinana.

INTERNAL ROAD NETWORK

With an indicative dwelling yield of approximately 990 dwellings and the Service Commercial land in the north-western corner of the site, the Structure Plan is forecast to generate 8,676 residential trips and 2,100 commercial trips, resulting in a total of 10,776 trips per day.

The internal road network features a series of roads to complement the surrounding network, as identified in **Figure 21**.

NEIGHBOURHOOD CONNECTORS

Landgren Road is shown to carry less than 5,000 vehicles per day through the subject site, and is therefore to be classified as a neighbourhood connector.

Landgren Road will provide the main north-south spine through the Structure Plan area and will also provide access to the future primary school.

Landgren Road will extend through to Southern Precinct via an extension from the end at its current location when structure planning for the Southern Precinct occurs.

A 25m wide road reservation is identified for Landgren Road to provide a boulevard style treatment (Refer **Figure 18**). This road treatment is similar to that applied to Honeywood Boulevard in the suburbs of Aubin Grove / Wandi to the north.

ACCESS STREETS TYPE C

The higher order residential streets within the subject site will be classified as Access Road Type C as traffic demands are below the threshold of 3,000 vehicles per day.

A 6.5 to 7.0m road pavement is suited to these residential streets with a residual verge of a minimum of 4.5m. A minimum road reservation width of 16 metres is suited to these streets (refer **Figure 19**).

ACCESS STREETS TYPE D

Access Street Type D will be the most used road classification within the Structure Plan area. These roads are quiet residential streets and predominantly provide access to frontage properties.

Access Street connections will be provided to the land to the south for connecting into when structure planning occurs for the Southern Precinct.

A 5.5m wide pavement is suited to these streets to ensure traffic is not encouraged to drive at inappropriate speeds. Combined with 4.5m residual verges the minimum road reservation would be 15m (refer **Figure 20**).

NEIGHBOURHOOD CONNECTOR

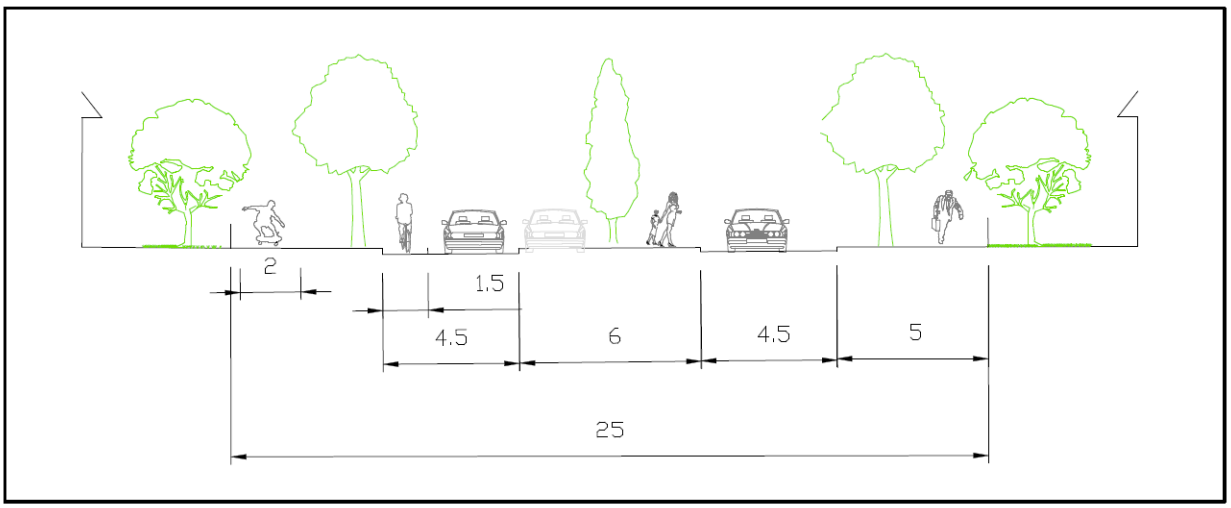


Figure 18 Neighbourhood Connector Typical Cross Section

ACCESS STREET TYPE C

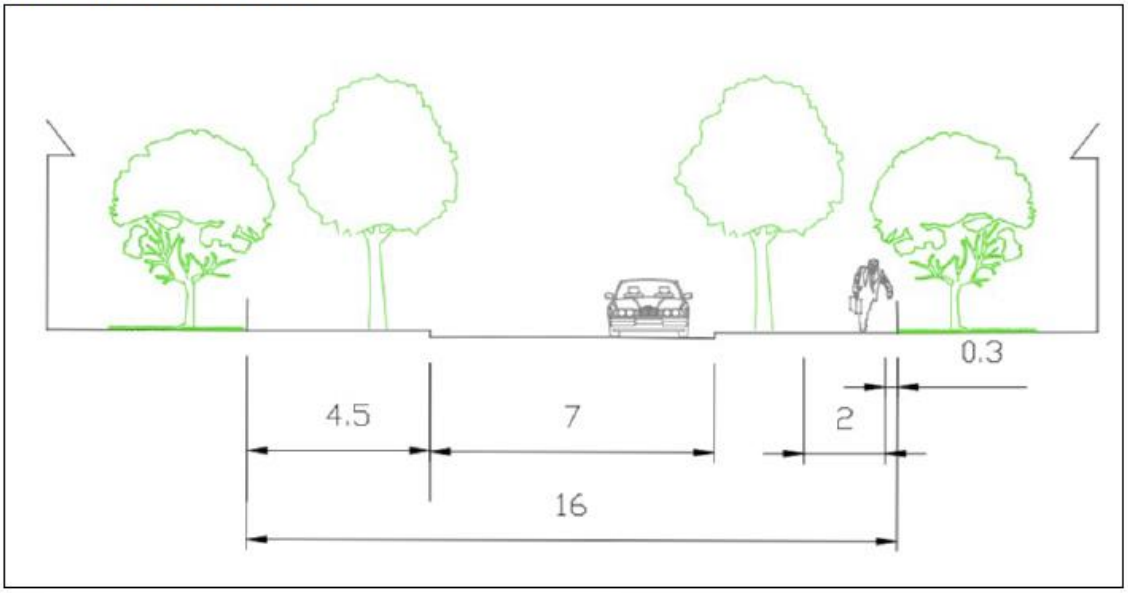


Figure 19 Access Street Type C Typical Cross Section

ACCESS STREET TYPE D

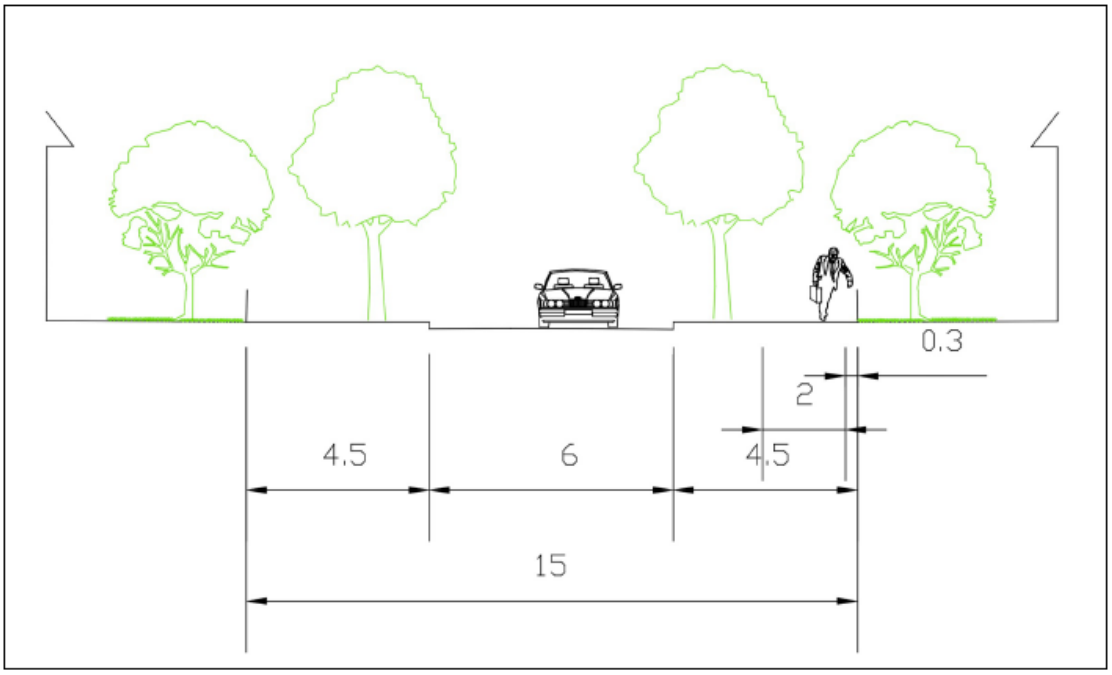


Figure 20 Access Street Type D Typical Cross Section

INTERSECTIONS

All roads within the subject site have low traffic demand with no street shown to carry more than 5,000 vehicles per day. The modelling shows that no four-way intersection between access streets will require control. Give way markings are appropriate at all internal road intersections.

Two roundabouts are proposed on Landgren Road to provide U-turn opportunity for frontage properties and to provide speed management. The northern roundabout will provide safe access to the primary school.

A potential third roundabout at the southern end of the subject site, which may be required when the land to the south is developed.

There are no roads within the subject land holding that would require control of access to frontage properties. Properties fronting Landgren Road will be restricted to left-in / left-out movements due to the median.

WALKING AND CYCLING NETWORK

A footpath will be provided along at least one side of all access streets, higher order access streets and adjacent to POS. A shared path network is also proposed to provide safe and appropriate access to the primary school. The provision of the central median in Landgren Road will also provide refuge for pedestrians, in particular children crossing this road.

All roads will have relatively low traffic flows, and therefore pedestrian crossings are not required to be provided. Pedestrians will not be restricted in crossing any internal road as a result of the passing traffic.

On street cycle lanes will be provided on both sides of Landgren Road to accommodate the high level of service to cyclists within the locality.

The Transport Impact Assessment concluded the structure plan achieves a permeable and walkable environment and a safe walking environment to the future primary school.

This pedestrian and shared path network is detailed on **Figure 21** with shared paths also depicted on the Structure Plan.

PUBLIC TRANSPORT ROUTES

The majority of dwellings will be within 400 metres of Landgren Road where future bus services can be expected to operate. The route would eventually pass through the northern and southern precincts and link to the Kwinana railway station.

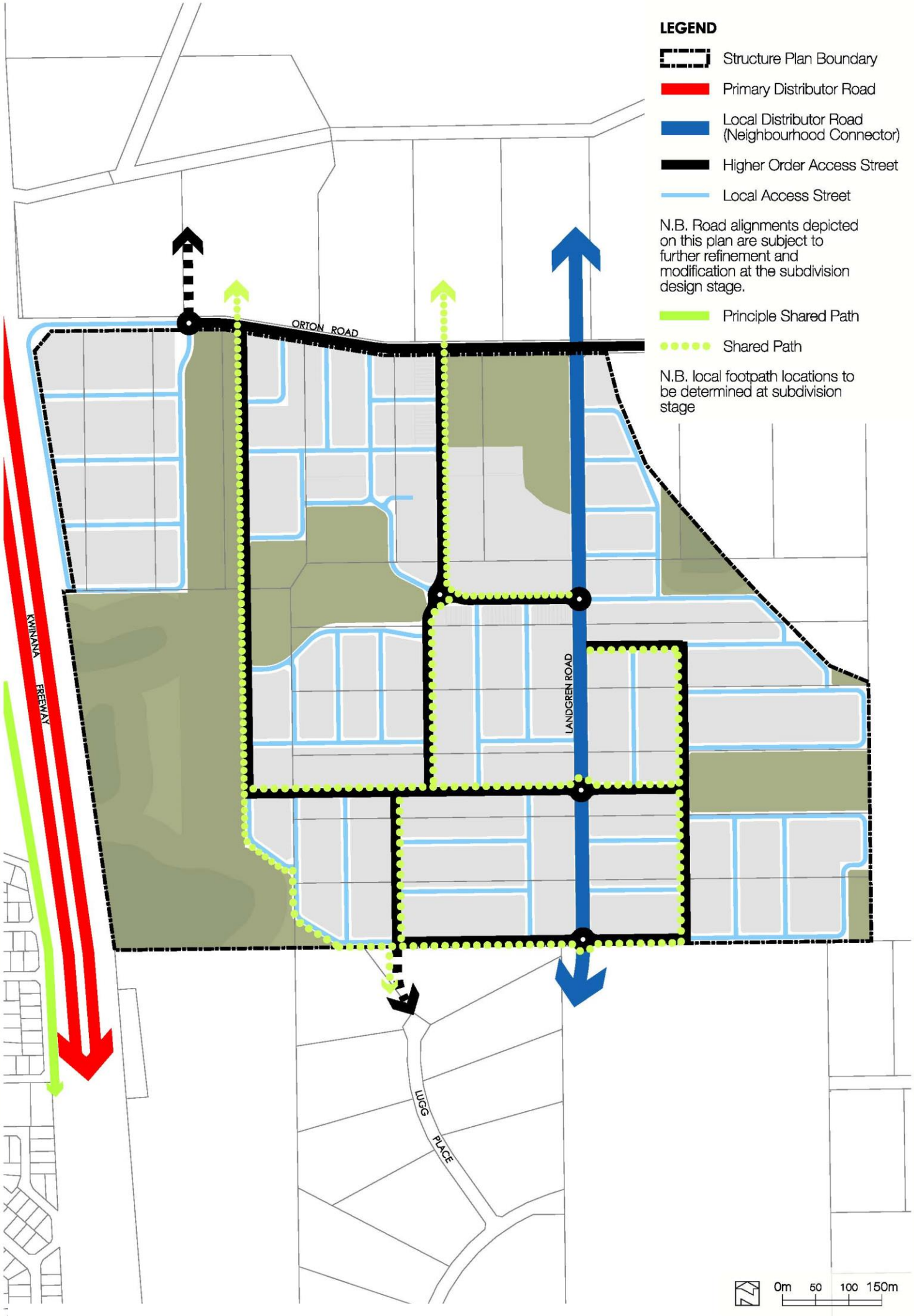


Figure 21 Movement Network

3.7 TRANSPORTATION NOISE ASSESSMENT

A Transportation Noise Assessment has been undertaken by Lloyd George Acoustics to assess the noise impact on the Structure Plan area from transportation along the Kwinana Freeway in accordance with the criteria of SPP 5.4.

The assessment included noise measuring and modelling which concluded with no noise control, road traffic noise levels for future dwellings in the south-western corner of the subject site will exceed the acceptable target by the forecast year of 2031, which is only a small portion of residents within the Structure Plan area. Additionally, the modelling concluded that road traffic noise levels for upper storeys in multi-storey dwellings along the western edge of the site, adjacent to the power easement were predicted to exceed the target by the forecast of year 2031.

As such, noise mitigation must be implemented. To achieve the target noise level required in SPP 5.4 for the lots in the south-west corner of the site, a noise wall in excess of 4.5 metres high would be required to the west of the access road in the south-west corner. This is considered impractical, in excess of the maximum acceptable wall height in Western Australia and would have a negative impact on the streetscape. Alternatively, to minimise noise levels, various architectural treatments would be applied to future dwellings in the form of Package Treatment requirements. The affected lots will also have notifications on titles, in accordance with SPP 5.4 requirements.

Additionally, architectural treatments would be applied to the upper storeys of dwellings predicted to experience future noise levels above the target along the western edge of the subject site. These lots would also require notifications on title to advise prospective purchasers that additional noise mitigation requirements are required if a multi-storey dwelling is to be constructed.

Road traffic noise will also impact the service commercial / mixed business area located on the western side of the power easement, however as this land will not be developed for residential purposes, noise mitigation measures are not required to be identified at this stage. Some form of noise mitigation may be required on these sites if land uses are proposed which are considered to be 'sensitive' in SPP 5.4, such as child care centres, educational buildings and places of worship, are proposed. The requirement for noise mitigation will depend on the location of the non-residential sensitive uses and the height and orientation of adjacent buildings. As such, these lots will have notifications on titles advising of SPP 5.4 requirements in relation to non-residential sensitive uses.

4 IMPLEMENTATION AND STAGING

4.1 STRUCTURE PLAN

This Structure Plan will be in operation until such time as the Town Planning Scheme has been 'normalised'.

4.2 MANAGEMENT PLANS

Management Plans will be prepared at the subdivision stage, as detailed in Part One.

4.3 STAGING

Development of the Structure Plan area is likely to progress in a north to south direction extending from Orton Road. The main considerations for this approach include:

i) There is existing road access into the Structure Plan area via Orton Road and Landgren Road.
ii) Construction of a wastewater pumping station north of Orton Road will be required to service the development and the connecting gravity sewer mains will be extended from this pumping station into the development.
iii) All other existing services including water, power and gas are located either within Orton Road or Landgren Road and can be extended to service development.

As mentioned, it is important that the State and Local Governments ensure the ongoing use of Bombay Boulevard as the critical link between Orton Road and Thomas Road for the Central Precinct. Until such time as the Landgren Road extension occurs, it is important that Bombay Boulevard remains in service for public use.

The initial stages of subdivision will continue to utilise Orton Road to provide access into the subject site and east of the subject site. It is acknowledged that subject to the detailed planning in the Casuarina North Precinct proposing District Open Space north of the subject site, Orton Road may be diverted to enable a continuous area of District and Local Open Space between the Central and the Northern Precincts.

Development staging is likely to be refined further, particularly given there is an element of fragmented land ownership, although the majority landowner within the Precinct is likely to commence development first. The following provides the basis for future decision-making:

i) Construction to occur in 40-60 lots stages.
ii) Construction to occur in consecutive staging subject to market conditions.

APPENDIX A
PRE-LODGEMENT CONSULTATION

AGENCY	DATE OF CONSULTATION	METHOD OF CONSULTATION	SUMMARY OF OUTCOME
Local Government – City of Kwinana	31 May 2018	Meeting	• City's preference for POS to be co-located with the Primary School. • City's preference regarding POS to be provided is 8%, comprising 6% unrestricted and 2% restricted. • Requirement for Landgren Road to align with the existing intersection of Nicholas and Mortimer Roads, and alignment of the road through the 3 precincts if fluid. • The road network along the western edge would be best served by reducing the potential for residential and service/commercial traffic to interact and the road structure / network should respond accordingly. • LPP No. 1 – Landscape Feature and Tree Retention: tree survey to be undertaken as part of SP. • City acknowledged the document should be consistent with Structure Plan Framework. • Northern cell – Aigle Royal's SP covers the western and north one third of the Northern precinct for bulky goods / commercial land use. • TBB advised EPBC Act referral is in preparation and will be lodged. • Mushroom Farm: City confirmed importance of addressing the interface to the Mushroom farm through appropriate land uses, and importance of appropriate transport links. • Powerline Easement: City acknowledged development of the easement in line with what has been undertaken in other locations within he City such as within Anketell South SP area is appropriate. • Road reserve sizes: City confirmed preference for 15.4m wide local access streets, however would consider other potential cross sections taking into consideration the City's amenity and streetscape policy. Other examples in the City are 15m
	25 July 2018	Meeting	• Presented a draft Concept Plan for the location of POS, emphasising the constraints posed by wetlands, vegetation and easements which inhibited achievement of reduced POS.
	6-19 September 2018	Meeting and email	• Feedback sought on Revised Draft Concept Plan to inform Structure Plan • City advised its preference was for POS to

			be co-located with the Primary School, with the POS on Orton Rd so as to provide for co-location with DOS and a local centre on the north side of Orton Rd. In this regard, a copy of the Casuarina North LSP Context plan was provided showing the location of the DOS on the north side of Orton Rd. • Balance between tree retention/conservation POS and active POS is required. The City appreciates that this may mean that reduced POS (8%) may not be able to be achieved in this Precinct. • City subsequently provided advice that a marked up plan to suggest that consideration was being given to disconnection of Orton Rd to enable co-location of sporting facilities and a more direct road connection between the commercial areas in the north and central structure plan areas, as well as a connection between Bombay Blvd and the extension of Landgren Rd (even just as an interim measure). • City advised 3.5ha was suitable for the PS site and approx. 4.2ha of co-located POS subject to siting of oval (which may result in less than 4.2ha). This was also supported by DoEd (as advised by City).
	29 September 2018	Letter	Submission prepared on Casuarina North Structure Plan. Matters raised include: Need for greater level of detail on the Northern Concept Plan (particularly the are noted as 'subject to future planning') to facilitate structure planning and concept plan preparation in the central precinct, as well as to understand any potential land uses conflicts between the two areas, drainage design etc; Raised inconsistencies between Northern Concept Plan and the accompanying Traffic Impact Assessment; Raised inconsistencies in land use designations in the northern concept plan (Appendix 1) and the Structure Plan; Absence of Retail Assessment to support land use designation in order to inform the extent of service commercial that can also be supported in the Central Precinct; Further analysis of road planning between Orton and Thomas Rd and traffic volumes required.
	3- 27 November 2017	Meeting	City advised it was preparing a Local Planning Policy for Casuarina. A preliminary draft of the policy was discussed and a copy of the Draft LPP was subsequently provided on 6 November 2017 for comment. A

			submission was made on the Draft LPP on 27 November 2017. Submission raised the following points of relevance to structure planning in the Central Precinct: The size of the co-located PS in the context of the recommendations in DCP 3 and the City's CIP (2015); The ability to reduce POS provision to 8% and justification for cash-in-lieu requirement to fund acquisition of land in the Southern Precinct; Need to confirm formal temporary and permanent arrangements for road connection between Orton and Thomas Rds in order to provide certainty for development in Casuarina (including retention of Bombay Boulevard until Landgren Rd is extended); Local Centre to be confirmed in the Northern Precinct;
	21 May 2018	Email	City advised proposed LPP 6 – Guidelines for Structure Planning in the Casuarina Cell to be presented to Council on 23 May 2018. Council adopted a modified policy which: Changed the requirement for 7.2ha of POS in the Central Precinct to the requirement for the co-location of POS and PS in accordance with a revised CIP; Require odour and noise assessments to demonstrate adequate separation between the mushroom farm and sensitive land uses; Require potential land use compatibility matters to be taken into account and appropriately mitigated abutting Rural water Resource Zone;
Department of Planning, Lands and Heritage	24 October 2018	Meeting	• Introduced overall concept and approach to Structure Plan. • Design influenced by key strategic documents including Jandakot District Structure Plan and City of Kwinana Eastern Residential Intensification Concept Plan. • Other design considerations include co-located oval and primary school, Landgren Road extension, and other non-residential uses. • Bombay Boulevard's ongoing use was raised and the need for this to be protected for future connection between Orton Road and Thomas Road. • Summary of prior discussions with the City of Kwinana. • DPLH supported application of Structure Plan Framework approach.

	29 & 30 October 2018	Email	• Clarification regarding application of Density Code Ranges. Support provided by DPLH.
Department of Water and Environmental Regulation	28 February 2018	Email	Reduction of groundwater monitoring for last winter.
Department of Education	21 June 2018	Email	The DoE advised the minimise size the school can be with a shared oval is 3.5ha with appropriate road access surrounding the school.

APPENDIX B
ENVIRONMENTAL ASSESSMENT REPORT



intelligent outcomes | respected experience

Casuarina Central Precinct
Local Structure Plan

Environmental Assessment Report

Prepared for
CDN No1 Pty Ltd
by Strategen

December 2018

strategen
ENVIRONMENTAL

Casuarina Central Precinct
Local Structure Plan

Environmental Assessment Report

Strategen is a trading name of
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ACN: 056 190 419

December 2018

Limitations

Scope of services

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

Reliance on data

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

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

Environmental conclusions

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

Client: CDN No1 Pty Ltd

Report Version	Revision No.	Purpose	Strategen author/reviewer	Submitted to Client	
				Form	Date
Preliminary Draft Report	A	Client Review	C Lehman / K Choo / D Newsome	Electronic	20/11/2018
Draft Report	B	Client Review	K Choo	Electronic	04/12/2018
Final Report	0	For lodgement	K Choo	Electronic	11/12/2018

Filename: PRP17655.02_R001_Rev_0 - 11 December 2018

Table of contents

1. Introduction 1

1.1 Background 1
1.2 Local Structure Plan 1
1.3 Planning Background 1
1.3.1 Zoning 1
1.3.2 Metropolitan Region Scheme Amendment 1
1.3.3 Jandakot Structure Plan 2
1.3.4 Eastern Residential Intensification Concept 2
1.4 Objectives 2

2. Legislation, policy and guidelines 4

2.1 Commonwealth 4
2.1.1 Assessment under the EBPC Act 1999 4
2.1.2 Policy, recovery and conservation advice 4
2.2 State 5
2.3 Local 9
2.3.1 Overview 9

3. Existing environment 10

3.1 Climate 10
3.2 Topography, landform and soils 10
3.2.1 Acid sulfate soils 11
3.3 Hydrology 11
3.3.1 Groundwater 11
3.3.2 Surface water 12
3.3.3 Public drinking water source areas 12
3.3.4 Flood potential 12
3.3.5 Wetlands 13
3.4 Potentially contaminating activities 13
3.4.1 Contaminated Sites Register Database 13
3.4.2 Current land use(s) 13
3.4.3 Previous land use(s) 13
3.5 Biodiversity and natural assets 16
3.5.1 Flora and vegetation 16
3.5.2 Floristic Community Types 20
3.5.3 Fauna 24
3.5.4 Surrounding conservation areas 27
3.5.5 Ecological linkages 27
3.5.6 Environmentally sensitive areas 27
3.6 Bushfire risk 28
3.7 Cultural heritage 29
3.7.1 Aboriginal heritage 29
3.7.2 European heritage 29
3.8 Surrounding Land uses 29
3.8.1 Mushroom farm 29

4. Potential impacts and management measures 31

4.1 Acid Sulfate Soils 31
4.1.1 Policy and management objectives 31
4.1.2 Local Structure Plan considerations 31
4.1.3 Management requirements 31
4.1.4 Predicted outcomes 31
4.2 Potential contamination and future land use 32
4.2.1 Potential impacts 32
4.2.2 Policy and management objectives 32
4.2.3 Predicted environmental outcomes 32
4.2.4 Secondary approval requirements 32
4.3 Hydrology 32
4.3.1 Potential impacts 32
4.3.2 Policy and management objectives 33
4.3.3 Local Structure Plan considerations 34
4.3.1 Management requirements 34
4.3.2 Secondary approval requirements 35

4.4 Biodiversity and natural assets 35
4.4.1 Potential impacts 35
4.4.2 Policy and management objectives 35
4.4.3 Local Structure Plan considerations 36
4.4.4 Management requirements 36
4.4.5 Predicted environmental outcome 37
4.4.6 Secondary approval requirements 37

5. References 39

List of tables

Table 1: Lots within the Project Area 1
Table 2: Federal policies and guidance 4
Table 3: Other relevant legislation 5
Table 4: Policies and guidance statements 6
Table 5: Strategies, Local Planning Policies and By-Laws 9
Table 6: Groundwater abstraction licences within the Project Area 12
Table 7: Vegetation types mapped within the Project Area 18
Table 8: Vegetation condition 20
Table 9: Likelihood of Threatened and Priority Fauna species occurring within the vicinity of Project Area 24
Table 10: Management measures for ASS 31
Table 11: Management measures for potential contamination 32
Table 12: Water management principles 34
Table 13: Management measures for hydrology 35
Table 14: Occurrence of key environmental attributes within the POS areas 36
Table 15: Management measures for Biodiversity and Natural Assets 37

List of figures

Figure 1: Project Area 3
Figure 2: Topography, landform and soils 14
Figure 3: Hydrology 15
Figure 4: Surrounding conservation estates 17
Figure 5: Vegetation types 21
Figure 6: Vegetation condition 22
Figure 7: Banksia Woodlands TEC 23
Figure 8: Black Cockatoo Habitat 26

List of appendices

Appendix 1 Casuarina Central Precinct Local Structure Plan
Appendix 2 Flora, Vegetation and Black cockatoo habitat assessment (360 Environmental 2018)
Appendix 3 Targeted Spring Flora Survey
Appendix 4 Black cockatoo tree hollow assessment
Appendix 5 (COSTA) Mushroom Exchange, Casuarina Revision of Predicted Odour Levels Based on Sampling of Sterilisation Building Emissions (Environmental Alliances 2015)

1. Introduction

1.1 Background

CDN No1 Pty Ltd (CDN) are proposing to develop land within the Casuarina Central Precinct Local Structure Plan, which is bounded by Kwinana Freeway to the west, Orton Road to the north a conservation reserve to the east and rural residential properties to the south (the Project Area; Figure 1). CDN are proposing to develop the Project Area for residential, mixed business, a primary school, Public Open Space (POS) and conservation areas. Currently, the Project Area is comprised of various rural residential and vacant lots.

The Project Area occurs approximately 30 km south of the Perth CBD directly adjacent to the Kwinana Freeway. In addition to the proposed residential and mixed-use business, the Project Area planning has also provided space for an overhead power line easement which will be located on the western side of the development running north to south (Appendix 1).

Table 1: Lots within the Project Area

Lot number	Plan	Lot number	Plan	Lot number	Plan
24	P008390 24	37	P008390 37	45	P008390 45
25	P008390 25	38	P008390 38	46	P008390 46
31	P008390 31	39	P008390 39	47	P008390 47
32	P008390 32	40	P008390 40	48	P008390 48
33	P008390 33	41	P008390 41	49	P008390 49
34	P008390 34	42	P008390 42	50	P008390 50
35	P008390 35	43	P008390 43	1	P045805 1
36	P008390 36	44	P008390 44	9000	P048382 9000

1.2 Local Structure Plan

A Local Structure Plan has been prepared which includes residential and non-residential lots, roads, the powerline easement and areas of managed and active POS (Appendix 1).

The proposed development layout and activities within the Project Area includes POS for future conservation to support retention of the site's most significant environmental attributes and demonstrates linkages to Regional Open Space (ROS).

1.3 Planning Background

1.3.1 Zoning

Currently, all lots within the Project Area are zoned urban under the Metropolitan Regional Scheme (MRS) and Development under the City of Kwinana's Town Planning Scheme No. 2.

1.3.2 Metropolitan Region Scheme Amendment

The Project Area was part of an MRS Amendment for a wider area (No. 1117/33 Jandakot Structure Plan, Cell 4 – Casuarina), which rezoned the land from Rural to Urban Deferred in 2006. The MRS amendment was referred to the Environmental Protection Authority (EPA) under Part IV of the *Environmental Protection Act 1986* (EP Act) for its consideration.

The EPA advised that MRS Amendment 1117/33 did not require assessment under Part IV of the EP Act. The EPA provided advice on drainage, special catchment requirements (Peel Harvey), wetlands, remnant vegetation, fauna, soil and groundwater contamination, emissions, noise and vibration.

1.3.3 Jandakot Structure Plan

In August 2007, the Jandakot Structure Plan was finalised. The structure plan coordinates and guides future development of the area, whilst managing key environmental issues.

The structure plan identifies environmental issues such as nutrient, drainage and water resource management as well as conservation areas and how these issues could be addressed during the subsequent stages of planning.

1.3.4 Eastern Residential Intensification Concept

The Town of Kwinana prepared the Eastern Residential Intensification Concept (ERIC) in 2005 to provide further guidance on land use planning for the urban growth areas of Mandogalup, Wandi, Anketell, Casuarina and Wellard.

1.4 Objectives

The objective of the Environmental Assessment Report (EAR) is to:

- describe the environmental values within the Project Area and surroundings based on existing information
- demonstrate that the key environmental considerations associated with future development have been adequately considered and can be managed in accordance with the relevant policy requirements and
- Identify potential opportunities to secure and manage the significant environmental values on site
- develop appropriate environmental management measures that will be implemented as part of future development and subdivision of the site.

To ensure that an integrated approach is developed for the precinct area the EAR has been prepared in parallel with the Local Water Management Strategy (LWMS) and Bushfire Management Plan (BMP).



Figure 1: Project area

N

Scale 1:10,000 at A4

0 100 200 m

Legend

- Project Area (96.12 ha)
- Cadastral boundaries

Coordinate System: GDA 1994 MGA Zone 50

Date: 13/11/2018

Q:\Consult\2017\PRP\PRP17655\01_GIS_documents\ArcMap_documents\PRP17655_G003_RevB.mxd

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Data source: Nearmap: Aerial image, flown 06/2018. Landgate: Cadastre, 11/2017. Client: LWP Property Pty Ltd. Development layout, 08/2018. Created by: c.thatcher

2. Legislation, policy and guidelines

The following legislation, policies and guidelines and their implementation may be applicable for the redevelopment of the Project Area.

2.1 Commonwealth

The Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) is administered by the Department of the Environment and Energy (DEE). The EPBC Act aims to protect and manage nine Matters of National Environmental Significance (MNES) throughout Australia including:

- World Heritage Properties
- National Heritage Places
- wetlands of international importance (listed under the Ramsar Convention)
- listed threatened species and ecological communities
- migratory species protected under international agreements
- Commonwealth Marine Areas
- the Great Barrier Reef Marine Park
- nuclear actions (including uranium mines).

The MNES applicable for the site is listed threatened species and ecological communities:

- Banksia Woodlands of the Swan Coastal Plain Threatened Ecological Community (TEC)
- Black cockatoo foraging habitat and potential breeding trees, namely Carnaby's Cockatoo (Calyptorhynchus latirostris) and Forest Red-tailed Black Cockatoo (Calyptorhynchus banksii naso).

2.1.1 Assessment under the EBPC Act 1999

Under the EPBC Act an action that could be a significant impact on any MNES in accordance with the Significant Impact Guidelines 1.1-Matters of National Significance (Department of the Environment, Water, Heritage and the Arts, 2013) should be referred to the DEE for assessment by the minister.

2.1.2 Policy, recovery and conservation advice

The recovery plans and conservation advice relevant to the precinct include the following (Table 2).

Table 2: Federal policies and guidance

Policy, recovery plan/advice	Description/Objective	Regulatory authority	Relevance
Conservation advice for the Banksia Woodlands of the Swan Coastal Plain ecological community (2016)	To mitigate the risk of extinction of the Banksia Woodlands of the Swan Coastal Plain ecological community, and help recover its biodiversity and function.	DEE, OEPA, DBCA, Department of Water and Environmental Regulation (DWER) City of Kwinana	Removal and protection/restore TEC.
Carnaby's Cockatoo (*Calyptorhynchus latirostris*) Recovery Plan (2013)	To stop further decline in the distribution and abundance of Carnaby's cockatoo by protecting the birds throughout their life stages and enhancing habitat critical for survival throughout their breeding and non-breeding range, ensuring that the reproductive capacity of the species remains stable or increases.	DEE, OEPA, DBCA and DWER	Removal of significant fauna habitat.

Policy, recovery plan/advice	Description/Objective	Regulatory authority	Relevance
Baudin's Cockatoo (*Calyptorhynchus baudinii*) and Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) Recovery Plan (2008)	To stop further decline in the breeding populations of Baudin's Cockatoo and the Forest Red tailed Black Cockatoo and to ensure their persistence throughout their range in the south-west of Western Australia.	DEE, OEPA, DBCA and DWER	Removal of significant fauna habitat.
Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy (2012)	To compensate for the residual adverse impacts of an action on the environment.	DEE, DBCA and DWER	

The application of management measures and recommendations as specified within the above are discussed in Section 4.

2.2 State

Applicable legislation includes the *Environmental Protection Act 1986*, the *Planning and Development Act 2005* (PD Act) and *Planning and Development (Local Planning Schemes) Regulations 2015* (PD Regulations). Under the PD Regulations the City must seek comments regarding the proposed local structure plan (LSP) from any public authority or service provider that the City considers appropriate.

Other legislation relevant to the management of the precinct are outlined in Table 3.

Table 3: Other relevant legislation

Legislation	Description	Regulatory Authority	Relevance
Aboriginal Heritage Act 1972	Protection of amendment sites of Aboriginal heritage significance, both known and as yet unknown.	Department of Planning, Lands and Heritage (DPLH)	Disturbance to Aboriginal sites.
Bush Fires Act 1954	Minimising dangers resulting from bush fires, and the prevention, control and extinguishment of bush fires.	Department of Fire and Emergency Services (DFES)	Fire management.
Conservation and Land Management Act 1984	Preservation and conservation of flora and fauna.	Department of Biodiversity, Conservation and Attractions (DBCA)	Removal of threatened flora or TECs/priority ecological communities (PECs).
Contaminated Sites Act 2003	Regulation of matters relating to the identification, assessment, recording, management and clean-up of contaminated land.	Department of Water and Environmental Regulation (DWER)	Contamination, acid sulfate soils.
Dangerous Goods and Safety Act 2004	Safe storage, handling and transport of dangerous goods.	Department of Mines, Industry Regulation and Safety (DMIRS)	Proposed land use within the Project area.
Electricity Act 1945	Licensing of persons carrying out works relating to electricity.	Department of Mines, Industry Regulation and Safety (DMIRS)	Proposed land use within the Project area.
Health Act 1911 Regulations concerning	Regulations concerning emissions disposal of sewage.	Department of Health	Sewage management.
Native Title (State Provisions) Act 1999	Recognition and protection of native title.	DPLH	Registered heritage sites.

Legislation	Description	Regulatory Authority	Relevance
Rights in Water and Irrigation Act 1914	Protection and licensing of water resources.	DWER	Development within the Perth Groundwater Area.
Waterways Conservation Act 1976	Conservation and management of waterways and their associated environment.	DWER	Waterways management.
Wildlife Conservation Act 1950 (WA) Note: This Act will eventually be replaced by the *Biodiversity Conservation Act 2016*	Conservation and protection of wildlife (flora and fauna). Special provisions and schedules apply to the protection and management of gazetted rare flora and fauna.	DBCA	Removal of threatened flora or TECs/PECs and fauna.

In addition to the above legislation, there are several policy and guidance documents which relate to specific environmental factors that are relevant to the development of the precinct. The assessment has been designed to address the recommendations of the State regulatory guidance as described in Table 4.

Table 4: Policies and guidance statements

Statement No.	Title	Application	Relevance
Guidance statements			
3	Separation Distances between Industrial and Sensitive Land Uses.	Outlines generic separation distances between industrial and sensitive land uses to avoid conflict between land uses.	Management of impacts to surrounding land uses.
6	Rehabilitation of Terrestrial Ecosystems.	Outlines the principles to be applied during clearing in the areas that will be rehabilitated after construction. These areas may include batters, service infrastructure corridors and road verges.	Clearing of vegetation.
33	Environmental Guidance for Planning and Development.	Provides guidance on the environmental protection process in respect of the land use planning and development process.	Land use planning.
41	Assessment of Aboriginal Heritage.	If Aboriginal heritage values are identified on or associated with the Project area, this guidance statement will be used to assess the impact of the project on those values.	Protection and management of heritage site values.
EP Act			
	Social Surroundings.	Provides guidance on the management of noise and dust in relation to proposals and surrounding land uses.	Management of impacts to surrounding land uses.
	Flora and Vegetation.	Outlines how the factor Flora and Vegetation is considered by the EPA in the environmental impact assessment (EIA) process.	Management of impacts to flora and vegetation.
	Terrestrial Fauna.	Outlines how the factor Terrestrial Fauna is considered by the EPA in the environmental impact assessment (EIA) process.	Management of impacts to flora and vegetation.
Technical Guidance/guidelines			
Technical Guidance	Flora and vegetation surveys for Environmental Impact Assessment.	Provides guidance on the assessment on the biodiversity implications of vegetation clearing.	Clearing of vegetation, or impact to threatened vegetation or flora species.
Technical Guidance	Sampling methods for terrestrial vertebrate fauna.	Provides guidance on the assessment on the biodiversity implications of vegetation clearing on fauna habitat.	Clearing of vegetation, or impact to threatened fauna species.

Statement No.	Title	Application	Relevance
Technical Guidance	Terrestrial fauna surveys.	Provides direction and information on general standards and protocols for terrestrial fauna surveys for environmental impact assessment.	Clearing of vegetation, or impact to threatened fauna species.
Guidelines	WA Environmental Offset Guidelines.	Clarifies the determination and application of environmental offsets in Western Australia.	Environmental management.
Guidelines	Statement of Environmental Principles, Factors and Objectives, and some factor guidelines.	Communicates how, for the purposes of environmental impact assessment, the EPA: • considers the object and principles of the Environmental Protection Act 1986 • uses environmental factors and objectives to organise and systemise environmental impact assessment and reporting • takes a holistic view of the environment and a proposal or scheme's potential impact on the environment • considers significance when determining whether to assess a proposal or scheme and recommend whether an assessed proposal or scheme may be implemented.	Environmental management.
Guidelines	Assessment and Management of Contaminated Sites guidelines (DER 2014).	Provides guidance on the assessment and management of contaminated sites in Western Australia (WA) within the legislative framework provided by: the Contaminated Sites Act 2003 (CS Act) and the Contaminated Sites Regulations 2006 (CS Regulations); and the revised national site assessment framework provided in the National Environment Protection (Assessment of Site Contamination) Measure 1999 (NEPM).	Environmental management.
Policies			
Government of Western Australia	WA Environmental Offsets Policy (EPA 2011).	Provides a framework for consistent application of environmental offsets to protect and conserve environmental and biodiversity.	Environmental management.
State Planning Policy 2	Environment and Natural Resources Policy (WAPC 2003).	Provides guidance on planning developments to conserve the natural environment.	Environmental management.
State Planning Policy 2.8	Bushland Policy for the Perth Metropolitan Region (WAPC 2010).	Provides guidance to ensure bushland protection in the Perth Metropolitan Region in the respect of land use planning.	Clearing of vegetation, or impact to threatened vegetation or flora species.
State Planning Policy 2.9	Water Resources (WAPC 2006).	Provides guidance on how to protect, conserve, enhance and manage sustainable use of water resources of environmental value.	Impact on hydrological regime Urban water management.
State Planning Policy 5.4	Road and Rail Transport Noise and Freight Considerations in Land Use Planning, Section 5.3 – Noise Criteria.	Seeks to minimise the adverse impact of transport noise, without placing unreasonable restrictions on noise-sensitive residential development, or adding unduly to the cost of transport infrastructure.	Management of impacts to surrounding land uses.

Statement No.	Title	Application	Relevance
State Planning Policy 4.2	Activity Centres for Perth and Peel.	Specify broad planning requirements for the planning and development of new activity centres and the redevelopment and renewal of existing centres in Perth and Peel.	The development of an activity Centre is proposed as part of the Project.

Perth and Peel green growth plan for 3.5 million (Draft)

The Draft Green Growth Plan (or also known as SAPPR) indicates that there are specific commitments and broad commitments and values identified within the project area. The Green Growth Plan does not specify which commitments are depicted but based on the environmental assessment undertaken, the areas mapped appear to correspond with the following environmental attributes:

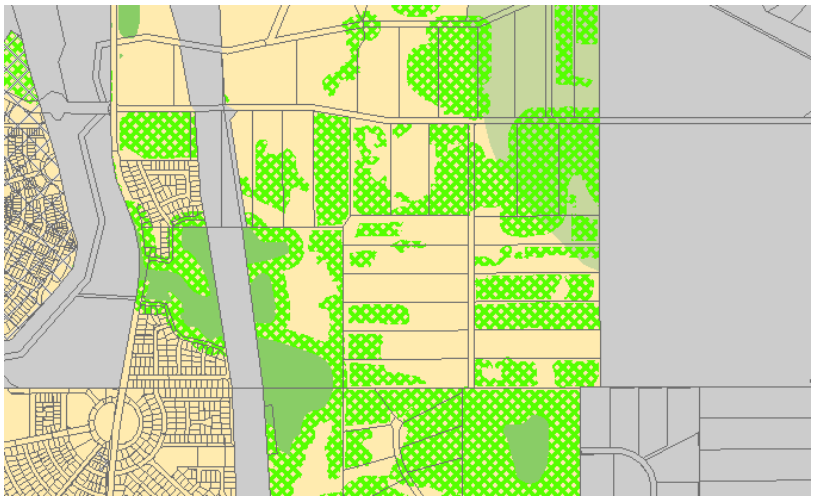
Specific Commitments

- conservation category wetlands and wetlands of international importance (refer to Section 3).

Broad Commitments and Values

- threatened fauna habitat (including Carnaby's Cockatoo habitat, Chuditch and Ring Tail Possum sites) (refer to Section 3)
- vegetation complexes with more than 10 per cent but less than 30 per cent remaining 'negotiated planning solution' and 'rural complementary' Bush Forever areas, and Peel Regionally Significant Natural Areas (refer to Section 3)
- resource enhancement wetlands with remnant vegetation, including a 50 metre buffer (refer to Section 3)
- 50 metre buffers for conservation category wetlands (refer to Section 3).

As of the 6 April 2018, the State Government suspended work and is currently re-evaluating the SAPPR through an independent review. The Government has advised that "SAPPR sought to secure up front environmental approval for future development and raw materials extraction for an identified development footprint for a 30-year period. It represents the largest and most complex land use reconciliation work, attempting to balance certainty for development and long term environmental protection" (Department of the Premier and Cabinet, 2018). While the SAPPR has been suspended, the Specific Commitments and Broad Commitments and Values mapping was reviewed and given due regard in formulating the design of the LSP.



Source: Government of Western Australia (2017)

Plate 1: Green Growth Plan for the LSP and surrounding area

2.3 Local

2.3.1 Overview

The following Strategies, Local Planning Policies and By-laws are relevant to the City of Kwinana and precinct.

Table 5: Strategies, Local Planning Policies and By-Laws

Reference No.	Title	Application	Relevance to project
Local Planning Policy 1	Landscape Feature and Tree Retention (2016)	This policy applies to all land within the City of Kwinana (City) Town Planning Schemes No. 2 and 3 (TPS 2 and TPS 3) and is to be implemented during the preparation and assessment of: a) District structure plans b) Local structure plans c) Local development plans d) Subdivision applications for 10 lots or more (where there is no adopted structure plan or where the adopted structure plan was approved prior to the commencement of this policy); e) Subdivision applications in areas of Landscape Protection as designated by TPS 2 f) Development applications on sites 1 hectare or greater.	The site is within the policy area and is currently going through local structure planning. The policy measures outlined in LPP 1 are being considered and incorporated (where relevant) as part of this process.
Local Planning Policy 66	Guidelines for Structure Planning in the Casuarina Cell	This policy provides guidance on the district planning matters that should be considered during the preparation of LSPs within the Casuarina Urban Development zone (Casuarina Cell) to ensure subdivision and/or development proceeds in an orderly and proper manner across the whole cell.	The Project area is within the Casuarina Cell – Central Precinct and in addition to the WAPC requirements for structure planning, general guidelines are also provided on the following matters: • Bushfire protection • Compatible land uses in the vicinity of the mushroom farm • Interface treatment between Development and Rural zones • Local water management • Residential densities.

3. Existing environment

3.1 Climate

The Casuarina locality experiences a Mediterranean climate characterised by mild, wet winters and warm to hot, dry summers. The nearest Bureau of Meteorology (BoM) weather station with long-term climate data is Medina Research Centre (Station No. 009194).

Average annual rainfall recorded at Medina Research Centre since 1983 is 745.5 mm (BoM 2017). Rainfall may occur at any time of year; however, most occurs in winter in association with cold fronts from the southwest. Highest temperatures occur between January and February, with average monthly maximums ranging from 18°C in July to 31.5°C in February (BoM 2017). Lowest temperatures occur in July and August, with average monthly minimums ranging from 8.2°C in July and August to 17.6°C in February (BoM 2017).

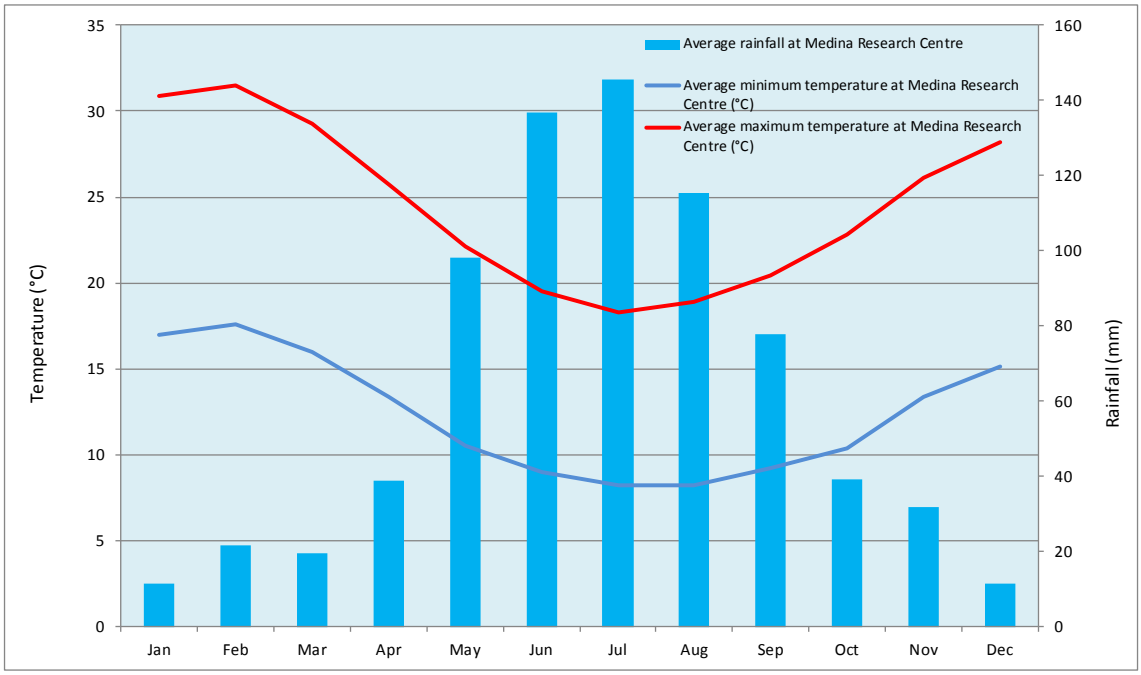


Plate 2: Mean monthly climatic data (temperature and rainfall) for Medina Research Centre

3.2 Topography, landform and soils

Topography of the Project Area is undulating and ranges from 11 m to 30 m Australian Height Datum (AHD) (Figure 2).

The Project Area is located within the Swan Coastal Plain 2 (SWA2 – Swan Coastal Plain subregion) of Western Australia (Mitchell et al. 2002). Within the Swan Coastal Plain, there are five major geomorphologic systems that lie parallel to the coast, namely (from west to east) the Quindalup Dunes, Spearwood Dunes, Bassendean Dunes, Pinjarra Plain and Ridge Hill Shelf (Churchward & McArthur 1980; Gibson et al. 1994).

Mapping on the Department of Primary Industries and Regional Development (DPIRD) database (DPIRD 2018), indicates the Project Area occurs within the Bassendean Sands (212Bs) geological unit (Figure 2), which is characterised by basal conglomerate overlain by dune quartz sand with heavy mineral concentrations (Geoscience Australia 2008).

A total of four soils types occur within the Project Area (Figure 2) and are described below (DPIRD 2018):

- Bassendean B1 Phase (212Bs_B1) - which are described as deep bleached grey sands sometimes with a pale yellow B horizon or a weak iron-organic hardpan at depths generally greater than 2m. These soils occur on extremely low to very low relief dunes, undulating sandplain and discrete sand rises
- Bassendean B2 Phase (212Bs_B2) – Flat to very gently undulating sandplain with well to moderately well drained deep bleached grey sands with a pale yellow B horizon or a weak iron-organic hardpan 1-2 m
- Bassendean B3 Phase (212Bs_B3) - are soils on closed depressions and poorly defined stream channels. These soils are moderately deep, bleached sands with an iron-organic pan, or clay subsoil. Surfaces are dark grey sand or sandy loam
- Bassendean B6 Phase (212Bs_B6) - Sandplain and broad extremely low rises with imperfectly drained deep or very deep grey siliceous sands.

Phase 1 and 2 soils are located across the central portions of the Project Area, while Phase 3 is in the southwest corner and Phase 6 soils are confined to the north east corner (Figure 2).

3.2.1 Acid sulfate soils

Acid Sulfate Soil (ASS) risk mapping available from the Department of Water and Environmental Regulation (DWER) website indicated most of the Project Area is mapped at a moderate risk of ASS occurring within 3 m of the natural soil surface (DWER 2018); however, two locations within the Project Area are mapped to have a high risk of ASS occurring within 3 m of the natural surface. Areas mapped with a high risk of ASS correspond to the locations wetlands are identified across the Project Area (DWER 2018). Considering the identification of wetlands within the Project Area and the mapping of moderate and high risks of ASS occurring within 3 m of the natural soil surface, an ASS investigation is required as per DWERs guideline for the *Identification and investigation of Acid Sulfate Soils* (2015).; therefore, an ASS investigation will be conducted across the Project Area to advise appropriate management measures prior to subdivision.

3.3 Hydrology

A Local Water Management Strategy has been prepared by Hyd2O (2018) in accordance with *Better Urban Water Management* guidelines (WAPC 2008) on advice from DWER. The LWMS is consistent with regional and district scale urban water management planning, including the *State Water Plan* (DPC 2007) as well as *State Planning Policy 2.9 Water Resources* (WAPC 2006). The LWMS aims to meet the principles and objectives of stormwater management in Western Australia, as detailed in the *Stormwater Management Manual for Western Australia* (DoW 2007).

3.3.1 Groundwater

There are three aquifers underlying the Project Area; each assigned the name of the major geological unit in which the aquifer occurs (DWER 2017). In descending order of depth from natural surface they are:

- Superficial Swan Aquifer (unconfined)
- Leederville Aquifer (confined)
- Yarragadee North (confined).

The Superficial Swan and the Leederville aquifers are both fully allocated while the Yarragadee North aquifer has allocation available. Currently, there are three lots within the Project Area with groundwater abstraction licences. Table 6 below details the groundwater abstraction licences currently existing over the Project Area.

Table 6: Groundwater abstraction licences within the Project Area

Licence No.	Licence Address	Applicant	Expiry	Allocation (kL) Perth Superficial Swan
48591	Lot 32 Orton Rd Casuarina	Harvey, Douglas William, Harvey, Maureen Patricia 126 Orton Rd Casuarina WA 6167 Australia	29/5/2023	18000
108183	Lot 33 Landgren Rd, Casuarina	Pearson, Steven Arnold 37 Landgren Rd Casuarina WA 6167 Australia	7/4/2024	36500
163411	41, Landgren Rd, Casuarina	The Trustee for Moonspark Unit Trust 37 St Georges Tce Perth WA 6000 Australia	20/9/2027	4920

Depth to groundwater across the Project Area ranges from 10 m Australian height datum (AHD) in the south west corner to 17 mAHD in the south east corner of the Project Area (DWER 2018), and flows in a westerly direction.

Due to the variation in topography depth to groundwater fluctuates across the site. Generally, the north-west corner of the Project Area has a larger depth to groundwater of up to 5 m whereas the south-west corner of the Project Area has a depth to groundwater as low as 0.8 m; however, changes in topography produce a high variability and some areas in the central and south-west sections of the Project Area have a depth to groundwater of 7.5 m (DWER 2018).

3.3.2 Surface water

The site is located within the Peel-Harvey Coastal Catchment. No natural surface water flows occur within the Project Area, two constructed drains occur in the north east corner of the Project Area across Lots 24, 25, 31 and 32.

The site has four topographic surface water catchments. In three of the catchments (Johnson Rd East, Nicolas Rd, and Lugg Rd Nth), runoff travels as diffuse overland flow towards topographic low points. In the Landgren Rd catchment runoff is directed towards the Peel Sub P1A drain located in the north eastern area of the site. The Peel Sub P1A drain commences within the site and directs flow in an eastward direction to outside the site boundary prior to crossing Orton and travelling northwards to join the Peel Sub P Drain. (Hyd2O 2018).

Presented in the (then) DoWs (2009) *Jandakot Drainage and Water Management Plan* are the discharges allowed from each of the four surface water catchments post development. Landgren Rd post development catchments are completely contained within the site area and contribute to the Peel Sub1A with a combined allowable discharge of 0.16 m3/s post development for a 1 in 100 year ARI event. Modelling also shows that the 1 in 100 year ARI top water level in the drain upstream of Landgren Rd is 16.35 mAHD (Hyd2O 2018)..

3.3.3 Public drinking water source areas

Within the Project Area, no Public drinking water source areas (PDWSAs) occur, however, directly adjacent to the north-east corner of the Project Area is an underground water pollution control area Priority 2 (P2) category and a P1 category further to the east. Both protection areas are part of the Jandakot Mound Protection Zone.

3.3.4 Flood potential

Flood mapping available on the DPIRD database indicates the Project Area is not identified as a flood risk area in the 10yr ARI, 25 yr ARI, 50yr ARI and the 100yr ARI (DPIRD 2018). Further information on flood potential and stormwater modelling to determine flood storage requirements for the Project Area is provided in the LWMS prepared by Hyd2O (2018).

3.3.5 Wetlands

There are no Ramsar wetlands or Directory of Important Wetlands on the site (DEE 2018). The nearest Directory of Important Wetlands site is located approximately 900 m north west of the site and is known as "Spectacles Swamp".

Regional geomorphic mapping indicates that four wetlands categorised as either Resource Enhancement Wetland (REW) or Conservation Category Wetland (CCW) occur within the Project Area, which are described below and identified in Figure 3:

- REW UFI – 6670
- CCW UFI – 15968
- CCW UFI – 15970
- CCW UFI – 15973.

All three CCWs are located within the south western corner of the Project Area, adjacent to the Kwinana Freeway. CCWs are considered to be the highest priority wetlands and the EPA (2008) recommends that that all CCWs and appropriate buffers are fully protected. Generally, a minimum 50 metre buffer distance is required.

The REW is located within the north eastern corner of the Project Area and extends further east of the site. Within the Project Area (Lot 32), the REW has been cleared and is now a grassed paddock. Lot 45 contains the western most tip of the wetland and the vegetation is still intact, whereas Lot 31 contains the majority of the REW and the vegetation is also still intact. REW's are considered as priority wetlands where they have been partially modified but still support substantial ecological attributes and function. The ultimate objective is to manage, restore and protect towards improving their conservation value. A generic wetland buffer of 30 m to protect the wetlands ecosystem is usually associated with REW.

3.4 Potentially contaminating activities

3.4.1 Contaminated Sites Register Database

The DWER (2017) Contaminated Site Database was searched and there are currently no registered contaminated sites within four kilometres of the Project Area existing on the register.

3.4.2 Current land use(s)

Currently there are no identified contaminated material within the Project Area; however, uncontrolled fill has been observed within the Project Area which may have introduced hydrocarbons or Asbestos contaminated material. A Preliminary Site Investigation will be required prior to subdivision to determine if a Detailed Site is required.

3.4.3 Previous land use(s)

Land clearing within the Project Area begun between 1965 and 1974, aerial imagery indicates that lot boundaries were established in very close association to their current configuration from this time. Large portions of Lots 42 and 34 appear to have been cleared at this time, the purpose of the clearing and the activities being conducted on these lot is unclear; however, agriculture and horticulture are likely to be primary reasons. Practices associated with these activities may have introduced fertilisers and pesticides to the land, a Preliminary Site Investigation will be required for the Project Area prior to subdivision to determine if a Detailed Site Investigation for the Project Area is required.

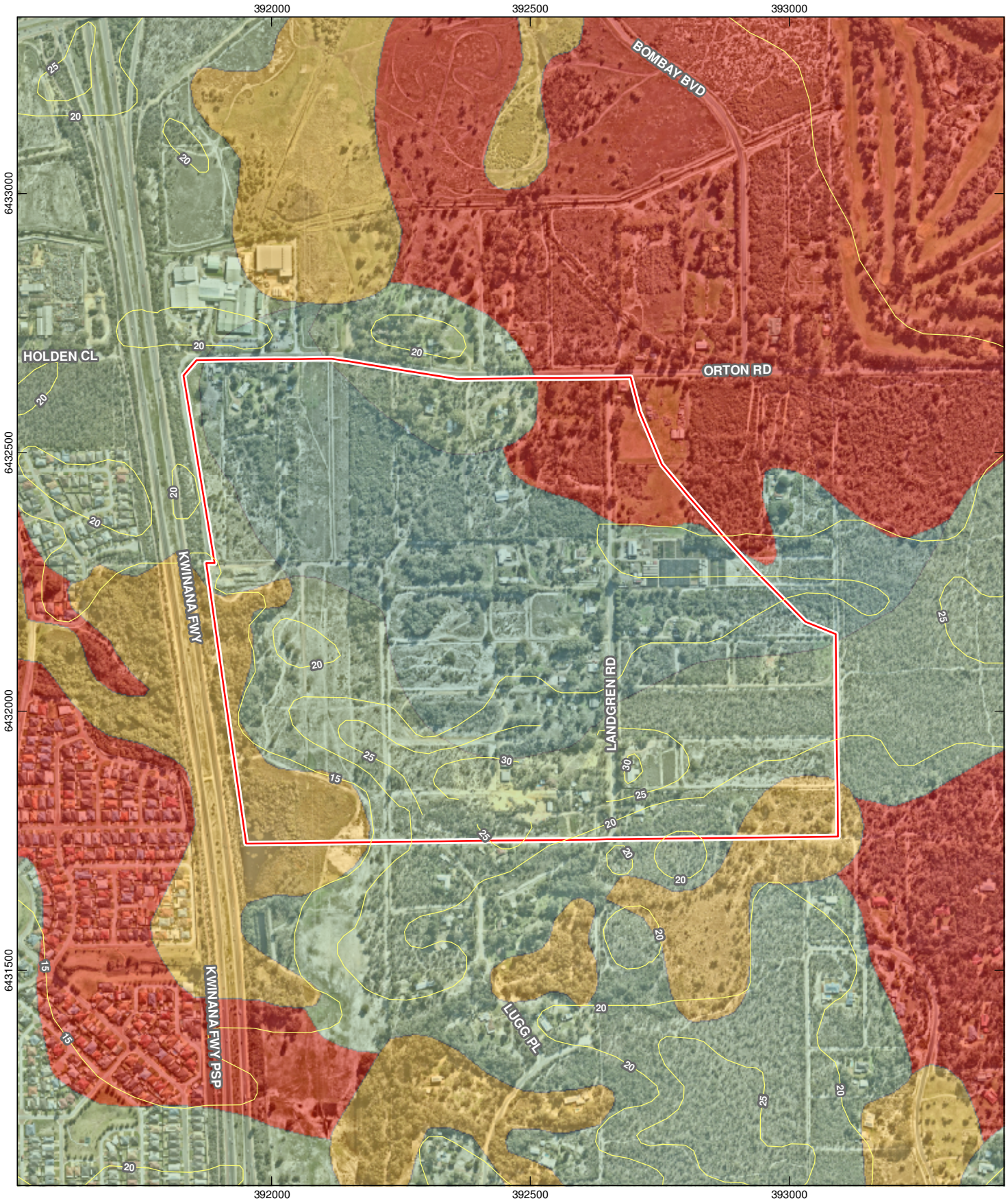


Figure 2: Topography, landform soils

N

Scale 1:10,000 at A4

0 100 200 m

Coordinate System: GDA 1994 MGA Zone 50

Date: 13/11/2018

Legend

- Project Area
- Topographic contours (mAHD)

Soil landscape

- Bassendean B1 Phase
- Bassendean B2 Phase
- Bassendean B3 Phase
- Bassendean B6 Phase

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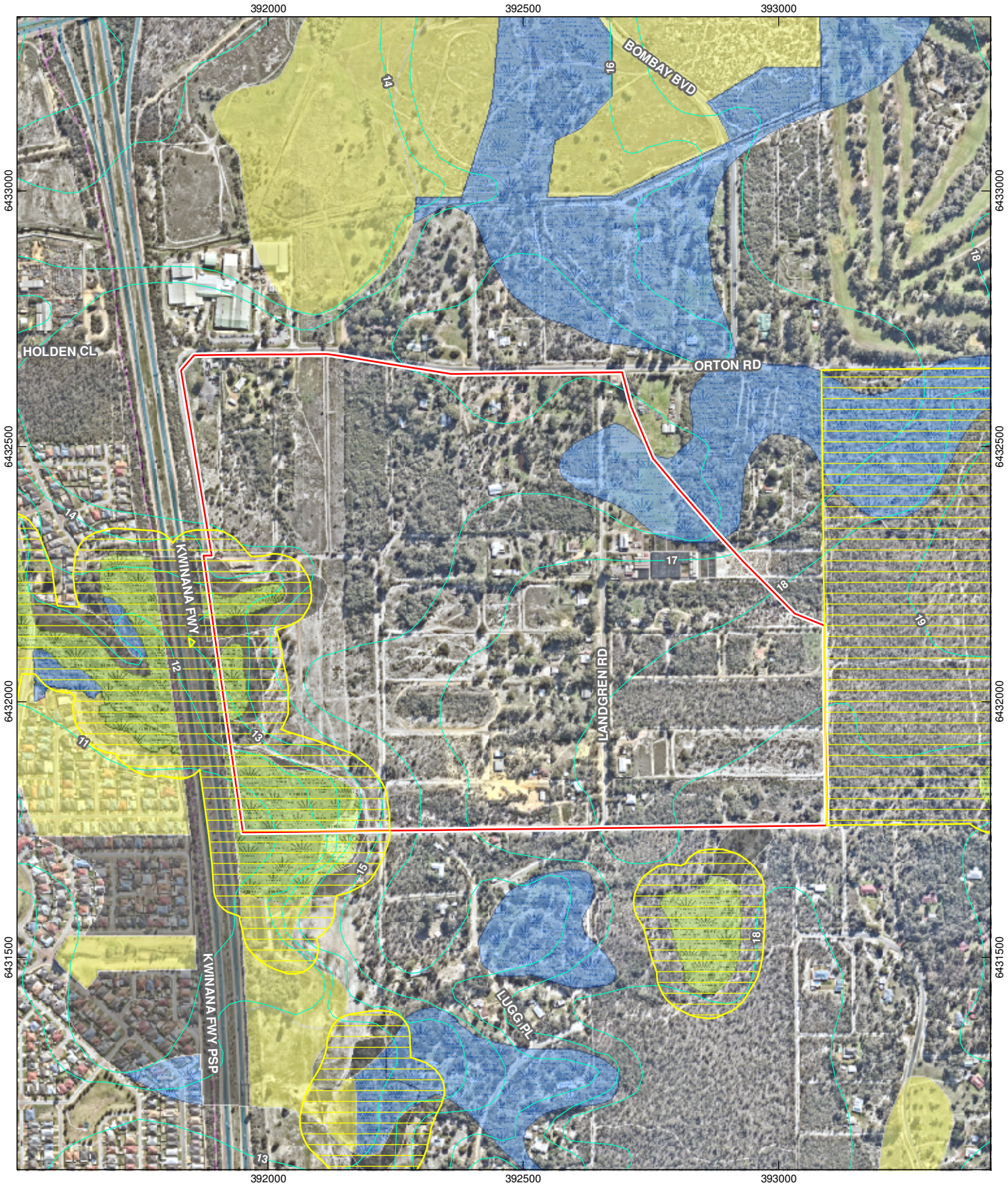


Figure 3: Hydrology

N

Scale 1:10,000 at A4

0 100 200 m

Coordinate System: GDA 1994 MGA Zone 50

Date: 13/11/2018

Legend

- Project area
- Environmentally sensitive areas
- Groundwater contours (max)

Wetlands

- Conservation
- Resource enhancement
- Multiple use
- Not applicable

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3.5 Biodiversity and natural assets

3.5.1 Flora and vegetation

Overview

Regional vegetation association mapping (Beard, 1981) indicates that 1001 Medium very sparse woodland; jarrah, with low woodland; banksia and casuarina occurs within the Project Area. DBCA (2017) reports that approximately 22% of this association is remaining with the IBRA (SCP Perth-SWA02) region and approximately 37% remaining within the City of Kwinana.

The Heddle vegetation complex Bassendean Complex Central South is mapped within the Project Area. This vegetation complex is characteristic by woodland of jarrah-sheoak-banksia on the sand dunes, to a low woodland of Melaleuca spp., and sedgelands on the low-lying depressions and swamps. It includes the transition area of jarrah and pricklybark in the vicinity of Perth. *B. attenuata, B. grandis* and *B. menziesii* are common on the upper slopes; with *B. menziesii* decreasing southwards as it reaches the southern limit of its range near Mandurah. *B. ilicifolia, B. littoralis and M. preissiana* are common on the low-lying moister soils, where marri replaces jarrah in dominance. Other plant species include *Kunzea vestita, Hypocalymma angustifolium, Adenanthos obovatus* and Verticordia spp. (Heddle et al. 1980).

It is estimated that approximately 26% of the complex remained compared to the pre-European extent (DBCA 2017).

Within the Swan Coastal Plain, vegetation complexes that are less than 10% of the original extent are considered to be significant with focus on the retention of the remaining vegetation complex within the SCP, the remaining area for this complex is above the 10% threshold.

Historically, a significant portion of the Project Area has been progressively cleared. Remnant vegetation on site has been fragmented through semi-rural land development and clearing. There are remaining areas of vegetation on several lots.

The Project Area is adjacent to Bush Forever site 273 and the Beeliar Regional Park and Jandakot Regional Park are within 4 km of the Project Area (Figure 4).

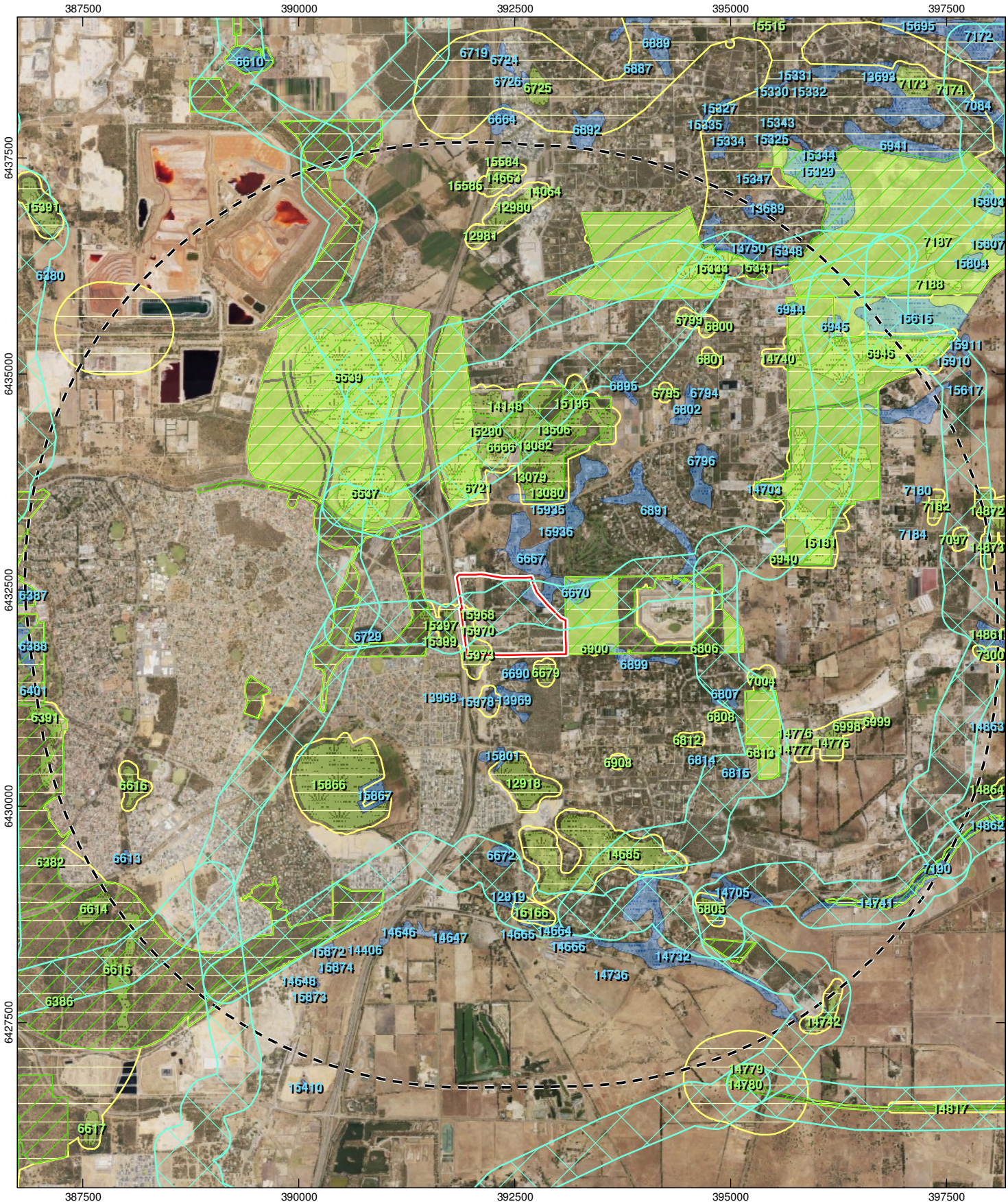


Figure 4: Surrounding conservation estates

N

Scale 1:60,000 at A4

0 0.5 1 1.5 km

Coordinate System: GDA 1994 MGA Zone 50

Date: 20/11/2018

Legend

- Project Area
- Bush Forever Sites
- Environmentally Sensitive Areas
- 5km Project Area buffer
- Regional Ecological Linkages

Wetlands

- Conservation
- Resource enhancement

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Table 7: Vegetation types mapped within the Project Area

Vegetation type	Description	Area (ha)	Portion of the Project Area (%)
BaBm	Banksia attenuata, Banksia menziesii, *Eucalyptus marginata* low woodland with scattered *Xylomelum occidentale* and *Allocasuarina fraseriana* over *Hibbertia hypericoides* low open Heath over *Mesomelaena pseudostygia* and *Lepidosperma squamatum*.	8.29	7.34
BaBmBi	*Banksia attenuata, Banksia menziesii* and *Banksia ilicifolia* over Kunzea *glabrescens, Jacksonia furcellata, Jacksonia sternbergiana* and *Xanthorrhoea preissii* over *Scholtzia involucrata*, *Bossiaea eriocarpa, Leucopogon conostephioides* over *Desmocladus flexuosus*, *Phlebocarya ciliata*	1.91	1.69
BaBmAf:	*Banksia attenuata, Banksia menziesii, Allocasuarina fraseriana* low woodland over *Xanthorrhoea preissii* open shrubland over *Hibbertia hypericoides*, *Eremaea asterocarpa subsp. asterocarpa, Hibbertia subvaginata, Leucopogon conostephioides* low open heathland over Mesomelaena pseudostygia, *Desmocladus flexuosus* very open sedgeland with *Amphipogon turbinatus, *Ehrharta calycina* scattered grasses.	1.18	1.05
CcBa	*Corymbia calophylla, Banksia attenuata* and *Banksia ilicifolia* over *Xanthorrhoea preissii.*	0.55	0.49
CcKg	*Corymbia calophylla* and *Melaleuca preissiana* scattered trees over *Kunzea glabrescens* scattered tall shrubs over *Acacia pulchella* var. *glabrescens*, *Xanthorrhoea preissii* over *Pericalymma ellipticum* over *Hypocalymma angustifolium, Eutaxia virgata* low closed heath over *Schoenus efoliatus, Cyathochaeta avenacea* open sedgeland.	2.46	2.18
MpAsCt	*Melaleuca preissiana* low woodland over *Astartea scoparia* high shrubland and *Cyathochaeta teretifolia* sedgeland.	0.68	0.60
ErMp	*Eucalyptus rudis subsp*. rudis open forest over *Melaleuca preissiana* open woodland.	0.99	0.88
ErMrMp	*Eucalyptus rudis subsp. rudis* woodland over *Melaleuca rhaphiophylla, Melaleuca preissiana* low woodland.	0.44	0.39
CcMp	*Corymbia calophylla, Melaleuca preissiana* woodland over *Astartea scoparia* high shrubland over *Leucopogon australis, Xanthorrhoea preissii* open shrubland over *Dielsia stenostachya* sedgeland.	1.06	0.94
CcBiEm	*Corymbia calophylla* woodland over *Banksia menziesii* scattered low trees over *Kunzea glabrescens* high open shrubland to high shrubland over *Xanthorrhoea preissii* open shrubland over *Hibbertia hypericoides* scattered low shrubs over *Dielsia stenostachya, Lepidosperma squamatum* complex open sedgeland with *Dasypogon bromeliifolius* open herbland.	1.27	1.13
CcXp	*Corymbia calophylla* and *Allocasuarina fraseriana* over *Xanthorrhoea preissii, Xanthorrhoea gracilis*, *Hibbertia hypericoides* over *Lepidosperma squamatum* and *Dasypogon bromeliifolius.*	0.44	0.39
CcEm	*Corymbia calophylla, Eucalyptus marginata, Banksia menziesii* and *Xylomelum occidentalis* over *Kunzea glabrescens, Xanthorrhoea preissii, hibbertia hypericoides, Macrozamia riedlei, Conostylis aculeata, Desmocladus flexuosus* and *Bossiaea eriocarpa.*	1.41	1.25
BaKg	*Banksia attenuata* low woodland over *Kunzea glabrescens* tall shrubland over *Xanthorrhoea reissii, Hibbertia hypericoides, Hypocalymma robustum* over *Phlebocarya ciliata* and *Kennedia prostrata.*	0.39	0.35
MpKg	Low Open woodland of *Melaleuca preissiana* over tall closed shrubland of *Kunzea glabrescens* over *Xanthorrhoea preissii, Hypocalymma angustifolium* and *Jacksonia gracillima* over *Dasypogon bromeliifolius.*	2.16	1.91
KgXpPc	Pruned and maintained power easement of *Kunzea glabrescens* and *Xanthorrhoea preissii* low shrubland over *Dasypogon bromeliifolius* and *Phlebocarya ciliata*.	1.11	0.98
AfNE	Various Native tree species with Non-endemic species and grass weeds.	2.05	1.82
Ac	*Adenanthos cygnorum* open shrubland with scattered *Eucalyptus todtiana* over grass weeds.	0.88	0.79

Vegetation type	Description	Area (ha)	Portion of the Project Area (%)
CcAf	*Allocasuarina fraseriana*, *Corymbia calophylla* and *Banksia littoralis* over *Kunzea glabrescens.*	0.31	0.27
NE	Non-endemic species and grass weeds.	1.51	1.35
Em	Individual *Eucalyptus marginata.*	0.23	0.20
Kg	*Kunzea glabrescens* scrub.	0.08	0.07
Pe	*Pteridium esculentum* fern land.	0.47	0.42
Eg	Individual *Eucalyptus gomphocephala.*	0.49	0.43
Cc	Individual *Corymbia calophylla.*	0.24	0.22
Regen	Areas of natural regeneration.	0.7	0.62
Cleared		39.67	35.18
Unmapped		41.82	37.07
Total		**112.8**	**100**

Conservation significant species

No species listed as Threatened under the EPBC Act or Threatened under the WC Act were identified during the surveys. A total of three Priority flora species were observed within the Project Area *Cyathochaeta teretifolia* (P3), *Jacksonia gracillima* (P3) and *Tetraria sp. Chandala* (P2).

Following the surveys conducted by 360 Environmental, a targeted spring flora survey for the following conservation significant species with potential to occur within the Project Area was undertaken by Strategen in October 2018 (Strategen 2018a) (Appendix 3):

- *Caladenia huegelii* (Grand spider orchid)
- *Diuris micrantha* (Dwarf bee orchid)
- *Diuris purdiei* (Purdie's donkey orchid)
- *Drakaea micrantha* (Dwarf hammer orchid)
- *Lepidosperma rostratum*.

However, due to limited site access the targeted spring flora survey was undertaken over CDN landholdings (Lots 47, 44, 43, 42, 41, 40, 39, 37 and 34). No new conservation significant species or locations were observed in the survey area conducted by Strategen (2018a). Whilst on site, the vegetation condition was observed during the 2018 spring survey and considered to be consistent with previous surveys (Strategen 2018a).

Suitable habitat (was observed for *Drakaea elastica* (Glossy-leaved hammer orchid); however, the survey period was not optimal for the detection of the species, therefore, the potential of this species to occur within the project area cannot be ruled out. However, it is worthwhile to note that the area identified as suitable habitat was within the central POS area proposed within the Local Structure Plan.

Vegetation condition

Vegetation condition through the Project Area ranged from Excellent to Completely Degraded, primarily, the vegetation was observed to be in a Completely Degraded state.

Table 8 and Figure 5 demonstrate vegetation condition across the Project Area.

Table 8: Vegetation condition

Condition	Extent of Project Area (ha)	Proportion of Project Area (%)
Excellent	5.93	5.26
Excellent – Very Good	2.63	2.34
Very Good	5.27	4.67
Very Good – Good	1.34	1.19
Good	2.90	2.58
Good – Degraded	3.26	2.90
Degraded	5.33	4.73
Completely Degraded	42.55	37.73
Cleared	1.76	1.56
Unknown	41.78	37.05

Of the Project Area that has been surveyed, most of it is in a Completely Degraded condition. Whilst a large portion of the following lots within the Project Area has not been surveyed due limited site access (Figure 6), review of aerial imagery shows that:

- Lots 23, 49, 1 and the power easement through Lots 9000 and 48 have been heavily cleared of remanent vegetation
- Lots 24, 25, 31, 38 and 50 all retain remnant vegetation.

3.5.2 Floristic Community Types

360 Environmental performed a floristic analysis to determine the presence / absence of Floristic Community Types (FCTs) within the Project Area. Data analysis determined five FCTs occur within the Project Area (360 Environmental 2018):

- FCT SCP 21a – Central Banksia attenuata – *Eucalyptus marginata* woodlands
- FCT SCP 23a – Central Banksia attenuata – *Banksia menziesii* woodlands
- FCT SCP 11– Wet forests and woodlands
- FCT SCP 4 – *Melaleuca preissiana* damplands
- FCT SCP S17 – *Eucalyptus rudis/Agonis linearifolia* wetlands in Bassendean Dunes.

Threatened Ecological Communities

Of the five FCTs listed within the Project Area, the following FCTs are listed as sub-communities of the Federally listed Threatened Ecological Communities (TEC) Banksia woodlands of the Swan Coastal Plain under the EPBC Act (360 Environmental 2018):

- FCT SCP 21a - Central Banksia attenuata - Eucalyptus marginata woodlands
- FCT SCP 23a - Central Banksia attenuata - Banksia menziesii woodlands.

Based on the approved Conservation advice on Banksia woodlands of the Swan Coastal Plain (DEE 2016), the varying densities of Banksia canopy and condition, not every occurrence of SCP 21a and SCP 23a within the area that was surveyed is considered to be representative of Banksia woodlands of the Swan Coastal Plain TEC (360 Environmental 2018). Instead, only 11 remnants, equating to 9.26 ha, are considered to be representative of Banksia woodlands of the Swan Coastal Plain TEC (Figure 7).

Prior to subdivision, further flora and vegetation surveys will be required across the lots that have not been surveyed (Figure 6).

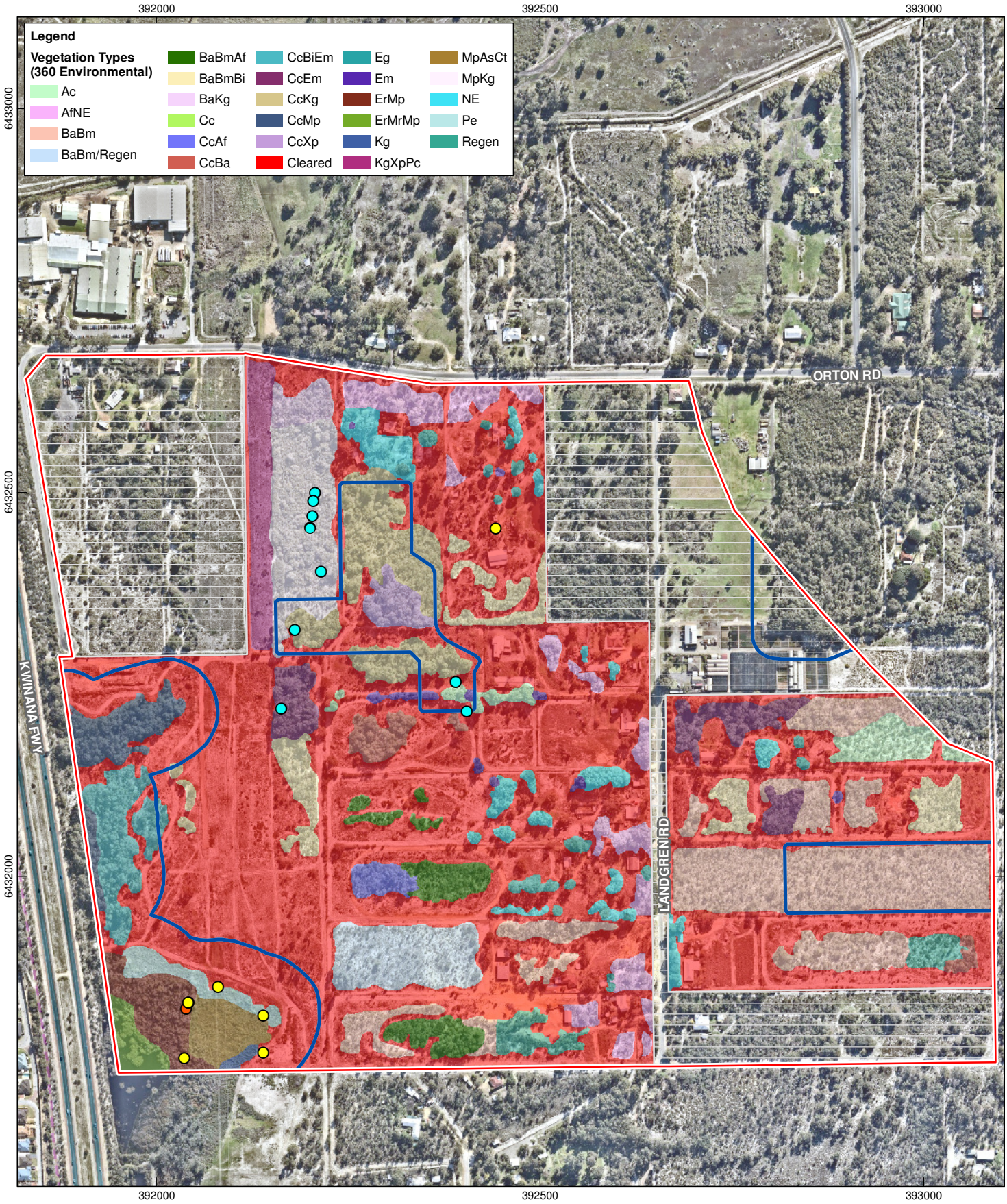


Figure 5: Vegetation type

N

Scale 1:6,750 at A4

0 100 200 m

Coordinate System: GDA 1994 MGA Zone 50

Date: 29/11/2018

Legend

- Project Area
- Unsurveyed Area
- Public Open Space

Location of Priority Flora (360 Environmental)

- *Cyathochaeta teretifolia*
- *Jacksonia gracillima*
- *Tetraria* sp. Chandala (G.J. Keighery 17055)

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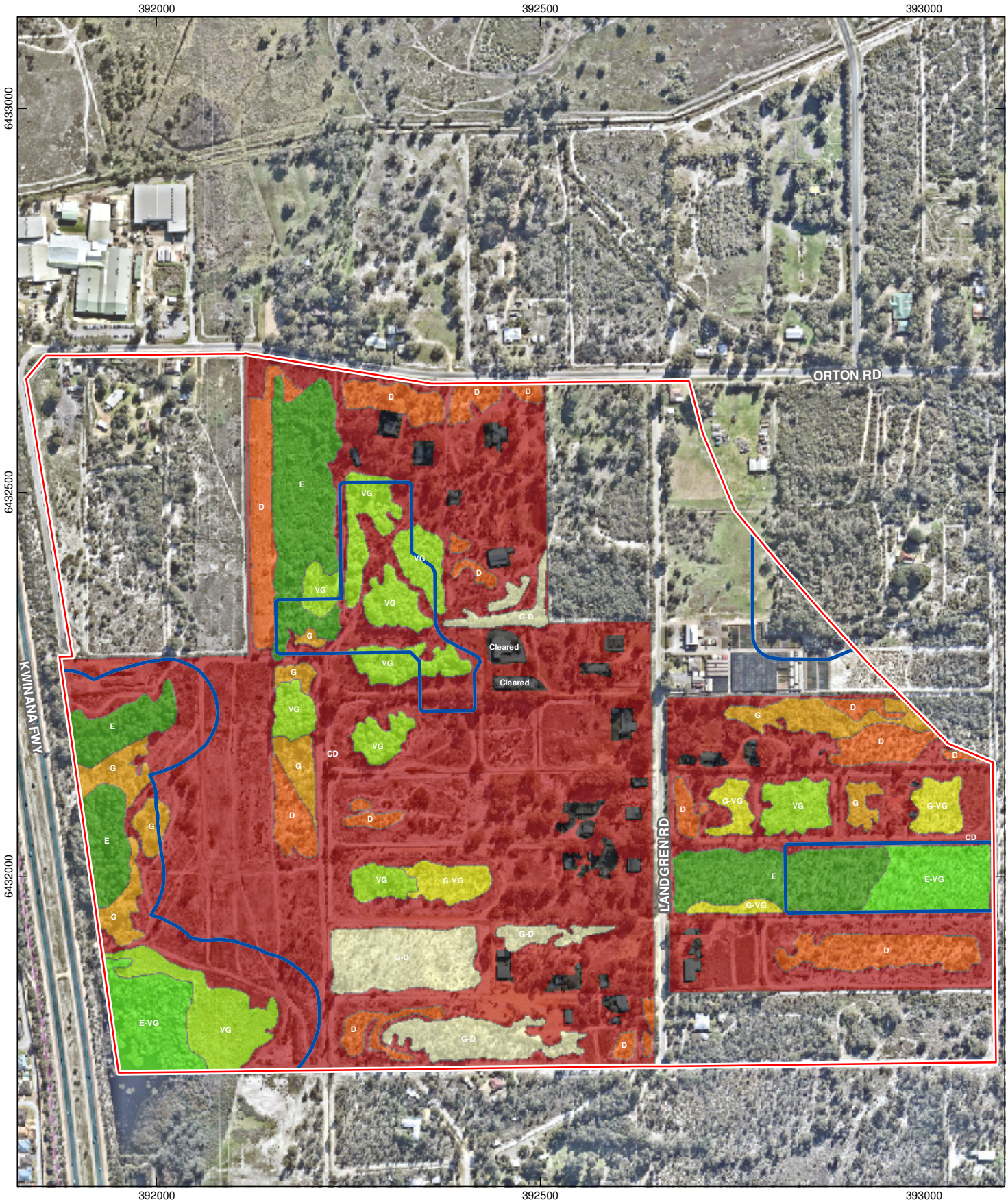


Figure 6: Vegetation condition

N

Scale 1:6,750 at A4

0 100 200 m

Coordinate System: GDA 1994 MGA Zone 50

Date: 29/11/2018

Legend

- Project Area
- Public Open Space

Vegetation Condition (360 Environmental 2018)

- Cleared
- Completely Degraded
- Degraded
- Good
- Good - Degraded
- Good - Very Good
- Very Good
- Excellent - Very Good
- Excellent

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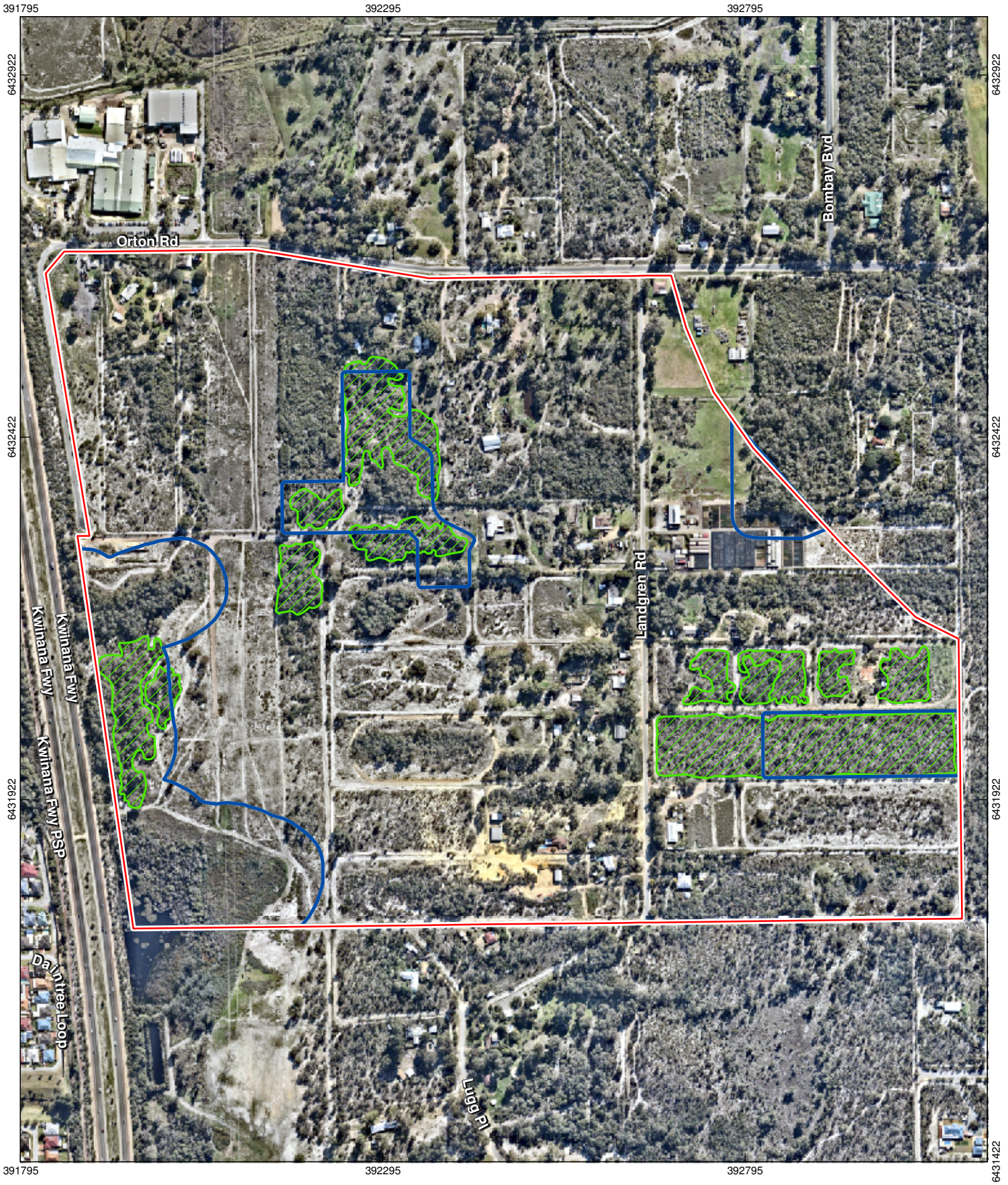


Figure 7: Banksia Woodlands TEC

N

Scale 1:7,000 at A4

0 100 200 m

Legend

- Project Area
- Banksia Woodlands TEC (360 Environmental 2018)
- Public Open Space

Coordinate System: GDA 1994 MGA Zone 50

Date: 29/11/2018

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Data source: Nearmap: Aerial image, flown 06/2018. Landgate: Cadastre, 11/2017. Client: LWP Property Pty Ltd. Development layout, 08/2018. Created by: CJT

3.5.3 Fauna

Overview

A desktop search of the DBCA Naturemap and EPBC Act Protected Matters Databases identified several conservation significant fauna that have a potential to occur within a 5 km radius of the Project Area. There are no open water bodies (appropriate habitat) within the Project Area, and therefore it is on this basis migratory bird wetland species have not been considered.

Table 9: Likelihood of Threatened and Priority Fauna species occurring within the vicinity of Project Area

Species	Conservation status		Habitat	Likelihood of presence within Central Precinct
	WC Act	EPBC Act		
Australasian Bittern (*Botaurus poiciloptilus*)		E	Includes wetlands with tall dense vegetation, where it forages in still, shallow water up to 0.3 m deep, often at the edges of pools or waterways, or from platforms or mats of vegetation over deep water.	Unlikely- outside of known distribution area and habitat not present on site.
Red Knot (*Calidris canutus)*	IA	E	Inhabit intertidal mudflats, sandflats and sandy beaches of sheltered coasts and sometimes on sandy ocean beaches or shallow pools on exposed rock platforms.	Unlikely- outside of known distribution area and habitat not present on site.
Curlew Sandpiper (*Calidris ferruginea*)	T	CE	Intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms.	Unlikely- outside of known distribution area and habitat not present on site.
Carnaby's Black cockatoo *(Calyptorhynchus latirostris)*	T	E		Present on site. Evidence of foraging was observed during 360 Environmental 2018 surveys.
Forest Red-tailed Black cockatoo (*Calyptorhynchus banksii subsp.. naso*)	T	V		
Malleefowl (*Leipoa ocellate)*		V	Semi-arid to arid shrublands and low woodlands, especially those dominated by mallee and/or acacias.	Unlikely- outside of known distribution area and habitat not present on site.
Australian Painted Snipe (*Rostratula australis*)		E	Shallow freshwater (occasionally brackish) wetlands, both ephemeral and permanent, such as lakes, swamps, claypans, inundated or waterlogged grassland/saltmarsh, dams, rice crops, sewage farms and bore drains, generally with a good cover of grasses, rushes and reeds, low scrub.	Unlikely- outside of known distribution area and habitat not present on site.
Chuditch, Western Quoll (*Dasyurus geoffroii*)	T		Forest, mallee shrublands, woodland and desert. The most dense populations have been found in riparian jarrah forest.	Unlikely- outside of known distribution area and habitat not present on site.
Quenda, southwestern brown bandicoot (*Isoodon fusciventer*)	P4		Quenda have a patchy distribution through the Jarrah and Karri forest, the Swan Coastal Plain. Scrubby, often swampy, vegetation with dense cover up to 1 m high, often feeds in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and cropland lying close to dense cover.	Likely.
Black-striped Snake, (Neelaps calonotos)	P3		Banksia woodlands and sandy areas of the Perth region.	Potentially occurring.
Oxyura australis (Blue-billed Duck)	P4		Prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. The species is completely aquatic, swimming low in the water along the edge of dense cover.	Unlikely- habitat not present on site.

Black Cockatoos

Carnaby's Black Cockatoos (CBCs), feed on the seeds, nuts and flowers, of a variety of native and introduced plant species and insect larvae (Johnstone and Kirby 1999). Food plants generally occur within proteaceous genera such as Banksia, Dryandra, Hakea and Grevillea, though are known to forage on eucalypt species in woodland areas. CBCs have also adapted to feeding on exotic species such as pines and cape lilac and weeds such as wild radish and wild geranium (Johnstone and Kirby 1999). CBCs usually breed between July and December in the hollows of live or dead eucalypts; primarily in Salmon Gum and Wandoo, but also within Jarrah, Marri and other eucalypt species (Johnstone 2010). Hollows are usually at least 2 m above ground, sometimes over 10 m and the depth of the hollow varies from 0.25 m to 6 m (DPAW 2013). The Department of Parks and Wildlife (now DBCA), renewed the Carnaby's Cockatoo Recovery Plan in 2013, clearly mapping the distribution of likely breeding and non-breeding areas in southwest WA for CBCs (Johnstone and Kirby 1999). Based on this map, the Project Area is situated within the CBC breeding range.

Forest Red-tailed Black Cockatoos (FRTBCs), listed as Vulnerable under the EPBC Act, depend primarily on Marri and Jarrah trees for both foraging and nesting. The seeds of both eucalypts are the favoured food source of the birds and hollows within live or dead individual trees are utilised for nesting purposes (Johnstone & Kirkby 1999). Breeding varies between years and occurs at times of Jarrah and Marri fruiting. These black cockatoos breed in woodland, forest or artificial nest boxes, but may also breed in former woodland or forest that has been reduced to isolated trees (Chapman 2005).

Site surveys

As part of the Black cockatoo habitat assessment undertaken by 360 Environmental (2018), a desktop search identified there were no records of Baudin's Black Cockatoos (BBCs) occurring within 10 km of Project Area. Carnaby's Black Cockatoos (CBCs) had 258 records of the species occurring within 10 km of the Project Area; furthermore, the Project Area was identified to occur within a 6 km buffer for a known CBC roosting site. No possible breeding area buffers for CBCs occur within the Project Area. Desktop results reported nine records of FRTBCs occurring within 10 km buffer of the Project Area.

During the field investigation twenty sightings of FRTBCs were observed across the Project Area (360 Environmental 2018); most observations were within the located in the CCWs in the south western corner of the Project Area. A flock of 40 individuals of CBCs were observed from Lot 48 flying over the northern portion of the Project Area (360 Environmental 2018).

Across the 70.98 ha of vegetation surveyed across the Project Area, three different Black Cockatoo foraging habitats totalling 26.39 ha were observed. Specifically, the foraging habitats within the Project Area are (Figure 8):

- isolated foraging trees (1.26 ha)
- Eucalypt woodland dominated by Marri and Jarrah (6.83 ha)
- Low *Banksia* woodland (1.35 ha)
- *Banksia* woodland with scattered Eucalypts (16.94 ha).

During the survey, evidence of FRTBC foraging was observed throughout the Eucalypt woodland dominated by Marri and Jarrah and most of the *Banksia* woodland. Chewed Marri fruit were observed in Lots 35 and 36. CBC foraging evidence was observed in the form of chewed pine cones in Lots 42 and 47. Chew marks on two Marri fruit in Lot 35 were also characteristic of CBC foraging (360 Environmental 2018).

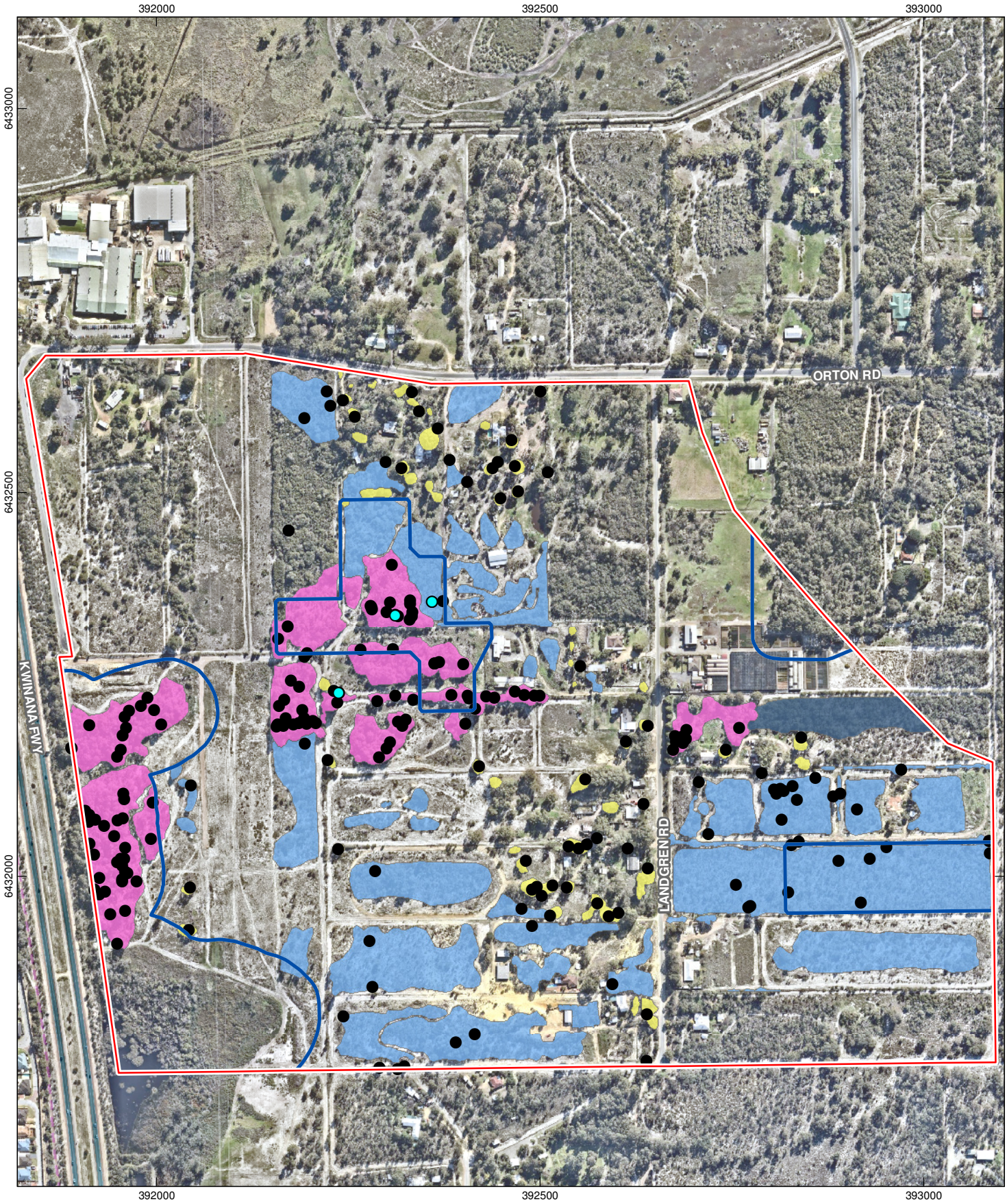


Figure 8: Black Cockatoo habitat

N

Scale 1:6,750 at A4

0 100 200 m

Coordinate System: GDA 1994 MGA Zone 50

Date: 3/12/2018

Legend

- Project Area
- Public Open Space

Black Cockatoo Potential Breeding Trees

- Black cockatoo potential breeding trees
- Black cockatoo trees with potentially suitable hollows

Black Cockatoo Foraging Habitat (360 Environmental)

- *Allocasuarina* Sp
- Banksia Woodland with scattered Eucalypts
- Low Banksia Woodland
- Marri/Jarrah Woodland

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During the 360 Environmental (2018) survey, a total of 70 trees were observed to contain hollows. However, it was noted that not all trees would be appropriate for nesting and that further investigation would be required to determine suitability. No evidence of breeding or roosting was recorded during the survey. (360 Environmental 2018).

A follow-up Black cockatoo tree hollow assessment was undertaken in October by Strategen (2018b) (Appendix 4). The assessment was confined to Lots 34, 37, 39, 40, 41, 42, 43, 44 and 47 which are owned or managed by CDN. The purpose of the survey was to inspect the trees containing hollows and determine their suitability for nesting by Black Cockatoos (Strategen 2018b). Prior to the follow-up survey, literature was consulted in order to determine the characteristics that are required for a tree hollow to be considered suitable for nesting (i.e. size, height and angle). Suitable hollows have been identified to be between 250 mm and 270 mm (Saunders et al. 1982, Saunders and Dawson 2017) and 300 mm x 340 mm (Johnstone et al. 2013).

Of the trees previously identified as having hollows that might be suitable for Black Cockatoos to breed in (360 Environmental 2018; Appendix H), 26 were confined to the lots mentioned above and inspected for hollows to determine their suitability for nesting by Black cockatoos (Strategen 2018b) (Appendix 4). Of the 26 trees inspected, only three trees were assessed as having the potential to be suitable for nesting when viewed from the ground (Figure 8) (Strategen 2018b). All three trees showed no signs of current use; an internal inspection of each hollow in these three trees would be required to determine their suitability for nesting.

The remaining 28 trees were unsuitable because either their hollow entrances were too small, they were blind openings (i.e. they did not go far in enough to be suitable), were in branches that in many instances were horizontal, and were not high enough off the ground (Strategen 2018b).

Prior to subdivision, further Black cockatoo habitat assessments will be required across the lots that have not been surveyed (Figure 6).

3.5.4 Surrounding conservation areas

No Conservation Reserves occur within the Project Area. Regionally, the Beeliar Regional Park (1.5 km to the north-west) and the Jandakot Regional Park (3.9 km to the north-east) both offer substantial portions of bushland reserved in conservation (Figure 4).

The Project Area is adjacent to Bush Forever site 273 and regionally, Bush Forever sites within a 5 km radius from the Project Area total 3144 ha. This includes the Beeliar Regional Park which occurs within the same vegetation complex as the Project Area. In addition to the Beeliar and Jandakot Regional Parks, there are 272 ha of unmanaged reserves of sizes greater than 2 ha within the 5 km of the Project Area (Figure 4).

3.5.5 Ecological linkages

According to Del Marco et al. (2004) the importance of ecological linkage is to connect natural areas, preferably with continuous corridors of native vegetation, which assists in fauna movement between the areas and to access resources and habitats. The protection, management and buffering of existing natural areas within an ecological linkage is a higher priority than revegetation of cleared portions of the link. The Project Area has been identified within the Perth Regional Ecological Linkage network.

3.5.6 Environmentally sensitive areas

Environmentally Sensitive Areas (ESAs) are areas that have been identified for protection due to their environmental significance as outlined in the Western Australian Environmental Protection (Environmentally Sensitive Areas) Notice 2005, which was gazetted on 8 April 2005.

Exceptions offered for clearing under Regulation 5 of the Environmental Protection (Clearing of Native Vegetation) Regulations 2004 do not apply within ESAs. ESAs are protected under the EP Act, and include the following:

- World Heritage areas
- areas included on the National Estate Register
- defined wetlands and associated buffers
- vegetation within 50 m of a listed Threatened species
- TECs.

The western portion of the Project Area is mapped as an ESA and appears to be associated with the CCW and its designated 50 m wetland buffer (Figure 4). Immediately east of the Project Area, Bush Forever site 273 is mapped as an ESA, and just south of the Project Area, a CCW and its associated 50 m buffer is mapped as an ESA (Figure 4).

3.6 Bushfire risk

Based on regional Bush Fire Prone Mapping, nearly all of the Project Area is mapped within the designated bushfire prone area (DFES 2018) (Plate 3).



Plate 3: Bush fire prone area (DFES 2018)

As a result of the bushfire prone status of the site, a Bushfire Management Plan (BMP) is required to accompany the Structure Plan to address the following requirements of *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (SPP 3.7; namely Policy Measure 6.3):

1. Bushfire hazard level assessment or where lot layout is known a Bushfire Attack Level (BAL) assessment.
2. Identification of any bushfire hazard issues arising from the above assessments.
3. Assessment against the bushfire protection criteria requirements contained within the Guidelines demonstrating compliance can be achieved in subsequent planning stages.

Eco Logical Australia (2018) has prepared a BMP in accordance with *Guidelines for Planning in Bushfire Prone Areas* (the Guidelines). The BMP is a separate document and should be read concurrently with this EAR.

3.7 Cultural heritage

3.7.1 Aboriginal heritage

An interrogation of the Department of Aboriginal Affairs (DAA) Aboriginal Heritage Inquiry System (AHIS) identifies there are no Registered Heritage Places within the suburb of Casuarina. Registered Site 3568 is the closest Registered Site to the Project Area and occurs approximately 3 km to the south west. Site 3568 is known as Wally's Camp. Only one Other Heritage Place occurs with thin the Suburb of Casuarina, Other Heritage Place 3627, has been assessed by the DAA and maintains the status of not a site.

Due to the distance of the nearest Registered Site being 3 km to the south west and no other sites listed as an Aboriginal Heritage site by the DAA, Aboriginal Heritage is not a considered a constraint to future development of the Project Area.

3.7.2 European heritage

Old Armadale-Rockingham Rd, Place Number 12128, the closest European Heritage listing to the Project Area. Place 12128 occurs approximately 800 m to the north west of the Project Area. Place Number 12128 continues in a south west direction away from the Project Area; therefore, this heritage site is unlikely to be impacted by the development of the Project Area.

3.8 Surrounding Land uses

Immediately north of the Project Area is a mushroom farm, which is located on Lot 1 Orton Road. Rural residential development surrounds the Project Area to the north, north east and south. The western boundary of the Project Area is bounded by the Kwinana Freeway, with residential development immediately west of the freeway (Figure 1).

There are areas of intact native vegetation as well as wetlands mapped as REW and CCW to the north, east and south (Figure 3). Located immediately east of the Project Area is Bush Forever site 273 (Figure 4).

3.8.1 Mushroom farm

The EPA (2005) separation distance guidelines (Guidance Statement No. 3) specifies a generic separation distance of 500-1000 m (depending on the size of the farm) for mushroom farms which conduct on-site blending of soils and compost (EPA 2005). However, this is applied in the absence of site-specific studies.

Odour assessment

As a result of the mushroom farm reducing leakages from odour sources, an assessment of the odour emissions and impacts from the mushroom farm was undertaken by Environmental Alliances (2015) (Appendix 5). In the absence of any formal guidance, the 2.5ou, 1 hour, 99.5 Percentile contour is used a criterion for acceptable odour impacts.

The 2.5ou, 1 hour contour was modelled for a number of scenarios/sources (Appendix 5). Based on the 2.5ou, 1 hour contours that were modelled, only the northern most portion of Lots 1, 50 and 49 were impacted under some scenarios and at worst, extending only 50 m into the Project Area.

The Local Structure Plan addresses the presence and interface with the mushroom farm by placing mixed business development within the north western portion of the Project Area and thereby, ensuring that no sensitive land uses are permitted within the area affected by the mushroom farm.

Noise assessment

In relation to noise, Herring Storer Acoustics (2015) undertook a noise assessment on the mushroom farm. The noise assessment showed exceedances at night by 6dB(A) and 4dB(A) during the day and based on the noise contour plot provided in the noise assessment, the north western corner of the Project Area may be affected by noise impacts.

The Local Structure Plan addresses this by placing mixed business development within this portion of the Project Area, ensuring that no sensitive land uses are permitted within the area affected by the mushroom farm. Furthermore, future noise impacts on mixed business development are considered to be low.

4. Potential impacts and management measures

As part of the formulation of the Local Structure Plan for the Project Area, the documentation and assessment of the following key environmental opportunities and constraints was undertaken which influenced the design of the Local Structure Plan including the placement of POS areas for conservation and drainage basins/swales.

4.1 Acid Sulfate Soils

4.1.1 Policy and management objectives

To ensure that the subdivision and development of land containing ASS is planned and managed to avoid potential adverse effects on the natural and built environment.

4.1.2 Local Structure Plan considerations

The opportunity and constraints analysis of regional landform mapping (i.e. topography, soils and potential ASS) environmental elements has indicated that portions of the Project Area corresponding to the wetland are mapped as a high risk of ASS occurring within 3 m of the natural surface. An ASS investigation will be required prior to development, there were no other significant elements to be considered or potentially impede development opportunities.

4.1.3 Management requirements

Management measures have been identified to assist in achieving the ASS management objectives (Table 10).

Table 10: Management measures for ASS

Parameter	Management actions	Timing / Responsibility
ASS	Confirm if dewatering below the water table or the excavation of more than 100 m3 is required as part of earthworks for future development.	Prior to earthworks commencing within the Project Area. Developer.
	Complete an ASS desktop investigation and completion of a self-assessment form to confirm whether ASS investigations are required.	Completion and finalisation precinct earth works plans (cut and fill, infrastructure, drainage services). Developer.
	Prepare an ASS Management Plan (if ASS is present, and site works will intersect ASS areas) that includes; potential environmental impacts—groundwater drawdown, disruption to existing bore users, vegetation stress, reduction in water quality, noise and air impacts; • earthwork strategy—soil extraction methods, stockpile management, soil treatment/neutralisation, calculated liming rate and disposal techniques • dewatering strategy—procedure and control measures, treatment and disposal options, contingency measures if acidification of groundwater occurs • monitoring program—soil, groundwater, vegetation, noise and air.	Before earthworks commence onsite (Subdivision). Developer.

4.1.4 Predicted outcomes

Through the implementation of the management recommendations outlined in Table 10, the quality of land and soils can be managed during constriction.

4.2 Potential contamination and future land use

4.2.1 Potential impacts

As described in Section 3.3, currently there are no registered contaminated sites within or near the Project Area. Historical and current land practices may have introduced fertilisers and pesticides to the soils and groundwater within the Project Area; additionally, rubbish dumping across the Project Area may have introduced contaminated material which may require remediation.

4.2.2 Policy and management objectives

In accordance with the DER (2014a) Assessment and management of contaminated sites, the following management measures have been identified to assist in achieving the potential contamination management objectives.

Table 11: Management measures for potential contamination

Parameter	Management actions	Timing / Responsibility
Potential contamination	Complete a Preliminary Site Investigation to confirm whether further detailed site investigations are required.	Prior to subdivision. Developer.

4.2.3 Predicted environmental outcomes

Further investigations will confirm if further detailed site investigations are required to support future residential development and identify appropriate management controls are in place before subdivision commences.

4.2.4 Secondary approval requirements

Sites where potential contamination exists will be managed through the land use planning process in accordance with the *Contaminated Sites Act 2003* (CS Act). The CS Act specifies that to clear any conditions relating to the assessment and management of contaminated sites requires the approval of resulting investigations by a Western Australian accredited contaminated sites auditor. Approval to commence residential development will be required under the CS Act and prior to subdivision.

4.3 Hydrology

A Local Water Management Strategy (LWMS) has been prepared for the Project Area by Hyd2O (2018) to inform the infiltration basin design and development of the Project Area.

4.3.1 Potential impacts

Surface water

While the Project Area pre-development and post-development surface water flows are to coincide in accordance with the WAPC (2008) Better Urban Water Management Guidelines, the estimated surface water volumes are expected to increase through urbanisation within the precinct. Therefore, the allocation of detention or infiltration basins and underground storage are proposed as per the LWMS.

Wetlands

Conservation Category Wetland

Local structure planning for the Project Area has considered the location and size of the REW and CCWs, as well as their values; and consequently, all three CCWs in the south west corner have been prioritised for retention (Appendix 1) (Figure 3). Implementation of the Local Structure Plan will lead to the long-term conservation of the wetlands and subsequent enhancement of their buffer, which is currently completely degraded, providing greater protection for the riparian vegetation within the CCWs.

In relation to the current wetland mapping for the largest CCW (UFI 15973) located within the south western portion of the site, the current mapped wetland boundary does not align with area of intact wetland vegetation that has been mapped by 360 Environmental (2018). Considering, the Completely Degraded state of the western portion of the mapped CCW and to inform the local structure planning design, the 50 m buffer has been defined by following the area of intact wetland vegetation.

However, as part of future development and prior to subdivision, a detailed wetland assessment will be undertaken to evaluate the wetland's values and accurately map the CCW boundary. This will inform future detailed subdivision design and ensure the wetland buffer is correctly sized and future development is appropriately setback. The wetland assessment will also inform a future Wetland Management Plan and the management responses and measures required to ensure the long-term conservation of the CCW.

Resource Enhancement Wetland

Consistent with Draft District Structure Plan – ERIC, the Primary School is located within the north eastern portion of the Local Structure Plan, and across the western most tip of the REW (UFI 6670) located within Lot 45. Therefore, development of the Primary School will result in the removal of the REW within Lot 45 (approximately 0.64 ha). Aerial imagery identifies that the same REW has been dissected by a road and located across the road within Lot 32 the REW has been cleared. This has resulted in the small pocket of REW within Lot 45 becoming isolated from the remainder of the wetland located further to the east within Lot 31.

Therefore, retention and management of this small area of the REW with its remaining intact vegetation in the long-term is considered unviable and not a high priority for retention, when balanced against the State and Federal significant environmental attributes identified within the Project Area (i.e. Banksia woodlands TEC, BC foraging habitat and potential breeding trees, CCWs, etc). However, the remaining REW located within Lot 31, which is part of larger area of intact wetland vegetation that extends further east into the adjacent Bush Forever site 273, is proposed to be retained along with the provision of 30 m wetland buffer.

Figure 4 illustrates the regional representation of geomorphic wetlands mapped as REW and CCW within a 5 km radius from the Project Area.

It should be noted that due to limited site access within the Project Area, Lot 45 has never been surveyed and a detailed flora and vegetation survey will be required prior to subdivision.

4.3.2 Policy and management objectives

The key principles and objectives for sustainable water management for the Residential Precinct is provided in the following:

- *Liveable Neighbourhoods Edition 4* (WAPC 2009)
- *Water Resources Statement of Planning Policy 2.9* (WAPC 2004)
- *Stormwater Management Manual for WA* (Department of Water 2007)
- *Decision Making Process for Stormwater in Western Australia* (Decision Process, DWER 2017)
- *Better Urban Water Management* (WAPC 2008)
- *Interim: Developing a Local Water Management Strategy* (DoW 2008)
- *Forrestfield North District Water Management Strategy* (Strategen 2015).

The key points of these policies are discussed below. For further information refer to the LWMS.

Table 12: Water management principles

Category	Principles	Objectives
Water use	Consider all potential water sources in water supply planning • integration of water and land use planning • sustainable and equitable use of all water sources having consideration for the needs of all users, including community, industry and the environment.	• minimise the use of potable water where drinking water quality is not essential • achieve a significant reduction in water use below the 100 kL/person/year State Water Plan (Government of Western Australia 2007) target.
Groundwater and surface water quantity	• to retain natural drainage systems and protect ecosystem health • to protect from flooding and water-logging • to implement economically viable stormwater systems • post development annual discharge volume and peak flow rates to remain at pre-development levels or defined environmental water requirements.	• where there are identified impacts on significant ecosystems, maintain or restore desirable environmental flows and/or hydrological cycles • for flood management, manage up to the 1 in 100-year ARI event within the development area to pre-development flows and the requirements of Water Corporation (Water Corporation 2010).
Groundwater and surface water quality	• to maintain or improve groundwater and surface water quality • where waterways/open drains intersect the water table, minimise the discharge of pollutants from groundwater • where development is associated with an ecosystem dependent upon a particular hydrologic regime, minimise discharge or pollutants to shallow groundwater and receiving waterways and maintain water quality in the specified environment.	• maintain surface water and groundwater quality • ensure that the 1 in 1 year, 1 hour event (16 mm) receives treatment prior to discharge to a receiving environment.

4.3.3 Local Structure Plan considerations

The Local Structure Plan boundary follows the design of the LSP has incorporated the following:

- All three CCWs (UFIs 15968, 15970 and 15973) located within the south west corner of Project Area and their associated buffer (50 m) will be retained within POS
- Portion of REW (UFI 6670) located on Lot 31, within the Project Area, and its associated buffer (30 m) will be retained within POS
- Detention/infiltration basins area (refer to LWMS).

4.3.1 Management requirements

Management measures have been identified to assist in achieving the hydrology management objectives (Table 13). Refer to the LWMS for management objectives for specific surface water /drainage basin requirements for the project.

Table 13: Management measures for hydrology

Parameter	Management actions	Timing/ Responsibility
Groundwater and surface water	Development of Urban Water Management Plan/s: • water management outcomes and performance indicators • risk assessment and management measures • monitoring • contingency response and corrective action • report and review.	Prior to development commencing within adjacent subdivision Stage. Developed in consultation with the City of Kwinana.
Wetland	Development of Wetland Management Plan/s: • areas to be rehabilitated (including revegetation low fuel plant species [FESA, 2011), KPIs planting densities, weed control) • controlled access and fencing requirements particularly along the interface of passive recreation and conservation areas • contingency measures • monitoring program • implementation and responsibilities.	Prior to development commencing within adjacent subdivision Stage. Developed in consultation with the City of Kwinana.
	Undertake detailed wetland assessment to accurately define CWW boundary and values, in accordance with relevant DBCA guidelines.	Prior to development commencing within adjacent subdivision Stage. Developed in consultation with the City of Kwinana.

4.3.2 Secondary approval requirements

Refer to the LWMS.

4.4 Biodiversity and natural assets

4.4.1 Potential impacts

The proposed development and Local Structure Plan will result in the following potential impacts to the Project Area's biodiversity and natural assets:

- removal of native vegetation
- removal of TEC *Banksia Woodland of the Swan Coastal Plain*
- removal of Black cockatoo foraging habitat and potential breeding trees.

4.4.2 Policy and management objectives

To consolidate existing fragmented environmental areas and to retain and conserve viable significant CCWs, TEC and fauna habitat and thereby, create a planning outcome which will ensure the long-term protection and management of the proposed POS areas for conservation.

Retention of these matters (i.e. black cockatoo habitat trees) within proposed POS areas will be subject to drainage, landscaping, bushfire and engineering requirements and will be finalised during subsequent planning stages i.e. subdivision.

4.4.3 Local Structure Plan considerations

Vegetation, Flora and Fauna

As part of the opportunity and constraints analysis of environmental matters within the precinct, the outcomes of 360 Environmental (2018) Flora, Vegetation and Black cockatoo assessment and the recent site assessments undertaken by Strategen (2018a; 2018b) identified the following key environmental attributes:

- Banksia Woodlands of the Swan Coastal Plain TEC
- Black cockatoo potential breeding trees
- Black cockatoo foraging habitat
- Geomorphic wetland mapping for the Swan Coastal Plain, namely CCW and REW, and their associated buffers.

Appendix 1 provides an overlay which identifies the Project Area's key environmental attributes. Upon comparison, there were similarities within the figures which assisted in addressing and prioritising areas to be retained within the Project Area. Areas containing Banksia Woodland TEC, black cockatoo potential breeding trees, and CCWs were identified as being of state significance and requiring retention, where practicable.

Regional ecological linkages were also considered during the Local Structure Plan design. This consideration is demonstrated by the sequence of POS areas across the Project Area which provides an east west ecological link across the site. Additionally, future development of the Project Area will seek to retain significant trees, where practicable.

In response to the above, proposed POS areas for conservation were developed and are depicted in the Local Structure Plan (Appendix 1).

The occurrences of these environmental attributes within the proposed POS areas are provided in Table 14.

Table 14: Occurrence of key environmental attributes within the POS areas

Environmental attribute	Area (ha)/ No. in Project Area	Area (ha)/ No. in POS (ha)	Occurrence % within POS areas
Banksia Woodland TEC (ha)	9.26 (surveyed portion)	5.19	56%
Vegetation in Good to Excellent condition	18.07 (surveyed portion)	9.42	52%
Conservation Category Wetland	4.12 (online mapping)	4.12	100%
Black cockatoo potential breeding trees (number of trees)	207 (surveyed portion)	76	37%
Black cockatoo foraging habitat (ha)	26.39 (surveyed portion)	7.72	29%

4.4.4 Management requirements

Management measures have been identified to assist in achieving the Biodiversity and Natural Assets management objectives (Table 15).

Table 15: Management measures for Biodiversity and Natural Assets

Parameter	Management actions	Timing/responsibility
Bushfire Risk	Implementation of the Bushfire Management Plan.	Once BMP approved by relevant government agencies- Ongoing. City of Kwinana /developer.
Flora, vegetation and fauna	Undertake detailed flora, vegetation and fauna investigations for the areas that have not been surveyed.	Prior to subdivision. Developer.
Protection of POS areas for conservation	Development of Conservation Area Management Plan/s for POS areas, that considers the conservation objectives Banksia woodlands TEC, Black cockatoo habitat and to include (but not limited to): • areas to be revegetated (including revegetation low fuel plant species [FESA, 2011), KPIs planting densities, weed control) • controlled access and fencing requirements particularly along the interface of passive recreation and conservation areas • contingency measures • monitoring program • implementation and responsibilities.	Once LSP has been approved. City of Kwinana in consultation with (DBCA).
	Development of a construction environmental management plan to incorporate environmental elements during pre-construction and during construction: • identification of potential threats/impacts and risks associated with construction activities within and adjacent to the POS areas for conservation (i.e. dieback, fauna and habitat management) • environmental outcomes and performance indicators • management measures and monitoring • contingency response and corrective actions • reporting and review.	Once LSP has been approved and prior to the commencement of redevelopment within 100m of the POS areas. City of Kwinana / developer.
Tree retention and ecological linkage between POS areas	• Complete a Landscape Feature and Tree Retention Plan, which will include location, species, size and structural health of significant trees (>50cm DBH) on site • Assess the feasibility of tree retention in response to engineering, bushfire and recreational requirements.	Currently being completed and will be submitted to City of Kwinana. Developer in consultation with the City of Kwinana
	• Where possible retention of Black cockatoo habitat trees- with priority to trees containing hollows.	Prior to subdivision design. Developer in consultation with the City of Kwinana.

4.4.5 Predicted environmental outcome

Future POS areas within the Local Structure Plan, will lead to the following significant environmental attributes being conserved and managed for the long-term:

- Banksia Woodland TEC
- Priority flora
- Black cockatoo foraging habitat and potential breeding trees
- CCWs (south western corner of Project Area) and REW (Lot 31), and associated 50 m and 30 m buffer, respectively.

4.4.6 Secondary approval requirements

As discussed in Section 2.1, due to the presence of MNES within the precinct, the developable areas, and areas to be retained, will be subject to an EPBC Act referral.

Under the DP Act, application for subdivision to implement the development areas will be required. It is likely that there will be subdivision conditions associated with key environmental attributes identified in Table 15.

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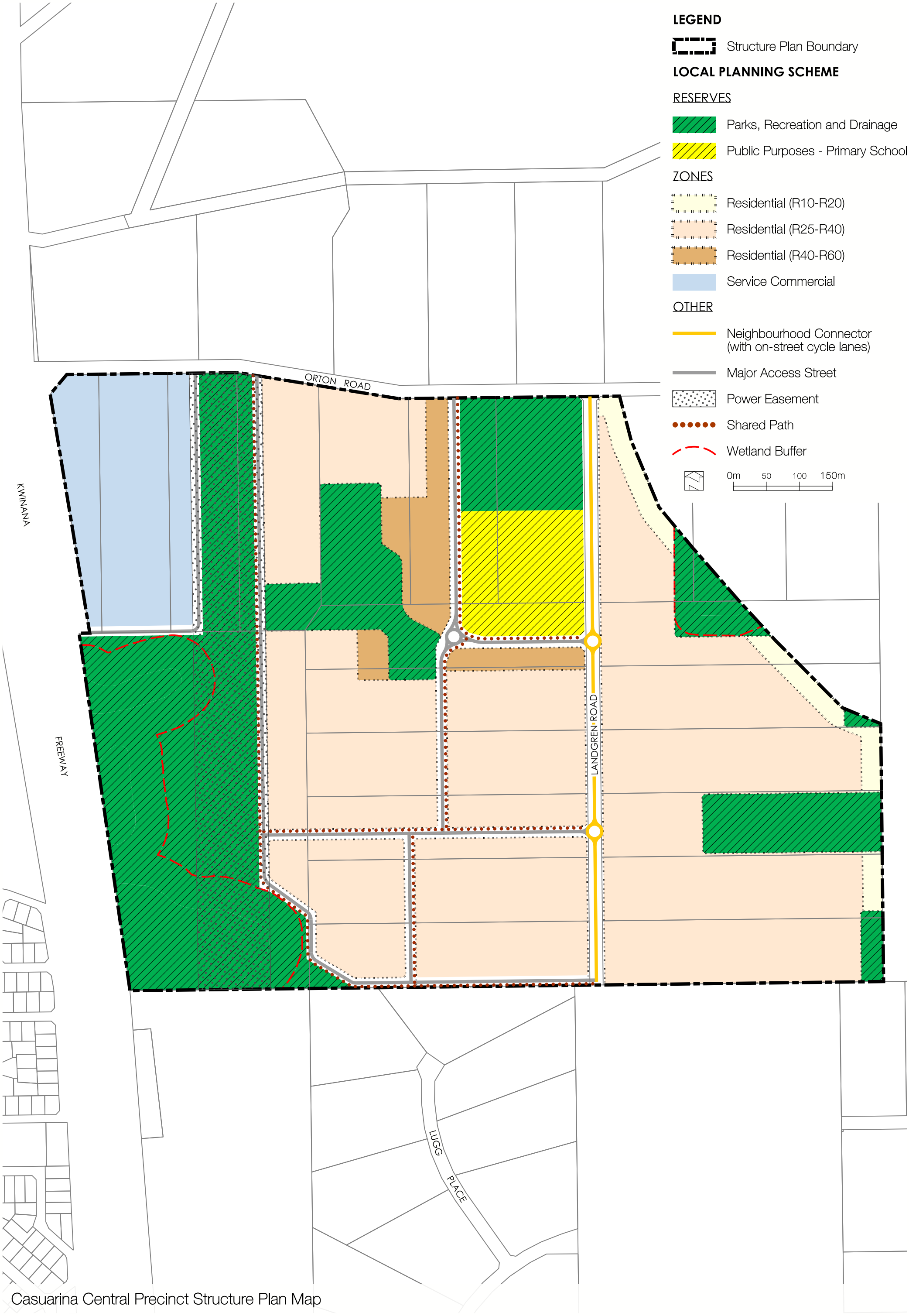
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Appendix 1
Casuarina Central Precinct
Local Structure Plan



Casuarina Central Precinct Structure Plan Map



Casuarina Central Precinct Development Concept Plan

Appendix 2
Flora, Vegetation and Black cockatoo habitat assessment
(360 Environmental 2018)

360 environmental

Various Lots, Orton Road and Landgren Road, Casuarina

Flora, Vegetation and Black Cockatoo Assessment

Prepared for:

PRM Property Holdings Pty Ltd

November 2018

people • planet • professional

Document Reference	Revision	Prepared by	Reviewed by	Admin Review	Submitted to Client	
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2717AB	0 CLIENT FINAL	360 ENV	PRM	NL	1 Electronic (email)	22/11/18

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Executive Summary

PRM Property Holdings Pty Ltd (PRM Property) commissioned 360 Environmental Pty Ltd (360 Environmental) to undertake a Detailed Flora and Vegetation Survey and Targeted Black Cockatoo Survey on various lots along Orton Road and Landgren Road, Casuarina, (herein known as the Survey Area).

The Survey Area is 71 ha and is located approximately 30 km south of Perth Central Business District, Western Australia.

Numerous surveys have been undertaken within the Survey Area since 2010. The 2010 Detailed (Level 2) Flora and Vegetation Survey and Wetland Delineation Assessment was undertaken between 2 October and 16 November and a follow-up Detailed (Level 2) Flora and Vegetation Survey, Landgren Road Casuarina was undertaken on the 16 and 17 November 2015. A recent Detailed Flora and Vegetation Survey (April 2018) was undertaken on two lots which hadn't been surveyed previously. A Black Cockatoo Habitat Assessment was also undertaken in April 2018 across the entire Survey Area. The purpose of this report is to bring together the information from these surveys and present an accurate picture of the flora and vegetation and Black Cockatoo habitat of the study area.

Key Findings from the Detailed Flora and Vegetation Survey

Numerous flora and vegetation surveys have been undertaken within the Survey Area since 2010. The flora and vegetation surveys have been consistent for environmental surveying and reporting requirements for a Detailed Flora and Vegetation Survey (EPA 2016a). The most recent 2018 field survey was a reconnaissance survey with quadrats established in vegetation that had not been previously surveyed, with additional targeted searches for perennial conservation significant species.

A total of 217 flora taxa from 133 genera and 50 families were identified within the Survey Area, of these a total of 24 introduced species were recorded, representing approximately 11% of the total taxa. Two of these are listed as Declared Pests, and **Zantedeschia aethiopica* and **Asparagus asparagoides* with the later also listed as a Weeds of National Significance (WONS) under the Biosecurity and Agriculture Management Act 2007.

No Threatened flora species pursuant to the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and/or gazetted as Threatened/ Declared Rare Flora pursuant to the *Wildlife Conservation Act 1950* were recorded during the survey. Three Priority species were recorded in the Survey Area as follows:

- *Cyathochaeta teretifolia* (P3) found at six locations;
- *Jacksonia gracillima* (P3) found at nine locations; and
- *Tetraria* sp. Chandala (P2) found at two locations.

Sixteen vegetation types and eight individual units consisting of individual trees, scattered native plants over weeds and monocultures were identified and mapped over the Survey

Area. Vegetation types BaBm, CcEm, BaKg, CcKg, CcXp, CcBiEm, CcAf and CcBa have been determined to have affiliation with FCT SCP21a - Central *Banksia attenuata* - *Eucalyptus marginata* woodlands. Vegetation types BaBmAf, BaBmAf and BaBmBi have been determined to have affiliation with FCT SCP23a - Central *Banksia attenuata* – *Banksia menziesii* woodlands. FCTs SCP 21a and 23a are not listed as TECs by the State, however, are listed as sub-communities of *Banksia* woodlands of the Swan Coastal Plain. *Banksia* woodlands of the Swan Coastal Plain are listed as Endangered under the EPBC Act.

The absence of *Banksia* trees within vegetation types CcAf and CcXp indicates that they do not represent *Banksia* Woodlands of the Swan Coastal Plain, therefore it is not considered a TEC under the Endangered category under the EPBC Act;

Eleven remnants within the Survey Area equating to 9.26 ha are considered eligible for National Protection as the Banksia Woodlands of the Swan Coastal Plain TEC under the Endangered category of the EPBC Act.

Key Findings from the Targeted Black Cockatoo Habitat Assessment

- The presence of Carnaby's Black Cockatoo and Forest Red-tailed Black Cockatoo was recorded within the Survey Area;
- Evidence of Carnaby's Black Cockatoo and Forest Red-tailed Black Cockatoo foraging was identified within the Survey Area;
- Evidence suggests that while Carnaby's Black Cockatoos may utilise habitat contained within the Survey Area, they are not foraging within the Survey Area frequently or extensively;
- *Eucalypt/Corymbia* Woodland dominated by Marri and Jarrah, is heavily utilised by Forest Red-tailed Black Cockatoo;
- No evidence of breeding or roosting was identified in the Survey Area;
- A total of 26.39 ha of Black Cockatoo foraging habitat was recorded in the Survey Area;
- A total of 207 trees were identified as potential Black Cockatoo breeding habitat (DBH > 500 mm, as defined in the EPBC Black Cockatoo Referral Guidelines); and
- 70 breeding trees contained hollows.

Table of Contents

1 Introduction 1
1.1 The Project 1
1.2 Objectives and Scope 1
1.3 Protection of Flora and Vegetation 2
2 Background 5
2.1 Biophysical Environment 5
2.2 Biological Environment 6
3 Methods 15
3.1 Flora and Vegetation 15
3.2 Black Cockatoo Habitat Assessment 21
4 Results 23
4.1 Limitations and Constraints 23
4.2 Flora and Vegetation 24
4.3 Black Cockatoo Habitat Assessment 48
5 Discussion 56
5.1 Flora and Vegetation 56
5.2 Black Cockatoo Habitat Assessment 58
6 Conclusions 61
7 References 63
8 Limitations 66

List of Figures

Figure 1: Location of the Survey Area 4
Figure 2: Long-term Monthly Average Rainfall and Maximum and Minimum Temperatures (from 1989 to 2017) as well as Monthly Rainfall Data for the 12 months Prior to the Survey Recorded in Jandakot Aero (9172) (Bureau of Meteorology, 2018) .. 5
Figure 3: Hydrology 12
Figure 4: Environmentally Sensitive Areas 13
Figure 5: Ecological Linkages and Bush Forever Sites 14
Figure 6: Quadrat Locations and Survey Effort 19
Figure 7: DBCA Threatened and Priority Flora Database Search Results 26
Figure 8: DBCA Threatened Ecological Communities 27
Figure 9: Location of Threatened and Priority Flora Recorded in the Survey Area 30
Figure 10: Vegetation Type Mapping of the Survey Area 41
Figure 11: Vegetation Condition Mapping of the Survey Area 42
Figure 12: Banksia Woodlands TEC within Survey Area 47
Figure 13: Black Cockatoo Evidence 53
Figure 14: Black Cockatoo Foraging Habitat 54
Figure 15: Black Cockatoo Potential Breeding Trees 55

List of Tables

Table 1: Broad Vegetation Types within the Survey Area, State And Regional Representation (Government of Western Australia, 2018) 7
Table 2: Database Search Particulars 17
Table 3: Limitations and Constraints Associated with the Survey Area 23
Table 4: Summary of Previous Survey Reports 25
Table 5: Conservation Significant Species with the Potential to Occur in the Survey Area 25
Table 6: Locations of Conservation Significant Flora within the Survey Area 28
Table 7: Introduced Flora Recorded in the Survey Area 31
Table 8: Vegetation Condition Extent in the Survey Area 33
Table 9: Vegetation Types Recorded for the Survey Area 34
Table 10: Floristic Community Type Quadrat Analysis 43

Table 11: Floristic Community Types for Relevés and Mapping Notes 45
Table 12: Representative Broad Vegetation Types and Corresponding Vegetation Types 46

List of Plates

Plate 1: *Cyathochaeta teretifolia (P3)* 29
Plate 2: *Jacksonia gracillima (P3)* 29
Plate 3: *Homalospermum firmum* (Photograph sourced from the FloraBase, DBCA). ... 31
Plate 4: Two female Forest Red-tailed Black Cockatoos Observed within the Survey Area 49
Plate 5: Forest Red-tailed Black Cockatoo feathers (top left, top right, bottom left) and a Carnaby's Black Cockatoo feather (bottom right) 49
Plate 6: Extensive Forest Red-tailed Black Cockatoo Foraging Evidence on Marri Fruit 50
Plate 7: Potential Carnaby's Black Cockatoo Foraging Evidence on *Banksia* Fruit 51
Plate 8: Potential Carnaby's Black Cockatoo Foraging Evidence on a Pine Cone 51
Plate 9: White-tailed Black Cockatoo Foraging Evidence on Marri Fruit 52

List of Appendices

Appendix A: Protection of Flora, Vegetation and Ecological Communities
Appendix B: WONS, Declared Plant and Environmental Weed Categories
Appendix C: Vegetation Condition Scale
Appendix D: Flora Likelihood Table
Appendix E: Flora Inventory
Appendix F: Flora Site Sheets
Appendix G: Black Cockatoo Distribution Maps
Appendix H: Black Cockatoo Potential Breeding Trees
Appendix I: Desktop Database Searches

1 Introduction

1.1 The Project

PRM Property Holdings Pty Ltd (PRM Property) commissioned 360 Environmental Pty Ltd (360 Environmental) to undertake a Detailed Flora and Vegetation Survey and Targeted Black Cockatoo Survey on various lots along Orton Road and Landgren Road, Casuarina, Western Australia (herein known as the Survey Area) (Figure 1).

The Survey Area is 71 hectares (ha) and is located approximately 30 km south of Perth Central Business District, Western Australia. It encompasses Lots 46, 47, 48 and 9000, Orton Road, and Lots 34, 35, 36, 37, 39, 40, 41, 42, 43 and 44, Landgren Road (Figure 1).

Numerous surveys have been undertaken within the Survey Area since 2010. The 2010 Detailed (Level 2) Flora and Vegetation Survey and Wetland Delineation Assessment was undertaken between 2 October and 16 November and a follow-up Detailed (Level 2) Flora and Vegetation Survey, Landgren Road Casuarina was undertaken on the 16 and 17 November 2015. A recent Detailed Flora and Vegetation Survey (April 2018) was undertaken on two lots which hadn't been surveyed previously. A Black Cockatoo Habitat Assessment was also undertaken in April 2018 across the entire Survey Area. The purpose of this report is to bring together the information from these surveys and present an accurate picture of the flora and vegetation and Black Cockatoo habitat of the study area.

1.2 Objectives and Scope

The purpose of the biological survey is to delineate key environmental and biological values within the predetermined Survey Area that included flora, vegetation and Black Cockatoo values. The baseline information will then be used in the required environmental approvals processes to allow for clearing of vegetation and progression of the proposed development.

The following scope of works was completed to support the overarching objectives in:

- Detailed Flora and Vegetation Survey;
    - Conduct a desktop assessment of relevant literature, databases and spatial datasets to determine the environmental values and any potential issues, such as Threatened/Rare and significant species, Threatened Ecological Communities (TECs) and Priority Ecological Communities (PECs), that may be present in the Survey Area and the surrounding areas;
    - Undertake a field survey including the use of quadrats along with targeted searches for species of conservation significance where required to verify the accuracy of the desktop assessment;

- Delineate and characterise the flora and the range of vegetation units present in the Survey Area; and
- Assess and map the vegetation condition in the Survey Area.

- Targeted Black Cockatoo Habitat Assessment;
  - Record opportunistically observed Black Cockatoos occurring within the Survey Area; and
  - Identify and determine the type and extent of habitat (breeding, foraging and roosting) suitable for Black Cockatoos in the Survey Area with reference to the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and referral guidelines for three threatened Black Cockatoo species (Department of Sustainability Environment Water Population and Communities, 2012).

1.3 Protection of Flora and Vegetation

Flora and vegetation is governed formally and informally by various legislative and non-legislative measures. The Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) aims to protect matters of national environmental significance (MNES) including listed flora, fauna and ecological communities and heritage places. Under the EPBC Act, the Commonwealth Department of the Environment and Energy (DoEE) lists Threatened flora species in categories determined by criteria set out in the EPBC Act. These categories are described in Appendix A.

The WA Department of Biodiversity, Conservation and Attractions (DBCA) (formerly the WA Department of Parks and Wildlife) lists flora under the provisions of the Wildlife Conservation Act 1950 (WC Act) as protected according to their need for protection (Appendix A).

Flora is given Declared Rare status when populations are geographically restricted or are threatened by local processes. In addition, The DBCA lists 'Priority' flora that have not been assigned statutory protection as Declared Rare or 'Scheduled' under the WC Act, but which are under consideration for declaration as DRF. This list is for species that may be rare or threatened but cannot be considered as Declared Rare until further surveys have been undertaken. Priority floras are listed according to the conservation categories described in Appendix A.

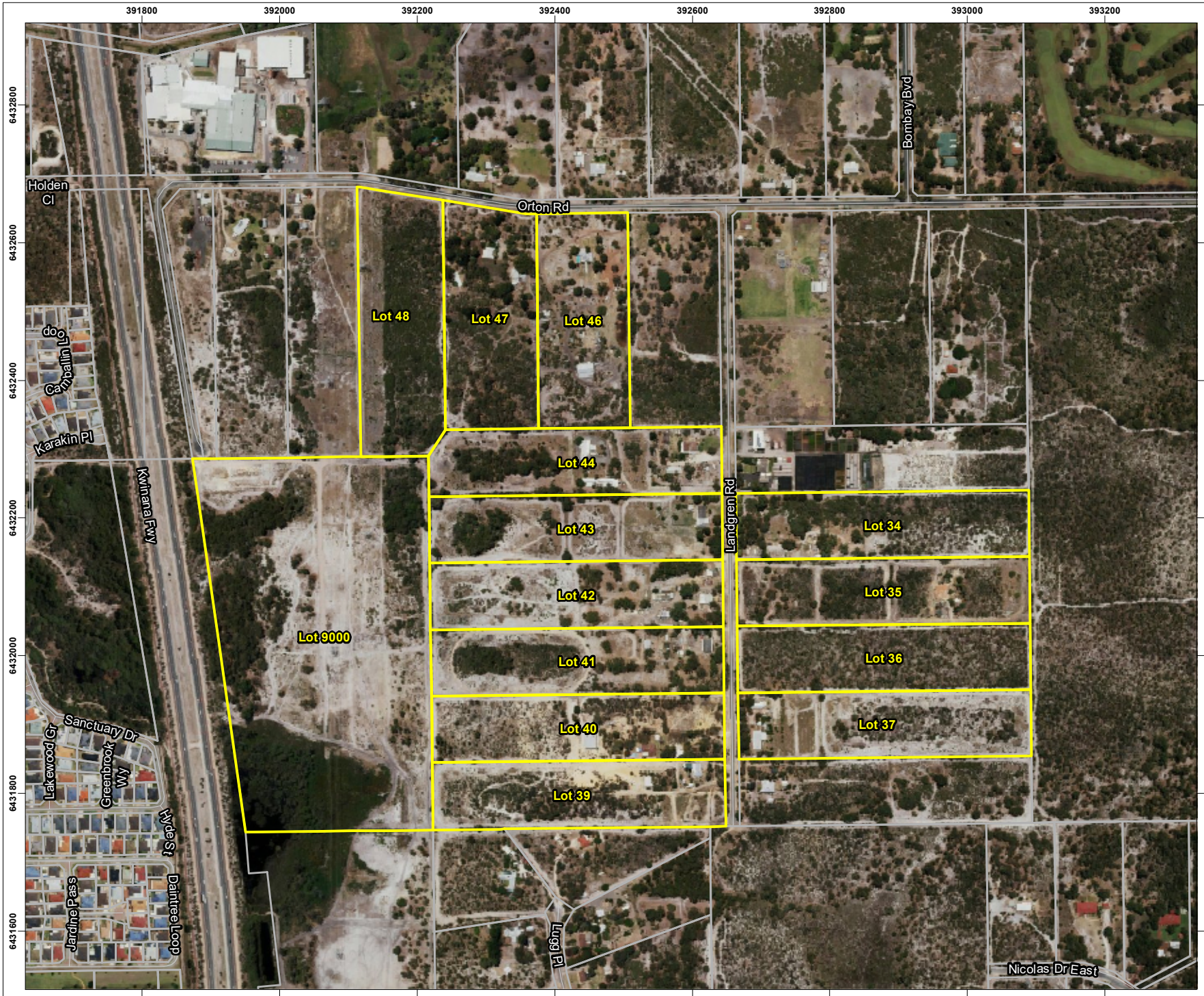
Certain populations or communities of flora may be of local significance or interest because of their patterns of distribution and abundance. For example, specific locations of flora may be locally significant because they are range extensions to the previously known distribution or are newly discovered taxa (and have the potential to be of more than local significance). In addition, many species are in decline as a result of threatening processes (land clearing, grazing, changed fire regimes), and relict populations of such species assume local importance for the DBCA.

Threatened Ecological Communities (TECs) refer to communities that may be subject to processes that threaten to destroy or significantly modify it across much of its range. TECs are listed at both Commonwealth level, under to EPBC Act, and State level, by the Western Australian (WA) Minister for Environment. Conservation categories for TECs are presented in Appendix A.

A list of Priority Ecological Communities (PECs) is also kept by the WA DBCA. This list consists of communities with insufficient information available to be considered a TEC, or which are rare but not currently threatened. PECs are assigned to one of four Priority rankings according to the criteria presented in Appendix A.

Environmentally Sensitive Areas (ESAs) are declared to prevent degradation of important environmental values such as Threatened flora, TECs or significant wetlands.





Legend

- Survey Area
- Lot Boundary

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- LOCALITY MAP SOURCED LANDGATE 2017
- CADASTRE SOURCED LANDGATE 2018
- AERIAL PHOTOGRAPHY SOURCED LANDGATE 2017
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LOCALITY MAP



PROJECT ID	DATE
2717	11/05/2018

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
SL	AH	SW	0

PRM Property Pty Ltd
Orton Road and Landgren Road

Flora, Vegetation and Black Cockatoo Assessment

Figure 1
Location of Study Area

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K:\Projects\1.0 EBS\2717 Orton Rd Flora and BC Survey, Casuarina\2717 F1 Location of the Survey Area.mxd

2 Background

2.1 Biophysical Environment

2.1.1 Climate

The most representative long term official Bureau of Meteorology weather station currently operating near the Survey Area is Jandakot Aero (Station Number 9172), located approximately 15 km north of the Survey Area. Jandakot received 783.2 mm of rain in the 12 months prior to the survey (April 2017 – March 2018) (Bureau of Meteorology, 2018). This is 40.5 mm below the long-term average rainfall for the same period. For the three months prior to the survey (January – March 2018), Jandakot recorded 125.8 mm of rainfall which is 74.8 mm above the long-term average rainfall for the same period (Figure 2) (Bureau of Meteorology, 2018).

The average maximum and minimum temperatures for March 2018 were 29.8˚C and 16.5˚C respectively (Bureau of Meteorology, 2018). The average temperatures for March 2018 were slightly higher than the long-term averages; the long-term mean maximum temperature for February is 29.6˚C and the long-term mean minimum temperature is 15.5˚C (Bureau of Meteorology, 2018). During the survey, daily maximum temperatures ranged from 22.3˚C to 29.2˚C and daily minimum temperatures ranged from 10.8˚C to 19.1˚C. 8.4 mm of rainfall was recorded during the survey (Bureau of Meteorology, 2018).

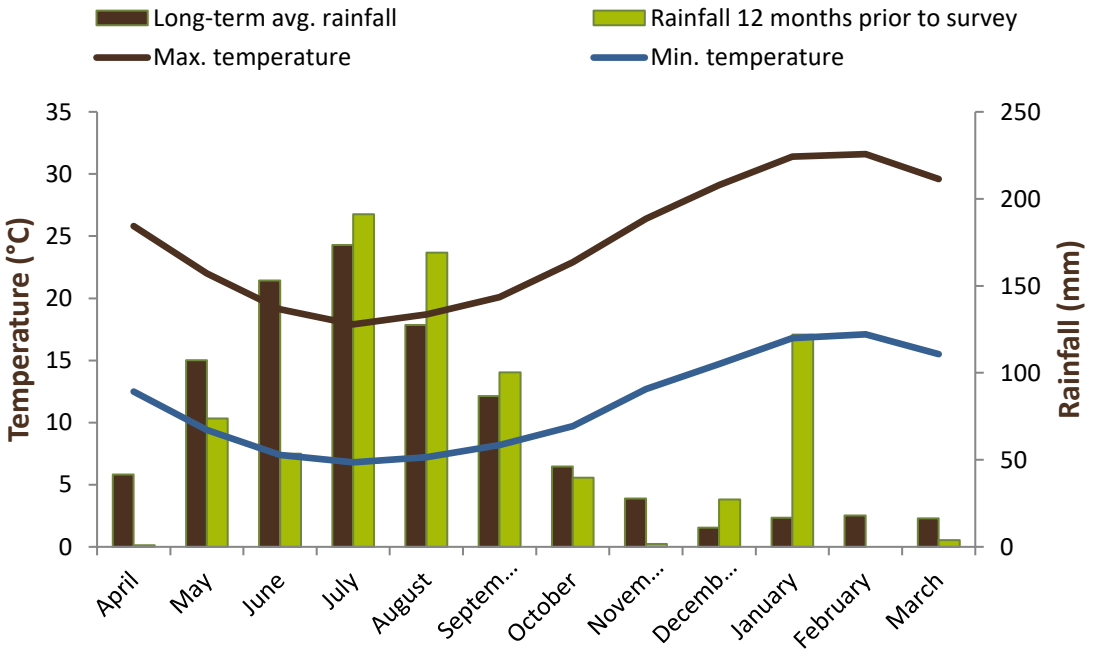


Figure 2: Long-term Monthly Average Rainfall and Maximum and Minimum Temperatures (from 1989 to 2017) as well as Monthly Rainfall Data for the 12 months Prior to the Survey Recorded in Jandakot Aero (9172) (Bureau of Meteorology, 2018)

2.1.2 Hydrology

Wetlands of the Swan Coastal Plain have been described and mapped by Hill *et al.*, (1996) and assigned a management category reflecting their condition. The DBCA Geomorphic Wetlands dataset identified three wetlands occurring within the western portion of the Survey Area (Figure 3) (Department of Biodiversity Conservation and Attractions, 2017b).

These are as follows:

- Conservation Wetland UFI 15968;
- Conservation Wetland UFI 15970; and
- Conservation Wetland UFI 15973.

A review of GIS datasets has identified that areas within the western portion of the Survey Area are subject to inundation and a major drain occurs at the southwest corner of the Survey Area (Department of Water and Environmental Regulation, 2016).

2.1.3 Land Systems and Surface Geology

Soil-landscape system mapping of Western Australia describes broad soil and landscape characteristics from regional to local scales. The Survey Area is located within the Bassendean System, which occurs from the Swan Coastal Plain from Busselton to Jurien and is characterised as sand dunes and sandplains with pale deep sand, semi-wet and wet soil, with banksia-paperbark woodlands and mixed heaths (Department of Agriculture and Food WA, 2012).

The 1:1,000,000 surface geology mapping indicates the geology of the Survey Area falls within the Bassendean Sand surface geology unit, which is characterised by basal conglomerate overlain by dune quartz sand with heavy mineral concentrations (Geoscience Australia, 2008).

2.2 Biological Environment

2.2.1 Interim Biogeographic Regionalisation of Australia

The Interim Biogeographic Regionalisation of Australia (IBRA) divides Australia into 89 bioregions based on major biological, geographical and geological attributes. These bioregions are subdivided into 419 subregions as part of a refinement of the IBRA framework. The Survey Area occurs within the Swan Coastal Plain subregion of the Swan Coastal Plain bioregion (Department of the Environment and Energy, 2016).

The Swan Coastal Plain subregion is a low lying coastal plain, mainly covered with woodlands. It is dominated by Tuart or *Banksia* on sandy soils, *Casuarina obesa* on outwash plains, and paperbark in swampy areas. In the east, the plain rises to duricrusted Mesozoic sediments dominated by Jarrah woodland (Mitchell, Williams and Desmond, 2002).

2.2.2 Broad Vegetation Types

Mapping of the vegetation of the Swan Coastal Plain region which included the Survey Area was completed on a broad scale (1:1,000,000) by (Beard, 1981). These vegetation units were later re-assessed by Shepherd, Beeston and Hopkins (2002) to account for clearing in the intensive land use zone, dividing some larger vegetation units into smaller units. This pre-European database contains a total of 819 vegetation types within Western Australia.

There is one Shepherd, Beeston and Hopkins (2002) broad vegetation type mapped over the Survey Area. The vegetation type is described below and its representation in the local government, region and state is shown in Table 1.

- **Bassendean 1001:** Medium very sparse woodland; jarrah, with low woodland; banksia and casuarina.

Table 1: Broad Vegetation Types within the Survey Area, State And Regional Representation (Government of Western Australia, 2018)

Vegetation Type	Pre-European Extent (ha)	Current Extent (ha)	Remaining (%)	Current Extent Managed in DBCA Lands (%)
Vegetation Types (Shepherd, Beeston and Hopkins, 2002) in WA				
1001	57,410.23	12,704.45	22.13	12.63
Vegetation Types (Shepherd, Beeston and Hopkins, 2002) in Swan Coastal Plain bioregion				
1001	57,410.23	12,704.45	22.13	12.63
Vegetation Types (Shepherd, Beeston and Hopkins, 2002) in Perth Subregion				
1001	57,410.23	12,704.45	22.13	12.63

Mapping by Heddle, Loneragan and Havel (1980) used landform-soil units determined by Churchward and McArthur (1978). The delineation of vegetation complexes is based on the concept of a series of plant communities forming regularly repeating complexes associated with a particular soil unit. One Heddle, Loneragan and Havel (1980) vegetation complex occurs within the Survey Area and is described below;

- **Bassendean Complex – Central and South:** Vegetation ranges from woodland of *Eucalyptus marginata - Allocasuarina fraseriana - Banksia* spp. to low woodland of *Melaleuca* spp. and sedgelands on the moister sites.

2.2.3 Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESAs) are declared to prevent degradation of important environmental values such as Threatened flora, TECs or significant wetlands. Exemptions contained in the *Environmental Protection (Clearing of Native vegetation) Regulations 2004* for low impact land clearing do not apply in ESAs and a clearing permit is required.

One ESA identified as a Swan Coastal Plain wetland and associated 50 m buffer occurs within the western portion of the Survey Area. Five nearby ESAs identified as Swan Coastal Plain wetlands and associated 50 m buffers are located within 100 m to the north and 750 m to the west of the Survey Area. Additionally, three ESAs identified as declared rare flora and associated 50 m buffers are located approximately 150 m west / north-west of the Survey Area (Figure 4) (Department of Water and Environmental Regulation, 2018).

2.2.4 Conservation Areas

There are no conservation areas within the Survey Area. The nearest conservation areas are the Banksia Nature Reserve, located approximately 2 km east of the Survey Area, the Modong Nature Reserve, located approximately 2.5 km east of the Survey Area and the Wandi Nature Reserve, located approximately 3.5 km north of the Survey Area (Department of Biodiversity Conservation and Attractions, 2017a).

2.2.5 Bush Forever

Bush Forever is a State Government Policy and programme that identifies 51,200 ha of regionally significant vegetation for protection, covering 26 vegetation complexes. This amounts to approximately 18% of the original vegetation on the Swan Coastal Plain biogeographic region of the Perth metropolitan area. Regionally significant vegetation has been identified based on criteria relating to its conservation value. Important criteria in the identification process include the achievement, where possible, of a comprehensive representation of all the ecological communities originally occurring in the region, principally through protecting a target of at least 10% of each vegetation complex in the Bush Forever project boundary (Government of Western Australia, 2000).

No Bush Forever Sites were found within the Survey Area. Bush Forever Site 273 is directly adjacent to the eastern boundary of the Survey Area and Bush Forever Site 272 is located approximately 350 m west of the Survey Area (Department of Planning, 2014) (Figure 5)

2.2.6 Ecological Linkages

The Survey Area forms part of the Perth Biodiversity Project's (PBP) Draft Regional Ecological Linkage Network (Western Australian Local Government Authority, 2014). The purpose of the Regional Ecological Linkages identified by the PBP was to link protected natural areas with other areas of mapped native vegetation. Priority was given to identifying linkages through those areas having the greatest assumed protection and to those areas that maximised opportunities to form continuous corridors of native vegetation. One Ecological Linkage was found to intersect the Survey Area (Figure 5): Link ID 57.

2.2.7 Introduced Flora

The Australian Weed Strategy identifies Weeds of National Significance (WONS) based on four major criteria (Appendix B) (Thorp and Lynch, 2000). Each WONS has a national strategy and a national coordinator, responsible for implementing the strategy. WONS are regarded as the worst weeds in Australia because of their invasiveness, potential for spread, and economic and environmental impacts (Thorp and Lynch, 2000).

Plants may also be 'Declared' under the *Biosecurity and Agriculture Management Act 2007* (BAM Act) through the provisions of the Western Australian Organism List (WAOL). The WAOL contains information on the area(s) in which a plant is Declared and the control and keeping categories to which it has been assigned in Western Australia (Department of Primary Industries and Regional Development, 2018). Species listed as Declared under the BAM Act are allocated to one of three categories which are described in Appendix B.

2.2.8 Black Cockatoos

All three Black Cockatoos have suffered a substantial decline in numbers and breeding distribution in the past 50 years (Johnstone and Storr, 1998). Direct causes of population decline include the large numbers shot by orchardists (mainly associated with Baudin's Black Cockatoo), clearing and fragmentation of habitat (especially the loss of breeding hollows), the impact of hollow competitors including the Galah (*Cacatua roseicapilla*), Corellas including Butler's Corella (*C. pastinator butleri*), Australian Shelduck (*Tadorna tadornoides*), Australian Wood Duck (*Chenonetta jubata*), the feral European Honey Bee (*Apis mellifera*), and also vehicle strikes. Around 60% of the original vegetation on the Swan Coastal Plain has been cleared and up to 85% in other parts of the south-west region for agriculture (crops), meat production, dairying, farms, orchards, vineyards, pine plantations, mining, timber and wood chipping, cities and towns. At present, extensive tracts of uncleared land only remain in State forest and conservation reserves and what is left of remnant vegetation (in roadside verges etc.) is often disturbed to a varying degree (Johnstone and Kirkby, 2011).

The south-west region is now a severely fragmented landscape and the further loss of foraging habitat, the lack of suitable breeding sites, climate change, and alterations in the landscape has led to significant changes in forest structure. Almost every part of the Jarrah-Marri forest has been logged in the past, and most present-day trees are too young to form hollows, and competition with exotic species, exacerbate the future conservation of Carnaby's Black Cockatoo, Forest Red-tailed Black Cockatoo and Baudin's Black Cockatoo (Johnstone and Kirkby, 2011).

Black cockatoos breed in large hollow-bearing trees, generally within woodlands or forests (Johnstone and Kirkby, 2011). The size of the tree can be a useful indication of the hollow-bearing potential of the tree. Trees of suitable DBH are potentially important for maintaining breeding in the long-term, through maintaining the integrity of the habitat and allowing trees to provide future nest hollows. Maintaining the long-term supply of larger

trees, of an appropriate size to provide suitable nest hollows, is particularly important in woodland stands that are known to support Black Cockatoo breeding (Department of Sustainability Environment Water Population and Communities, 2012).

The distribution of all three Black Cockatoo species can be seen in the 2014 and 2017 distribution maps in Appendix G. The Survey Area is within the known distribution of the Carnaby's Black Cockatoo and Forest Red-tailed Black Cockatoo and occurs on the northwestern boundary of the known distribution of the Baudin's Black Cockatoo.

Baudin's Black Cockatoo

Baudin's Black Cockatoo has white tail feathers that is distributed through south-west WA from the northern Darling Range and adjacent far east of the Swan Coastal Plain (south of the Swan River), south to Bunbury and across to Albany (Johnstone and Kirkby, 2011). Baudin's Black Cockatoo rarely occurs near coastal communities north of Mandurah, and rarely occurs north of the Swan River (Johnstone and Storr, 1998; Johnstone and Kirkby, 2011). Baudin's Black Cockatoo usually occur in small flocks of up to 30, or occasionally up to 50 and rarely in aggregations of up to 1,200 (Johnstone and Kirkby, 2011). Baudin's Black Cockatoo is distinguished from Carnaby's Black Cockatoo by its longer bill and slight variation in call.

This species forages primarily in *Eucalyptus* forest, where it feeds on Marri seeds, flowers, nectar and buds. They also feed on a wide range of seeds of *Eucalyptus* spp., *Banksia* spp., *Hakea* spp. and *Pinus* spp., as well as fruiting apples and pears and beetle larvae from under the bark of trees (Johnstone and Storr, 1998; Johnstone and Kirkby, 2011). Baudin's Black Cockatoo forages at all levels of the forest from the canopy to the ground, often feeding in the understorey on proteaceous trees and shrubs (especially *Banksia*) and in orchard trees within the canopy and on fallen fruit.

According to Johnstone and Kirkby (2011) the breeding biology of this species is poorly known. Breeding locations of this species span from the south-west, north to the Whicher Range and east to Lowden. Isolated breeding locations have also been recorded at Wungong Catchment, Serpentine (hills area) and east to Kojonup and near Albany (Johnstone and Kirkby, 2011). They nest in large, mostly vertical, hollows of Karri (*E. diversicolor*), Marri, Wandoo, and Bullich (*E. megacarpa*).

Carnaby's Black Cockatoo

Carnaby's Black Cockatoo also has white tail feathers that is endemic to south-west WA, and is distributed from the Murchison River to Esperance and inland to Coorow, Kellerberrin and Lake Cronin (Cale, 2003). The species was once common, but the population has declined significantly in the last half century, and is now locally extinct in some areas (Johnstone and Storr, 1998; Shah, 2006). In the last 45 years the species has suffered a 50% reduction in its abundance (Cale, 2003). This reduction is due to the clearing of core breeding habitat in the Wheatbelt, the deterioration of nesting hollows, and clearing of food resources on the Swan Coastal Plain (Cale, 2003). The total

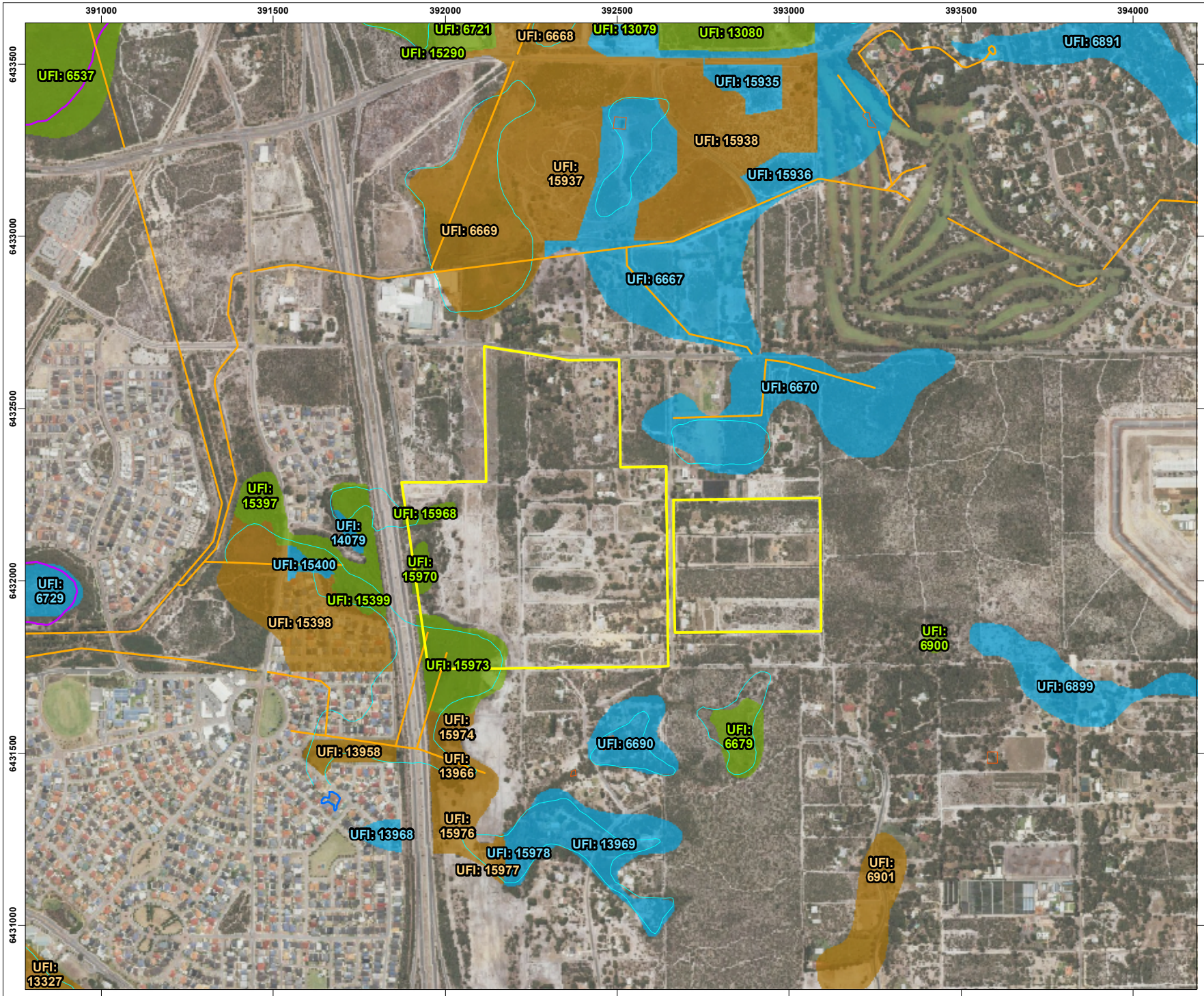
population of Carnaby's Black Cockatoo is currently estimated at 40,000 (Johnstone and Kirkby, 2011). Breeding has been recorded from early July to mid-December, and primarily occurs in the Wheatbelt in the semi-arid and subhumid interior (Johnstone and Storr, 1998).

Carnaby's Black Cockatoos feed on seeds, nuts and flowers of a variety of native and exotic plants. Food plants include *Banksia* sp. (including those previously included in the genus *Dryandra*), Pine trees (*Pinus* sp.), Marri, Jarrah, *Grevillea*, *Allocasuarina*, and *Hakea* species (Shah, 2006). As Carnaby's Black Cockatoos are less efficient at extracting Marri seeds than the other two Black Cockatoo species, the seeds from seed pods of Banksia and the cones of Pine trees provide the Carnaby's Black Cockatoo with the highest energetic yield (Cooper *et al.*, 2002).

Forest Red-tailed Black Cockatoo

The Forest Red-tailed Black Cockatoo is a large Black Cockatoo with a pair of black central tail feathers and a bright red, orange/yellow barring on the tail (Department of Sustainability Environment Water Population and Communities, 2012). It is distributed through the south-west of WA from Gingin through the Darling Ranges to the south-west from Bunbury to Albany. It also occasionally occurs in the southern Swan Coastal Plain and rarely in the Perth metropolitan area. The Forest Red-tailed Black Cockatoo occurs in pairs or small flocks, and occasionally large flocks of up to 200 birds (Johnstone and Storr, 1998). The Forest Red-tailed Black Cockatoo inhabits dense Jarrah, Karri (*E. diversicolor*) and Marri forests that receive more than 600 mm average annual rainfall (Department of Sustainability Environment Water Population and Communities, 2012).

The Forest Red-tailed Black Cockatoo feeds primarily on Marri and Jarrah fruit (Johnstone and Kirkby 1999) and to a lesser extent on Swan River Blackbutt (*E. patens*), Albany Blackbutt (*E. staeri*), Karri, Sheoak (*Allocasuarina fraseriana*) and Snottygobble (*Persoonia longifolia*). Forest Red-tailed Black Cockatoos can obtain energy faster when feeding on Marri and Jarrah than other food sources (Cooper *et al.*, 2002) and these two plant species make up 90% of its diet.



Legend

- Survey Area

Hydrography

- Watercourse - minor, perennial
- Drain - major
- Swamp - perennial
- Area Subject to Inundation
- Earth Dam

Geomorphic Wetlands

- Conservation
- Resource Enhancement
- Multiple Use

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- LOCALITY MAP SOURCED LANDGATE 2017
- WETLAND SOURCED DBCA 2018
- HYDROGRAPHY SOURCED DWER 2018
- CADASTRE SOURCED LANDGATE 2018
- AERIAL PHOTOGRAPHY SOURCED LANDGATE 2017
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LOCALITY MAP



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GDA 1994 MGA Zone 50

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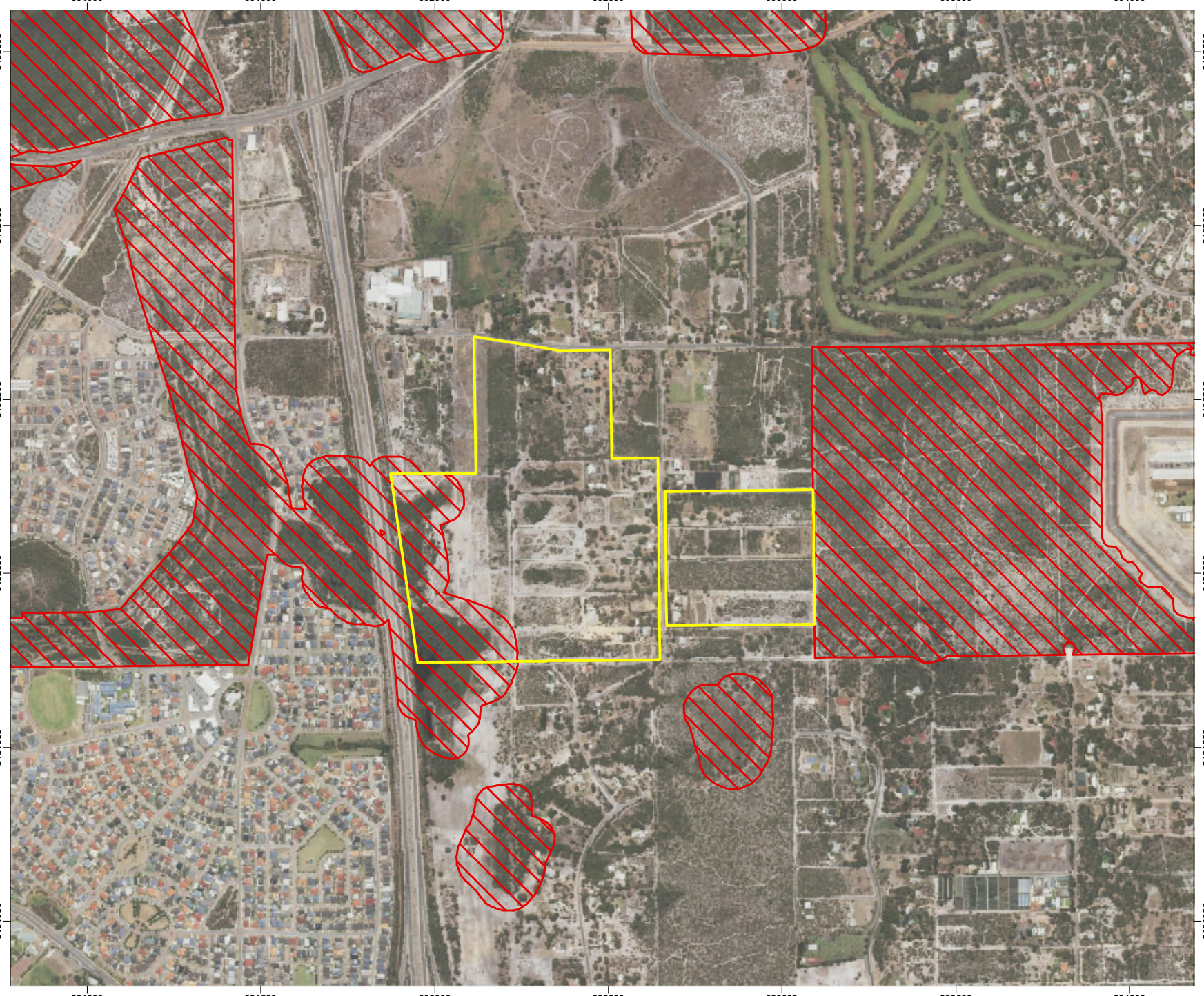
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Flora, Vegetation and Black Cockatoo Assessment

Figure 3
Hydrology

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Legend

- Survey Area
- Environmentally Sensitive Areas

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- LOCALITY MAP SOURCED LANDGATE 2017
- ESA SOURCED DBCA 2018
- CADASTRE SOURCED LANDGATE 2018
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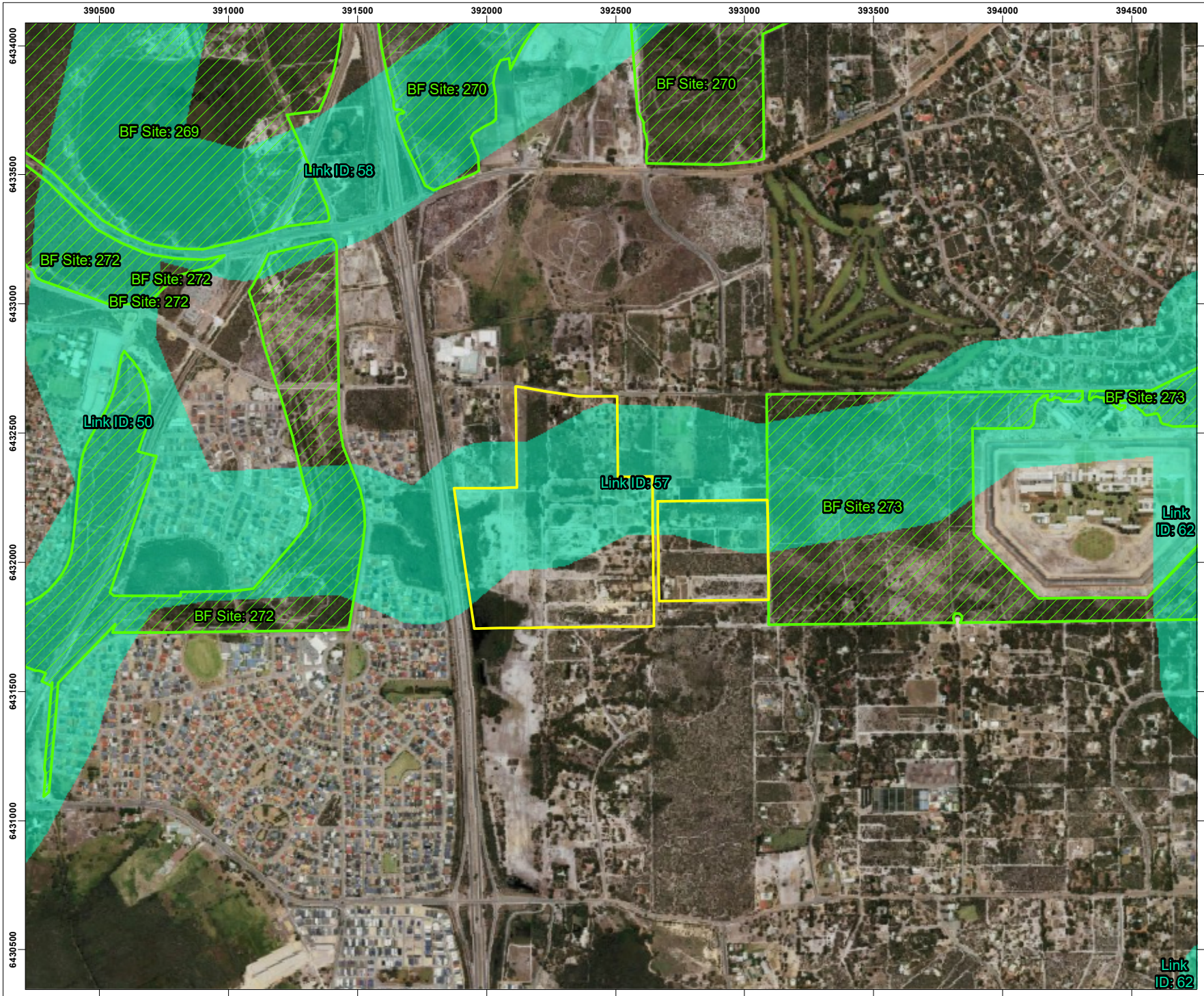
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Flora, Vegetation and Black Cockatoo Assessment

Figure 4
Environmentally Sensitive Areas

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Legend

- Survey Area
- Bush Forever Areas
- Perth Regional Ecological Linkage

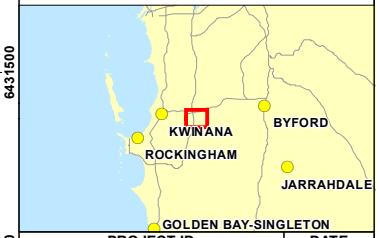
- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- LOCALITY MAP SOURCED LANDGATE 2017
- BFA SOURCED DPLH 2018
- PREL SOURCED WALGA 2012
- AERIAL PHOTOGRAPHY SOURCED LANDGATE 2017
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LOCALITY MAP



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HORIZONTAL DATUM AND PROJECTION
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Flora, Vegetation and Black Cockatoo Assessment

Figure 5 Ecological Linkages and Bush Forever Sites

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3 Methods

3.1 Flora and Vegetation

The 2018 flora and vegetation assessment was consistent with an out of season Detailed Flora survey, as per the Environmental Protection Authority (EPA) requirements for environmental surveying and reporting for flora and vegetation in WA, where practicable, as set out in the following documents:

- Technical Guidance – Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment (Environmental Protection Authority, 2016).

The 2010 Level 2 survey and Wetland Delineation Assessment was undertaken between 2 October and 16 November and the Level 2 Flora and Vegetation Survey, Landgren Road Casuarina was undertaken on the 16 and 17 November 2015. These two surveys were consistent a Level 2 survey as per the EPA requirements for environmental surveying and reporting for flora and vegetation in Western Australia at that time, where possible and as set out in the following documents:

- EPA Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia No. 51 (EPA 2004a); and
- EPA Guidance for the Level of Assessment for Proposals affecting Natural Areas within the System 6 Region and Swan Coastal Plain Portion of the System 1 region. Guidance Statement No. 10 (EPA 2006).

3.1.1 Desktop Assessment

Database searches were undertaken to identify potential conservation significant flora species and ecological communities within, or in close proximity to, the Survey Area. Database search particulars are outlined in

Table 2 and the results of the flora database searches are presented in Appendix J.

The following three data sources have been reviewed as part of the desktop study:

- Level 2 Flora and Vegetation Survey and Wetland Delineation Assessment (360 Environmental 2011);
- Level 2 Flora and Vegetation Survey Landgren Road Casuarina (field work only) (360 Environmental 2016); and
- Threatened Ecological Community Mapping (based on data collected from above field work) (360 Environmental 2017).

Table 2: Database Search Particulars

DATABASE NAME	RECEIPT DATE	SEARCH TARGET	SEARCH BUFFER
Threatened and Priority Ecological Communities database (DBCA 2018)	June 2018	Listed TECs and PECs	5 km
Threatened and Priority Flora Database (TPFL)	May 2018	Threatened and Priority flora	5 km
Threatened and Priority Flora Species List (TP list) (Department of Parks and Wildlife 2018e)	May 2018		5 km
Western Australian Herbarium flora (Department of Parks and Wildlife 2018e)	May 2018		5 km
NatureMap (2018)	June 2018		5 km

3.1.1.1 Likelihood of Occurrence

Prior to the field survey, the Threatened and Priority flora species returned from the database searches were assessed to determine the likely potential of them occurring within the Survey Area. This assessment was based on the following criteria:

- Likely to occur - Previously recorded within Survey Area or within 5 km and suitable habitat potentially occurs in the Survey Area;
- Possible to occur - Previously recorded within 5 to 15 km of the Survey Area and/or suitable habitat potentially occurs in the Survey Area; and
- Unlikely to occur - No suitable habitat appears to be present in the Survey Area.

The conservation significant species identified in the desktop assessment as being likely to occur within the Survey Area, yet were not recorded during the field survey, were re-assessed. This likelihood of occurrence post-survey was based on a greater knowledge of the habitat types within the survey area and following a targeted survey effort.

3.1.2 Field Survey

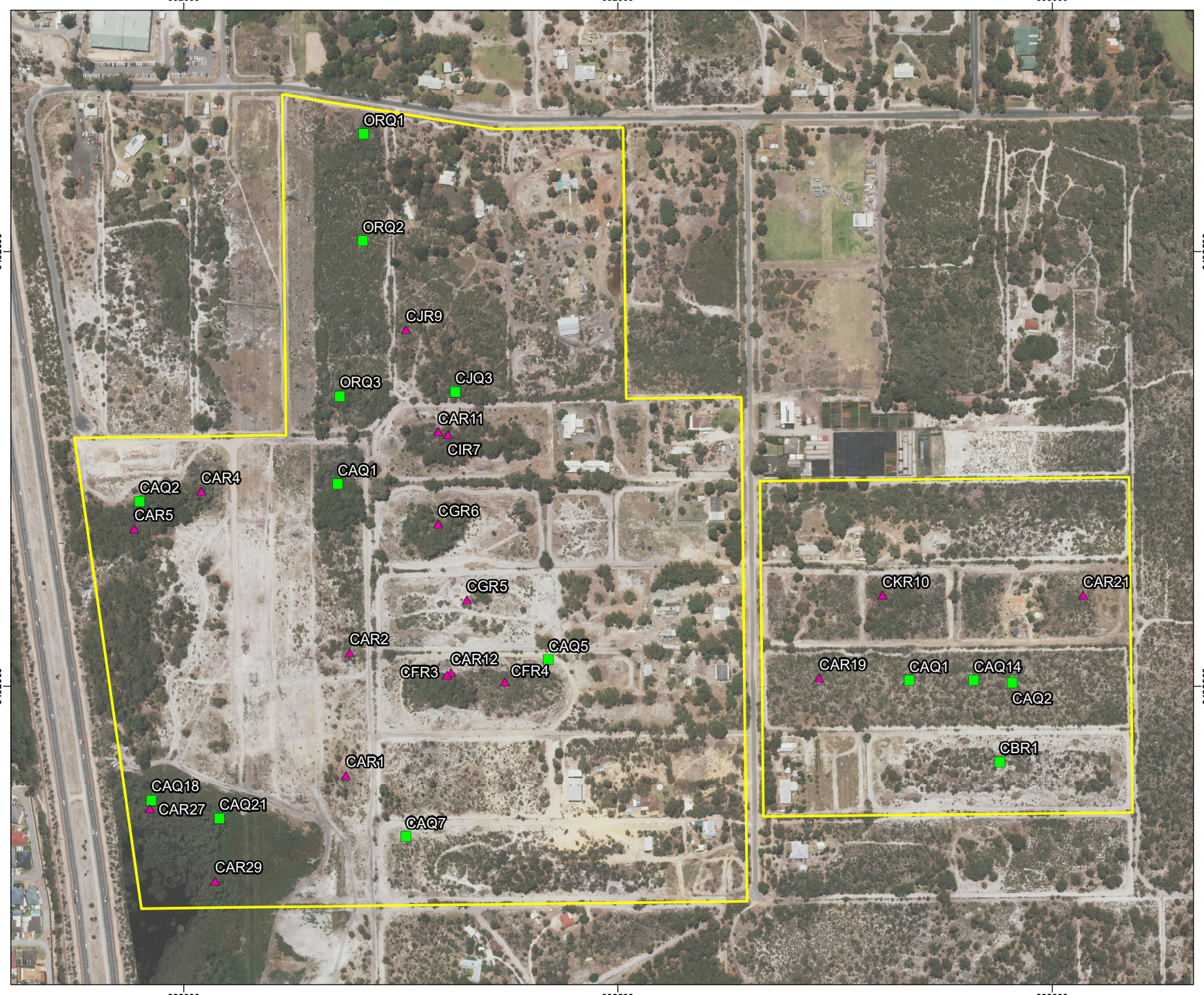
Numerous surveys have been undertaken within the Survey Area since 2010. The flora and vegetation surveys have been consistent for environmental surveying and reporting requirements for flora and vegetation (Environmental Protection Authority, 2016). The 2018 field survey was a reconnaissance survey with quadrats established and targeted searches for perennial conservation significant species. The survey was conducted 11 April 2018 by 360 Environmental botanist, Narelle Whittington (flora licence SL012191 and declared rare flora permit 75-1718).

The field surveys collectively included the use of 13 Quadrats and 18 relevés, compilation of a systematic flora species list, vegetation type mapping and vegetation condition mapping. Quadrat locations showing survey effort is presented in Figure 6.

Quadrats were accurately measured using measuring tapes and each corner was demarcated with a steel fence dropper. The location of the north-west corner of each quadrat was recorded using a handheld Garmin GPS unit. Quadrats were 10 m x 10 m in size, which is the standard for the Swan Coastal Plain bioregion (Environmental Protection Authority, 2016). At each quadrat and relevé, the following data was recorded:

- Site code - a unique identifier allocated to each quadrat;
- Date and recorder – a record of the date of quadrat sample and a list of the personnel involved in sampling the quadrat;
- Location – GPS coordinates (MGA94) measured from the north west corner of the quadrat;
- Dimensions – the size and shape of the quadrat;
- Landform and soil description – a description of the quadrat habitat;
- Additional site descriptors – location information that might be useful in vegetation classification including, slope, aspect, litter cover, bare ground cover and fire history;
- Species list – a comprehensive vascular flora species list, including weeds;
- Foliar cover – the estimated total percentage foliar cover for each species recorded;
- Height – the average height (in meters) of each species recorded;
- Vegetation description – a description of the vegetation according to the National Vegetation Information System (NVIS), Level 5. According to this level, vegetation is classified to 'association', where the dominant growth form, height, cover and species (three species) for the three traditional strata (upper, mid and ground) are described;
- Vegetation condition – assessed according to the vegetation condition scale (Environmental Protection Authority, 2016) as adapted from Keighery (1994) and Trudgen (1988) (Appendix C); and
- Photographs – a photograph from the north west corner looking toward the south east corner was taken. Due to historical data photographs for a number of quadrats aren't available.

The location of quadrats and relevés within the Survey Area are presented in Figure 6.



Legend

Survey Area

Site Locations

Quadrat

Releve

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
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- CADASTRE SOURCED LANDGATE 2018
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LOCALITY MAP



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Figure 6
Site Locations

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K:\Projects\1.0 EBS\2717 Orton Rd Flora and BC Survey, Casuarina\2717 Figure X Site Locations.mxd

3.1.3 Taxonomy and Nomenclature

Where field identification of plant taxa was not possible, specimens were collected systematically for later identification utilising resources of the Western Australian Herbarium (WAH).

The finalised species list was checked against FloraBase (Department of Biodiversity Conservation and Attractions, 2018a) to determine the species' conservation status. Threatened and Priority Flora were verified against the EPBC Act listing of threatened species to determine Commonwealth listing. Introduced flora species were compared to the WONS list (Thorp and Lynch, 2000) and the DAFWA list to determine if any are listed as Declared (Department of Primary Industries and Regional Development, 2018).

3.1.4 Vegetation Type and Condition Mapping

The vegetation mapping units were described based on their structure and species composition, as defined by the quadrat data observations from each of the study years. In addition to the data collected from quadrats, traverses throughout the Survey Area were undertaken for vegetation mapping purposes.

Vegetation types and vegetation condition boundaries were mapped in the field using handheld GPS (Garmin) units, standardised forms, Fulcrum, a mobile data collection application, and high-resolution aerial photographs (1:3,000 scale), which were digitised software in the office using GIS.

3.1.5 Statistical Analyses

Quadrats were classified on the basis of similarity in species composition using Primer-E version 6.1.5. Species presence/absence quadrat data was pre-treated and transformed and then computed using Bray-Curtis similarity analysis with a dendrogram output.

A Bray-Curtis similarity analysis was undertaken on the floristic composition of the quadrats recorded during the survey with weed and native flora quadrat data compiled between 1990 - 1996 for the Southern Swan Coastal Plain (Keighery et al. 2012). The Keighery et al. (2012) data set combines a total of 1098 sites from numerous studies on the swan coastal plain including Gibson et al. (1994); Griffin (1994); DEP (1996) and Keighery (1996).

The purpose of the similarity analysis was to help clarify the assignment of Floristic Community type (FCT) to the quadrat sites recorded during the current survey. The end assignment of FCTs to the survey quadrats was made by the nearest neighbour method. The nearest neighbour method involved determination of sites most similar from the Keighery et al. (2012) data set to quadrats recorded during this survey.

3.2 Black Cockatoo Habitat Assessment

3.2.1 Desktop Assessment

The background research is designed to gather existing data on known locations of breeding and feeding for Black Cockatoo. The background research and desktop study included review of the following websites and documents:

- A specific Black Cockatoo database search with a 10 km radial buffer from the Survey Area (Department of Biodiversity Conservation and Attractions, 2018b) Appendix I;
- EPBC referral guidelines (Department of Sustainability Environment Water Population and Communities, 2012); and
- Black Cockatoo distribution maps (Department of Sustainability Environment Water Population and Communities, 2012; Department of Environment and Energy, 2017) Appendix G.

3.2.2 Field Survey

The Targeted Black Cockatoo Survey was undertaken on four days in 26th March, 6th April, 23rd and 24th April 2018 by Senior Ecologist Andrew Hide and Ecologist Evan Webb. The field survey was consistent with standard protocols for the region and relevant EPBC Black Cockatoo referral guidelines.

3.2.2.1 Foraging Habitat

The foraging habitat assessment involved assessing the habitat for tree and shrub species known to be important dietary items as listed in the EPBC Black Cockatoo referral guidelines (Department of Sustainability Environment Water Population and Communities, 2012). It also included looking for:

- Evidence of feeding (chewed cones, seed and nut material around tree and shrub species suitable for foraging); and
- Making opportunistic observations of Black Cockatoos in the Survey Area.

The locations of trees and shrubs around which searching for foraging evidence occurred were recorded and electronically logged using a hand-held GPS unit. Intermittent photographic evidence of habitat was also captured throughout the Survey Area.

3.2.2.2 Breeding Habitat

A breeding habitat assessment involved the onsite assessment and measurement of potential breeding trees based on being:

- Native trees known to support Black Cockatoo species as listed in the EPBC Black Cockatoo referral guidelines (Department of Sustainability Environment Water Population and Communities, 2012); and

- Diameter at breast height (DBH) > 500 mm regardless of the presence or absence of hollows (DBH > 300 mm for Wandoo and Salmon Gum).

Any trees, within the Survey Area, meeting the above criteria were recorded and electronically logged using a hand-held Global Positioning System (GPS) unit. Key measurements of each tree were recorded including the location, species, tree DBH, the presence of hollows and any other important descriptive information.

Trees with multiple stems, swellings or forking/branching at breast height were measured separately. When this occurred, the diameter of the tree was measured just above breast height to gain a more accurate measurement of diameter.

Measured trees were then placed into the following size class categories for mapping:

- 500 – 750 mm DBH;
- 750 – 1,000 mm DBH;
- 1,000 – 1,250 mm DBH; and
- > 1,250 mm DBH.

Any potential breeding trees that contained a hollow were visually assessed from the ground and recorded for evidence of past/present occupancy, and/or current activity of Black Cockatoos. The ground assessment of hollows is likely to be an over estimation as this method does not allow for a comprehensive assessment of the hollow dimensions (i.e. depth, height, angle) which is suitable for the Black Cockatoo. However, this method does provide a reasonable estimation of the abundance of hollows. Further assessment can be undertaken to determine hollows that are currently 'suitable' for nesting.

3.2.2.3 Roosting Habitat

Opportunistic searches for roosting evidence were undertaken during the field assessment. Evidence of roosting usually involved the observation of bird scat in a specific area and evidence of tree limb damage throughout the canopy and on the ground.

4 Results

4.1 Limitations and Constraints

Survey constraints are often difficult to predict, as is the extent to which they influence survey effort. Survey limitations and constraints of the flora, vegetation and Black Cockatoo surveys are detailed in Table 3.

Table 3: Limitations and Constraints Associated with the Survey Area

VARIABLE	IMPACT ON SURVEY OUTCOMES
Access	The Survey Area was accessible via vehicle and/or on foot. Particular focus was given to areas expected to be impacted and areas that may have species of conservation significance.
Experience	The personnel who executed the 2018 survey were practitioners suitably qualified in their respective fields: ● Field Staff: Narelle Whittington (Principal Botanist), Andrew Hide (Senior Zoologist/Ecologist) and Evan Webb (Ecologist); ● Flora Taxonomy: Narelle Whittington (Principal Botanist); ● Data Interpretation and Reporting: Narelle Whittington, Andrew Hide and Evan Webb; and ● Report Review: Scott Walker (Principal Ecologist/ Group Leader).
Timing, weather, season	The 2010 survey was conducted in October and November, the 2016 survey was conducted in early November and the 2018 field survey was conducted in April. April is outside of the recommended flora survey period for the Swan Coastal Plain. The Jandakot Aero weather station recorded 125.8 mm of rainfall which is 74.8 mm above the long-term average rainfall for the same period (refer to Section 2.1). Flora composition changes with time, particularly seasonally as a result of changes in conditions such as rainfall. Therefore, botanical surveys completed at

VARIABLE	IMPACT ON SURVEY OUTCOMES
	different times of the year will often produce varying results. The Black Cockatoo survey was undertaken outside of the breeding season which may result in a lower likelihood of detecting evidence of breeding activity.
Scope: Life forms sampled	An appropriate number of life forms were sampled in relation to the level of survey undertaken.
Sources of information	Relevant DBCA and EPBC searches were undertaken for the Survey Area. Relevant DBCA database searches were undertaken for the Survey Area and are listed in Appendix I (Excluding GPS coordinates). In addition, previous flora and fauna survey reports for the area were sourced providing sufficient information to accurately undertake the survey.
Completeness	The entire Survey Area was accessed at least once over the course of the three surveys. Of the 218 specimens collected, 16 could not be confidently identified to species level due to lack of identifying features such as flowering or fruiting parts. None of these specimens are thought to represent significant species.

4.2 Flora and Vegetation

4.2.1 Desktop Assessment

Eleven Threatened flora have been recorded within 5 km of the Survey Area (Department of Biodiversity Conservation and Attractions, 2018b, 2018c, 2018e; Department of Environment and Energy, 2018). Eleven Priority flora have previously been recorded within 5 km of the Survey Area, including one Priority 1, one Priority 2, five Priority three and four Priority 4 (Figure 7; Appendix I).

Four Priority Ecological Communities (PEC) and one TEC listed by the State was within a five km radius of the Survey Area, two of these communities are also listed as Threatened Ecological Communities (TEC) under the EPBC Act and the others have the potential to

be listed as part of the TEC Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region (Figure 8).

The communities are:

- Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region (Priority 3 [DPaW], Endangered [EPBC]);
- SCP21c: Low lying *Banksia attenuata* woodlands or shrublands (Priority 3 [DPaW], Part of Endangered [EPBC]);
- SCP22: *Banksia ilicifolia* woodlands (Priority 3 [DPaW], Part of Endangered [EPBC]);
- SCP25: Southern *Eucalyptus gomphocephala-Agonis flexuosa* woodlands (Priority 3 [DPaW); and
- Mound Springs SCP: Communities of Tumulus Springs (Organic Mound Springs, Swan Coastal Plain) (Critically Endangered [DPaW], Endangered [EPBC]).

The literature review identified a Level 2 flora and vegetation survey that overlapped the Survey Area. Key findings of this report are summarised in Table 4.

Table 4: Summary of Previous Survey Reports

REPORT TITLE	SURVEY AREA	CONSERVATION SIGNIFICANT FLORA AND COMMUNITIES	INTRODUCED FLORA
Level 2 Flora and Vegetation Survey and Wetland Delineation Assessment	Overlaps entire Survey Area except two Lots.	*Tetraria* sp. *chandala* (G.J. Keighery 17,055), Cyathochaeta teretifolia (P3), Jacksonia gracillima (P3)	66

4.2.1.1 Likelihood

The database searches identified 22 conservation significant flora species as potentially occurring in the vicinity of the Survey Area. Based on the post-survey assessment of likelihood, 10 species are considered to have the potential to occur yet were not recorded in the Survey Area (Table 5, Appendix D).

Table 5: Conservation Significant Species with the Potential to Occur in the Survey Area

SPECIES	CONSERVATION STATUS	SPECIES	CONSERVATION STATUS
Caladenia huegelii	T	*Lepidosperma rostratum*	T
Diuris micrantha	T	*Boronia juncea* subsp. *juncea*	P1
Diuris purdiei	T	*Stylidium paludicola*	P3
Drakaea elastica	T	*Aponogeton hexatepalus*	P3
Drakaea micrantha	T	*Stylidium longitubum*	P4



Legend

Survey Area

DBCA Threatened and Priority Flora

- Threatened
- Priority 1
- Priority 2
- Priority 3
- Priority 4

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
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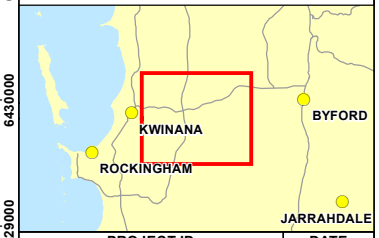
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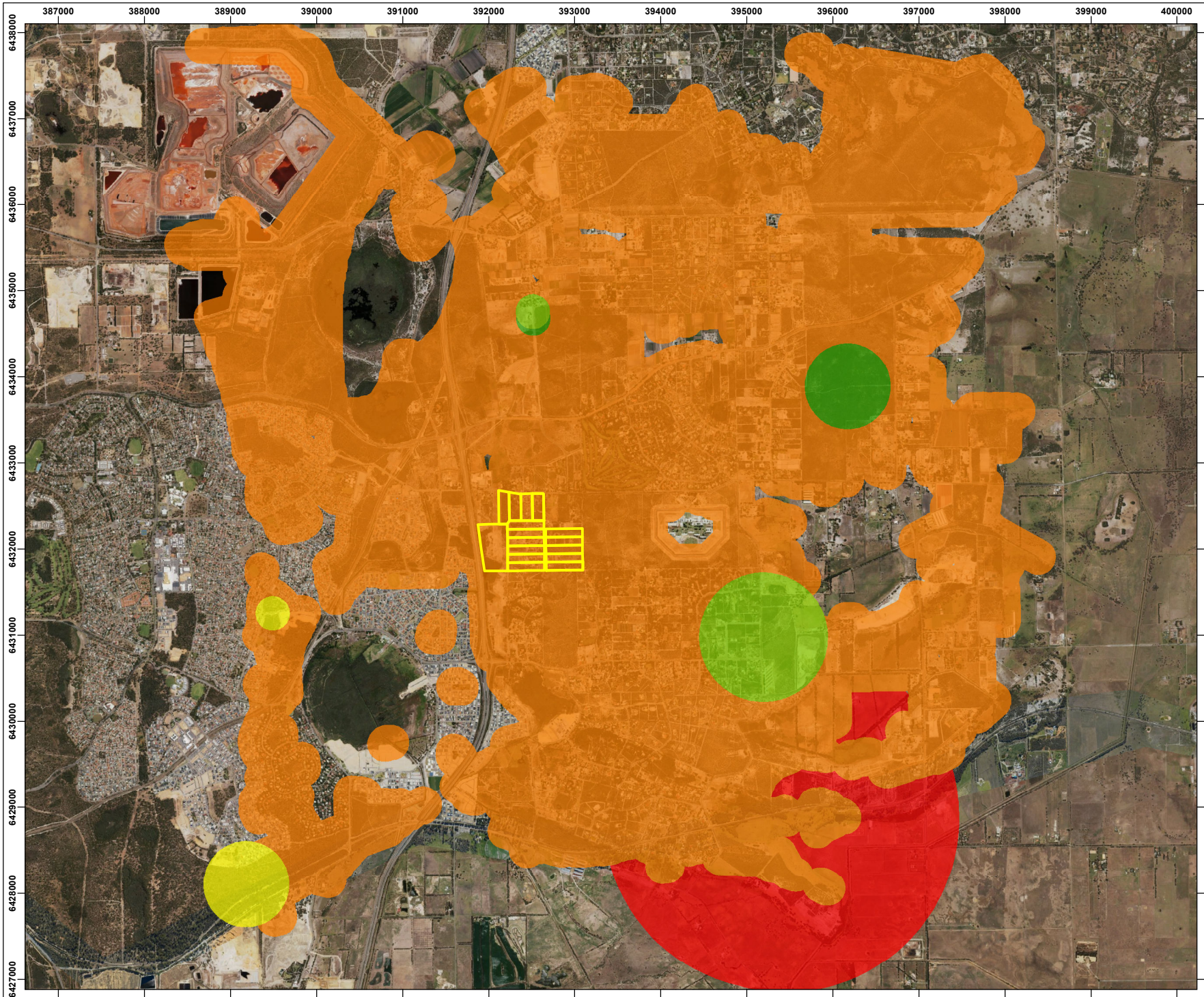
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Figure 7
DBCA Threatened Priority Flora

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Legend

Survey Area

Threatened and Priority Ecological Communities

- Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region (Priority 3)
- Banksia ilicifolia woodlands (Priority 3)
- Communities of Tumulus Springs (Organic Mound Springs, Swan Coastal Plain) (Endangered)
- Low lying Banksia attenuata woodlands or shrublands (Priority 3)
- Southern Eucalyptus gomphocephala-Agonis flexuosa woodlands (Priority 3)

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
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Figure 8
Threatened Ecological Communities

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4.2.2 Field Survey

4.2.2.1 Flora

A total of 217 flora species (including species, subspecies, varieties and forms) from 50 families and 133 genera were identified in the Survey Area from quadrats, relevés and opportunistic collections, of these, 24 were weed species. The most commonly occurring families were Myrtaceae (25 taxa) Fabaceae (25 taxa), Asparagaceae (16 taxa) and Cyperaceae (15). The most frequently recorded genus was Acacia (8) and Banksia (6). A complete species list is presented in Appendix E.

Of the 218 specimens collected, 16 could not be confidently identified to species level due to lack of identifying features such as flowering or fruiting parts. None of these specimens are thought to represent significant species.

4.2.2.2 Flora of Conservation Significance

No Threatened species listed under the EPBC Act and gazetted as Declared Rare Flora (Threatened) pursuant to the WC Act was recorded in the Survey Area. Three Priority species were recorded in the Survey Area (Figure 9).

Cyathochaeta teretifolia (P3) (Plate 1) was found at six locations, *Jacksonia gracillima* (P3) (Plate 2) was found at nine locations, and *Tetraria sp. Chandala (P2)* was found at two locations (Table 6).

Table 6: Locations of Conservation Significant Flora within the Survey Area

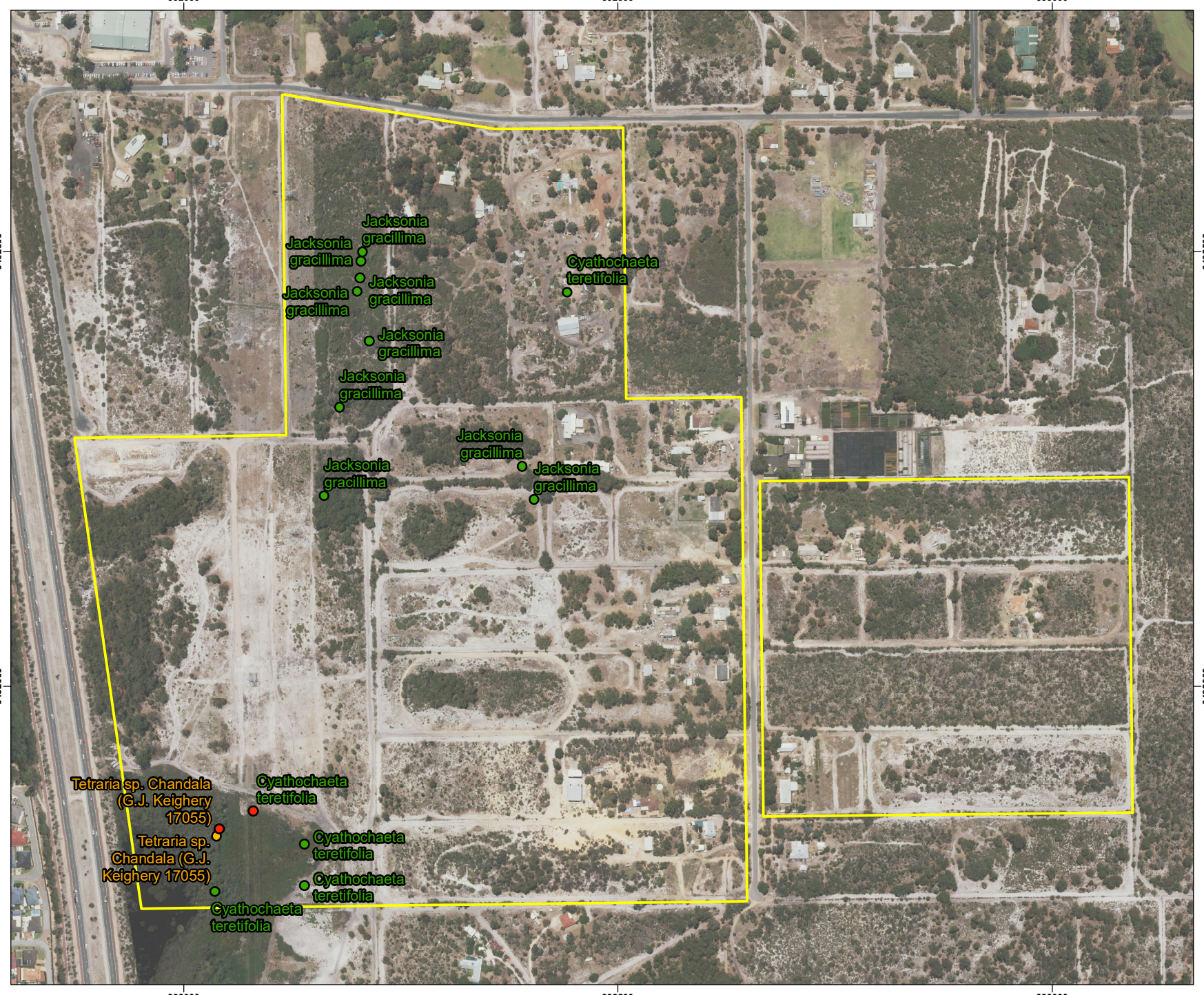
Taxa	Coordinates UTM	
Cyathochaeta teretifolia (P3)	392080	6431856
Cyathochaeta teretifolia (P3)	392139	6431770
Cyathochaeta teretifolia (P3)	392041	6431835
Cyathochaeta teretifolia (P3)	392036	6431763
Cyathochaeta teretifolia (P3)	392139	6431818
Cyathochaeta teretifolia (P3)	392442	6432453
Jacksonia gracillima (P3)	392162	6432219
Jacksonia gracillima (P3)	392404	6432215
Jacksonia gracillima (P3)	392390	6432253
Jacksonia gracillima (P3)	392206	6432500
Jacksonia gracillima (P3)	392180	6432321
Jacksonia gracillima (P3)	392204	6432489
Jacksonia gracillima (P3)	392203	6432470
Jacksonia gracillima (P3)	392200	6432454
Jacksonia gracillima (P3)	392214	6432397
Tetraria sp. Chandala (P2)	392038	6431827
Tetraria sp. Chandala (P2)	392041	6431835



Plate 1: *Cyathochaeta teretifolia (P3)*



Plate 2: *Jacksonia gracillima (P3)*



Legend

- Survey Area
- Regionally Significant, *Homalospermum firmum*

Priority Flora Surveyed

- Priority 2
- Priority 3

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
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Figure 9
Priority Flora Surveyed

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4.2.2.3 Flora of Interest

Homalospermum firmum is a tall shrub or tree that grows to a height of 1 to 4 m and has large white flowers between August and December (Plate 3; Paczkowska and Chapman, 2000). It grows in winter-wet depressions and swamps. It occurs along the south coast of Western Australia, with Perth being near the northern end of a disjointed distribution.

H. firmum was recorded as a subdominant shrub in the dampland vegetation in Lot 2001 (Figure 9).

It does not appear to have been recorded previously in wetlands in Perth's southern suburbs.

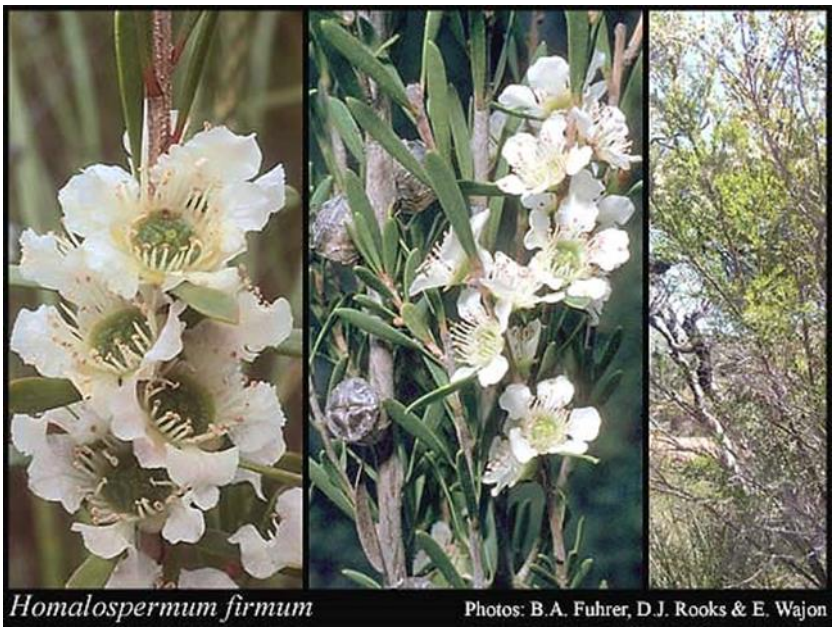


Plate 3: *Homalospermum firmum* (Photograph sourced from the FloraBase, DBCA).

4.2.2.4 Introduced Flora

A total of 24 introduced species were recorded during the survey, representing approximately 11% of the total taxa. Two of these are listed as Declared Pests and one is listed as a WONS under the BAM Act (Table 7).

Table 7: Introduced Flora Recorded in the Survey Area

TAXA	COMMON NAME	WONS	DECLARED
**Asparagus asparagoides*	Bridal Creeper	Yes	Yes
**Avena barbata*	Bearded Oat	No	No
**Briza maxima*	Blowfly Grass	No	No
**Bromus diandrus*	Great Brome	No	No

TAXA	COMMON NAME	WONS	DECLARED
**Carpobrotus aequilaterus*	Angular Pigface	No	No
**Carpobrotus edulis*	Hottentot Fig	No	No
**Ehrharta calycina*	Perennial Veldt Grass	No	No
**Ehrharta longiflora*	Annual Veldt Grass	No	No
**Eragrostis curvula*	African Lovegrass	No	No
**Disa bracteata*	South African orchid	No	No
**Echium plantagineum*	Paterson's Curse	No	Yes
**Eucalyptus microcorys*	Tallow wood	No	No
**Gladiolus caryophyllaceus*	Wild Gladiolus	No	No
**Holcus lanatus*	Yorkshire Fog	No	No
**Hypochaeris glabra*	Smooth Cats-ear	No	No
**Hypochaeris radicata*	Flat Weed	No	No
**Lotus uliginosus*	Greater Lotus	No	No
**Navarretia squarrosa*	Californian Stinkweed	No	No
**Pinus sp.*	Pine	No	No
** Romulea rosea var. australis*	Guildford Grass	No	No
**Sonchus oleraceus*	Common Sowthistle	No	No
**Symphyotrichum squamatum*	Bushy Starwort	No	No
**Ursinia anthemoides*	Ursinia	No	No
**Zantedeschia aethiopica*	Arum Lily	No	Yes

4.2.2.5 Vegetation Types

16 vegetation types were mapped for the Survey Area as well as eight units consisting of individual trees, scattered native plants over weeds and monocultures (Table 9; Figure 10). The data collected from each quadrat/relevé is presented in Appendix F.

4.2.2.6 Vegetation Condition

Vegetation condition ranged from Excellent to Completely Degraded with the majority of the Survey Area considered to be in Completely Degraded (42.55 ha) condition (Table 8, Figure 11).

Past and current land uses land clearing, infrastructure and weeds have all contributed to overall vegetation condition. The urban setting of the Survey Area and current land uses, such as housing, a plant nursery, grazing and kennels have caused major fragmentation of the vegetation. Fire breaks, informal tracks, unauthorised access, rubbish dumping, and storage of equipment, cars and storage containers have also impacted the vegetation. Non-endemic tree species and garden plants were also a common feature in the Survey Area.

In contrast, there was several intact dense native vegetation that is considered to be in Excellent to Very Good condition.

Table 8: Vegetation Condition Extent in the Survey Area.

CONDITION	EXTENT IN SURVEY AREA (HA)	PROPORTION IN SURVEY AREA (%)
Excellent	5.93	8.57
Excellent – Very Good	2.63	3.80
Very Good	5.21	7.53
Very Good - Good	1.34	1.93
Good	2.90	4.19
Good - Degraded	3.26	4.71
Degraded	5.33	7.70
Completed Degraded	42.55	61.53
Total	**69.15**	**100**

Table 9: Vegetation Types Recorded for the Survey Area

Vegetation Type code and Description	Sites	Total Area (ha)	Representative Site Photograph
BaBm: *Banksia attenuata*, *Banksia menziesii*, *Eucalyptus marginata* low woodland with scattered *Xylomelum occidentale* and *Allocasuarina fraseriana* over *Hibbertia hypericoides* low open Heath over *Mesomelaena pseudostygia* and *Lepidosperma squamatum*.	CAQ14, CJQ1, CJQ2, CAR19 CBR1 CAQ7 CAR1 (now cleared)	6.76	
BaBmBi: *Banksia attenuata*, *Banksia menziesii* and *Banksia ilicifolia* over *Kunzea glabrescens*, *Jacksonia furcellata*, *Jacksonia sternbergiana* and Xanthorrhoea preissii over *Scholtzia involucrata*, *Bossiaea eriocarpa*, *Leucopogon conostephioides* over *Desmocladus flexuosus*, *Phlebocarya ciliata*.	CAR21 CAR2	1.91	
BaBmAf: *Banksia attenuata*, *Banksia menziesii*, *Allocasuarina fraseriana* low woodland over *Xanthorrhoea preissii* open shrubland	CAQ5 (now cleared) CFR4	1.18	

Vegetation Type code and Description	Sites	Total Area (ha)	Representative Site Photograph
over *Hibbertia hypericoides*, *Eremaea asterocarpa* subsp. *asterocarpa*, *Hibbertia subvaginata*, *Leucopogon conostephioides* low open heathland over *Mesomelaena pseudostygia*, *Desmocladus flexuosus* very open sedgeland with *Amphipogon turbinatus*, **Ehrharta calycina* scattered grasses.	CGR5		
CcBa: *Corymbia calophylla*, *Banksia attenuata* and *Banksia ilicifolia* over *Xanthorrhoea preissii*	CGR6	0.55	
CcKg: *Corymbia calophylla* and *Melaleuca preissiana* scattered trees over *Kunzea glabrescens* scattered tall shrubs over *Acacia pulchella* var. *glabrescens*, *Xanthorrhoea preissii* over *Pericalymma ellipticum* over *Hypocalymma angustifolium*, *Eutaxia virgata* low closed heath over *Schoenus efoliatus*, *Cyathochaeta avenacea* open sedgeland	CIR7 ORQ3 CAR11 CJR9	2.46	
MpAsCt: *Melaleuca preissiana* low woodland over *Astartea scoparia* high shrubland and *Cyathochaeta teretifolia* sedgeland	CAR29	0.68	

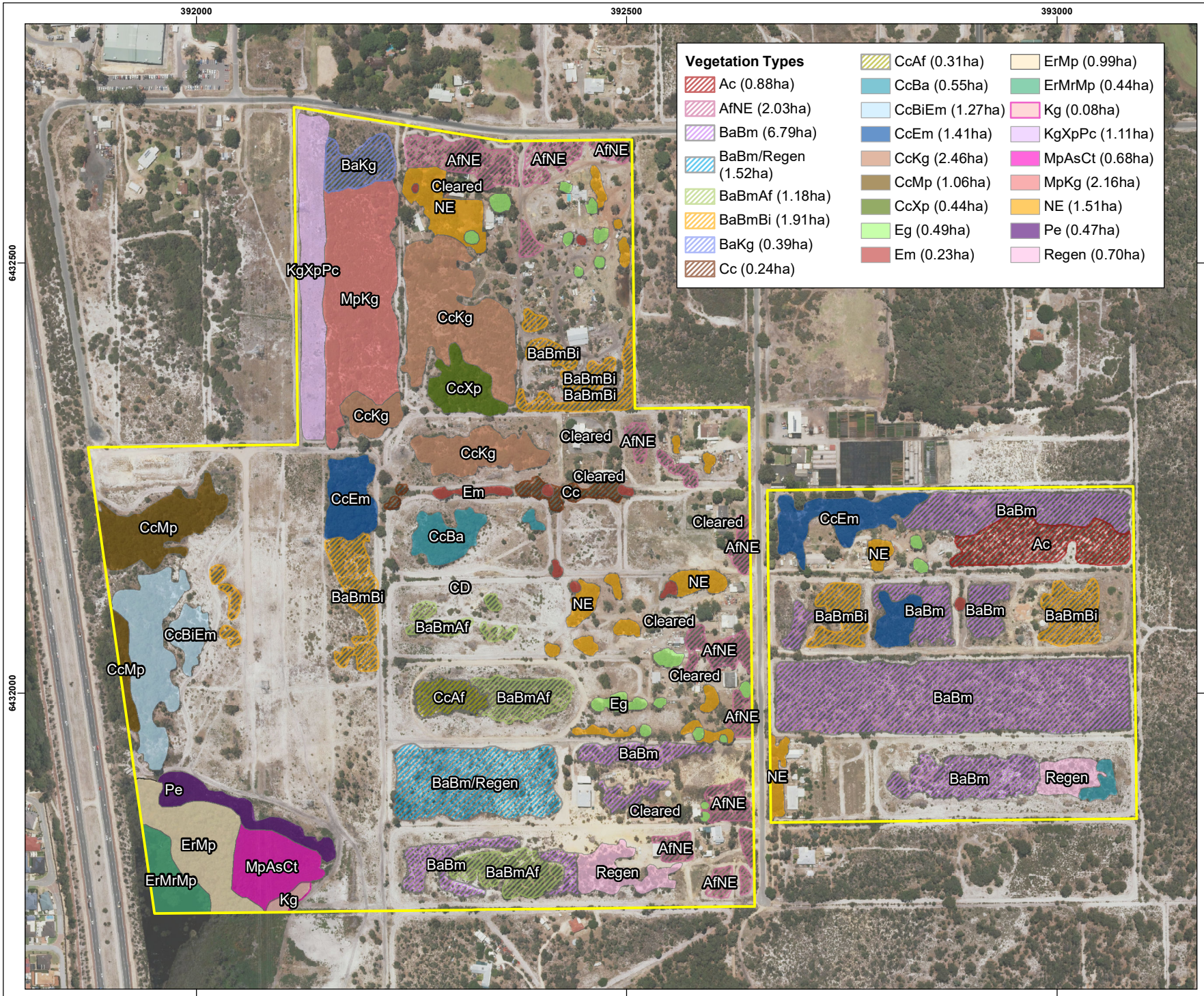
Vegetation Type code and Description	Sites	Total Area (ha)	Representative Site Photograph
ErMp: *Eucalyptus rudis* subsp. *rudis* open forest over *Melaleuca* preissiana open woodland.	CAQ21 CAQ18 CAR27	0.99	
ErMrMp: *Eucalyptus rudis* subsp. *rudis* woodland over *Melaleuca rhaphiophylla*, *Melaleuca preissiana* low woodland	Mapping notes	0.44	
CcMp: *Corymbia calophylla*, *Melaleuca preissiana* woodland over *Astartea scoparia* high shrubland over *Leucopogon australis*, *Xanthorrhoea preissii* open shrubland over *Dielsia stenostachya* sedgeland.	CAQ2 CAR4 CAR5	1.06	

Vegetation Type code and Description	Sites	Total Area (ha)	Representative Site Photograph
CcBiEm: *Corymbia calophylla* woodland over *Banksia menziesii* scattered low trees over *Kunzea glabrescens* high open shrubland to high shrubland over *Xanthorrhoea preissii* open shrubland over *Hibbertia hypericoides* scattered low shrubs over *Dielsia stenostachya*, *Lepidosperma squamatum* complex open sedgeland with *Dasypogon bromeliifolius* open herbland.	Mapping notes	1.27	
CcXp: *Corymbia calophylla* and *Allocasuarina fraseriana* over *Xanthorrhoea preissii*, *Xanthorrhoea gracilis*, *Hibbertia hypericoides* over *Lepidosperma squamatum* and *Dasypogon bromeliifolius*.	CJQ3	0.44	
CcEm: *Corymbia calophylla*, *Eucalyptus marginata*, *Banksia menziesii* and *Xylomelum occidentalis* over *Kunzea glabrescens*, *Xanthorrhoea preissii*, *hibbertia hypericoides*, *Macrozamia riedlei*, *Conostylis aculeata*, *Desmocladus flexuosus* and *Bossiaea eriocarpa*.	CKR10 CAQ1	1.41	

Vegetation Type code and Description	Sites	Total Area (ha)	Representative Site Photograph
BaKg: *Banksia attenuata* low woodland over *Kunzea glabrescens* tall shrubland over *Xanthorrhoea preissii*, *Hibbertia hypericoides*, *Hypocalymma robustum* over *Phlebocarya ciliata* and *Kennedia prostrata*	ORQ1	0.39	
MpKg: Low Open woodland of *Melaleuca preissiana* over tall closed shrubland of *Kunzea glabrescens* over *Xanthorrhoea preissii*, *Hypocalymma angustifolium* and *Jacksonia gracillima* over *Dasypogon bromeliifolius*	ORQ2	2.16	

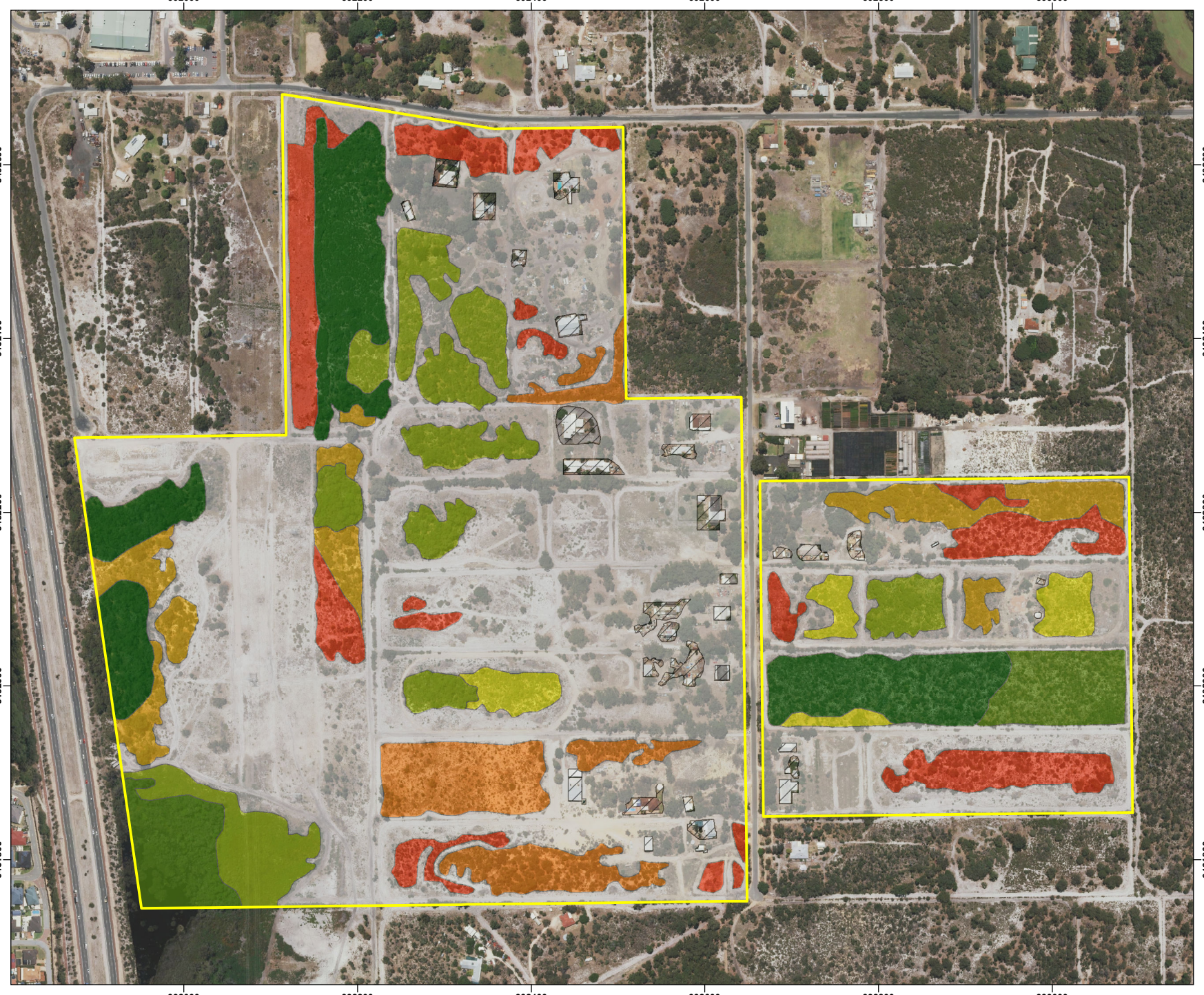
Vegetation Type code and Description	Sites	Total Area (ha)	Representative Site Photograph
KgXpPc: Pruned and maintained power easement of *Kunzea glabrescens* and *Xanthorrhoea preissii* low shrubland over *Dasypogon bromeliifolius* and *Phlebocarya ciliata*.	Mapping notes	1.11	
AfNE: Various Native tree species with Non-endemic species and grass weeds	Mapping notes	2.03	
Ac: *Adenanthos cygnorum* open shrubland with scattered *Eucalyptus todtiana* over grass weeds.	Mapping notes	0.88	

Vegetation Type code and Description	Sites	Total Area (ha)	Representative Site Photograph
CcAf: *Allocasuarina fraseriana*, *Corymbia calophylla* and *Banksia littoralis* over *Kunzea glabrescens*	CAR12 CFR3	0.31	
Em: Individual *Eucalyptus marginata*	Mapping notes	0.23	
Kg: *Kunzea glabrescens* scrub	Mapping notes	0.08	-
Pe: *Pteridium esculentum* fern land	Mapping notes	0.47	
Eg: Individual *Eucalyptus gomphocephala*	Mapping notes	0.49	
Cc: Individual *Corymbia calophylla*	Mapping notes	0.24	
Regen: Areas of natural regeneration	Mapping notes	0.70	



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K:\Projects\1.0 EBS\2717 Orton Rd Flora and BC Survey, Casuarina\2717 Figure 10 Vegetation Associations.mxd



Legend

- Survey Area

Vegetation Condition

- Excellent (5.93ha)
- Excellent - Very Good (2.63ha)
- Very Good (5.21ha)
- Very Good - Good (1.34ha)
- Good (2.90ha)
- Good - Degraded (3.26ha)
- Degraded (5.33ha)
- Completely Degraded (42.55ha)
- Cleared (1.76ha)

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
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LOCALITY MAP



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Flora, Vegetation and Black Cockatoo Assessment

Figure 11
Vegetation Condition

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4.2.3 Floristic Community Types

The results of the floristic analysis on the quadrats are presented in Table 10. This includes the five most similar sites (nearest neighbour method). Statistical analysis (multivariate analysis) and data interpretation identified five Floristic Community Types (FCTs) represented by the vegetation in the Survey Area (Table 10).

There were several relevés recorded in the Survey Area in addition to the quadrats. The size and condition of several vegetation remnants meant establishing quadrats in these areas was not suitable or warranted, relevés and/or mapping notes were therefore established. Statistical analysis was not undertaken for these sites and therefore FCTs were inferred (Table 11). The five FCTs identified are:

- FCT SCP 21a – Central *Banksia attenuata – Eucalyptus marginata* woodlands;
- FCT SCP 23a – Central *Banksia attenuata – Banksia menziesii* woodlands;
- FCT SCP 11– Wet forests and woodlands;
- FCT SCP 4 – *Melaleuca preissiana* damplands; and
- FCT SCP S17 – *Eucalyptus rudis/Agonis linearifolia* wetlands in Bassendean Dunes.

Table 10: Floristic Community Type Quadrat Analysis.

Quadrat	Nearest neighbour analysis			Notes	Conclusion
	Similarity	Site	FCT		
CAQ21	43.4	MILT-2	13	Given the community's location near to open water, dominant species present and soil type it is more analogue to S17	S17 – *Eucalyptus rudis/Agonis linearifolia* wetlands in Bassendean Dunes
	37.0	PAGA-2	13		
	34.4	Raven02	S17		
	32	White04	S17		
	32	Pinj13	S17		
CAQ5	53.2	Cas03	23a	Given the results of the analysis as well as location, dominant plants and surrounding occurrences CAQ5 is thought to be analogue to 23a.	23a – Central *Banksia attenuata – Banksia menziesii* woodlands
	52.6	Bibra01	23a		
	52.2	Tele01	23a		
	52.0	Light01	23a		
	51.8	Perth08	23a		
CAQ7	48.5	Wire01	28	The presence of *Corymbia calophylla* and *Eucalyptus marginata* along with the understorey species present makes it more analogue to 21a than to 23a	21a - Central *Banksia attenuata - Eucalyptus marginata* woodlands
	46.4	Cas03	23a		
	46	Cresw01	23a		
	45.9	TAM-1	21a		
	45.9	Cavs10	21a		
CAQ1	47.2	ELE04	21a		

Quadrat	Nearest neighbour analysis			Notes	Conclusion
	Similarity	Site	FCT		
	38.8	Cavs10	21a	The presence of *Corymbia calophylla* and *Eucalyptus marginata* along with numerous typical species common for FCT SCP 21a	21a - Central *Banksia attenuata* - *Eucalyptus marginata* woodlands
	37.9	ELE05	S02		
	37.8	rowe01	11		
	37.5	card7	21a		
CAQ14	54.2	cas03	23a		21a - Central *Banksia attenuata* - *Eucalyptus marginata* woodlands
	50	cresw01	23a		
	49.5	low13b	23a		
	49.0	BULLER-2	21a		
	48.5	YULE-2	23a		
CAQ18	32	raven02	S17	Given the community's location near to open water, dominant species present and soil type it is more analogue to S17	S17 – *Eucalyptus rudis/Agonis linearifolia* wetlands in Bassendean Dunes
	28.5	ELE37	S17		
	28.5	gosn05	S03		
	28.5	pinj11	S03		
	28.5	pinj13	S17		
CAQ2	32.2	ELE26	S02	The vegetation community doesn't fit into the supplementary communities identified by the analysis and is more analogue to FCT SCP 11	11 – Wet forests and woodlands
	32	ELE34	S02		
	29.6	ELE36	S05		
	28.5	ELE30	S02		
	28.5	ELE35	S05		
ORQ1	40	THOM-2	24	The presence of *Corymbia calophylla* and *Eucalyptus marginata* along with numerous typical species common for FCT SCP 21a	21a - Central *Banksia attenuata* - *Eucalyptus marginata* woodlands
	38.4	ELE04	21a		
	37.2	NINE-1	21a		
	36.6	HARRY-5	21a		
	36.0	Card7	21a		
ORQ2	35.7	ELE06	S02	The vegetation community is considered a dampland dominated by tall *Kunzea glabrescens* with scattered *Melaleuca preissiana* with no Banksia canopy. For this reason, it is more equivalent to FCT SCP 4.	4 – *Melaleuca preissiana* damplands
	34.6	Gosn01	4		
	34.0	Cavs02	21a		
	33.3	MUK02	4		
	32.6	White03	4		
ORQ3	30.1	low07	21c		

Quadrat	Nearest neighbour analysis			Notes	Conclusion
	Similarity	Site	FCT		
	27.5	raven05	22	The presence of *Corymbia calophylla* and *Eucalyptus marginata* along with numerous typical species common for FCT SCP 21a	21a - Central *Banksia attenuata* - *Eucalyptus marginata* woodlands
	27.2	gosn13	23a		
	25.8	FL-4	21a		
	25	ELE05	S02		
CJQ1	47.1	KING-2	28		21a - Central *Banksia attenuata* - *Eucalyptus marginata* woodlands
	47.0	low04	21a		
	45.4	WELL-2	21a		
	44.2	yela01	28		
	43.75	cas03	23a		
CJQ2	50.5	kailis02	23a		21a - Central *Banksia attenuata* - *Eucalyptus marginata* woodlands
	48.8	cas03	23a		
	46.1	WELL-2	21a		
	45.6	Tele01	23a		
	44.9	perth08	23a		
CJQ3	41.7	THOM-2	24		21a - Central *Banksia attenuata* - *Eucalyptus marginata* woodlands
	36.9	DEPOT-1	28		
	36.6	KING-02	28		
	36.6	Light04	23a		
	36.3	TAM-1	21a		

Table 11: Floristic Community Types for Relevés and Mapping Notes

Releve	Vegetation Type	Inferred Floristic Community Type
CBR1	BaBm	21a - Central *Banksia attenuata* - *Eucalyptus marginata* woodlands
CAR19	BaBm	
CIR7	CcKg	
CAR11	CcKg	
CJR9	CcKg	
CFR3	CcAf	
CFR12	CcAf	
CKR10	CcEm	
CGR6	CcBa	
CAR1	BaBm	
*INF	CcBiEm	
CAR4	CcMp	11 – Wet forests and woodlands
CAR5	CcMp	
CAR27	ErMp	

RELEVE	VEGETATION TYPE	INFERRED FLORISTIC COMMUNITY TYPE
CAR29	MpAsCt	S17 – *Eucalyptus rudis/Agonis linearifolia* wetlands in Bassendean Dunes
CFR4	BaBmAf	23a – Central *Banksia attenuata – Banksia menziesii* woodlands
CGR5	BaBmAf	
CAR21	BaBmBi	
CAR2	BaBmBi	
*INF	ErMrMp	13 – Deeper wetlands on heavy soils
*INF	KgXpPc	4 – *Melaleuca preissiana* damplands (Altered)

*INF – inferred as no quadrat or releve information available

4.2.3.1 Threatened and Priority Ecological Communities

None of the FCTs identified from the statistical analysis are listed as TECs under The EBPC Act, however, FCT SCP21a - Central *Banksia attenuata - Eucalyptus marginata* woodlands FCT SCP23a - Central *Banksia attenuata – Banksia menziesii* woodlands have been listed as sub-communities under the EPBC Act listed Banksia woodlands of the Swan Coastal Plain. They, therefore, have the potential to be listed and protected under the EPBC Act (DEE 2016). FCT SCP21a and SCP 23a are also listed as Priority 3 by the State.

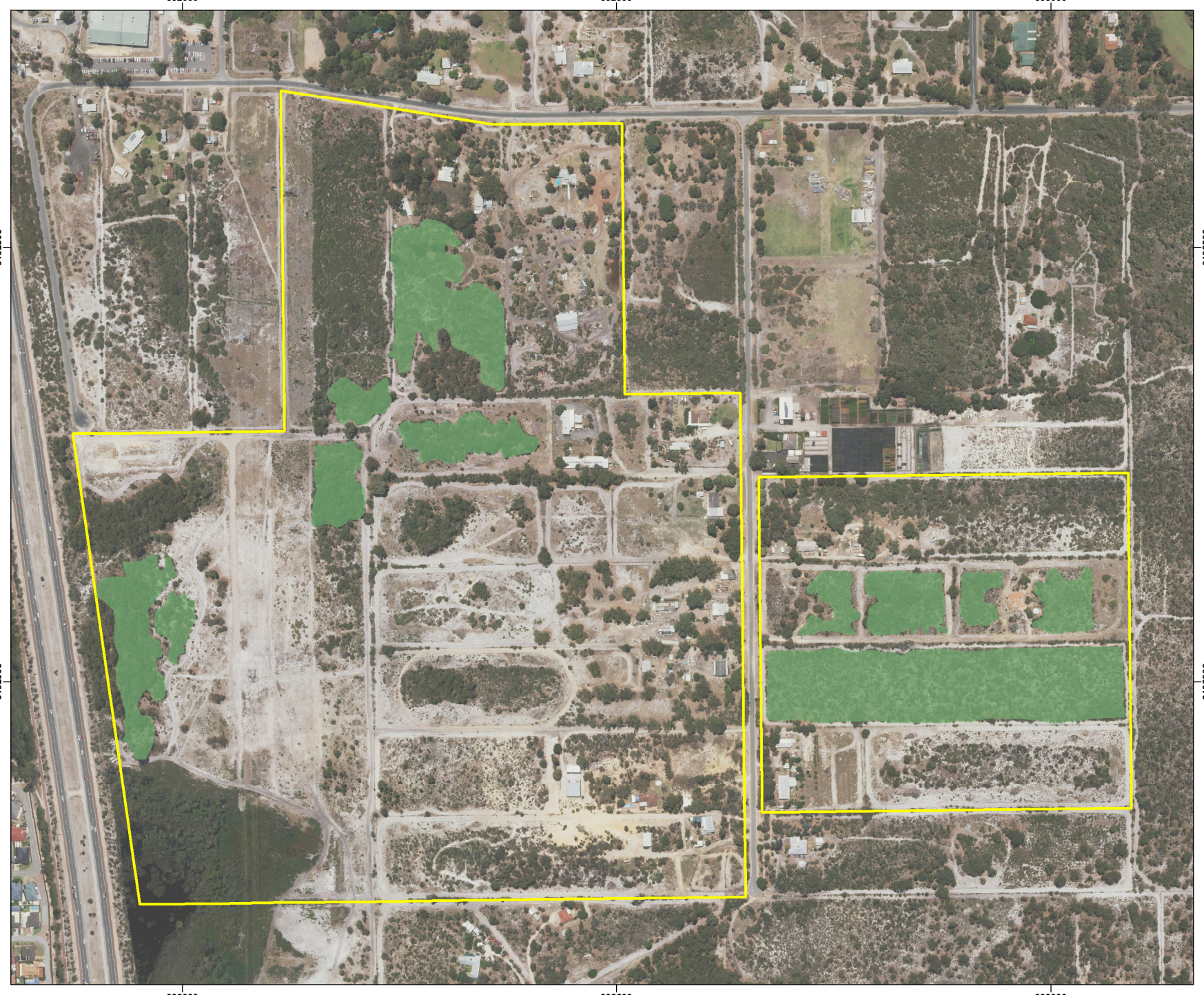
Eleven remnants within the Survey Area equating to 9.26 ha are considered eligible for National Protection as the Banksia Woodlands of the Swan Coastal plain TEC under the Endangered category of the EPBC Act (**Error! Reference source not found.**).

4.2.3.2 Regional Representation

Vegetation mapping units described in the Survey Area were correlated with the Beard (1981) and Shepherd, Beeston and Hopkins (2002) broad vegetation types as much as possible by examining similarities in vegetation descriptions (Table 12). Differences exist with the terminology used in the descriptions as they are based on different methods of categorising and characterising vegetation types, and the different spatial scale of the analysis (i.e. region vs. local scale).

Table 12: Representative Broad Vegetation Types and Corresponding Vegetation Types

VEGETATION TYPE AND DESCRIPTION	CORRESPONDING VEGETATION TYPE	VEGETATION TYPE EXTENT IN SURVEY AREA (HA)
Bassendean 1001: Medium very sparse woodland; Jarrah, with low woodland; *Banksia* & *Casuarina*	BaBm, BaBm/regen, BaBmAf, BaBmBi, BaKg, CcAf, CcBa, CcBiEm, CcEm	15.55



Legend

- Survey Area (70.98 ha)
- Vegetation considered to be eligible for National Protection as *Banksia woodlands* of the Swan Coastal Plain (9.26 ha)

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
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Figure 12
Banksia Woodland TEC

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4.3 Black Cockatoo Habitat Assessment

4.3.1 Desktop Assessment

Three species of Black Cockatoo are found in south-west WA; Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*), Forest Red-tailed Black Cockatoo (*C. banksia naso*) and Baudin's Black Cockatoo (*C. baudinii*). The database search returned:

- No records of the Baudin's Black Cockatoo within a 10 km radius of the Survey Area (Department of Biodiversity Conservation and Attractions, 2018b);
- A total of 258 records of the Carnaby's Black Cockatoo within a 10 km radius of the Survey Area recorded between 1941 and 2016, of which 251 were recorded within the last 20 years (Department of Biodiversity Conservation and Attractions, 2018b). The Survey Area occurs within the 6 km radial buffer for a Carnaby's Black Cockatoo confirmed roosting area, and the Survey Area occurs 5.6 km east, outside of a 12 km radial buffer for a Carnaby's Black Cockatoo possible breeding area (approximately 18 km away); and
- A total of nine (9) records of the Forest Red-tailed Black Cockatoo within a 10 km radius of the Survey Area recorded between 2000 and 2016 (Department of Biodiversity Conservation and Attractions, 2018b).

4.3.2 Field Survey

Twenty (20) sightings of Forest Red-tailed Black Cockatoos were recorded during the field survey, with the number of individuals recorded per sighting ranging from one to eight (Plate 4). These sightings included both individuals flying overhead and individuals actively foraging within the Survey Area. Most of these sightings occurred in Lot 9000, in the western portion of the Survey Area. Additionally, three Forest Red-tailed Black Cockatoo feathers were found within the Survey Area, two in Lot 9000 and one in Lot 34 (Figure 13; Plate 5).

One sighting of Carnaby's Black Cockatoos was recorded, with a flock of approximately 40 individuals seen flying over the northern portion of the Survey Area. Additionally, a Carnaby's Black Cockatoo feather was found at the northernmost boundary of Lot 48 (Figure 13; Plate 5).



Plate 4: Two female Forest Red-tailed Black Cockatoos Observed within the Survey Area



Plate 5: Forest Red-tailed Black Cockatoo feathers (top left, top right, bottom left) and a Carnaby's Black Cockatoo feather (bottom right)

4.3.2.1 Foraging Habitat

A total of 26.39 ha of Black Cockatoo foraging habitat was identified within the Survey Area (Figure 14), of which 16.94 ha consisted of *Banksia* Woodland with scattered Eucalypts, with dominant plant species including *Banksia attenuata*, *Banksia menziesii*, Sheoak (*Allocasuarina* sp.), Jarrah (*Eucalyptus marginata*), Marri (*Corymbia calophylla*) and *Xanthorrhoea preissii*, 6.83 ha consisted of *Eucalypt/Corymbia* Woodland dominated by Jarrah and Marri and 1.36 ha consisted of Low *Banksia* Woodland dominated by *Banksia attenuata* and *Banksia menziesii*. The remaining 1.26 ha of Black Cockatoo foraging habitat consisted of isolated foraging tree species including Marri, Jarrah, Tuart, Sheoak, and *Pinus* sp. The condition of Black Cockatoo foraging habitat ranged from Excellent to Completely Degraded.

Extensive evidence of Forest Red-tailed Black Cockatoos foraging was found throughout the *Eucalypt/Corymbia* Woodland foraging habitat and in the majority of the *Banksia* Woodland with scattered Eucalypts foraging habitat in the form of chewed Marri and Jarrah fruit (Figure 13; Plate 6).

Additional foraging evidence was found in the form of chewed Sheoak and Western Woody Pear (*Xylomelum occidentale*) fruit.

Chewed *Banksia* fruit were found within Lots 35 and 36 (Figure 13; Plate 7) and chewed pine cones were found within Lots 42 and 47 (Figure 13; Plate 8), constituting potential evidence of the Carnaby's Black Cockatoo foraging.

Chew marks on two Marri fruits found within Lot 35 did not appear to be characteristic of the Forest Red-tailed Black Cockatoo and were more likely from a White-tailed Black Cockatoo species, however the dentition marks were not sufficient to identify whether they were left by Carnaby's Black Cockatoo or Baudin's Black Cockatoo (Figure 13; Plate 9).



Plate 6: Extensive Forest Red-tailed Black Cockatoo Foraging Evidence on Marri Fruit



Plate 7: Potential Carnaby's Black Cockatoo Foraging Evidence on *Banksia* Fruit



Plate 8: Potential Carnaby's Black Cockatoo Foraging Evidence on a Pine Cone



Plate 9: White-tailed Black Cockatoo Foraging Evidence on Marri Fruit

4.3.2.2 Breeding Habitat

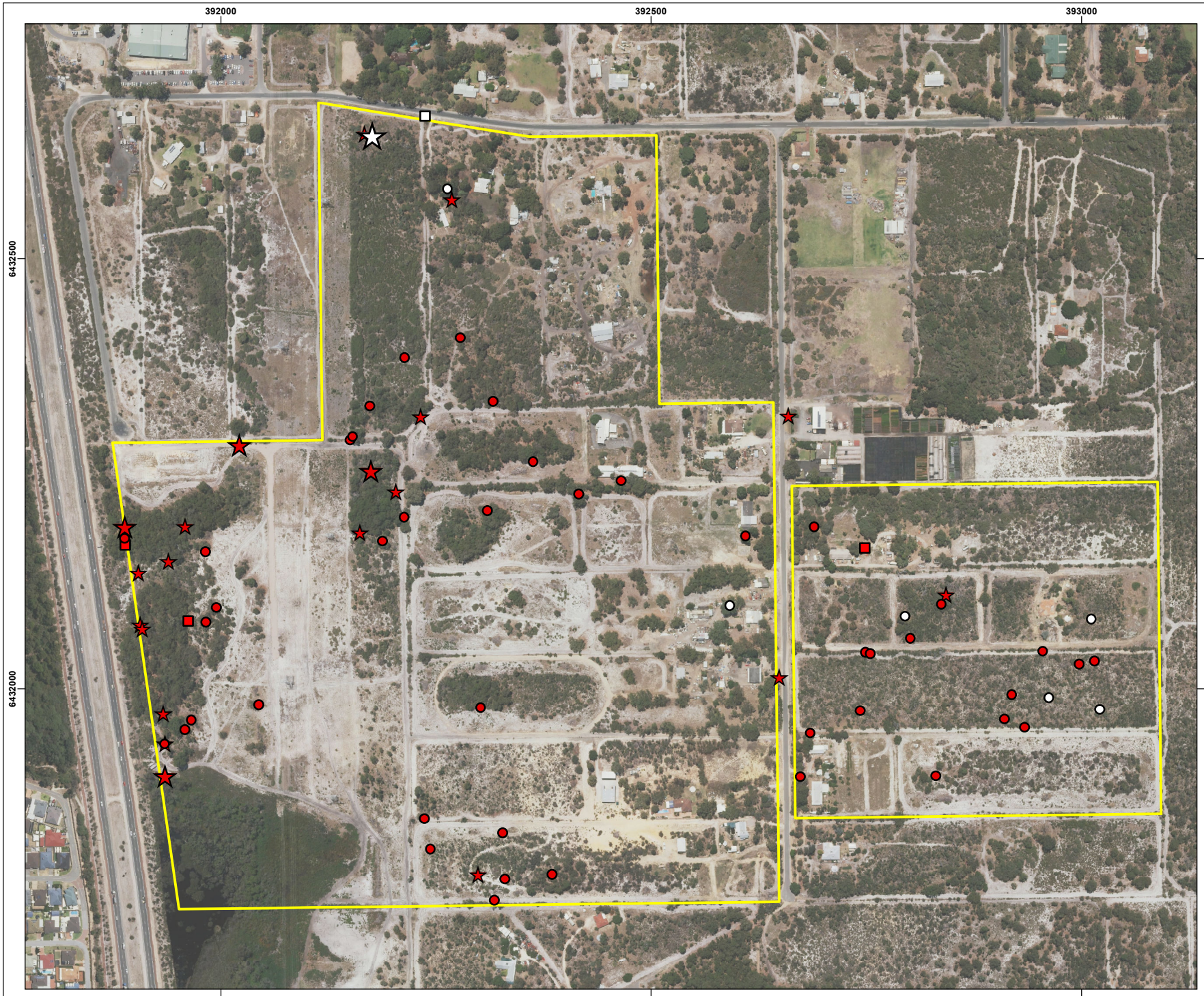
A total of 207 native trees that met the criteria for potential breeding trees (Section 3.2.2.2) were recorded within the Survey Area (Figure 15), of which 101 were Marri (*Corymbia calophylla*), 75 were Jarrah (*Eucalyptus marginata*), 27 were Tuart (*Eucalyptus gomphocephala*) and four were *Eucalyptus todtiana*. 70 of these potential breeding trees were observed as containing hollows.

No evidence of breeding was recorded within the Survey Area.

The raw data for Black Cockatoo potential breeding trees are presented in Appendix H.

4.3.2.3 Roosting Habitat

No evidence of roosting was found within the Survey Area.



Legend

Survey Area

Black Cockatoo Evidence

Carnaby's Black Cockatoo sighting

10 - 40 Individuals

Forest Red-tailed Black Cockatoo sighting

1 - 5 Individuals

5 - 10 Individuals

Black Cockatoo Foraging Evidence

Carnaby's Black Cockatoo foraging evidence

Forest Red-tailed Black Cockatoo foraging evidence

Black Cockatoo Secondary Evidence

Carnaby's Black Cockatoo feather

Forest Red-tailed Black Cockatoo feather

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
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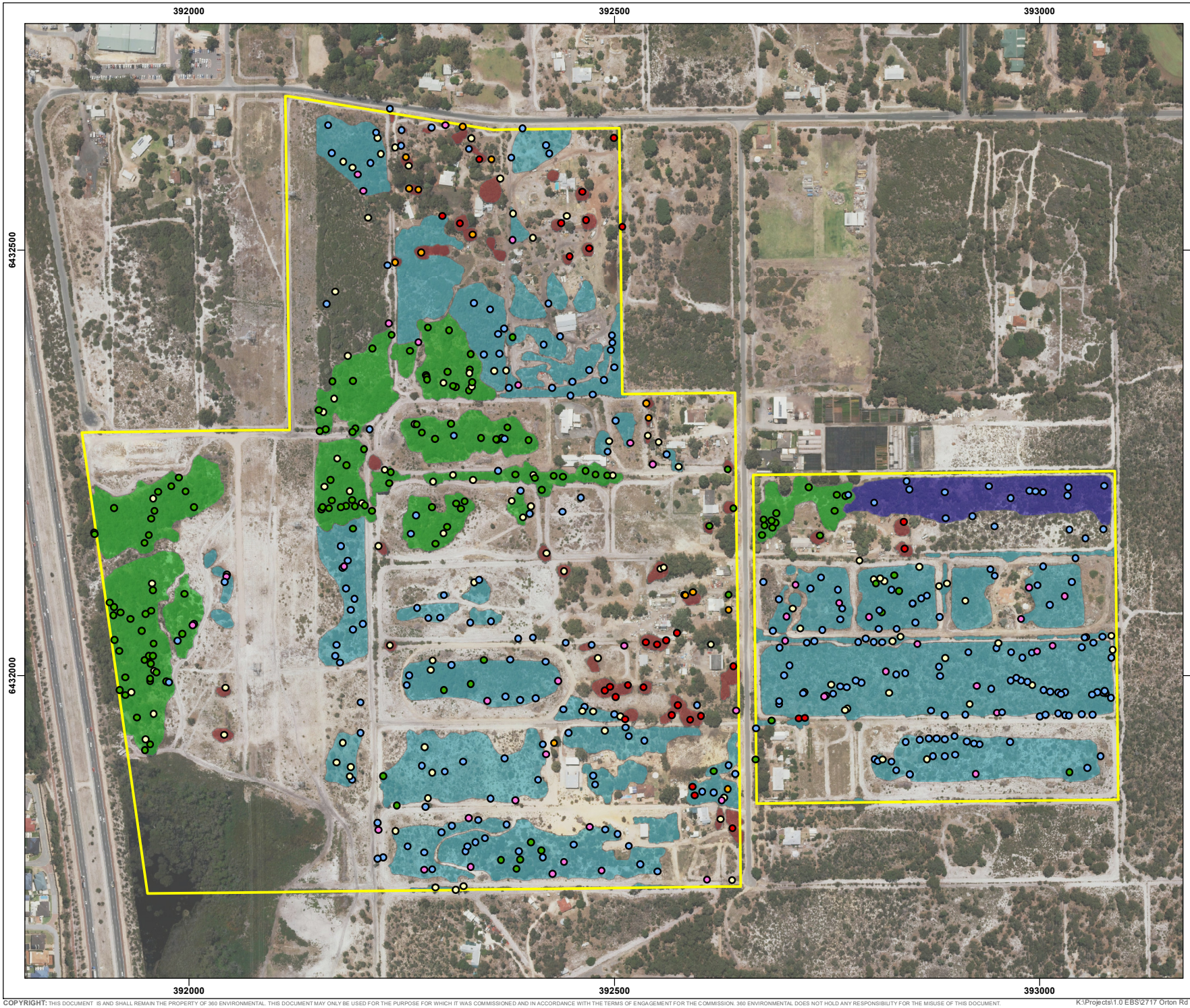
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Flora, Vegetation and Black Cockatoo Assessment

Figure 13
Black Cockatoo Evidence

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K:\Projects\1.0 EBS\2717 Orton Rd Flora and BC Survey, Casuarina\2717 Figure 12 Black Cockatoo Evidence Jun 2018.mxd



Legend

Survey Area

Black Cockatoo Foraging Trees

- Allocasuarina Spp.
- Banksia spp.
- Jarrah (*Eucalyptus marginata*)
- Marri (*Corymbia calophylla*)
- Pine (*Pinus Sp.*)
- Tuart (*Eucalyptus gomphocephala*)

Black Cockatoo Foraging

- Banksia Woodland with scattered Eucalypts (16.9 ha)
- Eucalypt / Corymbia Woodland (6.8 ha)
- Isolated foraging trees (1.3 ha)
- Low Banksia Woodland (1.4 ha)

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- LOCALITY MAP SOURCED LANDGATE 2017
- CADASTRE SOURCED LANDGATE 2018
- AERIAL PHOTOGRAPHY SOURCED LANDGATE 2017
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LOCALITY MAP



PROJECT ID	DATE
2717	4/07/2018

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
DV	AH	SW	0

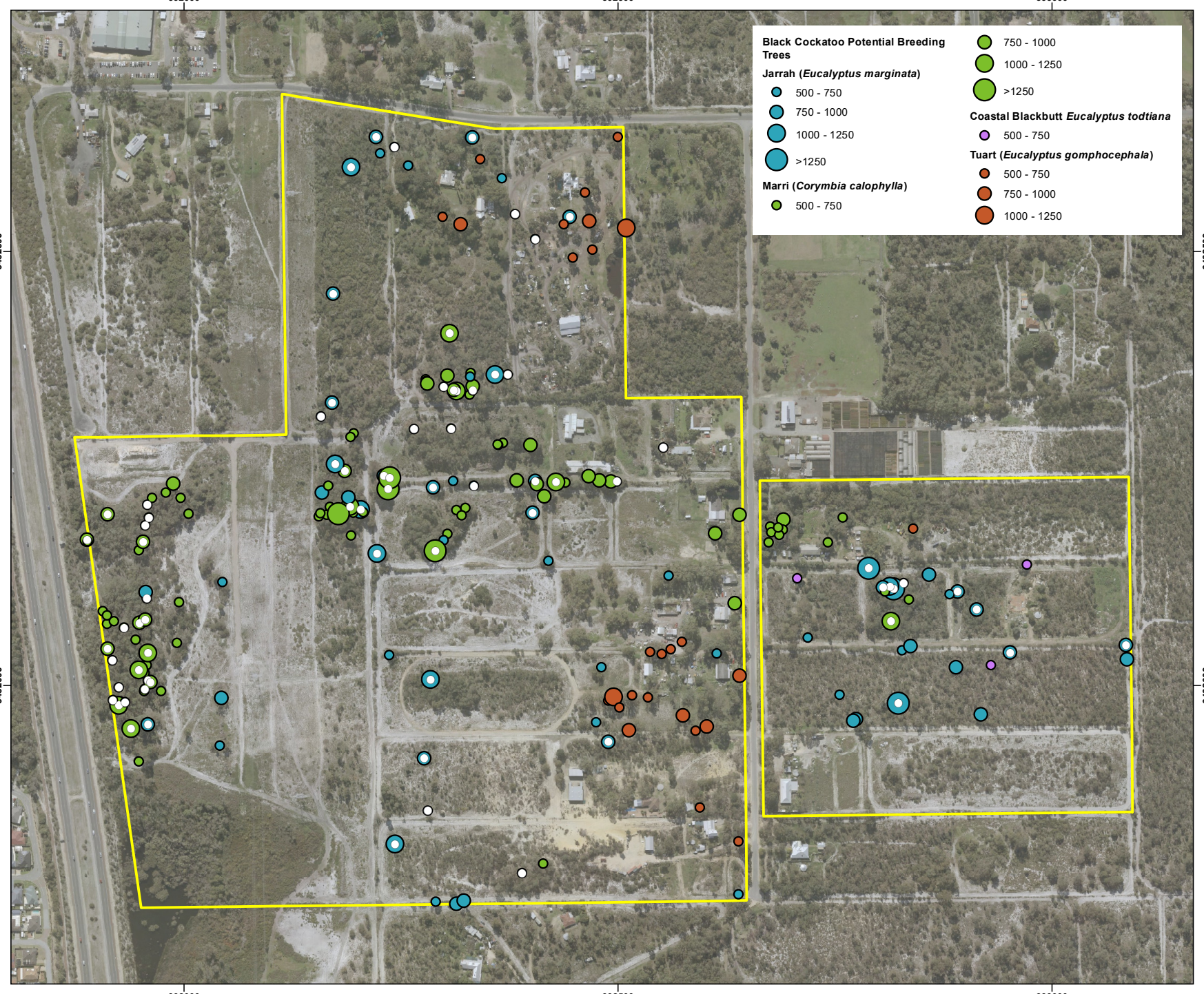
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Flora, Vegetation and Black Cockatoo Assessment

Figure 14
Black Cockatoo Foraging Habitat

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K:\Projects\1.0 EBS\2717 Orton Rd Flora and BC Survey, Casuarina\2717 Figure 13 Black Cockatoo Foraging.mxd



Legend

- Survey Area
- Black Cockatoo Breeding Trees with hollow

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- LOCALITY MAP SOURCED LANDGATE 2017
- CADASTRE SOURCED LANDGATE 2018
- AERIAL PHOTOGRAPHY SOURCED LANDGATE 2017
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LOCALITY MAP



PROJECT ID	DATE
2717	21/11/2018

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
DV	EW	SW	0

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Flora, Vegetation and Black Cockatoo Assessment

Figure 15 Black Cockatoo Potential Breeding Trees

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K:\Projects\1.0 EBS\2717 Orton Rd Flora and BC Survey, Casuarina\2717 Figure 14 Black Cockatoo Potential Breeding Trees.mxd

5 Discussion

5.1 Flora and Vegetation

5.1.1 Flora of Conservation Significance

No Threatened species listed under the EPBC Act or gazetted as T/DRF (Threatened) pursuant to the WC Act were recorded during the survey.

The results from the desktop assessment and database searches identified 11 T/DRF flora species as potentially occurring in the vicinity of the Survey Area. Of these species, five are unlikely based on the habitat type present and known distribution. One is possible and five is likely in *Caladenia huegelii*, *Diuris micrantha*, *Diuris purdiei*, *Drakaea elastica*, *Drakaea micrantha* and *Lepidosperma rostratum*.

The potential orchids identified by the database search are tuberous perennials which are short lived and flowers between September and November. Outside of these times they are unlikely to be found and/or difficult to identify. The Survey Area has been previously surveyed four times with three being during spring when flowering times are favourable. Given that these threatened species have not been found, it is unlikely that they occur in the Survey Area.

Three Priority species were recorded in the Survey Area in *Cyathochaeta teretifolia* (P3) *Jacksonia gracillima* (P3) and *Tetraria sp. Chandala (P2)*. The presence of these Priority species does not form a statutory constraint for the Survey Area. There is no written policy on how to respond to the presence of priority flora species within proposed development sites. The presence of the species is dealt with by DWER on a case by case basis.

Of the remaining Priority Flora (nine taxa) identified as potentially occurring within the Survey Area during the desktop assessment, five are unlikely based on the habitat type present and known distribution and four are likely. The surveys that have been undertaken in the Survey Area have been within the flowering times of the potential species identified by the database searches and none were found.

5.1.2 Vegetation of Conservation Significance

The desktop assessment identified four PEC and one TEC listed by the State (WA) as occurring within a 5km radius of the Survey Area. Two of these communities are also listed as Threatened Ecological Communities (TEC) under the Federal EPBC Act. The remaining communities have the potential to be listed as part of the TEC Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region.

Sixteen vegetation types were mapped as well as eight units, consisting of individual trees, scattered native plants over weeds and monocultures. Vegetation types BaBm, CcEm, BaKg, CcKg, CcXp, CcBiEm, CcAf and CcBa have been determined to have affiliation with FCT SCP21a - Central *Banksia attenuata* - *Eucalyptus marginata* woodlands. Vegetation types BaBmAf and BaBmBi have been determined to have affiliation with FCT

SCP23a - Central *Banksia attenuata – Banksia menziesii* woodlands. Both of these FCTs have been listed as sub-communities under the EPBC Act listed Banksia woodlands of the Swan Coastal Plain (DEE 2016). The absence of Banksia trees within vegetation types CcAf and CcXp indicates that they do not represent Banksia Woodlands of the Swan Coastal Plain, therefore is not considered a TEC under the Endangered category under the EPBC Act. The remaining vegetation types ErMp (SCP S17), CcMp (SCP 11), MpKg (SCP 4), MpAsCt (SCP S17), ErMp (S17) are not considered to represent any known TECs or PECs.

For vegetation remnants to be under full national protection the community must meet key diagnostic characteristics. Regarding the presence of the TEC, the Approved Conservation Advice for the thresholds state that for vegetation in Excellent Condition the minimum patch size should be 0.5 ha, while vegetation in Very Good condition should be a minimum of one hectare and vegetation in Good condition should be a minimum of two hectares. If a vegetation patch is considered Degraded or worse, it is not considered favourable for national protection. The Banksia woodlands generally have a dominant Banksia component, which includes at least one of four key species, *Banksia attenuata*, *B. menziesii*, *B. prionotes* and/or *B. ilicifolia*. The absence of Banksia trees within vegetation types CcAf and CcXp indicates that they do not represent Banksia Woodlands of the Swan Coastal Plain, therefore is not considered a TEC under the Endangered category under the EPBC Act.

Determining the value of each of the remnants identified as FCTs SCP 21a and SCP 23a is problematic due to the fragmented and disturbed nature of the Survey Area. The approved Conservation advice on Banksia woodlands states that remnants that are further than 30m should be treated as separate occurrences. Based on this information, the varying densities of *Banksia* canopy and condition, not every occurrence of SCP21a and SCP23a in the Survey Area is considered representative of Banksia Woodlands of the Swan Coastal Plain and therefore not considered suitable for national protection.

Eleven remnants within the Survey Area equating to 9.26 ha are considered eligible for National Protection as the Banksia Woodlands of the Swan Coastal plain TEC under the Endangered category under the EPBC Act.

Possible impacts to TECs are considered by State assessment bodies when applications to develop or clear land are evaluated. Under the EP Act, any clearing of native vegetation requires a permit unless done for an exempt purpose. These exemptions do not apply in ESAs. TECs have been defined under the regulations as ESAs so the exemptions from requiring a clearing permit do not apply. Any such clearing proposal, therefore, must be undertaken under a specific permit and be assessed for any environmental impact.

Under the State legislation FCT SCP21a and SCP 23a are considered to have potential to form part of the Priority 3 Ecological Community *Banksia dominated woodlands of the Swan Coastal Plain IBRA region*. Vegetation that has an over storey dominated by Banksia are all listed as a Priority 3 ecological community. There is no written policy on

how to respond to the presence of PECs within proposed development sites and the presence of these communities is dealt with by DBCA on a case-by-case basis.

5.1.3 Regional Representation

The DBCA has mapped native vegetation extent by vegetation complex on the Swan Coastal Plain. It is estimated that Bassendean 1001 has 22.13% native vegetation remaining based on the pre-European extent.

The EPA recognises vegetation complexes that are not well represented as being significant. Vegetation complexes which have 10%-30% remaining may be considered regionally significant. Proposals that would affect a vegetation complex with 10% or less remaining are likely to be formally assessed by the EPA (EPA 2006).

These levels may be modified for 'Constrained Areas'. Such areas include the Swan Coastal Plain portion of the Perth Metropolitan Region, and may include urban, urban deferred and industrial zoned lands, and lands with development approvals.

The modified objectives for Constrained Areas are to:

- Retain at least 10% of the pre-clearing extent of the ecological community where >10% of the ecological community remains; or
- Retain all remaining areas of each ecological community where <10% of this ecological community remains.

The remaining extent of this vegetation community types are greater than the 10% threshold set by the EPA for protecting Australia's biological diversity in constrained areas.

5.2 Black Cockatoo Habitat Assessment

5.2.1 Foraging Habitat

The *Eucalypt/Corymbia* Woodland dominated by Jarrah and Marri is heavily utilised for foraging by the Forest Red-tailed Black Cockatoo. Marri and Jarrah fruits displaying dentition marks of the species were found throughout this habitat, which is also where 11 of the 20 Forest Red-tailed Black Cockatoo sightings occurred.

Chewed Marri and Jarrah fruits were found extensively within the *Banksia* Woodland with scattered *Eucalypts*, although in lower densities than in the *Eucalypt/Corymbia* Woodland. Most of the chewed Marri and Jarrah fruits displayed dentition marks characteristic of Forest Red-tailed Black Cockatoos, indicating that the habitat is heavily utilised by the species. Two Marri nuts were found with dentition marks that were not characteristic of the Forest Red-tailed Black Cockatoo, however the marks were not sufficient to conclusively identify whether they were foraging evidence of a Carnaby's Black Cockatoo or Baudin's Black Cockatoo; given their respective distributions and the results of the specific Black Cockatoo database search it is considered most likely to be Carnaby's Black Cockatoo.

Evidence of foraging on *Banksia* fruit was also located within *Banksia* Woodland with scattered *Eucalypts*, which is most likely to be Carnaby's Black Cockatoo. Both the *EPBC Act referral guidelines for three threatened black cockatoo species* (Department of Sustainability Environment Water Population and Communities, 2012) and Johnstone and Kirkby (2011) indicate that the Carnaby's Black Cockatoo is the only species likely to forage on *Banksia attenuata* and *Banksia menziesii*.

The Low *Banksia* Woodland is likely to provide an important foraging resource to the Carnaby's Black Cockatoo; however no evidence of foraging was found within this habitat type, suggesting that the habitat type is not currently or frequently utilised for foraging. The Low Banksia Woodland is unlikely to be utilised by Forest Red-tailed Black Cockatoos and Baudin's Black Cockatoos as their preferred food sources, particularly Marri and Jarrah, are not present.

The remaining foraging habitat consisted of isolated foraging tree species in otherwise completely degraded areas of vegetation, lacking any understorey. The majority of these trees were not found to have evidence of foraging, with the exception of some isolated Marri and Jarrah trees and chewed pine cones found at the base of *Pinus* sp. trees in Lots 47 and 42. The *EPBC Act referral guidelines for three threatened black cockatoo species* (Department of Sustainability Environment Water Population and Communities, 2012) and Johnstone and Kirkby (2011) indicate that the Carnaby's Black Cockatoo is the only Black Cockatoo species likely to forage on pine cones, therefore the chewed pine cones constitute Carnaby's Black Cockatoo foraging evidence.

5.2.2 Breeding Habitat

While evidence of breeding was not recorded during the field survey, the Survey Area contains many native Eucalypt trees with a DBH > 500 mm and hollows that are of suitable size for use by all three Black Cockatoo species for breeding. Additionally, many of these trees may develop suitable hollows in the future. The Targeted Black Cockatoo Survey was undertaken outside of breeding season which may result in a lower likelihood of detecting evidence of breeding activity.

5.2.3 Baudin's Black Cockatoo

The Baudin's Black Cockatoo was not returned by the specific Black Cockatoo database search (Department of Biodiversity Conservation and Attractions, 2018b) or the field survey, therefore it is considered unlikely that Baudin's Black Cockatoo are currently utilising the Survey Area. While there was White-tailed Black Cockatoo foraging evidence in the form of chewed marri nuts, the dentition marks were not sufficient to identify the species with a high degree of certainty.

The *Eucalypt/Corymbia* Woodland dominated by Marri and Jarrah is preferred foraging habitat for the Baudin's Black Cockatoo. While this habitat is unlikely to be in current use by the species, it appears that populations of the species that currently spend the non-

breeding season in the Perth hills districts are moving westwards onto the Swan Coastal Plain (Johnstone and Kirkby, 2011), so any suitable habitat retained within the Survey Area may be of higher value to this species in the future.

5.2.4 Carnaby's Black Cockatoo

The specific Black Cockatoo database search (Department of Biodiversity Conservation and Attractions, 2018b) indicated that the Carnaby's Black Cockatoo has been recorded extensively within 10 km of the Survey Area. While the species was recorded during the field survey (a flock of Carnaby's Black Cockatoos seen flying overhead), no active foraging was observed within the Survey Area. Additionally, limited foraging evidence suggests that while Carnaby's Black Cockatoos may utilise habitat contained within the Survey Area, they are not foraging within the Survey Area frequently or extensively at present.

Although the desktop results suggest the Survey Area may be within the species known breeding distribution, it is not within the buffer area of any known or possible breeding areas (Department of Biodiversity Conservation and Attractions, 2018b), and therefore will not directly impact these breeding areas.

5.2.5 Forest Red-tailed Black Cockatoo

The Forest Red-tailed Black Cockatoo was returned by the specific Black Cockatoo database search (Department of Biodiversity Conservation and Attractions, 2018b) and was recorded extensively during the field survey, through both opportunistic observations and foraging evidence. Foraging habitat contained within the Survey Area, particularly the *Eucalypt/Corymbia* Woodland dominated by Marri and Jarrah, is currently heavily utilised by the species and is of high value as foraging habitat.

6 Conclusions

Flora and Vegetation

Of the four field surveys undertaken in the Survey Area three were within the recommended seasonal and flowering period for the Swan Coastal Plain botanical province. The Survey Area was sufficiently traversed and as such the following conclusions can be drawn:

- A total of 217 flora taxa from 133 genera and 50 families were identified within the Survey Area;
- A total of 24 introduced species were recorded during the survey, representing approximately 11% of the total taxa. Two of these are listed as Declared Pests and one is listed as a WONS under the BAM Act;
- No Threatened flora species pursuant to the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and/or gazetted as Threatened/ Declared Rare Flora pursuant to the *Wildlife Conservation Act 1950* were recorded during the survey;
- Three Priority species were recorded in the Survey Area, *Cyathochaeta teretifolia* (P3) was found at six locations, *Jacksonia gracillima* (P3) was found at nine locations and *Tetraria* sp. *chandala* (P2) was found at two locations;
- Sixteen vegetation types were mapped for the Survey Area as well as eight units consisting of individual trees, scattered native plants over weeds and monocultures;
- Vegetation condition ranged from Excellent to Completely Degraded with the majority of the Survey Area considered to be in Completely Degraded condition;
- Vegetation types BaBm, CcEm, BaKg, CcKg, CcXp, CcBiEm, CcAf and CcBa have been determined to have affiliation with FCT SCP21a - Central *Banksia attenuata - Eucalyptus marginata* woodlands. Vegetation types BaBmAf, BaBmAf and BaBmBi have been determined to have affiliation with FCT SCP23a - Central *Banksia attenuata – Banksia menziesii* woodlands. FCTs SCP 21a and 23a are not listed as TECs by the State, however, are listed as sub-communities of Banksia woodlands of the Swan Coastal Plain. Banksia woodlands of the Swan Coastal Plain are listed as Endangered under the EPBC Act;
- The absence of Banksia trees within vegetation types CcAf and CcXp insinuates that they do not represent Banksia Woodlands of the Swan Coastal Plain, therefore is not considered a TEC under the Endangered category under the EPBC Act; and

- Eleven remnants within the Survey Area equating to 9.26 ha are considered eligible for National Protection as the Banksia Woodlands of the Swan Coastal plain TEC under the Endangered category of the EPBC Act.

Black Cockatoo Habitat Assessment

The following conclusions can be drawn from the Targeted Black Cockatoo Habitat Assessment:

- A total of 26.39 ha of Black Cockatoo foraging habitat was recorded within the Survey Area;
- Carnaby's Black Cockatoos and Forest Red-tailed Black Cockatoos were observed within the Survey Area;
- Evidence of Carnaby's Black Cockatoo and Forest Red-tailed Black Cockatoo foraging was identified within the Survey Area;
- No evidence of breeding or roosting was identified within the Survey Area;
- A total of 207 trees were identified as Black Cockatoo potential breeding trees, of which 70 had hollows, and showed evidence of being used for breeding; and
- Not all 70 trees that contained hollows will currently be suitable for breeding as the assessment of each hollow from the ground does not allow for an assessment of the suitability of the hollow dimensions. Further investigation would be required to determine such suitability.

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8 Limitations

This report is produced strictly in accordance with the scope of services set out in the contract or otherwise agreed in accordance with the contract. 360 Environmental makes no representations or warranties in relation to the nature and quality of soil and water other than the visual observation and analytical data in this report.

In the preparation of this report, 360 Environmental has relied upon documents, information, data and analyses ("client's information") provided by the client and other individuals and entities. In most cases where client's information has been relied upon, such reliance has been indicated in this report. Unless expressly set out in this report, 360 Environmental has not verified that the client's information is accurate, exhaustive or current and the validity and accuracy of any aspect of the report including, or based upon, any part of the client's information is contingent upon the accuracy, exhaustiveness and currency of the client's information. 360 Environmental shall not be liable to the client or any other person in connection with any invalid or inaccurate aspect of this report where that invalidity or inaccuracy arose because the client's information was not accurate, exhaustive and current or arose because of any information or condition that was concealed, withheld, misrepresented, or otherwise not fully disclosed or available to 360 Environmental.

Aspects of this report, including the opinions, conclusions and recommendations it contains, are based on the results of the investigation, sampling and testing set out in the contract and otherwise in accordance with normal practices and standards. The investigation, sampling and testing are designed to produce results that represent a reasonable interpretation of the general conditions of the site that is the subject of this report. However, due to the characteristics of the site, including natural variations in site conditions, the results of the investigation, sampling and testing may not accurately represent the actual state of the whole site at all points.

It is important to recognise that site conditions, including the extent and concentration of contaminants, can change with time. This is particularly relevant if this report, including the data, opinions, conclusions and recommendations it contains, are to be used a considerable time after it was prepared. In these circumstances, further investigation of the site may be necessary.

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APPENDIX A:

Protection of Flora, Vegetation and Ecological Communities

Categories of Threatened Flora Species Under the EPBC Act (Commonwealth of Australia, 1999)

Conservation Code	Description
Ex	**Extinct** A native species is eligible to be included in the extinct category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
ExW	**Extinct in the Wild** A native species is eligible to be included in the extinct in the wild category at a particular time if, at that time, it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
CE	**Critically Endangered** A native species is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
E	**Endangered** A native species is eligible to be included in the endangered category at a particular time if, at that time, it is not critically endangered and it is facing a very high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
V	**Vulnerable** A native species is eligible to be included in the vulnerable category at a particular time if, at that time , it is not critically endangered or endangered and it is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
CD	**Conservation Dependent** A native species is eligible to be included in the conservation dependent category at a particular time if, at that time, the species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years.

Categories of Declared Rare Flora (WC Act) and DBCA Priority Flora Rankings (Department of Parks and Wildlife, 2017)

CONSERVATION CODE	DESCRIPTION
X	Presumed Extinct Flora (Declared Rare Flora – Extinct) "Taxa which have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such (Schedule 2 under the *Wildlife Conservation Act 1950*)."
T	Threatened Flora (Declared Rare Flora – Extant) "Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such (Schedule 1 under the *Wildlife Conservation Act 1950*)." "Threatened Flora (Schedule 1) are further ranked by the Department according to their level of threat using IUCN Red List criteria: CR: Critically Endangered – considered to be facing an extremely high risk of extinction in the wild; EN: Endangered – considered to be facing a very high risk of extinction in the wild; VU: Vulnerable – considered to be facing a high risk of extinction in the wild."
P1	Priority One: Poorly-known taxa "Taxa which are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes."
P2	Priority Two: Poorly-known taxa "Taxa which are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown Land, water reserves, etc. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes."

CONSERVATION CODE	DESCRIPTION
P3	**Priority Three: Poorly-known taxa** "Taxa which are known from collections or sight records from several localities not under imminent threat, or few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Taxa may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them."
P4	**Priority Four: Rare, Near Threatened and other taxa in need of monitoring** a. Rare. "Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands." b. Near Threatened. "Taxa that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable." c. "Taxa that have been removed from the list of threatened species during the past five years for reasons other than taxonomy."
P5	**Priority Five: Conservation Dependent taxa** "Taxa that are not threatened but are subject to a specific conservation program, the cessation of which would result in the taxon becoming threatened within five years."

Definitions of Threatened Ecological Communities as Endorsed by the Western Australian Minister for the Environment (Department of Environment and Conservation, 2013)

PRESUMED TOTALLY DESTROYED (PD)

An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant and either of the following applies (A or B);

A) Records within the last 50 years have not been confirmed despite thorough searches or known or likely habitats or

B) All occurrences recorded within the last 50 years have since been destroyed.

CRITICALLY ENDANGERED (CR)

An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (A, B or C):

A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and either or both of the following apply (i or ii)

i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 5 years)

ii) modification throughout its range is continuing such that in the immediate future (within approximately 5 years) the community is unlikely to be capable of being substantially rehabilitated.

B) Current distribution is limited, and one or more of the following apply (i, ii or iii):

i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 5 years)

ii) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes

iii) there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes

C) The ecological community exists only as highly modified occurrences which may be capable of being rehabilitated if such work begins in the immediate future (within approximately 5 years)

ENDANGERED (EN)
An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (A, B or C): A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 70% and either or both of the following apply (i or ii) i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term (within approximately 10 years) ii) modification throughout its range is continuing such that in the short term future (within approximately 10 years) the community is unlikely to be capable of being substantially restored or rehabilitated. B) Current distribution is limited, and one or more of the following apply (i, ii or iii): i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 10 years) ii) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes iii) there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes C) The ecological community exists only as highly modified occurrences which may be capable of being rehabilitated if such work begins in the short term future (within approximately 10 years).
VULNERABLE (VU)
An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction in the medium to long term future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (A, B or C): A) The ecological community exists largely as modified occurrences which are likely to be capable of being substantially restored or rehabilitated. B) The ecological community can be modified or destroyed and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations. C) The ecological community may still be widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.

Definitions of Priority Ecological Communities as Listed by DBCA (Department of Environment and Conservation, 2013)

Possible threatened ecological communities that do not meet survey criteria or that are not adequately defined are added to the Priority Ecological Community Lists under Priorities 1, 2 and 3. These three categories are ranked in order of priority for survey and/or definition of the community, and evaluation of conservation status, so that consideration can be given to their declaration as threatened ecological communities. Ecological Communities that are adequately known, and are rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5.

PRIORITY ONE: POORLY KNOWN ECOLOGICAL COMMUNITIES
Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
PRIORITY TWO: POORLY KNOWN ECOLOGICAL COMMUNITIES
Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, State forest, unallocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.
PRIORITY THREE: POORLY KNOWN ECOLOGICAL COMMUNITIES
(i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or: (ii) Communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; (iii) Communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.

PRIORITY FOUR: ECOLOGICAL COMMUNITIES THAT ARE ADEQUATELY KNOWN, RARE BUT NOT THREATENED OR MEET CRITERIA FOR NEAR THREATENED OR THAT HAVE BEEN RECENTLY REMOVED FROM THE THREATENED LIST.
These communities require regular monitoring. (a) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands. (b) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (c) Ecological communities that have been removed from the list of threatened communities during the past five years.
PRIORITY FIVE: CONSERVATION DEPENDENT ECOLOGICAL COMMUNITIES.
Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years

APPENDIX B:

WONS, Declared Plant and Environmental Weed Categories

To help focus national efforts to address weed problems in Australia, a list of Weeds of National Significance (WoNS) was compiled. Plant species were selected on the basis of their invasiveness and impact characteristics, their potential and current area of spread and their primary industry, environmental and socioeconomic impacts. Thirty-two WoNS have been identified by Australian governments. In Western Australia many of these WoNS are also declared pests under the *Biosecurity and Agriculture Management Act 2007*.

To protect Western Australia's agriculture, the Department of Primary Industries and Regional Development:

- Regulates weeds under the Biosecurity and Agriculture Management Act 2007 (BAM Act);
- Provides a weed identification service; and
- Provides information on weed control, crop weeds, regulated/declared plants and herbicides.

Under the BAM Act, all declared pests are placed in one of three categories, namely C1 (exclusion), C2 (eradication) or C3 (management).

Declared Pest Categories Under the BAM Act (Department of Primary Industries and Regional Development, 2018)

C1 CATEGORY (EXCLUSION)
Pests will be assigned to this category if they are not established in WA and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.
C2 CATEGORY (ERADICATION)
Pests will be assigned to this category if they are present in WA in low enough numbers or in sufficiently limited areas that their eradication is still a possibility
C3 CATEGORY (MANAGEMENT)
Pests will be assigned to this category if they are established in WA but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest.

The Weed Prioritisation Process for DBCA contains criteria for the assessment and ranking of weeds in terms of their environmental impact on biodiversity (Department of Parks and Wildlife, 2013). These criteria are as follows:

- **Potential Distribution** – Area of potential habitat in the Region that could be occupied or the area at risk of invasion by the weed;
- **Current Distribution -** Area of habitat in the Region currently occupied by the weed, in relation to the habitat that it could invade;
- **Ecological Impact -** Impact of species within the Region, from low impact (causes minimal disruption to ecological processes or loss of biodiversity) to high (causes acute disruption of ecological processes, dominates and/or significantly alters vegetation structure, composition and function of ecosystems);
- **Invasiveness** – rate of spread of a weed in native vegetative, encompassing factors of establishment, reproduction and long distance dispersal (>100m); and
- **Feasibility of Control** - The longer a coordinated control program takes to achieve its desired goal, the more expensive and less feasible it becomes. Is it feasible to eradicate or at least contain the infestation?

Weed Prioritisation Process prioritises weeds in each DBCA region in terms of Ecological impact under each of the categories of very high (VH), high (H), medium (M), low (L) and negligible (N). Weeds are also prioritised by regions in relation to invasiveness according to the categories of slow (S), Moderate (M), Rapid (R) and Unknown (U) (Department of Parks and Wildlife, 2013).

APPENDIX C:

Vegetation Condition Scale

Vegetation Condition Scale (Environmental Protection Authority, 2016)

Vegetation Condition	South West and Interzone Botanical Provinces	Eremaean and Northern Botanical Provinces
Pristine	Pristine or nearly so, no obvious signs of disturbance or damage caused by human activities since European settlement.	
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.	Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement.
Very Good	Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.	Some relatively slight signs of damage caused by human activities since European settlement. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds, or occasional vehicle tracks.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.	More obvious signs of damage caused by human activity since European settlement, including some obvious impact on the vegetation structure such as that caused by low levels of grazing or slightly aggressive weeds.
Poor		Still retains basic vegetation structure or ability to regenerate it after very obvious impacts of human activities since European settlement, such as grazing, partial clearing, frequent fires or aggressive weeds.

VEGETATION CONDITION	SOUTH WEST AND INTERZONE BOTANICAL PROVINCES	EREMAEAN AND NORTHERN BOTANICAL PROVINCES
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing.	Severely impacted by grazing, very frequent fires, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with a number of weed species present including very aggressive species.
Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees and shrubs.	Areas that are completely or almost completely without native species in the structure of their vegetation; i.e. areas that are cleared or 'parkland cleared' with their flora comprising weed or crop species with isolated native trees or shrubs.

APPENDIX D:

Flora Likelihood Table

Appendix D: Assessment of the Likely Occurrence of DRF and Priority Flora (DBCA and EPBC Database Searches) in the Survey Area

[1]Closest record to Survey Area based on DBCA 2018.Likely = Suitable habitat present and records less than 5 km from the Survey Area, Possible = Suitable habitat present and records between 5 km and 15 km from the Survey Area, and Unlikely = No suitable habitat present and/or records greater than 15 km from the Survey Area. En = Listed as Endangered under the EBPC Act, Vu = Listed as Vulnerable under the EBPC, Ce= Critically Endangered under the EBPC Act, P = Listed as Priority by the DPaW DRF = Declared Rare Flora as listed by the State

Source	Conservation Status		Species	Habitat information	Distance to nearest Record	Suitable Habitat present	Likelihood of occurrence in the Survey area
	EPBC	DPaW					
PMST	Endangered	DRF/T	*Andersonia gracilis*	White/grey sand, sandy clay, gravelly loam. Winter-wet areas, near swamps.	24km	Yes	Unlikely
DBCA NatureMap PMST	Endangered	DRF/T	*Caladenia huegelii*	Grey or brown sand, Clay loam.	850m	Yes	Likely
DBCA NatureMap PMST	Vulnerable	DRF/T	*Diuris micrantha*	Brown loamy clay. Winter-wet swamps, in shallow water.	460m	Yes	Likely
PMST	Endangered	DRF/T	*Diuris purdiei*	Grey-black sand, moist. Winter-wet swamps	5.3km	Yes	Likely
DBCA NatureMap PMST	Endangered	DRF/T	*Drakaea elastica*	Low-lying situations adjoining winter-wet swamps	2km	Yes	Likely
PMST	Endangered	DRF/T	*Drakaea micrantha*	White-grey sand	11.1km	Yes	Possible
PMST	Vulnerable	DRF/T	*Eleocharis keigheryi*	Clay, sandy loam. Emergent in freshwater: creeks, claypans	22.6km	Yes	Unlikely
PMST	Endangered	DRF/T	*Eucalyptus x balanites*	Sandy soils with lateritic gravel.	15.7km	No	Unlikely
PMST	Endangered	DRF/T	*Lepidosperma rostratum*	Peaty sand, clay.	10.4km	Yes	Likely

Source	Conservation Status		Species	Habitat information	Distance to nearest Record	Suitable Habitat present	Likelihood of occurrence in the Survey area
	EPBC	DPaW					
PMST	Critically Endangered	DRF/T	*Synaphea sp. Fairbridge Farm*	Sandy with lateritic pebbles. Near winter-wet flats, in low woodland with weedy grasses.	16km	No	Unlikely
PMST	Critically Endangered	DRF/T	*Synaphea sp. Serpentine*	Seasonally wet. Grey loamy sand. Yellow/brown sand.	16km	Yes	Unlikely
DBCA NatureMap	-	P1	*Boronia juncea subsp. juncea*	Sand. Low scrub	2.6km	Yes	Likely
DBCA	-	P2	*Thelymitra variegata*	Sandy clay, sand, laterite.	14.3km	No	Unlikely
DBCA NatureMap	-	P3	*Cyathochaeta teretifolia*	Grey sand, sandy clay. Swamps, creek edges.	2km	Yes	Found in Survey Area
DBCA NatureMap		P3	*Jacksonia gracillima*	Winter – wet Bassendean sands. Littered, grey, peaty loamy sands	4.1km	Yes	Found in Survey Area
NatureMap		P3	*Pithocarpa corymbulosa*	Gravelly or sandy loam. Amongst granite outcrops	4.9km	No	Unlikely
DBCA	-	P3	*Schoenus capillifolius*	Brown mud. Claypans.	10.4km	No	Unlikely
DBCA NatureMap	-	P3	*Stylidium paludicola*	Peaty sand over clay. Winter-wet areas. Marri and Melaleuca woodland, Melaleuca shrubland.	2.9km	Yes	Likely
DBCA NatureMap	-	P4	*Aponogeton hexatepalus*	Mud. Freshwater: ponds, rivers, claypans.	426m	Yes	Likely
DBCA NatureMap	-	P4	*Dodonaea hackettiana*	Sand. Outcropping limestone	2.3km	No	Unlikely
DBCA NatureMap		P4	*Stylidium ireneae*	Sandy loam. Valleys near creek lines, woodland, often with Agonis.	1.9km	No	Unlikely

Source	Conservation Status		Species	Habitat information	Distance to nearest Record	Suitable Habitat present	Likelihood of occurrence in the Survey area
	EPBC	DPaW					
DBCA NatureMap	-	P4	*Stylidium longitubum*	Sandy clay, clay. Seasonal wetlands.	2.5km	Yes	Likely

APPENDIX E:

Flora Inventory

Family	Taxa
Aizoaceae	**Carpobrotus aequilaterus*
	**Carpobrotus edulis*
Anarthriaceae	*Lyginia barbata*
	Lyginia imberbis
Apiaceae	*Centella asiatica*
	Homalosciadium homalocarpum
	Platysace filiformis
	Xanthosia huegelii subsp. *huegelii*
Araceae	**Zantedeschia aethiopica*
Araliaceae	*Trachymene pilosa*
Asparagaceae	**Asparagus asparagoides*
	Chamaescilla corymbosa var. *corymbosa*
	Laxmannia grandiflora subsp. *grandiflora*
	Laxmannia sp.
	Laxmannia squarrosa
	Lomandra caespitosa
	Lomandra hermaphrodita
	Lomandra nigricans
	Lomandra preissii
	Lomandra sp.
	Lomandra suaveolens
	Sowerbaea laxiflora
	Thysanotus manglesianus
	Thysanotus manglesianus/patersonii
	Thysanotus multiflorus
	Thysanotus sp.
	Thysanotus sparteus
Asteraceae	**Hypochaeris glabra*
	**Hypochaeris radicata*
	**Sonchus oleraceus*
	**Symphyotrichum squamatum*
	**Ursinia anthemoides*
	Hyalosperma simplex
	Lagenophora huegelii

Family	Taxa
	Podotheca angustifolia
	Podotheca chrysantha
	Podotheca gnaphalioides
	Siloxerus filifolius
	Siloxerus humifusus
Boraginaceae	**Echium plantagineum*
Campanulaceae	*Lobelia anceps*
	Lobelia tenuior subsp. *dictyosperma*
Casuarinaceae	*Allocasuarina fraseriana*
Centrolepidaceae	*Centrolepis drummondiana*
Colchicaceae	*Burchardia congesta*
Crassulaceae	*Crassula colorata* var. *acuminata*
Cyperaceae	*Baumea preissii* subsp. *laxa*
	Baumea vaginalis
	Cyathochaeta avenacea
	Cyathochaeta teretifolia (P3)
	Isolepis cyperoides
	Lepidosperma longitudinale
	Lepidosperma sp.
	Lepidosperma sp. Coastal Dunes
	Lepidosperma squamatum
	Lepidosperma squamatum complex
	Mesomelaena pseudostygia
	Mesomelaena stygia
	Schoenus curvifolius
	Schoenus efoliatus
	Schoenus grandiflorus
	Tetraria sp.
Dasypogonaceae	*Calectasia narragara*
	Dasypogon bromeliifolius
Dennstaedtiaceae	*Pteridium esculentum*
Dilleniaceae	*Hibbertia hypericoides*
	Hibbertia racemosa
	Hibbertia subvaginata

Family	Taxa
Droseraceae	*Drosera erythrorhiza* subsp. *erythrorhiza*
	Drosera menziesii subsp. *penicillaris*
	Drosera paleacea
	Drosera pallida
	Drosera porrecta
	Drosera porrecta/stolonifera
	Drosera stolonifera
Ericaceae	*Astroloma pallidum*
	Astroloma sp.
	Conostephium pendulum
	Leucopogon australis subsp. *australis*
	Leucopogon conostephioides
	Leucopogon nutans
Euphorbiaceae	*Euphorbia* sp.
Fabaceae	**Lotus uliginosus*
	Acacia alata
	Acacia applanata
	Acacia huegelii
	Acacia lasiocarpa
	Acacia longifolia
	Acacia pulchella var. *glaberrima*
	Acacia saligna
	Acacia stenoptera
	Bossiaea eriocarpa
	Daviesia incrassata subsp. *incrassata*
	Daviesia physodes
	Daviesia triflora
	Euchilopsis linearis
	Eutaxia virgata
	Gastrolobium capitatum
	Gastrolobium ebracteolatum
	Gompholobium confertum
	Gompholobium tomentosum
	Hardenbergia comptoniana

Family	Taxa
	Hovea trisperma var. trisperma
	Jacksonia furcellata
	Jacksonia gracillima (P3)
	Jacksonia sternbergiana
	Kennedia prostrata
Goodeniaceae	*Dampiera alata*
	Dampiera linearis
	Lechenaultia floribunda
Haemodoraceae	*Anigozanthos manglesii subsp. manglesii*
	Conostylis aculeata subsp. *aculeata*
	Conostylis juncea
	Conostylis setigera subsp. *setigera*
	Phlebocarya ciliata
Haloragaceae	*Gonocarpus pithyoides*
	Myriophyllum tillaeoides
Hemerocallidaceae	*Arnocrinum preissii*
	Caesia micrantha
	Dianella revoluta var. *divaricata*
	Tricoryne elatior
Iridaceae	**Gladiolus caryophyllaceus*
	** Romulea rosea* var. *australis*
	Patersonia occidentalis var. *occidentalis*
Juncaginaceae	*Triglochin huegelii*
Lamiaceae	*Hemiandra pungens*
Lauraceae	*Cassytha racemosa* forma *racemosa*
Loganiaceae	*Phyllangium paradoxum*
Loranthaceae	*Nuytsia floribunda*
Molluginaceae	*Macarthuria australis*
Myrtaceae	*Astartea scoparia*
	Calytrix angulata
	Calytrix flavescens
	Calytrix fraseri
	Chamelaucium uncinatum
	Corymbia calophylla

Family	Taxa
	Eremaea asterocarpa subsp. *asterocarpa*
	Eremaea pauciflora var. *pauciflora*
	Eucalyptus gomphocephala
	Eucalyptus marginata subsp. *marginata*
	**Eucalyptus microcorys*
	Eucalyptus rudis subsp. *rudis*
	Eucalyptus todtiana
	Homalospermum firmum
	Hypocalymma angustifolium
	Hypocalymma robustum
	Hypocalymma sp.
	Kunzea glabrescens
	Melaleuca preissiana
	Melaleuca rhaphiophylla
	Melaleuca teretifolia
	Melaleuca thymoides
	Pericalymma ellipticum
	Scholtzia involucrata
	Taxandria linearifolia
Orchidaceae	**Disa bracteata*
	Caladenia flava subsp. *flava*
	Cryptostylis ovata
	Leporella fimbriata
	Microtis media
	Pterostylis sanguinea
	Pyrorchis nigricans
Phyllanthaceae	*Poranthera microphylla*
	Poranthera sp.
Pinaceae	**Pinus* sp.
Pittosporaceae	*Billardiera heterophylla*
Plantaginaceae	*Gratiola pubescens*
Poaceae	**Avena barbata*
	**Briza maxima*
	**Bromus diandrus*

Family	Taxa
	**Ehrharta calycina*
	**Ehrharta longiflora*
	**Eragrostis curvula*
	**Holcus lanatus*
	Amphipogon turbinatus
	Austrostipa compressa
	Austrostipa flavescens
	Austrostipa sp.
	Rytidosperma occidentale
	Rytidosperma sp.
Polemoniaceae	**Navarretia squarrosa*
Proteaceae	*Adenanthos cygnorum*
	Adenanthos obovatus
	Banksia attenuata
	Banksia dallanneyi var. *dallanneyi*
	Banksia grandis
	Banksia ilicifolia
	Banksia littoralis
	Banksia menziesii
	Conospermum capitatum subsp. glabratum
	Hakea varia
	Persoonia saccata
	Petrophile linearis
	Stirlingia latifolia
	Synaphea spinulosa subsp. *spinulosa*
	Xylomelum occidentale
Restionaceae	*Desmocladus fasciculatus*
	Desmocladus flexuosus
	Dielsia stenostachya
	Hypolaena exsulca
	Meeboldina roycei
	Meeboldina scariosa
Rubiaceae	*Opercularia hispidula*
	Opercularia vaginata

Family	Taxa
Rutaceae	*Boronia crenulata* subsp. *viminea*
	Boronia sp.
	Philotheca spicata
Santalaceae	*Leptomeria preissiana*
Stylidiaceae	*Levenhookia stipitata*
	Stylidium brunonianum subsp. *brunonianum*
	Stylidium piliferum
	Stylidium repens
	Stylidium schoenoides
	Stylidium striatum (P4)
Thymelaeaceae	*Pimelea rosea* subsp. *rosea*
Violaceae	*Hybanthus calycinus*
Xanthorrhoeaceae	*Xanthorrhoea gracilis*
	Xanthorrhoea preissii
Zamiaceae	*Macrozamia riedlei*

APPENDIX F:

Flora Site Sheets

Orton Road Casuarina 2717

Site CAQ1

Described by BRM

Date 10/10/2010

Type Q 10x10

Season

Uniformity

Location lot 2001

MGA Zone 50 392177 **mE** 6432220 **mN**

115.855501 **E** -32.241395 **S**

Habitat swale between dunes

Soil grey sand

Rock Type

Vegetation Corymbia calophylla (Marri) open forest over Hibbertia hypericoides, Hypocalymma robustum scattered low shrubs to low open shrubland over Cyathochaeta avenacea open sedgeland and Dasypogon bromeliifolius, Kennedia prostrata very open herbland.

Veg Condition Very good- Excellent

Fire Age >10

Notes



SPECIES LIST:

Name	Cover	C Class	Height	Specimen	Notes
Bossiaea eriocarpa	1		20		
Briza maxima	+		20		
Burchardia congesta	+		60		
Caesia micrantha	+		40		
Caladenia flava subsp. flava	+		20		
Conostephium pendulum	+		35		
Corymbia calophylla	60		14		
Cyathochaeta avenacea	20		40		
Dasypogon bromeliifolius	1		30		
Desmocladus flexuosus	10		30		
Drosera erythrorhiza subsp. erythrorhiza	+		1		
Hibbertia hypericoides	2		45		
Hypocalymma robustum	1		35		
Kennedia prostrata	6		15		
Kunzea glabrescens	4		350		
Lepidosperma longitudinale	+		70		
Patersonia occidentalis var. occidentalis	+		35		
Philotheca spicata	+		40		
Pterostylis sanguinea	+		20		
Sowerbaea laxiflora	+		30		
Tricoryne elatior	+		25		
Xanthorrhoea preissii	2		130		

Orton Road Casuarina 2717

Site CAQ2

Described by BRM

Date 10/10/2018

Type Q 10x10

Season

Uniformity

Location Lot 2001

MGA Zone 50

391949 **mE** 6432200 **mN**

115.853079 **E** -32.241554 **S**

Habitat linear swale bewtween dunes

Soil grey sand

Rock Type

Vegetation Corymbia calophylla, Melaleuca preissiana woodland over Astartea scoparia high shrubland over Leucopogon australis, Xanthorrhoea preissii open shrubland over Dielsia stenostachya

Veg Condition Very Good to Excellent

Fire Age >10

Notes

SPECIES LIST:

Name	Cover	C Class	Height	Specimen	Notes
Acacia saligna	6		6		
Astartea scoparia	30		230		
Corymbia calophylla	20		1200		
Cyathochaeta avenacea	4		40		
Dielsia stenostachya	70		60		
Hardenbergia comptoniana	+		C		
Hypochaeris radicata	+		5		
Lepidosperma longitudinale	5		60		
Leucopogon australis	12		180		
Melaleuca preissiana	15		1200		
Opercularia hispidula	1		50		
Pterostylis sanguinea	+		30		
Schoenus grandiflorus	+		20		
Taxandria linearifolia	+		15		
Xanthorrhoea preissii	3		140		

Orton Road Casuarina 2717

Site CAQ5
Described by BRM
Date 16/10/2010
Type Q 10x10
Season
Uniformity
Location lot 41
MGA Zone 50 392420 **mE** 6432018 **mN**
115.858057 **E** -32.243241 **S**
Habitat gentle, west facing upper slope of low dune
Soil pale grey sand
Rock Type
Vegetation Banksia attenuata, Banksia menziesii, Allocasuarina fraseriana low woodland over Xanthorrhoea preissii open shrubland over Hibbertia hypericoides, Eremaea asterocarpa subsp. asterocarpa, Hibbertia subvaginata, Leucopogon conostephioides low open heathland over Mesomelaena pseudostygia, Desmocladus flexuosus very open sedgeland with Amphipogon turbinatus, *Ehrharta calycina scattered grasses.

Veg Condition Very Good **Fire Age** >10

SPECIES LIST:

Name	Cover	C Class	Height	Specimen	Notes
Acacia applanata	+		35		
Acacia pulchella var. glaberrima	+		130		
Allocasuarina fraseriana	2		350		
Amphipogon turbinatus	1		35		
Arnocrinum preissii	+		30		
Avena barbata	+		30		
Banksia attenuata	13		500		
Banksia menziesii	34		650		
Bossiaea eriocarpa	+		35		
Briza maxima	+		15		
Burchardia congesta	+		45		
Caladenia flava subsp. flava	+		10		
Carpobrotus edulis	+		15		
Conostephium pendulum	1		30		
Conostylis aculeata subsp. aculeata	+		25		
Conostylis setigera subsp. setigera	+		10		
Dampiera linearis	+		30		
Dasypogon bromeliifolius	+		20		
Daviesia triflora	+		45		
Desmocladus flexuosus	6		20		
Drosera menziesii subsp. penicillaris	+		40		
Ehrharta calycina	3		70		
Eremaea asterocarpa subsp. asterocarpa	1		40		
Gastrolobium capitatum	+		30		
Gladiolus caryophyllaceus	+		60		
Gompholobium tomentosum	+		35		
Hibbertia hypericoides	14		45		
Hibbertia subvaginata	+		30		
Hybanthus calycinus	+		35		
Hypochaeris glabra	+		5		
Kunzea glabrescens	+		100		
Lepidosperma sp. Coastal Dunes	+		40		
Leucopogon conostephioides	10		45		
Lomandra hermaphrodita	+		35		
Lomandra suaveolens	+		15		
Lyginia barbata	+		35		
Mesomelaena pseudostygia	+		40		
Opercularia vaginata	+		35		
Patersonia occidentalis var. occidentalis	+		30		
Persoonia saccata	+		120		
Petrophile linearis	+		30		
Philotheca spicata	+		40		
Podotheca gnaphalioides	+		12		
Sonchus oleraceus	+		5		
Sowerbaea laxiflora	+		35		
Stirlingia latifolia	3		70		
Stylidium repens	+		5		

Thysanotus manglesianus/patersonii	+	40
Thysanotus sparteus	+	120
Trachymene pilosa	+	4
Ursinia anthemoides	+	10
Xanthorrhoea preissii	7	160
Xylomelum occidentale	+	450

Orton Road Casuarina 2717

Site CAQ7

Described by BRM

Date 13/10/2010

Type Q 10x10

Season

Uniformity

Location lot 39

MGA Zone 50 392256 **mE** 6431814 **mN**

115.856293 **E** -32.245065 **S**

Habitat Gentle south west facing, lower slope of dune

Soil Pale grey sand

Rock Type

Vegetation Eucalyptus marginata subsp. marginata (Jarrah) scattered trees over Banksia attenuata, Banksia menziesii, Allocasuarina fraseriana low woodland over Kunzea glabrescens scattered tall shrubs



Veg Condition very good **Fire Age** 7-10

SPECIES LIST:

Name	Cover	C Class	Height	Specimen	Notes
Acacia huegelii	+		30		
Acacia pulchella var. glaberrima	1		90		
Allocasuarina fraseriana	1		400		
Amphipogon turbinatus	+		30		
Anigozanthos manglesii	+		60		
Austrostipa flavescens	+		15		
Banksia attenuata	23		700		
Banksia menziesii	12		500		
Bossiaea eriocarpa	+		35		
Briza maxima	+		15		
Burchardia congesta	+		60		
Caladenia flava subsp. flava	+		10		
Chamaescilla corymbosa	+		20		
Conostylis aculeata subsp. aculeata	+		20		
Desmocladus flexuosus	+		20		
Dianella revoluta var. divaricata	+		50		
Drosera pallida	+		C		
Drosera porrecta/stolonifera	+		15		
Ehrharta calycina	+		60		
Eucalyptus marginata subsp. marginata	3		500		
Gastrolobium capitatum	+		50		
Gladiolus caryophyllaceus	+		60		
Gompholobium tomentosum	+		30		
Hibbertia hypericoides	25		50		
Homalosciadium homalocarpum	+		4		
Hovea trisperma	+		10		
Hypochaeris glabra	+		1		
Kunzea glabrescens	3		500		
Lepidosperma sp. Coastal Dunes	+		30		
Leucopogon conostephioides	20		60		
Lomandra caespitosa	+		30		
Lomandra suaveolens	+		20		
Patersonia occidentalis var. occidentalis	2		40		
Petrophile linearis	+		30		
Podotheca angustifolia	+		3		
Podotheca chrysantha	+		15		
Poranthera sp.	+		3		
Pyrorchis nigricans	+		2		
Siloxerus filifolius	+		2		
Sowerbaea laxiflora	+		45		
Stirlingia latifolia	5		100		
Stylidium repens	+		3		

Stylidium saxifragoides	+	20
Synaphea spinulosa subsp. spinulosa	+	20
Trachymene pilosa	+	3
Ursinia anthemoides	+	12

Orton Road Casuarina 2717

Site CAQ9
Described by BRM
Date 14/10/2010
Type Q 10x10
Season
Uniformity
Location lot 38
MGA Zone 50
392789 **mE** 6431777 **mN**
115.861946 **E** -32.245450 **S**
Habitat swale between dunes
Soil grey sand
Rock Type
Vegetation Eucalyptus marginata subsp. marginata scattered trees (not in quadrat) over Banksia attenuata, Banksia menziesii, Allocasuarina fraseriana, Banksia ilicifolia low woodland over Xanthorrhoea preissii scattered shrubs over Hibbertia hypericoides, Conostephium pendulum low open heath over Desmocladus flexuosus, (Lepidosperma squamatum complex) open sedgeland with Dasypogon bromeliifolius very open herbland.
Veg Condition Very good - excellent
Fire Age >10
Notes
SPECIES LIST:

Name	Cover	C Class	Height	Specimen	Notes
Allocasuarina fraseriana	5		800		
Austrostipa flavescens	+		15		
Banksia attenuata	35		700		
Banksia ilicifolia	6		600		
Banksia menziesii	3		700		
Bossiaea eriocarpa	+		30		
Briza maxima	+		20		
Burchardia congesta	+		40		
Caesia micrantha	+		40		
Caladenia flava subsp. flava	+		15		
Chamaescilla corymbosa	+		15		
Conostephium pendulum	5		50		
Conostylis aculeata subsp. aculeata	+		15		
Dampiera linearis	+		10		
Dasypogon bromeliifolius	4		40		
Desmocladus flexuosus	17		20		
Dianella revoluta var. divaricata	+		60		
Drosera erythrorhiza subsp. erythrorhiza	+		1		
Drosera menziesii subsp. penicillaris	+		35		
Drosera porrecta/stolonifera	+		30		
Ehrharta calycina	+		40		
Ehrharta longiflora	+		20		
Eremaea pauciflora var. pauciflora	1		150		
Gompholobium tomentosum	+		50		
Hibbertia hypericoides	26		45		
Hibbertia racemosa	+		20		
Hovea trisperma	+		30		
Hypocalymma sp.	+		40		
Hypochaeris glabra	+		1		
Kunzea glabrescens	+		180		
Lepidosperma sp. Coastal Dunes	+		30		
Lepidosperma squamatum complex	1		70		
Leporella fimbriata	+		4		
Leucopogon conostephioides	+		30		
Lomandra hermaphrodita	+		20		
Lomandra preissii	+		40		
Lyginia barbata	+		40		
Macrozamia riedlei	1		140		
Patersonia occidentalis var. occidentalis	+		30		
Phlebocarya ciliata	+		30		
Platysace filiformis	+		30		
Poranthera microphylla	+		4		
Pterostylis sanguinea	+		25		

Sowerbaea laxiflora	+	35
Thysanotus manglesianus/patersonii	+	40
Tricoryne elatior	+	40
Xanthorrhoea preissii	6	120

Orton Road Casuarina 2717

Site CAQ14

Described by BRM

Date 24/10/2010

Type Q 10x10

Season

Uniformity

Location lot 36

MGA Zone 50

392910 **mE** 6431994 **mN**

115.863255 **E** -32.243504 **S**

Habitat crest of low dune

Soil pale grey sand over yellow sand

Rock Type



Vegetation Eucalyptus marginata subsp. marginata (Jarrah) scattered trees over Banksia menziesii, Banksia attenuata, Allocasuarina fraseriana, Xylomelum occidentale (Woody Pear) low woodland over Hibbertia hypericoides low open heath over Mesomelaena pseudostygia, Lepidosperma squamatum complex very open sedgeland.

Veg Condition Very Good **Fire Age**7- 10

SPECIES LIST:

Name	Cover	C Class	Height	Specimen	Notes
Allocasuarina fraseriana	8		600		
Amphipogon turbinatus	+		35		
Astroloma pallidum	+		10		
Austrostipa flavescens	+		20		
Banksia attenuata	5		600		
Banksia menziesii	9		400		
Briza maxima	+		20		
Burchardia congesta	+		30		
Caesia micrantha	+		50		
Calectasia narragara	+		35		
Calytrix flavescens	+		20		
Centrolepis drummondiana	+		3		
Chamaescilla corymbosa	+		10		
Conostephium pendulum	+		25		
Conostylis setigera subsp. setigera	+		10		
Crassula colorata var. acuminata	+		3		
Dasypogon bromeliifolius	+		30		
Desmocladus flexuosus	+		12		
Drosera erythrorhiza subsp. erythrorhiza	+		1		
Drosera menziesii subsp. penicillaris	+		25		
Drosera paleacea	+		1		
Drosera porrecta	+		12		
Eucalyptus marginata subsp. marginata	5		500		
Gladiolus caryophyllaceus	+		20		
Hibbertia hypericoides	35		50		
Hovea trisperma	+		40		
Hypocalymma angustifolium	+		60		
Hypochaeris glabra	+		3		
Jacksonia sternbergiana	+		140		
Laxmannia squarrosa	+		6		
Lepidosperma squamatum complex	+		50		
Lomandra caespitosa	+		20		
Lomandra hermaphrodita	+		15		
Lomandra nigricans	+		30		
Lomandra suaveolens	+		15		
Macrozamia riedlei	+		100		
Mesomelaena pseudostygia	2		45		
Patersonia occidentalis var. occidentalis	+		30		
Petrophile linearis	+		30		

Orton Road Casuarina 2717	**Site**	CAQ14
Podotheca angustifolia	+	4
Podotheca chrysantha	+	15
Poranthera microphylla	+	2
Pyrorchis nigricans	+	5
Schoenus grandiflorus	+	10
Stirlingia latifolia	+	50
Stylidium repens var. repens	+	5
Stylidium saxifragoides	+	30
Stylidium schoenoides	+	20
Stylidium striatum	+	20
Thysanotus manglesianus/patersonii	+	40
Thysanotus sparteus	+	50
Trachymene pilosa	+	6
Xanthosia huegelii	+	10
Xylomelum occidentale	1	110

Orton Road Casuarina 2717

Site CAQ18

Described by BRM

Date 30/10/2010

Type Q

Season

Uniformity

Location lot 2001

MGA Zone 50 391963 **mE** 6431856 **mN**
115.853188 **E** -32.244658 **S**

Habitat flat damplands adjacent to inundated wetland

Soil balck peaty clay loam

Rock Type

Vegetation Eucalyptus rudis subsp. rudis open forest over Astartea scoparia scattered shrubs over Baumea vaginalis, Baumea preissii subsp. laxa closed sedgeland.

Veg Condition excellent

Fire Age

Notes

SPECIES LIST:

Name	Cover	C Class	Height	Specimen	Notes
Astartea scoparia	5		180		
Baumea preissii subsp. laxa	5		120		
Baumea vaginalis	80		150		
Cassytha racemosa forma racemosa	+		T		
Centella asiatica	+		10		
Eucalyptus rudis subsp. rudis	35		1600		
Holcus lanatus	+		35		
Lepidosperma longitudinale	2		150		
Lobelia anceps	+		20		
Lotus uliginosus	+		20		
Taxandria linearifolia	2		400		

Orton Road Casuarina 2717

Site CAQ21

Described by BRM

Date 2/11/2010

Type Q 10x10

Season

Uniformity

Location lot 2001

MGA Zone 50

392041 **mE** 6431835 **mN**

115.854014 **E** -32.244855 **S**

Habitat dampland on edge of open water on plain

Soil Balck peat

Rock Type



Vegetation Eucalyptus rudis subsp. rudis open forest over Melaleuca preissiana, Melaleuca rhaphiophylla open woodland over Taxandria linearifolia scattered tall shrubs over Cyathochaeta teretifolia high closed sedgeland with Pteridium esculentum (Bracken) high fernland.

Veg Condition Excellent

Fire Age >10

Notes

SPECIES LIST:

Name	Cover	C Class	Height	Specimen	Notes
Baumea preissii subsp. laxa	+		90		
Cassytha racemosa forma racemosa	+		160		
Cyathochaeta teretifolia	70		220		
Eucalyptus rudis subsp. rudis	20		1700		
Gastrolobium ebracteolatum	1		350		
Homalospermum firmum	+		300		
Isolepis cyperoides	+		12		
Meeboldina roycei	+		110		
Meeboldina scariosa	+		110		
Meeboldina scariosa	+		80		
Melaleuca preissiana	25		1400		
Melaleuca rhaphiophylla	10		900		
Pteridium esculentum	40		220		
Schoenus grandiflorus	+		30		
Symphyotrichum squamatum	+		30		
Taxandria linearifolia	2		300		
Tetraria sp. Chandala	6		70		
Triglochin huegelii	+		20		

Orton Road Casuarina 2717

Site CAR1
Described by BRM
Date 10/10/2018
Type R
Season
Uniformity
Location
MGA Zone 50
392187 **mE** 6431885 **mN**
115.855569 **E** -32.244418 **S**
Habitat moderate, South-facing midslope of low ridge (dune).
Soil grey sand.
Rock Type
Vegetation Eucalyptus marginata woodland (lot of regrowth) over Allocasuarina fraseriana, Banksia attenuata, Banksia menziesii low open woodland over Kunzea glabrescens scattered tall shrubs to high open shrubland (high shrubland in parts) over Xanthorrhoea preissii open shrubland over Hibbertia hypericoides scattered low shrubs to low open shrubland over *Ehrharta calycina scattered grasses to very open tussock grassland and Desmocladus flexuosus scattered sedges with Dasypogon bromeliifolius very open herbland.
Veg Condition good
Fire Age 6-8
Notes
SPECIES LIST:

Name	Cover	C Class	Height	Specimen	Notes
Allocasuarina fraseriana					
Banksia attenuata					
Banksia menziesii					
Conostylis aculeata subsp. aculeata					
Dasypogon bromeliifolius					
Desmocladus flexuosus					
Ehrharta calycina					
Eucalyptus marginata					
Gladiolus caryophyllaceus					
Hardenbergia comptoniana					
Hibbertia hypericoides					
Kunzea glabrescens					
Lepidosperma squamatum					
Leucopogon conostephioides					
Lyginia imberbis					
Phlebocarya ciliata					
Pterostylis sanguinea					
Sowerbaea laxiflora					
Thysanotus manglesianus					
Xanthorrhoea preissii					

Orton Road Casuarina 2717

Site CAR2

Described by BRM

Date 10/10/2018 **Type** R

Season

Uniformity

Location lot 2001

MGA Zone 50

392191 **mE** 6432026 **mN**

115.855627 **E** -32.243147 **S**

Habitat Swale between dunes and adjacent lower dune slopes

Soil Pale grey sand.

Rock Type

Vegetation Banksia ilicifolia, Banksia attenuata, Banksia menziesii low woodland over Kunzea glabrescens, Jacksonia furcellata, Adenanthos cygnorum high open shrubland over Xanthorrhoea preissii open shrubland over Scholtzia involucrata scattered low shrubs over *Ehrharta calycina open tussock grassland with Dasypogon bromeliifolius very open herbland

Veg Condition Good to Degraded

Fire Age 6-8

Notes

SPECIES LIST:

Name	Cover	C Class	Height	Specimen	Notes
Adenanthos cygnorum					
Banksia attenuata					
Banksia ilicifolia					
Banksia menziesii					
Conostephium pendulum					
Dampiera linearis					
Dasypogon bromeliifolius					
Desmocladus flexuosus					
Ehrharta calycina					
Gastrolobium capitatum					
Jacksonia furcellata					
Kunzea glabrescens					
Laxmannia squarrosa					
Lyginia barbata					
Scholtzia involucrata					
Xanthorrhoea preissii					

Orton Road Casuarina 2717

Site CAR4
Described by BRM
Date 10/10/2018 **Type** R
Season
Uniformity
Location lot 2001
MGA Zone 50
392020 **mE** 6432212 **mN**
115.853834 **E** -32.241453 **S**
Habitat Swale between dunes
Soil Grey sand.
Rock Type
Vegetation Melaleuca preissiana, (Corymbia calophylla (Marri), Eucalyptus marginata subsp. marginata, (Jarrah)) woodland over Kunzea glabrescens high open shrubland to high shrubland over Dielsia stenostachya, Lepidosperma squamatum sedgeland with Dasypogon bromeliifolius open
Veg Condition Very Good
Fire Age >10
Notes
SPECIES LIST:

Name	Cover	C Class	Height	Specimen	Notes
Corymbia calophylla					
Dasypogon bromeliifolius					
Dielsia stenostachya					
Eucalyptus marginata subsp. marginata					
Jacksonia furcellata					
Kunzea glabrescens					
Lepidosperma squamatum					
Melaleuca preissiana					
Opercularia hispidula					
Xanthorrhoea preissii					

Orton Road Casuarina 2717

Site CAR5
Described by BRM
Date 10/10/2010
Type R
Season
Uniformity
Location lot 2001
MGA Zone 50
391943 **mE** 6432169 **mN**
115.853012 **E** -32.241833 **S**
Habitat Lower slopes of dune
Soil Grey sand
Rock Type
Vegetation Corymbia calophylla (Marri) woodland over Banksia menziesii (on edges) scattered low trees over Kunzea glabrescens high open shrubland to high shrubland over Xanthorrhoea preissii open shrubland over Hibbertia hypericoides scattered low shrubs over Dielsia stenostachya, Lepidosperma squamatum complex open sedgeland with Dasypogon bromeliifolius open
Veg Condition Very Good
Fire Age >7
Notes
SPECIES LIST:

Name	Cover	C Class	Height	Specimen	Notes
Banksia menziesii					
Boronia crenulata subsp. viminea					
Burchardia congesta					
Corymbia calophylla					
Dasypogon bromeliifolius					
Dielsia stenostachya					
Hardenbergia comptoniana					
Hibbertia hypericoides					
Kunzea glabrescens					
Lepidosperma squamatum					
Opercularia hispidula					
Philotheca spicata					
Phlebocarya ciliata					
Xanthorrhoea preissii					

Orton Road Casuarina 2717

Site CAR11

Described by BRM

Date 12/10/2018

Type R

Season

Uniformity

Location lot 44

MGA Zone 50

392293 **mE** 6432280 **mN**

115.856739 **E** -32.240865 **S**

Habitat Slightly lower area on plain

Soil Grey sand.

Rock Type

Vegetation Corymbia calophylla (Marri) scattered trees (around edges) over Kunzea glabrescens scattered tall shrubs to high shrubland over Acacia pulchella var. glaberrima, Xanthorrhoea preissii scattered shrubs over Pericalymma ellipticum shrubland over Hypocalymma angustifolium, Eutaxia virgata low closed heath over Schoenus efoliatus, Cyathochaeta avenacea open.

Veg Condition Excellent

Fire Age >5

Notes

SPECIES LIST:

Name	Cover	C Class	Height	Specimen	Notes
Acacia pulchella var. glaberrima					
Corymbia calophylla					
Cyathochaeta avenacea					
Daviesia incrassata subsp. incrassata					
Eutaxia virgata					
Hypocalymma angustifolium					
Kunzea glabrescens					
Pericalymma ellipticum					
Schoenus efoliatus					
Xanthorrhoea preissii					

Orton Road Casuarina 2717

Site CAR12

Described by BRM

Date 13/10/2010

Type R

Season

Uniformity

Location lot 41

MGA Zone 50

392308 **mE** 6432003 **mN**

115.856866 **E** -32.243365 **S**

Habitat Swale between low rises

Soil Grey sand

Rock Type

Vegetation Corymbia calophylla (Marri) woodland over Allocasuarina fraseriana scattered low trees over Kunzea glabrescens scattered tall shrubs to high shrubland over Xanthorrhoea preissii open shrubland over Philotheca spicata, Conostephium pendulum scattered low shrubs over Lepidosperma squamatum scattered sedges with Dasypogon bromeliifolius, Phlebocarya ciliata open herbland.

Veg Condition Very Good to Excellent

Fire Age >10

Notes

SPECIES LIST:

Name	Cover	C Class	Height	Specimen	Notes
Allocasuarina fraseriana					
Conostephium pendulum					
Corymbia calophylla					
Dasypogon bromeliifolius					
Gompholobium confertum					
Kennedia prostrata					
Kunzea glabrescens					
Lepidosperma squamatum					
Leucopogon australis					
Leucopogon conostephioides					
Philotheca spicata					
Phlebocarya ciliata					
Xanthorrhoea preissii					

Orton Road Casuarina 2717

Site CAR19

Described by BRM

Date 22/10/2010

Type R 10x10

Season

Uniformity

Location

MGA Zone 50

392732 **mE** 6431997 **mN**

115.861366 **E** -32.243460 **S**

Habitat gentle, north facing, mid to upper slope of low dune

Soil Pale grey sand over yellow sand

Rock Type

Vegetation Eucalyptus marginata subsp. marginata (Jarrah) scattered trees over Banksia attenuata, Banksia menziesii, Allocasuarina fraseriana, (Xylomelum occidentale (woody pear)) low woodland over Kunzea glabrescens scattered tall shrubs over Hibbertia hypericoides, Bossiaea eriocarpa, Conostephium pendulum low shrubland to low open heath over Mesomelaena pseudostygia very open sedgeland.

Veg Condition Good

Fire Age 5-7

Notes widespread Banksia death

SPECIES LIST:

Name	Cover	C Class	Height	Specimen	Notes
Allocasuarina fraseriana					
Amphipogon turbinatus					
Banksia attenuata					
Banksia menziesii					
Bossiaea eriocarpa					
Calytrix flavescens					
Conostephium pendulum					
Conostylis aculeata subsp. aculeata					
Conostylis setigera subsp. setigera					
Eucalyptus marginata subsp. marginata					
Gompholobium tomentosum					
Hibbertia hypericoides					
Kunzea glabrescens					
Lomandra suaveolens					
Mesomelaena pseudostygia					
Schoenus curvifolius					
Stirlingia latifolia					
Stylidium striatum					
Thysanotus manglesianus/patersonii					
Xylomelum occidentale					

Orton Road Casuarina 2717

Site CAR21
Described by BRM
Date 22/10/2010
Type R 10x10
Season
Uniformity
Location Lot 35
MGA Zone 50
393036 **mE** 6432092 **mN**
115.864603 **E** -32.242632 **S**
Habitat Swale between dunes
Soil
Rock Type
Vegetation Banksia attenuata, Banksia menziesii, Banksia ilicifolia, Allocasuarina fraseriana low woodland over Kunzea glabrescens, Jacksonia sternbergiana scattered tall shrubs over Melaleuca thymoides, Xanthorrhoea preissii scattered shrubs over Leucopogon conostephioides, Conostephium pendulum, Bossiaea eriocarpa low open heath over Desmocladus flexuosus, Lyginia imberbis very open sedgeland with Phlebocarya ciliata, Dasypogon bromeliifolius very
Veg Condition Good
Fire Age >10
Notes A lot of Banksia death, low weed cover
SPECIES LIST:

Name	Cover	C Class	Height	Specimen	Notes
Allocasuarina fraseriana					
Banksia attenuata					
Banksia ilicifolia					
Banksia menziesii					
Bossiaea eriocarpa					
Briza maxima					
Burchardia congesta					
Chamaescilla corymbosa					
Conostephium pendulum					
Conostylis aculeata subsp. aculeata					
Dasypogon bromeliifolius					
Desmocladus flexuosus					
Drosera erythrorhiza subsp. erythrorhiza					
Gompholobium tomentosum					
Hypolaena exsulca					
Jacksonia sternbergiana					
Kunzea glabrescens					
Leucopogon conostephioides					
Lyginia imberbis					
Macarthuria australis					
Melaleuca thymoides					
Petrophile linearis					
Phlebocarya ciliata					
Scholtzia involucrata					
Stirlingia latifolia					
Xanthorrhoea preissii					

Orton Road Casuarina 2717

Site CAR27

Described by

Date 2/11/2010

Type R 10x10

Season

Uniformity

Location lot 2001

MGA Zone 50

391961 **mE** 6431846 **mN**

115.853166 **E** -32.244748 **S**

Habitat Wetland on Braod, very gently undulating plain.

Soil

Rock Type

Vegetation Eucalyptus rudis subsp. rudis woodland over Melaleuca rhaphiophylla, Melaleuca preissiana low woodland over Astartea scoparia open shrubland over Lepidosperma sp., Baumea vaginalis sedgeland with Myriophyllum tillaeoides open herbland.



Veg Condition Excellent

Fire Age 7-10

Notes

SPECIES LIST:

Name	Cover	C Class	Height	Specimen	Notes
Astartea scoparia					
Baumea vaginalis					
Eucalyptus rudis subsp. rudis					
Gratiola pubescens					
Lepidosperma sp.					
Lobelia anceps					
Melaleuca preissiana					
Melaleuca rhaphiophylla					
Myriophyllum tillaeoides					

Orton Road Casuarina 2717

Site CAR29

Described by BRM

Date 2/11/2010

Type R 10x10

Season

Uniformity

Location Lot2001

MGA Zone 50

392036 **mE** 6431763 **mN**

115.853953 **E** -32.245504 **S**

Habitat Banks of inundated depressionon Plain (wetland)

Soil

Rock Type

Vegetation Eucalyptus rudis subsp. rudis scattered trees to open woodland over Melaleuca preissiana low woodland to low open forest over Taxandria linearifolia high open shrubland over Cyathochaeta teretifolia tall sedgeland.

Veg Condition Excellent

Fire Age >10

Notes Very low weed cover, all elements of structure present

SPECIES LIST:

Name	Cover	C Class	Height	Specimen	Notes
Baumea vaginalis					
Cyathochaeta teretifolia					
Eucalyptus rudis subsp. rudis					
Melaleuca preissiana					
Melaleuca rhaphiophylla					
Melaleuca teretifolia					
Pteridium esculentum					
Taxandria linearifolia					
Triglochin huegelii					

Orton Road Casuarina 2717

Site opportunis

SPECIES LIST

Name	Notes
Adenanthos obovatus	
Allocasuarina fraseriana	
Banksia ilicifolia	
Carpobrotus edulis	
Chamelaucium uncinatum	
Conospermum capitatum	
Conostephium pendulum	
Ehrharta calycina	
Eucalyptus microcorys	
Hakea varia	
Jacksonia gracillima	392204 6432489, 392203 6432470, 392200 6432454, 3920241 6432397
Lyginia barbata	
Macrozamia riedlei	
Nuytsia floribunda	
Pinus sp.	
Pteridium esculentum	
Xylomelum angustifolium	

Casuarina Lvl 2

Site CAQ1

Described by AMB

Date 16/11/2016

Type Q

Season

Location

MGA Zone 50

392836 **mE** 6431994 **mN**

115.862469 **E** -32.243497 **S**

Habitat

Soil Yellow/Grey sand

Rock Type



Vegetation Banksia attenuata, Banksia menziesii and Xylomelum occidentale low woodland over Hibbertia hypericoides and Conostephium pendulum low shrubland over Conostylis setigera subsp. setigera, Mesomelaena pseudostygia, Desmocladus flexuosus, Lomandra suaveolens and Rytidosperma occidentale open grassland.

Veg Condition Excellent

Fire Age 8-12

Notes Disturbance: Weeds

SPECIES LIST:

Name	Cover	C Class	Height	Specimen	Notes
Allocasuarina fraseriana	+		50		
Astroloma sp.	+		30	CAQ1-15	Andersonia sp
Austrodanthonia sp.	1		40		
Banksia attenuata	2		5		
Banksia menziesii	10		4		
Briza maxima	3		30		
Burchardia congesta	+		40		
Conostephium pendulum	2		50	CAQ1-8	Leuco ? Nutens
Conostylis aculeata	1		20		
Conostylis setigera subsp. setigera	1		20	CAQ1-1	Cono set
Desmocladus flexuosus	1		20	CASQ1-10	Desmo flex
Dianella revoluta	+		50		
Disa bracteata	+		20	CAQ1-7	Microtis
Drosera stolonifera	+		20	CAQ1-13	Drosera robust
Ehrharta calycina	+		50		
Gladiolus caryophyllaceus	+		50		
Gompholobium tomentosum	+		30		
Hibbertia hypericoides	10		50		
Hypocalymma robustum	+		50		
Kunzea glabrescens	1		100		
Lagenifera huegelii	+		10		
Laxmannia grandiflora	+		20		
Lepidosperma calcicola	+		30	CAQ1-6	lepido (Lepidosperma ?calcicola)
Levenhookia stipitata	+		10	CAQ1-16	
Lobelia tenuior subsp. dictyosperma	+		20	CAQ1-9	Lobelia
Lomandra caespitosa	+		30	CAR1-4	Loman blue
Lomandra hermaphrodita	+		30	CAQ1-5	Loman herm
Lomandra preissii	+		30	CAQ1-12	Lomandra spike
Lomandra suaveolens	1		30	CAQ1-11	Loman caesp
Mesomelaena pseudostygia	1		30		
Patersonia occidentalis	1		40		
Petrophile linearis	+		50		
Phyllangium paradoxum	+		10		
Podotheca gnaphalioides	+		30	CAQ1-14	Podolepis
Romulea rosea	+		20		
Rytidosperma occidentale	2		50	CAR1-3	Austrostipa
Stirlingia latifolia	+		50		
Stylidium brunonianum	+		30		
Stylidium piliferum	+		40	CAQ1-2	Stylidium ? Pilif
Stylidium repens	+		CR		

Trachymene pilosa	+	10
Tricoryne elatior	+	30
Ursinia anthemoides	1	30
Xylomelum occidentale	5	5

Casuarina Lvl 2

Site CAQ2

Described by AD
Date 17/11/2016
Type Q 10 x 10 m
Location Lot A
MGA Zone 50 392954**mE** 6431991**mN**
Habitat Plain, flat



Vegetation *Banksia menziesii, Banksia attenuata, Allocasuarina fraseriana* and *Xylomelum occidentale* low woodland over *Hibbertia hypericoides* low shrubland over Desmocladus flexuosus and Mesomelaena pseudostygia grassland.

Veg Condition Excellent to Very Good

Fire Age > 12 yrs

Notes Disturbance: Weeds

SPECIES LIST:

Name	Cover	C Class	Height	Specimen	Notes
Allocasuarina fraseriana	5		500		
Amphipogon turbinatus	1		50	CAQ2-4	Amphipogon ? Turb
Austrostipa compressa	+		40	CAQ1-3	Austrostipa
Banksia attenuata	5		300		
Banksia menziesii	10		500		
Bossiaea eriocarpa	+		15	CAQ2-3	Sterile bossiaea
Briza maxima	+		20		
Burchardia congesta	+		40		
Conostephium pendulum	1		30	CAQ1-8	Leucopogon ? Nu
Conostylis aculeata	+		20		
Conostylis setigera subsp. setigera	1		15	CAQ2-1	Cono white hair
Dasypogon bromeliifolius	+		40		
Desmocladus flexuosus	2		40	CAQ2-2	Tall Desmo
Desmocladus flexuosus	1		15	CAQ1-10	Desmo
Dianella revoluta	+		40		
Ehrharta calycina	+		60		
Gladiolus caryophyllaceus	+		50		
Hibbertia hypericoides	30		30		
Hyalosperma simplex	+		15		Yellow aster
Hypocalymma angustifolium	1		30		
Kunzea glabrescens	1		200		
Laxmannia sp.	+		10		
Lepidosperma calcicola	1		40	CAQ1-6	Lepidosperma (Lepidosperma ?calcicola)
Lobelia tenuior subsp. dictyosperma	+		15	CAQ1-	Lobelia
Lomandra hermaphrodita	+		20	CAQ1-5	Lomandra ? Herm
Macrozamia riedlei	2		100		
Mesomelaena pseudostygia	2		40		
Patersonia occidentalis	+		40		
Persoonia saccata				CAQ20PAD-	Persoonia sp.
Podotheca gnaphalioides	+		20	CAQ1-4	Lomandra blue
Podotheca gnaphalioides	+		20	CAQ1-4	Podolepis
Stirlingia latifolia	+		50		
Stylidium brunonianum	+		20		
Trachymene pilosa	+		10		
Ursinia anthemoides	+		20		

Xanthorrhoea preissii	1	100		
Xanthosia huegelii	1	15	CAQ2-5	Small white hair
Xylomelum occidentale	5	400		

Casuarina Lvl 2

Site CBR1
Described by AMB
Date 17/11/2016
Type R
Season
Uniformity
Location Lot C
MGA Zone 50
392940 **mE** 6431900 **mN**
115.863562 **E** -32.244355 **S**
Habitat
Soil Grey/white
Rock Type
Vegetation Adenanthos cygnorum and Kunzea glabrescens tall shrubland over Erhrarta calycina, Conostylis aculeata and Dasypogon bromeliifolius grassland
Veg Condition Degraded
Fire Age 1-4
Notes Disturbance: Weeds, fire
2 % Leaf Litter Cover, 20 % Cover Bare Ground, 1 % Cover twigs, 1 % Cover Logs

SPECIES LIST:

Name	Cover	C Class	Height	Specimen	Notes
Adenanthos cygnorum					
Allocasuarina fraseriana					
Amphipogon turbinatus				CBR1-2	
Austrostipa compressa				CBR1-3	
Banksia attenuata					
Banksia ilicifolia					
Bossiaea eriocarpa					
Briza maxima					
Bromus diandrus					
Calytrix fraseri				CBR1-4	
Carpobrotus aequilaterus					
Conostylis aculeata					
Dasypogon bromeliifolius					
Ehrharta calycina					
Hemiandra pungens				CBR1-1	Hemiandra
Kunzea glabrescens					
Laxmannia grandiflora					
Patersonia occidentalis					
Pericalymma ellipticum					
Stirlingia latifolia					
Stylidium brunonianum					
Xylomelum occidentale					

Casuarina Lvl 2

Site CCR2

Described by AD

Date 16/11/2016

Type R

Season

Uniformity

Location

MGA Zone 50

392719 **mE** 6431756 **mN**

115.861201 **E** -32.245633 **S**

Habitat

Soil Grey sand

Rock Type

Vegetation Banksia menziesii and Banksia attenuata low open woodland over Xanthorrhoea preissii, Kunzea glabrescens and Adenanthos cygnorum shrubland over *Ehrharta calycina grassland

Veg Condition Good - Degraded

Fire Age

Notes

SPECIES LIST:

Name	Cover	C Class	Height	Specimen	Notes
Adenanthos cygnorum					
Banksia attenuata					
Banksia menziesii					
Boronia crenulata				CLQ4-3	
Briza maxima					
Carpobrotus edulis					
Ehrharta calycina					
Eucalyptus marginata					
Gladiolus caryophyllaceus					
Kennedia prostrata					
Kunzea glabrescens					
Macrozamia riedlei					
Xanthorrhoea preissii					

Casuarina Lvl 2

Site CCR3

Described by AMB

Date 16/11/2016

Type R

Season

Uniformity

Location Lot E

MGA Zone 50

392300 **mE** 6431941 **mN**

115.856775 **E** -32.243924 **S**

Habitat Slope

Soil Grey sand

Rock Type

Vegetation Corymbia calophylla scattered trees over Banksia attenuata and Banksia menziesii low woodland over weeds

Veg Condition Degraded

Fire Age 1-4

Notes Disturbance: weeds
<1% Cover Leaf Litter, 2 % Cover Bare Ground, <1 % Cover Twigs, 1 % Cover Logs

SPECIES LIST:

Name	Cover	C Class	Height	Specimen	Notes
Adenanthos cygnorum					
Allocasuarina fraseriana					
Banksia attenuata					
Banksia menziesii					
Conostylis aculeata					
Corymbia calophylla					
Dasypogon bromeliifolius					
Ehrharta calycina					
Jacksonia furcellata					
Jacksonia sternbergiana					
Kennedia prostrata					
Kunzea glabrescens					
Lobelia tenuior subsp. dictyosperma				CAQ1-9	
Macrozamia riedlei					
Mesomelaena stygia					
Patersonia occidentalis					
Stirlingia latifolia					
Ursinia anthemoides					

Casuarina Lvl 2

Site CFR3

Described by AMB

Date 16/11/2016

Type R

Season

Uniformity

Location Lot F

MGA Zone 50

392303 **mE** 6432000 **mN**

115.856813 **E** -32.243392 **S**

Habitat

Soil Sandy loam

Rock Type

Vegetation Allocasuarina fraseriana and Corymbia calophylla woodland over Banksia littoralis open woodland over Kunzea glabrescens and Xanthorrhoea preissii shrubland over Phlebocarya

Veg Condition Excellent to Very Good

Fire Age 8-12

Notes 40 % Cover Leaf Litter, 0 % Cover Bare Ground, 10 % Cover Twigs, 1 % Cover Logs

SPECIES LIST:

Name	Cover	C Class	Height	Specimen	Notes
Allocasuarina fraseriana	2		1500		
Banksia littoralis	10		800		
Corymbia calophylla	15		2500		
Daviesia physodes				CRR3-1	
Gompholobium tomentosum	+		40		
Hovea trisperma	+		CR	CFR3-3	Gastro balls
Kennedia prostrata	5		CR		
Kunzea glabrescens	10		200		
Leucopogon australis	1		50	CFR3-2	
Phlebocarya ciliata	30		30		
Tricoryne elatior	+		40		
Xanthorrhoea gracilis	5		50		
Xanthorrhoea preissii	15		100-200		

Casuarina Lvl 2

Site CFR4

Described by AD

Date 16/11/2016

Type

Season

Uniformity

Location Lot F

MGA Zone 50

392370 **mE** 6431992 **mN**

115.857523 **E**

-32.243470 **S**

Habitat Flat

Soil Grey sand

Rock Type



Vegetation Banksia menziesii and Banksia attenuata low woodland over Kunzea glabresecens and Xanthorrhoea preissii shrubland to tall shrubland over Mesomelaena psuedostygia grassland

Veg Condition Very Good - Good

Fire Age

Notes

SPECIES LIST:

Name	Cover	C Class	Height	Specimen	Notes
Acacia lasiocarpa					
Banksia attenuata	20		400		
Banksia ilicifolia					
Banksia menziesii	20		400		
Briza maxima	1		15		
Burchardia congesta	+		30		
Carpobrotus edulis	1		C		
Conostephium pendulum	2		40	CAQ1-8	Leucopogon ? Nutens
Conostylis aculeata	+		30		
Dampiera linearis	+		20	CFR4-1	? Scaevola
Dasypogon bromeliifolius	1		40		
Desmocladus flexuosus	+			CAQ1-10	Desmocladus flex
Dianella revoluta	+		50		
Ehrharta calycina	+		50		
Gompholobium tomentosum	1		40		
Kunzea glabrescens	40		200		
Laxmannia grandiflora	+		20		
Macarthuria australis	+		20	CFR4-2	Small yellow ball
Macrozamia riedlei	1		100		
Mesomelaena pseudostygia	2		40		
Patersonia occidentalis	+		40		
Petrophile linearis	+		40		
Podotheca gnaphalioides	+		20	CAQ1-4	Lomandra blue
Stirlingia latifolia					
Tricoryne elatior	3		20		
Ursinia anthemoides	+		30		
Xanthorrhoea preissii	2		150		

Casuarina Lvl 2 **Site** CGR5

Described by AMB **Date** 16/11/2016 **Type** R

Season **Uniformity**

Location Site G?

MGA Zone 50 392326 **mE** 6432087 **mN** 115.857067 **E** -32.242609 **S**

Habitat

Soil Grey sand

Rock Type

Vegetation Isolated trees over weeds

Veg Condition Degraded - Completely Degraded

Fire Age 8-12

Notes <1% Cover Leaf Litter, 5% Cover Bare Ground, 0% Cover Twigs, 0% Cover Logs

SPECIES LIST:

Name	Cover	C Class	Height	Specimen	Notes
Banksia attenuata					
Banksia ilicifolia					
Banksia menziesii					
Briza maxima					
Carpobrotus edulis					
Ehrharta calycina					
Eucalyptus todtiana					
Kunzea glabrescens					
Ursinia anthemoides					
Xanthorrhoea preissii					

Casuarina Lvl 2 **Site** CGR6

Described by AD **Date** 16/11/2016 **Type** R

Season **Uniformity**

Location Lot H

MGA Zone 50 392293 **mE** 6432174 **mN** 115.856727 **E** -32.241822 **S**

Habitat

Soil

Rock Type

Vegetation Corymbia calophylla open woodland over Kunzea glabrescens and Xanthorrhoea preissii shrubland over Phlebocarya ciliata herbland

Veg Condition Good

Fire Age

Notes Lots of Red tail Cockatoos

SPECIES LIST:

Name	Cover	C Class	Height	Specimen	Notes
Acacia stenoptera				CHRG-1	Acacia alata
Banksia ilicifolia					
Briza maxima					
Corymbia calophylla					
Dasypogon bromeliifolius					
Daviesia physodes					
Gladiolus caryophyllaceus					
Gompholobium tomentosum					
Hibbertia racemosa				CHR6-2	Hibertia racemosa
Hypocalymma robustum					
Kennedia prostrata					
Kunzea glabrescens					
Lepidosperma squamatum				CHR6-4	Lepidosperma
Melaleuca preissiana					
Microtis media				CHR6-3	Leels orchid
Phlebocarya ciliata					
Xanthorrhoea gracilis					
Xanthorrhoea preissii					
Zantedeschia aethiopica					

Casuarina Lvl 2 **Site** CIR7

Described by AMB **Date** 16/11/2016 **Type** R

Season **Uniformity**

Location Lot I

MGA Zone 50 392304 **mE** 6432277 **mN** 115.856855 **E** -32.240894 **S**

Habitat

Soil Sandy loam

Rock Type

Vegetation Corymbia calophylla woodland over Kunzea glabrescens and Xanthorrhoea preissii shrubland over Hypocalymma angustifolium and Hypocalymma robustum low open shrubland

Veg Condition VG

Fire Age

Notes 10% Cover Leaf Litter, 0% Cover Bare Ground, 5% Cover Twigs, 0% Cover Logs

SPECIES LIST:

Name	Cover	C Class	Height	Specimen	Notes
Allocasuarina fraseriana					
Banksia attenuata					
Briza maxima					
Cassytha racemosa				CIR7-6	Cassytha
Corymbia calophylla					
Dampiera linearis				CFR4-1	Scaevola
Dasypogon bromeliifolius					
Eutaxia virgata				CIR7-3	Jacksonia ? Grac
Hypocalymma angustifolium					
Hypocalymma robustum					
Jacksonia sternbergiana				CIR7-2	jacksonia
Kunzea glabrescens					
Lechenaultia floribunda				CIR7-4	Scaevola delicate
Lepidosperma squamatum				CAR6-4	Lepido dark
Lobelia tenuior subsp. dictyosperma				CAQ1-9	
Melaleuca preissiana					
Opercularia hispidula					
Pericalymma ellipticum				CIR7-5	Peri elip
Pimelea rosea subsp. rosea				CIR7-OPP1	Pimelia pink opp CIR7-OPP1
Stylidium brunonianum					
Xanthorrhoea gracilis					
Xanthorrhoea preissii					

Casuarina Lvl 2 **Site** CJQ3

Described by AMB **Date** 16/10/2016 **Type** Q 10 x 10

Season **Uniformity**

Location

MGA Zone 50 392313 **mE** 6432326 **mN** 115.856956 **E** -32.240452 **S**

Habitat Plain

Soil Sandy loam/Grey

Rock Type

Vegetation Corymbia calophylla tall woodland over Allocasuarina low open woodland over Xanthorrhoea preissii Xanthorrhoea gracilis and Hibbertia hypericoides shrubland to low shrubland over Desmocladus flexuosus grassland.

Veg Condition Very Good - Good

Fire Age 8-12

Notes

SPECIES LIST:

Name	Cover	C Class	Height	Specimen	Notes
Allocasuarina fraseriana	5		600		
Briza maxima	20		30		
Burchardia congesta	1		50		
Conostylis aculeata	+		30		
Corymbia calophylla	20		2500		
Cryptostylis ovata	+		30		Leek Orchid
Dasypogon bromeliifolius	1		50		
Desmocladus flexuosus	5		30	CJQ3-1	Desmo flex
Ehrharta calycina	1		50		
Gladiolus caryophyllaceus	+		50		
Gompholobium tomentosum	+		50		
Hardenbergia comptoniana	+		CR		
Hibbertia hypericoides	30		50		
Hovea trisperma	+		CR		Gastro balls
Hypocalymma robustum	+		50		
Lagenifera huegelii	+		20		
Lepidosperma squamatum	5		50		Lepidosperma dark
Lobelia tenuior subsp. dictyosperma	+		20		Lobelia
Romulea rosea	+		20		
Sonchus oleraceus	+		50		
Thysanotus patersonii/manglesianus	+		CR		
Xanthorrhoea gracilis	10		50		
Xanthorrhoea preissii	10		150		

Casuarina Lvl 2 **Site** CJR9

Described by AD **Date** 16/11/2016 **Type** R

Season **Uniformity**

Location Lot F

MGA Zone 50 392256 **mE** 6432398 **mN** 115.856359 **E** -32.239798 **S**

Habitat Flat

Soil

Rock Type

Vegetation Corymbia calophylla and Melaleuca preissiana low woodland over Kunzea glabrescens and Xanthorrhoea preissii shrubland over Dasypogon bromeliifolius and Lepidosperma squamatum grassland/herbland

Veg Condition VG

Fire Age 8-12

Notes 1% Cover Leaf Litter, <1% Cover Bare Ground, 1% Cover Twigs, 0% Cover Logs

SPECIES LIST:

Name	Cover	C Class	Height	Specimen	Notes
Acacia lasiocarpa	+		50		Acacia lasio
Allocasuarina fraseriana	1		300		Allo fras
Austrostipa sp.	+		70		
Banksia attenuata	+		200		Bank atten
Briza maxima	+		20		Briza max
Briza maxima	1		30		Briza max
Conostylis juncea	+		30	CJR9-1	Conostylis white hair
Corymbia calophylla	20		800		Corymbia cal
Dampiera linearis	+		20	CRF4-1	Damp lin
Dasypogon bromeliifolius	30		40		Dasy brom
Dianella revoluta	1		60		Dianela rev
Gladiolus caryophyllaceus	+		60		Gladi cary
Gompholobium tomentosum	1		50		Gomph tom
Hardenbergia comptoniana	+		C		Hardenberg comp
Hypocalymma robustum	+		40		Hypo robust
Kunzea glabrescens	20		300		Kunz glab
Lechenaultia floribunda	+		30	CRF-4	? Scaevola
Lepidosperma squamatum	2		40		
Lomandra hermaphrodita	+		30	CAQ1-5	Lomandra hem
Melaleuca preissiana	10		800		Mel pre
Mesomelaena pseudostygia	+		40		Meso pseudo
Navarretia squarrosa	+		40		Stink weed
Pericalymma ellipticum	1		60		Perical elip
Pimelea rosea subsp. rosea	+		40	CIRTOP1	Pink pimelea
Stylidium brunonianum	+		20		Stylid bru
Thysanotus multiflorus	+		30		Thysanotus multi
Trachymene pilosa	+		10		Trachy pil
Xanthorrhoea preissii	5		200		Xanth pre

Casuarina Lvl 2 **Site** CKR10

Described by AMB **Date** 17/11/2016 **Type** R

Season **Uniformity**

Location 392805

MGA Zone 50 392805 **mE** 6432092 **mN** 115.862151 **E** -32.242610 **S**

Habitat Flat

Soil Sandy loam

Rock Type

Vegetation Corymbia calophylla, Eucalyptus marginata and Xylomelum occidentale woodland over Kunzea glabrescens and Xanthorrhoea preissii shrubland over Hibbertia hypericoides low open

Veg Condition Excellent to Very Good

Fire Age 4-8

Notes

SPECIES LIST:

Name	Cover	C Class	Height	Specimen	Notes
Acacia lasiocarpa					
Allocasuarina fraseriana					
Banksia attenuata					
Banksia grandis					
Banksia menziesii					
Bossiaea eriocarpa					
Briza maxima					
Burchardia congesta					
Conostylis aculeata					
Conostylis setigera					
Corymbia calophylla					
Desmocladus flexuosus					
Dianella revoluta					
Echium plantagineum					
Ehrharta calycina					
Eragrostis curvula					
Eucalyptus marginata					
Gompholobium confertum				CKR10-1	Purple terminal
Hibbertia hypericoides					
Kunzea glabrescens					
Lepidosperma sp.					
Leucopogon nutans					
Macrozamia riedlei					
Patersonia occidentalis					
Xanthorrhoea preissii					
Xylomelum occidentale					

Casuarina Lvl 2 **Site** CR12

Described by AD **Date** 17/11/2016 **Type** R

Season **Uniformity**

Location

MGA Zone 50 392826 **mE** 6431793 **mN** 115.862340 **E** -32.245309 **S**

Habitat

Soil

Rock Type

Vegetation Eucalyptus marginata and Banksia open woodland over Kunzea glabrescens shrubland over Dasypogon bromeliifolius grassland

Veg Condition G - D

Fire Age 8-12

Notes Disturbance: Weeds

SPECIES LIST:

Name	Cover	C Class	Height	Specimen	Notes
Adenanthos cygnorum					
Allocasuarina fraseriana					
Austrostipa compressa				CAQ1-3	Austrostipa
Banksia attenuata					
Banksia ilicifolia					
Banksia menziesii					
Briza maxima					
Dasypogon bromeliifolius					
Desmocladus flexuosus				CAQ1-10	Desmo
Ehrharta calycina					
Eucalyptus marginata					
Kunzea glabrescens					
Lobelia tenuior subsp. dictyosperma				CAQ1-9	Lobelia sp.
Lomandra hermaphrodita				CAQ1-5	Lom herm
Macrozamia riedlei					
Melaleuca thymoides				R11-2	
Patersonia occidentalis					
Stylidium brunonianum					
Trachymene pilosa					
Tricoryne elatior					
Ursinia anthemoides					
Xanthorrhoea preissii					

Casuarina Lvl 2 **Site** OPPCOL

Described by **Date** **Type** O

Season **Uniformity**

Location

MGA Zone **mE** **mN** **E** **S**

Habitat

Soil

Rock Type

Vegetation

Veg Condition

Fire Age

Notes

SPECIES LIST:

Name	Cover	C Class	Height	Specimen	Notes
Acacia longifolia				ADOP3	Acacia long leaf
Banksia attenuata					Outside Q3
Boronia crenulata					Boronia pink (Outside Q3)
Boronia sp.				CJQ3-1OPP	? Boronia spike (Outside Q3) Boronia spicata?
Bossiaea eriocarpa					
Calytrix angulata				CAQ1-OP02	Caly yellow
Cryptostylis ovata					
Eucalyptus todtiana					
Euphorbia sp				ADOP4	Euphorbia sp
Eutaxia virgata				WP40	Jacksonia
Hardenbergia comptoniana					
Hemiandra pungens				ADOP1	Hemiandra
Hemiandra pungens				CAQ1-OPP01	
Hibbertia vaginata				ADOP5	Hibbertia cun
Hyalosperma simplex				ADOP2	Waitsia
Jacksonia sternbergiana					
Leptomeria preissiana					Exocarpus
Lyginia imberbis					
Macrozamia riedlei					
Macrozamia riedlei					Outside Q3
Melaleuca rhaphiophylla					
Opercularia hispidula					Outside Q3
Siloxerus humifusus				WOPPAD2	
Xanthorrhoea preissii					
Xylomelum occidentale					Outside Q3
Zantedeschia aethiopica					Outside Q3

Orton Road Casuarina 2717

Site ORQ1
Described by NW
Date 18/04/2018
Type Q 10x10
Season
Uniformity
Location Lot 48
MGA Zone 50
392207 **mE** 6432623 **mN**
115.855865 **E** -32.237763 **S**
Habitat lower slope, flat
Soil grey sand
Rock Type
Vegetation Low Open Forest of Banskia attenuata over Kunzea glabrescens, Xanthorrhoe preissii and Hibbertia hypericoides over Desmocladus flexuosus, Dianella revoluta and Phlebocarya ciliata
Veg Condition Excellent
Fire Age 8-12
Notes



SPECIES LIST:

Name	Cover	C Class	Height	Specimen	Notes
Asparagus asparagoides	.5		C		
Banksia attenuata	65		900		
Billardiera heterophylla	3		C		
Briza maxima	2		30		
Burchardia congesta	.2		60		
Conostylis aculeata	.5		30		
Conostylis juncea	.1		10		
Dasypogon bromeliifolius	2		30		
Desmocladus flexuosus	15		15		
Dianella revoluta	1		80		
Hardenbergia comptoniana	1		C		
Hibbertia hypericoides	3		50		
Hypocalymma robustum	1		40		
Hypochaeris glabra	.1		1		
Kennedia prostrata	2		C		
Kunzea glabrescens	35		250		
Lepidosperma sp.	.5		30		
Lomandra sp.	.2		30		
Macrozamia riedlei	.5		100		
Melaleuca preissiana	2		600		
Phlebocarya ciliata	4		30		
Xanthorrhoea preissii	6		120		

Orton Road Casuarina 2717

Site ORQ2

Described by NW

Date 18/04/2018

Type Q 10x10

Season

Uniformity

Location lot 48

MGA Zone 50

392206 **mE** 6432500 **mN**

115.855840 **E**-32.238873 **S**

Habitat

Soil grey sand

Rock Type



Vegetation Low Open Woodland of Melaleuca preissiana over tall shrubland of Kunzea glabrescens, Xanthorrhoea preissii and Hypocalyma angustifolium over low open forbland of Dasypogon bromeliifolius and Phlebocaryra ciliata.

Veg Condition Excellent

Fire Age 8-12

SPECIES LIST:

Name	Cover	C Class	Height	Specimen	Notes
Banksia dallanneyi var. dallanneyi	2		10		
Dampiera linearis	.1		20		
Dasypogon bromeliifolius	45		30		
Desmocladus fasciculatus	.2		15		
Dianella revoluta	.2		40		
Ehrharta calycina	1		60		
Gompholobium tomentosum	.5		15		
Hypocalymma angustifolium	1		45		
Jacksonia gracillima	1.5		130		
Kunzea glabrescens	70		270		
Lepidosperma sp.	.2		40		
Lomandra hermaphrodita	.2		15		
Melaleuca preissiana	10		600		
Phlebocarya ciliata	10		30		
Xanthorrhoea preissii	3		130		

Orton Road Casuarina 2717

Site ORQ3

Described by NW

Date 18/04/2018

Type Q 10x10

Season

Uniformity

Location lot 48

MGA Zone 50

392180 **mE** 6432321 **mN**

115.855544 **E**-32.240485 **S**

Habitat

Soil grey sand

Rock Type

Vegetation Mid Woodland of Corymbia calophyllaover tall shrubland of Kunzea glabrescens, Melaleuca thymoides and Bossiaea eriocarpa over low open forbland of Dasypogon bromeliifolius and lepidosperma sp.



Veg Condition excellent

Fire Age 8-12

Notes

SPECIES LIST:

Name	Cover	C Class	Height	Specimen	Notes
Acacia pulchella	.5		45		
Bossiaea eriocarpa	3		35		
Briza maxima	.1		20		
Corymbia calophylla	25		1300		
Dampiera alata	.1		60		
Dasypogon bromeliifolius	6		15		
Desmocladus flexuosus	1		15		
Gompholobium tomentosum	.3		30		
Gonocarpus pithyoides	.2		15		
Jacksonia gracillima	1		30		
Kunzea glabrescens	25		330		
Lepidosperma sp.	7		70		
Lomandra sp.	.1		25		
Melaleuca thymoides	5		180		

APPENDIX G:

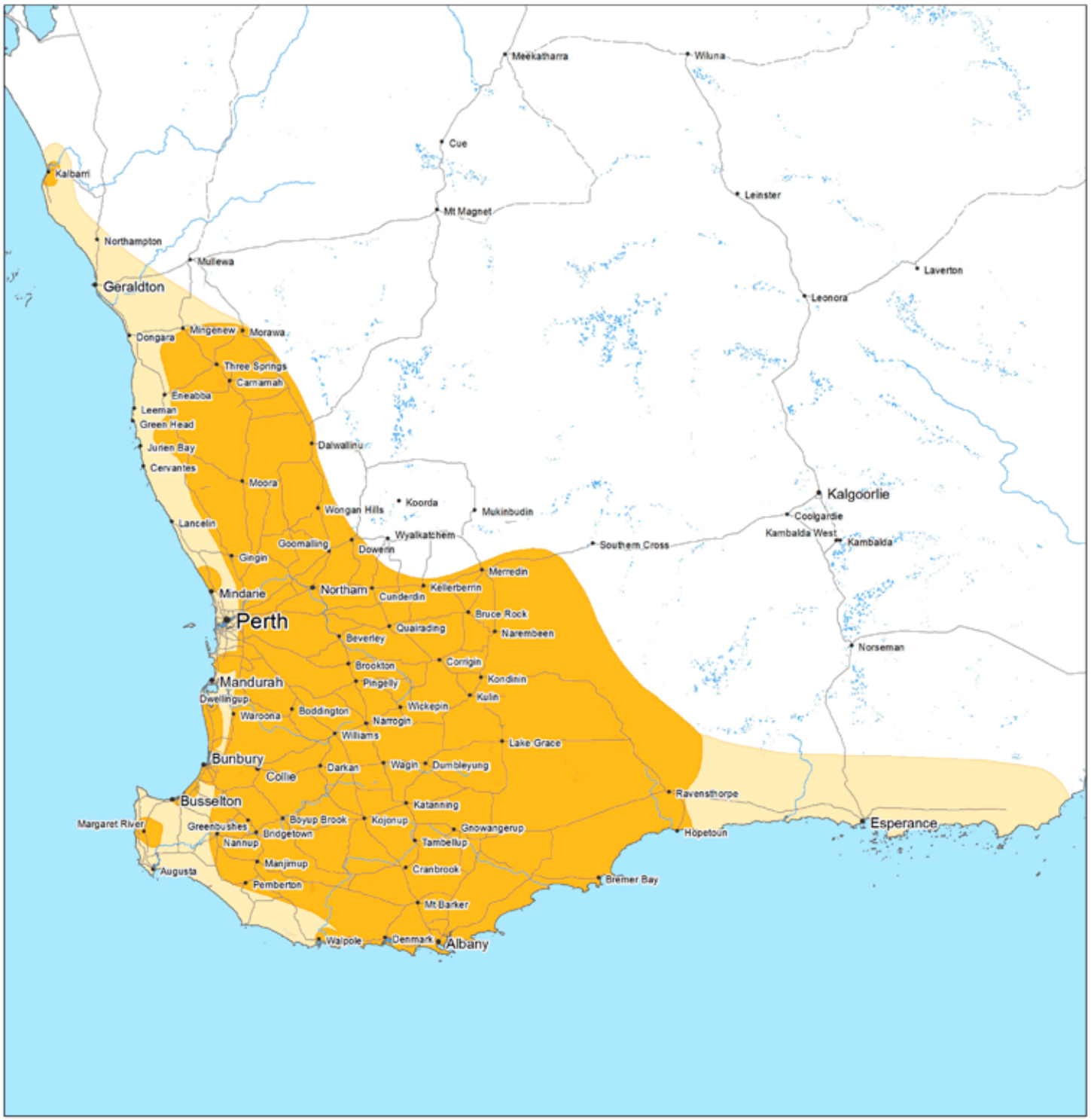
Black Cockatoo Distribution Maps

Carnaby's Black Cockatoo Distribution Maps



Photo: Female Carnaby's cockatoo *Calyptorhynchus latirostrise* (Rick Dawson, Department of Parks and Wildlife), sourced from the Carnaby's Cockatoo (*Calyptorhynchus latirostris*) Recovery Plan 2013.

Map 2: Modelled distribution of Carnaby's black cockatoo (*Calyptorhynchus latirostris*)



INDICATIVE MAP ONLY: For the latest departmental information, please refer to the Protected Matters Search Tool at www.environment.gov.au/epbc/index.html



0 50 100 150 200 250 km

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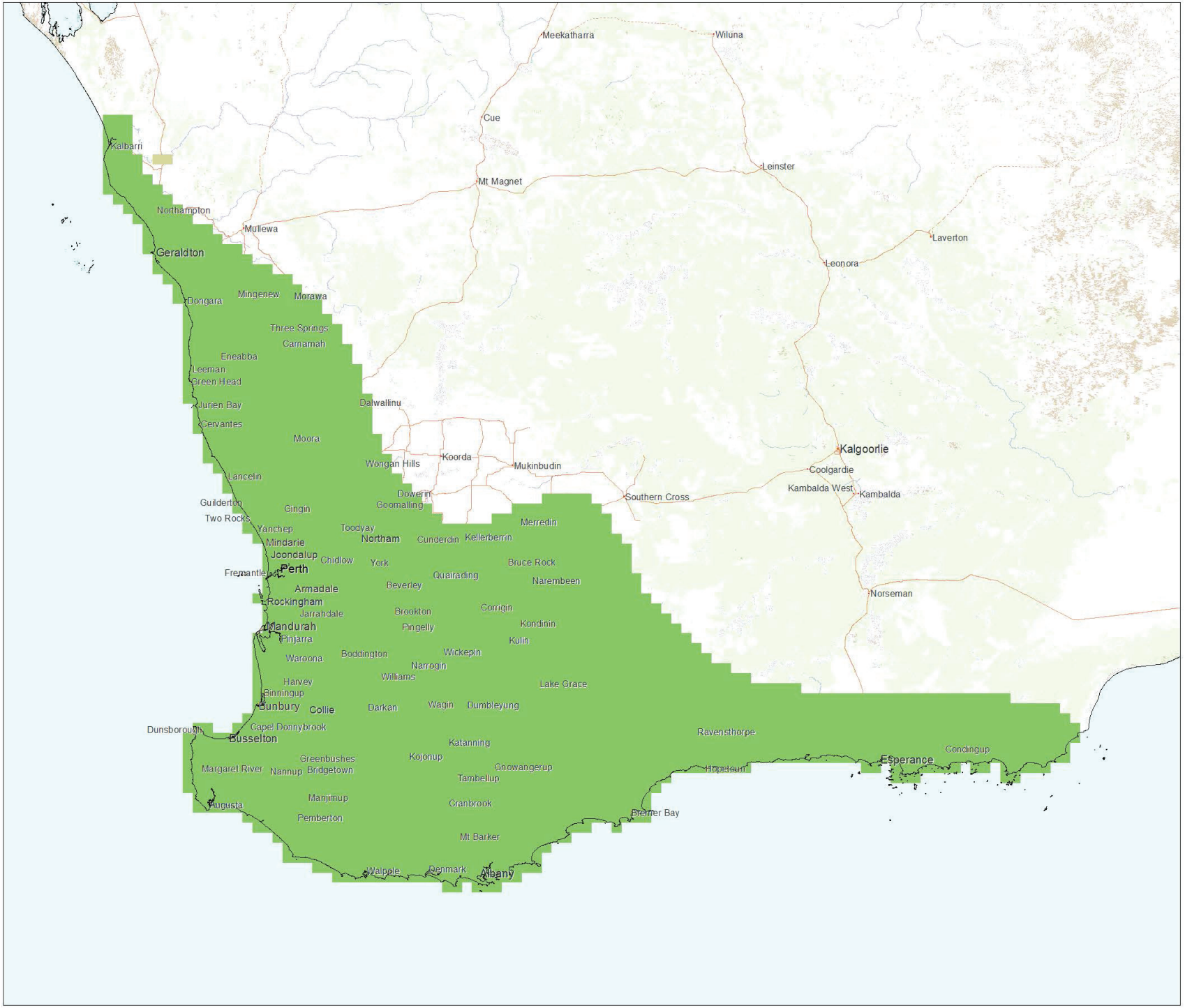
Legend

- Breeding Range
- Non-breeding Range
- Cities & Towns
- Roads
- Major Rivers
- Lakes

Please Note: The breeding range represents the areas known to be used by birds for breeding as at December 2009. As habitat has been lost in traditional breeding areas, birds have begun breeding at new locations. Distribution created and verified using point locations in SPRAT database (DSEWPaC, 2011) and from expert feedback (R. Johnstone, 2011).

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Calyptorhynchus latirostris Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo



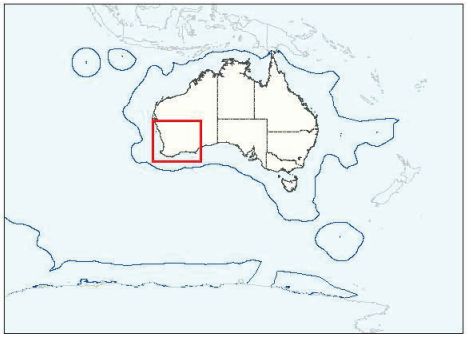
Species of National Environmental Significance, Map Summary Version 1 2014

Distribution

Species or species habitat likely to occur

Species or species habitat may occur

Commonwealth Marine Area



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Contextual data source: Geoscience Australia (2006), Geodata Topo 250K Topographic Data
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Forest Red-tailed Black Cockatoo Distribution Maps



Photo: Female Forest Red-tailed Black cockatoo *Calyptorhynchus baudinii* (Tony Kirkby (Western Australian Museum), sourced from the Forest Black Cockatoo (Baudin's Cockatoo) *Calyptorhynchus baudinii* and Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso* Recovery Plan 2008.

Map 3: Modelled distribution of forest red-tailed black cockatoo (*Calyptorhynchus banksii naso*)



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Department of Sustainability, Environment, Water, Population and Communities

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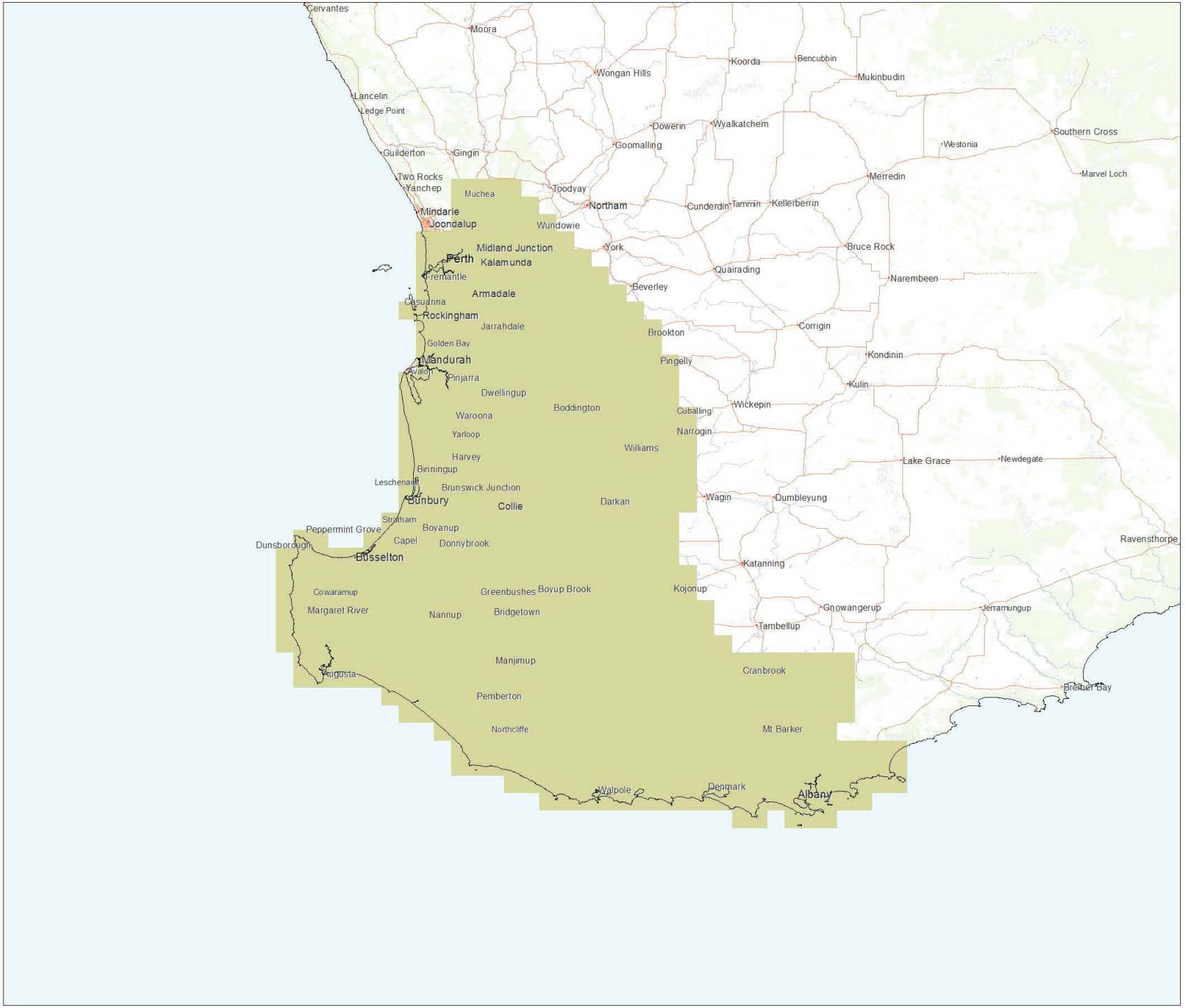
Legend

- Species May Occur
- Cities & Towns
- Roads
- Major Rivers
- Lakes

Please Note: Distribution created and verified using point locations in SPRAT database (DSEWPaC, 2011) and from expert feedback (R. Johnstone, 2011).

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Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo



0 40 80 120 160 km

s67034.asc 2/04/2014

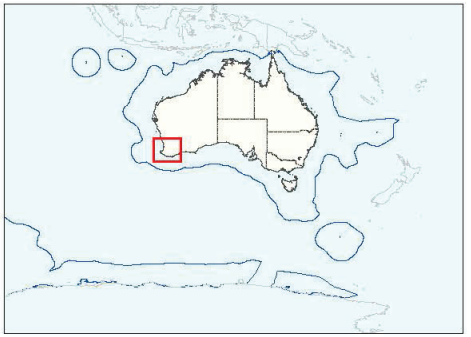
Species of National Environmental Significance, Map Summary Version 1 2014

Distribution

Species or species habitat likely to occur

Species or species habitat may occur

Commonwealth Marine Area



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Contextual data source: Geoscience Australia (2006), Geodata Topo 250K Topographic Data
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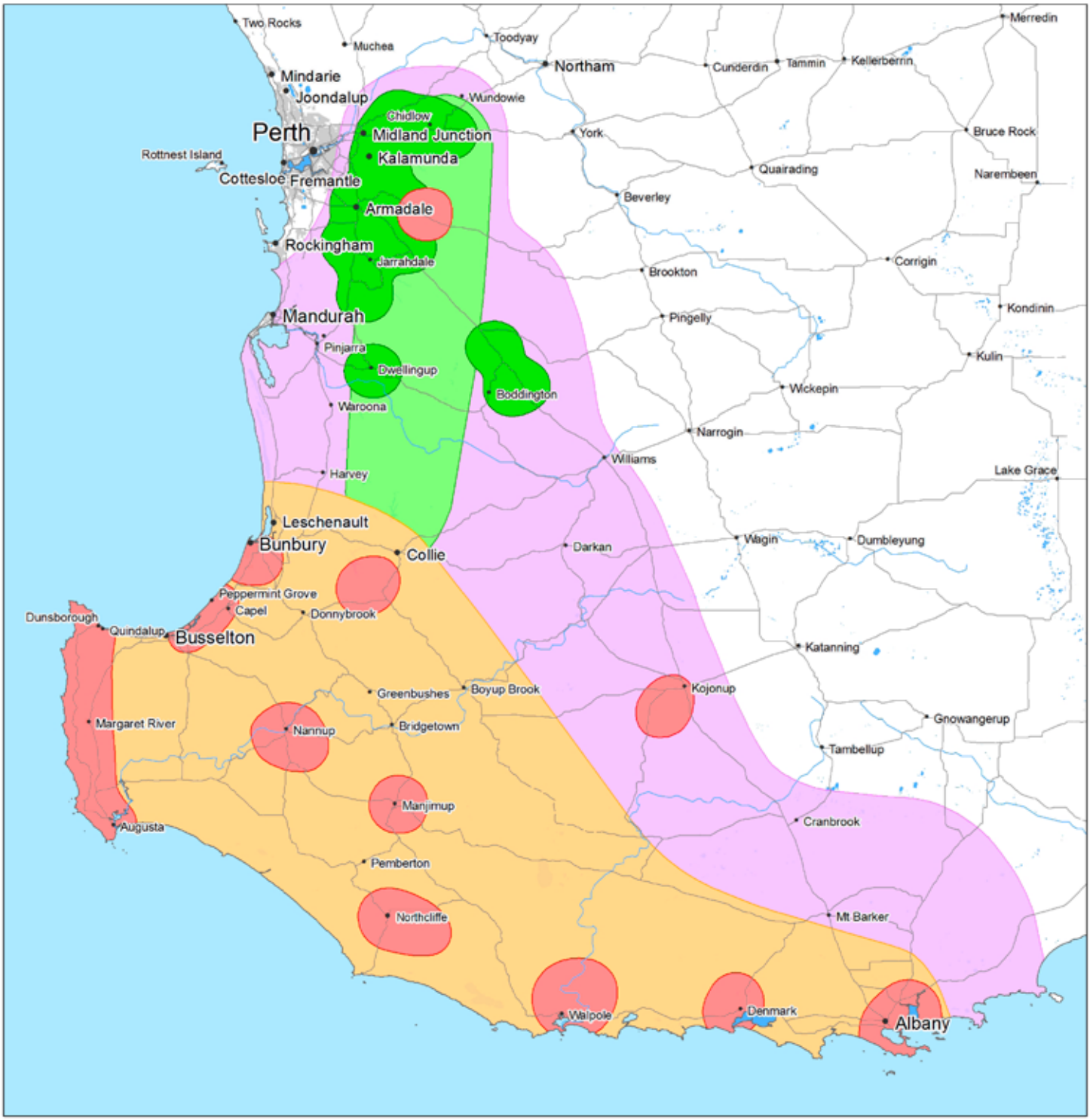
Department of the Environment

Baudin's Black Cockatoo Distribution Maps



Photo: Female Baudin's cockatoo *Calyptorhynchus baudinii* (Tony Kirkby (Western Australian Museum), sourced from the Forest Black Cockatoo (Baudin's Cockatoo) *Calyptorhynchus baudinii* and Forest Redtailed Black Cockatoo *Calyptorhynchus banksii naso* Recovery Plan 2008.

Map 1: Modelled distribution of Baudin's black cockatoo (*Calyptorhynchus baudinii*)



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0 20 40 60 80 100 km

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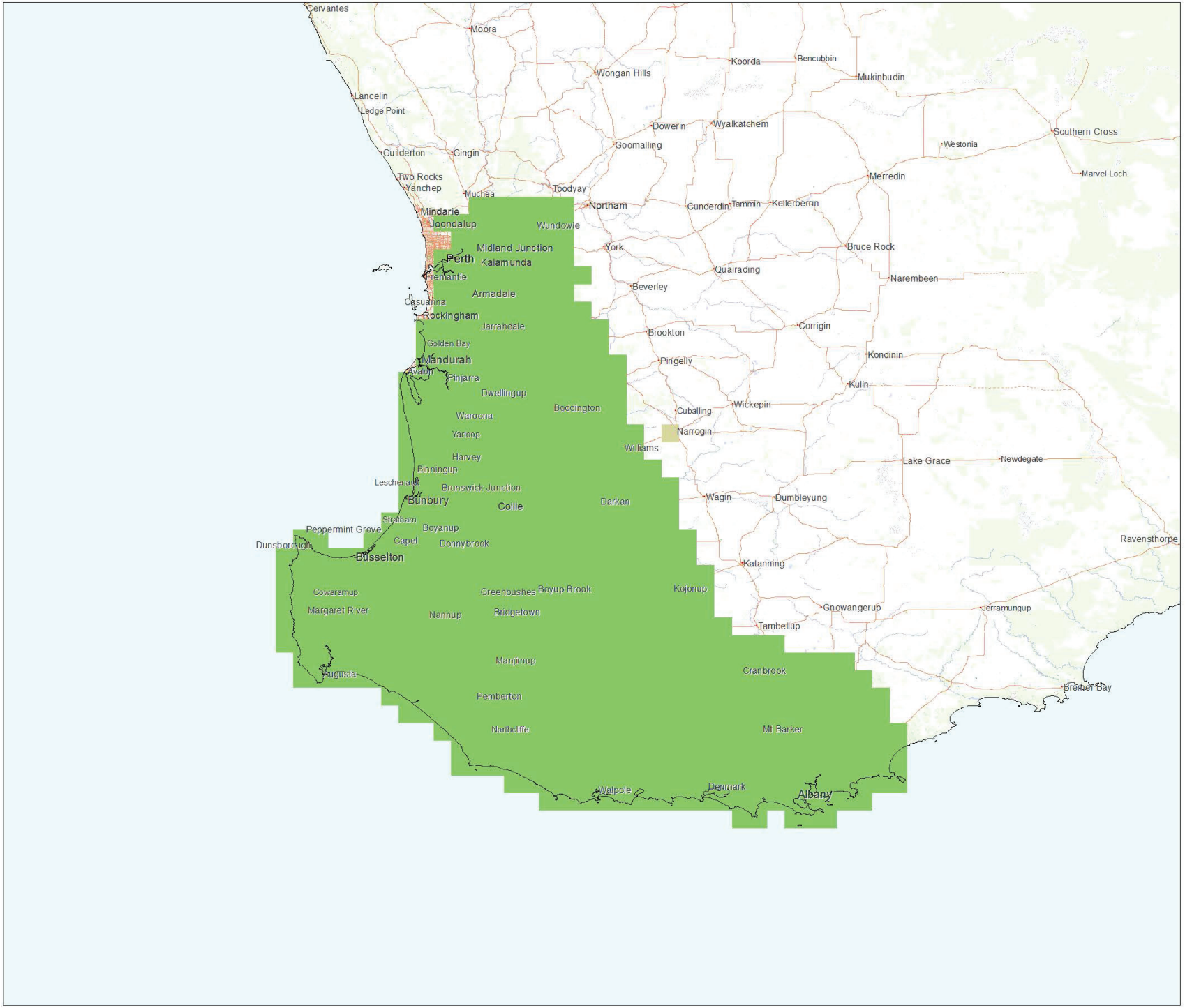
Legend

- Known Breeding Areas
- Predicted Breeding Range
- Known Foraging Areas
- Main Wintering Area
- Species Likely to Occur
- Cities & Towns
- Roads
- Major Rivers
- Lakes

Please Note: Known breeding areas represent locations known to be used by birds for breeding as at December 2009. As habitat has been lost in traditional breeding areas, birds have begun breeding at new locations. Distribution created and verified using point locations in SPRAT database (DSEWPaC, 2011) and from expert feedback (R. Johnstone, 2011).

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Calyptorhynchus baudinii Baudin's Black-Cockatoo, Long-billed Black-Cockatoo



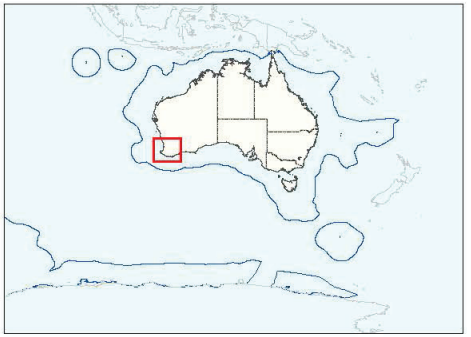
Species of National Environmental Significance, Map Summary Version 1 2014

Distribution

Species or species habitat likely to occur

Species or species habitat may occur

Commonwealth Marine Area



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APPENDIX H:

Black Cockatoo Potential Breeding Trees

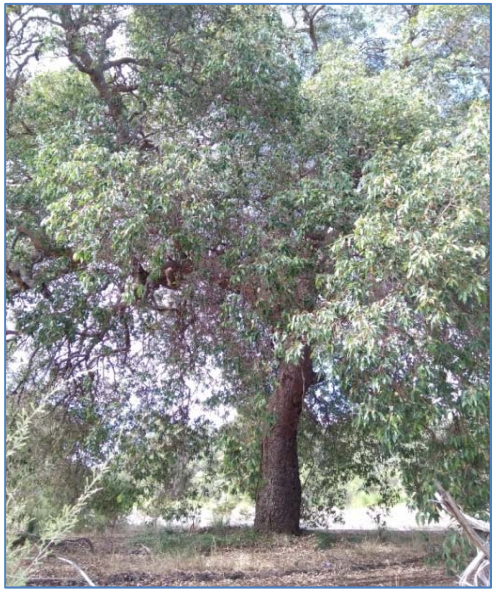
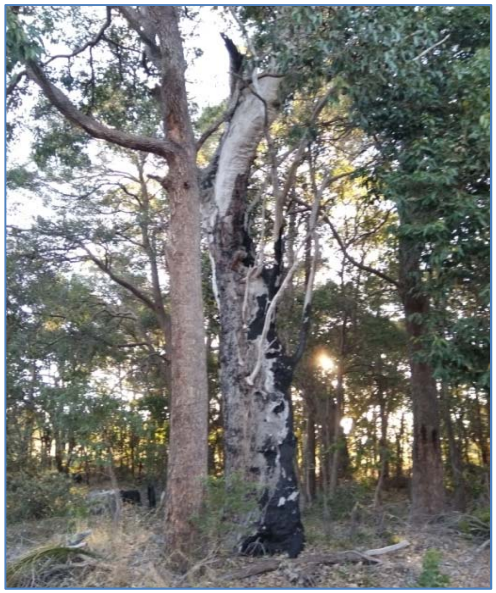
DATE	TAXA	EASTING	NORTHING	DBH (mm)	HEIGHT (m)	HOLLOWS	# HOLLOWS	SUITABLE FOR BC	COMMENTS	PHOTO REF
2018-04-06 12:14:47 AWST	*Jarrah (Eucalyptus marginata)*	392789	6432135	1750	8	yes	5	yes	At least 2 hollows large enough for bc	1
2018-04-06 09:40:44 AWST	*Jarrah (Eucalyptus marginata)*	392823	6431980	1730	10	possible	3		At least 2 little hollows, could be be larger but couldnt spot from ground due to complex structure of tree	2
2018-04-06 11:57:54 AWST	*Jarrah (Eucalyptus marginata)*	392818	6432111	1430	10	yes	3	yes	Huge stag - trunk burnt, would be thicker otherwise. At least 3 large hollows. One occupied by bees.	3
2018-04-24 12:08:21 AWST	*Marri (Corymbia calophylla)*	392237	6432239	1420	15	yes	2	yes	1 large 1 medium	4
2018-04-06 17:33:48 AWST	*Marri (Corymbia calophylla)*	392178	6432198	1360	12	yes	1	no	too small for bc	5
2018-04-24 15:59:25 AWST	*Marri (Corymbia calophylla)*	392290	6432155	1350	13	yes	5	yes	1 large 4 potential medium	6
2018-04-24 11:55:28 AWST	*Marri (Corymbia calophylla)*	392235	6432226	1310	16	yes	1	yes	medium sized hollow	7
2018-04-23 11:23:08 AWST	*Jarrah (Eucalyptus marginata)*	392359	6432358	1250	10	yes	4	yes	3 medium 1 small hollow. stag	8
2018-04-23 15:23:35 AWST	*Tuart (Eucalyptus gomphocephala)*	392495	6431987	1230	12	no				9
2018-04-06 17:11:44 AWST	*Jarrah (Eucalyptus marginata)*	392204	6432203	1180	6	yes	5	yes	cant clearly see openings but potentially 5 large hollows	10
2018-03-26 11:36:57 AWST	*Marri (Corymbia calophylla)*	391925	6431977	1180	15	yes	2	yes	1 very large hollow, one small, pair of redtails foraging at top of tree	11
2018-03-26 12:46:00 AWST	*Marri (Corymbia calophylla)*	391948	6432018	1180	14	yes	4	yes	At least 2 hollows potential cockatoo	12
2018-04-23 10:59:18 AWST	*Marri (Corymbia calophylla)*	392314	6432339	1170	10	yes	2	yes	potential bc suitable medium size	13
2018-04-24 11:27:01 AWST	*Marri (Corymbia calophylla)*	392429	6432234	1170	16	yes	2	yes	1 medium 1 small	14
2018-04-23 14:56:41 AWST	*Jarrah (Eucalyptus marginata)*	392284	6432007	1150	8	yes	3	yes	2 large 1 small hollow	15
2018-04-24 16:10:16 AWST	*Jarrah (Eucalyptus marginata)*	392223	6432152	1110	13	yes	1	yes	large hollow	16
2018-04-06 14:37:15 AWST	*Jarrah (Eucalyptus marginata)*	392243	6431817	1100	8	yes	5	yes	Burnt stag, 5 potentially large hollows	17
2018-04-23 11:40:10 AWST	*Marri (Corymbia calophylla)*	392306	6432406	1100	16	yes	1	yes	medium hollow	18
2018-03-26 11:17:06 AWST	*Marri (Corymbia calophylla)*	391939	6431950	1085	12	possible	1		One large spout visible from ground - unable to tell if suitable for cockatoo without closer inspection	19
2018-04-06 12:01:50 AWST	*Jarrah (Eucalyptus marginata)*	392814	6432114	1060	5	yes	2	yes	Burnt stag - 2 medium hollows bc potential	20
2018-04-06 12:18:31 AWST	*Marri (Corymbia calophylla)*	392815	6432074	1060	0	possible	1		Potential large spout	21
2018-04-06 17:49:53 AWST	*Jarrah (Eucalyptus marginata)*	392174	6432255	1042	12	yes	1	yes	large hollow	22
2018-03-26 13:22:01 AWST	*Marri (Corymbia calophylla)*	391959	6432037	1028	12	possible	3		Only spotted three small hollows, but very large tree with complex structure so may have more	23
2018-04-06 17:20:28 AWST	*Marri (Corymbia calophylla)*	392192	6432206	1020	8	yes	1	yes	very large hollow	
2018-04-23 08:58:23 AWST	*Jarrah (Eucalyptus marginata)*	392193	6432597	1010	7	possible	4		stag, 4 potential medium sized spouts	
2018-04-23 13:36:50 AWST	*Tuart (Eucalyptus gomphocephala)*	392510	6432527	1010	14	no				
2018-04-06 10:39:28 AWST	*Jarrah (Eucalyptus marginata)*	393085	6432046	1000	5	yes	2	yes	Stag. Feral bees at base so estimated dbh. Hollows potentially big enough, no chew marks	
2018-04-23 13:41:21 AWST	*Jarrah (Eucalyptus marginata)*	392445	6432540	1000	4	yes	1	yes	medium hollow stag	
2018-03-26 13:00:47 AWST	*Marri (Corymbia calophylla)*	391912	6432042	1000	15	yes	3	yes	At least one potential bc suitable hollow	
2018-04-23 10:50:42 AWST	*Marri (Corymbia calophylla)*	392280	6432348	1000	14	no				
2018-04-06 10:40:39 AWST	*Jarrah (Eucalyptus marginata)*	393086	6432030	990	6	no			Tree broken at base	
2018-04-06 09:00:48 AWST	*Jarrah (Eucalyptus marginata)*	392918	6431966	990	8	yes	2	no	Hollows too small for bc	
2018-04-06 16:16:34 AWST	*Jarrah (Eucalyptus marginata)*	392043	6431985	970	8	yes	1	no	hollow too small for bc	
2018-03-26 17:01:41 AWST	*Marri (Corymbia calophylla)*	391953	6432165	970	14	yes	5	yes	Stag. 5 potentially large hollows	
2018-04-06 17:47:56 AWST	*Marri (Corymbia calophylla)*	392185	6432247	970	12	yes	1	yes	large hollow	
2018-04-06 09:38:24 AWST	*Jarrah (Eucalyptus marginata)*	392775	6431961	955	12	yes	2	no	2 small hollows	
2018-04-24 10:36:02 AWST	*Jarrah (Eucalyptus marginata)*	392489	6431935	940	8	yes	1	yes	burnt stag, medium hollow occupied by bees, 3 trunks measured largest	
2018-03-26 16:50:17 AWST	*Marri (Corymbia calophylla)*	391912	6432197	940	7	yes	2	yes	Stag. 2 large hollows	
2018-04-24 11:39:28 AWST	*Marri (Corymbia calophylla)*	392384	6432236	930	14	no			measured just above fork	
2018-04-06 14:54:28 AWST	*Jarrah (Eucalyptus marginata)*	392323	6431752	920	14	no				
2018-04-24 11:50:17 AWST	*Jarrah (Eucalyptus marginata)*	392288	6432228	910	12	yes	2	yes	bc suitable	
2018-04-06 11:27:55 AWST	*Jarrah (Eucalyptus marginata)*	392892	6432108	900	6	yes	3	yes	2 large 1 medium - stag	
2018-04-06 11:33:01 AWST	*Jarrah (Eucalyptus marginata)*	392913	6432088	900	7	yes	3	yes	Burnt stag - trunk severely burnt out so dbh estimated. 3 large hollows	
2018-04-06 11:41:54 AWST	*Jarrah (Eucalyptus marginata)*	392859	6432128	900	9	no			Stag - a branch falling would create hollows	
2018-04-23 09:57:09 AWST	*Jarrah (Eucalyptus marginata)*	392222	6432632	900	8	yes	3	yes	2 small 1 medium hollow	
2018-04-24 11:34:42 AWST	*Jarrah (Eucalyptus marginata)*	392405	6432235	900	8	yes	2	yes	large hollows, stag	
2018-04-24 12:06:22 AWST	*Jarrah (Eucalyptus marginata)*	392231	6432242	900	14	yes	1	yes	medium hollow occupied by bees	
2018-04-23 11:03:52 AWST	*Marri (Corymbia calophylla)*	392311	6432340	890	10	yes	1	yes	large hollow	
2018-04-24 11:18:38 AWST	*Marri (Corymbia calophylla)*	392479	6432236	890	14	no				
2018-03-26 14:29:42 AWST	*Jarrah (Eucalyptus marginata)*	391956	6432108	880	10	yes	3	no	3 small hollows spotted from ground	
2018-04-06 10:25:53 AWST	*Jarrah (Eucalyptus marginata)*	392952	6432038	880	10	yes	1	yes	Jarrah or todtiana stag with medium to large spout hollow that could be appropriate for black Cockatoo. No evidence of chew marks.	
2018-04-06 09:31:26 AWST	*Eucalyptus todtiana*	392890	6432021	880	8	yes	2	no	Hollows too small for bc - potential todtiana?	
2018-03-26 12:23:15 AWST	*Marri (Corymbia calophylla)*	391962	6432004	880	12	possible	1		Forked at dbh, measured just below. Potential spout hollow	
2018-04-06 17:41:04 AWST	*Jarrah (Eucalyptus marginata)*	392189	6432217	870	12	no				
2018-04-24 15:42:10 AWST	*Jarrah (Eucalyptus marginata)*	392402	6432199	860	12	yes	1	yes	medium size hollow	
2018-04-23 13:34:55 AWST	*Tuart (Eucalyptus gomphocephala)*	392467	6432535	860	11	no				
2018-04-23 11:53:33 AWST	*Tuart (Eucalyptus gomphocephala)*	392319	6432531	850	14	no				
2018-04-23 15:50:33 AWST	*Tuart (Eucalyptus gomphocephala)*	392575	6431965	840	15	no				
2018-03-26 17:35:07 AWST	*Marri (Corymbia calophylla)*	391988	6432232	830	14	no				
2018-04-06 12:06:31 AWST	*Jarrah (Eucalyptus marginata)*	392806	6432113	820	8	yes	2	yes	Burnt stag 1 large 1 small hollow	
2018-03-26 13:59:30 AWST	*Marri (Corymbia calophylla)*	391956	6432076	820	15	yes	2	no	2 small hollows visible from ground, potentially more	
2018-04-23 11:36:00 AWST	*Marri (Corymbia calophylla)*	392304	6432357	820	12	no				
2018-04-24 08:02:01 AWST	*Marri (Corymbia calophylla)*	392635	6432095	820	11	no				

DATE	TAXA	EASTING	NORTHING	DBH (mm)	HEIGHT (m)	HOLLOWS	# HOLLOWS	SUITABLE FOR BC	COMMENTS	PHOTO REF
2018-04-24 11:31:31 AWST	*Marri (Corymbia calophylla)*	392415	6432218	820	14	no				
2018-04-24 15:26:10 AWST	*Marri (Corymbia calophylla)*	392641	6432196	820	12	no				
2018-04-24 11:15:50 AWST	*Marri (Corymbia calophylla)*	392492	6432235	810	14	no				
2018-04-23 16:01:26 AWST	*Tuart (Eucalyptus gomphocephala)*	392641	6432011	810	14	no				
2018-04-06 14:49:42 AWST	*Jarrah (Eucalyptus marginata)*	392314	6431748	800	12	yes	2	no	Not bc suitable	
2018-04-23 12:43:04 AWST	*Jarrah (Eucalyptus marginata)*	392332	6432631	800	8	yes	1	yes	bees occupying base of trunk, dbh is estimated	
2018-04-24 10:24:57 AWST	*Jarrah (Eucalyptus marginata)*	392277	6431916	800	5	yes	1	yes	large hollow stag	
2018-04-24 11:37:43 AWST	*Marri (Corymbia calophylla)*	392407	6432232	800	14	no			measured in between first and second fork	
2018-04-23 15:16:40 AWST	*Tuart (Eucalyptus gomphocephala)*	392513	6431948	800	12	no				
2018-04-06 10:18:05 AWST	*Jarrah (Eucalyptus marginata)*	392837	6432045	790	10	yes	2	no	Stag, two small hollows	
2018-04-24 15:30:12 AWST	*Marri (Corymbia calophylla)*	392612	6432175	790	14	no				
2018-03-26 11:26:20 AWST	*Jarrah (Eucalyptus marginata)*	391958	6431955	780	9	possible	1		At least one maybe more hollows, can't tell if cockatoo suitable from ground	
2018-04-23 09:14:41 AWST	*Jarrah (Eucalyptus marginata)*	392171	6432325	780	8	yes	2	yes	2 medium sized hollows, one occupied by bees	
2018-03-26 16:41:41 AWST	*Marri (Corymbia calophylla)*	391888	6432168	780	12	yes	3	yes	Two trunks, measured largest. At least two hollows potentially bc suitable.	
2018-04-06 17:36:03 AWST	*Jarrah (Eucalyptus marginata)*	392159	6432222	770	9	no				
2018-04-23 09:35:05 AWST	*Jarrah (Eucalyptus marginata)*	392172	6432451	770	8	yes	3	yes	stag 2 medium spouts 1 medium hollow	
2018-03-26 13:56:52 AWST	*Marri (Corymbia calophylla)*	391949	6432072	770	13	possible	1		One small hollow visible from ground, potentially more	
2018-04-23 11:15:49 AWST	*Marri (Corymbia calophylla)*	392333	6432345	770	14	no				
2018-04-24 13:32:19 AWST	*Marri (Corymbia calophylla)*	392691	6432191	770	10	no				
2018-04-06 09:41:33 AWST	*Jarrah (Eucalyptus marginata)*	392772	6431959	760	12	no				
2018-04-24 11:21:54 AWST	*Marri (Corymbia calophylla)*	392467	6432241	760	14	no			2 trunks measured largest	
2018-04-24 12:41:40 AWST	*Marri (Corymbia calophylla)*	392400	6432277	760	14	no				
2018-04-23 15:58:24 AWST	*Tuart (Eucalyptus gomphocephala)*	392603	6431953	760	16	no				
2018-04-06 11:38:53 AWST	*Jarrah (Eucalyptus marginata)*	392882	6432105	750	12	no				
2018-04-23 09:25:09 AWST	*Jarrah (Eucalyptus marginata)*	392158	6432310	750	8	yes	2	yes	1 potential medium sized spout, hollow leading in to trunk	
2018-04-24 08:55:37 AWST	*Jarrah (Eucalyptus marginata)*	392420	6432143	750	8	no				
2018-04-24 11:47:01 AWST	*Jarrah (Eucalyptus marginata)*	392311	6432235	750	8	yes	2	no	stag, 2 small hollows	
2018-04-24 12:25:01 AWST	*Marri (Corymbia calophylla)*	392308	6432296	750	12	possible	1		potential small to medium spout	
2018-04-06 10:24:06 AWST	*Eucalyptus todtiana*	392930	6432023	750	8	no			Todtiana	
2018-04-23 13:26:52 AWST	*Tuart (Eucalyptus gomphocephala)*	392500	6432632	750	11	no				
2018-04-24 14:33:27 AWST	*Tuart (Eucalyptus gomphocephala)*	392841	6432181	750	13	yes	1	no	hollow to small for bc	
2018-04-23 14:51:28 AWST	*Jarrah (Eucalyptus marginata)*	392237	6432035	740	8	no				
2018-03-26 12:02:24 AWST	*Marri (Corymbia calophylla)*	391974	6431993	740	10	no				
2018-04-23 15:29:52 AWST	*Tuart (Eucalyptus gomphocephala)*	392517	6431988	740	14	no				
2018-03-26 16:28:47 AWST	*Jarrah (Eucalyptus marginata)*	392044	6432119	730	10	no			Multiple trunks, difficult to measure. Attempted to measure thickest trunk.	
2018-04-06 16:23:05 AWST	*Jarrah (Eucalyptus marginata)*	392041	6431930	730	12	no				
2018-04-06 14:43:12 AWST	*Jarrah (Eucalyptus marginata)*	392290	6431751	730	11	yes	2	no	Too small for bc	
2018-04-06 15:35:12 AWST	*Jarrah (Eucalyptus marginata)*	392639	6431759	730	12	yes	1	no	1 small hollow	
2018-03-26 17:20:15 AWST	*Marri (Corymbia calophylla)*	391960	6432193	730	14	possible	2		One potentially suitable but needs checking	
2018-03-26 17:37:53 AWST	*Marri (Corymbia calophylla)*	392006	6432198	730	14	no				
2018-04-23 11:11:21 AWST	*Marri (Corymbia calophylla)*	392330	6432335	730	12	no				
2018-04-06 14:25:20 AWST	*Marri (Corymbia calophylla)*	392390	6431784	720	6	possible	1		Burnt stag potential large spout	
2018-04-23 13:29:34 AWST	*Tuart (Eucalyptus gomphocephala)*	392462	6432568	720	11	no				
2018-04-23 13:42:26 AWST	*Tuart (Eucalyptus gomphocephala)*	392438	6432532	710	10	no				
2018-03-26 14:25:08 AWST	*Marri (Corymbia calophylla)*	391958	6432100	705	12	possible	1		Only spotted 1 small one, could be more	
2018-04-06 10:16:18 AWST	*Jarrah (Eucalyptus marginata)*	392828	6432040	700	10	no			Stag	
2018-04-24 10:15:31 AWST	*Jarrah (Eucalyptus marginata)*	392281	6431856	700	5	yes	4	yes	burnt stag, medium sized hollows	
2018-04-24 12:19:12 AWST	*Jarrah (Eucalyptus marginata)*	392266	6432296	700	12	possible	1		potential medium spout	
2018-03-26 17:13:44 AWST	*Marri (Corymbia calophylla)*	391955	6432184	700	12	yes	4	yes	One hollow potential suitable bc	
2018-04-06 15:41:13 AWST	*Tuart (Eucalyptus gomphocephala)*	392639	6431820	700	10	no				
2018-04-23 13:47:54 AWST	*Tuart (Eucalyptus gomphocephala)*	392448	6432493	700	9	no			pile of wood made measuring difficult, dbh estimated	
2018-04-23 15:31:30 AWST	*Tuart (Eucalyptus gomphocephala)*	392535	6431986	700	12	no				
2018-04-24 09:50:23 AWST	*Tuart (Eucalyptus gomphocephala)*	392595	6431859	700	8	no				
2018-03-26 14:06:07 AWST	*Marri (Corymbia calophylla)*	391931	6432066	690	8	possible	2		Burnt stag. 2 spouts with potential hollows, one large	
2018-04-23 10:09:10 AWST	*Jarrah (Eucalyptus marginata)*	392243	6432620	680	8	yes	2	yes	2 large hollows	
2018-04-06 17:29:16 AWST	*Marri (Corymbia calophylla)*	392157	6432198	680	12	no				
2018-04-23 15:55:52 AWST	*Tuart (Eucalyptus gomphocephala)*	392590	6431948	680	14	no				
2018-04-24 11:24:22 AWST	*Marri (Corymbia calophylla)*	392440	6432233	670	9	no				
2018-04-24 12:37:11 AWST	*Marri (Corymbia calophylla)*	392362	6432278	670	14	no				
2018-03-26 16:57:31 AWST	*Marri (Corymbia calophylla)*	391948	6432156	660	12	no				
2018-04-24 12:36:21 AWST	*Marri (Corymbia calophylla)*	392362	6432277	660	14	no				
2018-04-24 13:42:12 AWST	*Marri (Corymbia calophylla)*	392685	6432182	660	11	no			measured below fork	
2018-03-26 12:16:58 AWST	*Jarrah (Eucalyptus marginata)*	391959	6432005	650	8	yes	4	yes	Burnt stag. At least two hollows are large	

DATE	TAXA	EASTING	NORTHING	DBH (mm)	HEIGHT (m)	HOLLOWS	# HOLLOWS	SUITABLE FOR BC	COMMENTS	PHOTO REF
2018-04-23 10:12:15 AWST	*Jarrah (Eucalyptus marginata)*	392258	6432599	650	8	no				
2018-04-24 09:06:59 AWST	*Jarrah (Eucalyptus marginata)*	392559	6432127	650	10	no			stag fork at dbh measured just below	
2018-03-26 11:55:55 AWST	*Marri (Corymbia calophylla)*	391925	6431998	650	13	yes	2	yes	1 hollow potentially bc suitable	
2018-03-26 12:10:08 AWST	*Marri (Corymbia calophylla)*	391955	6431996	650	14	possible	1		Potential hollow in spout	
2018-03-26 17:30:38 AWST	*Marri (Corymbia calophylla)*	391964	6432216	650	12	no				
2018-04-24 13:24:20 AWST	*Marri (Corymbia calophylla)*	392674	6432165	650	12	no			measured thickest trunk above fork	
2018-04-23 11:56:10 AWST	*Tuart (Eucalyptus gomphocephala)*	392298	6432540	650	12	no				
2018-04-23 14:36:55 AWST	*Tuart (Eucalyptus gomphocephala)*	392574	6432050	650	10	no				
2018-03-26 17:22:08 AWST	*Jarrah (Eucalyptus marginata)*	391958	6432208	640	7	yes	3	yes	Stag. 3 hollows large enough for bc. One occupied by bees	
2018-04-24 11:44:50 AWST	*Jarrah (Eucalyptus marginata)*	392334	6432230	640	6	yes	2	yes	stag, 2 medium hollows	
2018-04-24 12:55:13 AWST	*Jarrah (Eucalyptus marginata)*	392553	6432274	640	5	possible	1		potential medium hollow at top	
2018-04-24 15:54:19 AWST	*Marri (Corymbia calophylla)*	392304	6432175	640	11	no				
2018-04-06 12:51:03 AWST	*Eucalyptus todtiana*	392707	6432124	640	8	no			Todtiana	
2018-04-06 09:57:20 AWST	*Jarrah (Eucalyptus marginata)*	392755	6431989	630	9	no			Stag, will have hollows when drops branch	
2018-04-23 10:54:03 AWST	*Jarrah (Eucalyptus marginata)*	392299	6432344	630	6	yes	1	yes	stag large hollow. trunk hollowed by fire, dbh would have been much bigger originally	
2018-04-06 17:23:17 AWST	*Marri (Corymbia calophylla)*	392185	6432200	630	14	no				
2018-04-24 12:34:40 AWST	*Marri (Corymbia calophylla)*	392368	6432279	630	12	no				
2018-04-23 13:38:28 AWST	*Tuart (Eucalyptus gomphocephala)*	392471	6432502	630	10	no				
2018-03-26 11:51:34 AWST	*Jarrah (Eucalyptus marginata)*	391932	6431981	620	14	possible	2		Two potential large hollows	
2018-04-23 15:09:40 AWST	*Jarrah (Eucalyptus marginata)*	392481	6432021	620	8	no				
2018-04-24 11:13:59 AWST	*Jarrah (Eucalyptus marginata)*	392499	6432235	620	7	yes	2	yes	stag, medium hollows 1 occupied by bees	
2018-03-26 12:33:44 AWST	*Marri (Corymbia calophylla)*	391953	6432023	620	10	no				
2018-03-26 13:37:34 AWST	*Marri (Corymbia calophylla)*	391995	6432096	620	10	no				
2018-03-26 16:45:41 AWST	*Marri (Corymbia calophylla)*	391889	6432166	620	12	no				
2018-04-24 14:04:36 AWST	*Marri (Corymbia calophylla)*	392759	6432193	620	10	no				
2018-04-23 14:41:09 AWST	*Tuart (Eucalyptus gomphocephala)*	392550	6432036	620	12	no				
2018-04-23 11:19:01 AWST	*Jarrah (Eucalyptus marginata)*	392373	6432358	610	10	yes	1	yes	medium spout	
2018-03-26 11:45:09 AWST	*Marri (Corymbia calophylla)*	391918	6431983	610	15	possible	1		One spout visible needs further inspection	
2018-04-06 18:02:11 AWST	*Marri (Corymbia calophylla)*	392192	6432286	610	10	yes	1	no	too small for bc	
2018-04-23 10:45:07 AWST	*Marri (Corymbia calophylla)*	392280	6432351	610	10	no				
2018-04-24 13:26:30 AWST	*Marri (Corymbia calophylla)*	392676	6432183	610	12	no				
2018-04-06 17:18:17 AWST	*Marri (Corymbia calophylla)*	392195	6432199	600	14	no			forked at dbh measured just below	
2018-04-06 17:27:20 AWST	*Marri (Corymbia calophylla)*	392156	6432195	600	10	no				
2018-04-24 14:09:44 AWST	*Marri (Corymbia calophylla)*	392753	6432172	600	12	no				
2018-04-23 14:01:40 AWST	*Jarrah (Eucalyptus marginata)*	392405	6432514	590	4	yes	1	yes	large hollow	
2018-03-26 13:06:50 AWST	*Marri (Corymbia calophylla)*	391912	6432081	590	12	no				
2018-04-06 17:07:38 AWST	*Marri (Corymbia calophylla)*	392193	6432173	590	8	no				
2018-04-24 15:48:39 AWST	*Marri (Corymbia calophylla)*	392314	6432202	590	10	no			2 trunks, measured thickest	
2018-04-06 17:31:41 AWST	*Marri (Corymbia calophylla)*	392168	6432206	580	10	no				
2018-03-26 13:10:31 AWST	*Marri (Corymbia calophylla)*	391911	6432071	570	13	no				
2018-03-26 13:12:47 AWST	*Marri (Corymbia calophylla)*	391907	6432085	570	10	no				
2018-04-24 13:40:00 AWST	*Marri (Corymbia calophylla)*	392686	6432173	570	12	no				
2018-04-06 11:22:55 AWST	*Eucalyptus todtiana*	392971	6432139	570	8	no			Todtiana	
2018-03-26 17:42:16 AWST	*Marri (Corymbia calophylla)*	391996	6432216	565	12	no				
2018-04-23 12:37:36 AWST	*Jarrah (Eucalyptus marginata)*	392366	6432584	560	10	no				
2018-04-23 14:34:54 AWST	*Jarrah (Eucalyptus marginata)*	392614	6432036	560	8	no			stag	
2018-04-23 12:41:13 AWST	*Tuart (Eucalyptus gomphocephala)*	392342	6432606	560	12	no				
2018-03-26 11:05:42 AWST	*Marri (Corymbia calophylla)*	391948	6431912	550	8	no				
2018-03-26 12:30:52 AWST	*Marri (Corymbia calophylla)*	391955	6432014	550	12	no				
2018-03-26 12:39:56 AWST	*Marri (Corymbia calophylla)*	391958	6432023	550	14	no				
2018-03-26 14:11:44 AWST	*Marri (Corymbia calophylla)*	391920	6432074	550	12	no				
2018-04-06 17:39:52 AWST	*Marri (Corymbia calophylla)*	392166	6432230	550	11	no				
2018-04-24 15:50:52 AWST	*Marri (Corymbia calophylla)*	392320	6432196	550	12	no				
2018-04-23 14:38:02 AWST	*Tuart (Eucalyptus gomphocephala)*	392561	6432042	550	10	no				
2018-04-23 14:42:36 AWST	*Tuart (Eucalyptus gomphocephala)*	392537	6432039	550	12	no			two trunks measured thickest	
2018-04-23 15:22:31 AWST	*Tuart (Eucalyptus gomphocephala)*	392489	6431983	550	12	no				
2018-04-23 15:14:20 AWST	*Jarrah (Eucalyptus marginata)*	392475	6431958	540	8	no				
2018-04-06 11:53:46 AWST	*Marri (Corymbia calophylla)*	392835	6432099	540	10	no				
2018-04-06 12:09:27 AWST	*Marri (Corymbia calophylla)*	392808	6432108	540	10	no				
2018-04-06 17:24:55 AWST	*Marri (Corymbia calophylla)*	392165	6432197	540	12	no				
2018-04-06 17:59:49 AWST	*Marri (Corymbia calophylla)*	392196	6432291	540	12	no				
2018-04-06 14:18:25 AWST	*Marri (Corymbia calophylla)*	392414	6431794	540	10	no			Check ID	
2018-04-23 15:26:14 AWST	*Tuart (Eucalyptus gomphocephala)*	392502	6431975	540	11	no			two trunks measured largest	

DATE	TAXA	EASTING	NORTHING	DBH (mm)	HEIGHT (m)	HOLLOWS	# HOLLOWS	SUITABLE FOR BC	COMMENTS	PHOTO REF
2018-04-23 09:47:58 AWST	*Jarrah (Eucalyptus marginata)*	392226	6432613	530	8	no			stag 2 trunks. no suitable bc hollows	
2018-03-26 12:07:29 AWST	*Marri (Corymbia calophylla)*	391954	6431994	530	14	no				
2018-04-23 10:43:47 AWST	*Marri (Corymbia calophylla)*	392279	6432353	530	8	no				
2018-03-26 13:50:25 AWST	*Marri (Corymbia calophylla)*	391945	6432053	528	12	no				
2018-04-23 11:12:43 AWST	*Jarrah (Eucalyptus marginata)*	392333	6432340	520	8	yes	1	yes	medium size hollow, stag	
2018-04-24 15:56:26 AWST	*Jarrah (Eucalyptus marginata)*	392300	6432167	520	10	no				
2018-03-26 12:53:05 AWST	*Marri (Corymbia calophylla)*	391918	6432029	520	9	yes	1	yes	One large hollow - burnt stag	
2018-04-06 17:15:52 AWST	*Marri (Corymbia calophylla)*	392207	6432200	520	12	no				
2018-04-24 13:35:36 AWST	*Marri (Corymbia calophylla)*	392677	6432176	520	11	no				
2018-04-24 15:46:18 AWST	*Marri (Corymbia calophylla)*	392324	6432204	520	7	no				
2018-04-06 12:58:10 AWST	*Jarrah (Eucalyptus marginata)*	392719	6432055	510	8	no			Stag	
2018-04-23 11:32:18 AWST	*Jarrah (Eucalyptus marginata)*	392330	6432355	510	8	no				
2018-03-26 13:29:25 AWST	*Marri (Corymbia calophylla)*	391992	6432049	505	12	no				
2018-04-23 14:09:10 AWST	*Jarrah (Eucalyptus marginata)*	392382	6432543	500	8	yes	2	yes	medium size hollows stag	
2018-03-26 17:32:05 AWST	*Marri (Corymbia calophylla)*	391979	6432222	500	14	no			Measured largest trunk	
2018-04-06 11:49:41 AWST	*Marri (Corymbia calophylla)*	392829	6432118	500	6	yes	1	yes	BC suitable	
2018-04-23 11:28:58 AWST	*Marri (Corymbia calophylla)*	392331	6432360	500	11	no				
2018-04-24 13:37:01 AWST	*Marri (Corymbia calophylla)*	392690	6432179	500	11	no				

		
Photo Reference: 1	Photo Reference: 2	Photo Reference: 3
		
Photo Reference: 4	Photo Reference: 5	Photo Reference: 6

		
Photo Reference: 7	Photo Reference: 8	Photo Reference: 9
		
Photo Reference: 10	Photo Reference: 11	Photo Reference: 12

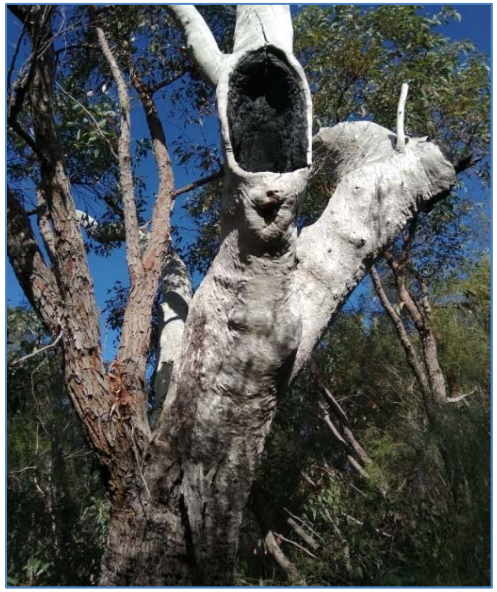
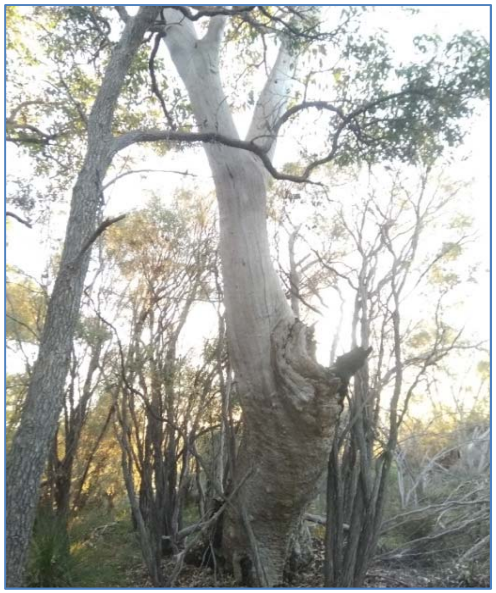
		
Photo Reference: 13	Photo Reference: 14	Photo Reference: 15
		
Photo Reference: 16	Photo Reference: 17	Photo Reference: 18

		
Photo Reference: 19	Photo Reference: 20	Photo Reference: 21
		
Photo Reference: 22	Photo Reference: 23	

APPENDIX I:

Desktop Database Searches

Australian Government
Department of the Environment and Energy

EPBC Act Protected Matters Report

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

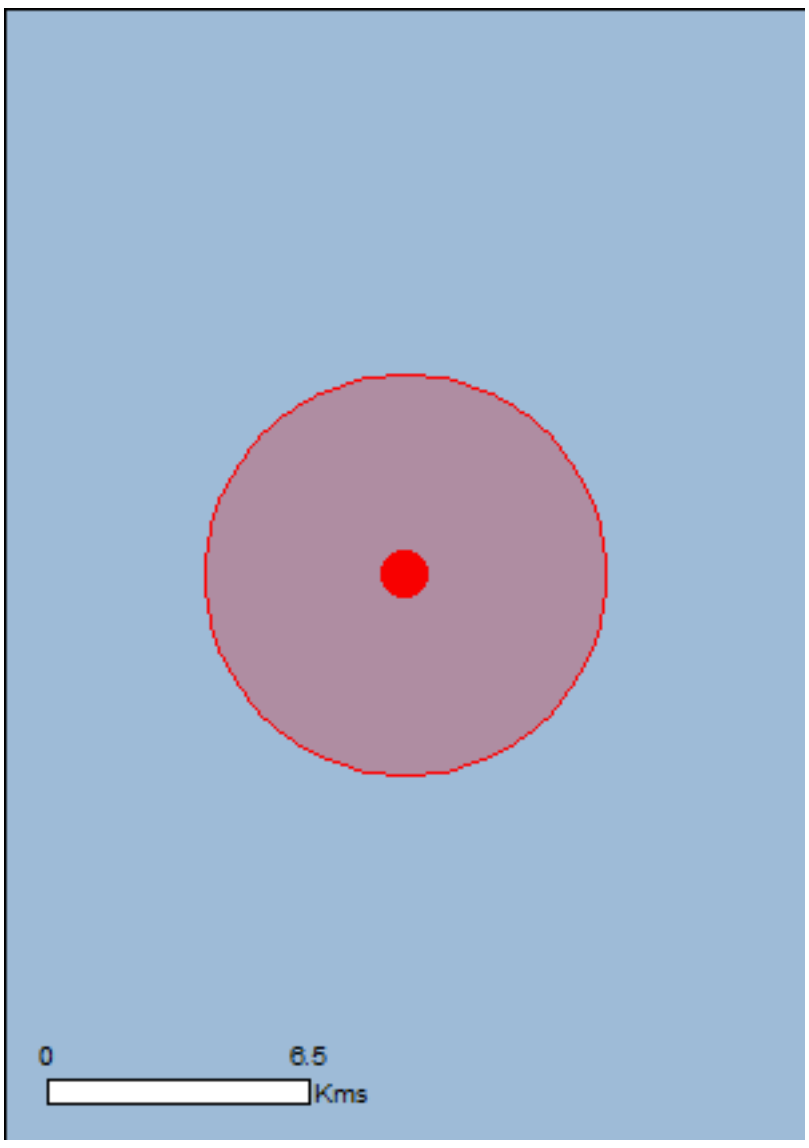
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 19/06/18 22:32:23

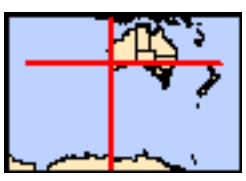
Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements



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

Coordinates
Buffer: 5.0Km



Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	2
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	24
Listed Migratory Species:	10

Other Matters Protected by the EPBC Act

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

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

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

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	16
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

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

State and Territory Reserves:	4
Regional Forest Agreements:	None
Invasive Species:	38
Nationally Important Wetlands:	2
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Forrestdale and thomsons lakes	Within 10km of Ramsar
Peel-yalgorup system	30 - 40km upstream

Listed Threatened Ecological Communities [Resource Information]

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

Name	Status	Type of Presence
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat likely to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat known to occur within area
Calyptorhynchus baudinii Baudin's Cockatoo, Long-billed Black-Cockatoo [769]	Endangered	Roosting known to occur within area
Calyptorhynchus latirostris Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat known to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Mammals		
Bettongia penicillata ogilbyi Woylie [66844]	Endangered	Species or species habitat may occur within

Name	Status	Type of Presence
		area
[Dasyurus geoffroii](#) Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat known to occur within area
[Pseudocheirus occidentalis](#) Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Critically Endangered	Species or species habitat likely to occur within area
Other		
[Westralunio carteri](#) Carter's Freshwater Mussel, Freshwater Mussel [86266]	Vulnerable	Species or species habitat likely to 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 known to occur within area
[Diuris micrantha](#) Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat known to occur within area
[Diuris purdiei](#) Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat likely to occur within area
[Drakaea elastica](#) Glossy-leafed Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid [16753]	Endangered	Species or species habitat known to occur within area
[Drakaea micrantha](#) Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat likely to occur within area
[Eleocharis keigheryi](#) Keighery's Eleocharis [64893]	Vulnerable	Species or species habitat may occur within area
[Eucalyptus x balanites](#) Cadda Road Mallee, Cadda Mallee [87816]	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 likely to occur within area
[Synaphea sp. Serpentine (G.R. Brand 103)](#) [86879]	Critically Endangered	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

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

Name	Threatened	Type of Presence
Migratory Marine Birds		
[Apus pacificus](#) Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
[Motacilla cinerea](#) Grey Wagtail [642]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat known to occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat likely to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat likely to occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus		
Osprey [952]		Species or species habitat likely to occur within area
Tringa nebularia		
Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

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

Name
Commonwealth Land -

Listed Marine Species [Resource Information]

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

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat known to occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat likely to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Banksia	WA
Leda	WA
Modong	WA
Wandi	WA

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

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Funambulus pennantii Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur

Name	Status	Type of Presence
		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
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Solanum elaeagnifolium Silver Nightshade, Silver-leaved Nightshade,		Species or species

Name	Status	Type of Presence
White Horse Nettle, Silver-leaf Nightshade, Tomato Weed, White Nightshade, Bull-nettle, Prairie-berry, Satansbos, Silver-leaf Bitter-apple, Silverleaf-nettle, Trompillo [12323] Tamarix aphylla		habitat likely to occur within area
Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area

Nationally Important Wetlands

[Resource Information]

Name	State
Gibbs Road Swamp System	WA
Spectacles Swamp	WA

Caveat

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

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

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

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

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

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

- migratory and
- marine

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

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

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

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

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

Coordinates

-32.24083 115.85972

Acknowledgements

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

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

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

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NatureMap
Mapping Western Australia's biodiversity

NatureMap Species Report

Created By Guest user on 19/06/2018

Current Names Only Yes
Core Datasets Only Yes
Method 'By Circle'
Centre 115° 51' 35" E,32° 14' 27" S
Buffer 5km
Group By Conservation Status

Conservation Status	Species	Records
Non-conservation taxon	615	5083
Other specially protected fauna	1	1
Priority 1	1	1
Priority 3	6	19
Priority 4	8	114
Protected under international agreement	3	8
Rare or likely to become extinct	6	254
TOTAL	**640**	**5480**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Rare or likely to become extinct					
1.	1596	*Caladenia huegelii (Grand Spider Orchid)*		T	
2.	24731	*Calyptorhynchus banksii subsp. naso (Forest Red-tailed Black Cockatoo)*		T	
3.	24734	*Calyptorhynchus latirostris (Carnaby's Cockatoo, White-tailed Short-billed Black Cockatoo)*		T	
4.	24092	*Dasyurus geoffroii (Chuditch, Western Quoll)*		T	
5.	12938	*Diuris micrantha*		T	
6.	1639	*Drakaea elastica (Glossy-leaved Hammer Orchid)*		T	
Protected under international agreement					
7.	41323	*Actitis hypoleucos (Common Sandpiper)*		IA	
8.	24843	*Plegadis falcinellus (Glossy Ibis)*		IA	
9.	24808	*Tringa nebularia (Common Greenshank, greenshank)*		IA	
Other specially protected fauna					
10.	48070	*Phascogale tapoatafa subsp. wambenger (South-western Brush-tailed Phascogale, Wambenger)*		S	
Priority 1					
11.	16633	*Boronia juncea subsp. juncea*		P1	
Priority 3					
12.	16245	*Cyathochaeta teretifolia*		P3	
13.	20462	*Jacksonia gracillima*		P3	
14.	25147	*Lerista lineata (Perth Slider, Lined Skink)*		P3	
15.	25249	*Neelaps calonotos (Black-striped Snake, black-striped burrowing snake)*		P3	
16.	8163	*Pithocarpa corymbulosa (Corymbose Pithocarpa)*		P3	
17.	25800	*Stylidium paludicola*		P3	
Priority 4					
18.	141	*Aponogeton hexatepalus (Stalked Water Ribbons)*		P4	
19.	4763	*Dodonaea hackettiana (Hackett's Hopbush)*		P4	
20.	48588	*Isoodon fusciventer (Quenda, southwestern brown bandicoot)*		P4	
21.	48022	*Notamacropus irma (Western Brush Wallaby)*		P4	
22.	24328	*Oxyura australis (Blue-billed Duck)*		P4	
23.	17850	*Stylidium ireneae*		P4	
24.	7756	*Stylidium longitubum (Jumping Jacks)*		P4	
25.	33992	*Synemon gratiosa (Graceful Sunmoth)*		P4	
Non-conservation taxon					
26.	15466	*Acacia applanata*			
27.	3374	*Acacia huegelii*			
28.	3502	*Acacia pulchella (Prickly Moses)*			
29.	3557	*Acacia stenoptera (Narrow Winged Wattle)*			
30.	3602	*Acacia willdenowiana (Grass Wattle)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
31.	24260	*Acanthiza apicalis (Broad-tailed Thornbill, Inland Thornbill)*			
32.	24261	*Acanthiza chrysorrhoa (Yellow-rumped Thornbill)*			
33.	24262	*Acanthiza inornata (Western Thornbill)*			
34.	24560	*Acanthorhynchus superciliosus (Western Spinebill)*			
35.	25535	*Accipiter cirrocephalus (Collared Sparrowhawk)*			
36.	24281	*Accipiter cirrocephalus subsp. cirrocephalus (Collared Sparrowhawk)*			
37.	25536	*Accipiter fasciatus (Brown Goshawk)*			
38.	24282	*Accipiter fasciatus subsp. fasciatus (Brown Goshawk)*			
39.	42368	*Acritoscincus trilineatus (Western Three-lined Skink)*			
40.	25755	*Acrocephalus australis (Australian Reed Warbler)*			
41.	6203	*Actinotus glomeratus*			
42.	1775	*Adenanthos cygnorum (Common Woollybush)*			
43.	11837	*Adenanthos cygnorum subsp. cygnorum (Common Woollybush)*			
44.	1791	*Adenanthos obovatus (Basket Flower)*			
45.		*Afraflacilla huntorum*			Y
46.	184	*Aira caryophyllea (Silvery Hairgrass)*	Y		
47.		*Aira caryophyllea/cupaniana group*			
48.	187	*Aira praecox (Early Hairgrass)*	Y		
49.	1728	*Allocasuarina fraseriana (Sheoak, Kondil)*			
50.	4585	*Amperea ericoides*			
51.	20184	*Amphipogon laguroides subsp. laguroides*			
52.	200	*Amphipogon turbinatus*			
53.		*Aname mainae*			
54.	24312	*Anas gracilis (Grey Teal)*			
55.	24315	*Anas rhynchotis (Australasian Shoveler)*			
56.	24316	*Anas superciliosa (Pacific Black Duck)*			
57.	47414	*Anhinga novaehollandiae (Australasian Darter)*			
58.	11434	*Anigozanthos humilis subsp. humilis*			
59.	1411	*Anigozanthos manglesii (Mangles Kangaroo Paw, Kurulbrang)*			
60.	11261	*Anigozanthos manglesii subsp. manglesii*			
61.		*Anser anser*			
62.	24561	*Anthochaera carunculata (Red Wattlebird)*			
63.	24562	*Anthochaera lunulata (Western Little Wattlebird)*			
64.	3686	*Aotus cordifolia*			
65.	3688	*Aotus gracillima*			
66.	3692	*Aotus procumbens*			
67.	1117	*Aphelia cyperoides*			
68.	24991	*Aprasia repens (Sand-plain Worm-lizard)*			
69.	24285	*Aquila audax (Wedge-tailed Eagle)*			
70.		*Araneus cyphoxis*			
71.		*Araneus senicaudatus*			
72.	7838	*Arctotheca calendula (Cape Weed, African Marigold)*	Y		
73.	38964	*Arcyria cinerea*			
74.	38967	*Arcyria incarnata*			
75.	41324	*Ardea modesta (great egret, white egret)*			
76.	24340	*Ardea novaehollandiae (White-faced Heron)*			
77.		*Argiope protensa*			
78.	1264	*Arnocrinum preissii*			
79.	25566	*Artamus cinereus (Black-faced Woodswallow)*			
80.	24353	*Artamus cyanopterus (Dusky Woodswallow)*			
81.		*Artoria flavimana*			
82.		*Artoria linnaei*			
83.		*Artoriopsis expolita*			
84.	8779	*Asparagus asparagoides (Bridal Creeper)*	Y		
85.	20350	*Astartea affinis (West-coast Astartea)*			
86.	20283	*Astartea scoparia (Common Astartea)*			
87.		*Asterella drummondii*			
88.	6334	*Astroloma pallidum (Kick Bush)*			
89.	17234	*Austrostipa compressa*			
90.	17240	*Austrostipa flavescens*			
91.	233	*Avena barbata (Bearded Oat)*	Y		
92.	234	*Avena fatua (Wild Oat)*	Y		
93.	24318	*Aythya australis (Hardhead)*			
94.	18280	*Babiana nana*	Y		
95.	36441	*Babingtonia camphorosmae (Camphor Myrtle)*			
96.		*Backobourkia brounii*			
97.	38979	*Badhamia utricularis*			
98.	1800	*Banksia attenuata (Slender Banksia, Piara)*			
99.	1822	*Banksia ilicifolia (Holly-leaved Banksia)*			
100.	1834	*Banksia menziesii (Firewood Banksia)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
101.		*Barnardius zonarius*			
102.	748	*Baumea vaginalis (Sheath Twigrush)*			
103.	5382	*Beaufortia elegans (Elegant Beaufortia)*			
104.		*Bianor maculatus*			
105.	24319	*Biziura lobata (Musk Duck)*			
106.	4413	*Boronia crenulata (Aniseed Boronia)*			
107.	16636	*Boronia crenulata subsp. viminea*			
108.	4417	*Boronia dichotoma*			
109.	11381	*Boronia ramosa subsp. anethifolia*			
110.	3710	*Bossiaea eriocarpa (Common Brown Pea)*			
111.	6341	*Brachyloma preissii (Globe Heath)*			
112.	7878	*Brachyscome iberidifolia*			
113.	3000	*Brassica tournefortii (Mediterranean Turnip)*	Y		
114.	244	*Briza maxima (Blowfly Grass)*	Y		
115.	245	*Briza minor (Shivery Grass)*	Y		
116.	249	*Bromus diandrus (Great Brome)*	Y		
117.	250	*Bromus hordeaceus (Soft Brome)*	Y		
118.	1366	*Bulbine semibarbata (Leek Lily)*			
119.	1383	*Burchardia bairdiae*			
120.	12770	*Burchardia congesta*			
121.	25715	*Cacatua roseicapilla (Galah)*			
122.	25716	*Cacatua sanguinea (Little Corella)*			
123.	24729	*Cacatua tenuirostris (Eastern Long-billed Corella)*	Y		
124.	25598	*Cacomantis flabelliformis (Fan-tailed Cuckoo)*			
125.	42307	*Cacomantis pallidus (Pallid Cuckoo)*			
126.	1276	*Caesia micrantha (Pale Grass Lily)*			
127.	1277	*Caesia occidentalis*			
128.	1586	*Caladenia discoidea (Dancing Orchid)*			
129.	1592	*Caladenia flava (Cowslip Orchid)*			
130.	15348	*Caladenia flava subsp. flava*			
131.	15361	*Caladenia longicauda subsp. calcigena*			
132.	17760	*Caladenia nobilis*			
133.		*Caladenia sp.*			
134.	2848	*Calandrinia corrigioloides (Strap Purslane)*			
135.	19309	*Calectasia narragara*			
136.	5415	*Calothamnus lateralis*			
137.	25717	*Calyptorhynchus banksii (Red-tailed Black-Cockatoo)*			
138.	5458	*Calytrix flavescens (Summer Starflower)*			
139.	5460	*Calytrix fraseri (Pink Summer Calytrix)*			
140.	5476	*Calytrix sapphirina*			
141.	2795	*Carpobrotus edulis (Hottentot Fig)*	Y		
142.	1162	*Cartonema philydroides*			
143.	2954	*Cassytha micrantha*			
144.	2957	*Cassytha racemosa (Dodder Laurel)*			
145.	11242	*Cassytha racemosa forma pilosa*			
146.	11799	*Cassytha racemosa forma racemosa*			
147.	6214	*Centella asiatica*			
148.	1121	*Centrolepis aristata (Pointed Centrolepis)*			
149.	1125	*Centrolepis drummondiana*			
150.	1132	*Centrolepis mutica*			
151.		*Cercophonius sulcatus*			
152.	24186	*Chalinolobus gouldii (Gould's Wattled Bat)*			
153.	1280	*Chamaescilla corymbosa (Blue Squill)*			
154.	24377	*Charadrius ruficapillus (Red-capped Plover)*			
155.	24321	*Chenonetta jubata (Australian Wood Duck, Wood Duck)*			
156.	24980	*Christinus marmoratus (Marbled Gecko)*			
157.		*Chroicocephalus novaehollandiae*			
158.	24431	*Chrysococcyx basalis (Horsfield's Bronze Cuckoo)*			
159.	24288	*Circus approximans (Swamp Harrier)*			
160.	24774	*Cladorhynchus leucocephalus (Banded Stilt)*			
161.	25675	*Colluricincla harmonica (Grey Shrike-thrush)*			
162.	24399	*Columba livia (Domestic Pigeon)*	Y		
163.	4550	*Comesperma calymega (Blue-spike Milkwort)*			
164.	4555	*Comesperma integerrimum*			
165.	4564	*Comesperma virgatum (Milkwort)*			
166.	15611	*Conospermum stoechadis subsp. stoechadis (Common Smokebush)*			
167.	6348	*Conostephium pendulum (Pearl Flower)*			
168.	6349	*Conostephium preissii*			
169.	1418	*Conostylis aculeata (Prickly Conostylis)*			
170.	11826	*Conostylis aculeata subsp. aculeata*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
171.	1436	*Conostylis juncea*			
172.	1455	*Conostylis setosa (White Cottonhead)*			
173.		*Conyza sp.*			
174.	25568	*Coracina novaehollandiae (Black-faced Cuckoo-shrike)*			
175.		*Cormocephalus novaehollandiae*			
176.	38776	*Cortinarius phalarus*			
177.	25592	*Corvus coronoides (Australian Raven)*			
178.	1285	*Corynotheca micrantha (Sand Lily)*			
179.	24671	*Coturnix pectoralis (Stubble Quail)*			
180.	25595	*Cracticus tibicen (Australian Magpie)*			
181.	24422	*Cracticus tibicen subsp. dorsalis (White-backed Magpie)*			
182.	25596	*Cracticus torquatus (Grey Butcherbird)*			
183.	3137	*Crassula colorata (Dense Stonecrop)*			
184.	11563	*Crassula colorata var. colorata*			
185.	25399	*Crinia glauerti (Clicking Frog)*			
186.	30893	*Cryptoblepharus buchananii*			
187.	30899	*Ctenophorus adelaidensis (Southern Heath Dragon, Western Heath Dragon)*			
188.	25027	*Ctenotus australis*			
189.	25039	*Ctenotus fallens*			
190.	768	*Cyathochaeta avenacea*			
191.		*Cyclosa trilobata*			
192.	24322	*Cygnus atratus (Black Swan)*			
193.	806	*Cyperus polystachyos (Bunchy Sedge)*	Y		
194.	30901	*Dacelo novaeguineae (Laughing Kookaburra)*	Y		
195.	38781	*Dacryopinax spathularia*			
196.	7454	*Dampiera linearis (Common Dampiera)*			
197.	25673	*Daphoenositta chrysoptera (Varied Sittella)*			
198.	1218	*Dasypogon bromeliifolius (Pineapple Bush)*			
199.	3807	*Daviesia divaricata (Marno)*			
200.	3832	*Daviesia physodes*			
201.	3845	*Daviesia triflora*			
202.	25766	*Delma fraseri (Fraser's Legless Lizard)*			
203.	24999	*Delma grayii*			
204.	38785	*Descomyces angustisporus*			
205.	16595	*Desmocladus flexuosus*			
206.	299	*Deyeuxia quadriseta (Reed Bentgrass)*			
207.	1259	*Dianella revoluta (Blueberry Lily)*			
208.	25607	*Dicaeum hirundinaceum (Mistletoebird)*			
209.	39019	*Didymium clavus*			Y
210.	17838	*Dielsia stenostachya*			
211.	9027	*Diplolaena drummondii*			
212.	19649	*Disa bracteata*	Y		
213.	7054	*Dischisma arenarium*	Y		
214.	7055	*Dischisma capitatum (Woolly-headed Dischisma)*	Y		
215.		*Diuris corymbosa/magnifica*			
216.	12939	*Diuris magnifica*			
217.	3095	*Drosera erythrorhiza (Red Ink Sundew)*			
218.	3097	*Drosera gigantea (Giant Sundew)*			
219.	16244	*Drosera gigantea subsp. geniculata*			
220.	3098	*Drosera glanduligera (Pimpernel Sundew)*			
221.	3106	*Drosera macrantha (Bridal Rainbow)*			
222.	3109	*Drosera menziesii (Pink Rainbow)*			
223.	13216	*Drosera menziesii subsp. penicillaris*			
224.	13189	*Drosera oreopodion*			
225.	13188	*Drosera paleacea subsp. paleacea*			
226.	3118	*Drosera pallida (Pale Rainbow)*			
227.	29178	*Drosera porrecta*			
228.	3124	*Drosera pulchella (Pretty Sundew)*			
229.		*Drosera sp. "climbing"*			
230.	25100	*Egernia napoleonis*			
231.		*Egretta novaehollandiae*			
232.		*Ehrharta ?longiflora*			Y
233.	11485	*Ehrharta brevifolia var. cuspidata*	Y		
234.	347	*Ehrharta calycina (Perennial Veldt Grass)*	Y		
235.	349	*Ehrharta longiflora (Annual Veldt Grass)*	Y		
236.		*Ehrharta sp.*			
237.		*Elanus axillaris*			
238.	47937	*Elseyornis melanops (Black-fronted Dotterel)*			
239.	1643	*Elythranthera brunonis (Purple Enamel Orchid)*			
240.		*Eolophus roseicapillus*			

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241.	11756	*Epilobium billardiereanum subsp. cinereum (Variable Willow Herb)*			
242.	6132	*Epilobium ciliatum*	Y		
243.	379	*Eragrostis elongata (Clustered Lovegrass)*			
244.	13950	*Eremaea asterocarpa subsp. asterocarpa*			
245.		*Eriophora biapicata*			
246.	6219	*Eryngium pinnatifidum (Blue Devils)*			
247.	15446	*Eryngium pinnatifidum subsp. pinnatifidum*			
248.	24379	*Erythrogonys cinctus (Red-kneed Dotterel)*			
249.	5708	*Eucalyptus marginata (Jarrah, Djara)*			
250.	13547	*Eucalyptus marginata subsp. marginata (Jarrah)*			
251.	5763	*Eucalyptus rudis (Flooded Gum, Kulurda)*			
252.	5790	*Eucalyptus todtiana (Coastal Blackbutt)*			
253.	3872	*Euchilopsis linearis (Swamp Pea)*			
254.	15137	*Euchiton sphaericus*			
255.	4638	*Euphorbia peplus (Petty Spurge)*	Y		
256.	4648	*Euphorbia terracina (Geraldton Carnation Weed)*	Y		
257.	3880	*Eutaxia virgata*			
258.	835	*Evandra pauciflora*			
259.	25622	*Falco cenchroides (Australian Kestrel, Nankeen Kestrel)*			
260.	24472	*Falco cenchroides subsp. cenchroides (Australian Kestrel, Nankeen Kestrel)*			
261.	25623	*Falco longipennis (Australian Hobby)*			
262.	24041	*Felis catus (Cat)*	Y		
263.	25727	*Fulica atra (Eurasian Coot)*			
264.	24761	*Fulica atra subsp. australis (Eurasian Coot)*			
265.		*Fumaria sp.*			
266.	7323	*Galium murale (Small Goosegrass)*	Y		
267.	25729	*Gallinula tenebrosa (Dusky Moorhen)*			
268.	24763	*Gallinula tenebrosa subsp. tenebrosa (Dusky Moorhen)*			
269.	20473	*Gastrolobium ebracteolatum*			
270.	3936	*Genista linifolia (Flaxleaf Broom)*	Y		
271.	25530	*Gerygone fusca (Western Gerygone)*			
272.	1520	*Gladiolus caryophyllaceus (Wild Gladiolus)*	Y		
273.	47962	*Glyciphila melanops (Tawny-crowned Honeyeater)*			
274.	3957	*Gompholobium tomentosum (Hairy Yellow Pea)*			
275.	6161	*Gonocarpus pithyoides*			
276.	7538	*Goodenia pulchella*			
277.	24443	*Grallina cyanoleuca (Magpie-lark)*			
278.	37500	*Grammatotheca bergiana var. bergiana*	Y		
279.		*Gymnopilus allantopus*			
280.	2788	*Gyrostemon subnudus*			
281.		*Haemodorum sp.*			
282.	1475	*Haemodorum spicatum (Mardja)*			
283.	24293	*Haliaeetus leucogaster (White-bellied Sea-Eagle)*			
284.	25541	*Haliastur indus (Brahminy Kite)*			
285.	24295	*Haliastur sphenurus (Whistling Kite)*			
286.	24296	*Hamirostra isura (Square-tailed Kite)*			
287.	3961	*Hardenbergia comptoniana (Native Wisteria)*			
288.	25410	*Heleioporus eyrei (Moaning Frog)*			
289.	3016	*Heliophila pusilla*	Y		
290.	6839	*Hemiandra pungens (Snakebush)*			
291.	25119	*Hemiergis quadrilineata*			
292.	1293	*Hensmania turbinata*			
293.	5135	*Hibbertia hypericoides (Yellow Buttercups)*			
294.	45534	*Hibbertia hypericoides subsp. hypericoides*			
295.	5154	*Hibbertia perfoliata*			
296.	5162	*Hibbertia racemosa (Stalked Guinea Flower)*			
297.	5173	*Hibbertia subvaginata*			
298.	5176	*Hibbertia vaginata*			
299.	47965	*Hieraaetus morphnoides (Little Eagle)*			
300.	25734	*Himantopus himantopus (Black-winged Stilt)*			
301.	24491	*Hirundo neoxena (Welcome Swallow)*			
302.		*Holasteron perth*			
303.		*Holconia westralia*			
304.	445	*Holcus setiger (Annual Fog)*	Y		
305.		*Holoplatys dejongi*			
306.	6222	*Homalosciadium homalocarpum*			
307.	3966	*Hovea pungens (Devil's Pins, Puyenak)*			
308.	3968	*Hovea trisperma (Common Hovea)*			
309.	12859	*Hovea trisperma var. trisperma*			
310.	5216	*Hybanthus calycinus (Wild Violet)*			

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311.	6224	*Hydrocotyle blepharocarpa*			
312.	6240	*Hydrocotyle scutellifera*			
313.	5817	*Hypocalymma angustifolium (White Myrtle, Kudjid)*			
314.	35070	*Hypocalymma angustifolium subsp. Swan Coastal Plain (G.J. Keighery 16777)*			
315.	5825	*Hypocalymma robustum (Swan River Myrtle)*			
316.	8086	*Hypochaeris glabra (Smooth Catsear)*	Y		
317.	1070	*Hypolaena exsulca*			
318.		*Idiommata blackwalli*			
319.	48508	*Inocybe brunneidisca*			
320.	40870	*Inocybe rufuloides*	Y		
321.		*Iridaceae sp.*			Y
322.	912	*Isolepis cyperoides*			
323.	917	*Isolepis marginata (Coarse Club-rush)*			
324.	919	*Isolepis oldfieldiana*			
325.	924	*Isolepis stellata (Star Club-rush)*			
326.		*Isopeda leishmanni*			
327.	7396	*Isotoma hypocrateriformis (Woodbridge Poison)*			
328.	3992	*Isotropis cuneifolia (Granny Bonnets)*			
329.	4012	*Jacksonia furcellata (Grey Stinkwood)*			
330.	4029	*Jacksonia sternbergiana (Stinkwood, Kapur)*			
331.	4044	*Kennedia prostrata (Scarlet Runner)*			
332.	5832	*Kunzea ericifolia (Spearwood, Pondil)*			
333.	15498	*Kunzea glabrescens (Spearwood)*			
334.	20019	*Lachnagrostis filiformis*			
335.	19955	*Lachnagrostis plebeia*			
336.	19956	*Lachnagrostis preissii*			
337.	8096	*Lactuca serriola (Prickly Lettuce)*	Y		
338.		*Lampona cylindrata*			
339.	24511	*Larus novaehollandiae subsp. novaehollandiae (Silver Gull)*			
340.	4052	*Latrobea tenella*			
341.		*Latrodectus hasseltii*			
342.	1307	*Laxmannia ramosa (Branching Lily)*			
343.	1309	*Laxmannia squarrosa*			
344.	7574	*Lechenaultia floribunda (Free-flowering Leschenaultia)*			
345.	39038	*Leocarpus fragilis*			
346.	44490	*Leontodon rhagadioloides*	Y		
347.	925	*Lepidosperma angustatum*			
348.	937	*Lepidosperma longitudinale (Pithy Sword-sedge)*			
349.	940	*Lepidosperma pubisquameum*			
350.	944	*Lepidosperma scabrum*			
351.		*Lepidosperma sp.*			
352.		*Lepidosperma sp. Baldivis*			Y
353.	29150	*Lepidosperma sp. Margaret River (B.J. Lepschi 1841)*			
354.	945	*Lepidosperma squamatum*			
355.	946	*Lepidosperma striatum*			
356.	1653	*Leporella fimbriata (Hare Orchid)*			
357.	19833	*Leptocarpus laxus*			
358.	1080	*Leptocarpus scariosus*			
359.	2344	*Leptomeria empetriformis*			
360.	1090	*Lepyrodia muirii*			
361.	25131	*Lerista distinguenda*			
362.	25133	*Lerista elegans*			
363.	6360	*Leucopogon australis (Spiked Beard-heath)*			
364.	6374	*Leucopogon conostephioides*			
365.	6436	*Leucopogon propinquus*			
366.		*Levenhookia pusilla/stipitata*			
367.	7677	*Levenhookia stipitata (Common Stylewort)*			
368.	25005	*Lialis burtonis*			
369.	31280	*Lichenomphalia chromacea*			
370.	31333	*Lichenomphalia umbellifera*			
371.	25661	*Lichmera indistincta (Brown Honeyeater)*			
372.	25415	*Limnodynastes dorsalis (Western Banjo Frog)*			
373.	25378	*Litoria adelaidensis (Slender Tree Frog)*			
374.	9289	*Lobelia anceps (Angled Lobelia)*			
375.	7407	*Lobelia rhytidosperma (Wrinkled-seeded Lobelia)*			
376.	7408	*Lobelia tenuior (Slender Lobelia)*			
377.	476	*Lolium perenne (Perennial Ryegrass)*	Y		
378.		*Lomandra ?caespitosa*			
379.		*Lomandra ?preissii*			
380.	1223	*Lomandra caespitosa (Tufted Mat Rush)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
381.	1228	*Lomandra hermaphrodita*			
382.	1232	*Lomandra micrantha (Small-flower Mat-rush)*			
383.	1234	*Lomandra nigricans*			
384.	1239	*Lomandra preissii*			
385.	1243	*Lomandra sericea (Silky Mat Rush)*			
386.	1246	*Lomandra suaveolens*			
387.	8564	*Lotus subbiflorus*	Y		
388.	1198	*Luzula meridionalis (Field Woodrush)*			
389.	39048	*Lycogala epidendrum*			
390.		*Lycosa ariadnae*			
391.	1097	*Lyginia barbata*			
392.		*Lyginia barbata/imberbis*			
393.	18049	*Lyginia imberbis*			
394.	1656	*Lyperanthus serratus (Rattle Beak Orchid)*			
395.	36375	*Lysimachia arvensis (Pimpernel)*	Y		
396.	6456	*Lysinema ciliatum (Curry Flower)*			
397.	6458	*Lysinema elegans*			
398.	2839	*Macarthuria australis*			
399.	24132	*Macropus fuliginosus (Western Grey Kangaroo)*			
400.	18119	*Macrozamia fraseri*			
401.	85	*Macrozamia riedlei (Zamia, Djiridji)*			
402.	24326	*Malacorhynchus membranaceus (Pink-eared Duck)*			
403.	25654	*Malurus splendens (Splendid Fairy-wren)*			
404.	24583	*Manorina flavigula (Yellow-throated Miner)*			
405.		*Maratus pavonis*			
406.	25758	*Megalurus gramineus (Little Grassbird)*			
407.	5926	*Melaleuca lateritia (Robin Redbreast Bush)*			
408.	5952	*Melaleuca preissiana (Moonah)*			
409.	5978	*Melaleuca teretifolia (Banbar)*			
410.	5980	*Melaleuca thymoides*			
411.	47997	*Melanodryas cucullata (Hooded Robin)*			
412.	25184	*Menetia greyii*			
413.	24598	*Merops ornatus (Rainbow Bee-eater)*			
414.	955	*Mesomelaena pseudostygia*			
415.	957	*Mesomelaena tetragona (Semaphore Sedge)*			
416.		*Microcarbo melanoleucos*			
417.	25693	*Microeca fascinans (Jacky Winter)*			
418.	485	*Microlaena stipoides (Weeping Grass)*			
419.	1658	*Microtis atrata (Swamp Mignonette Orchid)*			
420.	10954	*Microtis media (Tall Mignonette Orchid)*			
421.	15419	*Microtis media subsp. media*			
422.	37440	*Monopsis debilis var. depressa*	Y		
423.	4662	*Monotaxis grandiflora (Diamond of the Desert)*			
424.	4666	*Monotaxis occidentalis*			
425.	19179	*Moraea flaccida (One-leaf Cape Tulip)*	Y		
426.	25191	*Morethia lineoocellata*			
427.	25192	*Morethia obscura*			
428.	24223	*Mus musculus (House Mouse)*	Y		
429.	25420	*Myobatrachus gouldii (Turtle Frog)*			
430.	24738	*Neophema elegans (Elegant Parrot)*			
431.		*Nephila edulis*			
432.	492	*Neurachne alopecuroidea (Foxtail Mulga Grass)*			
433.		*Nicodamus mainae*			
434.	25252	*Notechis scutatus (Tiger Snake)*			
435.	2401	*Nuytsia floribunda (Christmas Tree, Mudja)*			
436.	25564	*Nycticorax caledonicus (Rufous Night Heron)*			
437.		*Ocrisiona parmeliae*			
438.	24407	*Ocyphaps lophotes (Crested Pigeon)*			
439.		*Ommatoiulus moreletii*			
440.	12782	*Ophioglossum gramineum*			
441.	24085	*Oryctolagus cuniculus (Rabbit)*	Y		
442.	4358	*Oxalis purpurea (Largeflower Wood Sorrel)*	Y		
443.	25680	*Pachycephala rufiventris (Rufous Whistler)*			
444.	1667	*Paracaleana nigrita (Flying Duck Orchid)*			
445.	516	*Parapholis incurva (Coast Barbgrass)*	Y		
446.	25253	*Parasuta gouldii*			
447.	25681	*Pardalotus punctatus (Spotted Pardalote)*			
448.	25682	*Pardalotus striatus (Striated Pardalote)*			
449.	24642	*Passer montanus (Eurasian Tree Sparrow)*	Y		
450.	1550	*Patersonia occidentalis (Purple Flag, Koma)*			

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451.	30471	*Patersonia occidentalis var. angustifolia*			
452.	4343	*Pelargonium capitatum (Rose Pelargonium)*	Y		
453.	24648	*Pelecanus conspicillatus (Australian Pelican)*			
454.	40423	*Pentameris airoides (False Hairgrass)*	Y		
455.	6006	*Pericalymma ellipticum (Swamp Teatree)*			
456.	16477	*Pericalymma ellipticum var. ellipticum*			
457.	2273	*Persoonia saccata (Snottygobble)*			
458.	48060	*Petrochelidon ariel (Fairy Martin)*			
459.	48061	*Petrochelidon nigricans (Tree Martin)*			
460.	48066	*Petroica boodang (Scarlet Robin)*			
461.	24659	*Petroica goodenovii (Red-capped Robin)*			
462.	2299	*Petrophile linearis (Pixie Mops)*			
463.	2301	*Petrophile macrostachya*			
464.	2312	*Petrophile striata*			
465.	25697	*Phalacrocorax carbo (Great Cormorant)*			
466.	25698	*Phalacrocorax melanoleucos (Little Pied Cormorant)*			
467.	24667	*Phalacrocorax sulcirostris (Little Black Cormorant)*			
468.	25699	*Phalacrocorax varius (Pied Cormorant)*			
469.	24409	*Phaps chalcoptera (Common Bronzewing)*			
470.	18529	*Philotheca spicata (Pepper and Salt)*			
471.		*Phlebia subceracea*			
472.	1478	*Phlebocarya ciliata*			
473.		*Phryganoporus candidus*			
474.	48071	*Phylidonyris niger (White-cheeked Honeyeater)*			
475.	24596	*Phylidonyris novaehollandiae (New Holland Honeyeater)*			
476.	16177	*Phyllangium paradoxum*			
477.	4675	*Phyllanthus calycinus (False Boronia)*			
478.	39071	*Physarum luteolum*			Y
479.	39079	*Physarum viride*			
480.		*Phytophthora cinnamomi*			
481.	5252	*Pimelea lanata*			
482.		*Pinkfloydia harveii*			
483.	24841	*Platalea flavipes (Yellow-billed Spoonbill)*			
484.	25720	*Platycercus icterotis (Western Rosella)*			
485.	24747	*Platycercus spurius (Red-capped Parrot)*			
486.	24750	*Platycercus zonarius subsp. semitorquatus (Twenty-eight Parrot)*			
487.	6249	*Platysace compressa (Tapeworm Plant)*			
488.	25007	*Pletholax gracilis subsp. gracilis (Keeled Legless Lizard)*			
489.		*Pluteus atromarginatus*			
490.	38825	*Pluteus pauperculus*			
491.	573	*Poa drummondiana (Knotted Poa)*			
492.		*Poaceae sp.*			
493.	25703	*Podargus strigoides (Tawny Frogmouth)*			
494.	25704	*Podiceps cristatus (Great Crested Grebe)*			
495.	8175	*Podolepis gracilis (Slender Podolepis)*			
496.		*Podotheca ?gnaphalioides*			
497.	8182	*Podotheca angustifolia (Sticky Longheads)*			
498.	8184	*Podotheca gnaphalioides (Golden Long-heads)*			
499.	25510	*Pogona minor (Dwarf Bearded Dragon)*			
500.	24907	*Pogona minor subsp. minor (Dwarf Bearded Dragon)*			
501.	24681	*Poliocephalus poliocephalus (Hoary-headed Grebe)*			
502.	582	*Polypogon monspeliensis (Annual Beardgrass)*	Y		
503.	583	*Polypogon tenellus*			
504.	25722	*Polytelis anthopeplus (Regent Parrot)*			
505.	4691	*Poranthera microphylla (Small Poranthera)*			
506.		*Poranthera microphylla/moorokatta*			
507.	25731	*Porphyrio porphyrio (Purple Swamphen)*			
508.	24767	*Porphyrio porphyrio subsp. bellus (Purple Swamphen)*			
509.	1670	*Prasophyllum drummondii (Swamp Leek Orchid)*			
510.	1676	*Prasophyllum hians (Yawning Leek Orchid)*			
511.	10853	*Prasophyllum plumiforme*			
512.	25511	*Pseudonaja affinis (Dugite)*			
513.	25259	*Pseudonaja affinis subsp. affinis (Dugite)*			
514.	42416	*Pseudonaja mengdeni (Western Brown Snake)*			
515.	25433	*Pseudophryne guentheri (Crawling Toadlet)*			
516.		*Pterostylis aff. nana*			
517.		*Pterostylis aff. nana long sepal*			Y
518.	1693	*Pterostylis recurva (Jug Orchid)*			
519.	12217	*Pterostylis sanguinea*			
520.	1698	*Pterostylis vittata (Banded Greenhood)*			

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521.	11260	*Ptilotus drummondii var. drummondii (Pussytail)*			
522.	4181	*Pultenaea reticulata*			
523.		*Purpureicephalus spurius*			
524.	16367	*Pyrorchis nigricans (Red beaks, Elephants ears)*			
525.	8195	*Quinetia urvillei*			
526.	24245	*Rattus rattus (Black Rat)*	Y		
527.		*Raveniella peckorum*			
528.	24776	*Recurvirostra novaehollandiae (Red-necked Avocet)*			
529.	48096	*Rhipidura albiscapa (Grey Fantail)*			
530.	25614	*Rhipidura leucophrys (Willie Wagtail)*			
531.	13300	*Rhodanthe citrina*			
532.		*Rickenella fibula*			
533.	1556	*Romulea rosea (Guildford Grass)*	Y		
534.	40431	*Rytidosperma acerosum*			
535.	40426	*Rytidosperma occidentale*			
536.	7603	*Scaevola canescens (Grey Scaevola)*			
537.	982	*Schoenus clandestinus*			
538.	984	*Schoenus curvifolius*			
539.	986	*Schoenus efoliatus*			
540.	1007	*Schoenus pedicellatus*			
541.	1017	*Schoenus subbulbosus*			
542.	6033	*Scholtzia involucrata (Spiked Scholtzia)*			
543.	25534	*Sericornis frontalis (White-browed Scrubwren)*			
544.		*Servaea melaina*			
545.		*Servaea spinibarbis*			
546.	2909	*Silene gallica (French Catchfly)*	Y		
547.	8225	*Siloxerus humifusus (Procumbent Siloxerus)*			
548.		*Siloxerus humifusus/filifolius*			
549.		*Simaetha tenuior*			
550.	25266	*Simoselaps bertholdi (Jan's Banded Snake)*			
551.	30948	*Smicrornis brevirostris (Weebill)*			
552.	7022	*Solanum nigrum (Black Berry Nightshade)*	Y		
553.	8231	*Sonchus oleraceus (Common Sowthistle)*	Y		
554.	1312	*Sowerbaea laxiflora (Purple Tassels)*			
555.		*Steatoda grossa*			
556.	39087	*Stemonitis splendens*			
557.	2316	*Stirlingia latifolia (Blueboy)*			
558.	25597	*Strepera versicolor (Grey Currawong)*			
559.	25589	*Streptopelia chinensis (Spotted Turtle-Dove)*	Y		
560.	30951	*Streptopelia chinensis subsp. tigrina (Spotted Turtle-Dove)*	Y		
561.	25590	*Streptopelia senegalensis (Laughing Turtle-Dove)*	Y		
562.	25831	*Stylidium araeophyllum (Stilt Walker)*			
563.		*Stylidium araeophyllum/neurophyllum*			
564.	7693	*Stylidium brunonianum (Pink Fountain Triggerplant)*			
565.	7696	*Stylidium calcaratum (Book Triggerplant)*			
566.	7699	*Stylidium carnosum (Fleshy-leaved Triggerplant)*			
567.	7717	*Stylidium divaricatum (Daddy-long-legs)*			
568.	7718	*Stylidium diversifolium (Touch-me-not)*			
569.	7734	*Stylidium guttatum (Dotted Triggerplant)*			
570.	7774	*Stylidium piliferum (Common Butterfly Triggerplant)*			
571.	7785	*Stylidium repens (Matted Triggerplant)*			
572.	7798	*Stylidium schoenoides (Cow Kicks)*			
573.	7806	*Stylidium utricularioides (Pink Fan Triggerplant)*			
574.	2326	*Synaphea polymorpha (Albany Synaphea, Pinda)*			
575.	2329	*Synaphea spinulosa*			
576.	15532	*Synaphea spinulosa subsp. spinulosa*			
577.	25705	*Tachybaptus novaehollandiae (Australasian Grebe, Black-throated Grebe)*			
578.	24682	*Tachybaptus novaehollandiae subsp. novaehollandiae (Australasian Grebe, Black-throated Grebe)*			
579.	24331	*Tadorna tadornoides (Australian Shelduck, Mountain Duck)*			
580.		*Tamopsis distinguenda*			
581.		*Tamopsis perthensis*			
582.	24167	*Tarsipes rostratus (Honey Possum, Noolbenger)*			
583.	20135	*Taxandria linearifolia*			
584.		*Tetragnatha valida*			
585.	1702	*Thelymitra campanulata (Shirt Orchid)*			
586.	1705	*Thelymitra crinita (Blue Lady Orchid)*			
587.	11143	*Thelymitra graminea*			
588.	11053	*Thelymitra macrophylla*			
589.	1710	*Thelymitra mucida (Plum Orchid)*			

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590.	20731	*Thelymitra vulgaris*			
591.	20728	*Thelymitra xanthotricha*			
592.	24845	*Threskiornis spinicollis (Straw-necked Ibis)*			
593.	1318	*Thysanotus arbuscula*			
594.	1319	*Thysanotus arenarius*			
595.	1328	*Thysanotus dichotomus (Branching Fringe Lily)*			
596.		*Thysanotus manglesianus/patersonii complex*			
597.	1339	*Thysanotus multiflorus (Many-flowered Fringe Lily)*			
598.	1343	*Thysanotus patersonii*			
599.	1351	*Thysanotus sparteus*			
600.	1357	*Thysanotus thyrsoideus*			
601.	25203	*Tiliqua occipitalis (Western Bluetongue)*			
602.	25519	*Tiliqua rugosa*			
603.	25207	*Tiliqua rugosa subsp. rugosa*			
604.	25549	*Todiramphus sanctus (Sacred Kingfisher)*			
605.	6280	*Trachymene pilosa (Native Parsnip)*			
606.	38845	*Trechispora farinacea*			
607.	1481	*Tribonanthes australis*			
608.	48141	*Tribonyx ventralis (Black-tailed Native-hen)*			
609.	25723	*Trichoglossus haematodus (Rainbow Lorikeet)*			
610.	25521	*Trichosurus vulpecula (Common Brushtail Possum)*			
611.	24158	*Trichosurus vulpecula subsp. vulpecula (Common Brushtail Possum)*			
612.	1361	*Tricoryne elatior (Yellow Autumn Lily)*			
613.	1363	*Tricoryne tenella*			
614.	39103	*Tubifera ferruginosa*			
615.	48147	*Turnix varius (Painted Button-quail)*			
616.	24852	*Tyto alba subsp. delicatula (Barn Owl)*			
617.		*Unknown Annual Grasses*			
618.		*Urodacus novaehollandiae*			
619.	8254	*Urospermum picroides (False Hawkbit)*	Y		
620.	8255	*Ursinia anthemoides (Ursinia)*	Y		
621.	25218	*Varanus gouldii (Bungarra or Sand Monitor)*			
622.		*Venatrix pullastra*			
623.	24040	*Vulpes vulpes (Red Fox)*	Y		
624.	722	*Vulpia bromoides (Squirrel Tail Fescue)*	Y		
625.	724	*Vulpia myuros (Rat's Tail Fescue)*	Y		
626.	12052	*Vulpia myuros forma megalura*	Y		
627.	33101	*Vulpia myuros forma myuros*	Y		
628.		*Vulpia sp.*			
629.	7384	*Wahlenbergia capensis (Cape Bluebell)*	Y		
630.	7389	*Wahlenbergia preissii*			
631.	8282	*Waitzia suaveolens (Fragrant Waitzia)*			
632.	18118	*Watsonia meriana var. meriana*	Y		
633.	12072	*Wurmbea dioica subsp. alba*			
634.	1256	*Xanthorrhoea preissii (Grass tree, Palga)*			
635.		*Xanthorrhoea sp.*			
636.	6289	*Xanthosia huegelii*			
637.	2331	*Xylomelum occidentale (Woody Pear, Djandin)*			
638.	1049	*Zantedeschia aethiopica (Arum Lily)*	Y		
639.		*Zebraplatys fractivittata*			
640.	25765	*Zosterops lateralis (Grey-breasted White-eye, Silvereye)*			

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

FID	Sheet	NameID	Taxon	Cons_Code	Plant_Desc	Site	Vegetation	Frequency	Notes	Locality	Latitude	Longitude	Geocode_Me	Precision	Date
10812	7332025	16633	Boronia juncea subsp. juncea	1	Shrub to 1 m high x 0.5 m wide. Pink and purple flowers.	Gentle slope with a north aspect. Surface soil is dark brown sandy loam and sub surface soil is dark brown sandy loam. Drainage is poor and wet during winter and spring only with soil being waterlogged at present.	Melaleuca preissiana, M. rhaphiophylla low open woodland over Astartea scoparia closed heath over Centella asiatica herbland. Excellent to pristine vegetation condition with some weed species affecting the herb layer.	a couple.		Braddock Road, Wellard	-32.267472	115.874611	GPS	1	2/12/2005
15529	7332149	16245	Cyathochaeta teretifolia	3	Tufty sedge with height of 1.5 m and width of 1 m.	Gentle slope with a north aspect. Surface soil is dark brown sandy loam and sub surface soil is dark brown sandy loam. Drainage is poor and wet during winter and spring only with soil being waterlogged at present.	Melaleuca preissiana, M. rhaphiophylla low open woodland over Astartea scoparia closed heath over Centella asiatica herbland. Excellent to pristine vegetation condition with some weed species affecting the herb layer.	locally common.	Outside quadrat.	Braddock Road, Wellard	-32.267472	115.874611	GPS	1	2/12/2005
15543	7858736	16245	Cyathochaeta teretifolia	3		Black peat.	Melaleuca preissiana, Eucalyptus rudis subsp. rudis, Pteridium esculentum			Lot 100, Treeby Rd, Anketell	-32.257853	115.85987	GPS	0	24/10/2007
17868	8649731	12938	Diuris micrantha	T	Orchid.	Swamp. Inundated black clay peat. Burnt in 2009.	Open scrub over dense low sedges. Lepidosperma longitudinale, Wurmbea sp., Burchardia sp., Romulea rosea, Trifolium sp., cape tulip.	7 plants.	Area occupied is c. 2.5 m x 1.5 m. Population 1a.	Lot 9206 Johnson Road, Bertram. Population occurs within swamp on W side of Johnson Road c. 630 m S of Holden and Johnson Roads intersection and c. 70 m W of E boundary fence	-32.242791	115.847805	GPS	1	22/09/2009
17962	7104588	4763	Dodonaea hackettiana	4	Perennial, erect shrub, 4 m high x 3 m wide. Orange flowers. Reproductive method: seeds.	Plain. Reserve. Lake upland. Beeliar Regional Park. Grey dry sand. Soil disturbed 20 years ago.	Tall trees with Eucalyptus rudis and paperbarks.	6-20 plants in 10 m x 10 m area.	Population structure: 50% in bud, 100% flowering. With many alien species.	About 40 m S of Osprey Drive and just E of the drain going under Osprey Drive (which is W of Parkes Road); Yangebup	-32.280451	115.832321	GPS	1	16/10/2003
18030	231282	1639	Drakaea elastica	T		In deep grey sand on gradual slopes in undulating plain.	Low woodland of Banksia attenuata, B. menziesii, B. ilicifolia, and Jarrah over scrub of Adenanthos cygnorum and Kunzea over herbs.	ca 60 plants.	Abundance: ca 60 plants.	Mandogalup, S of Perth, 0.8 km S of Hope Valley Road, along Treeby Road	-32.2	115.866667	MAN	3	28/10/1982
31901	4463781	20462	Jacksonia gracillima	3	Swamp Form. Low spreading shrub.	Soil: Grey sand. Topography/drainage: Well drained flat. Geomorphology: Bassendean sands.	Vegetation: Banksia attenuata, B. ilicifolia Low Forest A over Melalueca thymoides, Kunzea ericifolia Scrub over Patersonia occidentalis, Dasypogon bromilifolius Herbs over Lepidosperma angustatum Very Open Low Sedges.			Location: Modong Nature Reserve, S of Thomas Rd, 10 km W of Byford (plot modo-5).	-32.223227	115.903153	GPS	1	27/11/1992
43601	7746865	17850	Stylidium ireneae	4						Kwinana	-32.25	115.833333	UNK	3	2/12/2004
43932	7332416	25800	Stylidium paludicola	3	Small herb to 400 mm high. Just finished flowering.	Gentle slope with a south east aspect. Surface soil is a very dark brown sandy loam and the subsurface soil is a very dark brown sandy loam/loam. Wetland - winter wet. Litter cover 90% with 10% bare ground.	Melaleuca preissiana woodland over Astartea scoparia open heath over Lepidosperma longitudinale open sedgeland.	occasional.		Miyak Court, Anketell	-32.218444	115.880611	GPS	1	7/12/2005

Taxon	Status	Rank	UCNCriteri	EPBC	DPaWRegion	DPaWDistrict	Distribution	oweringPeri	ecoveryPlan	
Aponogeton hexatepalus	4				SWAN,SWST	BLACKWOOD,PERTH HILLS,SWAN COASTAL,WELLINGTON	Perth, Pinjarra, Capel, Bunbury, Boyanup, Nannup, Bertram, Mundijong	Aug-Sep		
Boronia juncea subsp. juncea	1				SWAN,SWST	BLACKWOOD,SWAN COASTAL	Myalup, Wellard	Apr		
Cyathochaeta teretifolia	3				SWAN,WARR	FRANKLAND,SWAN COASTAL	Whiteman Park, Lake Gnangara, Ellenbrook, Muchea, Denbarker, Yelverton, Wellard, Mundijong	Dec		
Diuris micrantha	T	VU	D1	VU	SWAN,SWST	PERTH HILLS,SWAN COASTAL,WELLINGTON	Medina, Yarloop, Yunderup, Manjimup, Bowelling, Meelon, Bertram	Aug-Oct		
Dodonaea hackettiana	4				SWAN	SWAN COASTAL	Wattleup, Thompson Lake, Kings Park, Jandakot, Bibra Lake-The Spectacles, Gingin, Peron, Baldivis, Beeliar, Baldivis, Harry Waring Marsupial Reserve	Jul-Oct		
Schoenus capillifolius	3				SWAN,SWST,WHTB	PERTH HILLS,SWAN COASTAL,WELLINGTON,GREAT SOUTHERN,CENTRAL WHEATBELT	Upper Swan, Kenwick, Waterloo, Beauford River, Beverley, Goomalling, Carousel Swamp, Pearce, Waroona, Karnup, Baldivis	Sep-Nov		
Stylidium paludicola	3				SWAN,SWST	BLACKWOOD,SWAN COASTAL,WELLINGTON	Bullsbrook, Ruabon, Mandogalup, Lake Clifton, Cookernup, Capel, Dardanup			
Thelymitra variegata	2				SCST,SWAN,SWST,WARR,WHTB	BLACKWOOD,ALBANY,FRANKLAND,SWAN COASTAL,GREAT SOUTHERN	Baldivis, Capel, Albany, Hyden, Mt Lindesay	Aug-Sep		

FID	PopId	Nameid	Taxon	ConsStatus	WARank	PopNumber	SubPopCode	PopStatus	Location	District	Vesting	Purpose1	Purpose2	CountDate	Method	MatureCoun	JuvenileCo	SeedlingCo	LiveTotal	PlantTypeC	AreaOccupi	inFlower	Population
2446	84399	141	Aponogeton hexatepalus	4		22			ca 600m S of Orton Rd on Johnson Rd, W side. W side of swamp, almost adj drain on E side.	SWAN COASTAL	NON	UCL		16/09/1993 0:00	ESTMT	0			100			N	
4550	84970	1596	Caladenia huegelii	T	CR	9			West of Johnson Road, 200m west and then 120m south of intersection (roundabout) of Holden Close (extension of Orton Road). Opposite Johnson Rd and Orton Rd intersection.	SWAN COASTAL	RDL	UCL		1/10/2004 0:00		0			0			N	
4605	97306	1596	Caladenia huegelii	T	CR	59	A		The north western boundary of Wandi Nature Reserve (Reserve No. 36110), within the Town of Kwinana. Approximately 100m NE of 30 Blackboy Grove, Wandi.	SWAN COASTAL	CC	CFF		21/09/2004 0:00		1			1			N	
4606	97307	1596	Caladenia huegelii	T	CR	59	B		Wandi Nature Reserve (Reserve No. 36110), from 30 Blackboy Grove, Wandi head south along Wandi NR boundary fence for ca. 150m, then east ca. 200m (ca. 130m NW of the southern boundary fence).	SWAN COASTAL	CC	CFF		21/09/2004 0:00		1			1			Y	
4607	97308	1596	Caladenia huegelii	T	CR	59	C		Western boundary of Wandi Nature Reserve (Reserve No. 36110). Halfway down track along W boundary. Approx 320m in from De Haer Rd. ~5m E of track. Town of Kwinana.	SWAN COASTAL	CC	CFF		4/10/2010 0:00	ACT_IND	0			0			N	
4608	97309	1596	Caladenia huegelii	T	CR	59	D		121 De Haer Rd, Wandi. The southern boundary of Wandi Nature Reserve (Reserve No. 36110). Approx 440m SW down De Haer Rd from E corner of Reserve, approx 40m in from Road verge. Within the Town of Kwinana.	SWAN COASTAL	CC	CFF		4/10/2011 0:00	ACT_IND	1			0	PLANTS	1	Y	HEALTHY
4633	106981	1596	Caladenia huegelii	T	CR	78	A		Private Property Lot 674 Lyon Road, Wandi. Site is 720m north of Anketell Road. Plant is on the disturbed edge of the eastern firebreak that runs parallel to Lyon Road.	SWAN COASTAL	PRI			25/09/2012 0:00	ACT_IND	1	1		0	PLANTS	1	Y	HEALTHY
4634	107683	1596	Caladenia huegelii	T	CR	78	B		Private Property Lot 52 Lyon Road, Wandi. Site is 430m north of Anketell Road. Plants are on the disturbed edge of the eastern firebreak that runs parallel to Lyon Road and approx 20m in the bushland.	SWAN COASTAL	PRI			25/09/2013 0:00	ACT_IND	3			0	PLANTS		Y	HEALTHY
6260	93196	16245	Cyathochaeta teretifolia	3		12			Private Property. Lot 100, Treeby Rd. Anketell. Kwinana.	SWAN COASTAL	PRI			24/10/2007 0:00		0			0			N	
6273	93210	16245	Cyathochaeta teretifolia	3		25			Private Property. No. 52 Braddock Rd, Wellard (in possible wetland ca.360m N-NNE of Braddock-Levington Rd intersection - EXTRAPOLATED). Kwinana	SWAN COASTAL	PRI			2/12/2005 0:00		0			0			N	
7148	101444	12938	Diuris micrantha	T	VU	1	A		UCL, Lot 9206. Johnson Road, Bertram. Population occurs within swamp on western side of Johnson Road approximately 630m south of Holden and Johnson intersection, and approximately 70m west of eastern boundary fence	SWAN COASTAL	NON	UCL		20/09/2010 0:00	ACT_IND	6			0	PLANTS	3.75	Y	HEALTHY
7149	101445	12938	Diuris micrantha	T	VU	1	B		UCL. Ca 600m S of Orton Rd on Johnson Rd, W side. On W side of drain (previously known as Lot 1201, State Housing Commission).	SWAN COASTAL	NON	UCL		24/09/2002 0:00		0			0			N	
7227	87256	4763	Dodonaea hackettiana	4		15			Near the Spectacles, Peel Estate. W side of Johnson Rd, 1 km N of Thomas Rd.	SWAN COASTAL	PRI			5/01/1987 0:00	ESTMT	3			3			N	
7235	87263	4763	Dodonaea hackettiana	4		22			NON Lot.459. About 40m S of Ospery Drv & just E of the drain going under Osprey Drv (which is W of Parkes Rd); Yangebup. Beeliar Regional Park.	SWAN COASTAL	NON	UCL		16/10/2003 0:00	UNKNOWN	12			12			Y	
7293	97391	1639	Drakaea elastica	T	CR	2	A	X	**Extinct - Cleared for housing** Mandogalup, south west of Perth. 0.8km south of Hope Valley Rd on west side of Treeby Rd, on Lot 33.	SWAN COASTAL	PRI			28/07/2005 0:00		0			0			N	
7294	97392	1639	Drakaea elastica	T	CR	2	B	X	**Extinct - cleared for housing** Mandogalup, south west of Perth. 0.8km south of Hope Valley Rd on west side of Treeby Rd, on Lot 34.	SWAN COASTAL	PRI			28/07/2005 0:00		0			0			N	
7295	97393	1639	Drakaea elastica	T	CR	2	C	X	**Extinct - cleared for housing** Mandogalup, south west of Perth. 0.8km south of Hope Valley Rd on west side of Treeby Rd, on Lot 35.	SWAN COASTAL	PRI			28/07/2005 0:00		0			0			N	
15711	89306	7756	Stylidium longitubum	4		23			PRI Lot.305. Braddock Rd, Wellard.	SWAN COASTAL	PRI			17/11/1995 0:00		0			0			N	

NAME_SCI	SOURCE	SOURCE_ID	NAME_ID	FAMILY	GENUS	SPECIES	SUBSPECIES	NAME_COM	KINGDOM	CLASS	CONS_CODE	CERTAINTY	METHOD	TYPE	EVIDENCE	BREEDING / NON	COUNT	LOCALITY	SITE	ACCURACY_M	DAY	MONTH	YEAR
Calyptorhynchus sp. 'white-tailed black cocaktoo'	BIRDATLAS1	45940|266	0	Cacatuidae	Calyptorhynchus	sp. 'white-tailed black cockatoo'		white-tailed black cockatoo	Animalia	BIRD	EN	Moderately Certain	Observational	Sighting			1	OLDBURY	OLDBURY	18000	14	7	1978
Calyptorhynchus latirostris	BIRDATLAS2	218338|794	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Observational	Sighting			1	BANJUP	Denis De Young Reserve	100	14	5	2004
Calyptorhynchus latirostris	BIRDATLAS2	218339|794	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Observational	Sighting			1	BANJUP	Denis De Young Reserve	100	16	7	2004
Calyptorhynchus latirostris	BIRDATLAS2	218891|794	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Observational	Sighting			1	BANJUP	Buckingham Reserve	100	17	7	2005
Calyptorhynchus latirostris	BIRDATLAS2	266533|794	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Observational	Sighting			1	WATTLEUP	Thompsons Lake	100	30	12	2001
Calyptorhynchus latirostris	BIRDATLAS2	267982|794	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Observational	Sighting			1	WATTLEUP	Thomsons Lake, Beeliar	100	30	12	2001
Calyptorhynchus latirostris	BIRDATLAS2	286456|794	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Observational	Sighting			1	THE SPECTACLES	The Spectacles	100	19	9	2002
Calyptorhynchus latirostris	BIRDATLAS2	33905|794	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Observational	Sighting			1	OAKFORD	Modong Nature Reserve, Oakford	100	3	7	1999
Calyptorhynchus latirostris	BIRDATLAS2	5080156|794	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Observational	Sighting			1	BALDIVIS	wellard wetlands	0	19	3	2011
Calyptorhynchus latirostris	BIRDATLAS2	5103590|794	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Observational	Sighting			1	BALDIVIS	Wellard Wetlands	100	27	4	2012
Calyptorhynchus latirostris	BIRDATLAS2	5103604|794	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Observational	Sighting			1	BALDIVIS	Wellard Wetlands	100	31	8	2010
Calyptorhynchus latirostris	BIRDATLAS2	5130679|794	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Observational	Sighting			1	BALDIVIS	wellard wetlands	0	1	8	2013
Calyptorhynchus latirostris	BIRDATLAS2	770720|794	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Observational	Sighting			1	BALDIVIS	Lake Wellard	0	26	6	2009
Calyptorhynchus latirostris	BIRDATLAS2	88888|794	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Observational	Sighting			1	MEDINA	Thomas Oval, Medina	500	20	7	2000
Calyptorhynchus latirostris	BIRDATLAS2	88889|794	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Observational	Sighting			1	HOPE VALLEY	Hope Valley	5000	22	7	2000
Calyptorhynchus banksii naso	FAUNASURVEY	547125	24731	Cacatuidae	Calyptorhynchus	banksii	naso	forest red-tailed black cockatoo	Animalia	BIRD	VU	Certain	Survey	Unknown			2	BALDIVIS	Baldivis, Tamworth Reservoir	100	4	12	2012
Calyptorhynchus banksii naso	FAUNASURVEY	547126	24731	Cacatuidae	Calyptorhynchus	banksii	naso	forest red-tailed black cockatoo	Animalia	BIRD	VU	Certain	Survey	Unknown			10	BALDIVIS	Baldivis, Tamworth Reservoir	100	4	12	2012
Calyptorhynchus banksii naso	FAUNASURVEY	1208904	24731	Cacatuidae	Calyptorhynchus	banksii	naso	forest red-tailed black cockatoo	Animalia	BIRD	VU	Certain	Survey	Unknown			2	WELLARD	Casuarina, Banksia Road	100	14	4	2015
Calyptorhynchus latirostris	FAUNASURVEY	756634	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Unknown			6	WELLARD	Casuarina, LOT 1320 LOT 53	100	23	11	2013
Calyptorhynchus latirostris	FAUNASURVEY	756635	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Unknown			32	WELLARD	Casuarina, LOT 1320 LOT 53	100	22	11	2013
Calyptorhynchus latirostris	FAUNASURVEY	756636	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Unknown			12	WELLARD	Casuarina, LOT 1320 LOT 53	100	23	11	2013
Calyptorhynchus latirostris	FAUNASURVEY	756637	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Unknown			13	WELLARD	Casuarina, LOT 1320 LOT 53	100	21	11	2013
Calyptorhynchus latirostris	FAUNASURVEY	756638	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Unknown			6	WELLARD	Casuarina, LOT 1320 LOT 53	100	23	11	2013
Calyptorhynchus latirostris	FAUNASURVEY	1208064	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Unknown			6	HOPE VALLEY	Perth, Anketell	100	29	10	2014
Calyptorhynchus latirostris	FAUNASURVEY	1208166	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Unknown			8	HOPE VALLEY	Perth, Anketell	100	3	11	2014
Calyptorhynchus latirostris	FAUNASURVEY	1208202	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Unknown			4	BALDIVIS	Perth, Wellard	100	5	11	2014
Calyptorhynchus latirostris	FAUNASURVEY	1208850	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Unknown			8	WELLARD	Casuarina, Banksia Road	100	14	4	2015
Calyptorhynchus latirostris	FAUNASURVEY	1208878	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Unknown			3	WELLARD	Casuarina, Banksia Road	100	14	4	2015
Calyptorhynchus latirostris	FAUNASURVEY	1208924	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Unknown			3	WELLARD	Casuarina, Banksia Road	100	14	4	2015
Calyptorhynchus latirostris	FAUNASURVEY	1208954	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Unknown			1	WELLARD	Casuarina, Banksia Road	100	14	4	2015
Calyptorhynchus banksii naso	TFAUNA	16100	24731	Cacatuidae	Calyptorhynchus	banksii	naso	forest red-tailed black cockatoo	Animalia	BIRD	VU	Certain	Opportunistic sighting	Day sighting			5	WANDI	at the end of Blackboy Grove. Wandi	1000	1	7	2008
Calyptorhynchus banksii naso	TFAUNA	20967	24731	Cacatuidae	Calyptorhynchus	banksii	naso	forest red-tailed black cockatoo	Animalia	BIRD	VU	Certain	Opportunistic sighting	Day sighting			6	KWINANA BEACH	Thomas Road Kwinana	1000	22	9	2011
Calyptorhynchus banksii naso	TFAUNA	22329	24731	Cacatuidae	Calyptorhynchus	banksii	naso	forest red-tailed black cockatoo	Animalia	BIRD	VU	Certain	Targeted survey	Day sighting			6	THE SPECTACLES	Thomas Road, Kwinana	1000	19	11	2000
Calyptorhynchus banksii naso	TFAUNA	22357	24731	Cacatuidae	Calyptorhynchus	banksii	naso	forest red-tailed black cockatoo	Animalia	BIRD	VU	Certain	Targeted survey	Day sighting			4	WELLARD	Arundel Road, Wellard	1000	19	7	2003
Calyptorhynchus banksii naso	TFAUNA	81056	24731	Cacatuidae	Calyptorhynchus	banksii	naso	forest red-tailed black cockatoo	Animalia	BIRD	VU	Moderately Certain	Opportunistic sighting	Day sighting			150	MARDELLA	In Tasmanian Blue gums next to house	1000	18	9	2015
Calyptorhynchus banksii naso	TFAUNA	84720	24731	Cacatuidae	Calyptorhynchus	banksii	naso	forest red-tailed black cockatoo	Animalia	BIRD	VU	Moderately Certain	Community survey	Dusk sighting			9	WELLARD	KWIWELR001	1000	3	4	2016
Calyptorhynchus latirostris	TFAUNA	1498	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			1	OAKFORD	Modong Nature Reserve A25886	1000	1	10	1997
Calyptorhynchus latirostris	TFAUNA	20033	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Community survey	Secondary sign			0	OAKFORD	141 King st Oakford. Pines trees at the back of th	1000	7	4	2010
Calyptorhynchus latirostris	TFAUNA	20034	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Community survey	Day sighting			167	OAKFORD	142 Cumming rd,	1000	7	4	2010
Calyptorhynchus latirostris	TFAUNA	20045	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Community survey	Day sighting			45	OAKFORD	88 Tuart Rd, Oakford	1000	7	4	2010
Calyptorhynchus latirostris	TFAUNA	20098	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Community survey	Secondary sign			63	WANDI	Eastern end of Wandi Drv, tall trees around horse	1000	4	6	2009
Calyptorhynchus latirostris	TFAUNA	20135	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Community survey	Day sighting			2	CASUARINA	Marri Park Golf Club 29 Surflin Ct, Casuarina	1000	7	4	2010
Calyptorhynchus latirostris	TFAUNA	20147	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Community survey	Day sighting			167	OAKFORD	Orton Rd and Cumming Rd, Oakford	1000	7	4	2010
Calyptorhynchus latirostris	TFAUNA	21300	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Not Sure	Opportunistic sighting	Secondary sign			0	HAMMOND PARK	10 Atkins Parade, Hammond Park	1000	22	8	2012
Calyptorhynchus latirostris	TFAUNA	21303	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Not Sure	Opportunistic sighting	Secondary sign			0	HAMMOND PARK	10 Atkins Parade, Hammond Park	1000	25	8	2012
Calyptorhynchus latirostris	TFAUNA	21304	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Opportunistic sighting	Day sighting			1	HAMMOND PARK	10 Atkins Parade, Hammond Park	1000	27	8	2012
Calyptorhynchus latirostris	TFAUNA	21305	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Opportunistic sighting	Day sighting			1	HAMMOND PARK	10 Atkins Parade, Hammond Park	1000	27	8	2012
Calyptorhynchus latirostris	TFAUNA	21306	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Not Sure	Opportunistic sighting	Secondary sign			0	HAMMOND PARK	10 Atkins Parade, Hammond Park	1000	29	8	2012
Calyptorhynchus latirostris	TFAUNA	21307	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Not Sure	Opportunistic sighting	Secondary sign			0	HAMMOND PARK	10 Atkins Parade, Hammond Park	1000	12	9	2012
Calyptorhynchus latirostris	TFAUNA	21308	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Not Sure	Opportunistic sighting	Secondary sign			0	HAMMOND PARK	10 Atkins Parade, Hammond Park	1000	12	9	2012
Calyptorhynchus latirostris	TFAUNA	21310	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Opportunistic sighting	Day sighting			4	HAMMOND PARK	10 Atkins Parade, Hammond hill	1000	18	9	2012
Calyptorhynchus latirostris	TFAUNA	21312	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Opportunistic sighting	Day sighting			30	HAMMOND PARK	Lot 33 Barfield road, hammond park. Behind lot 1	1000	4	11	2012
Calyptorhynchus latirostris	TFAUNA	21388	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Targeted survey	Day sighting			1200	WELLARD	Near Wellard	10000	1	3	2010
Calyptorhynchus latirostris	TFAUNA	22705	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Opportunistic sighting	Day sighting			10	HAMMOND PARK	Lot 35 Barfield road, Hammond Park	500	6	11	2012
Calyptorhynchus latirostris	TFAUNA	22706	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Opportunistic sighting	Day sighting			14	HAMMOND PARK	Barfield road, Hammond Park, Corner of Gaebler	1000	7	11	2012
Calyptorhynchus latirostris	TFAUNA	22707	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Opportunistic sighting	Day sighting			10	HAMMOND PARK	35 Barfield road, Hammond Park	1000	7	11	2012
Calyptorhynchus latirostris	TFAUNA	22708	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Opportunistic sighting	Day sighting			10	HAMMOND PARK	Some where on lot 46,33,32,31 Barfiield road Har	1000	7	11	2012
Calyptorhynchus latirostris	TFAUNA	22709	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Opportunistic sighting	Day sighting			50	HAMMOND PARK	Lot 33 Barfield road, Hammond Park, including be	1000	26	11	2012
Calyptorhynchus latirostris	TFAUNA	22710	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Opportunistic sighting	Day sighting			25	HAMMOND PARK	Lot 35 Barfield road, Hammond Park,corner of Ga	1000	8	12	2012
Calyptorhynchus latirostris	TFAUNA	22711	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Opportunistic sighting	Day sighting			25	HAMMOND PARK	Lot 33 Barfield road, Hammond Park	1000	8	12	2012
Calyptorhynchus latirostris	TFAUNA	22712	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Opportunistic sighting	Day sighting			1	HAMMOND PARK	North of 10 atkins parade, Hammond Park	1000	9	12	2012
Calyptorhynchus latirostris	TFAUNA	22713	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Opportunistic sighting	Day sighting			10	HAMMOND PARK	In bush on private property sputh of 10 Atkins Par	1000	10	12	2012
Calyptorhynchus latirostris	TFAUNA	22714	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Opportunistic sighting	Day sighting			15	HAMMOND PARK	In bush on private property sputh of 10 Atkins Par	1000	13	12	2012
Calyptorhynchus latirostris	TFAUNA	22715	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Opportunistic sighting	Secondary sign			0	HAMMOND PARK	Heard in bush on PP south of Atkins Parade, Ham	1000	14	12	2012
Calyptorhynchus latirostris	TFAUNA	22716	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Opportunistic sighting	Day sighting			15	HAMMOND PARK	Heard in bush on PP south of Atkins Parade, Ham	1000	21	12	2012
Calyptorhynchus latirostris	TFAUNA	22718	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Opportunistic sighting	Secondary sign			0	HAMMOND PARK	Flying through Hammond Park	1000	3	1	2012
Calyptorhynchus latirostris	TFAUNA	22719	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Opportunistic sighting	Secondary sign			0	HAMMOND PARK	South of 10 Atkins Parade, Hammond park	1000	5	1	2013
Calyptorhynchus latirostris	TFAUNA	22720	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Opportunistic sighting	Secondary sign			0	HAMMOND PARK	East of 10 Atkins Parade, Hammond park	1000	14	1	2013
Calyptorhynchus latirostris	TFAUNA	22721	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Opportunistic sighting	Day sighting			10	HAMMOND PARK	35 Barfield road, hammond park	1000	15	1	2013
Calyptorhynchus latirostris	TFAUNA	22722	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Opportunistic sighting	Day sighting			2	HAMMOND PARK	Atkins Parade, Hammond Park	1000	17	1	2013
Calyptorhynchus latirostris	TFAUNA	22723	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Opportunistic sighting	Day sighting			10	HAMMOND PARK	Atkins Parade, Hammond Park	1000	17	1	2013
Calyptorhynchus latirostris	TFAUNA	22926	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Secondary sign			1	HAMMOND PARK	Hammond Park Primary School	1000	1	7	2012
Calyptorhynchus latirostris	TFAUNA	23627	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Targeted survey	Day sighting			21	AUBIN GROVE	Tangle Park, Aubin Grove, Kardinya	1000	14	5	2006
Calyptorhynchus latirostris	TFAUNA	23642	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Targeted survey	Day sighting			1	CASUARINA	Lavery Drive, Casuarina	1000	26	3	2006
Calyptorhynchus latirostris	TFAUNA	23651	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Targeted survey	Day sighting			2	LEDA	Sloans Reserve, Leda	1000	26	3	2006
Calyptorhynchus latirostris	TFAUNA	23656	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Targeted survey	Day sighting			1520	BALDIVIS	Karnup PP, corner of 68 and 80 roads	10000	26	3	2006
Calyptorhynchus latirostris	TFAUNA	23685	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Targeted survey	Day sighting			61	ATWELL	Lyon Rd and Euphony way, Atwell	1000	26	3	2006

NAME_SCI	SOURCE	SOURCE_ID	NAME_ID	FAMILY	GENUS	SPECIES	SUBSPECIES	NAME_COM	KINGDOM	CLASS	CONS_CODE	CERTAINTY	METHOD	TYPE	EVIDENCE	BREEDING / NON	COUNT	LOCALITY	SITE	ACCURACY_M	DAY	MONTH	YEAR
Calyptorhynchus latirostris	TFAUNA	24180	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Community survey	Day sighting			63	WANDI	2013 Site code is KWIWANR001	1000	7	4	2010
Calyptorhynchus latirostris	TFAUNA	24181	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Community survey	Day sighting			1	WANDI	2013 Site code is KWIWANR001	1000	7	4	2013
Calyptorhynchus latirostris	TFAUNA	24182	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Community survey	Day sighting			15	WELLARD	2013 Site code is KWIWELR001	1000	15	4	2012
Calyptorhynchus latirostris	TFAUNA	24183	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Community survey	Day sighting			16	WELLARD	2013 Site code is KWIWELR001	1000	6	5	2012
Calyptorhynchus latirostris	TFAUNA	24184	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Community survey	Day sighting			50	WELLARD	2013 Site code is KWIWELR001	1000	7	4	2013
Calyptorhynchus latirostris	TFAUNA	24309	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Community survey	Day sighting			40	BALDIVIS	2013 Site code is ROCBALR004	1000	7	4	2011
Calyptorhynchus latirostris	TFAUNA	24317	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Community survey	Day sighting			110	OAKFORD	2013 Site code is SEROAKR001	1000	7	4	2011
Calyptorhynchus latirostris	TFAUNA	24318	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Community survey	Day sighting			109	OAKFORD	2013 Site code is SEROAKR002	1000	15	8	2010
Calyptorhynchus latirostris	TFAUNA	24319	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Community survey	Day sighting			2	OAKFORD	2013 Site code is SEROAKR002	1000	7	4	2013
Calyptorhynchus latirostris	TFAUNA	24320	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Community survey	Day sighting			3	OAKFORD	2013 Site code is SEROAKR004	1000	7	4	2011
Calyptorhynchus latirostris	TFAUNA	24321	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Community survey	Day sighting			30	OAKFORD	2013 Site code is SEROAKR004	1000	5	6	2011
Calyptorhynchus latirostris	TFAUNA	24322	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Community survey	Day sighting			15	OAKFORD	2013 Site code is SEROAKR004	1000	7	8	2011
Calyptorhynchus latirostris	TFAUNA	24323	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Community survey	Day sighting			31	OAKFORD	2013 Site code is SEROAKR005	1000	7	4	2010
Calyptorhynchus latirostris	TFAUNA	24324	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Community survey	Day sighting			148	OAKFORD	2013 Site code is SEROAKR005	1000	20	6	2010
Calyptorhynchus latirostris	TFAUNA	24325	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Community survey	Day sighting			129	OAKFORD	2013 Site code is SEROAKR005	1000	15	8	2010
Calyptorhynchus latirostris	TFAUNA	25141	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			120	KWINANA BEACH	Yangebup Road, Coogee	1000	17	4	2006
Calyptorhynchus latirostris	TFAUNA	25815	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Monitoring	Secondary sign			1	WELLARD	Wellard Road, Kwinana	1000	19	3	2009
Calyptorhynchus latirostris	TFAUNA	25818	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Historical (written)	Day sighting			12	WELLARD	Wellard	1000	1	1	1941
Calyptorhynchus latirostris	TFAUNA	25819	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Historical (written)	Day sighting			12	WELLARD	Wellard	1000	1	1	1941
Calyptorhynchus latirostris	TFAUNA	25820	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Historical (written)	Day sighting			12	WELLARD	Wellard	1000	1	1	1941
Calyptorhynchus latirostris	TFAUNA	25821	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Historical (written)	Day sighting			12	WELLARD	Wellard	1000	1	1	1941
Calyptorhynchus latirostris	TFAUNA	25952	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			1	WANDI	Wandi	1000	1	1	2010
Calyptorhynchus latirostris	TFAUNA	27413	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Monitoring	Secondary sign			1	PARMELIA	Parmelia Drive, Parmelia	1000	22	9	2009
Calyptorhynchus latirostris	TFAUNA	27414	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Monitoring	Secondary sign			1	PARMELIA	Parmelia Drive, Parmelia	1000	22	9	2009
Calyptorhynchus latirostris	TFAUNA	27415	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Monitoring	Secondary sign			1	PARMELIA	Parmelia Drive, Parmelia	1000	22	9	2009
Calyptorhynchus latirostris	TFAUNA	27416	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Monitoring	Secondary sign			1	PARMELIA	Parmelia Drive, Parmelia	1000	22	9	2009
Calyptorhynchus latirostris	TFAUNA	27417	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Monitoring	Secondary sign			1	PARMELIA	Parmelia Drive, Parmelia	1000	22	9	2009
Calyptorhynchus latirostris	TFAUNA	27418	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Monitoring	Secondary sign			1	PARMELIA	Parmelia Drive, Parmelia	1000	22	9	2009
Calyptorhynchus latirostris	TFAUNA	27419	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Monitoring	Secondary sign			1	PARMELIA	Parmelia Drive, Parmelia	1000	22	9	2009
Calyptorhynchus latirostris	TFAUNA	27420	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Monitoring	Secondary sign			1	PARMELIA	Parmelia Drive, Parmelia	1000	22	9	2009
Calyptorhynchus latirostris	TFAUNA	27421	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Monitoring	Secondary sign			1	PARMELIA	Parmelia Drive, Parmelia	1000	22	9	2009
Calyptorhynchus latirostris	TFAUNA	27422	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Monitoring	Secondary sign			1	PARMELIA	Parmelia Drive, Parmelia	1000	22	9	2009
Calyptorhynchus latirostris	TFAUNA	27423	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Monitoring	Secondary sign			1	PARMELIA	Parmelia Drive, Parmelia	1000	22	9	2009
Calyptorhynchus latirostris	TFAUNA	27424	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			12	PARMELIA	Parmelia Drive, Parmelia	1000	22	9	2009
Calyptorhynchus latirostris	TFAUNA	28351	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			1	OAKFORD	Oakford	1000	1	1	2010
Calyptorhynchus latirostris	TFAUNA	29767	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			12	WELLARD	Miller & Woolcoot Rds area	1000	20	1	2005
Calyptorhynchus latirostris	TFAUNA	29768	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			12	WELLARD	Miller & Woolcoot Rds area	1000	20	1	2005
Calyptorhynchus latirostris	TFAUNA	30275	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Historical (written)	Day sighting			40	HOPE VALLEY	Mandogalup	1000	7	7	1953
Calyptorhynchus latirostris	TFAUNA	30276	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Historical (written)	Day sighting			40	HOPE VALLEY	Mandogalup	1000	7	7	1953
Calyptorhynchus latirostris	TFAUNA	30594	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Monitoring	Secondary sign			1	LEDA	Leda Nature Reserve, Leda	1000	17	2	2009
Calyptorhynchus latirostris	TFAUNA	30827	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Monitoring	Secondary sign			1	CALISTA	Kwinana hub, Kwinana	1000	19	3	2009
Calyptorhynchus latirostris	TFAUNA	30828	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Monitoring	Secondary sign			1	CALISTA	Kwinana hub, Kwinana	1000	19	3	2009
Calyptorhynchus latirostris	TFAUNA	30829	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Monitoring	Secondary sign			1	CALISTA	Kwinana hub, Kwinana	1000	19	3	2009
Calyptorhynchus latirostris	TFAUNA	30830	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Monitoring	Secondary sign			1	CALISTA	Kwinana hub, Kwinana	1000	19	3	2009
Calyptorhynchus latirostris	TFAUNA	30831	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Monitoring	Secondary sign			1	CALISTA	Kwinana hub, Kwinana	1000	19	3	2009
Calyptorhynchus latirostris	TFAUNA	30832	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Monitoring	Secondary sign			1	CALISTA	Kwinana hub, Kwinana	1000	19	3	2009
Calyptorhynchus latirostris	TFAUNA	30833	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Monitoring	Secondary sign			1	CALISTA	Kwinana hub, Kwinana	1000	19	3	2009
Calyptorhynchus latirostris	TFAUNA	30834	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Secondary sign			3	CALISTA	Kwinana hub, Kwinana	1000	19	3	2009
Calyptorhynchus latirostris	TFAUNA	30919	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			30	OAKFORD	King Road, Thomas Road, Jandakot	1000	18	7	2003
Calyptorhynchus latirostris	TFAUNA	32781	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Monitoring	Secondary sign			1	LEDA	Gilmore Ave, Kwinana	1000	19	3	2009
Calyptorhynchus latirostris	TFAUNA	32782	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Monitoring	Secondary sign			1	LEDA	Gilmore Ave, Kwinana	1000	19	3	2009
Calyptorhynchus latirostris	TFAUNA	32783	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Monitoring	Secondary sign			1	LEDA	Gilmore Ave, Kwinana	1000	16	2	2009
Calyptorhynchus latirostris	TFAUNA	32784	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Monitoring	Secondary sign			1	LEDA	Gilmore Ave, Kwinana	1000	16	2	2009
Calyptorhynchus latirostris	TFAUNA	32785	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Monitoring	Secondary sign			1	LEDA	Gilmore Ave, Kwinana	1000	16	2	2009
Calyptorhynchus latirostris	TFAUNA	32965	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Monitoring	Secondary sign			1	BALDIVIS	Fifty Road, Baldivis	1000	15	2	2009
Calyptorhynchus latirostris	TFAUNA	32966	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Monitoring	Secondary sign			1	BALDIVIS	Fifty Road, Baldivis	1000	15	2	2009
Calyptorhynchus latirostris	TFAUNA	32967	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Monitoring	Secondary sign			1	BALDIVIS	Fifty Road, Baldivis	1000	15	2	2009
Calyptorhynchus latirostris	TFAUNA	32968	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Monitoring	Secondary sign			1	BALDIVIS	Fifty Road, Baldivis	1000	15	2	2009
Calyptorhynchus latirostris	TFAUNA	32969	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Monitoring	Secondary sign			1	BALDIVIS	Fifty Road, Baldivis	1000	15	2	2009
Calyptorhynchus latirostris	TFAUNA	32970	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Monitoring	Secondary sign			1	BALDIVIS	Fifty Road, Baldivis	1000	15	2	2009
Calyptorhynchus latirostris	TFAUNA	32971	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Monitoring	Secondary sign			1	BALDIVIS	Fifty Road, Baldivis	1000	15	2	2009
Calyptorhynchus latirostris	TFAUNA	32972	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Monitoring	Secondary sign			1	BALDIVIS	Fifty Road, Baldivis	1000	15	2	2009
Calyptorhynchus latirostris	TFAUNA	32973	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Monitoring	Secondary sign			1	BALDIVIS	Fifty Road, Baldivis	1000	15	2	2009
Calyptorhynchus latirostris	TFAUNA	32974	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Monitoring	Secondary sign			1	BALDIVIS	Fifty Road, Baldivis	1000	15	2	2009
Calyptorhynchus latirostris	TFAUNA	32975	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Monitoring	Secondary sign			1	BALDIVIS	Fifty Road, Baldivis	1000	15	2	2009
Calyptorhynchus latirostris	TFAUNA	32976	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Monitoring	Secondary sign			1	BALDIVIS	Fifty Road, Baldivis	1000	15	2	2009
Calyptorhynchus latirostris	TFAUNA	32977	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Monitoring	Secondary sign			1	BALDIVIS	Fifty Road, Baldivis	1000	15	2	2009
Calyptorhynchus latirostris	TFAUNA	33985	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			10	CASUARINA	Casuarina	1000	30	11	2005
Calyptorhynchus latirostris	TFAUNA	33986	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			1	OAKFORD	Casuarina	1000	1	1	2010
Calyptorhynchus latirostris	TFAUNA	33987	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			6	CASUARINA	Casuarina	1000	30	12	2005
Calyptorhynchus latirostris	TFAUNA	33988	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			6	CASUARINA	Casuarina	1000	30	12	2005
Calyptorhynchus latirostris	TFAUNA	33989	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			10	CASUARINA	Casuarina	1000	30	11	2005
Calyptorhynchus latirostris	TFAUNA	33990	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			10	CASUARINA	Casuarina	1000	29	11	2005
Calyptorhynchus latirostris	TFAUNA	33992	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			10	CASUARINA	Casuarina	1000	29	11	2005
Calyptorhynchus latirostris	TFAUNA	33993	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			50	CASUARINA	Casuarina	1000	18	6	2005
Calyptorhynchus latirostris	TFAUNA	33994	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			50	CASUARINA	Casuarina	1000	18	6	2005
Calyptorhynchus latirostris	TFAUNA	33995	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			150	CASUARINA	Casuarina	1000	14	1	2005

NAME_SCI	SOURCE	SOURCE_ID	NAME_ID	FAMILY	GENUS	SPECIES	SUBSPECIES	NAME_COM	KINGDOM	CLASS	CONS_CODE	CERTAINTY	METHOD	TYPE	EVIDENCE	BREEDING / NON	COUNT	LOCALITY	SITE	ACCURACY_M	DAY	MONTH	YEAR
Calyptorhynchus latirostris	TFAUNA	33996	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			150	CASUARINA	Casuarina	1000	14	1	2005
Calyptorhynchus latirostris	TFAUNA	33997	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			63	CASUARINA	Casuarina	1000	9	1	2005
Calyptorhynchus latirostris	TFAUNA	33998	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			63	CASUARINA	Casuarina	1000	9	1	2005
Calyptorhynchus latirostris	TFAUNA	33999	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			72	CASUARINA	Casuarina	1000	5	1	2005
Calyptorhynchus latirostris	TFAUNA	34000	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			72	CASUARINA	Casuarina	1000	5	1	2005
Calyptorhynchus latirostris	TFAUNA	34001	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			20	CASUARINA	Casuarina	1000	4	1	2005
Calyptorhynchus latirostris	TFAUNA	34002	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			20	CASUARINA	Casuarina	1000	4	1	2005
Calyptorhynchus latirostris	TFAUNA	34003	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			23	CASUARINA	Casuarina	1000	28	12	2004
Calyptorhynchus latirostris	TFAUNA	34004	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			23	CASUARINA	Casuarina	1000	28	12	2004
Calyptorhynchus latirostris	TFAUNA	34005	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			20	CASUARINA	Casuarina	1000	27	12	2004
Calyptorhynchus latirostris	TFAUNA	34006	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			20	CASUARINA	Casuarina	1000	27	12	2004
Calyptorhynchus latirostris	TFAUNA	34007	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			34	CASUARINA	Casuarina	1000	26	12	2004
Calyptorhynchus latirostris	TFAUNA	34008	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			34	CASUARINA	Casuarina	1000	26	12	2004
Calyptorhynchus latirostris	TFAUNA	34009	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			40	CASUARINA	Casuarina	1000	25	12	2004
Calyptorhynchus latirostris	TFAUNA	34010	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			40	CASUARINA	Casuarina	1000	25	12	2004
Calyptorhynchus latirostris	TFAUNA	34011	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			47	CASUARINA	Casuarina	1000	17	11	2004
Calyptorhynchus latirostris	TFAUNA	34012	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			47	CASUARINA	Casuarina	1000	17	11	2004
Calyptorhynchus latirostris	TFAUNA	34013	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			63	CASUARINA	Casuarina	1000	16	11	2004
Calyptorhynchus latirostris	TFAUNA	34014	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			63	CASUARINA	Casuarina	1000	16	11	2004
Calyptorhynchus latirostris	TFAUNA	34015	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			47	CASUARINA	Casuarina	1000	12	9	2004
Calyptorhynchus latirostris	TFAUNA	34016	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			47	CASUARINA	Casuarina	1000	12	9	2004
Calyptorhynchus latirostris	TFAUNA	34017	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			50	CASUARINA	Casuarina	1000	26	7	2004
Calyptorhynchus latirostris	TFAUNA	34018	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			50	CASUARINA	Casuarina	1000	26	7	2004
Calyptorhynchus latirostris	TFAUNA	34019	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			44	CASUARINA	Casuarina	1000	19	7	2004
Calyptorhynchus latirostris	TFAUNA	34020	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			44	CASUARINA	Casuarina	1000	19	7	2004
Calyptorhynchus latirostris	TFAUNA	34021	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			120	CASUARINA	Casuarina	1000	13	7	2004
Calyptorhynchus latirostris	TFAUNA	34022	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			120	CASUARINA	Casuarina	1000	13	7	2004
Calyptorhynchus latirostris	TFAUNA	34023	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			77	CASUARINA	Casuarina	1000	6	7	2004
Calyptorhynchus latirostris	TFAUNA	34024	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			77	CASUARINA	Casuarina	1000	6	7	2004
Calyptorhynchus latirostris	TFAUNA	34025	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			150	CASUARINA	Casuarina	1000	17	6	2004
Calyptorhynchus latirostris	TFAUNA	34026	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			150	CASUARINA	Casuarina	1000	17	6	2004
Calyptorhynchus latirostris	TFAUNA	34027	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			2220	CASUARINA	Casuarina	1000	28	5	2004
Calyptorhynchus latirostris	TFAUNA	34028	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			220	CASUARINA	Casuarina	1000	28	5	2004
Calyptorhynchus latirostris	TFAUNA	34029	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			20	CASUARINA	Casuarina	1000	25	5	2004
Calyptorhynchus latirostris	TFAUNA	34030	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			20	CASUARINA	Casuarina	1000	25	5	2004
Calyptorhynchus latirostris	TFAUNA	34031	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			60	CASUARINA	Casuarina	1000	23	5	2004
Calyptorhynchus latirostris	TFAUNA	34032	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			60	CASUARINA	Casuarina	1000	23	5	2004
Calyptorhynchus latirostris	TFAUNA	34033	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			80	CASUARINA	Casuarina	1000	22	5	2004
Calyptorhynchus latirostris	TFAUNA	34034	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			80	CASUARINA	Casuarina	1000	22	5	2004
Calyptorhynchus latirostris	TFAUNA	34035	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			100	CASUARINA	Casuarina	1000	15	5	2004
Calyptorhynchus latirostris	TFAUNA	34036	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			100	CASUARINA	Casuarina	1000	15	5	2004
Calyptorhynchus latirostris	TFAUNA	34037	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			20	CASUARINA	Casuarina	1000	30	4	2004
Calyptorhynchus latirostris	TFAUNA	34038	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			20	CASUARINA	Casuarina	1000	30	4	2004
Calyptorhynchus latirostris	TFAUNA	34039	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			170	CASUARINA	Casuarina	1000	29	4	2004
Calyptorhynchus latirostris	TFAUNA	34040	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			170	CASUARINA	Casuarina	1000	29	4	2004
Calyptorhynchus latirostris	TFAUNA	34041	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			270	CASUARINA	Casuarina	1000	19	4	2004
Calyptorhynchus latirostris	TFAUNA	34042	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			270	CASUARINA	Casuarina	1000	19	4	2004
Calyptorhynchus latirostris	TFAUNA	34043	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			270	CASUARINA	Casuarina	1000	19	4	2004
Calyptorhynchus latirostris	TFAUNA	34044	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			270	CASUARINA	Casuarina	1000	19	4	2004
Calyptorhynchus latirostris	TFAUNA	34045	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			2	CASUARINA	Casuarina	1000	11	4	2004
Calyptorhynchus latirostris	TFAUNA	34046	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			170	CASUARINA	Casuarina	1000	11	4	2004
Calyptorhynchus latirostris	TFAUNA	34047	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			170	CASUARINA	Casuarina	1000	11	4	2004
Calyptorhynchus latirostris	TFAUNA	34048	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			170	CASUARINA	Casuarina	1000	11	4	2004
Calyptorhynchus latirostris	TFAUNA	34049	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			170	CASUARINA	Casuarina	1000	11	4	2004
Calyptorhynchus latirostris	TFAUNA	34050	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			170	CASUARINA	Casuarina	1000	11	4	2004
Calyptorhynchus latirostris	TFAUNA	34051	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			170	CASUARINA	Casuarina	1000	11	4	2004
Calyptorhynchus latirostris	TFAUNA	34052	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			2	CASUARINA	Casuarina	1000	11	4	2004
Calyptorhynchus latirostris	TFAUNA	34053	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			170	CASUARINA	Casuarina	1000	11	4	2004
Calyptorhynchus latirostris	TFAUNA	34054	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			170	CASUARINA	Casuarina	1000	11	4	2004
Calyptorhynchus latirostris	TFAUNA	34055	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			12	CASUARINA	Casuarina	1000	10	4	2004
Calyptorhynchus latirostris	TFAUNA	34056	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			12	CASUARINA	Casuarina	1000	10	4	2004
Calyptorhynchus latirostris	TFAUNA	34057	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			9	CASUARINA	Casuarina	1000	1	4	2004
Calyptorhynchus latirostris	TFAUNA	34058	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			9	CASUARINA	Casuarina	1000	1	4	2004
Calyptorhynchus latirostris	TFAUNA	34059	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			34	CASUARINA	Casuarina	1000	4	2	2004
Calyptorhynchus latirostris	TFAUNA	34060	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			34	CASUARINA	Casuarina	1000	4	2	2004
Calyptorhynchus latirostris	TFAUNA	35311	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			30	WELLARD	Braddock Road, Wellard	1000	19	6	2004
Calyptorhynchus latirostris	TFAUNA	35312	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			30	WELLARD	Braddock Road, Wellard	1000	19	6	2004
Calyptorhynchus latirostris	TFAUNA	35534	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Survey	Day sighting			250	WATTLEUP	Bibra Drive, Bibra Lake	1000	20	2	2010
Calyptorhynchus latirostris	TFAUNA	74858	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Not Sure	Opportunistic sighting	Day sighting			1	AUBIN GROVE	Aubin Grove	1000	30	5	2014
Calyptorhynchus latirostris	TFAUNA	80391	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Community survey	Day sighting			19	CASUARINA	Marri Park Golf Club 29 Surflin Ct	1000	6	4	2014
Calyptorhynchus latirostris	TFAUNA	80401	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Community survey	Day sighting			50	OAKFORD	88 Tuart Rd	1000	6	4	2014
Calyptorhynchus latirostris	TFAUNA	80404	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Moderately Certain	Community survey	Day sighting			12	WANDI	Approx 123 Leslie Rd Wandi, near Frayne Place.	1000	7	4	2014
Calyptorhynchus latirostris	TFAUNA	80657	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Certain	Community survey	Day sighting			125	WELLARD	Henley Bushland between Henley Blvd/Lambreth	1000	12	4	2015
Calyptorhynchus latirostris	TFAUNA	89238	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	BALDIVIS	Bush blocks south west of MacNuts, Baldivis	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89240	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	BALDIVIS	MacNuts WA, 213 Doghill Rd Baldivis	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89241	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	BALDIVIS	MacNuts WA, Macadamia orchard, Baldivis	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89242	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	BALDIVIS	PP E end of Makin Rd, Baldivis	1000	19	5	2016

NAME_SCI	SOURCE	SOURCE_ID	NAME_ID	FAMILY	GENUS	SPECIES	SUBSPECIES	NAME_COM	KINGDOM	CLASS	CONS_CODE	CERTAINTY	METHOD	TYPE	EVIDENCE	BREEDING / NON	COUNT	LOCALITY	SITE	ACCURACY_M	DAY	MONTH	YEAR
Calyptorhynchus latirostris	TFAUNA	89243	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	BALDIVIS	PP between Doghill Rd and Horsfall Rd, Baldivis	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89246	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	BALDIVIS	Baldivis Reserve, Baldivis	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89252	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	LEDA	Leda Nature Reserve.	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89253	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	WELLARD	41 Nella Pl, Wellard	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89254	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	WELLARD	Remant bush on PP to W of Wellard rd, b/w Bert	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89255	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	LEDA	Leda Nature Reserve, N end	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89256	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	LEDA	Runnymead Bushland	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89257	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	WELLARD	Bushland to W of intersection b/w Boomerang & I	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89258	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	LEDA	Bushland to N of Leda Reserve b/w Gilmore Ave	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89259	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	WELLARD	Henley Bushland	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89260	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	WELLARD	Remnant bush on PP b/w Casuarina Prison & Jac	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89261	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	WELLARD	Remnant Bush, Bertram Rd, Wellard	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89262	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	CASUARINA	319 - 343 Mortimer Rd, Wellard. PP on both sides	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89263	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	WELLARD	King's College school, 170 Bertram rd, Wellard	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89264	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	CASUARINA	Bushland to north of Mortimer Rd, east of Nicolas	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89265	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	OLDBURY	Banksia Nature Reserve, Oldbury	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89267	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	CASUARINA	105 Lavery Dr, Oakford	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89268	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	CASUARINA	Bushland surrounding Casuarina Prison, Casuarin	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89269	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	OLDBURY	12 Tunney Rd, Oldbury	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89270	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	CASUARINA	158 Orton Rd, Casuarina. Incl SE corner of Marri	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89271	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	OAKFORD	545 - 589 Orton Rd, Oakford (N side of road)	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89272	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	OAKFORD	105-142 Cumming Rd, Oakford. PP on both sides	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89273	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	OAKFORD	141 King Rd, Oakford & adj. PP	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89274	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	CASUARINA	N end pf Marri Park Golf Course incl. adj. 21-29 S	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89275	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	CASUARINA	87 Newbold Rd, Casuarina	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89277	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	OAKFORD	Modong Nature Reserve, Oakford	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89281	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	OAKFORD	93-102 Tuart Rd, Oakford. PP on both sides of roa	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89285	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	WANDI	20 Frayne Pl, Wandi	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89286	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	OAKFORD	Jandakot Regional Park, Jandakot	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89289	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	WANDI	Remnant bush on PP b/w Rowley & Anketell Rds.	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89292	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	WANDI	38 Robinson Rd, Wandi	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89293	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	OAKFORD	PP N & S of Foxton Dr, Oakford, extending S to W	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89295	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	WANDI	31 The Horseshoe, Wandi	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89297	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	WANDI	PP on Wandi Dr b/w Satinover Way & Brooks Pl	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89298	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	OAKFORD	Ditton Rd, Oakford	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89301	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	FORRESTDALE	PP on Rowley Rd, Forrestdale	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89302	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	BIRD	EN	Very Certain	Regular monitoring	Remote sensing			1	BANJUP	PP on Wolfe & Liddelow Rds, Banjup	1000	19	5	2016
Calyptorhynchus sp. 'white-tailed black cockatoo'	TFAUNA	80553	0	Cacatuidae	Calyptorhynchus	sp. 'white-tailed black cockatoo'		white-tailed black cockatoo	Animalia	BIRD	EN	Certain	Opportunistic sighting	Day sighting			16	WELLARD	125 Braddock Rd, Wellard, east side of the Kwina	1000	4	6	2015
Calyptorhynchus sp. 'white-tailed black cockatoo'	TFAUNA	84699	0	Cacatuidae	Calyptorhynchus	sp. 'white-tailed black cockatoo'		white-tailed black cockatoo	Animalia	BIRD	EN	Moderately Certain	Community survey	Dusk sighting			26	OAKFORD	SEROAKR004	1000	3	4	2016
Calyptorhynchus latirostris	TFAUNA	1498	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			1	OAKFORD	Modong Nature Reserve A25886	1000	1	10	1997
Calyptorhynchus latirostris	TFAUNA	20033	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Moderately Certain	Community survey	Secondary sign			0	OAKFORD	141 King st Oakford. Pines trees at the back of th	1000	7	4	2010
Calyptorhynchus latirostris	TFAUNA	20034	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Moderately Certain	Community survey	Day sighting			167	OAKFORD	142 Cumming rd,	1000	7	4	2010
Calyptorhynchus latirostris	TFAUNA	20045	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Moderately Certain	Community survey	Day sighting			45	OAKFORD	88 Tuart Rd, Oakford	1000	7	4	2010
Calyptorhynchus latirostris	TFAUNA	20147	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Moderately Certain	Community survey	Day sighting			167	OAKFORD	Orton Rd and Cumming Rd, Oakford	1000	7	4	2010
Calyptorhynchus latirostris	TFAUNA	24182	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Community survey	Day sighting			15	WELLARD	2013 Site code is KWIWELR001	1000	15	4	2012
Calyptorhynchus latirostris	TFAUNA	24183	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Community survey	Day sighting			16	WELLARD	2013 Site code is KWIWELR001	1000	6	5	2012
Calyptorhynchus latirostris	TFAUNA	24184	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Community survey	Day sighting			50	WELLARD	2013 Site code is KWIWELR001	1000	7	4	2013
Calyptorhynchus latirostris	TFAUNA	22705	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Moderately Certain	Opportunistic sighting	Day sighting			10	HAMMOND PARK	Lot 35 Barfield road, Hammond Park	500	6	11	2012
Calyptorhynchus latirostris	TFAUNA	21300	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Not Sure	Opportunistic sighting	Secondary sign	Heard/Call		0	HAMMOND PARK	10 Atkins Parade, Hammond Park	1000	22	8	2012
Calyptorhynchus latirostris	TFAUNA	21303	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Not Sure	Opportunistic sighting	Secondary sign	Heard/Call		0	HAMMOND PARK	10 Atkins Parade, Hammond Park	1000	25	8	2012
Calyptorhynchus latirostris	TFAUNA	21304	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Moderately Certain	Opportunistic sighting	Day sighting			1	HAMMOND PARK	10 Atkins Parade, Hammond Park	1000	27	8	2012
Calyptorhynchus latirostris	TFAUNA	21305	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Moderately Certain	Opportunistic sighting	Day sighting			1	HAMMOND PARK	10 Atkins Parade, Hammond Park	1000	27	8	2012
Calyptorhynchus latirostris	TFAUNA	21306	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Not Sure	Opportunistic sighting	Secondary sign	Heard/Call		0	HAMMOND PARK	10 Atkins Parade, Hammond Park	1000	29	8	2012
Calyptorhynchus latirostris	TFAUNA	21307	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Not Sure	Opportunistic sighting	Secondary sign	Heard/Call		0	HAMMOND PARK	10 Atkins Parade, Hammond Park	1000	12	9	2012
Calyptorhynchus latirostris	TFAUNA	21308	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Not Sure	Opportunistic sighting	Secondary sign	Heard/Call		0	HAMMOND PARK	10 Atkins Parade, Hammond Park	1000	12	9	2012
Calyptorhynchus latirostris	TFAUNA	21310	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Moderately Certain	Opportunistic sighting	Day sighting			4	HAMMOND PARK	10 Atkins Parade, Hammond hill	1000	18	9	2012
Calyptorhynchus latirostris	TFAUNA	21312	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Moderately Certain	Opportunistic sighting	Day sighting			30	HAMMOND PARK	Lot 33 Barfield road, hammond park. Behind lot 1	1000	4	11	2012
Calyptorhynchus latirostris	TFAUNA	22706	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Moderately Certain	Opportunistic sighting	Day sighting			14	HAMMOND PARK	Barfield road, Hammond Park, Corner of Gaebler	1000	7	11	2012
Calyptorhynchus latirostris	TFAUNA	22707	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Moderately Certain	Opportunistic sighting	Day sighting			10	HAMMOND PARK	35 Barfield road, Hammond Park	1000	7	11	2012
Calyptorhynchus latirostris	TFAUNA	22708	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Moderately Certain	Opportunistic sighting	Day sighting			10	HAMMOND PARK	Some where on lot 46,33,32,31 Barfiield road Har	1000	7	11	2012
Calyptorhynchus latirostris	TFAUNA	22709	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Moderately Certain	Opportunistic sighting	Day sighting			50	HAMMOND PARK	Lot 33 Barfield road, Hammond Park, including be	1000	26	11	2012
Calyptorhynchus latirostris	TFAUNA	22710	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Moderately Certain	Opportunistic sighting	Day sighting			25	HAMMOND PARK	Lot 35 Barfield road, Hammond Park,corner of Ga	1000	8	12	2012
Calyptorhynchus latirostris	TFAUNA	22711	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Moderately Certain	Opportunistic sighting	Day sighting			25	HAMMOND PARK	Lot 33 Barfield road, Hammond Park	1000	8	12	2012
Calyptorhynchus latirostris	TFAUNA	22712	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Moderately Certain	Opportunistic sighting	Day sighting			1	HAMMOND PARK	North of 10 atkins parade, Hammond Park	1000	9	12	2012
Calyptorhynchus latirostris	TFAUNA	22713	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Moderately Certain	Opportunistic sighting	Day sighting			10	HAMMOND PARK	In bush on private property sputh of 10 Atkins Par	1000	10	12	2012
Calyptorhynchus latirostris	TFAUNA	22714	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Moderately Certain	Opportunistic sighting	Day sighting			15	HAMMOND PARK	In bush on private property sputh of 10 Atkins Par	1000	13	12	2012
Calyptorhynchus latirostris	TFAUNA	22715	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Moderately Certain	Opportunistic sighting	Secondary sign	Heard/Call		0	HAMMOND PARK	Heard in bush on PP south of Atkins Parade, Ham	1000	14	12	2012
Calyptorhynchus latirostris	TFAUNA	22716	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Moderately Certain	Opportunistic sighting	Day sighting			15	HAMMOND PARK	Heard in bush on PP south of Atkins Parade, Ham	1000	21	12	2012
Calyptorhynchus latirostris	TFAUNA	22718	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Moderately Certain	Opportunistic sighting	Secondary sign	Heard/Call		0	HAMMOND PARK	Flying through Hammond Park	1000	3	1	2012
Calyptorhynchus latirostris	TFAUNA	22719	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Moderately Certain	Opportunistic sighting	Secondary sign	Heard/Call		0	HAMMOND PARK	South of 10 Atkins Parade, Hammond park	1000	5	1	2013
Calyptorhynchus latirostris	TFAUNA	22720	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Moderately Certain	Opportunistic sighting	Secondary sign	Heard/Call		0	HAMMOND PARK	East of 10 Atkins Parade, Hammond park	1000	14	1	2013
Calyptorhynchus latirostris	TFAUNA	22721	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Moderately Certain	Opportunistic sighting	Day sighting			10	HAMMOND PARK	35 Barfield road, hammond park	1000	15	1	2013
Calyptorhynchus latirostris	TFAUNA	22722	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Moderately Certain	Opportunistic sighting	Day sighting			2	HAMMOND PARK	Atkins Parade, Hammond Park	1000	17	1	2013
Calyptorhynchus latirostris	TFAUNA	22723	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Moderately Certain	Opportunistic sighting	Day sighting			10	HAMMOND PARK	Atkins Parade, Hammond Park	1000	17	1	2013
Calyptorhynchus latirostris	TFAUNA	22926	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Secondary sign	Feeding residue		1	HAMMOND PARK	Hammond Park Primary School	1000	1	7	2012
Calyptorhynchus latirostris	TFAUNA	20135	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Moderately Certain	Community survey	Day sighting			2	CASUARINA	Marri Park Golf Club 29 Surflin Ct, Casuarina	1000	7	4	2010
Calyptorhynchus latirostris	TFAUNA	23642	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Targeted survey	Day sighting			1	CASUARINA	Lavery Drive, Casuarina	1000	26	3	2006

NAME_SCI	SOURCE	SOURCE_ID	NAME_ID	FAMILY	GENUS	SPECIES	SUBSPECIES	NAME_COM	KINGDOM	CLASS	CONS_CODE	CERTAINTY	METHOD	TYPE	EVIDENCE	BREEDING / NON	COUNT	LOCALITY	SITE	ACCURACY_M	DAY	MONTH	YEAR
Calyptorhynchus latirostris	TFAUNA	23685	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Targeted survey	Day sighting			61	ATWELL	Lyon Rd and Euphony way, Atwell	1000	26	3	2006
Calyptorhynchus latirostris	TFAUNA	23627	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Targeted survey	Day sighting			21	AUBIN GROVE	Tangle Park, Aubin Grove, Kardinya	1000	14	5	2006
Calyptorhynchus latirostris	TFAUNA	20098	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Moderately Certain	Community survey	Secondary sign			63	WANDI	Eastern end of Wandi Drv, tall trees around horse	1000	4	6	2009
Calyptorhynchus latirostris	TFAUNA	24180	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Community survey	Day sighting			63	WANDI	2013 Site code is KWIWANR001	1000	7	4	2010
Calyptorhynchus latirostris	TFAUNA	24181	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Community survey	Day sighting			1	WANDI	2013 Site code is KWIWANR001	1000	7	4	2013
Calyptorhynchus latirostris	TFAUNA	23651	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Targeted survey	Day sighting			2	LEDA	Sloans Reserve, Leda	1000	26	3	2006
Calyptorhynchus latirostris	TFAUNA	24309	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Community survey	Day sighting			40	BALDIVIS	2013 Site code is ROCBALR004	1000	7	4	2011
Calyptorhynchus latirostris	TFAUNA	30827	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Monitoring	Secondary sign	Feeding residue		1	CALISTA	Kwinana hub, Kwinana	1000	19	3	2009
Calyptorhynchus latirostris	TFAUNA	30828	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Monitoring	Secondary sign	Feeding residue		1	CALISTA	Kwinana hub, Kwinana	1000	19	3	2009
Calyptorhynchus latirostris	TFAUNA	30829	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Monitoring	Secondary sign	Feeding residue		1	CALISTA	Kwinana hub, Kwinana	1000	19	3	2009
Calyptorhynchus latirostris	TFAUNA	30830	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Monitoring	Secondary sign	Feeding residue		1	CALISTA	Kwinana hub, Kwinana	1000	19	3	2009
Calyptorhynchus latirostris	TFAUNA	30831	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Monitoring	Secondary sign	Feeding residue		1	CALISTA	Kwinana hub, Kwinana	1000	19	3	2009
Calyptorhynchus latirostris	TFAUNA	30832	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Monitoring	Secondary sign	Feeding residue		1	CALISTA	Kwinana hub, Kwinana	1000	19	3	2009
Calyptorhynchus latirostris	TFAUNA	30833	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Monitoring	Secondary sign	Feeding residue		1	CALISTA	Kwinana hub, Kwinana	1000	19	3	2009
Calyptorhynchus latirostris	TFAUNA	30834	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Secondary sign	Heard/Call		3	CALISTA	Kwinana hub, Kwinana	1000	19	3	2009
Calyptorhynchus latirostris	TFAUNA	24317	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Community survey	Day sighting			110	OAKFORD	2013 Site code is SEROAKR001	1000	7	4	2011
Calyptorhynchus latirostris	TFAUNA	24318	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Community survey	Day sighting			109	OAKFORD	2013 Site code is SEROAKR002	1000	15	8	2010
Calyptorhynchus latirostris	TFAUNA	24319	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Community survey	Day sighting			2	OAKFORD	2013 Site code is SEROAKR002	1000	7	4	2013
Calyptorhynchus latirostris	TFAUNA	24320	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Community survey	Day sighting			3	OAKFORD	2013 Site code is SEROAKR004	1000	7	4	2011
Calyptorhynchus latirostris	TFAUNA	24321	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Community survey	Day sighting			30	OAKFORD	2013 Site code is SEROAKR004	1000	5	6	2011
Calyptorhynchus latirostris	TFAUNA	24322	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Community survey	Day sighting			15	OAKFORD	2013 Site code is SEROAKR004	1000	7	8	2011
Calyptorhynchus latirostris	TFAUNA	24323	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Community survey	Day sighting			31	OAKFORD	2013 Site code is SEROAKR005	1000	7	4	2010
Calyptorhynchus latirostris	TFAUNA	24324	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Community survey	Day sighting			148	OAKFORD	2013 Site code is SEROAKR005	1000	20	6	2010
Calyptorhynchus latirostris	TFAUNA	24325	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Community survey	Day sighting			129	OAKFORD	2013 Site code is SEROAKR005	1000	15	8	2010
Calyptorhynchus latirostris	TFAUNA	28351	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			1	OAKFORD	Oakford	1000	1	1	2010
Calyptorhynchus latirostris	TFAUNA	30919	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			30	OAKFORD	King Road, Thomas Road, Jandakot	1000	18	7	2003
Calyptorhynchus latirostris	TFAUNA	25815	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Monitoring	Secondary sign	Feeding residue		1	WELLARD	Wellard Road, Kwinana	1000	19	3	2009
Calyptorhynchus latirostris	TFAUNA	25818	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Historical (written)	Day sighting			12	WELLARD	Wellard	1000	1	1	1941
Calyptorhynchus latirostris	TFAUNA	25819	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Historical (written)	Day sighting			12	WELLARD	Wellard	1000	1	1	1941
Calyptorhynchus latirostris	TFAUNA	25820	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Historical (written)	Day sighting			12	WELLARD	Wellard	1000	1	1	1941
Calyptorhynchus latirostris	TFAUNA	25821	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Historical (written)	Day sighting			12	WELLARD	Wellard	1000	1	1	1941
Calyptorhynchus latirostris	TFAUNA	29767	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			12	WELLARD	Miller & Woolcoot Rds area	1000	20	1	2005
Calyptorhynchus latirostris	TFAUNA	29768	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			12	WELLARD	Miller & Woolcoot Rds area	1000	20	1	2005
Calyptorhynchus latirostris	TFAUNA	27413	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Monitoring	Secondary sign	Feeding residue		1	PARMELIA	Parmelia Drive, Parmelia	1000	22	9	2009
Calyptorhynchus latirostris	TFAUNA	27414	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Monitoring	Secondary sign	Feeding residue		1	PARMELIA	Parmelia Drive, Parmelia	1000	22	9	2009
Calyptorhynchus latirostris	TFAUNA	27415	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Monitoring	Secondary sign	Feeding residue		1	PARMELIA	Parmelia Drive, Parmelia	1000	22	9	2009
Calyptorhynchus latirostris	TFAUNA	27416	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Monitoring	Secondary sign	Feeding residue		1	PARMELIA	Parmelia Drive, Parmelia	1000	22	9	2009
Calyptorhynchus latirostris	TFAUNA	27417	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Monitoring	Secondary sign	Feeding residue		1	PARMELIA	Parmelia Drive, Parmelia	1000	22	9	2009
Calyptorhynchus latirostris	TFAUNA	27418	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Monitoring	Secondary sign	Feeding residue		1	PARMELIA	Parmelia Drive, Parmelia	1000	22	9	2009
Calyptorhynchus latirostris	TFAUNA	27419	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Monitoring	Secondary sign	Feeding residue		1	PARMELIA	Parmelia Drive, Parmelia	1000	22	9	2009
Calyptorhynchus latirostris	TFAUNA	27420	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Monitoring	Secondary sign	Feeding residue		1	PARMELIA	Parmelia Drive, Parmelia	1000	22	9	2009
Calyptorhynchus latirostris	TFAUNA	27421	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Monitoring	Secondary sign	Feeding residue		1	PARMELIA	Parmelia Drive, Parmelia	1000	22	9	2009
Calyptorhynchus latirostris	TFAUNA	27422	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Monitoring	Secondary sign	Feeding residue		1	PARMELIA	Parmelia Drive, Parmelia	1000	22	9	2009
Calyptorhynchus latirostris	TFAUNA	27423	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Monitoring	Secondary sign	Feeding residue		1	PARMELIA	Parmelia Drive, Parmelia	1000	22	9	2009
Calyptorhynchus latirostris	TFAUNA	27424	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			12	PARMELIA	Parmelia Drive, Parmelia	1000	22	9	2009
Calyptorhynchus latirostris	TFAUNA	30275	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Historical (written)	Day sighting			40	HOPE VALLEY	Mandogalup	1000	7	7	1953
Calyptorhynchus latirostris	TFAUNA	30276	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Historical (written)	Day sighting			40	HOPE VALLEY	Mandogalup	1000	7	7	1953
Calyptorhynchus latirostris	TFAUNA	25952	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			1	WANDI	Wandi	1000	1	1	2010
Calyptorhynchus latirostris	TFAUNA	30594	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Monitoring	Secondary sign	Feeding residue		1	LEDA	Leda Nature Reserve, Leda	1000	17	2	2009
Calyptorhynchus latirostris	TFAUNA	25141	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			120	KWINANA BEACH	Yangebup Road, Coogee	1000	17	4	2006
Calyptorhynchus latirostris	TFAUNA	89301	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	FORRESTDALE	PP on Rowley Rd, Forrestdale	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	32965	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Monitoring	Secondary sign	Feeding residue		1	BALDIVIS	Fifty Road, Baldivis	1000	15	2	2009
Calyptorhynchus latirostris	TFAUNA	32966	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Monitoring	Secondary sign	Feeding residue		1	BALDIVIS	Fifty Road, Baldivis	1000	15	2	2009
Calyptorhynchus latirostris	TFAUNA	32967	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Monitoring	Secondary sign	Feeding residue		1	BALDIVIS	Fifty Road, Baldivis	1000	15	2	2009
Calyptorhynchus latirostris	TFAUNA	32968	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Monitoring	Secondary sign	Feeding residue		1	BALDIVIS	Fifty Road, Baldivis	1000	15	2	2009
Calyptorhynchus latirostris	TFAUNA	32969	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Monitoring	Secondary sign	Feeding residue		1	BALDIVIS	Fifty Road, Baldivis	1000	15	2	2009
Calyptorhynchus latirostris	TFAUNA	32970	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Monitoring	Secondary sign	Feeding residue		1	BALDIVIS	Fifty Road, Baldivis	1000	15	2	2009
Calyptorhynchus latirostris	TFAUNA	32971	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Monitoring	Secondary sign	Feeding residue		1	BALDIVIS	Fifty Road, Baldivis	1000	15	2	2009
Calyptorhynchus latirostris	TFAUNA	32972	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Monitoring	Secondary sign	Feeding residue		1	BALDIVIS	Fifty Road, Baldivis	1000	15	2	2009
Calyptorhynchus latirostris	TFAUNA	32973	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Monitoring	Secondary sign	Feeding residue		1	BALDIVIS	Fifty Road, Baldivis	1000	15	2	2009
Calyptorhynchus latirostris	TFAUNA	32974	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Monitoring	Secondary sign	Feeding residue		1	BALDIVIS	Fifty Road, Baldivis	1000	15	2	2009
Calyptorhynchus latirostris	TFAUNA	32975	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Monitoring	Secondary sign	Feeding residue		1	BALDIVIS	Fifty Road, Baldivis	1000	15	2	2009
Calyptorhynchus latirostris	TFAUNA	32976	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Monitoring	Secondary sign	Feeding residue		1	BALDIVIS	Fifty Road, Baldivis	1000	15	2	2009
Calyptorhynchus latirostris	TFAUNA	32977	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Monitoring	Secondary sign	Feeding residue		1	BALDIVIS	Fifty Road, Baldivis	1000	15	2	2009
Calyptorhynchus latirostris	TFAUNA	89238	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	BALDIVIS	Bush blocks south west of MacNuts, Baldivis	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89240	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	BALDIVIS	MacNuts WA, 213 Doghill Rd Baldivis	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89241	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	BALDIVIS	MacNuts WA, Macadamia orchard, Baldivis	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89242	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	BALDIVIS	PP E end of Makin Rd, Baldivis	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89243	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	BALDIVIS	PP between Doghill Rd and Horsfall Rd, Baldivis	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89246	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	BALDIVIS	Baldivis Reserve, Baldivis	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	35534	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			250	WATTLEUP	Bibra Drive, Bibra Lake	1000	20	2	2010
Calyptorhynchus latirostris	TFAUNA	33986	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			1	OAKFORD	Casuarina	1000	1	1	2010
Calyptorhynchus latirostris	TFAUNA	80401	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Moderately Certain	Community survey	Day sighting			50	OAKFORD	88 Tuart Rd	1000	6	4	2014
Calyptorhynchus latirostris	TFAUNA	89271	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	OAKFORD	545 - 589 Orton Rd, Oakford (N side of road)	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89272	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	OAKFORD	105-142 Cumming Rd, Oakford. PP on both sides	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89273	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	OAKFORD	141 King Rd, Oakford & adj. PP	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89277	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	OAKFORD	Modong Nature Reserve, Oakford	1000	19	5	2016

NAME_SCI	SOURCE	SOURCE_ID	NAME_ID	FAMILY	GENUS	SPECIES	SUBSPECIES	NAME_COM	KINGDOM	CLASS	CONS_CODE	CERTAINTY	METHOD	TYPE	EVIDENCE	BREEDING / NON	COUNT	LOCALITY	SITE	ACCURACY_M	DAY	MONTH	YEAR
Calyptorhynchus latirostris	TFAUNA	89281	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	OAKFORD	93-102 Tuart Rd, Oakford. PP on both sides of roa	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89286	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	OAKFORD	Jandakot Regional Park, Jandakot	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89293	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	OAKFORD	PP N & S of Foxton Dr, Oakford, extending S to W	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89298	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	OAKFORD	Ditton Rd, Oakford	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	35311	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			30	WELLARD	Braddock Road, Wellard	1000	19	6	2004
Calyptorhynchus latirostris	TFAUNA	35312	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			30	WELLARD	Braddock Road, Wellard	1000	19	6	2004
Calyptorhynchus latirostris	TFAUNA	80657	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Community survey	Day sighting			125	WELLARD	Henley Bushland between Henley Blvd/Lambreth	1000	12	4	2015
Calyptorhynchus latirostris	TFAUNA	89253	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	WELLARD	41 Nella Pl, Wellard	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89254	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	WELLARD	Remant bush on PP to W of Wellard rd, b/w Bert	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89257	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	WELLARD	Bushland to W of intersection b/w Boomerang & I	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89259	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	WELLARD	Henley Bushland	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89260	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	WELLARD	Remnant bush on PP b/w Casuarina Prison & Jac	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89261	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	WELLARD	Remnant Bush, Bertram Rd, Wellard	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89263	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	WELLARD	King's College school, 170 Bertram rd, Wellard	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	33985	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			10	CASUARINA	Casuarina	1000	30	11	2005
Calyptorhynchus latirostris	TFAUNA	33987	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			6	CASUARINA	Casuarina	1000	30	12	2005
Calyptorhynchus latirostris	TFAUNA	33988	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			6	CASUARINA	Casuarina	1000	30	12	2005
Calyptorhynchus latirostris	TFAUNA	33989	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			10	CASUARINA	Casuarina	1000	30	11	2005
Calyptorhynchus latirostris	TFAUNA	33990	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			10	CASUARINA	Casuarina	1000	29	11	2005
Calyptorhynchus latirostris	TFAUNA	33992	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			10	CASUARINA	Casuarina	1000	29	11	2005
Calyptorhynchus latirostris	TFAUNA	33993	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			50	CASUARINA	Casuarina	1000	18	6	2005
Calyptorhynchus latirostris	TFAUNA	33994	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			50	CASUARINA	Casuarina	1000	18	6	2005
Calyptorhynchus latirostris	TFAUNA	33995	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			150	CASUARINA	Casuarina	1000	14	1	2005
Calyptorhynchus latirostris	TFAUNA	33996	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			150	CASUARINA	Casuarina	1000	14	1	2005
Calyptorhynchus latirostris	TFAUNA	33997	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			63	CASUARINA	Casuarina	1000	9	1	2005
Calyptorhynchus latirostris	TFAUNA	33998	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			63	CASUARINA	Casuarina	1000	9	1	2005
Calyptorhynchus latirostris	TFAUNA	33999	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			72	CASUARINA	Casuarina	1000	5	1	2005
Calyptorhynchus latirostris	TFAUNA	34000	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			72	CASUARINA	Casuarina	1000	5	1	2005
Calyptorhynchus latirostris	TFAUNA	34001	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			20	CASUARINA	Casuarina	1000	4	1	2005
Calyptorhynchus latirostris	TFAUNA	34002	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			20	CASUARINA	Casuarina	1000	4	1	2005
Calyptorhynchus latirostris	TFAUNA	34003	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			23	CASUARINA	Casuarina	1000	28	12	2004
Calyptorhynchus latirostris	TFAUNA	34004	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			23	CASUARINA	Casuarina	1000	28	12	2004
Calyptorhynchus latirostris	TFAUNA	34005	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			20	CASUARINA	Casuarina	1000	27	12	2004
Calyptorhynchus latirostris	TFAUNA	34006	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			20	CASUARINA	Casuarina	1000	27	12	2004
Calyptorhynchus latirostris	TFAUNA	34007	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			34	CASUARINA	Casuarina	1000	26	12	2004
Calyptorhynchus latirostris	TFAUNA	34008	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			34	CASUARINA	Casuarina	1000	26	12	2004
Calyptorhynchus latirostris	TFAUNA	34009	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			40	CASUARINA	Casuarina	1000	25	12	2004
Calyptorhynchus latirostris	TFAUNA	34010	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			40	CASUARINA	Casuarina	1000	25	12	2004
Calyptorhynchus latirostris	TFAUNA	34011	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			47	CASUARINA	Casuarina	1000	17	11	2004
Calyptorhynchus latirostris	TFAUNA	34012	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			47	CASUARINA	Casuarina	1000	17	11	2004
Calyptorhynchus latirostris	TFAUNA	34013	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			63	CASUARINA	Casuarina	1000	16	11	2004
Calyptorhynchus latirostris	TFAUNA	34014	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			63	CASUARINA	Casuarina	1000	16	11	2004
Calyptorhynchus latirostris	TFAUNA	34015	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			47	CASUARINA	Casuarina	1000	12	9	2004
Calyptorhynchus latirostris	TFAUNA	34016	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			47	CASUARINA	Casuarina	1000	12	9	2004
Calyptorhynchus latirostris	TFAUNA	34017	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			50	CASUARINA	Casuarina	1000	26	7	2004
Calyptorhynchus latirostris	TFAUNA	34018	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			50	CASUARINA	Casuarina	1000	26	7	2004
Calyptorhynchus latirostris	TFAUNA	34019	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			44	CASUARINA	Casuarina	1000	19	7	2004
Calyptorhynchus latirostris	TFAUNA	34020	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			44	CASUARINA	Casuarina	1000	19	7	2004
Calyptorhynchus latirostris	TFAUNA	34021	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			120	CASUARINA	Casuarina	1000	13	7	2004
Calyptorhynchus latirostris	TFAUNA	34022	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			120	CASUARINA	Casuarina	1000	13	7	2004
Calyptorhynchus latirostris	TFAUNA	34023	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			77	CASUARINA	Casuarina	1000	6	7	2004
Calyptorhynchus latirostris	TFAUNA	34024	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			77	CASUARINA	Casuarina	1000	6	7	2004
Calyptorhynchus latirostris	TFAUNA	34025	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			150	CASUARINA	Casuarina	1000	17	6	2004
Calyptorhynchus latirostris	TFAUNA	34026	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			150	CASUARINA	Casuarina	1000	17	6	2004
Calyptorhynchus latirostris	TFAUNA	34027	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			2220	CASUARINA	Casuarina	1000	28	5	2004
Calyptorhynchus latirostris	TFAUNA	34028	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			220	CASUARINA	Casuarina	1000	28	5	2004
Calyptorhynchus latirostris	TFAUNA	34029	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			20	CASUARINA	Casuarina	1000	25	5	2004
Calyptorhynchus latirostris	TFAUNA	34030	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			20	CASUARINA	Casuarina	1000	25	5	2004
Calyptorhynchus latirostris	TFAUNA	34031	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			60	CASUARINA	Casuarina	1000	23	5	2004
Calyptorhynchus latirostris	TFAUNA	34032	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			60	CASUARINA	Casuarina	1000	23	5	2004
Calyptorhynchus latirostris	TFAUNA	34033	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			80	CASUARINA	Casuarina	1000	22	5	2004
Calyptorhynchus latirostris	TFAUNA	34034	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			80	CASUARINA	Casuarina	1000	22	5	2004
Calyptorhynchus latirostris	TFAUNA	34035	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			100	CASUARINA	Casuarina	1000	15	5	2004
Calyptorhynchus latirostris	TFAUNA	34036	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			100	CASUARINA	Casuarina	1000	15	5	2004
Calyptorhynchus latirostris	TFAUNA	34037	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			20	CASUARINA	Casuarina	1000	30	4	2004
Calyptorhynchus latirostris	TFAUNA	34038	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			20	CASUARINA	Casuarina	1000	30	4	2004
Calyptorhynchus latirostris	TFAUNA	34039	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			170	CASUARINA	Casuarina	1000	29	4	2004
Calyptorhynchus latirostris	TFAUNA	34040	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			170	CASUARINA	Casuarina	1000	29	4	2004
Calyptorhynchus latirostris	TFAUNA	34041	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			270	CASUARINA	Casuarina	1000	19	4	2004
Calyptorhynchus latirostris	TFAUNA	34042	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			270	CASUARINA	Casuarina	1000	19	4	2004
Calyptorhynchus latirostris	TFAUNA	34043	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			270	CASUARINA	Casuarina	1000	19	4	2004
Calyptorhynchus latirostris	TFAUNA	34044	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			270	CASUARINA	Casuarina	1000	19	4	2004
Calyptorhynchus latirostris	TFAUNA	34045	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			2	CASUARINA	Casuarina	1000	11	4	2004
Calyptorhynchus latirostris	TFAUNA	34046	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			170	CASUARINA	Casuarina	1000	11	4	2004
Calyptorhynchus latirostris	TFAUNA	34047	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			170	CASUARINA	Casuarina	1000	11	4	2004
Calyptorhynchus latirostris	TFAUNA	34048	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			170	CASUARINA	Casuarina	1000	11	4	2004
Calyptorhynchus latirostris	TFAUNA	34049	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			170	CASUARINA	Casuarina	1000	11	4	2004

NAME_SCI	SOURCE	SOURCE_ID	NAME_ID	FAMILY	GENUS	SPECIES	SUBSPECIES	NAME_COM	KINGDOM	CLASS	CONS_CODE	CERTAINTY	METHOD	TYPE	EVIDENCE	BREEDING / NON	COUNT	LOCALITY	SITE	ACCURACY_M	DAY	MONTH	YEAR
Calyptorhynchus latirostris	TFAUNA	34050	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			170	CASUARINA	Casuarina	1000	11	4	2004
Calyptorhynchus latirostris	TFAUNA	34051	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			170	CASUARINA	Casuarina	1000	11	4	2004
Calyptorhynchus latirostris	TFAUNA	34052	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			2	CASUARINA	Casuarina	1000	11	4	2004
Calyptorhynchus latirostris	TFAUNA	34053	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			170	CASUARINA	Casuarina	1000	11	4	2004
Calyptorhynchus latirostris	TFAUNA	34054	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			170	CASUARINA	Casuarina	1000	11	4	2004
Calyptorhynchus latirostris	TFAUNA	34055	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			12	CASUARINA	Casuarina	1000	10	4	2004
Calyptorhynchus latirostris	TFAUNA	34056	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			12	CASUARINA	Casuarina	1000	10	4	2004
Calyptorhynchus latirostris	TFAUNA	34057	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			9	CASUARINA	Casuarina	1000	1	4	2004
Calyptorhynchus latirostris	TFAUNA	34058	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			9	CASUARINA	Casuarina	1000	1	4	2004
Calyptorhynchus latirostris	TFAUNA	34059	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			34	CASUARINA	Casuarina	1000	4	2	2004
Calyptorhynchus latirostris	TFAUNA	34060	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Survey	Day sighting			34	CASUARINA	Casuarina	1000	4	2	2004
Calyptorhynchus latirostris	TFAUNA	80391	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Moderately Certain	Community survey	Day sighting			19	CASUARINA	Marri Park Golf Club 29 Surflin Ct	1000	6	4	2014
Calyptorhynchus latirostris	TFAUNA	89262	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	CASUARINA	319 - 343 Mortimer Rd, Wellard. PP on both sides	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89264	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	CASUARINA	Bushland to north of Mortimer Rd, east of Nicolas	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89267	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	CASUARINA	105 Lavery Dr, Oakford	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89268	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	CASUARINA	Bushland surrounding Casuarina Prison, Casuarin	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89270	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	CASUARINA	158 Orton Rd, Casuarina. Incl SE corner of Marri	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89274	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	CASUARINA	N end pf Marri Park Golf Course incl. adj. 21-29 S	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89275	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	CASUARINA	87 Newbold Rd, Casuarina	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	74858	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Not Sure	Opportunistic sighting	Day sighting			1	AUBIN GROVE	Aubin Grove	1000	30	5	2014
Calyptorhynchus latirostris	TFAUNA	80404	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Moderately Certain	Community survey	Day sighting			12	WANDI	Approx 123 Leslie Rd Wandi, near Frayne Place.	1000	7	4	2014
Calyptorhynchus latirostris	TFAUNA	89285	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	WANDI	20 Frayne Pl, Wandi	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89289	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	WANDI	Remnant bush on PP b/w Rowley & Anketell Rds.	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89292	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	WANDI	38 Robinson Rd, Wandi	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89295	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	WANDI	31 The Horseshoe, Wandi	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89297	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	WANDI	PP on Wandi Dr b/w Satinover Way & Brooks Pl	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	32781	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Monitoring	Secondary sign	Feeding residue		1	LEDA	Gilmore Ave, Kwinana	1000	19	3	2009
Calyptorhynchus latirostris	TFAUNA	32782	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Monitoring	Secondary sign	Feeding residue		1	LEDA	Gilmore Ave, Kwinana	1000	19	3	2009
Calyptorhynchus latirostris	TFAUNA	32783	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Monitoring	Secondary sign	Feeding residue		1	LEDA	Gilmore Ave, Kwinana	1000	16	2	2009
Calyptorhynchus latirostris	TFAUNA	32784	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Monitoring	Secondary sign	Feeding residue		1	LEDA	Gilmore Ave, Kwinana	1000	16	2	2009
Calyptorhynchus latirostris	TFAUNA	32785	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Monitoring	Secondary sign	Feeding residue		1	LEDA	Gilmore Ave, Kwinana	1000	16	2	2009
Calyptorhynchus latirostris	TFAUNA	89252	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	LEDA	Leda Nature Reserve.	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89255	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	LEDA	Leda Nature Reserve, N end	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89256	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	LEDA	Runnymead Bushland	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89258	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	LEDA	Bushland to N of Leda Reserve b/w Gilmore Ave	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89265	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	OLDBURY	Banksia Nature Reserve, Oldbury	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89269	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	OLDBURY	12 Tunney Rd, Oldbury	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	89302	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Very Certain	Regular monitoring	Remote sensing	No other signs	Non-breeding	1	BANJUP	PP on Wolfe & Liddelow Rds, Banjup	1000	19	5	2016
Calyptorhynchus latirostris	TFAUNA	23656	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Targeted survey	Day sighting			1520	BALDIVIS	Karnup PP, corner of 68 and 80 roads	10000	26	3	2006
Calyptorhynchus banksii naso	TFAUNA	22329	24731	Cacatuidae	Calyptorhynchus	banksii	naso	forest red-tailed black cockatoo	Animalia	VU	BIRD	Certain	Targeted survey	Day sighting			6	THE SPECTACLES	Thomas Road, Kwinana	1000	19	11	2000
Calyptorhynchus banksii naso	TFAUNA	22357	24731	Cacatuidae	Calyptorhynchus	banksii	naso	forest red-tailed black cockatoo	Animalia	VU	BIRD	Certain	Targeted survey	Day sighting			4	WELLARD	Arundel Road, Wellard	1000	19	7	2003
Calyptorhynchus banksii naso	TFAUNA	84720	24731	Cacatuidae	Calyptorhynchus	banksii	naso	forest red-tailed black cockatoo	Animalia	VU	BIRD	Moderately Certain	Community survey	Dusk sighting			9	WELLARD	KWIWELR001	1000	3	4	2016
Calyptorhynchus latirostris	TFAUNA	21388	24734	Cacatuidae	Calyptorhynchus	latirostris		Carnaby's cockatoo	Animalia	EN	BIRD	Certain	Targeted survey	Day sighting			1200	WELLARD	Near Wellard	10000	1	3	2010
Calyptorhynchus banksii naso	TFAUNA	81056	24731	Cacatuidae	Calyptorhynchus	banksii	naso	forest red-tailed black cockatoo	Animalia	VU	BIRD	Moderately Certain	Opportunistic sighting	Day sighting			150	MARDELLA	In Tasmanian Blue gums next to house	1000	18	9	2015
Calyptorhynchus banksii naso	TFAUNA	16100	24731	Cacatuidae	Calyptorhynchus	banksii	naso	forest red-tailed black cockatoo	Animalia	VU	BIRD	Certain	Opportunistic sighting	Day sighting			5	WANDI	at the end of Blackboy Grove. Wandi	1000	1	7	2008
Calyptorhynchus banksii naso	TFAUNA	20967	24731	Cacatuidae	Calyptorhynchus	banksii	naso	forest red-tailed black cockatoo	Animalia	VU	BIRD	Certain	Opportunistic sighting	Day sighting			6	KWINANA BEACH	Thomas Road Kwinana	1000	22	9	2011

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Appendix 3
Targeted Spring Flora Survey

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Phone (08) 9380 3100 Fax (08) 9380 4606
177 Spencer Street Bunbury WA 6230 PO Box 287 Bunbury WA 6231
Phone (08) 9792 4797 Fax (08) 9792 4708

To: Brendan Acott

Date: 20 November 2018

Company: LWP Property Group

Project No: PRP17655.03

Fax/email: brendana@lwpproperty.com.au

Inquiries: Darren Walsh

Casuarina Urban Cell
Targeted Flora Survey

Background

LWP Property Group (LWP) are proposing to develop land within the Casuarina Central Precinct Local Structure Plan, which is bounded by Kwinana Freeway to the west, Orton Road to the north a conservation reserve to the east and rural residential properties to the south (the Project Area; Figure 1). LWP are proposing to develop the Project Area for residential, mixed business, a primary school, Public Open Space (POS) and conservation areas. Currently, the Project Area is comprised of various rural residential and vacant lots.

Since 2010, the following surveys have been undertaken within the site:

- Level 2 flora and vegetation survey and Wetland Delineation Assessment (survey undertaken 2 October and 16 November 2010) (360 Environmental 2011)
- Level 2 Flora and Vegetation Survey, Landgren Road, Casuarina (survey undertaken 16 and 17 November 2015) (360 Environmental 2016 – field work only)
- Reconnaissance Flora and Vegetation Survey (April 2018) for areas not previously surveyed, with additional targeted searches for perennial conservation significant species.

A report produced in July 2018 (360 environmental) presented the above surveys and their findings. To progress approvals process within the project area, a targeted flora survey for conservation significant species, specifically Threatened flora species as listed under section 178 of the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act), with potential to occur within the project area was required to be undertaken.

Strategen Environmental was engaged to undertake a targeted flora survey in October 2018.

Methods

A targeted survey for Conservation Significant Flora species with the potential to occur within the project area was undertaken by two botanists form Strategen. Potential habitat within the project area was identified prior to the field survey during the desktop assessment. This ensured all potential habitat was searched during the field survey. Transects with a spacing of 5-10 metres will be walked within potential habitat areas as per EPBC Act flora survey guidance. Where conservation significant flora were located, their location was recorded using a handheld GPS unit.

The survey was conducted on 11 October 2018. This was the prime flowering time for most of the conservation significant flora species with potential to occur within the survey area. The survey timing was not optimal for *Drakaea elastica* (Glossy-leaved hammer orchid) and as such, the survey was unlikely to detect the presence of this species. The survey timing was considered appropriate for the following Threatened flora species:

- *Caladenia huegelii* (Grand spider orchid),
- *Diuris micrantha* (Dwarf bee orchid),
- *Diuris purdiei* (Purdie's donkey orchid),

- *Drakaea micrantha* (Dwarf hammer orchid)
- *Lepidosperma rostratum*.

The targeted survey will also search for and record if found locations of additional populations of Priority flora species previously recorded. These species are:

- *Cyathochaeta teretifolia* (P3)
- *Jacksonia gracillima* (P3)
- *Tetraria* sp. Chandala (P2).

During the targeted survey, vegetation condition previously mapped (360 environmental) was verified, with changes to boundaries made if required.

Results and Discussion

Conservation Significant Flora

The survey effort of the targeted survey is shown in Figure 1.

No Threatened flora species as listed under section 178 of the EPBC Act or pursuant to Schedule 1 of the WC Act and as listed by Parks and Wildlife (2015) were recorded within the survey area. No additional populations of Priority flora species as listed by Western Australian Herbarium (1998-) were recorded within the survey area.

Given the survey period for *Drakaea elastica* (Glossy-leaved hammer orchid) was not optimal for the detection of the species, the potential of this species to occur within the project area cannot be ruled out. Potential habitat for this species is considered to occur within the CcKg vegetation type. This can broadly described as *Corymbia calophylla* and *Melaleuca preissiana* scattered trees over *Kunzea glabrescens* scattered tall shrubs.

Vegetation Condition Mapping

No changes to the vegetation condition mapping within the project area were required. The on-ground survey determined no significant deviations to the mapped condition existed.



Figure 1: Project area

N

Scale 1:10,000 at A4

0 100 200 m

Coordinate System: GDA 1994 MGA Zone 50

Date: 19/11/2018

Legend

- Project Area (96.12 ha)
- Cadastral boundaries
- Survey tracks

strategen ENVIRONMENTAL

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Data source: Nearmap: Aerial image, flown 06/2018. Landgate: Cadastre, 11/2017. Client: LWP Property Pty Ltd. Development layout, 08/2018. Created by: c.thatcher

Appendix 4
Black cockatoo tree hollow assessment

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Assessment of Black Cockatoo Potential Breeding Trees – Lots 34, 37, 39, 40, 41, 42, 43, 44 and 47 Landgren Road, Casuarina

Background

Strategen was engaged by LWP Property to undertake an assessment of trees previously identified as having hollows that might be suitable for Black Cockatoos to breed in (360 Environmental 2018; Appendix H). However, it was noted that not all trees would be appropriate for nesting and that further investigation would be required to determine suitability (360 Environmental 2018).

Please note that the assessment undertaken by Strategen was confined to Lots 34, 37, 39, 40, 41, 42, 43, 44 and 47 which are owned or managed by LWP Property.

Methods

The site visit was undertaken on 11 October 2018. The co-ordinates of the previously identified trees were entered on the GPS so that they could be located. Of the trees previously identified as potentially being suitable, 26 were confined to the lots mentioned above and inspected for hollows to determine their suitability for nesting by Black Cockatoos (see Appendix 1 for the co-ordinates of trees that were assessed).

At each tree, we assessed from the ground (with the naked eye and with binoculars) and estimated the following three characteristics that might make a tree suitable for Black Cockatoos to nest in:

- size of the hollow opening (cm)
- height (m) of the hollow from the ground
- angle of the hollow.

Please note that these characteristics were observed and measured (estimated) as they are important aspects to consider whether a hollow is suitable for Black Cockatoos to nest in and they can be measured without having to climb the tree. The internal dimensions of a hollow are critical and ultimately determine whether the hollow is suitable or not in order for a nest to be constructed, however, to do this the tree needs to be climbed and the internal dimensions of the hollow measured (as already mentioned).

The literature was consulted in order to determine what size, height and angle the three characteristics of a tree above need to be to make them a potentially suitable nest tree. Past studies have found that on average hollow openings are 25 cm x 27 cm (Saunders et al. 1982, Saunders and Dawson 2017) and 30 cm x 34 cm (Johnstone et al. 2013). The height of a hollow entrance off the ground is on average14.49 m (Johnstone et al. 2013). Nearly all hollows the are used for nesting by Black Cockatoos are located in the main trunk and have a vertical aspect (Johnstone et al. 2013, Saunders and Dawson 2017). Black Cockatoos are large birds with shoulders that are about 10 cm wide, therefore they require hollows with an entrance bigger than this (as shown above they are much larger), but the internal dimensions (depth and floor base) need to be much larger in order for it to be suitable to lay eggs in and be able to move around.

Results and Discussion

Of the 26 trees inspected during the assessment only three trees (C3, C6 and C32) were considered as having the potential to be suitable for nesting when viewed from the ground (see Appendix 1 and 2).

The remaining 23 trees were unsuitable because either their hollow entrances were too small, they were blind openings (i.e. they did not go far in enough to be suitable), were in branches that in many instances were horizontal, and were not high enough off the ground (see Appendix 2 for some examples).

The three trees deemed potentially suitable for nesting showed no signs of current use, however, as discussed above perhaps the internal dimensions of the hollows are unsuitable. Therefore, to assess their suitability, an internal inspection of the hollows in these three trees would be required to determine this.

References

Johnstone, R. E, Kirkby, T., and Sarti, K. (2013). The breeding biology of the Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso* Gould in south-western Australia. I. Characteristics of nest trees and nest hollows. *Pacific Conservation Biology* **19**, 121–142.

Saunders, D. A., Smith, G. T. and Rowley, I. (1982). The availability and dimensions of tree hollows that provide nest sites for cockatoos (Psittaciformes) in Western Australia. *Australian Wildlife Research* **9**, 541-56.

Saunders, D. A. and Dawson, R. 2017. Cumulative learnings and conservation implications of a long-term study of the endangered Carnaby's Cockatoo *Calyptorhynchus latirostris*. *Australian Zoologist* **40**, 1-19.

360 Environmental (2018). Flora, vegetation and Black Cockatoo assessment – various lots, Orton and Landgren Road, Casuarina. Unpublished report prepared for PRM Property Holdings.

Appendix 1
Cockatoo table

360 Environmental data										Strategen data	
Common Name	Species		Easting	Northing	DBH	Height	Hollows	No hollows	Suitable for BC	Tree reference no.	Further assessed for BC hollow suitability
Marri	*(Corymbia*	*calophylla)*	392237	6432239	1420	15	yes	2	yes	3	Potentially suitable hollow
Marri	*(Corymbia*	*calophylla)*	392290	6432155	1350	13	yes	5	yes	4	Unsuitable
Marri	*(Corymbia*	*calophylla)*	392235	6432226	1310	16	yes	1	yes	5	Unsuitable
Jarrah	*(Eucalyptus*	*marginata)*	392359	6432358	1250	10	yes	4	yes	6	Potentially suitable hollow
Marri	*(Corymbia*	*calophylla)*	392314	6432339	1170	10	yes	2	yes	10	Unsuitable
Marri	*(Corymbia*	*calophylla)*	392429	6432234	1170	16	yes	2	yes	11	Unsuitable
Jarrah	*(Eucalyptus*	*marginata)*	392284	6432007	1150	8	yes	3	yes	12	Unsuitable
Jarrah	*(Eucalyptus*	*marginata)*	392223	6432152	1110	13	yes	1	yes	13	Unsuitable
Jarrah	*(Eucalyptus*	*marginata)*	392243	6431817	1100	8	yes	5	yes	14	Unsuitable
Marri	*(Corymbia*	*calophylla)*	392306	6432406	1100	16	yes	1	yes	15	Unsuitable
Jarrah	*(Eucalyptus*	*marginata)*	392445	6432540	1000	4	yes	1	yes	20	Unsuitable
Jarrah	*(Eucalyptus*	*marginata)*	392489	6431935	940	8	yes	1	yes	24	Unsuitable
Jarrah	*(Eucalyptus*	*marginata)*	392288	6432228	910	12	yes	2	yes	26	Unsuitable
Jarrah	*(Eucalyptus*	*marginata)*	392405	6432235	900	8	yes	2	yes	30	Unsuitable
Jarrah	*(Eucalyptus*	*marginata)*	392231	6432242	900	14	yes	1	yes	31	Unsuitable
Marri	*(Corymbia*	*calophylla)*	392311	6432340	890	10	yes	1	yes	32	Potentially suitable hollow
Jarrah	*(Eucalyptus*	*marginata)*	392402	6432199	860	12	yes	1	yes	34	Unsuitable
Jarrah	*(Eucalyptus*	*marginata)*	392332	6432631	800	8	yes	1	yes	36	Unsuitable
Jarrah	*(Eucalyptus*	*marginata)*	392277	6431916	800	5	yes	1	yes	37	Unsuitable
Jarrah	*(Eucalyptus*	*marginata)*	392281	6431856	700	5	yes	4	yes	42	Unsuitable
Jarrah	*(Eucalyptus*	*marginata)*	392243	6432620	680	8	yes	2	yes	44	Unsuitable
Jarrah	*(Eucalyptus*	*marginata)*	392334	6432230	640	6	yes	2	yes	48	Unsuitable
Jarrah	*(Eucalyptus*	*marginata)*	392299	6432344	630	6	yes	1	yes	49	Unsuitable
Jarrah	*(Eucalyptus*	*marginata)*	392499	6432235	620	7	yes	2	yes	50	Unsuitable
Jarrah	*(Eucalyptus*	*marginata)*	392373	6432358	610	10	yes	1	yes	51	Unsuitable
Jarrah	*(Eucalyptus*	*marginata)*	392333	6432340	520	8	yes	1	yes	53	Unsuitable

Appendix 2
Photographs

Trees with hollows in the project area that are potentially suitable for Black Cockatoo to nest in when viewed from the ground.

C32 – Marri



C3 – Marri



C6 – Stag



Examples of trees with hollows in the project area that are unsuitable for Black Cockatoos to nest in when viewed from the ground.

C36 - Stag



C53 – Jarrah



C44 – Stag (Jarrah)



C26 – Jarrah



C30 – Stag



C20 – Stag



C44 – Stag



C37 – Stag



Appendix 5
(COSTA) Mushroom Exchange, Casuarina Revision of Predicted Odour Levels Based on Sampling of Sterilisation Building Emissions (Environmental Alliances 2015)

(COSTA) MUSHROOM EXCHANGE, CASUARINA

REVISION OF PREDICTED ODOUR LEVELS BASED ON SAMPLING OF STERILISATION BUILDING EMISSIONS

Prepared for

MushroomExchange Pty Ltd Trading as Costa (Mushroom Category)

by

ENVALL

Environmental Alliances Pty Ltd

August 2015

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Where site inspections, testing or fieldwork have taken place, the report is based on the information made available by the client or their nominees during the visit, visual observations and any subsequent discussions with regulatory authorities. It is assumed that normal activities were undertaken at the site on the day of the site visit(s) unless explicitly stated otherwise.

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Client: MushroomExchange Pty Ltd Trading as Costa (Mushroom Category)

Job No: L2144c	Version	Prepared by	Reviewed by	Submitted to Client	
Status				Copies	Date
Draft Report	V0b	DP	-	*.doc	5/7/2015
Final Report	V1b	DP	KP	*.pdf	19/7/2015
Updated Final Report	V1c	DP	-	*.pdf	17/8/2015

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ABN: 75 103 600 620

TABLE OF CONTENTS

1. INTRODUCTION 1

1.1 2013 ODOUR MODELLING 1

1.2 SUMMARY OF ANNUAL EMISSIONS 1

1.3 REDUCTION OF ODOUR EMISSIONS FROM STERILISATION BUILDING 1

2. STERILISATION BUILDING ODOUR EMISSIONS RE-ASSESSMENT 1

2.1 FUNCTION OF STERILISATION BUILDING 1

2.2 EMISSIONS SAMPLING 2

2.2.1 Estimation of volume flow rate 3

2.2.2 Temperature 3

2.2.3 Odour concentration 4

2.3 OPERATING REGIME 4

2.4 ODOUR EMISSION RATE 4

3. MODELLING ASSUMPTIONS 5

4. RESULTS 5

4.1 STERILISATION BUILDING EMISSIONS IN ISOLATION 5

4.2 ALL MODELLED SOURCES (CURRENT SITUATION) 6

4.3 ASSESSMENT OF WALKING FLOOR DELIVERIES OF COMPOST 8

5. REFERENCES 11

LIST OF TABLES

1. Estimated annual average odour emission rates for quantified Mushroom Exchange odour sources 1

LIST OF FIGURES

1. Example of leakage between concrete panels 3

2. Predicted 2.5 ou 1-hour average 99.5 percentile odour concentrations from the Sterilisation Building only 6

3. Predicted 2.5 ou 1-hour average 99.5 percentile odour concentrations range for compost deliveries, Pasteurisation Building vents from 2013 modelling and Sterilisation Building from 2015 sampling 7

4. Comparison of hopper loading from front-end loader 25/7/2012 0817 hours and walking floor truck 1/7/2015 0900 hours 9

5. Predicted 2.5 ou 1-hour average 99.5 percentile odour concentrations range for compost deliveries assuming travelling floor discharge direct to hopper is implemented 10

6. Estimated odour concentration of emissions over pasteurisation (phase 2) process for a set of three tunnels 17

LIST OF APPENDICES

1. Results from odour concentration analysis of Sterilisation Building emissions

2. Mushroom Exchange odour sources and characteristics through production stages

1. INTRODUCTION

1.1 2013 ODOUR MODELLING

In 2012, Environmental Alliances was engaged to undertake an assessment of the odour emissions and impacts from the operating facility (ENVALL 2013). This included an investigation of other odour sources in addition to compost receivals/handling.

The three main sources of odour that were considered to be the main contributors to off-site odour impacts were:

- Compost Receivals and handling into the Pasteurisation Building;
- Pasteurisation Building Vents; and
- Sterilisation Building.

1.2 SUMMARY OF ANNUAL EMISSIONS

By way of some perspective, a summary of the odour emissions from the three main sources from the ENVALL (2013) report is shown in Table 1 below:

Table 1 Estimated annual average odour emission rates for quantified Mushroom Exchange odour sources

Source	Annual odour emission rate based on 2011-12 meteorology (ou.m^3/s)
Compost Receivals and handling into the Pasteurisation Building	
Bunker (incl storage and truck dumps)	1,674
Hopper (inclined belt loaded by FE loader incl transfer to conveyor)	3,680
Conveyor	151
Total Compost Receivals	5,505
Sterilisation	18,952
Pasteurisation Vents	8,149

1.3 REDUCTION OF ODOUR EMISSIONS FROM STERILISATION BUILDING

Since the 2013 study, Costa has reduced leakages from the Sterilisation Building. This report describes a re-assessment of odour emissions from this building and re-modelling of odour levels based on the results.

2. STERILISATION BUILDING ODOUR EMISSIONS RE-ASSESSMENT

2.1 FUNCTION OF STERILISATION BUILDING

The Sterilisation Building (also referred to as Cookout Building) contains two similarly sized chambers used to sterilise the mushroom-growing trays using steam produced by an adjacent boiler. Each chamber has its own vehicle door to allow a fork-lift to transport the trays into the chamber and remove them after the sterilisation process. The doors are fitted with rubberised seals. There is also a sub-surface drain within each chamber.

For a sterilisation cycle, steam is pumped into the required chamber for approximately 20 hours to heat the trays to the required temperature (72°C) then eased off to maintain that temperature for a further 8 hours before being shut off completely after which the trays are allowed to cool naturally.

When steam is pumped into a chamber containing the trays, heat transferred from the steam into the trays causes much of the steam to condense, which allows additional steam to be pumped in with little increase to the net pressure inside the building. The drain allows the condensed steam (as water) to escape to prevent flooding the floor.

The lower density of the incoming steam does, however, cause it to initially rise to the top of the chamber. This creates a small pressure difference between the upper part of the Chamber and the outside (cooler) ambient air. If there are gaps in the upper walls and roof, some of the steam, together with any odour from the trays that has been imparted into the steam, will escape.

The Sterilisation Building was considered to be a major source of odour emissions following the sampling in 2012.

2.2 EMISSIONS SAMPLING

The emissions from the Sterilisation Building were sampled on 1 July 2015.

It was observed that the volume of emission is much less than it was in 2012. In 2012, vertical gaps in the corners of the walls were in the order of a centimetre wide in places, and the resulting plume was visible well above the roof of the building.

Now, the emissions can only be observed by close inspection of the door and upper section of the walls. The emissions were through occasional very small gaps:

- between the concrete cladding where the roof section abutted the tilt-up wall panels; and
- around the truck door seal.

The gaps in the concrete were inconsistent in size and there were substantial lengths where no emission (i.e. no gap) was apparent (see Figure 1).



Figure 1 Example of leakage between concrete panels

The emission in the truck door seals was also intermittent and appeared less than the concrete.

2.2.1 Estimation of volume flow rate

It is not possible using conventional sampling methods to make a particularly accurate determination of volume flow rate in these circumstances. The approach used was to measure the velocity of the leakages using a hot-wire anemometer, which has a small probe that can be pressed into the gaps, then multiply this result by the estimated surface area of the gaps.

Using this method, the average of six velocity measurements through the largest of the gaps in the concrete was 1.5 m/s.

Even with the small probe, the velocity through the door seals gaps was too low to measure. There were no obvious gaps as such through the door seal – rather the leaks appeared to be where the rubber seal was only in weak contact with the frame, hence the emission was more of a "seepage". A probable contributing factor to the low emission through the door is that the internal pressure is lower near the base than near the roof due to the vertical temperature gradient. Therefore the anemometer threshold of 0.1 m/s was assumed for the velocity.

It is considered that an average 1 mm gap, if assumed continuous along the front (east), north and rear (west) concrete walls, would be a reasonable estimate. For the door seal, a 1 mm "gap", if assumed continuous around the entire door perimeter, would be a conservative estimate.

This gives the volume flow through the concrete gaps of:

[10.5m x 2 (east and west facing walls) + 21m (north facing wall)] x 0.001 m (gap) x 1.5 m/s = 0.063 m^3/s.

Similarly, the volume flow through the door seal is:

[3.5m (height) x 2 + 4m (width) x 2] x 0.001m (gap) x 0.1 m/s = 0.0015 m^3/s.

This gives a total volume flow of 0.0645 m^3/s.

There is a small hinged hatch in the door (dimensions 0.45 x 0.5 m) which acts as periodic pressure relief. This appears to discharge very infrequently (observed once in approximately 1 hour).

For the purpose of calculating the odour emission rate, the volume flow calculated for the gaps (as above) was therefore rounded up to 0.1 m^3/s, which should be quite conservative.

2.2.2 Temperature

The exit temperature of the leakage should be close to 72°C, which is the air temperature maintained and measured inside the cookhouse. The diffuse nature of the leakages means that the buoyancy is quickly lost, hence the plume rise above the roof is negligible. The remodelling was therefore based on the same "volume source" configuration as previously, except that the emission height was reduced to the roof height.

2.2.3 Odour concentration

The odour concentrations were sampled using the "drum" approach as described in Australian Standard AS4323:3, with a stainless steel probe being inserted into the building through the pressure relief hatch to extract the internal air sample. The samples were analysed for odour concentration in accordance with AS4323:3 by The Odour Unit, which is a NATA Certified laboratory. The detailed results are given in Appendix 1. The average odour concentration reported was 23,250 ou.

2.3 OPERATING REGIME

Since the 2013 assessment, the usage of the Sterilisation Building (also referred to as Cookhouses) has changed.

In 2013, the building was operated four times per week.

The current regime is[1]:

- Tuesday AM – Sterilisation Room opened up and trays removed and emptied.
- Tuesday PM – Next Growing Room that has completed growing cycle - trays put into Sterilisation Room. At approx. 4-5pm, sterilisation process started. Warm up to 72°C using steam from adjacent boiler; process normally reaches temperature (72°C) by approx. 12pm on the Wednesday. Hold at temperature for 12 hours. Steam then shut off and allowed to cool naturally.
- Thursday AM - Sterilisation Room opened up and trays removed and emptied.
- Thursday PM – Next Growing Room that has completed growing cycle - trays put into sterilisation room.
- Saturday AM - At approx. 8-9am sterilisation process started - warm up to 72°C using steam from adjacent boiler; process normally reaches temperature (72°C) by approx. 12am on the Sunday. Hold at temperature for 12 hours then turn steam off and allow to cool naturally.
- Tuesday AM – As per above and the cycle continues.

The key change from 2012 is that empty trays are no longer separately sterilised using steam. Instead, new and repaired trays are dipped prior to use in a fungicide treatment bath. All trays are sprayed on the day of re-use when filling with fresh mushroom substrate (spawned compost) with a germicide product to reduce the potential for wood mould propagation. The use of the Sterilisation Building has therefore been approximately halved. This in itself would lead to an approximate 50% reduction in emissions compared to 2012.

The summary of the odour sources and characteristics through production stages from the 2013 report has been updated incorporating these changes, and is shown in Appendix 2.

2.4 ODOUR EMISSION RATE

The revised, modelled odour emission rate when the Sterilisation Building is operating is 0.1 m^3/s x 23,250 ou = 2,325 ou.m^3/s, with a "pulse" of 9,256 ou.m^3/s, calculated assuming assumed the internal building air volume is released[2], over each hour during which the doors are opened.

---

[1] Costa email 27/5/2015.

[2] This ignores the displacement inside the building due to crates - which would over-state the odour emissions, however it is assumed that crates themselves will also contribute odour emissions. Therefore, the overall estimate is considered reasonable.

Over the 2011-12 year used as the basis for modelling, the revised average odour emission rate from the Sterilisation Building is 442 ou.m^3/s. This compares to 18,952 ou.m^3/s from 2013. The average odour emission is therefore approximately 2.3% of what it was previously.

3. MODELLING ASSUMPTIONS

The modelled re-assessment of odours from the Sterilisation Building has followed the same methodology and assumptions as used in the 2013 report, except for the revised emissions and operating regime.

The nominal time periods of operations, and therefore emissions from leakages, were obtained from temperature plots provided by Costa where the internal temperate was 72°C. These were:

- Wednesdays 0100 hours to 1300 hours (12 hour duration); and
- Saturdays 2000 hours to Sunday 0800 hours (12 hour duration).

For completeness, the odours from the building when the doors are opened at the end of the process were also incorporated. (Note that this was not done in the 2012 modelling).

4. RESULTS

4.1 STERILISATION BUILDING EMISSIONS IN ISOLATION

The predicted 2.5 ou 1-hour average 99.5 percentile odour concentrations from the Sterilisation Building only are shown in Figure 2. The orange contour is from the 2013 assessment. The green contour is from 2015 sampling and revised operating regime. The level of odour against the criterion is insignificant.

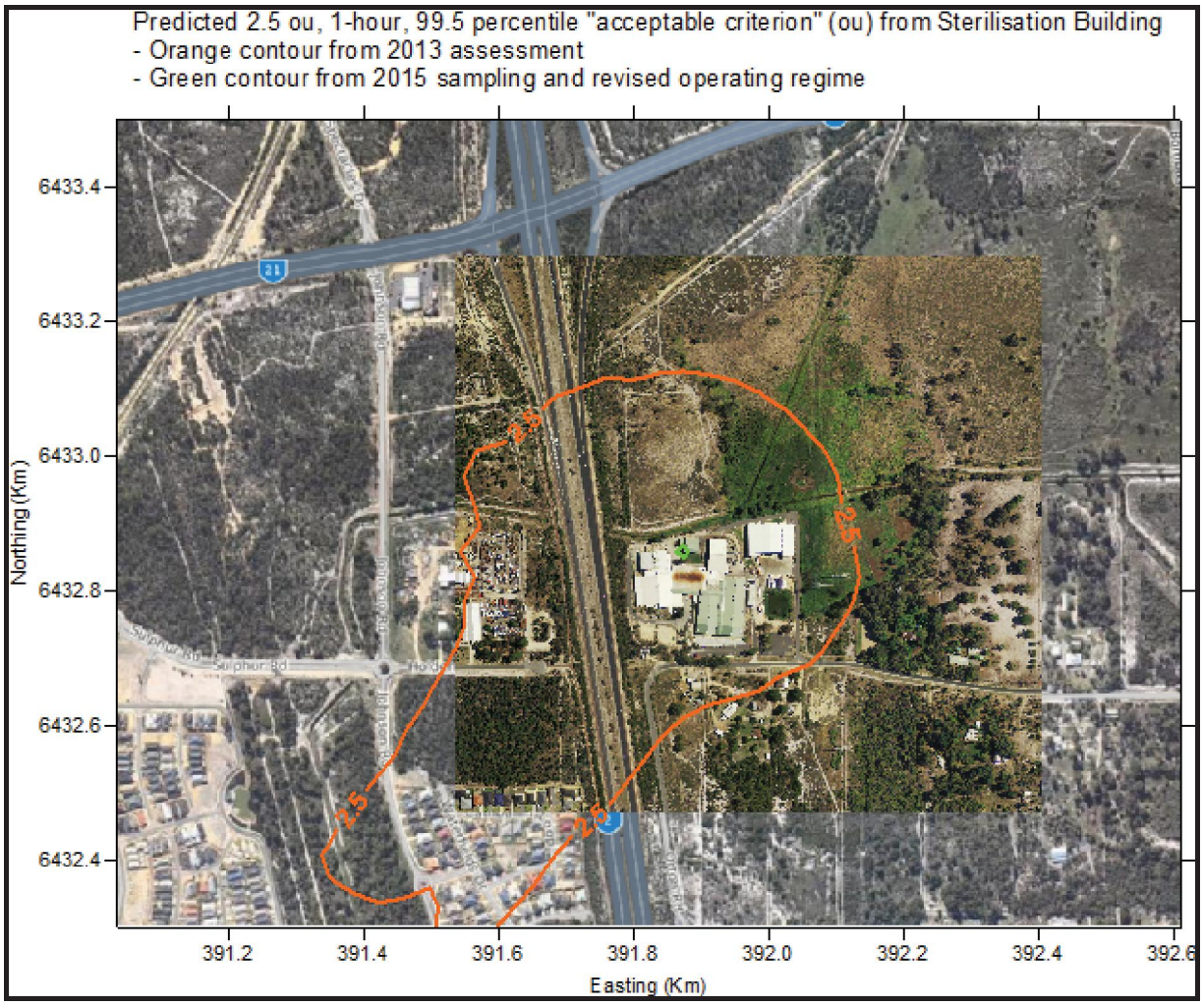


Figure 2 Predicted 2.5 ou 1-hour average 99.5 percentile odour concentrations from the Sterilisation Building only

4.2 ALL MODELLED SOURCES (CURRENT SITUATION)

The predicted odour contours from compost deliveries/handling, plus the Pasteurisation Building Vents, plus the Sterilisation emissions from the 2015 sampling, is shown in Figure 3. This, then, represents the best estimate of the current situation i.e. the 2.5 ou criterion level lies between the two contours shown - depending on modelling/assumption uncertainties.

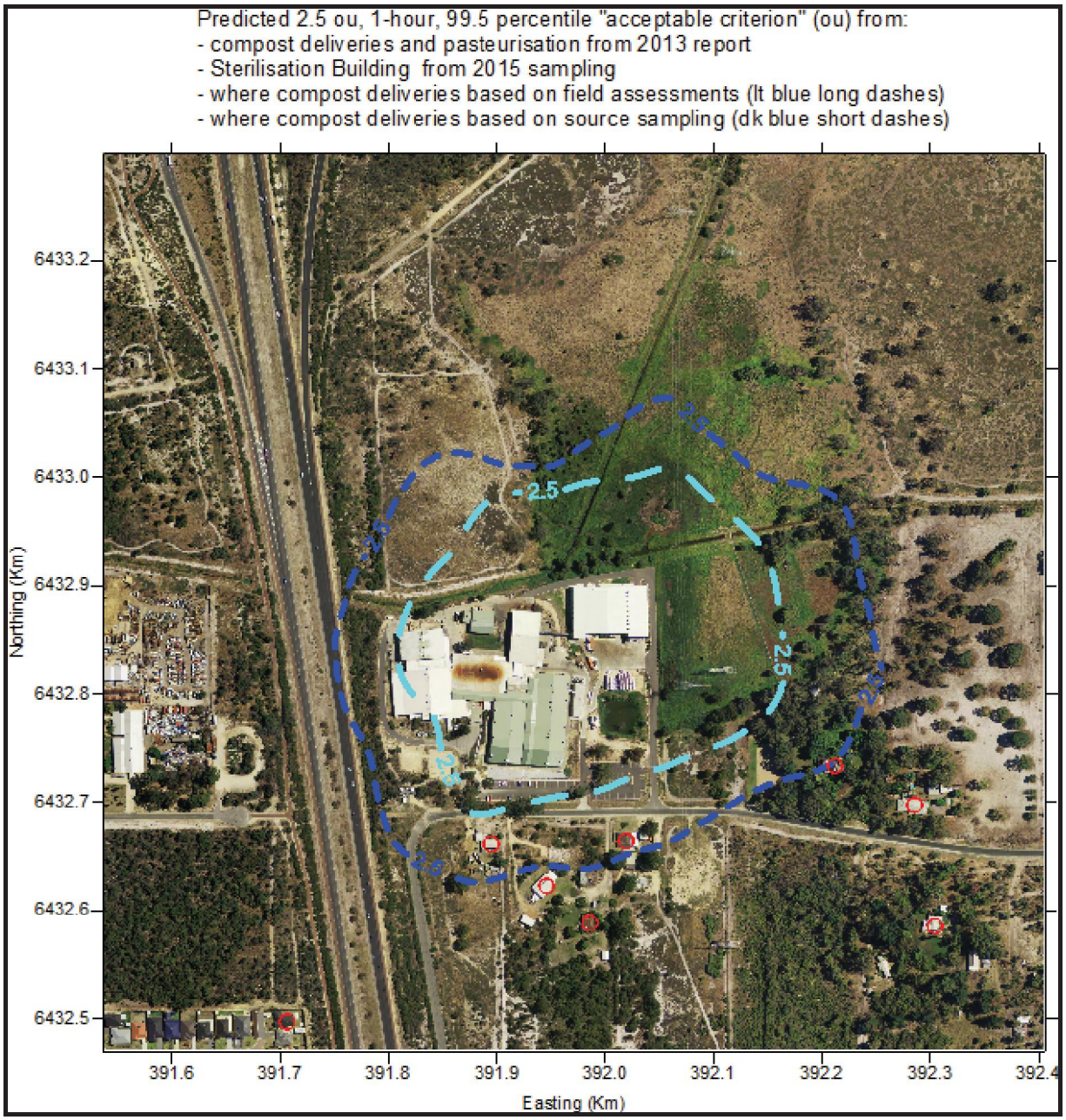


Figure 3 Predicted 2.5 ou 1-hour average 99.5 percentile odour concentrations range for compost deliveries, Pasteurisation Building vents from 2013 modelling and Sterilisation Building from 2015 sampling

Red circles show residences (from "Costa Mushroom Exchange – Environmental Management Plan – Casuarina Production Facility" (2014)).

The 2013 Report (in Figure 11) contained two estimates of odour contours from the compost deliveries/handling 1) based on field assessments and 2) based on source sampling, with the latter, more conservative estimate used in the final presentations (in Figure 12). In other words, the area between these contours lies within the predicted range of the "acceptable" odour levels in view of identified "scientific uncertainty".

4.3 ASSESSMENT OF WALKING FLOOR DELIVERIES OF COMPOST

Currently, trucks deliver compost by dumping it into a bunker. A front-end loader picks up the compost from the bunker and tips it into a hopper, which feeds a conveyor to the Pasteurisation Building.

On 1 July 2015, Costa trialled the use of a truck with a walking floor directly discharging the compost to the hopper.

This would eliminate odour emissions from aspects of the current arrangement whereby trucks dump initially into bunkers. The specific sources/mechanisms of odour generation eliminated would be:

- Truck dumps to the bunkers;
- Front-end loader pick up from the bunkers; and
- Emissions from stationary compost whilst in the bunkers.

From a visual review, the odour emissions from the walking floor discharge to the hopper are similar in magnitude to that from the front-end loader tipping into the hopper. This is because most of the emissions from the hopper appear to arise from the rotating paddle which levels the compost being discharged from the hopper to the conveyor by flinging and re-distributing it within the hopper. (Figure 4 shows a visual comparison, however conclusions shown not be drawn simply from this).

The predicted odour levels for the "current" scenario except assuming walking floor deliveries (i.e. omitting the odour emissions from the truck dumping to the compost bunker and front-end loader pick-up from the bunker) are shown in Figure 5.

The predicted odour levels meet the criteria at all of the residences – albeit only just at the most affected residence for the "conservative" prediction.

These predictions would, however, be further reduced if there were some covering of the hopper (and conveyor to the Pasteurisation). It is considered that if the walking floor deliveries were to be fully implemented together with covering of the hopper and conveyor (even without extraction), the odour criterion will be met at all of the nearby residences.



Figure 4 Comparison of hopper loading from front-end loader 25/7/2012 0817 hours and walking floor truck 1/7/2015 0900 hours

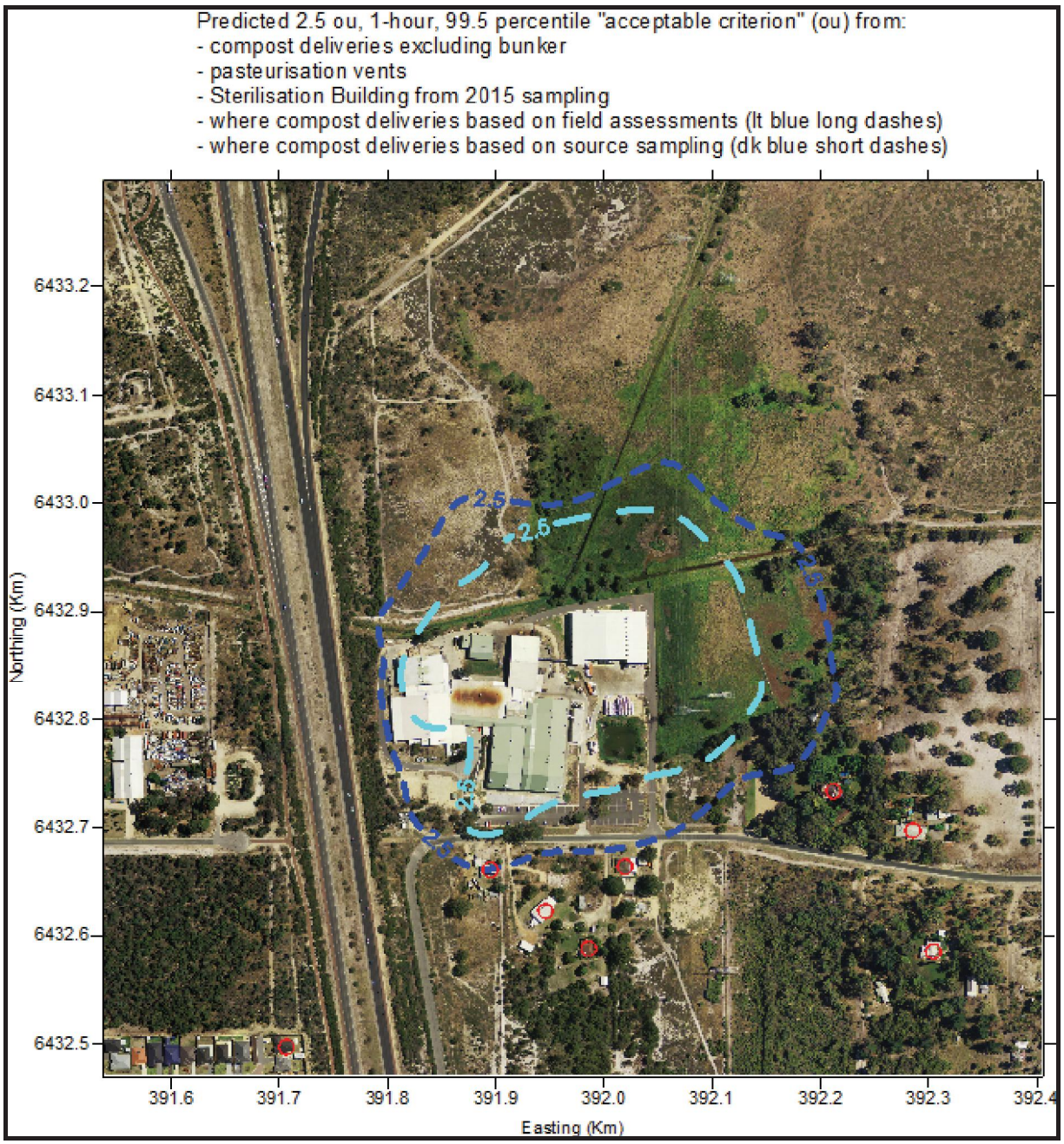


Figure 5 Predicted 2.5 ou 1-hour average 99.5 percentile odour concentrations range for compost deliveries assuming travelling floor discharge direct to hopper is implemented

5. REFERENCES

Environmental Alliances, 2005, "Determination of Odour Levels from Chiquita Mushrooms, Casuarina", Prepared for Chiquita Mushrooms by Environmental Alliances Pty Ltd, April 2005.

Environmental Alliances, 2008, "Modelling Of Off-Site Odours For Proposed New Compost Handing System At Costa Exchange Mushroom Farm, Casuarina", Draft Only, Prepared for Costa Exchange by Environmental Alliances Pty Ltd, January 2008.

ENVALL, 2013, "Investigation of Odour Impacts from Mushroom Exchange, Casuarina", Prepared for Mushroom Exchange by ENVALL Environmental Alliances Pty Ltd, December 2013.

Appendix 1 Results from odour concentration analysis of Sterilisation Building emissions

THE ODOUR UNIT (WA) PTY LTD

THE ODOUR UNIT

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NATA
Accreditation Number: 14074

Form 06 - Perth Laboratory
Odour Concentration Measurement Results

The measurement was commissioned by:

Organisation	Environmental Alliances	Telephone	(08) 9343 0554
Contact	David Pitt	Facsimile	(08) 9343 0079
Sampling Site	Costa Mushrooms	Email	david.pitt@ea.iinet.net.au
Sampling Method	Drum & Pump	Sampling Team	David Pitt

Order details:

Order requested by	David Pitt	Order accepted by	John Hurley
Date of order	July 2015	TOU Project #	W2060R.01
Order number	TBA	Project Manager	John Hurley
Signed by	TBA	Testing operator	Clayton Hough

Investigated Item	Odour concentration in odour units 'ou', determined by sensory odour concentration measurements, of an odour sample supplied in a sampling bag. Odour character is also assessed, however, AS4323.3:2001 and NATA accreditation do not cover the performance of this service. Where parties other than The Odour Unit perform the dilution of samples, the result that has been modified by the dilution factor is not covered by The Odour Units NATA accreditation. Sample collection using a hood or IFH (and calculation of the SOER) is not covered by The Odour Units NATA accreditation.
Identification	The odour sample bags were labelled individually. Each label recorded the testing laboratory, sample number, sampling location (or identification), sampling date and time, dilution ratio (if dilution was used) and whether further chemical analysis was required.
Method	The odour concentration measurements were performed using dynamic olfactometry according to the Australian Standard 'Determination of Odour Concentration by Dynamic Olfactometry AS/NZS4323.3:2001. The odour perception characteristics of the panel within the presentation series for the samples were analogous to that for butanol calibration. Any deviation from the Australian standard is recorded in the 'Comments' section of this report.
Measuring Range	The measuring range of the olfactometer is $2^2 \leq \chi \leq 2^{18}$ ou. If the measuring range was insufficient the odour samples will have been pre-diluted. This is specifically mentioned with the results.
Environment	The measurements were performed in an air- and odour-conditioned room. The room temperature is maintained at 25°C or less, with temperature fluctuations of less than ± 3 °C.
Measuring Dates	The date of each measurement is specified with the results.
Instrument Used	The olfactometer used during this testing session was: ODORMAT SERIES V02 The software used during this testing session was: ODORMAT V3.0
Instrumental Precision	The precision of this instrument (expressed as repeatability) for a sensory calibration must be $r \leq 0.477$ in accordance with the Australian Standard AS/NZS4323.3:2001. ODORMAT SERIES V02: $r = 0.168$ (18th & 19th November, 2014) Compliance – Yes
Instrumental Accuracy	The accuracy of this instrument for a sensory calibration must be $A \leq 0.217$ in accordance with the Australian Standard AS/NZS4323.3:2001. ODORMAT SERIES V02: $A = 0.057$ (18th & 19th November, 2014) Compliance – Yes
Lower Detection Limit (LDL)	The LDL for the olfactometer has been determined to be 16 ou (four times the lowest dilution setting)
Traceability	The measurements have been performed using standards for which the traceability to the national standard has been demonstrated. The assessors are individually selected to comply with fixed criteria and are monitored in time to keep within the limits of the standard. The results from the assessors are traceable to primary standards of n-butanol in nitrogen.

NATA

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Date: Wednesday, 1 July 2015

Report Number / Panel Roster Number: PER20150701_1

J. Hurley
State Manager WA

C. Hough
Authorised Signatory

The Odour Unit (WA) Pty Ltd
ACN 126 439 076
Form 06 – Odour Concentration Results Sheet

Issue Date: 13.11.2003
Issued By: SB
Odour Measurement Manual

Revision: 6.1
Revision Date: 02.09.2013
Approved By: TJS

THE ODOUR UNIT (WA) PTY LTD

Accreditation Number: 14074

Odour Sample Measurement Results

Sample Location	TOU Sample ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Nominal Sample Dilution	Actual Sample Dilution (adjusted for Temperature)	Sample Odour Concentration (as analysed, in the bag) (ou)	Sample Odour Concentration (Final, allowing for dilution) (ou)	Odour Character
EA 1	PC18267	01/07/2015 @ 07:30hrs	01/07/2015 @ 11:40hrs	4	8	-	-	21,200	21,200	Soil / manure / dry / chemical
EA 2	PC18268	01/07/2015 @ 07:30hrs	01/07/2015 @ 12:04hrs	4	8	-	-	25,300	25,300	Soil / manure / dry / chemical

THE ODOUR UNIT (WA) PTY LTD

Accreditation Number: 14074

Odour Panel Calibration Results

Reference Odorant	Reference Odorant Panel Roster Number	Concentration of Reference gas (ppm)	Panel Target Range for n-butanol (ppb)	Measured Concentration (ou)	Measured Panel Threshold (ppb)	Does this panel calibration measurement comply with AS/NZS4323.3:2001 (Yes / No)
n-butanol	PER20150701_1	50.2	$20 \leq \chi \leq 80$	1,450	35	Yes

Comments: None

Disclaimer: Parties, other than TOU, responsible for collecting odour samples hereby certify that they have voluntarily furnished these odour samples, appropriately collected and labelled, to The Odour Unit Pty Limited for the purpose of odour testing. The collection of odour samples by parties other than The Odour Unit Pty Limited relinquishes The Odour Unit Pty Limited from all responsibility for the sample collection and any effects or actions that the results from the test(s) may have.

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END OF DOCUMENT

Report Number / Panel Roster Number: PER20150701_1
The Odour Unit (WA) Pty Ltd
ACN 126 429 075
Form 06 – Odour Concentration Results Sheet
- 3 -
Issue Date: 13.11.2003
Issued By: GB
Odour Measurement Manual
Revision: 6.1
Revision Date: 02.09.2013
Approved By: TJS

Appendix 2 Mushroom Exchange odour sources and characteristics through production stages

Stage	Timing	Source Location	Emission characteristics	Qualitative Assessment[a]	
				Odour character	Potential for off-site impacts
Phase 1 compost receival	0800 to 1500 hours (latest) Wednesdays	Compost receival area	Off-site impacts likely to be wind speed dependent and fluctuate as a function of handling.	Earthy, ammonia	High, particularly for low moderate wind speeds cloudy days; may be detectable off-site.
Phase 2 composting	1 week, Wednesday to Tuesday	Pasteurisation building vent emissions	Elevated release during pasteurisation process – cycle repeated each 7 days therefore maximum emissions most likely from Wed evening to Thursday afternoons. See emissions profile in Figure 6.	Earthy, ammonia to start with (0 - 8 hours during levelling), possible smoulder character (8 – 16 hours), decreasing odour emission rate 16 – 144 hours)	Limited due to small volume flows and elevated release, noticeable but transient levels close to source.
Packing into trays and Casing	Twice per week Monday 0600 to 1630 Friday 0600 to 1630	Tray Line	No substantial emissions.	-	No.
Flushing initiation	Three rooms per week 1 on Tuesday 2 on Friday	Various Growing Rooms in Growing Buildings	Possible pulse of odour.	Mushroom	Possible transient.

Stage	Timing	Source Location	Emission characteristics	Qualitative Assessment[a]	
				Odour character	Potential for off-site impacts
Growing/ Harvesting	In each growing room: • 4 days • Initiate 1st flush lasting 7-10 days • 1 day to harvest (0700 to 1600 hours) • 2nd flush lasting 7-10 days • 1 day to harvest (0700 to 1600 hours) • 3rd flush lasting 7-10 days • 1 day to harvest (0700 to 1600 hours) • leave trays until ready to sterilise Total time = 6 weeks from trays in to trays out	Various Growing Rooms in Growing Buildings. A room (somewhere) is harvested each day.	Ventilation regime in each growing room is variable according to stage of growing. Possible pulses of odour if doors are opening for harvestings and final tray removal.	Mushroom	Possible transient. Limited due to nature of the odour character; may be detectable off-site as transient "slug".
Packing and transport	Packing is daily 0700 to 1600 hours. Transported off site daily (Mon-Sun).	Packing room. Picked up from west yard area.	No odours	-	-
Spent Compost & tray sterilisation[b]	Twice per week Wed approx. 0100-1300 hours & Sat-Sun approx. 2000-0800 hours (12 hours @ 72 °C). Ramp up to temperature takes 8-12 hours beforehand	Sterilisation Building – Cookout 1 & 2 alternating.	Very minor leakage from gaps in concrete panels abutting rook section. Possible "slug" as doors are opened afterwards.	Pine/wood/sweetish as observed in ambient air downwind. "Soil/manure/dry/ chemical" as reported by Odour Laboratory from source sample.	Negligible.
Spent compost removals	0700 to 1500 hours, Tuesdays and Thursdays	Spent compost bunker	Wind dependent.	Earthy Spent compost has only low odour when freshly dumped – need to confirm nature/level of odour when picking up older stockpile.	Appears unlikely if compost removed soon after stockpiling.

Stage	Timing	Source Location	Emission characteristics	Qualitative Assessment[a]	
				Odour character	Potential for off-site impacts
Total compost cycle time	4 weeks in tunnels 6 weeks in growing rooms				
Auxiliary activities					
Tray manufacture	Monday to Friday 0600 to 1430 hours	Growing trays assembly area	Minor odour from storage/assembly areas.	Fresh cut Pine/wood.	Unlikely.
Tray disposals	When skip bin is full	Skip bins on north boundary of premises	Minor odour from Skip Bins.	Decaying wood.	Unlikely.
Waste water disposal	Continuous wash downs from all buildings	4 intermediate below-ground covered sumps Main below-ground collection sump Pond	No odour from covered sumps. Minor odour from Main sump. Pond odour likely to be greater during warmer months due to anaerobic activity. Wind dependent.	Aerobic mild putrescent. Anaerobic/putrescent.	High during light winds – early morning, spring, summer.
Waste mushroom /solid waste disposal	Skip bins removed daily	Small yellow skip bins in mushroom pick up area	Minor odour from Skip Bins.	Mushroom, possibly putrescent/decaying if left for too long.	Unlikely.

[a] Note that Costa has developed a Risk Matrix based on the findings of the ENVALL investigations. The Risk Matrix is included in the EMP.

[b] Updated from the original Table in the ENVALL (2013) report on the basis of the current sampling. Also the "Tray sterilisation" referred to as an odour source/"Stage" in the ENVALL (2013) has been omitted from this revised Table as it is no longer undertaken.

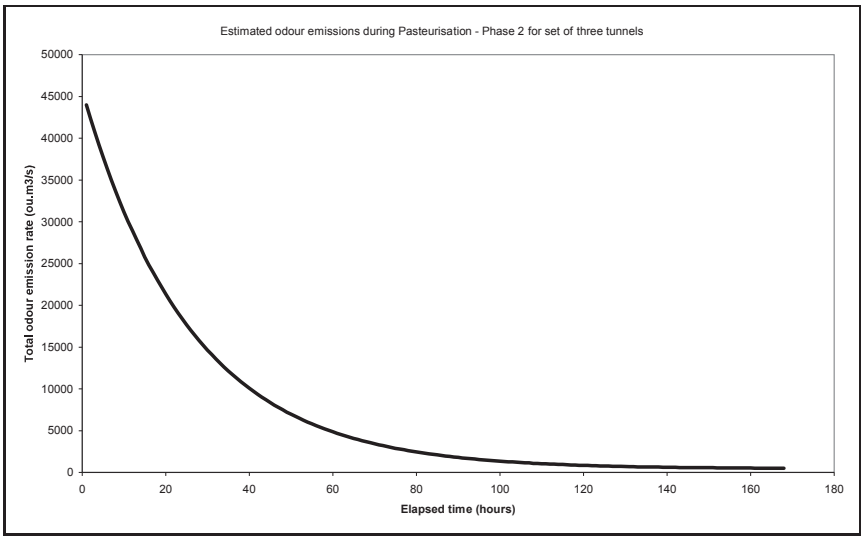


Figure 6 Estimated odour concentration of emissions over pasteurisation (phase 2) process for a set of three tunnels

APPENDIX C
BUSHFIRE MANAGEMENT PLAN

Bushfire Management Plan

Casuarina Central Precinct, Orton Rd and Landgren Rd, Casuarina

Prepared for
CDN No1 Pty Ltd

4 December 2018







DOCUMENT TRACKING

Item	Detail
Project Name	Bushfire Management Plan, Casuarina Central Precinct, Orton Rd and Landgren Rd,
Project Number	18PER-10570
Project Manager	Daniel Panickar Level 1, 235 St Georges Terrace Perth WA 6000
Prepared by	James Leonard
Reviewed by	Daniel Panickar (BPAD37802-L2)
Approved by	Daniel Panickar (BPAD37802-L2)
Status	DRAFT
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Last saved on	10 December 2018

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Template 29/9/2015

Contents

1 Introduction 5
1.1 Proposal details 5
1.2 Purpose and application of the plan 5
1.3 Environmental Considerations 5

2 Bushfire Assessment Results 9
2.1 Assessment inputs 9
2.1.1 General 9
2.1.2 Vegetation classification 9
2.1.3 Topography and slope under vegetation 9
2.2 Assessment outputs 11
2.2.1 Bushfire Hazard Level (BHL) assessment 11

3 Identification of Bushfire Hazard issues 14

4 Assessment against the Bushfire Protection Criteria 15
4.1 Compliance 15
4.2 Additional management strategies 17

5 Responsibilities for Implementation and Management of Bushfire Measures 19

6 Conclusion 20

References 21

Appendix A Plates 22

Appendix B Standards for Asset Protection Zones 35

Appendix C Vehicular access technical requirements (WAPC 2017) 37

Appendix D Emergency access arrangement 38

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List of figures

Figure 1: Site overview 6
Figure 2: Proposed Structure Plan 7
Figure 3: Bushfire Prone Areas of the subject site 8
Figure 4: Pre-development vegetation classification and effective slope 10
Figure 5: Pre- development BHL assessment 12
Figure 6: Post-development BHL assessment 13
Figure 7: Spatial representation of bushfire management strategies 18
Figure 8: Illustrated tree canopy cover projection (WAPC 2017) 35

List of tables

Table 1: Bushfire Hazard Level (BHL) Assessment 11
Table 2: Summary of solutions used to achieve bushfire performance criteria 15

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1 Introduction

1.1 Proposal details

Eco Logical Australia (ELA) was commissioned by CDN No1 Pty Ltd to prepare a Bushfire Management Plan (BMP) to support a Structure Plan for Various Lots, Orton Rd and Landgren Rd, Casuarina (hereafter referred to as the subject site; **Figure 1**,

Figure 2).

Majority of the subject site is within a designated bushfire prone area as per the *Western Australia State Map of Bush Fire Prone Areas* (DFES 2018; **Figure 3**), which triggers bushfire planning requirements under *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (SPP 3.7; WAPC 2015) and reporting to accompany submission of the Structure Plan in accordance with the associated *Guidelines for Planning in Bushfire Prone Areas v 1.3* (the Guidelines; WAPC 2017).

This assessment has been prepared by ELA Bushfire Consultant, James Leonard and quality assurance undertaken by ELA Senior Bushfire Consultant, Daniel Panickar (FPAA BPAD Level 2 Certified Practitioner No. BPAD37802-L2).

1.2 Purpose and application of the plan

The primary purpose of this BMP is to act as a technical supporting document to inform planning assessment.

This BMP is also designed to provide guidance on how to plan for and manage the bushfire risk to the subject site through implementation of a range of bushfire management measures in accordance with the Guidelines.

1.3 Environmental Considerations

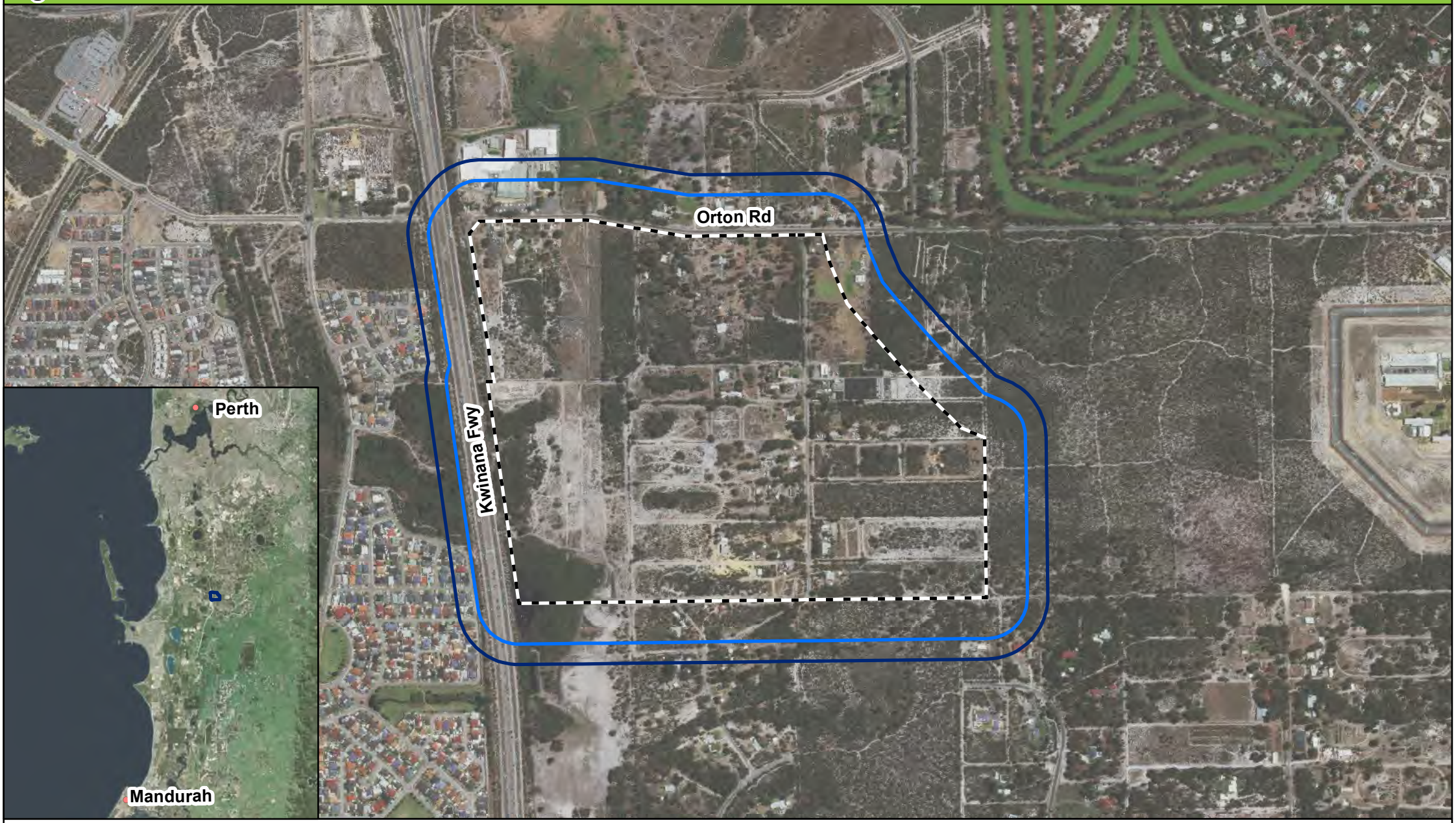
Some bushfire prone areas also have high biodiversity values. SPP 3.7 policy objective 5.4 recognises the need to consider bushfire risk management measures alongside environmental, biodiversity and conservation values.

Environmental approvals for the development are being obtained and impacts associated with bushfire protection measures have been considered through consultation with the project team.

Some revegetation is proposed within the subject site and this has been accounted for in the post development Bushfire Hazard Level assessment. Any changes to revegetation and landscaping will be addressed in future BMPs.

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Figure 1: Site Overview



Legend

- Subject Site
- 100m Assessment Area
- 150m Assessment Area

0 100 200 400

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

N

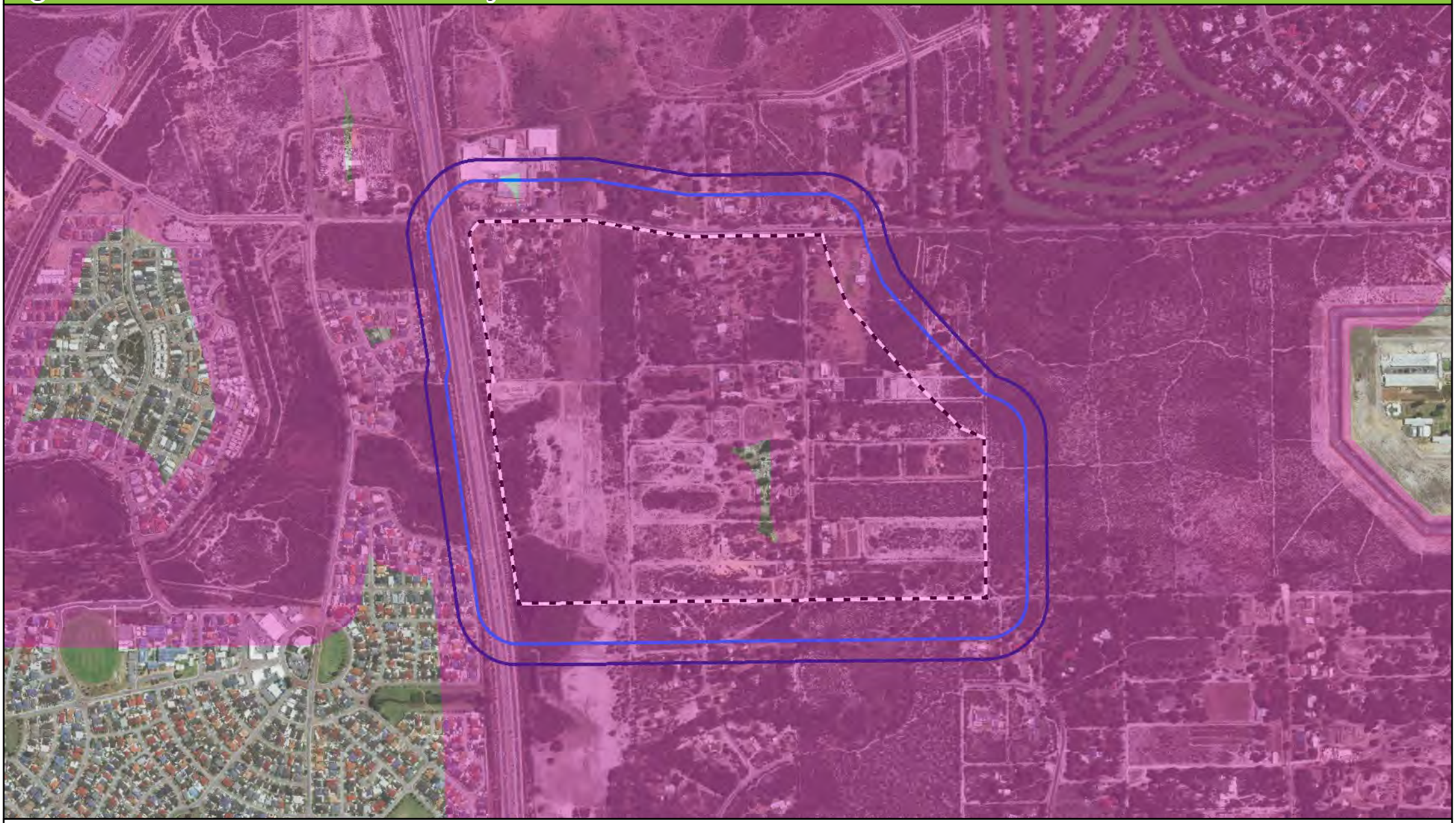
www.ecoaus.com.au

Prepared by: JL Date: 03/12/2018



Figure 2: Proposed Structure Plan

Figure 3: Bushfire Prone Areas of the subject site



Legend

- Subject Site
- 100m Assessment Area
- 150m Assessment Area
- Bushfire Prone Mapping (DFES 2018)

0 100 200 400

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

N

www.ecoaus.com.au

Prepared by: JL Date: 03/12/2018

2 Bushfire Assessment Results

2.1 Assessment inputs

The following section is a consideration of spatial bushfire risk and has been used to inform the bushfire assessment in this report.

2.1.1 General

The subject site is located in the City of Kwinana, and is bound by:

- Orton Rd and rural properties to the north;
- Native bushland to the east;
- Rural properties, a western power easement and native bushland to the south; and
- Kwinana Freeway to the west.

Visual assessment of the surrounding vegetation within the assessment area did not identify any recent fire scars and fire history was not able to be determined. Accumulation of vegetative matter over time, combined with the moderate to high risk of ignition associated with high levels of public access and proximity to urban areas would potentially facilitate a bushfire occurrence in this area.

2.1.2 Vegetation classification

Vegetation within the subject site and surrounding 150 m (the assessment area) was assessed in accordance with the Guidelines and AS 3959-2009 *Construction of Buildings in Bushfire Prone Areas* (SA 2009) with regard given to the *Visual guide for bushfire risk assessment in Western Australia* (DoP 2016). The site inspection was undertaken on 17 August 2018.

The following vegetation classes and exclusions were identified within the assessment area as depicted in and listed below:

- Class A forest;
- Class B woodland;
- Class C shrubland;
- Class D scrub;
- Class G grassland; and
- Exclusions as per clause 2.2.3.2 (e) and (f) (i.e. non-vegetated areas and low-threat vegetation).

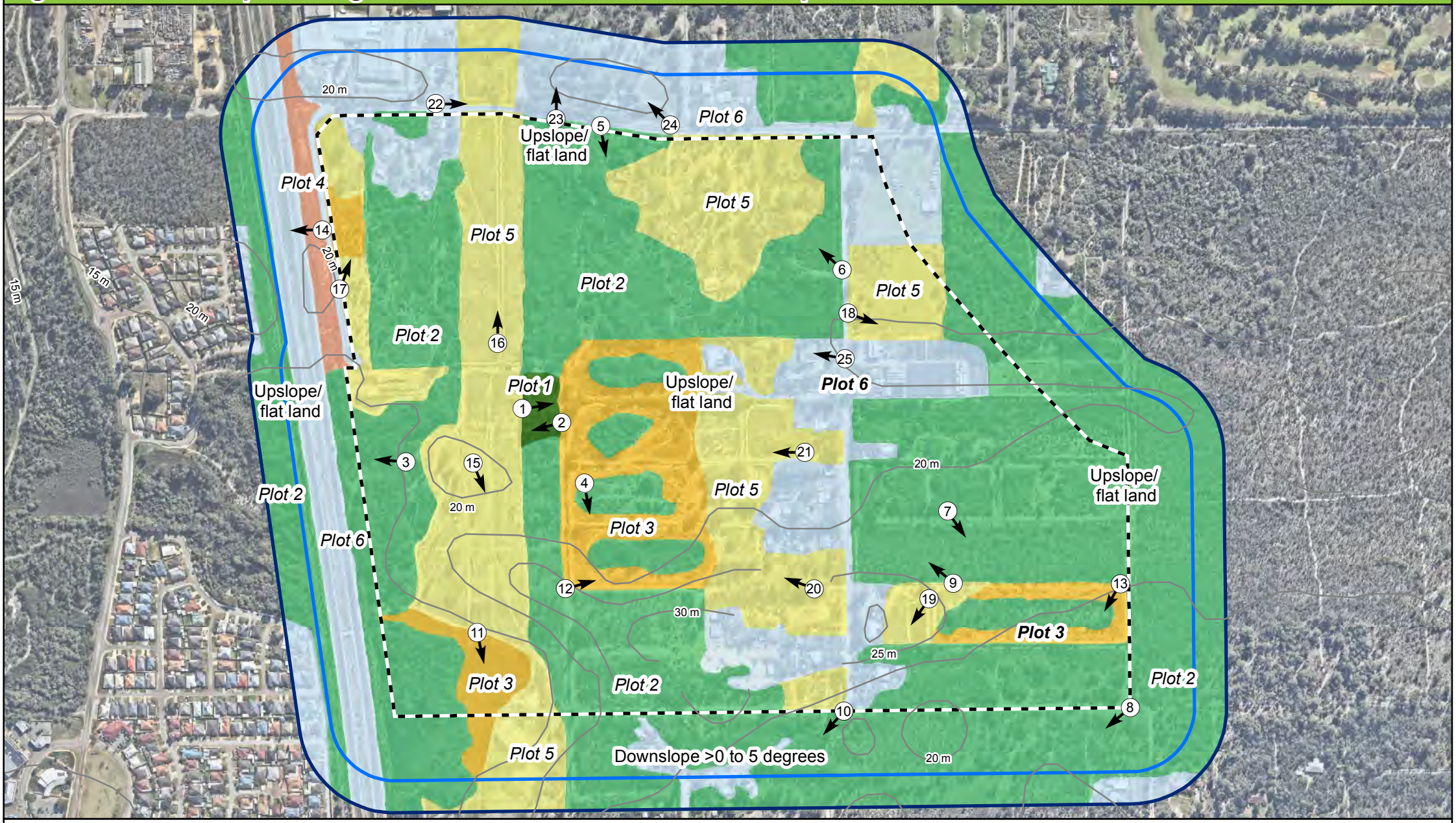
Photographs relating to each vegetation type are included in **Appendix A.**

2.1.3 Topography and slope under vegetation

Effective slope under vegetation was assessed for a distance of 150 m from the subject site in accordance with the Guidelines and AS 3959-2009. A ridge can be seen in the south eastern section of the subject site, with a rise in slope to the north (**Figure 4**). The slope to the north, east and west of the subject site is classified as upslope/ flat land. The slope to the south is downslope 0 to 5 degrees.

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Figure 4: Pre-development vegetation classification and effective slope



Legend

- Subject Site
- 100m Assessment
- 150m Assessment
- Contours (5m intervals)
- Photo location

Vegetation classification

- Class A Forest
- Class B Woodland
- Class C Shrubland
- Class D Scrub
- Class G Grassland
- Excluded under 2.2.3.2 (e) and (f)

0 62.5 125 250

Metres

Datum/Projection: GDA 1994 MGA Zone 50

N

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Prepared by: JL Date: 03/12/2018

2.2 Assessment outputs

A BHL assessment has been undertaken in accordance with SPP 3.7, the Guidelines, AS 3959-2009 and the bushfire assessment inputs in **Section 2.1**.

2.2.1 Bushfire Hazard Level (BHL) assessment

All land located within 150 m of the classified vegetation depicted in **Figure 4** is considered bushfire prone and is subject to a BHL assessment in accordance with AS 3959-2009.

Pre-development BHLs have been assessed for the subject site in accordance with the methodology contained within the Guidelines and incorporates the following factors:

- Vegetation class; and
- Slope under classified vegetation.

Table 1 contains a summary of the BHL assessment for each vegetation class or exclusion. All land within 100 m of Extreme and Moderate BHLs has also been mapped as a Moderate hazard as per the Guidelines, and the final result is depicted in **Figure 5**.

Table 1: Bushfire Hazard Level (BHL) Assessment

Plot	Vegetation Classification	Effective Slope	Bushfire Hazard Level
1	Class A forest	Upslope/flat	Extreme
2	Class B woodland	Upslope/flat	Extreme
3	Class C shrubland	Upslope/flat	Moderate
4	Class D scrub	Upslope/flat	Extreme
5	Class G grassland	Upslope/flat	Moderate
6	Excluded as per clause 2.2.3.2 (e) & (f)	N/A	Low

Clearing and revegetation will be undertaken within the subject site for development purposes, and consequently the pre-development BHLs are subject to change. A post-development BHL assessment is provided in **Figure 6** based on expected changes to vegetation within the subject site.

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Figure 5: Pre- development Bushfire Hazard Level assessment

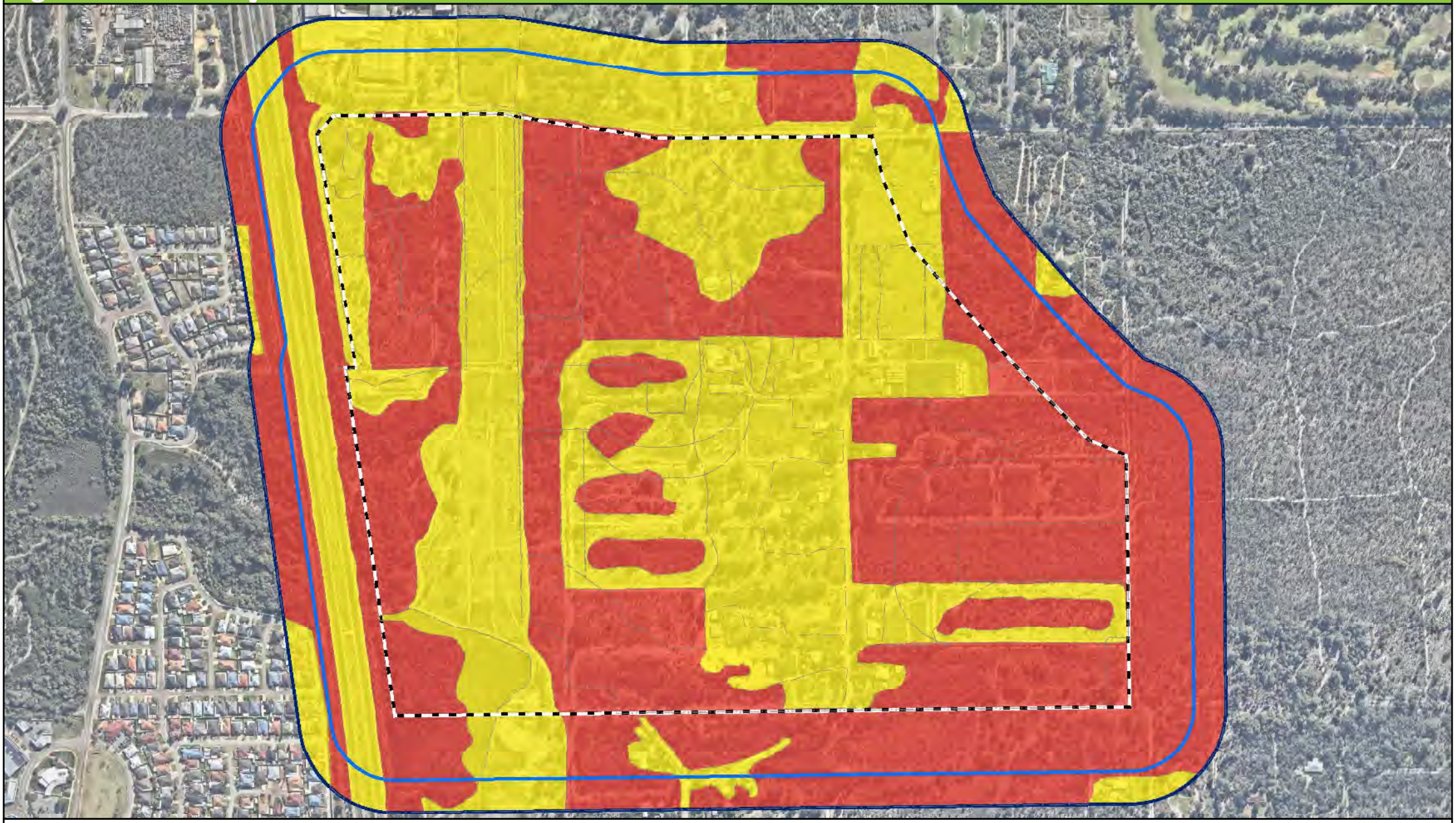
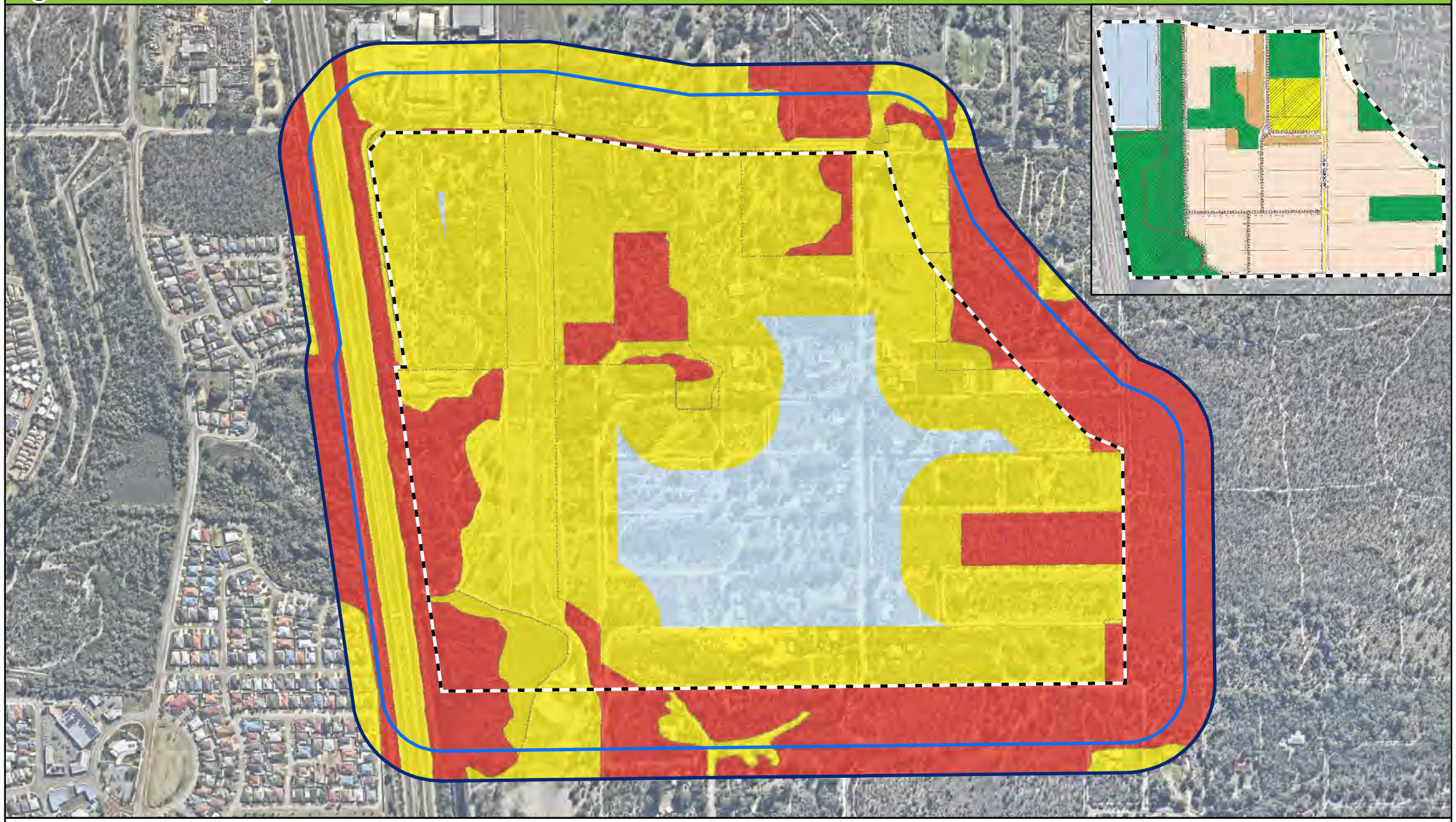


Figure 6: Post- development Bushfire Hazard Level assessment



Legend

- Subject Site
- 100m Assessment
- 150m Assessment
- Bushfire Hazard Interface

Bushfire Hazard Level

- Extreme
- Moderate
- Low

0 65 130 260

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

N

www.ecoaus.com.au

Prepared by: JL Date: 04/12/2018

3 Identification of Bushfire Hazard issues

The on-site vegetation extent is proposed to be cleared to enable development of a significant urban built footprint amongst areas of landscaped/managed Public Open Space (POS) and various easements. Therefore, for the purposes of strategic level planning, ELA does not consider the current on-site vegetation extent to be a bushfire hazard issue post-development, since these hazards can be managed through a staged clearing process, adequate separation of future built assets from classified vegetation (both external and internal [e.g. retained vegetation] to the subject site), and ongoing fuel management that can be undertaken in and around individual development stages.

On the basis of the above information, ELA considers that the bushfire hazards within and adjacent to the subject site and the associated bushfire risk is readily manageable through standard management responses and compliance with acceptable solutions outlined in the Guidelines and AS 3959-2009. These management measures will need to be factored into the development design as early as possible to ensure a suitable, compliant and effective bushfire management outcome is achieved to ensure protection of future life and property assets.

Demonstration of compliance with the relevant requirements of SPP 3.7, the Guidelines and AS 3959-2009 at future planning stages will also depend on the developer's ability to coordinate the timing and staging of clearing and development works within the subject site with those developments proposed on adjacent landholdings in the aim of avoiding bushfire impacts from temporary retained vegetation.

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4 Assessment against the Bushfire Protection Criteria

4.1 Compliance

The proposed Structure Plan is required to comply with policy measures 6.2 and 6.3 of SPP 3.7 and the Guidelines. Implementation of this BMP is expected to meet objectives 5.1 - 5.4 of SPP 3.7.

Bushfire management measures have been devised for the proposed development in accordance with Guideline acceptable solutions to meet compliance with bushfire protection criteria.

The 'acceptable solutions assessment' is provided below to assess the proposed bushfire management measures against each bushfire protection criteria in accordance with the Guidelines. The assessment demonstrates that the proposed measures meet the intent of each element of the bushfire protection criteria. **Figure 7** depicts bushfire management strategies where necessary.

Table 2: Summary of solutions used to achieve bushfire performance criteria

Bushfire Performance Criteria	AS	PS	N/A	Proposed bushfire management strategies
Element 1: Location A1.1 Development location	☒	☐	☐	Post-development, all buildings within the subject site will be situated in areas subject to BHLs of moderate or low (refer to **Figure 7**). The proposed development is considered to be compliant with A1.1.
Element 2: Siting and design of development A2.1 Asset Protection Zone (APZ)	☒	☐	☐	As the lot layout is currently unconfirmed, APZs are unable to be prescribed at this level of planning. APZs will be defined in BMPs supporting future planning applications to ensure that all future lots will be subject to a BAL rating of BAL-29 or lower. **Figure 7** demonstrates that APZs are able to be accommodated within road reserves, maintained Public Open Space areas etc. The proposed development is considered to be compliant with A2.1.
Element 3: Vehicular access A3.1 Two access routes	☒	☐	☐	There are currently seven vehicular access points within the proposed subject site that join onto the existing road network that lead away from the subject site (refer to **Figure 7**). The proposed development is considered to be compliant with A3.1.

Bushfire Performance Criteria	AS	PS	N/A	Proposed bushfire management strategies
Element 3: Vehicular access A3.2 Public Road	☒	☐	☐	The internal roads within the subject site will ensure that access and egress by civilians and emergency services can be undertaken in a safe manner. All public roads will comply with vehicular access requirements (refer to **Appendix C**). The proposed development is considered to be compliant with A3.2.
Element 3: Vehicular access A3.3 Cul-de-sac	☐	☐	☒	No cul-de-sacs are proposed as part of the development.
Element 3: Vehicular access A3.4 Battle-axe	☐	☐	☒	No battle-axe lots are proposed as part of the development.
Element 3: Vehicular access A3.5 Private Driveway longer than 50 m	☐	☐	☒	No private driveways longer than 50 m are proposed as part of the development.
Element 3: Vehicular access A3.6 Emergency Access way	☒	☐	☐	An emergency access way will be provided from the subject site to Lugg Place to the south (**Figure 7; Appendix D**). This will comply with the requirements for emergency access ways in the Guidelines (refer to **Appendix C)** and will be signposted. The proposed development is considered to be compliant with A3.6.
Element 3: Vehicular access A3.7 Fire-service access route	☐	☐	☒	No fire service access routes are proposed or required as part of the development.
Element 3: Vehicular access A3.8 Firebreak width	☒	☐	☐	There are currently 3 m wide firebreaks around the perimeter of the existing lots within the subject site that comply with the current City of Kwinana Fire Notice. Future BMPs, to support subsequent planning applications, will address this requirement in greater detail. The proposed development is considered to be compliant with A3.8.
Element 4: Water A4.1 Reticulated areas	☒	☐	☐	The subject site will be connected to a reticulated water supply. The proposed development is considered to be compliant with A4.1. A4.2 and A4.3 are not applicable to this proposed development.

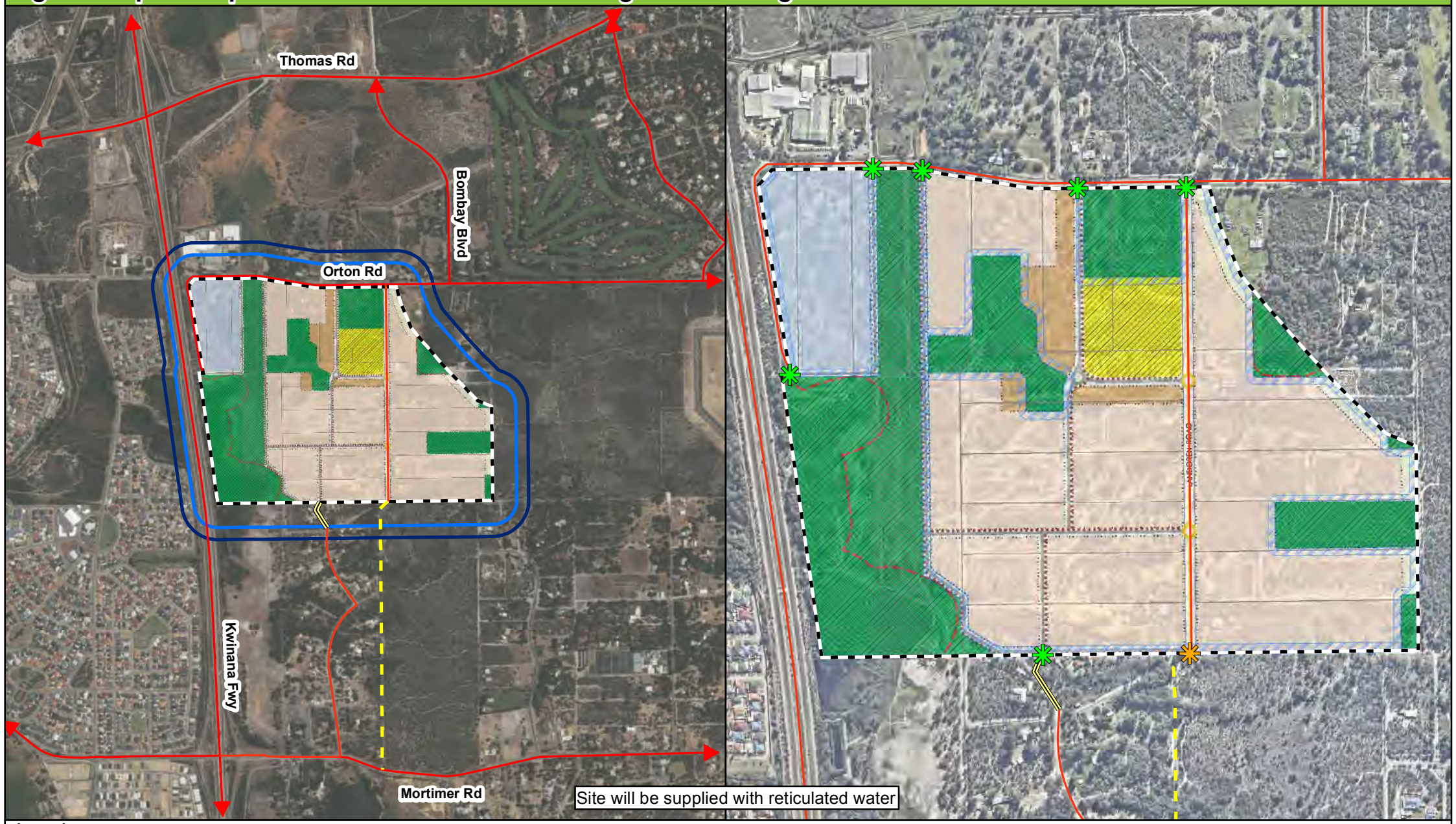
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4.2 Additional management strategies

Future demonstration of compliance with the relevant requirements of SPP 3.7, the Guidelines and AS 3959-2009 will depend on the developer's ability to coordinate the timing of development works within the subject site. Updated BMPs will be prepared to support subsequent planning applications where relevant and will contain re-assessments of bushfire risk including Bushfire Attack Level assessments etc.

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Figure 7: Spatial representation of the bushfire management strategies



Legend

- Subject Site
- 100m Assessment
- 150m Assessment

Access points

- Future Access/ Egress Points (not assessed in this BMP)
- Access/ Egress Points

Access/ Egress

- Access/ egress route
- Emergency Access Way
- Future Access/ Egress Way (not assessed in this BMP)
- Indicative Asset Protection Zone (APZ)

0 170 340 680
Metres
Datum/Projection:
GDA 1994 MGA Zone 50

N

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Prepared by: JL Date: 04/12/2018

5 Responsibilities for Implementation and Management of Bushfire Measures

Implementation of the BMP applies to CDN No1 Pty Ltd., the City of Kwinana, and future landowners to ensure bushfire management measures are adopted and implemented on an ongoing basis. This BMP has been prepared as a strategic guide to demonstrate how development compliance will be delivered at future planning stages in accordance with the Guidelines. In this respect, management measures documented in **Section 4**, where applicable, will be incorporated into development design as early as possible and confirmed through subdivision design. Therefore, aside from the revision of this BMP or preparation of a BMP addendum to accompany future subdivision applications, there are no further items to implement, enforce or review at this stage of the planning process.

The revised BMP or addendum to this BMP is required to meet the relevant commitments outlined in this strategic level BMP, address the relevant requirements of SPP 3.7 (i.e. Policy Measure 6.4) and demonstrate in detail how the proposed development will incorporate the relevant acceptable solutions to meet the performance requirements of the Guidelines.

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6 Conclusion

In the author's professional opinion, the bushfire protection requirements listed in this assessment provide an adequate standard of bushfire protection for the proposed development. As such, the proposed development is consistent with the aim and objectives of SPP 3.7 and associated guidelines and is recommended for approval.



Daniel Panickar
Senior Bushfire Consultant
FPAA BPAD Certified Practitioner
No. BPAD37802-L2



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Western Australian Planning Commission (WAPC). 2017. *Guidelines for Planning in Bushfire Prone Areas Version 1.3 (including appendices).* WAPC, Perth.

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Appendix A Plates

Plot	Photo ID	Photo and vegetation class
1	1	 **Class A Forest**
1	2	 **Class A Forest**

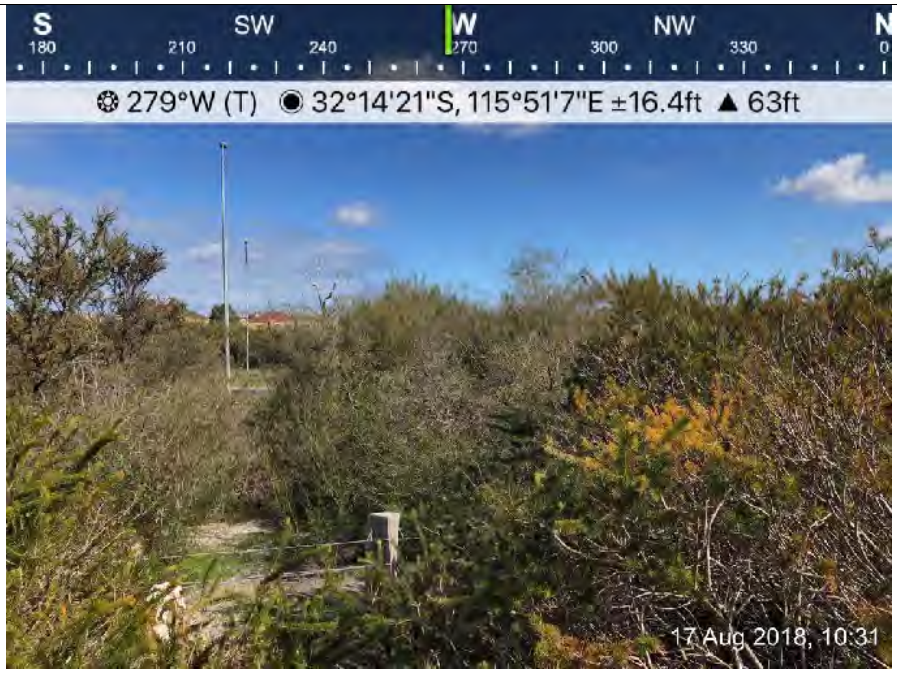
Plot	Photo ID	Photo and vegetation class
2	3	 **Class B Woodland**
2	4	 **Class B Woodland**

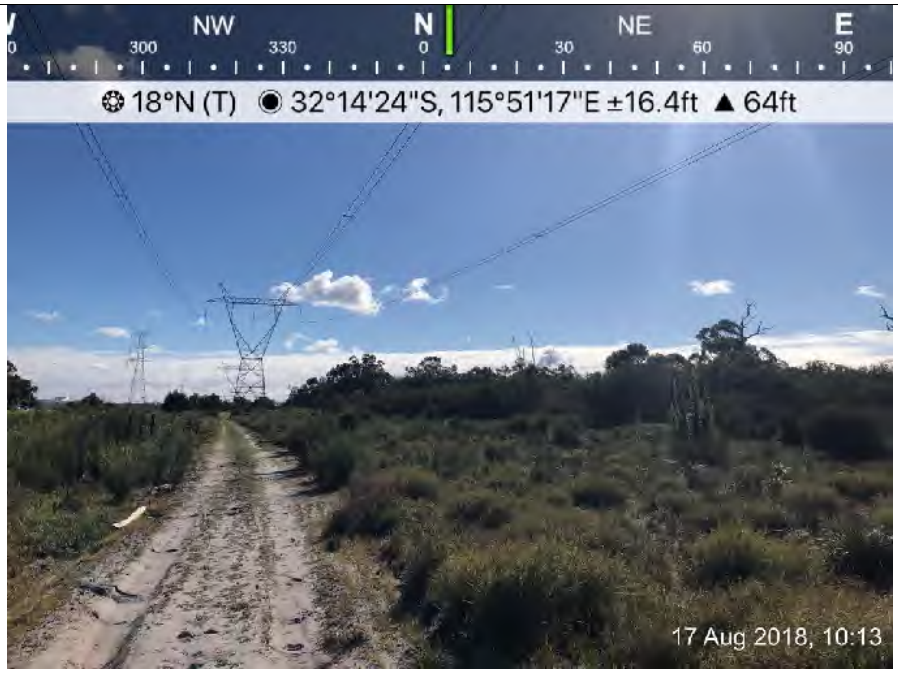
Plot	Photo ID	Photo and vegetation class
2	5	 **Class B Woodland**
2	6	 **Class B Woodland**

Plot	Photo ID	Photo and vegetation class
2	7	 **Class B Woodland**
2	8	 **Class B Woodland**

Plot	Photo ID	Photo and vegetation class
2	9	 **Class B Woodland**
2	10	 **Class B Woodland**

Plot	Photo ID	Photo and vegetation class
3	11	 **Class C Shrubland**
3	12	 **Class C Shrubland**

Plot	Photo ID	Photo and vegetation class
3	13	 **Class C Shrubland**
4	14	 **Class D Scrub**

Plot	Photo ID	Photo and vegetation class
5	15	 **Class G Grassland**
5	16	 **Class G Grassland**

Plot	Photo ID	Photo and vegetation class
5	17	 **Class G Grassland**
	18	 **Class G Grassland**

Plot	Photo ID	Photo and vegetation class
	19	 **Class G Grassland**
	20	 **Class G Grassland**

Plot	Photo ID	Photo and vegetation class
	21	 **Class G Grassland**
	22	 **Excluded under 2.2.3.2 (e) and (f)**

Plot	Photo ID	Photo and vegetation class
	23	 **Excluded under 2.2.3.2 (e) and (f)**
	24	 **Excluded under 2.2.3.2 (e) and (f)**

Plot	Photo ID	Photo and vegetation class
		 **Excluded under 2.2.3.2 (e) and (f)**

Appendix B Standards for Asset Protection Zones

The following standards have been extracted from the *Guidelines for Planning in Bushfire Prone Areas v 1.3* (WAPC 2017).

Every habitable building is to be surrounded by, and every proposed lot can achieve, an APZ depicted on submitted plans, which meets the following requirements:

a. Width: Measured from any external wall or supporting post or column of the proposed building, and of sufficient size to ensure the potential radiant heat impact of a fire does not exceed 29kW/m² (BAL 29) in all circumstances.

b. Location: the APZ should be contained solely within the boundaries of the lot on which a building is situated, except in instances where the neighbouring lot or lots will be managed in a low-fuel state on an ongoing basis, in perpetuity (see explanatory notes).

c. Management: the APZ is managed in accordance with the requirements of '*Standards for Asset Protection Zones*' (below):

- Fences: within the APZ are constructed from non-combustible materials (e.g. iron, brick, limestone, metal post and wire). It is recommended that solid or slatted non-combustible perimeter fences are used
- Objects: within 10 metres of a building, combustible objects must not be located close to the vulnerable parts of the building i.e. windows and doors
- Fine Fuel load: combustible dead vegetation matter less than 6 millimetres in thickness reduced to and maintained at an average of two tonnes per hectare
- Trees (> 5 metres in height): trunks at maturity should be a minimum distance of 6 metres from all elevations of the building, branches at maturity should not touch or overhang the building, lower branches should be removed to a height of 2 metres above the ground and or surface vegetation, canopy cover should be less than 15% with tree canopies at maturity well spread to at least 5 metres apart as to not form a continuous canopy (**Figure 8**).

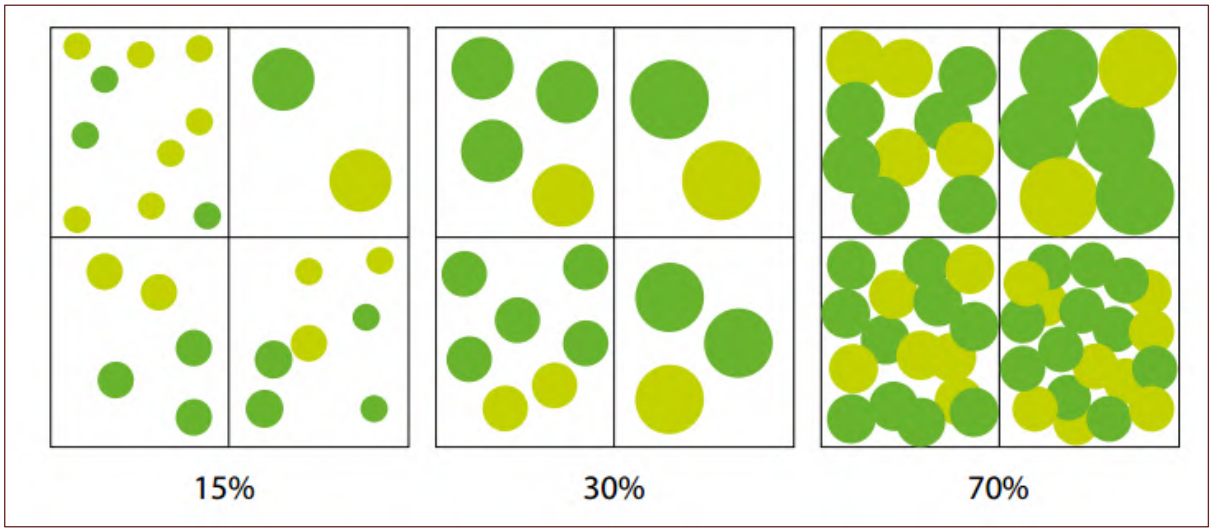


Figure 8: Illustrated tree canopy cover projection (WAPC 2017)

- **Shrubs (0.5 metres to 5 metres in height):** should not be located under trees or within 3 metres of buildings, should not be planted in clumps greater than 5m2 in area, clumps of shrubs should be separated from each other and any exposed window or door by at least 10 metres. Shrubs greater than 5 metres in height are to be treated as trees
- **Ground covers (<0.5 metres in height):** can be planted under trees but must be properly maintained to remove dead plant material and any parts within 2 metres of a structure, but 3 metres from windows or doors if greater than 100 millimetres in height. Ground covers greater than 0.5 metres in height are to be treated as shrubs
- **Grass:** should be managed to maintain a height of 100 millimetres or less.

Additional notes

The Asset Protection Zone (APZ) is an area surrounding a building that is managed to reduce the bushfire hazard to an acceptable level. Hazard separation in the form of using subdivision design elements or excluded and low threat vegetation adjacent to the lot may be used to reduce the dimensions of the APZ within the lot.

The APZ should be contained solely within the boundaries of the lot on which the building is situated, except in instances where the neighbouring lot or lots will be managed in a low-fuel state on an ongoing basis, in perpetuity. The APZ may include public roads, waterways, footpaths, buildings, rocky outcrops, golf courses, maintained parkland as well as cultivated gardens in an urban context, but does not include grassland or vegetation on a neighbouring rural lot, farmland, wetland reserves and unmanaged public reserves.

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Appendix C Vehicular access technical requirements (WAPC 2017)

Technical requirements	Public road	Cul-de-sac	Private driveway	Emergency access way	Fire service access route
Minimum trafficable surface (m)	6*	6	4	6*	6*
Horizontal distance (m)	6	6	6	6	6
Vertical clearance (m)	4.5	N/A	4.5	4.5	4.5
Maximum grade <50 m	1 in 10	1 in 10	1 in 10	1 in 10	1 in 10
Minimum weight capacity (t)	15	15	15	15	15
Maximum crossfall	1 in 33	1 in 33	1 in 33	1 in 33	1 in 33
Curves minimum inner radius	8.5	8.5	8.5	8.5	8.5

* Refer to E3.2 Public roads: Trafficable surface

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Appendix D Emergency access arrangement

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Hi Luke

Please have LWP draft an access agreement for review at their own cost including the construction route.

The access route must not negatively impact our rental property and tenants.

Regards,

Manuel Jardim

Managing Director

JARDIM

M: 0417 926 819

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Property Developments | Acquisitions | Joint Ventures | Project Management

---

On Wed, 24 Oct 2018 at 13:40, Luke Montgomery <Luke@tbbplanning.com.au> wrote:

Hi Manuel,

We act on behalf of CDN No. 1 Pty Ltd a development company managed by LWP Property Group, for the purposes of preparing the Casuarina Central Precinct Structure Plan.

We understand you control Lot 111 Lugg Place which is immediately adjacent to CDN's Lot 39 Landgren Road. As part of preparing the Structure Plan and investigating the associated bushfire planning requirements, it is preferable to accommodate a secondary access from the southern end of CDN's land for use in the event of an emergency. One option, which is considered the most logical, is to provide a connection through Lot 39 to Lot 111 which would continue through to Lugg Place. This would ensure the shortest route to the public road system for the short to medium term until the broader road network is planned and constructed.

Similarly, we would expect that a secondary access would be needed to the north for your project given Lugg Place is a cul-de-sac and there are no secondary / alternative routes in the event of an emergency.

Therefore, the connection would also be beneficial for your development providing a secondary escape route.

The extract below is taken from the Subdivision Concept Plan over CDN's land which is forming the basis for the Structure Plan. You will note a road interface within Lot 39 along the northern boundary of Lot 111. It would make sense for an emergency connection to be located along Lot 111's eastern or western boundary which connects to Lot 39. The eastern boundary would provide a short connection to Landgren Road and is preferable. The emergency access would be needed as part of Stage 1 of CDN's development so a temporary access would be provided by CDN to Lot 111, which would be extended through to Lugg Place.



Whilst I'm not sure of the exact standard at this stage, I assume a trafficable standard for a 2-wheeled drive vehicle would be sufficient, so a gravel / limestone or equivalent, with gated access to restrict use other than in the event of an emergency.

Could you please advise if 316 Developments would be amenable to this arrangement as we would like to reference this emergency access as part of the Structure Plan documentation and bushfire management. Subject to your acceptance, we can discuss the legalities for setting up this arrangement.

I look forward to your reply.

Regards,

Luke

Luke Montgomery | Senior Associate

Taylor Burrell Barnett

ecological AUSTRALIA

ISO 14001 Environmental Management

AS/NZS 4801:2001 Occupational Health and Safety Management

ISO 9001 Quality Management

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APPENDIX D
TRANSPORTATION NOISE ASSESSMENT

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Transportation Noise Assessment

Casuarina Central Precinct

Reference: 18054422-01 Rev 1.docx

Prepared for:
Taylor Burrell Barnett

Report: 18054422-01 Rev 1.docx

Lloyd George Acoustics Pty Ltd

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This report has been prepared in accordance with the scope of services described in the contract or agreement between Lloyd George Acoustics Pty Ltd and the Client. The report relies upon data, surveys, measurements and results taken at or under the particular times and conditions specified herein. Any findings, conclusions or recommendations only apply to the aforementioned circumstances and no greater reliance should be assumed or drawn by the Client. Furthermore, the report has been prepared solely for use by the Client, and Lloyd George Acoustics Pty Ltd accepts no responsibility for its use by other parties.

Date:	Rev	Description	Prepared By	Verified
05-Nov-18	-	Issued to Client	Olivier Mallié	Terry George
03-Dec-18	1	Finalised Precinct Concept Plan	Olivier Mallié	-

Table of Contents

1 INTRODUCTION 1

2 CRITERIA 2

3 METHODOLOGY 3

3.1 Site Measurements 3

3.2 Noise Modelling 5

3.2.1 Ground Topography, Road Design & Cadastral Data 5

3.2.2 Traffic Data 6

3.2.3 Ground Attenuation 6

3.2.4 Parameter Conversion 7

4 RESULTS 7

4.1 Noise Monitoring 7

4.2 Noise Modelling 10

5 ASSESSMENT 13

6 CONCLUSION 17

List of Tables

Table 2-1 Outdoor Noise Criteria 3

Table 3-1 Noise Relationship Between Different Road Surfaces 6

Table 3-2 Kwinana Freeway Traffic Information Used in the Modelling 6

Table 4-1 Measured Average Noise Levels at Logger Location 7

List of Figures

Figure 1-1 Subject Site Location _____ 1

Figure 1-2 Casuarina Central Precinct Development Concept _____ 2

Figure 3-1 Noise Logger Location (Google Earth Aerial) _____ 4

Figure 4-1 Kwinana Freeway Noise Monitoring Results (Chart 1) _____ 8

Figure 4-2 Kwinana Freeway Noise Monitoring Results (Chart 2) _____ 9

Figure 4-3 Future (Year 2031) Ground Floor Noise Contour Plot, dB $L_{Aeq(Day)}$ _____ 11

Figure 4-4 Future (Year 2031) Upper Floor Noise Contour Plot, dB $L_{Aeq(Day)}$ _____ 12

Figure 5-1 Residential Lots Ground Floor Noise Control Requirements _____ 15

Figure 5-2 Residential Lots Upper Floor Noise Control Requirements _____ 16

Appendices

A Acceptable Treatment Packages

B Terminology

1 INTRODUCTION

It is proposed to subdivide the land south of Orton Road, and east and west of Landgren Road in Casuarina into residential and commercial lots. *Figure 1-1* shows the location of the site, while *Figure 1-2* shows a subdivision concept.

As the site is located close to the Kwinana Freeway, road traffic noise impacts were assessed against the requirements of the *State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning*.

This report presents the methodology and results of the noise monitoring and modelling undertaken, and the assessment of transport noise impacts.

Appendix B contains a description of some of the terminology used throughout this report.



Figure 1-1 Subject Site Location



Figure 1-2 Casuarina Central Precinct Development Concept

2 CRITERIA

The criteria relevant to this assessment is the *State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning* (hereafter referred to as the Policy) produced by the Western Australian Planning Commission (WAPC). The objectives in the Policy are 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 redevelopment transport infrastructure proposals;
- Facilitate the development and operation of an efficient freight network; and
- Facilitate the strategic co-location of freight handling facilities.

The Policy's outdoor noise criteria are shown below in *Table 2-1*. These criteria apply at any point 1-metre from a habitable façade of a noise sensitive premises and in one outdoor living area.

Table 2-1 Outdoor Noise Criteria

Period	Target	Limit
Day (6am to 10pm)	55 dB $L_{Aeq(Day)}$	60 dB $L_{Aeq(Day)}$
Night (10pm to 6am)	50 dB $L_{Aeq(Night)}$	55 dB $L_{Aeq(Night)}$

Note: The 5 dB difference between the target and limit is referred to as the margin.

In the application of these outdoor noise criteria to new noise sensitive developments, the objectives of this Policy is to achieve -

- acceptable indoor noise levels in noise-sensitive areas (e.g. bedrooms and living rooms of houses); and
- a 'reasonable' degree of acoustic amenity in at least one outdoor living area on each residential lot.

If a noise sensitive development takes place in an area where outdoor noise levels will meet the *target*, no further measures are required under this policy.

In areas where the *target* is exceeded, customised noise mitigation measures should be implemented with a view to achieving the *target* in at least one outdoor living area on each residential lot, or if this is not practicable, within the *margin*. Where indoor spaces are planned to be facing outdoor areas that are above the *target*, mitigation measures should be implemented to achieve acceptable indoor noise levels in those spaces.

For residential buildings, "acceptable indoor noise levels" are taken to be 40 dB $L_{Aeq(Day)}$ in living areas and 35 dB $L_{Aeq(Night)}$ in bedrooms.

3 METHODOLOGY

Noise measurements and modelling have been undertaken in accordance with the requirements of the Policy as described below in *Sections 3.1* and *3.2*.

3.1 Site Measurements

Noise monitoring was undertaken at one location in order to:

- Quantify the existing noise levels;
- Determine the differences between different acoustic parameters ($L_{A10,18hour}$, $L_{Aeq(Day)}$ and $L_{Aeq(Night)}$); and
- Calibrate the noise model for existing conditions.

The instrument used was an ARL type Ngara noise data logger (S/N 8780F6), located approximately 30 metres from the edge of the freeway (refer *Figure 3-1*). The microphone was approximately 1.4 metres above ground level.

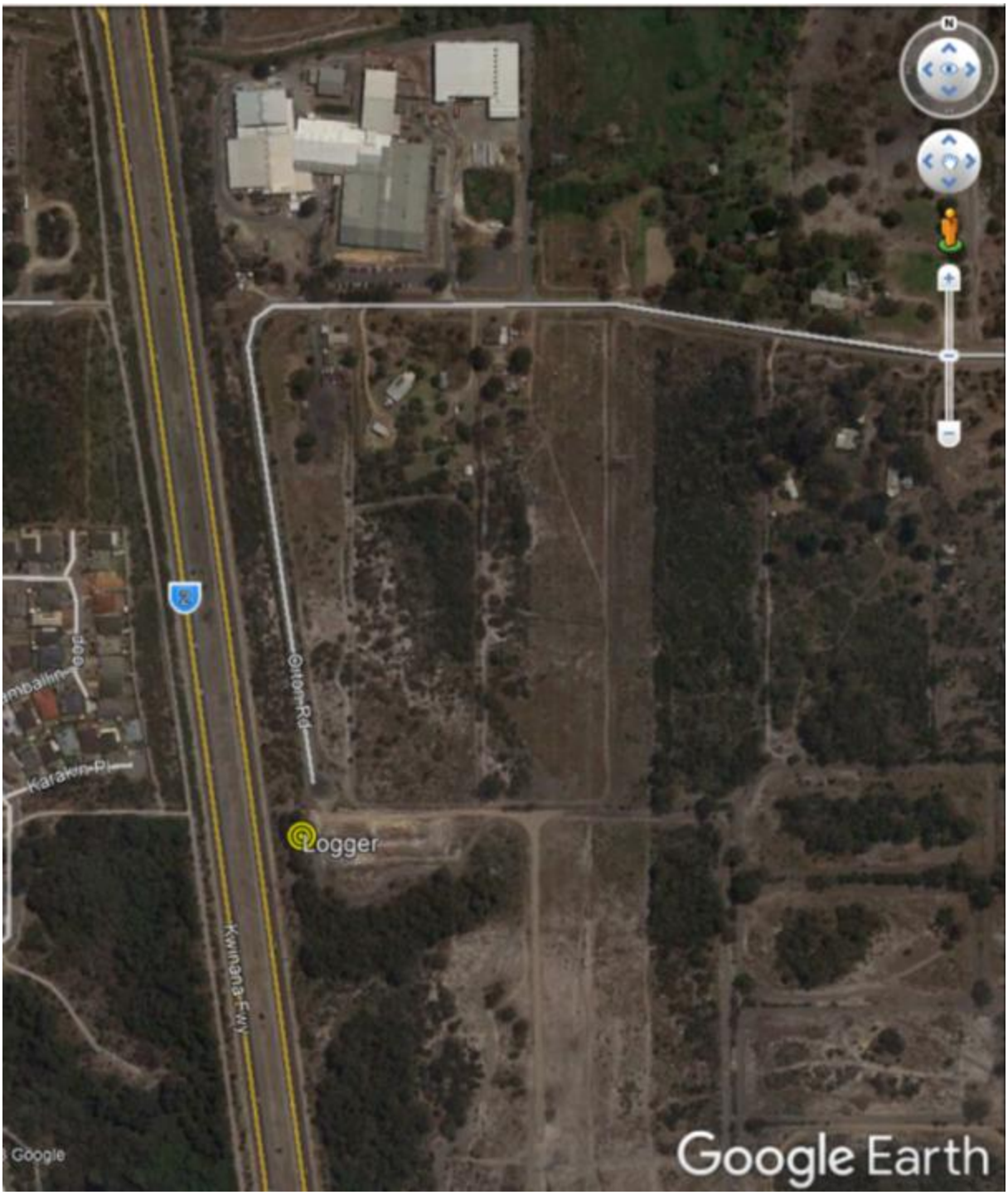


Figure 3-1 Noise Logger Location (Google Earth Aerial)

The logger was programmed to record hourly L_{A1}, L_{A10}, L_{A90}, and L_{Aeq} levels. This instrument complies with the instrumentation requirements of *Australian Standard 2702-1984 Acoustics – Methods for the Measurement of Road Traffic Noise*. The logger was field calibrated before and after the measurement session and found to be accurate to within +/- 1 dB. Lloyd George Acoustics also holds current laboratory calibration certificate for the loggers.

The noise data collected was verified by inspection and professional judgement and where hourly data was considered atypical, an estimated value was inserted.

The weather conditions during the measurement period were obtained from the Bureau of Meteorology's Perth station. This data was compared against the Main Roads Western Australia (MRWA) specifications for measurement conditions and data recorded under unacceptable conditions was not considered in the analysis.

3.2 Noise Modelling

The computer programme *SoundPLAN 8.0* was utilised incorporating the *Calculation of Road Traffic Noise* (CoRTN) algorithms, modified to reflect Australian conditions. The modifications included the following:

- Vehicles were separated into heavy (Austroads Class 3 upwards) and non-heavy (Austroads Classes 1 & 2) with non-heavy vehicles having a source height of 0.5 metres above road level and heavy vehicles having two sources, at heights of 1.5 metres and 3.6 metres above road level, to represent the engine and exhaust respectively. By splitting the noise source into three, allows for less barrier attenuation for high level sources where barriers are to be considered.
- Note that corrections are applied to the exhaust of –8.0 dB (based on Transportation Noise Reference Book, Paul Nelson, 1987) and to the engine source of –0.8 dB, so as to provide consistent results with the CoRTN algorithms for the no barrier scenario;
- Adjustments of -0.7 dB and -1.7 dB have been applied to the predicted $L_{A10,18hour}$ levels for the 'free-field' and 'at facade' cases respectively, based on the findings of *An Evaluation of the U.K. DoE Traffic Noise Prediction*; Australian Road Research Board, Report 122 ARRB – NAASRA Planning Group (March 1983).

Predictions are made at heights of 1.4 metres above ground floor level and at 1.0 metre from an assumed building façade (resulting in a + 2.5 dB correction due to reflected noise).

Various input data are included in the modelling such as ground topography, road design, traffic volumes etc. These model inputs are discussed below.

3.2.1 Ground Topography, Road Design & Cadastral Data

Topographical and road design data for this project was taken from publicly available data e.g. Google Earth. At this stage information on subdivision levels are unknown and therefore the modelling uses the existing topography.

Based on Main Roads ROM24 modelling data for the future scenario, the freeway would be widened from the existing 2 lanes to 3 lanes in both directions and this has been included in the model.

3.2.2 Traffic Data

Traffic data for this assessment include:

- Road Surface – The noise relationship between different road surface types is shown below in *Table 3-1*.

Table 3-1 Noise Relationship Between Different Road Surfaces

Road Surfaces						
Chip Seal			Asphalt			
14mm	10mm	5mm	Dense Graded	Novachip	Stone Mastic	Open Graded
+3.5 dB	+2.5 dB	+1.5 dB	0.0 dB	-0.2 dB	-1.0 dB	-2.5 dB

The existing and future road surface was assumed to be dense graded asphalt.

- Vehicle Speed – The existing posted speed is 100 km/hr and assumed to remain the same in the future.
- Traffic Volumes – Information used in the modelling is provided in *Table 3-2*.

Table 3-2 Kwinana Freeway Traffic Information Used in the Modelling

Parameter	Kwinana Freeway			
	Existing (2018)[1]		Future (2031)	
	Northbound	Southbound	Northbound	Southbound
24 Hour Volume	38,777	40,079	62,314[2]	60,019[2]
18 Hour Volume[3]	33,840	38,389	54,381	57,488
% Heavy	10	13	8	8

Notes:

1. From Main Roads WA online hourly data at sites 8212 and 8213, year 2017/18.
2. ROM24 24 hrs AAWT model data from Main Roads WA and adjusted based on predicted/observed data for year 2016. That is, the predicted 24 hrs traffic volumes for year 2031 were calibrated against the 2016 observations. The calibration factor was then applied to the predicted volumes for year 2031. MRWA job reference (#40925).
3. Based on the hourly data recorded in 2017/18 at sites 8212 and 8213.

3.2.3 Ground Attenuation

The ground attenuation has been assumed to be 0.0 (0 %) for the road and 1.0 (100 %) for the current land and public open space. A ground attenuation factor of 0.5 (50 %) was used for the future subdivision. Note 0.0 represents hard reflective surfaces such as water and 1.0 represents absorptive surfaces such as grass.

3.2.4 Parameter Conversion

The CoRTN algorithms used in the *SoundPlan* modelling package were originally developed to calculate the $L_{A10,18hour}$ noise level. The WAPC Policy however uses $L_{Aeq(Day)}$ and $L_{Aeq(Night)}$. The relationship between the parameters varies depending on the composition of traffic on the road (volumes in each period and percentage heavy vehicles).

As noise monitoring was undertaken, the relationship between the parameters is based on the results of the monitoring – refer *Section 4.1*.

4 RESULTS

4.1 Noise Monitoring

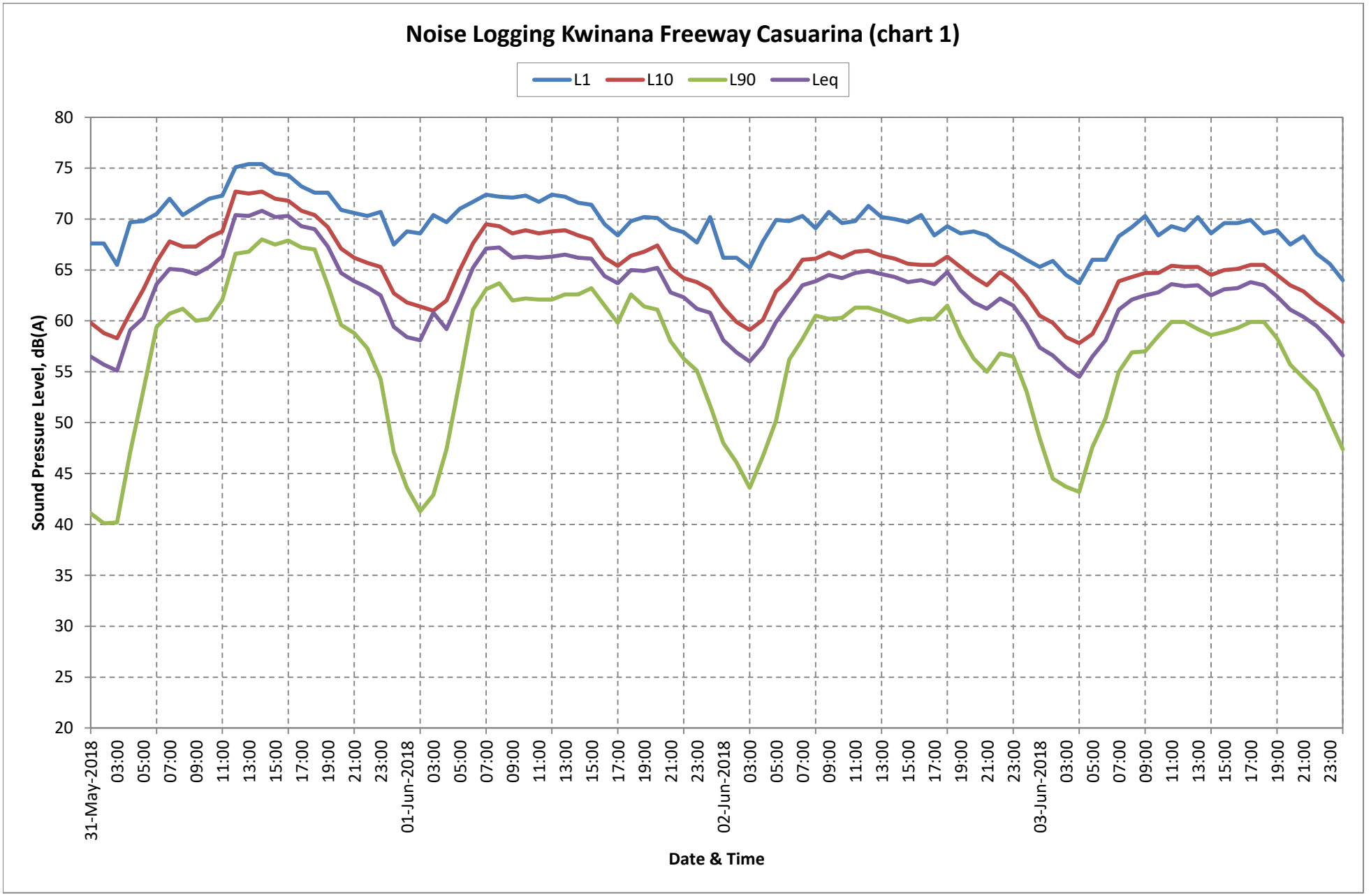
The results of the noise monitoring are summarised below in *Table 4-1* and shown graphically in *Figures 4-1* and *4-2*.

Table 4-1 Measured Average Noise Levels at Logger Location

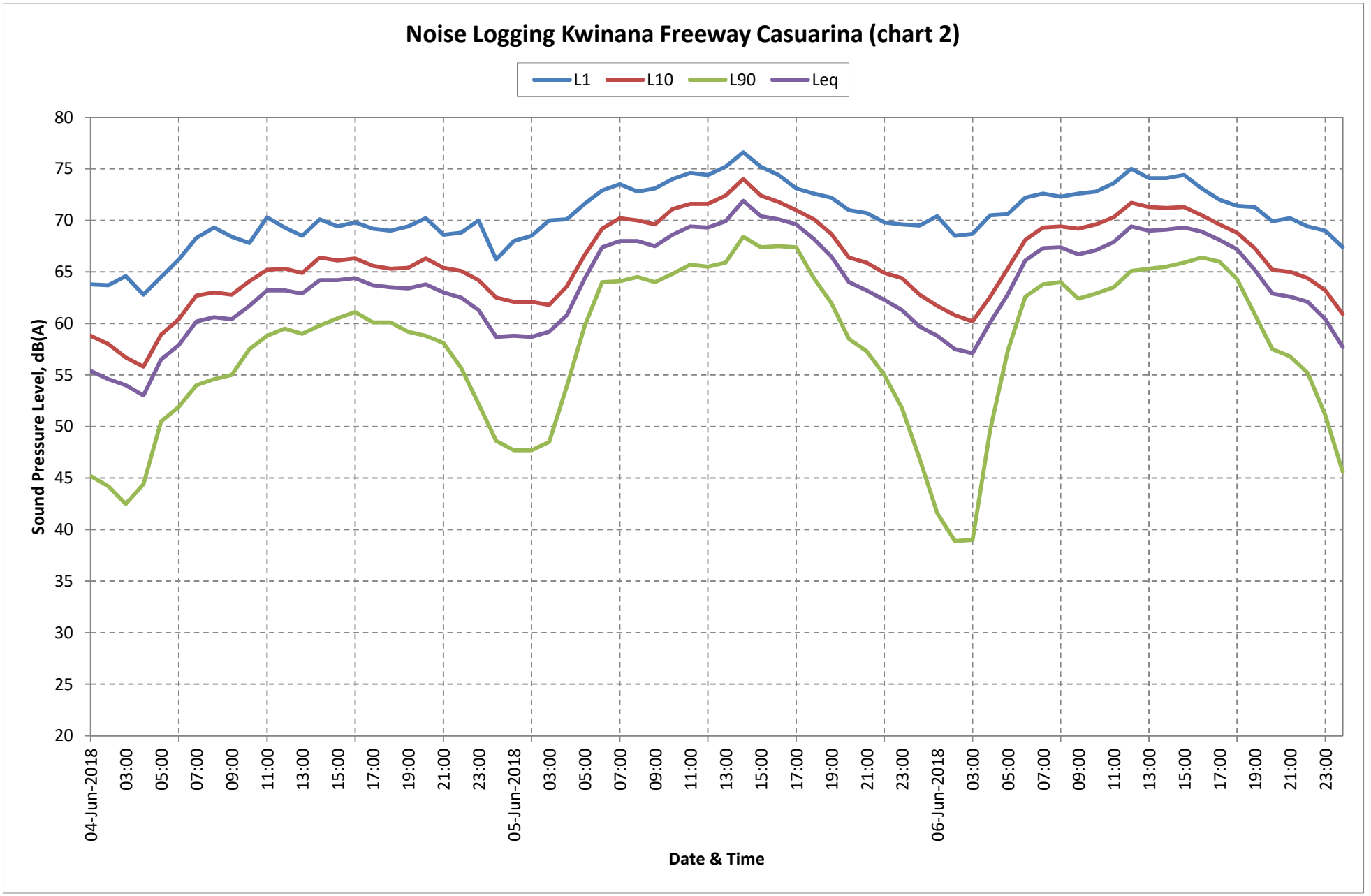
Date	Average Weekday Noise Level, dB			
	$L_{A10,18hour}$	$L_{Aeq,24hour}$	$L_{Aeq\ (Day)}$	$L_{Aeq\ (Night)}$
Thursday, 31 May 2018	*68.8*	*66.6*	*68.0*	*60.0*
Friday, 1 June 2018	67.1	64.6	65.6	61.3
Saturday, 2 June 2018	*65.5*	*62.8*	*63.8*	*59.4*
Sunday, 3 June 2018	*64.0*	*61.3*	*62.6*	*56.8*
Monday, 4 June 2018	*64.8*	*61.8*	*63.0*	*57.2*
Tuesday, 5 June 2018	*69.4*	*67.3*	*68.6*	*62.4*
Wednesday, 6 June 2018	68.2	66.1	67.4	61.2
Weekday Average	**67.7**	**65.4**	**66.5**	**61.3**

It is noted that weather conditions over the survey period were generally fine except for 31 May and 05 June (provided in *italics*), and data recorded on those dates were not included in the weekday average. Data recorded on the 04 June (also in *italics*) were also not included as it was a public holiday.

From the above, it can be seen that the average differences between the weekday $L_{A10,18hour}$ and $L_{Aeq(Day)}$ is 1.2 dB. This conversion has been used in the modelling for the future scenario. The average differences between the weekday $L_{Aeq(Day)}$ and $L_{Aeq(Night)}$ is 5.2 dB and therefore the daytime noise levels dictate compliance since the night-time levels are more than 5 dB over the daytime levels.



Reference: 18054422-01


Noise Logging Kwinana Freeway Casuarina (chart 2)
L1
L10
L90
Leq
Sound Pressure Level, dB(A)
80
75
70
65
60
55
50
45
40
35
30
25
20
04-Jun-2018
03:00
05:00
07:00
09:00
11:00
13:00
15:00
17:00
19:00
21:00
23:00
05-Jun-2018
03:00
05:00
07:00
09:00
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21:00
23:00
06-Jun-2018
03:00
05:00
07:00
09:00
11:00
13:00
15:00
17:00
19:00
21:00
23:00
Date & Time

4.2 Noise Modelling

The model was first calibrated against the survey results presented in *Table 4-1*.

For the future noise levels, an adjustment of -1.7 dB is applied to the predicted levels in accordance to the NAASRA report (refer *Section 3-2*) and a +2.5 dB facade adjustment is applied to account for facade reflection when assessed at houses.

The noise modelling is provided in *Figures 4-3* and *4-4* as a $L_{Aeq(Day)}$ noise level contour plot (including the +2.5 dB facade correction) for the future traffic conditions (year 2031) and for ground floor and upper floor levels respectively.

It can be seen that noise levels across the site are predicted to be below the *target*, with the exception of the lots west of the easement and a few lots in the south-west corner of the development. However, it is noted the modelling also shows that noise levels at an upper storey would be over the *target* for those future residential lots east of the easement.

In relation to the development area located west of the easement, it is understood these lots are marked as 'non residential uses' and therefore noise mitigation measures would not be required. However, it is noted that child care centres, educational buildings (schools) and places of worship are considered a sensitive use under the Policy although they are 'non-residential' and would therefore warrant noise mitigation.

Casuarina Central Precinct Development

$L_{Aeq(Day)}$ Noise Level Contours for Future Conditions (Year 2031) at Ground Floor Level

Figure 4-3



Traffic Assumptions
Road Surface: Dense Graded Asphalt
Speed: 100 km/hr
Southbound vpd (%HV): 60,019 (8%)
Northbound vpd (%HV): 62,314 (8%)

Noise levels
$L_{Aeq(Day)}$, dB

< 55
55 <= < 60
60 <= < 63
63 <=

N

Signs and symbols
Road
Area

03-Dec-18

Length Scale 1:6500
0 30 60 120 180 240 m

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by Olivier Mallié
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0439 987 455

Figure 4-4

Casuarina Central Precinct Development

$L_{Aeq(Day)}$ Noise Level Contours for Future Conditions (Year 2031) at Upper Floor Level



Traffic Assumptions
Road Surface: Dense Graded Asphalt
Speed: 100 km/hr
Southbound vpd (%HV): 60,019 (8%)
Northbound vpd (%HV): 62,314 (8%)

Noise levels
$L_{Aeq(Day)}$, dB

< 55
55 <= < 60
60 <= < 63
63 <=

N

Signs and symbols
Road

03-Dec-18

Length Scale 1:6500
0 30 60 120 180 240 m

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5 ASSESSMENT

The objectives of the criteria are for noise at all houses to be no more than the *limit* and preferably no more than the *target*. Where the *target* is achieved, no further controls are required. Where the *target* is exceeded, further controls are necessary.

It is noted that while the Policy mainly deals with residential uses, other uses such as child care centres, educational buildings (schools) and places of worship are also considered a sensitive use under the Policy, therefore requiring some degree of protection. In the case of child care centres, it is expected for at least one outdoor area which complies with the *target* to also be provided, therefore matching the requirements of residential buildings. For other sensitive uses such as a place of worship, only the internal noise level criteria are to be met.

With no noise control, road traffic noise levels to most of the land west of the easement will be above the daytime *target* of 55 dB $L_{Aeq(Day)}$, as well as a few lots in the south-western part of the development. It is noted that noise levels at future upper storeys were also predicted to exceed the *target* for those future residential lots east of the easement.

The *target* is achieved at the ground floor of most future residential lots with the exception of those located in the south western corner. A local noise wall to the west of the access road could be incorporated however, it would need to be in excess of 4.5 metres to achieve the *target* at those few lots. For those future lots in the south-west corner that are above the *target* of 55 dB $L_{Aeq(Day)}$, the following would be required:

- Where residences are predicted to experience future noise levels above *target* of 55 dB $L_{Aeq(Day)}$, (refer *Figure 5-1*) Package A (refer *Appendix A*) is to be incorporated, and
- All affected lots are to have notifications on lot titles as per the Policy requirements – refer *Appendix A*.
- The above requirement is shown on *Figure 5-1*.

Noise levels over the *target* are also predicted at upper floor levels for a number of future residential lots, however all future residential lots are below the *limit* of 60 dB $L_{Aeq(Day)}$. Since elevated receivers do not receive the same level of attenuation provided by walls, fences or other dwellings, architectural packages would be required only to the upper storey as follows:

- Where an upper storey is predicted to experience future noise levels above the *target* of 55 dB $L_{Aeq(Day)}$, Package A (refer *Appendix A*) is to be incorporated, and
- All affected lots are to have notifications on lot titles as per the Policy requirements (refer *Appendix A*) to advise prospective purchasers that additional noise mitigation requirements are required if a double storey dwelling be constructed.
- The above requirement is shown on *Figure 5-2.*

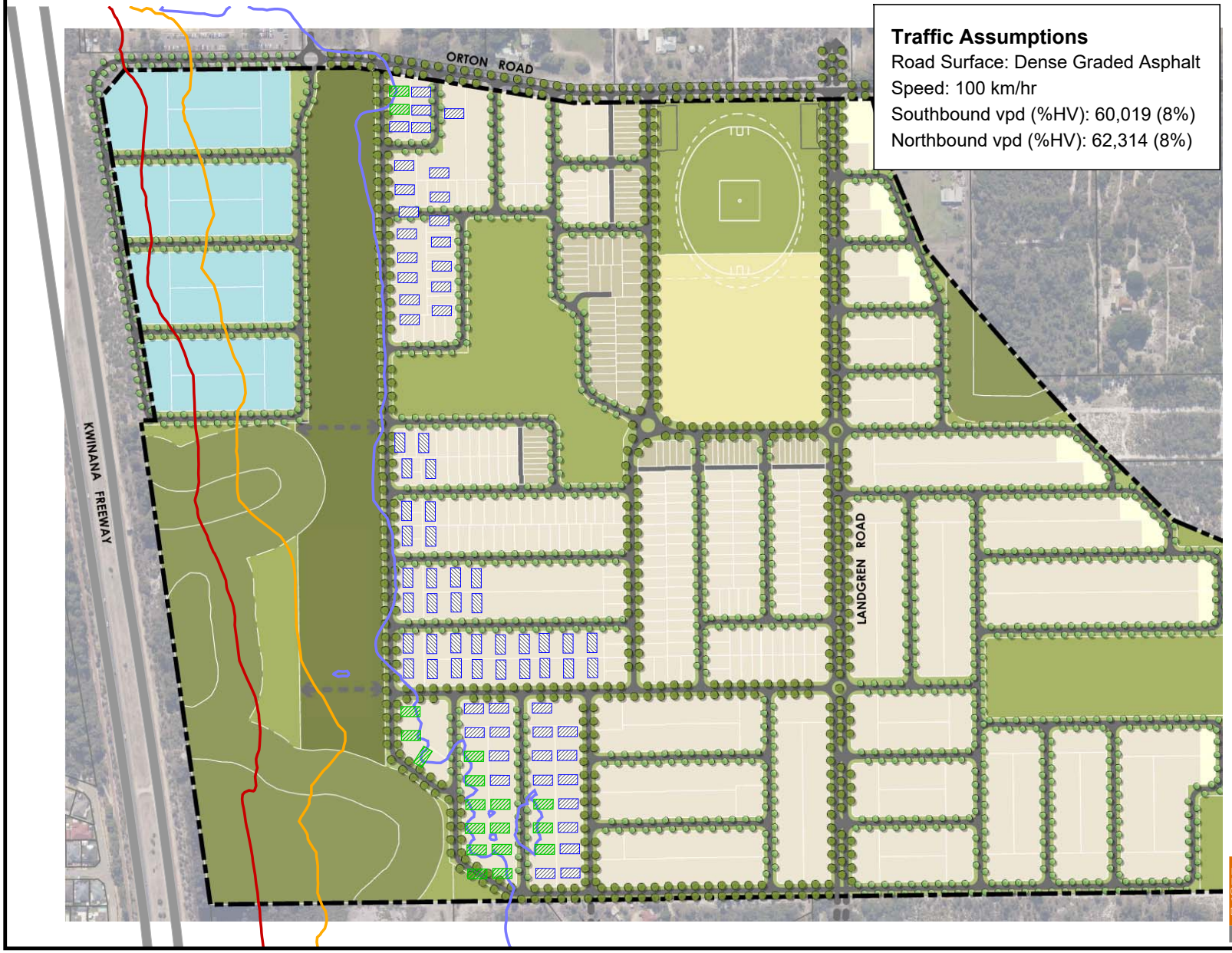
Alternative constructions to the Package A may be acceptable if supported by a report undertaken by a suitably qualified acoustical consultant once the lots specific building plans are available.

With regard to the lots west of the easement, these are marked for non-residential uses and therefore no noise mitigation is required. However, as noted above, child care centres, schools, places of worship and the like are considered sensitive uses and therefore some form of noise mitigation may still be required e.g. noise wall or architectural treatments. The requirements for mitigation measures will also depend on which lot the non-residential sensitive use would be built-on, and the height and orientation of adjacent buildings. At this stage, it is recommended for these lots to also have some form of notification on lot titles to advise of the Policy requirements in relation to non-residential sensitive use.

Figure 5-1

Casuarina Central Precinct Development

Ground Floor Package A Requirements and $L_{Aeq(Day)}$ Ground Floor Noise Level Contours for Future Conditions (Year 2031)



Traffic Assumptions
Road Surface: Dense Graded Asphalt
Speed: 100 km/hr
Southbound vpd (%HV): 60,019 (8%)
Northbound vpd (%HV): 62,314 (8%)

Noise levels
$L_{Aeq(Day)}$, dB

< 55
55 <= < 60
60 <= < 63
63 <=

N

Signs and symbols
Road
Package A

03-Dec-18

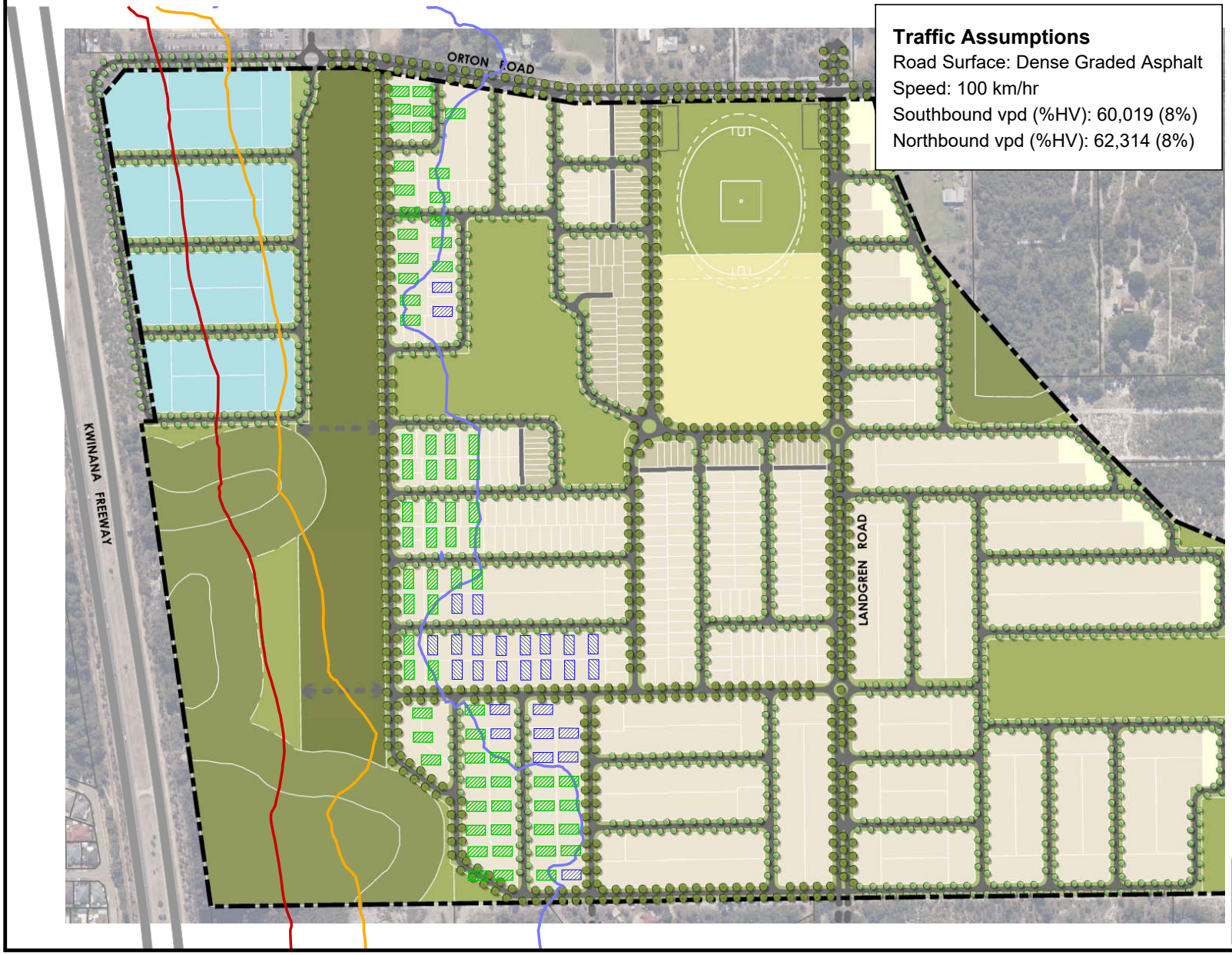
Length Scale 1:6500
0 30 60 120 180 240 m

Lloyd George Acoustics
by Olivier Mallié
olivier@lgacoustics.com.au
0439 987 455

Figure 5-2

Casuarina Central Precinct Development

Upper Floor Package A Requirements and $L_{Aeq(Day)}$ Upper Floor Noise Level Contours for Future Conditions (Year 2031)



Traffic Assumptions
Road Surface: Dense Graded Asphalt
Speed: 100 km/hr
Southbound vpd (%HV): 60,019 (8%)
Northbound vpd (%HV): 62,314 (8%)

Noise levels
$L_{Aeq(Day)}$, dB

	< 55
55 <=	< 60
60 <=	< 63
63 <=	

N

Signs and symbols
- Road
- Package A

03-Dec-18

Length Scale 1:6500

0 30 60 120 180 240 m

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by Olivier Mallié
olivier@lgacoustics.com.au
0439 987 455

6 CONCLUSION

To satisfy the requirements of the *State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning*, the following is required:

- Implement noise mitigation as shown on either *Figures 5-1* and *Figure 5-2*,
- Encourage non-noise sensitive uses on the western most lots,
- Locate non-residential sensitive uses on the western lots (e.g. child care) behind other buildings. Alternatively, localised noise walls to be incorporated,
- For dwellings / floor level requiring Package A, alternative treatment to the deemed to satisfy can be accepted if supported by a report by a suitable qualified acoustical engineer (member firm of the Association of Australasian Acoustical Consultants), and
- All residential affected lots are to have notifications on lot titles as per the Policy requirements – refer *Appendix A*. Non-residential lots to also have some form of notification to advise of the Policy requirements in relation to non-residential sensitive use.

Appendix A

ACCEPTABLE TREATMENT PACKAGES

The packages and information provided on the following pages are taken from *Implementation Guidelines for State Planning Policy 5.4 Road and Rail Transport Noise and freight Considerations in Land Use Planning*; December 2014.

Where outdoor noise levels are above the ***target*** level, excluding the effect of any boundary fences, the Guidelines propose acceptable treatment packages that may be implemented without requiring detailed review. The packages are also intended for residential development only. At higher noise levels or for other building usages, specialist acoustic advice will be needed.

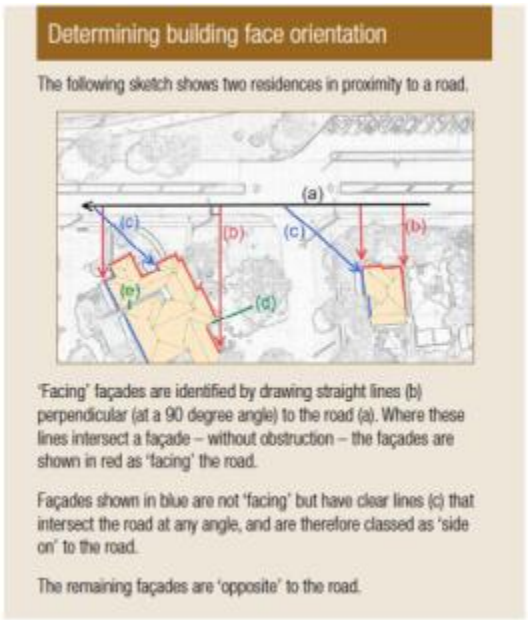
The acceptable treatment packages are intended to simplify compliance with the noise criteria, and the relevant package should be required as a condition of development in lieu of a detailed assessment.

Transition between each package should be made on the basis of the highest incident $L_{Aeq(Day)}$ or $L_{Aeq(Night)}$ value to the nearest whole number determined for the building development under assessment.

Any departures from the acceptable treatment specifications need to be supported by professional advice from a competent person that the proposal will achieve the requirements of the Policy.

With regards to the packages, the following definitions are provided:

- **Facing** the transport corridor: Any part of a building façade is 'facing' the transport corridor if any straight line drawn perpendicular to its nearest road lane or railway line intersects that part of the façade without obstruction (ignoring any fence).
- **Side-on** to transport corridor: Any part of a building façade that is not 'facing' is 'side-on' to the transport corridor if any straight line can be drawn from it to intersect the nearest road lane or railway line without obstruction (ignoring any fence).
- **Opposite** to transport corridor: Neither 'side on' nor 'facing', as defined above.



Package A

Area	Orientation to Road or Rail Corridor	Package A (up to 60 dB $L_{Aeq(Day)}$ and 55 dB $L_{Aeq(Night)}$)
Bedrooms	Facing	• Windows systems: Glazing up to 40% of floor area (minimum $R_w + C_{tr}$ 28) – 6mm thick glass (monolithic, toughened or laminated) in fixed sash, awning or casement opening with seals to openings.
	Side	• Windows systems: As above.
	Opposite	No requirements
Other Habitable Rooms Including Kitchens	Facing	• Windows and external door systems: Glazing up to 60% of floor area (minimum $R_w + C_{tr}$ 28) – 6mm thick glass (monolithic, toughened or laminated) in fixed sash, awning or casement opening with seals to openings. Doors to be either 35mm thick solid timber core door with full perimeter acoustic seals. Glazed inserts to match the above. Sliding glass doors to be same performance including brush seals.
	Side	• Windows and external door systems: As above.
	Opposite	No requirements
General	Any	• Walls (minimum $R_w + C_{tr}$ 45) – Two leaves of 90mm thick brick with minimum 50mm cavity • Roof and ceiling (minimum $R_w + C_{tr}$ 35) – Standard roof construction with 10mm plasterboard ceiling and minimum R2.5 insulation between ceiling joists. • Eaves to be closed using 4mm compressed fibre cement sheet. • Mechanical ventilation – Refer following pages.
Outdoor Living Area		• Locate on the side of the building that is opposite to the corridor if practicable; or • Locate within alcove area so that the house shields it from corridor if practicable.

Note: Any penetrations in a part of the building envelope must be acoustically treated so as to not downgrade the performance of the building elements affected. Most penetrations in external walls such as pipes, cables or ducts can be sealed through caulking gaps with non-hardening mastic or suitable mortar.

Mechanical Ventilation requirements

It is noted that natural ventilation must be provided in accordance with F4.6 and F4.7 of Volume One and 3.8.5.2 of Volume Two of the National Construction Code. Where the noise *limit* is likely to be exceeded, a mechanical ventilation system is usually required. Mechanical ventilation systems will need to comply with AS 1668.2 – *The use of mechanical ventilation and air-conditioning in buildings*.

In implementing the acceptable treatment packages, the following must be observed:

- Evaporative air conditioning systems will meet the requirements for Packages A and B provided attenuated air vents are provided in the ceiling space and designed so that windows do not need to be opened.
- Refrigerant based air conditioning systems need to be designed to achieve fresh air ventilation requirements.
- External openings (e.g. air inlets, vents) need to be positioned facing away from the transport corridor where practicable.
- Ductwork needs to be provided with adequate silencing to prevent noise intrusion.

Notification

Notifications on certificates of title and advice to prospective purchasers warning of the potential for noise impacts from major transport corridors help with managing expectations.

The area of land for which notification is required should be identified in the noise management plan and contain a description of major noise sources nearby (e.g. 24-hour freight rail).

Notification should be provided to prospective purchasers, and required as a condition of subdivision (including strata subdivision) for the purposes of noise sensitive development or planning approval involving noise sensitive development, where external noise levels are forecast or estimated to exceed the 'target' criteria as defined by the Policy.

In the case of subdivision and development, conditions of approval should include a requirement for registration of a notice on title, which is provided for under Section 165 of the Planning and Development Act 2005 and Section 70A of the Transfer of Land Act 1893. An example of a suitable notice is:

Notice: This lot is situated in the vicinity of a transport corridor and is currently affected, or may in the future be affected, by transport noise. Transportation noise controls and Quiet House design strategies at potential cost to the owner may be required to achieve an acceptable level of noise reduction. Further information is available on request from the relevant local government offices.

Appendix B

Terminology

The following is an explanation of the terminology used throughout this report.

Decibel (dB)
The decibel is the unit that describes the sound pressure and sound power levels of a noise source. It is a logarithmic scale referenced to the threshold of hearing.

A-Weighting
An A-weighted noise level has been filtered in such a way as to represent the way in which the human ear perceives sound. This weighting reflects the fact that the human ear is not as sensitive to lower frequencies as it is to higher frequencies. An A-weighted sound level is described as L_A dB.

L_1
An L_1 level is the noise level which is exceeded for 1 per cent of the measurement period and is considered to represent the average of the maximum noise levels measured.

L_{10}
An L_{10} level is the noise level which is exceeded for 10 per cent of the measurement period and is considered to represent the "*intrusive*" noise level.

L_{90}
An L_{90} level is the noise level which is exceeded for 90 per cent of the measurement period and is considered to represent the "*background*" noise level.

L_{eq}
The L_{eq} level represents the average noise energy during a measurement period.

$L_{A10,18hour}$
The $L_{A10,18\ hour}$ level is the arithmetic average of the hourly L_{A10} levels between 6.00 am and midnight. The *CoRTN* algorithms were developed to calculate this parameter.

$L_{Aeq,24hour}$
The $L_{Aeq,24\ hour}$ level is the logarithmic average of the hourly L_{Aeq} levels for a full day (from midnight to midnight).

$L_{Aeq,8hour}$ / $L_{Aeq\ (Night)}$
The $L_{Aeq\ (Night)}$ level is the logarithmic average of the hourly L_{Aeq} levels from 10.00 pm to 6.00 am on the same day.

$L_{Aeq,16hour}$ / $L_{Aeq\ (Day)}$
The $L_{Aeq\ (Day)}$ level is the logarithmic average of the hourly L_{Aeq} levels from 6.00 am to 10.00 pm on the same day. This value is typically 1-3 dB less than the $L_{A10,18hour}$.

R_w

This is the weighted sound reduction index and is similar to the previously used STC (Sound Transmission Class) value. It is a single number rating determined by moving a grading curve in integral steps against the laboratory measured transmission loss until the sum of the deficiencies at each one-third-octave band, between 100 Hz and 3.15 kHz, does not exceed 32 dB. The higher the R_w value, the better the acoustic performance.

C_{tr}

This is a spectrum adaptation term for airborne noise and provides a correction to the R_w value to suit source sounds with significant low frequency content such as road traffic or home theatre systems. A wall that provides a relatively high level of low frequency attenuation (i.e. masonry) may have a value in the order of –4 dB, whilst a wall with relatively poor attenuation at low frequencies (i.e. stud wall) may have a value in the order of -14 dB.

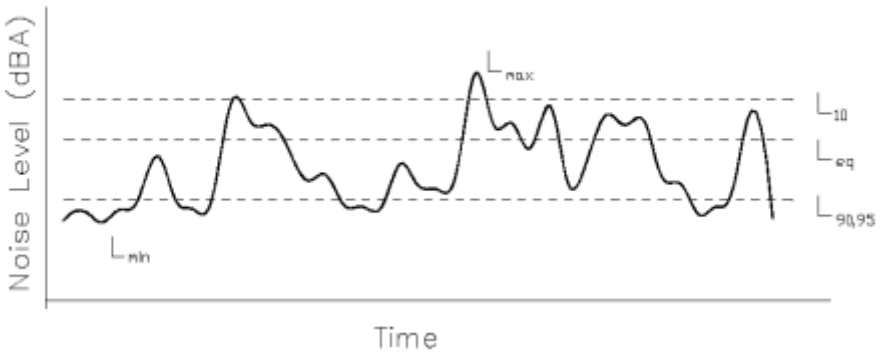
Satisfactory Design Sound Level

The level of noise that has been found to be acceptable by most people for the environment in question and also to be not intrusive.

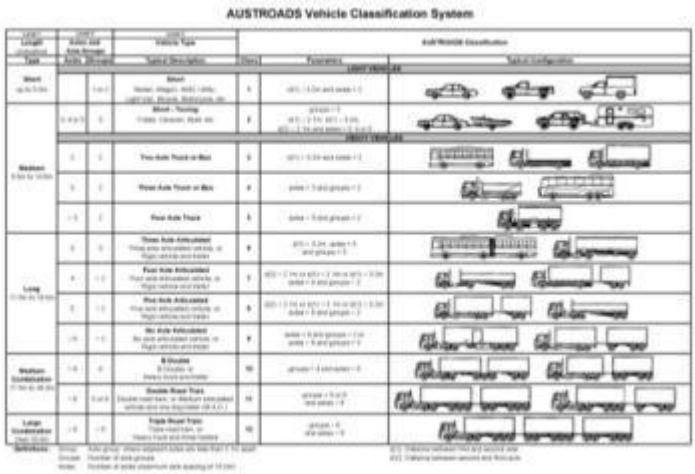
Maximum Design Sound Level

The level of noise above which most people occupying the space start to become dissatisfied with the level of noise.

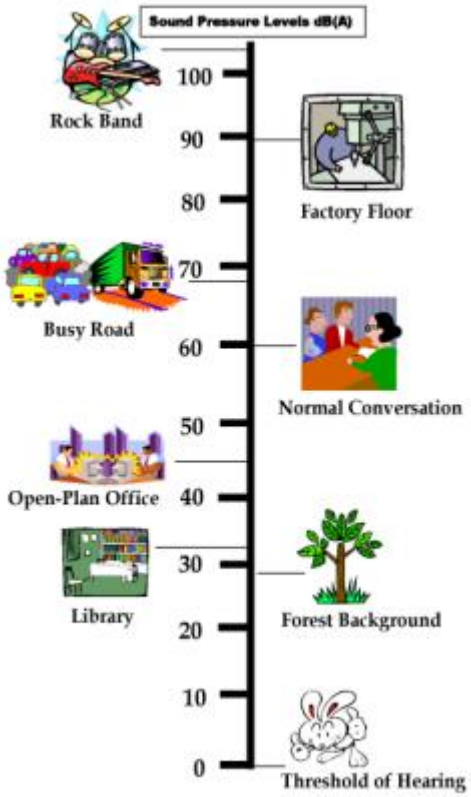
Chart of Noise Level Descriptors



Austroads Vehicle Class



Typical Noise Levels



APPENDIX E
ENGINEERING SERVICES REPORT

Cossill & Webley
CONSULTING ENGINEERS



Casuarina Central LSP
Engineering Servicing Report
December 2018

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Contents

1. INTRODUCTION 1
2. SITE DESCRIPTION 3
2.1 Site Vegetation 3
2.2 Existing Structures 3
2.3 Geology 4
2.4 Acid Sulfate Soils 5
2.5 Site Contours 5
2.6 Groundwater and Wetland Mapping 6
3. DRAINAGE AND GROUNDWATER MANAGEMENT 8
4. ROADWORKS & FOOTPATHS 9
5. WATER RETICULATION 9
6. SEWERAGE RETICULATION 10
7. POWER 12
8. GAS SUPPLY 13
9. TELECOMMUNICATIONS 13
10. DEVELOPMENT STAGING 14
11. CONCLUSION 14

APPENDIX A – LOCAL STRUCTURE PLAN

APPENDIX B – DEVELOPMENT CONCEPT PLAN

1. INTRODUCTION

This report has been prepared by Cossill & Webley Pty Ltd (CW) to support the preparation of the Casuarina Central Local Structure Plan (LSP). A copy of the LSP is included as Appendix A along with a copy of the Development Concept Plan as Appendix B. The report summarises the results of a preliminary assessment of the engineering aspects of the proposed urban development of various lots located along Landgren Road and Orton Road, Casuarina located in the City of Kwinana.

The area of land is identified by the black boundary overlaid on the City of Kwinana Town Planning Scheme 2 plan (Orelia and Casuarina locality maps) presented in Figure 1 below.

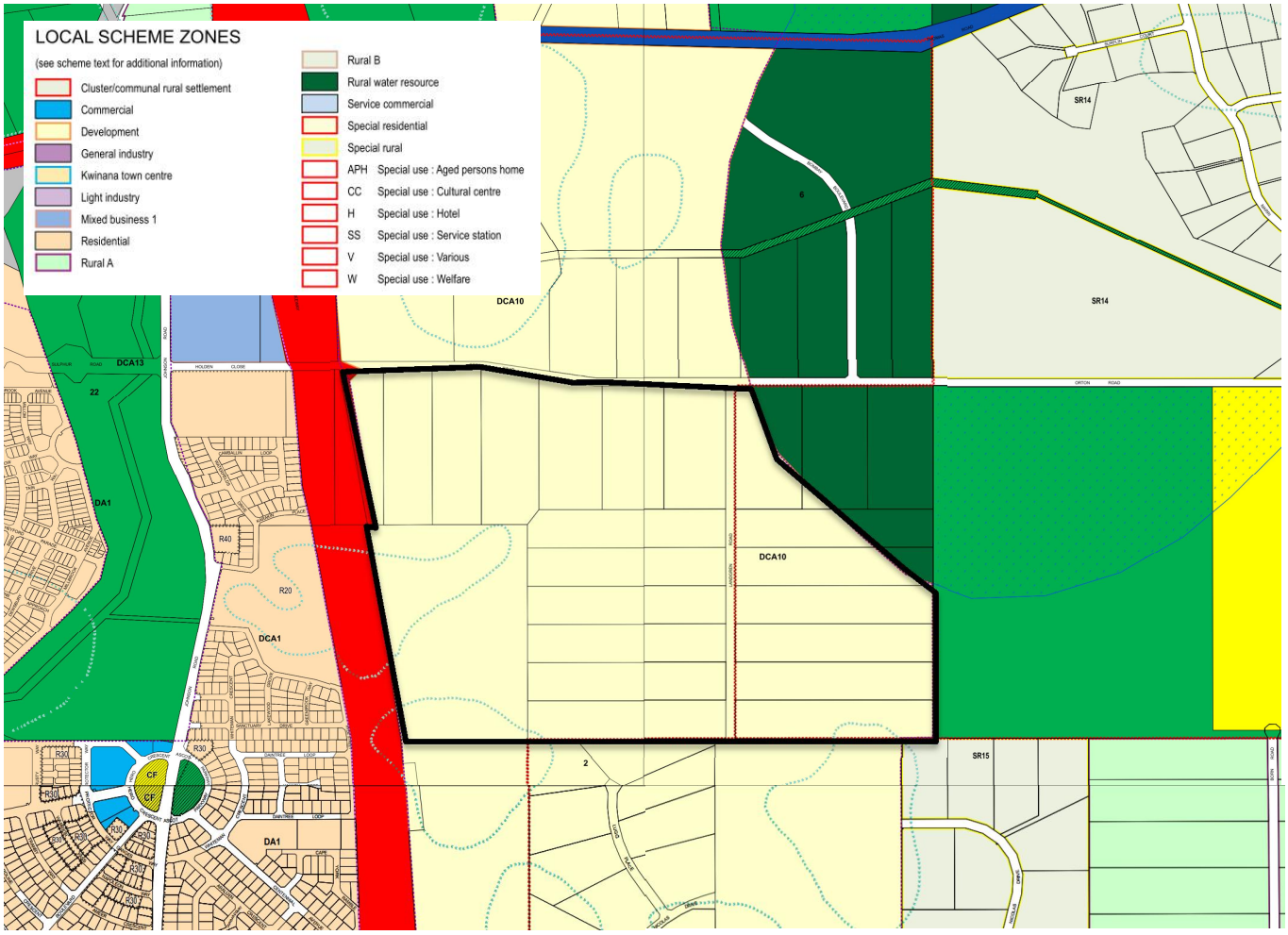


Figure 1: Town Planning Scheme 2 (City of Kwinana)

The LSP area is located east of Kwinana Freeway, bound by native vegetation zoned as Parks and Recreation to the east, Orton Road to the north and undeveloped lots to the South. Landgren Road runs north-south through the area. The location is indicated in Figure 2.



Figure 2: Existing Road Network (Google)

The landholding is zoned Urban under the Metropolitan Region Scheme (MRS). The LSP area is zoned Development under the City of Kwinana's Town Planning Scheme 2 as indicated in Figure 1.

The City of Kwinana has confirmed that the LSP area is within two gazetted Developer Contribution Scheme areas. Developer Contribution Plan 3 for Casuarina is applicable, with contributions towards the upgrade of Thomas Road and Mortimer Road, POS and improvement to the Peel main drain. Developer Contribution Plan 10 (Casuarina/Anketell) is also applicable with contributions from this scheme used for community infrastructure.

2. SITE DESCRIPTION

2.1 Site Vegetation

The area of the Casuarina Central LSP is approximately 100 hectares. The land is significantly cleared with a number of trees scattered across the LSP area as shown in the recent aerial photography presented in Figure 3 below.



Figure 3: Aerial Imagery (Spookfish 2018)

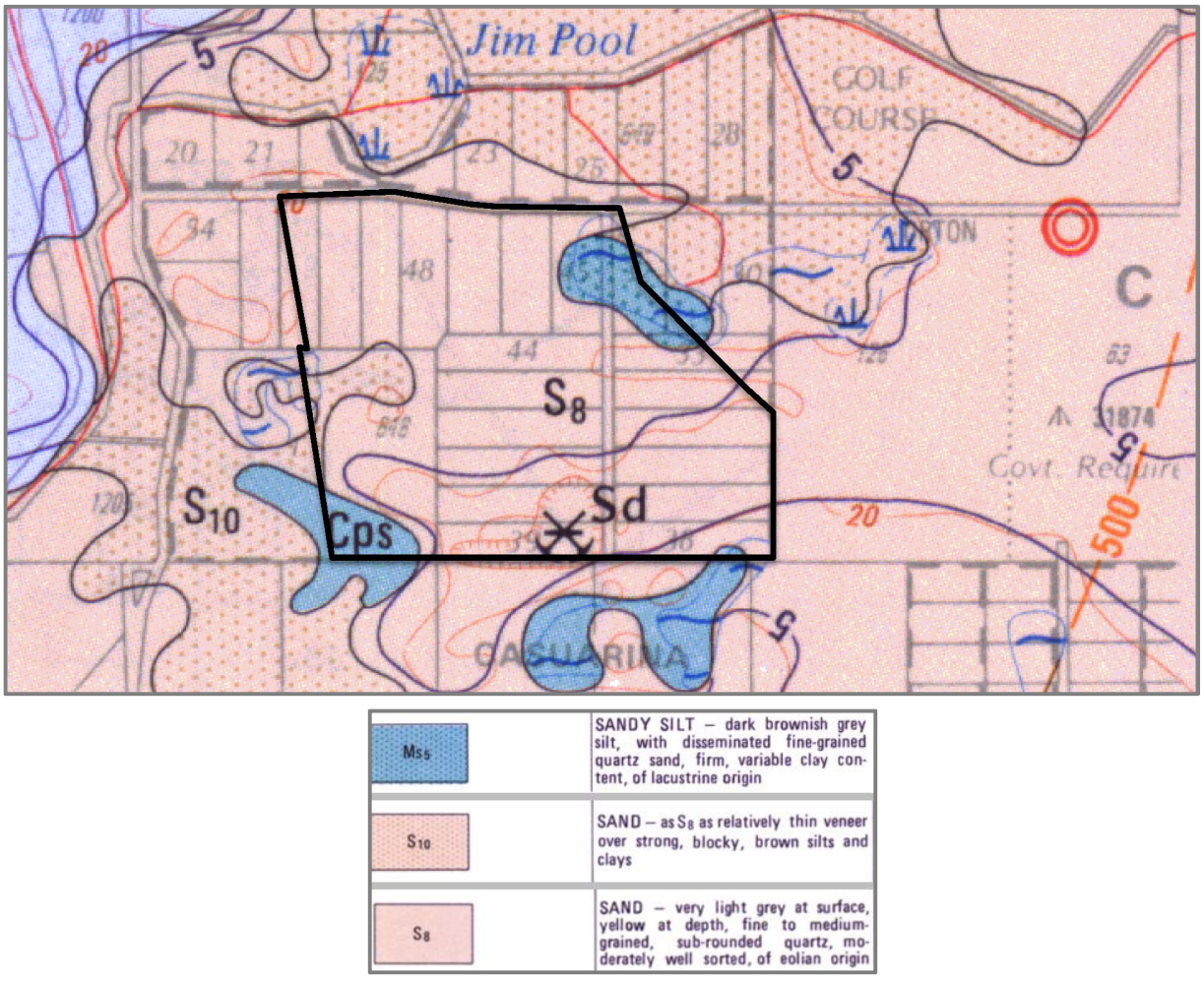
2.2 Existing Structures

Existing buildings can be seen in Figure 3. There are currently a number of existing residential dwellings and sheds on each lot that will need to be demolished prior to development.

Existing overhead power lines are present through the LSP area, with distribution power lines in the Orton Road and Landgren Road reserves. Existing transmission power lines also run through the LSP area in a north-south direction in the western portion of the LSP area. These are discussed further in Section 7 – Power.

2.3 Geology

The Geological Survey of Western Australia Perth Metropolitan Region soils map for Fremantle (part 2033I & 2133IV) indicates that the majority of the LSP area is characterised by Sand (refer to Figure 4). This soil type is generally pale to grey sands at the surface with yellow sands at depth. It is free draining and is well suited to urban development. There are some isolated pockets containing silty, clayey sands and sandy silt. These areas are generally associated with wetland areas and these soils will need to be taken into consideration to allow any development to occur in these areas.



Ms5	SANDY SILT – dark brownish grey silt, with disseminated fine-grained quartz sand, firm, variable clay content, of lacustrine origin
S10	SAND – as S8 as relatively thin veneer over strong, blocky, brown silts and clays
S8	SAND – very light grey at surface, yellow at depth, fine to medium-grained, sub-rounded quartz, moderately well sorted, of eolian origin

Figure 4: Geotechnical Information (Geological Survey of WA - Armadale)

2.4 Acid Sulfate Soils

A desk top review of the Department of Environment and Conservation's ASS Risk Map for the Central Metropolitan Region for potential acid sulfate soils (ASS) indicates the majority of the LSP area is classed as having moderate to low risk of ASS occurring within 3m of the natural soil surface (or deeper) as depicted in Figure 5 below. Small sections in the southern, south-western and north-eastern portions of the LSP area are indicated as having a high to moderate risk of ASS. It is recommended that an environmental consultant be engaged to confirm whether ASS treatment will be required at the time of subdivision.

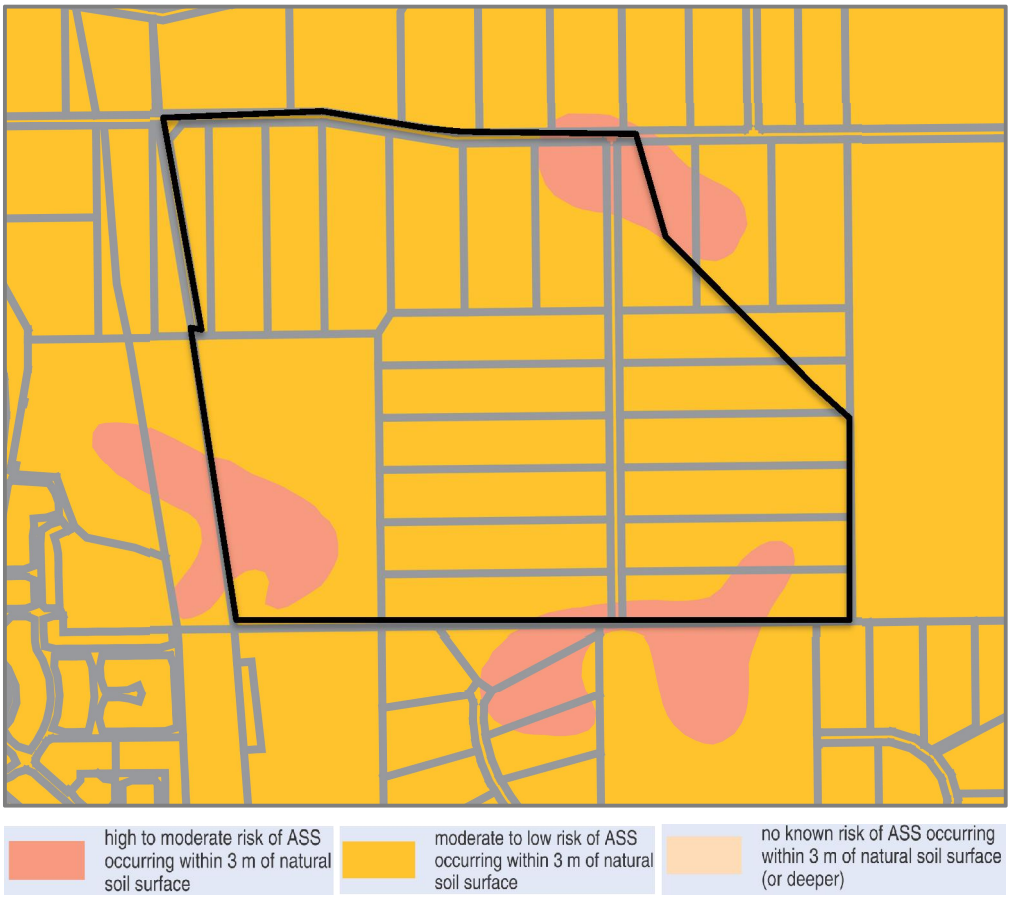


Figure 5: Acid Sulphate Soils Risk Mapping (Department of Environment and Conservation)

2.5 Site Contours

The LSP area is reasonably flat across the northern half, with an elevation across this section generally between RL17m-RL19m AHD. There is a large sand dune in the southern portion of the LSP area with a peak elevation of RL32m AHD as shown in Figure 6. It is anticipated the sand in this high point can be cut to create fill for use elsewhere in the LSP area due to the significant height differential with the surrounding area. The south eastern portion of the LSP area is relative low lying with a low point of approximately RL11m AHD associated with a wetland.

It is anticipated that some retaining will be required as part of the future development due to the grade of the natural topography.

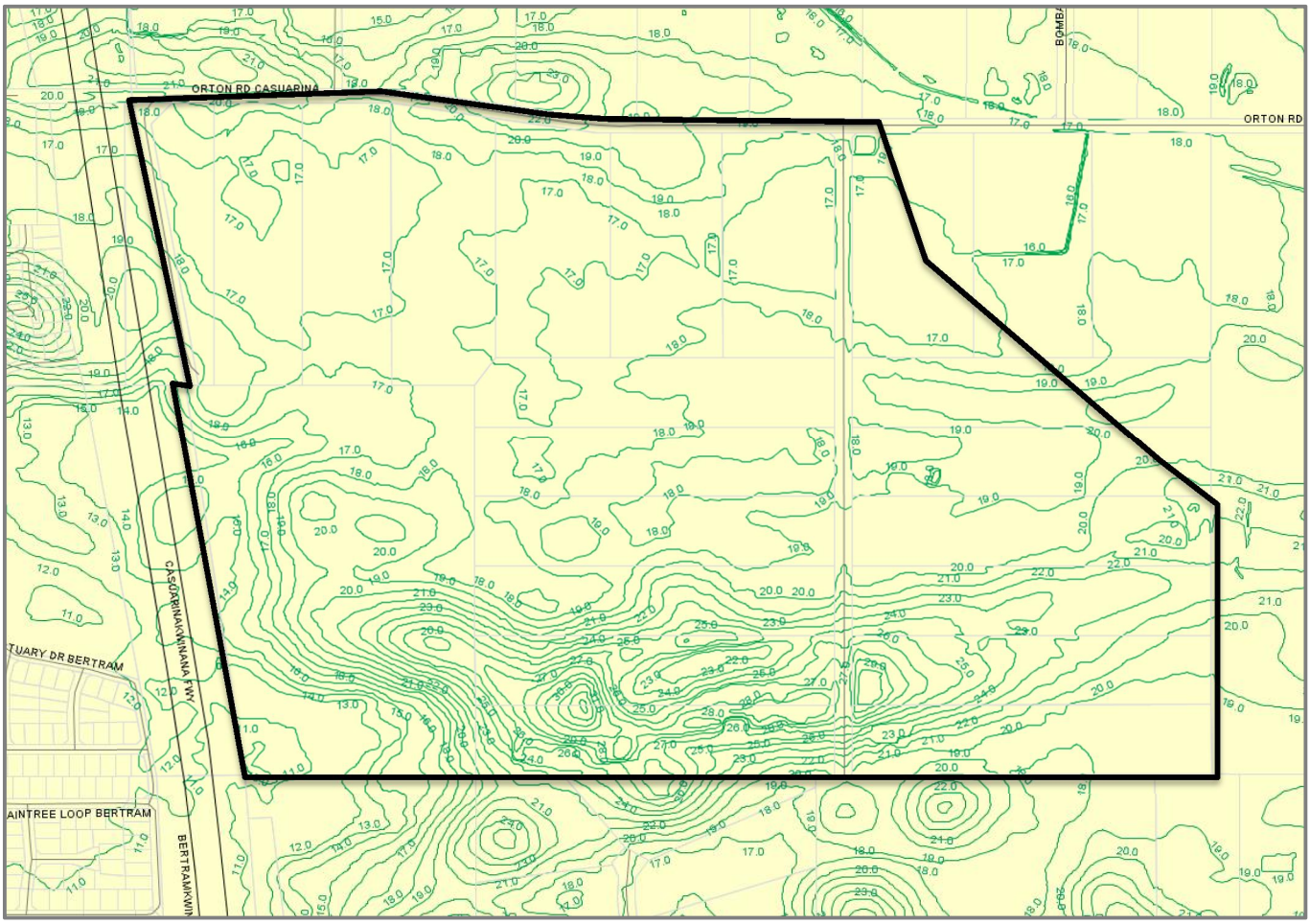


Figure 6: Existing Ground Contours of the LSP Area (Department of Water)

2.6 Groundwater and Wetland Mapping

A review of available groundwater contour information from the Department of Water Groundwater Atlas indicates the historical maximum groundwater levels in the LSP area are generally between RL15m-RL18m AHD with groundwater levels reducing to approximately RL11m AHD in the south-western corner, as depicted in Figure 7. The groundwater levels from May 2003 are presented in Figure 8 and show the groundwater level to be generally 1.5m to 2m below the historical maximum in most areas.

The maximum groundwater levels indicate there will be little separation to the natural surface over the northern half of the LSP area, with approximately 1 metre of separation. The amount of separation between the maximum groundwater levels and the natural surface levels generally increases further south in the LSP area.

Given that the groundwater separation is found to be less than 1.5m from the natural surface in some areas, fill will be required to provide adequate separation to groundwater, and subsoil drainage may be required to provide protection for future dwellings. It is anticipated that sand in the higher portions of the LSP area may be able to be utilized in filling some of the lower portions of the LSP area and increasing the separation to groundwater across the lower land. It is anticipated some imported fill will be required over portions of the LSP area.

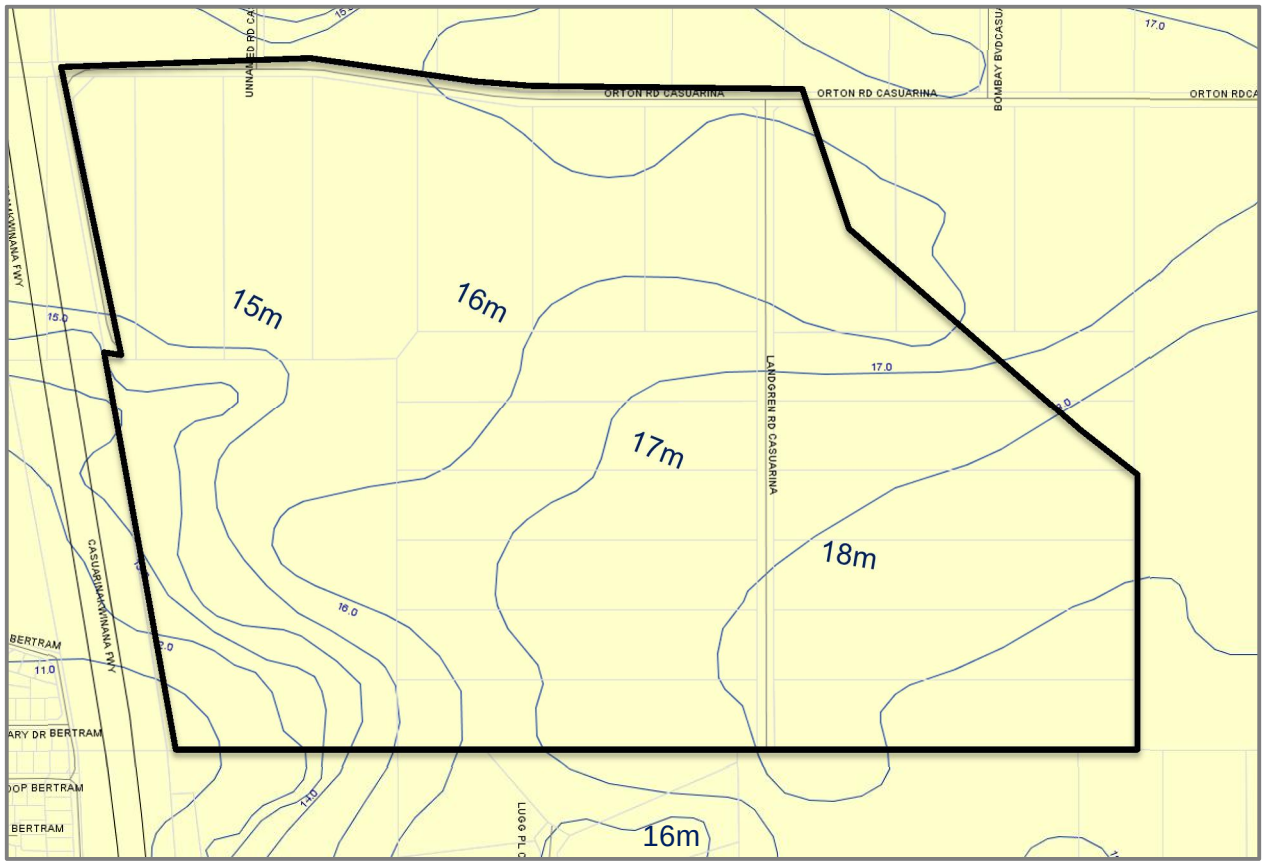


Figure 7: Historical Maximum Groundwater Levels (Department of Water)

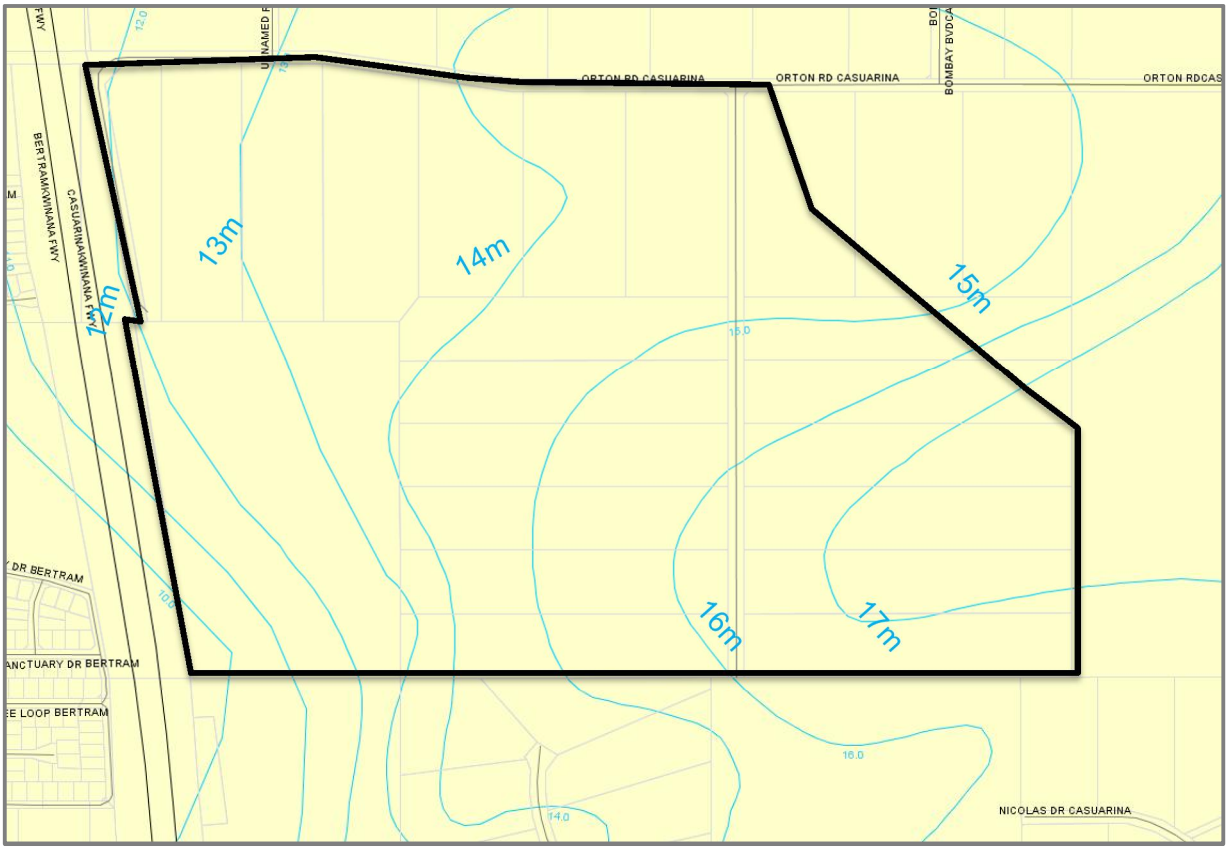


Figure 8: May 2003 Groundwater Levels (Department of Water)

Figure 9 indicates wetland mapping across the LSP area. A Resource Enhancement Wetland is identified in the north-eastern corner of the LSP area and a Conservation Wetland is identified in the south-western portion of the LSP area adjacent to Kwinana Freeway.

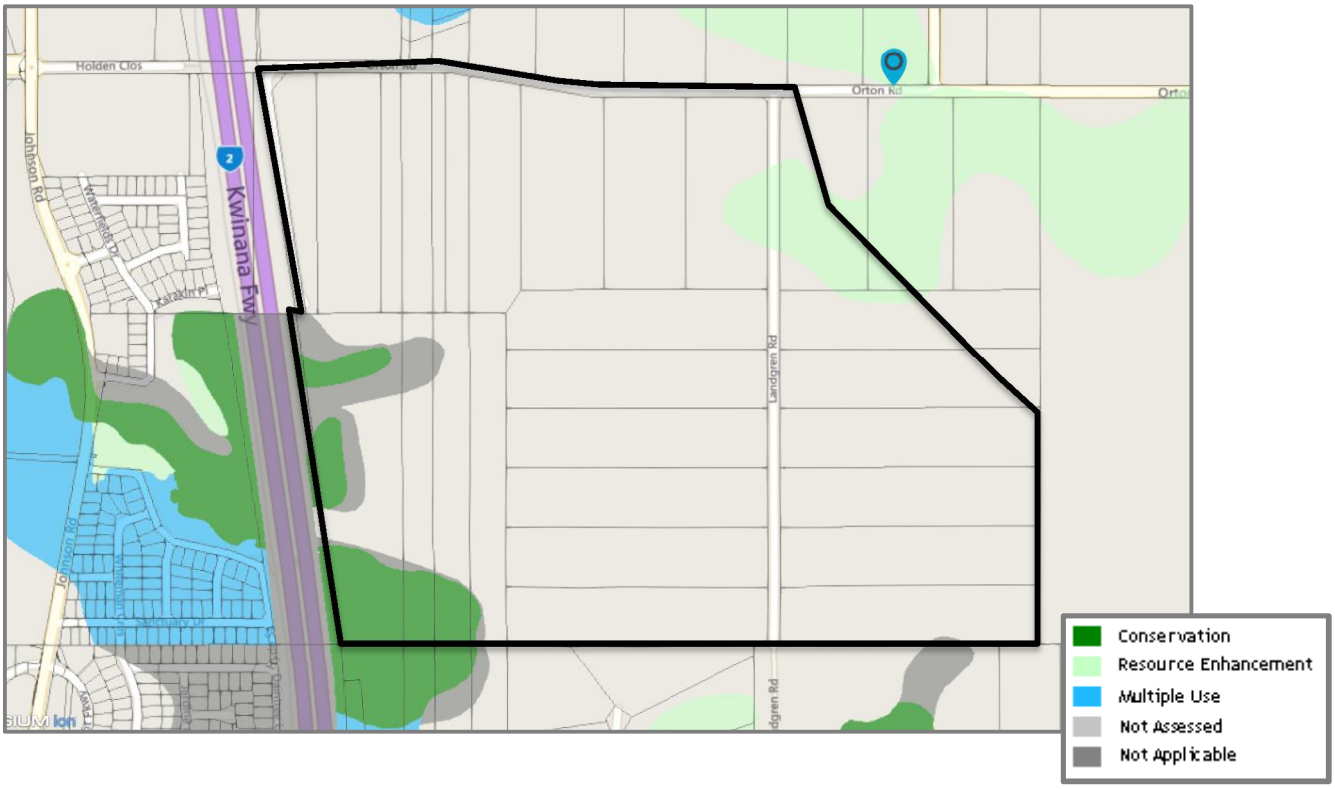


Figure 9: Geomorphic Wetlands (Perth Atlas)

3. DRAINAGE AND GROUNDWATER MANAGEMENT

The LSP area is located within the Jandakot Drainage and Water Management Plan (JDWMP) area. Figure 10 depicts the existing drainage network surrounding the LSP area. The Peel Sub P1 Drain runs north of the LSP area, with the Peel Sub P1A Drain located to the north-east of the LSP area and the Peel Sub O Drain located to the south. The City's engineering department has advised the drains may be re-routed during development, and may either be open channel (e.g. a living stream through a POS) or piped drainage. The Developer Contribution Scheme 3 includes a contribution for the Peel sub drains. This scheme identifies a living stream as the preferred drain treatment.

A Local Water Management Strategy (LWMS) has been prepared by Hyd2o (November 2018). The LWMS outlines that stormwater management for the development proposes a mix of detention storage and infiltration storage. Stormwater will be detained to rates specified in the Jandakot Drainage and Water Management Plan (DoW, 2009) prior to discharge into the Peel Sub 1A Drainage. All other stormwater within the site will be infiltrated and where possible infrequently occurring events will discharge towards wetland areas.

A condition of subdivision for properties within the LSP area will be the preparation and approval of an Urban Water Management Plan (UWMP) prior to the commencement of development.

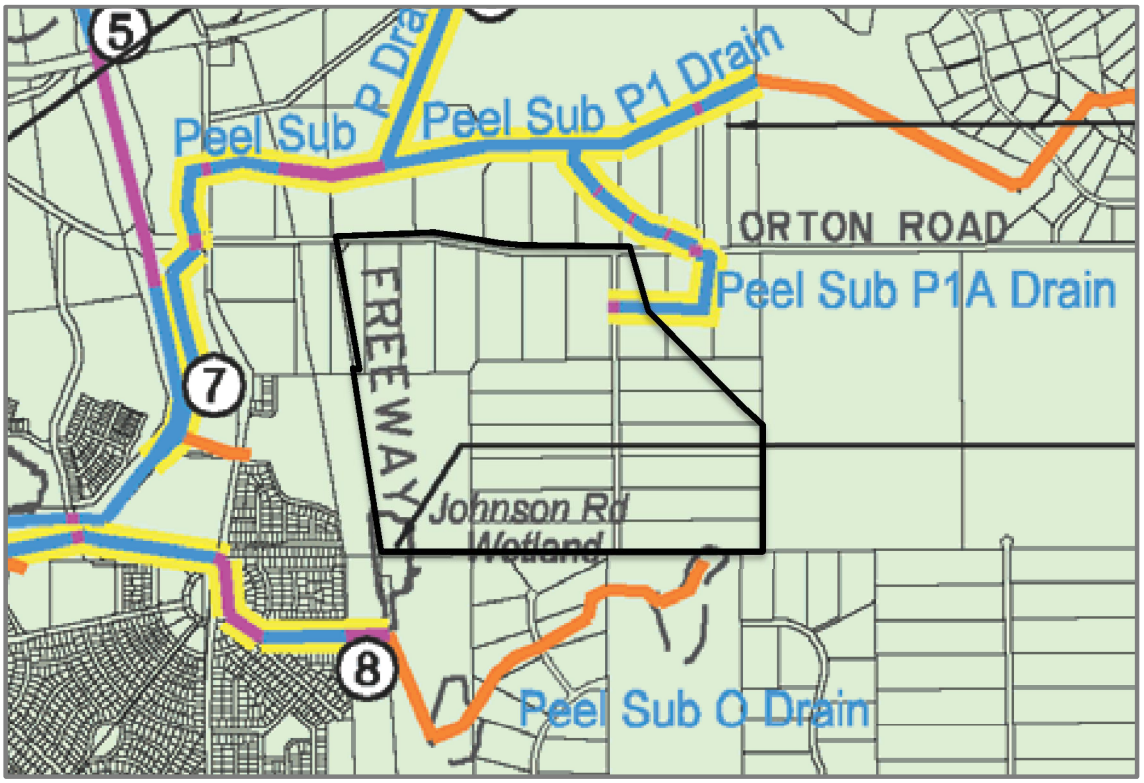


Figure 10: Existing Drainage Network (JDWMP 2009)

4. ROADWORKS & FOOTPATHS

The existing road network surrounding the LSP area is depicted in Figure 2. It is anticipated the predominant traffic movement from the development will be travel to and from the north along Bombay Boulevard, to Kwinana Freeway or Kwinana Town Centre via Thomas Road which acts as a District Distributor.

The existing roads within the LSP area being Orton Road and Landgren Road are in average condition and built to rural specifications. These roads will need to be upgraded/reconstructed as part of the development, including the installation of footpaths, kerbing and piped drainage.

All newly created roads, drainage and footpaths will need to be designed and constructed to the satisfaction of the City of Kwinana.

5. WATER RETICULATION

The existing water infrastructure network is depicted in Figure 11. There is an existing 220mm water reticulation main located in Orton Road.

The Water Corporation has advised that no water reticulation planning has been undertaken for the LSP area. However, there are not anticipated to be any water servicing issues.

Water Corporation planning advice indicates a large steel water main may need to be constructed through the LSP area from the south, travelling up Landgren Road, then heading west at Orton Road and extending beneath Kwinana Freeway. It is anticipated due to the size of these mains that they would be pre-funded by the Water Corporation at a later date.

Standard Water Corporation water headworks will apply.

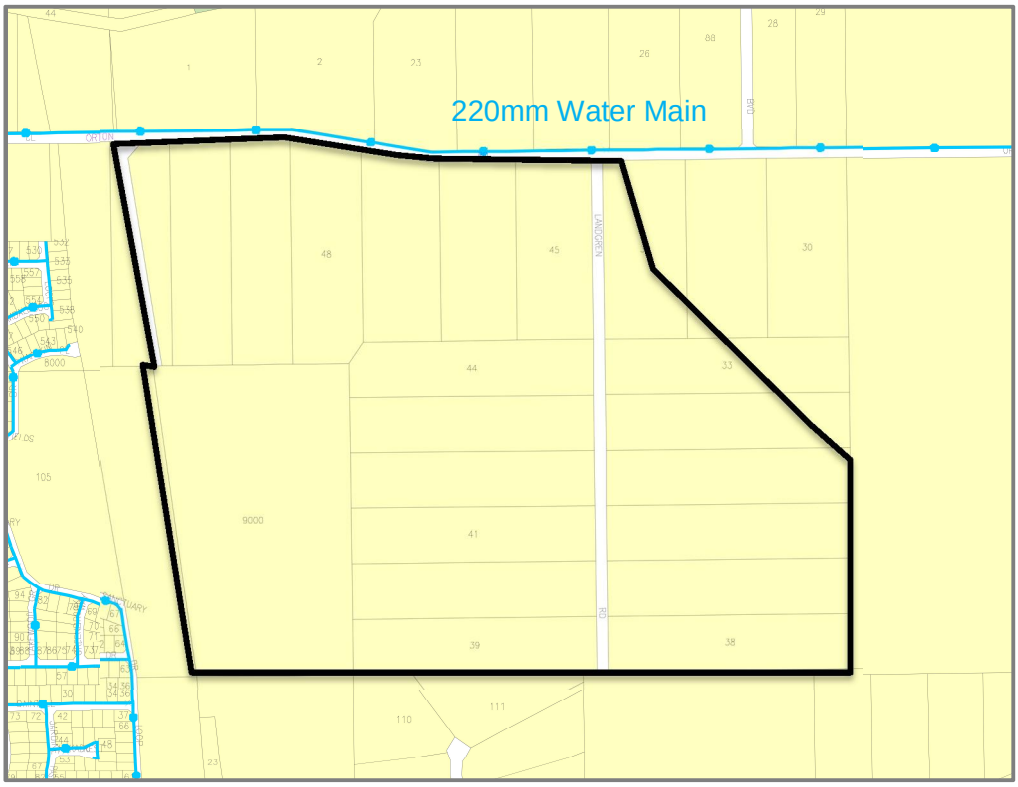


Figure 11: Existing Water Reticulation (Water Corporation)

6. SEWERAGE RETICULATION

The existing sewerage reticulation near the LSP area is presented in Figure 12 being a pressure main in Orton Road. There is insufficient existing sewer network in the vicinity to service the LSP area.

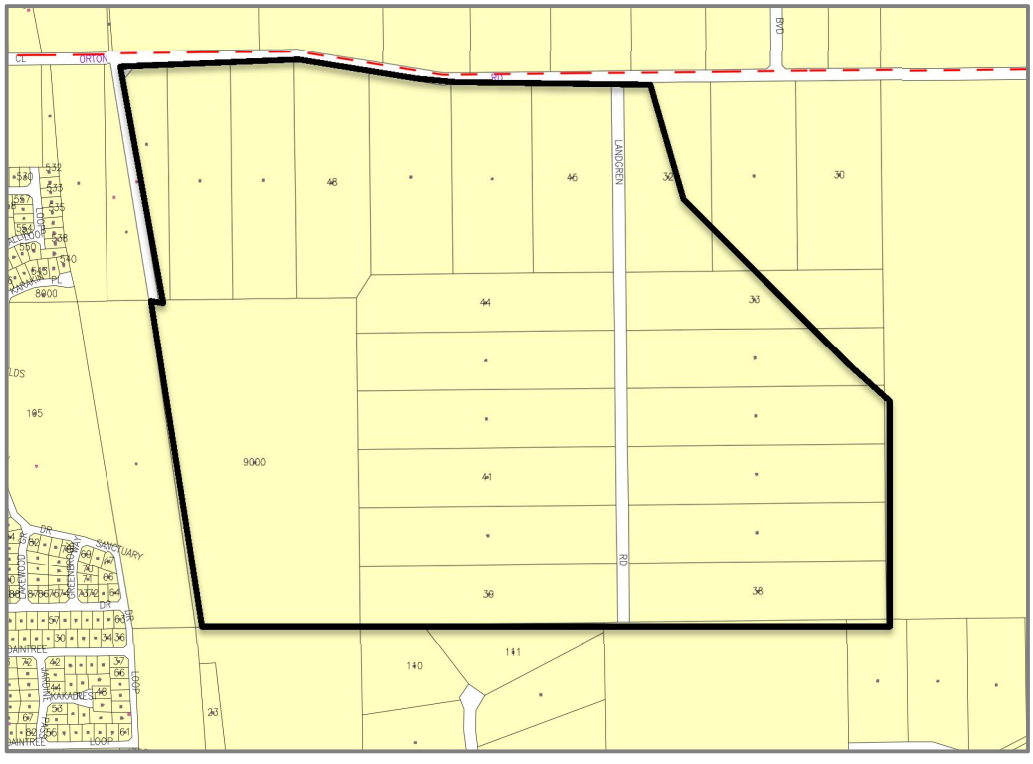


Figure 12: Existing Sewer Reticulation (Water Corporation)

The Water Corporation has provided wastewater planning information as presented in Figure 13.

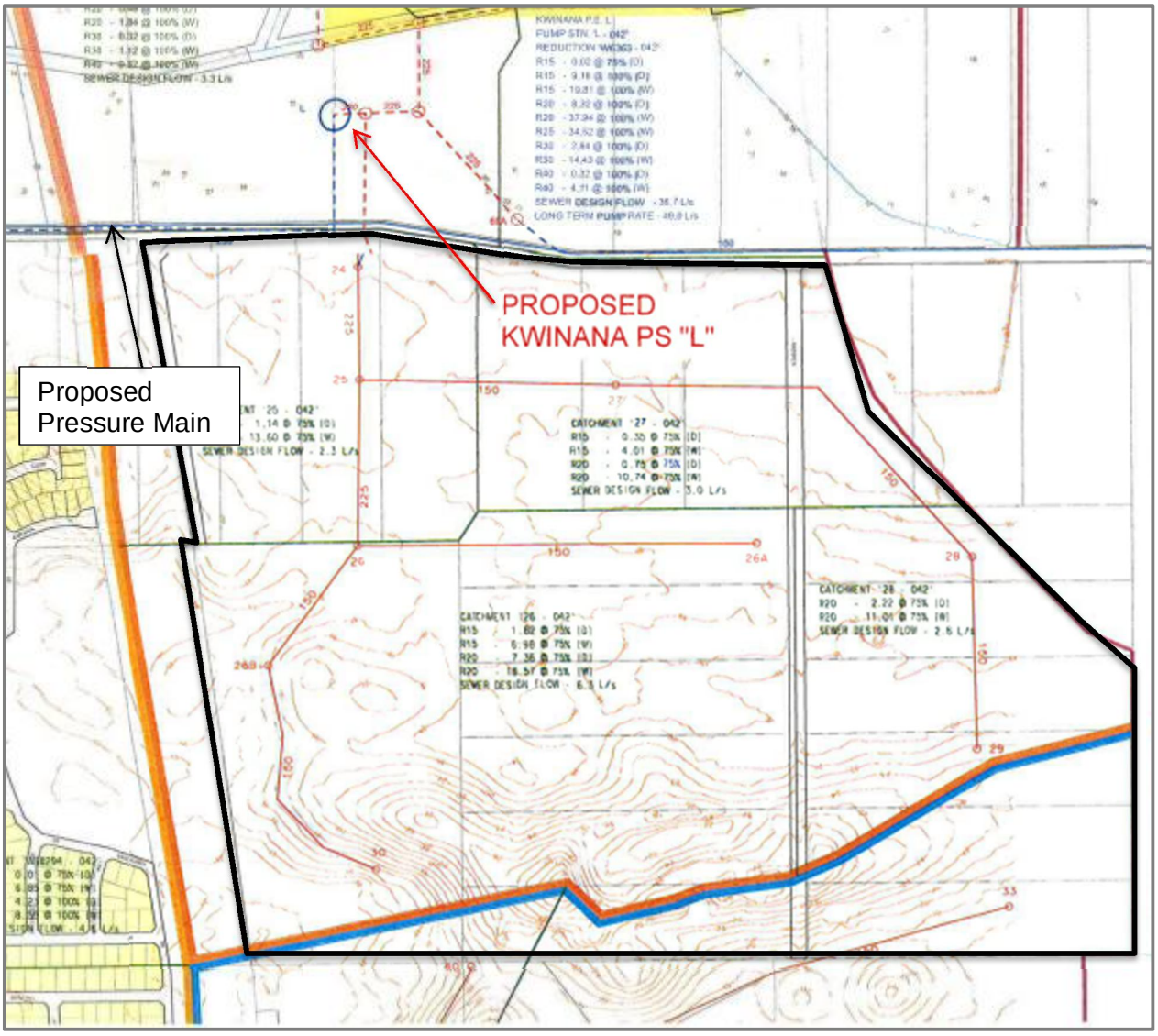


Figure 13: Wastewater Planning (Water Corporation)

The majority of the LSP area falls within a sewer catchment that will be serviced with conventional gravity reticulation that grades towards a proposed Type 40 pump station (Kwinana PS L) located just north of Orton Road (catchment outlined by the orange boundary in Figure 13). Outside of the residential development area, the pump station will also take flows from a catchment to the east through a pressure main running along Orton Road. The pump station will discharge via a proposed pressure main running along Orton Road west, beneath the Kwinana Freeway to a Water Corporation discharge point.

The proposed location of the Type 40 pump station is not within the LSP boundary. However, the majority landowner within the LSP area has agreed terms with the owner of Lot 2 Orton Road to secure access to their property for the purposes of building the Kwinana L WWPS and associated infrastructure.

The southern portion of the LSP area falls within a separate sewer catchment which grades southwards (outlined by the blue boundary in Figure 13). There may be an opportunity to modify finished ground levels in the southern section of the LSP area and liaise with the Water Corporation to amend the sewer catchment boundaries so that the majority of the LSP area falls within the northern sewer catchment. However, it is anticipated that some sections of the LSP area will still need to discharge to the south due to the levels of the LSP area and the need to coordinate these with adjoining land parcels.

Standard Water Corporation sewer headworks will apply.

7. POWER

The Western Power Network Capacity Mapping Tool was used to determine future forecast remaining capacity in the electricity network. This indicates that the network will have more than 20,000kVA remaining capacity in the future, so it is anticipated there will be adequate capacity in the network to supply future residential development. This will need to be confirmed formally with Western Power during detailed planning and design.

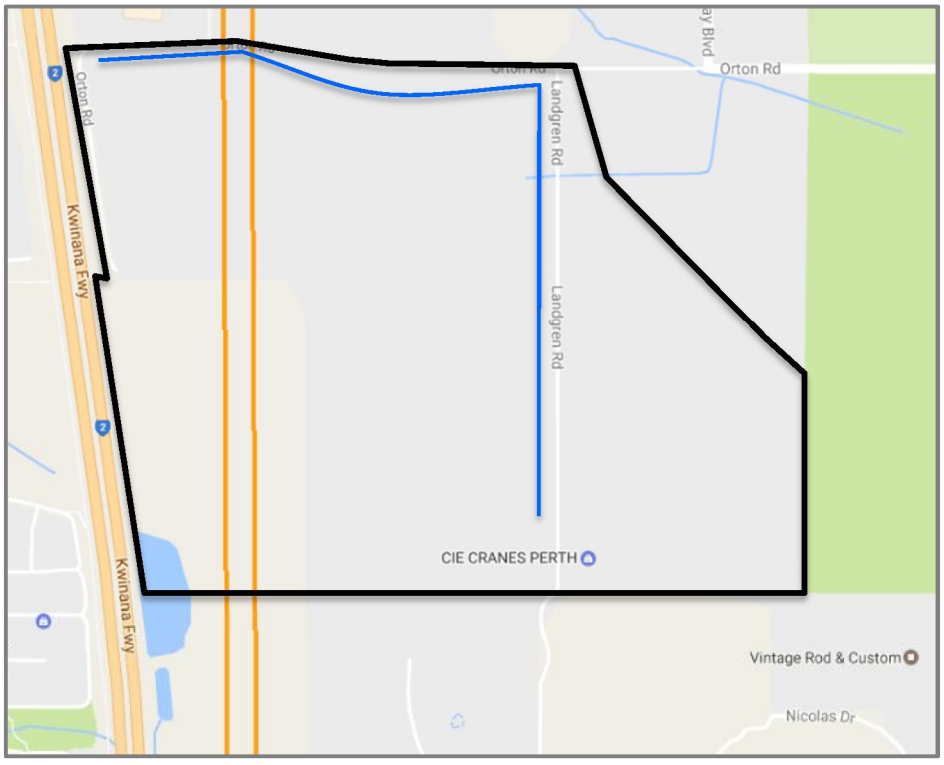


Figure 14: Existing Overhead Power Lines (Western Power)

There are two existing 330kV overhead transmission lines located parallel to the western boundary (indicated in orange in Figure 14). The lines are separated by approximately 45m and will require protection via an easement 20-30 metres either side of the lines. It is anticipated the easement may be used for on-site detention of stormwater from major events (this is subject to Western Power approval).

As part of the development it is anticipated that Western Power will require Earth Potential Rise (EPR) and Low Frequency Induction (LFI) testing to be undertaken around the transmission lines.

There are also existing co-located overhead high and low voltage distribution lines along Orton Road and Landgren Road, shown as blue in Figure 14. These overhead powerlines will need to be removed and reconstructed as underground power as part of development. During development, while undergrounding existing overhead powerlines, provisions will need to be made to provide power to existing residences.

There is very little existing underground power infrastructure near the LSP area. The mushroom farm to the north-west is served by high voltage underground power, which runs beneath the Kwinana Freeway.

All future power infrastructure within the proposed development will be underground and fed from existing infrastructure in the adjacent areas. It is not anticipated that any off-site headwork upgrades will be required.

8. GAS SUPPLY

An 80mm high pressure gas main runs along Orton Road (excluding the north-south leg along the Freeway) crossing beneath Kwinana Freeway to Holden Close. This will need to be protected during development and additional spotting of the main during construction will likely be required.

ATCO Gas has advised there will be sufficient capacity in the surrounding network to service the proposed development. ATCO Gas has advised the preferred option is to extend a main from Thomas Road along Bombay Boulevard to the LSP area. However, this relies on a pressure main being constructed in Thomas Road by the time development commences. If this has not occurred, ATCO Gas will consider alternative arrangements.

9. TELECOMMUNICATIONS

As per the Federal Government's New Developments Policy, new developments with 100 premises or more will be prioritised by NBN Co to have optic fibre infrastructure installed. The subject area is within NBN Co's fibre footprint, and hence can be serviced with optic fibre under their NBN roll-out scheme for Greenfield developments. Figure 15 depicts that the LSP area is currently serviced by NBN Co.

Under the current scheme, the developer is required to enter into an agreement with NBN Co to provide design, and pit and pipe infrastructure which is handed over free of charge to NBN Co upon completion.

Standard network deployment charges will apply.

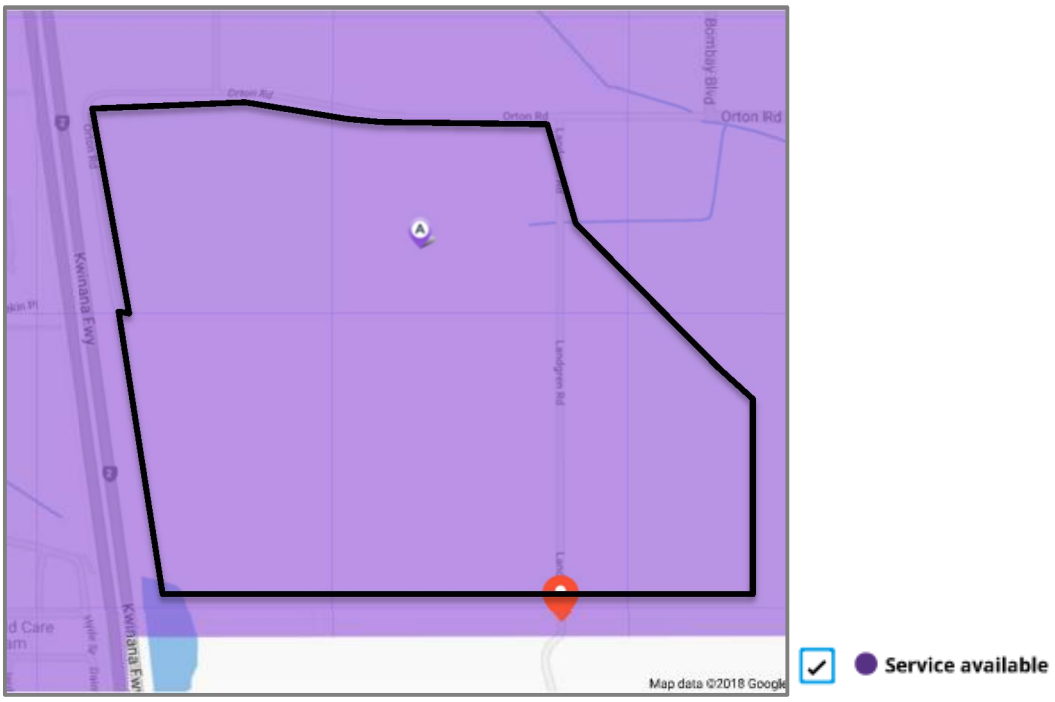


Figure 15: NBN Co Servicing (NBN Co.)

Alternative private telecommunication providers may also be considered to service this area.

10. DEVELOPMENT STAGING

It is anticipated development within the LSP area will commence from the north near Orton Road and Landgren Road. The reasoning for this is:

- There is existing road access into the LSP area via Orton Road and Landgren Road.
- Construction of a wastewater pumping station north of Orton Road will be required to service the development and the connecting gravity sewer mains will be extended from this pumping station into the development.
- All other existing services including water, power and gas are located either within Orton Road or Landgren Road and can be extended to service development.

To assist with development commencing in the northern and central sections of the LSP area, it is anticipated that earthworks will be concurrently undertaken in southern portions of the site to access sand for filling the lower lying land in the northern and central portions of the LSP.

11. CONCLUSION

Engineering services planning is generally in place to accommodate residential development of the Casuarina Central Local Structure Plan area.

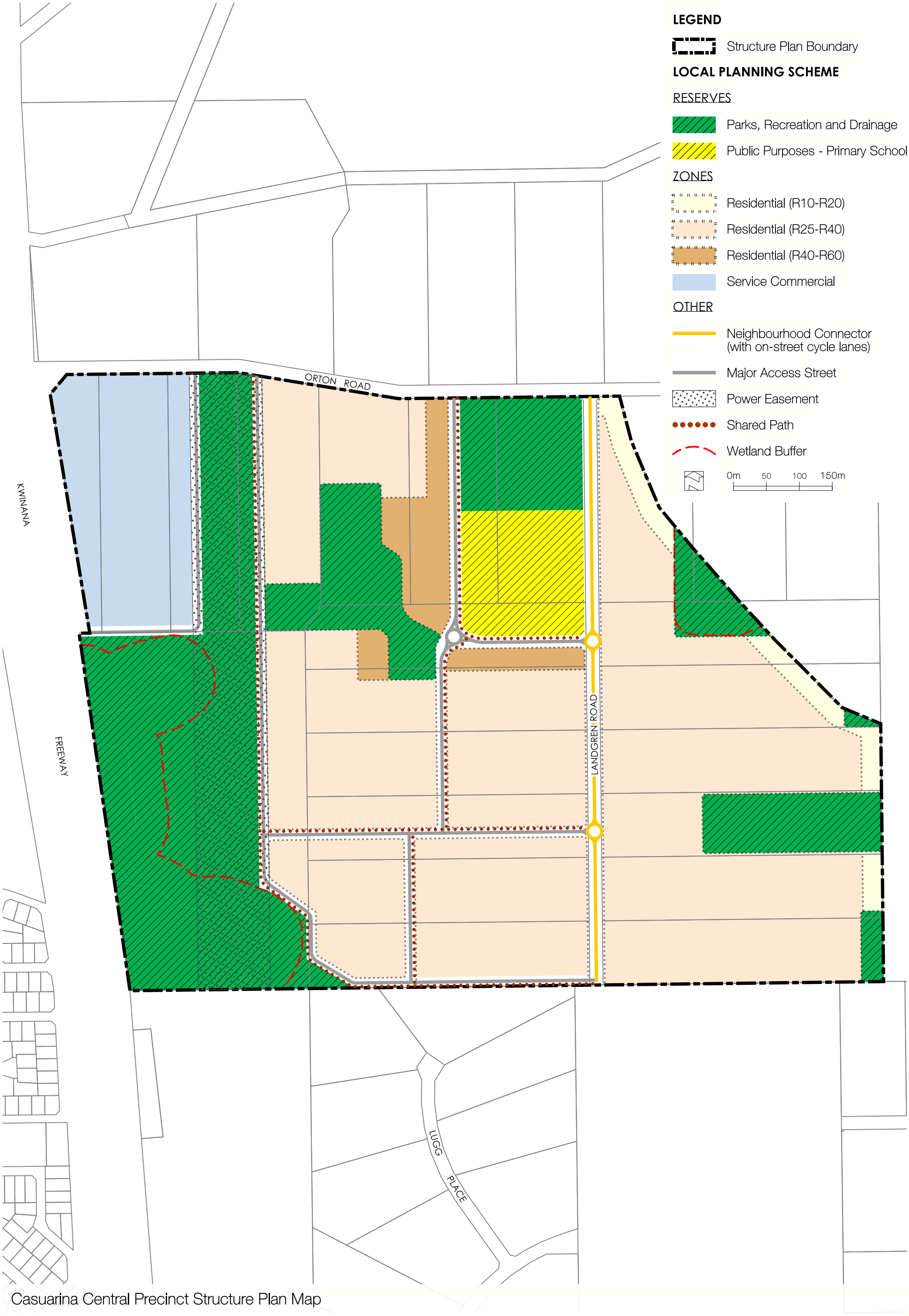
The major infrastructure required in order to facilitate development of the LSP area is a wastewater pumping station and associated pressure main in landholdings to the north.

Significant infrastructure is located within Orton Road and it is recommended, where possible, the alignment of this road is retained during planning.

From an engineering perspective, the LSP area is well suited to urban development.

APPENDIX A

LOCAL STRUCTURE PLAN



Casuarina Central Precinct Structure Plan Map

APPENDIX B

DEVELOPMENT CONCEPT PLAN



Casuarina Central Precinct Development Concept Plan

APPENDIX F
LOCAL WATER MANAGEMENT STRATEGY

Casuarina Central Precinct
Local Water Management Strategy

December 2018



Client: LWP Property Group

Contents

Executive Summary 3

1. Introduction 4

1.1 Planning Context 4

1.2 Key Documents 5

2. Proposed Development 6

3. Design Criteria 7

4. Pre-Development Environment 8

4.1 Site Conditions 8

4.2 Geotechnical 8

4.3 Acid Sulphate Soils 9

4.4 Contaminated Sites 10

4.5 Wetlands 10

4.6 Surface Water 10

4.7 Groundwater 11

4.7.1 Groundwater Levels 11

4.7.2 Groundwater Quality 12

5. Water Use Sustainability Initiatives 14

5.1 Water Efficiency Measures 14

5.2 Water Supply 14

5.3 Wastewater Management 15

6. Stormwater Management Strategy 16

6.1 Stormwater Modelling 16

6.2 Flood Protection (100 year ARI) 17

6.3 Ecological Protection (15 mm) 18

7. Groundwater Management Strategy 20

7.1 Fill and Subsoil Drainage 20

7.2 Acid Sulphate Soils 20

8. Urban Water Management Plans 21

9. Monitoring 22

9.1 Pre Development 22

9.2 Post Development 22

10. Implementation 23

11. References **24**

Appendices

A. LWMS Checklist for Developers
B. Lithological Logs
C. Jandakot DWMP (DoW, 2009) Extracts
D. Groundwater Monitoring Results (360 Environmental)
E. Landscape Plans (Emerge Associates)
F. Runoff Rate Calculator
G. Earthworks Plan (Cossill & Webley Engineers)

Figures

1. Location Plan
2. Local Structure Plan
3. Site Conditions
4. Environmental Geology Plan
5. Wetlands Plan
6. Surface Water Plan
7. Groundwater Plan
8. T200 DWER Bore Hydrograph
9. Stormwater Management Plan
10. Post Development Monitoring Plan

Tables

1. Urban Water Management Process
2. Design Criteria
3. Lithological Logs (360 Environmental)
4. AAMGL DWER Bore T200
5. AAMGL Site Bores
6. Pre Development Groundwater Quality
7. Current Groundwater Allocations within the Site
8. Stormwater Management
9. BMP Water Quality Performance in Relation to Design Criteria
10. Post Development Monitoring Programme
11. Implementation Responsibilities

Disclaimer

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Executive Summary

Hyd2o was commissioned by LWP Property Group to compile this local water management strategy (LWMS) to support the proposed local structure plan (LSP) for the Casuarina Central Precinct in the suburb of Casuarina (the site).

The site is approximately 96 ha in size and located approximately 40 km southeast of the Perth central business district within the City of Kwinana.

The local structure plan for the site has been prepared by Taylor Burrell Barnett (TBB). The proposed residential development consists of residential lots, non-residential landuses roads, public open space, primary school, a powerline easement and wetland (conservation) reserve.

The site is predominantly cleared and used for rural purposes. Some remnant patches of banksia woodland will be retained post development in addition to conservation category wetland areas. Topography across the site varies between 15mAHD-30mAHD with groundwater at surface in wetland areas and achieving a separation distance of up to 15m in higher ground.

Stormwater management within the site post development proposes a mix of detention storage and infiltration storage. Stormwater will be detained to rates specified in the Jandakot Drainage and Water Management Plan (DoW, 2009) prior to discharge into the Peel Sub 1A Drain. All other stormwater within the site will be infiltrated and where possible infrequently occurring events will discharge towards wetland areas.

This document has been prepared in accordance with the principles and objectives of Better Urban Water Management (Western Australian Planning Commission, 2008) and the Jandakot Drainage and Water Management Plan Peel Main Drain Catchment (DoW, 2009).

Implementation of the strategy will be undertaken in accordance with Better Urban Water Management through the development and implementation of Urban Water Management Plans for individual stages of development within the site.

1. Introduction

Hyd2o was commissioned by LWP Property Group to prepare this local water management strategy (LWMS) to support the local structure plan for the Casurina Central Precinct within the surburb of Casuarina.

The site is approximately 96 ha in size and located approximately 40 km southeast of the Perth central business district within the City of Kwinana (Figure 1).

The local structure plan for the site has been prepared by Taylor Burrell Barnett (TBB). The proposed residential development consists of residential lots, non-residential landuses, roads, public open space, primary school, a powerline easement, and wetland (conservation) reserve.

The proposed development of the site has considered the predevelopment environment and uses this information to inform the development of the local structure plan.

This LWMS provides an integrated total water cycle management approach to the development of the subdivision guide plan, with an assessment of the pre-development environment, development of water use sustainability initiatives, a stormwater management strategy, a groundwater management strategy and a plan for implementation.

A copy of the Better Urban Water Management (WAPC, 2008) LWMS Checklist for Developers is included as Appendix A to assist the Department of Water and Environmental Regulation (DWER) and City of Kwinana (CoK) in review of this document.

1.1 Planning Context

This site is currently zoned 'Urban' under the Metropolitan Region Scheme (2007) and zoned earmarked as 'Development' under the City of Kwinana's Town Planning Scheme No. 2 (City of Kwinana, 2018).

The urban water management planning process for the site is shown in Table 1. This LWMS supports the proposed development of the area to a residential development.

Table 1: Urban Water Management Process

Planning Phase	Planning Document	Urban Water Management Documents
MRS scheme amendment	Casuarina Cell	Casuarina District Water Management Strategy (JDA, 2013) **APPROVED**
Local	Local Structure Plan	Casuarina Central Precinct LWMS **THIS DOCUMENT**
Subdivision	Subdivision Application	Urban Water Management Plan **FUTURE PREPARATION**

1.2 Key Documents

This LWMS uses the following key documents to define its principles, criteria, objectives, and implementation responsibilities:

- Better Urban Water Management (WAPC, 2008)
- Stormwater Management Manual for WA (DoW, 2007)
- Decision Process for Stormwater Management in WA (DWER, 2017)
- Jandakot Drainage and Water Management Plan Peel Main Drain Catchment (DoW, 2009)
- Casuarina District Water Management Strategy (JDA, 2013)

2. Proposed Development

The proposed local structure plan is shown in Figure 2.

It consists of a mix of residential lots and non-residential land uses, roads, public open space, conservation area, wetland area and a primary school.

This LWMS aims to assist in maintaining the predevelopment hydrological regime of the conservation category wetlands by creating a 50m buffer outside conservation wetland areas and locating drainage infrastructure outside the buffer area and inside public open space.

The powerline easement will be utilised as a multiple use corridor by also providing drainage support for the proposed development.

This will allow POS areas to maximise their public amenity and environmentally sensitive conservation areas to be maintained.

3. Design Criteria

Key design criteria for the site are shown in Table 2 and have been established consistent with criteria specified in the key reference documents previously detailed in Section 1.2.

These design criteria are used to formulate the water management strategy for the site within the identified constraints and opportunities of the pre-development environment.

Table 2: Design Criteria

Strategy Elements	LWMS Method & Approach
Water Use Sustainability	
Water Efficiency	• Water efficiency requirements consistent with Building Codes of Australia • Maximising infiltration of stormwater where possible • "Waterwise" Public Open Space • Aim for less than 100 kL/person/year
Water Supply	• Water Corporation IWSS for lots, rainwater tanks • Minimise use of scheme water for non-drinking purposes
Wastewater	• Water Corporation reticulated sewerage
Stormwater	
Flood Protection	• Overland flow paths within road reserves identified for safe conveyance of flows exceeding pipe drainage system capacity • All discharge rates consistent with the Jandakot DWMP (DOW, 2009) • 1 in 100 year ARI event to be infiltrated within POS area or to be directed towards the conservation wetland via diffuse overland flow. • Establish minimum habitable floor levels at 0.5m above the 100 year ARI flood levels.
Serviceability	• Piped drainage system sized to convey 5 year event • 1 in 5 year ARI event to be detained or infiltrated within POS area or directed towards conservation wetland via diffuse overland flow.
Ecological Protection	• Use of soakwells at lot scale to infiltrate first 15mm on site. • Establishment of biofiltration area for treatment and infiltration of first 15mm road runoff within POS outside of wetland area and powerline easement.
Groundwater	
Fill Requirement & Subsoil Drainage	• Habitable floor levels to have clearance to groundwater through the use of sand fill. • No subsoil drainage proposed.
Acid Sulphate Soils & Contamination	• If required, management of Acid Sulphate Soils to be handled as a separate process to LWMS consistent with DoE (2004) requirements and reported in futureUWMP's.

4. Pre-Development Environment

4.1 Site Conditions

The 96 ha site is located in the vicinity of Orton Road and Landgren Road in the suburb of Casuarina in the City of Kwinana.

The site is bound to the north by Orton Road, to the east by Parks and Recreation reserve, to the south existing rural landholdings zoned for potential future development, and to the west by Kwinana Freeway (Figure 1).

The site currently consists of rural landholdings with existing buildings and sheds consistent with use as a rural property. There is some remnant vegetation on some lots across the site and some lots have been previously cleared and revegetated.

Figure 3 shows an aerial photograph with existing land use and topography.

The northern portion of the site is relatively flat, ranging from 17 mAHD to 19m AHD. There is mound in the southern portion of the site, with a maximum elevation of 30 mAHD.

4.2 Geotechnical

Environmental geology mapping on the Fremantle Part Sheet 2033 I and 2033 IV (Gozzard, 1983) is shown in Figure 4 and indicates the site is characterised by:

- S8 SAND – white to pale grey at surface, yellow at depth fine to medium-grained, moderately well sorted, subangular to subrounded quartz, of eolian origin
- S10 SAND- thin veener as S8 over, strong, blocky, brown silts and clays of the Guildford Formation.
- Cps PEATY CLAY - dark grey and black with variable sand and organic content, of lacustrine origin
- Ms5 SANDY SILT - dark brownish grey silt, with disseminated fine-grained quartz sand, firm, variable clay content, of lacustrine origin

The majority of the site can be characterised as Bassendean sand. The sections of the site characterised by peaty clay and sandy silt are also mapped as wetland. A small portion of the site on the western boundary is characterised by sand over sandy clay to clayey sand.

The lithological logs recorded by 360 Environmental during the drilling of the groundwater bores are consistent with the expected profiles based on Gozzard (1983). Lithological logs are included as Appendix B, and summarised in Table 3.

Due to current fragmented land ownership, a detailed geotechnical report for the site will be undertaken at the UWMP stage.

Table 3: Lithological Logs (360 Environmental)

Bore	Location	Soil Profile
CS01	North of Orton Rd	Clayey Sand
CS02	North of Orton Rd	Sand to Clayey Sand
CS03	North of Orton Rd	Sand
CS04	Within boundary	Sand
CS05	Within boundary	Sand
CS06	Within boundary	No description
CS07	Just outside southern boundary	Sand
CS08	Within boundary	No description

4.3 Acid Sulphate Soils

Acid Sulphate Soil (ASS) is the common name given to naturally occurring soil and sediment containing iron sulfides. These naturally occurring iron sulfides are generally found in a layer of waterlogged soil or sediment, and are benign in their natural state.

When disturbed and exposed to air, however, they oxidise and produce sulfuric acid, iron precipitates, and concentrations of dissolved heavy metals such as aluminium, iron and arsenic. Release of acid and metals as a result of the disturbance of ASS can cause significant harm to the environment and infrastructure.

The presence of ASS has been a recognised issue of concern in Western Australia since 2003. The Department of Environment and Conservation and the WAPC have released guidance notes on ASS, covering the requirement for assessing sites and the management of sites where ASS are identified. ASS investigations are commonly required as part of the conditions of subdivision or as a requirement for a dewatering license application.

The WAPC's Bulletin 64 (WAPC, 2003) ASS risk mapping for the site indicates that the majority of the site is classified as having a moderate to low ASS disturbance risk less than 3m from surface but high to moderate risk of ASS beyond 3m of natural soil surface.

WAPC (2003) mapping indicates that in some of the areas of the site mapped as wetland there is a high to moderate risk of acid sulphate soils within 3m of natural soil surface. This is typical of soil profile of wetland areas.

If further ASS investigations are required they will be undertaken as a separate process to the urban water management planning process.

4.4 Contaminated Sites

A search of the Department of Water and Environmental Regulation's Contaminated Sites Database (accessed September 18, 2018) indicates no known contaminated sites within the site.

4.5 Wetlands

The site is mapped as containing conservation category wetlands (13965, 13963, 13959, and 6679), a resource enhancement wetland (6670) and multiple use wetlands (15396 and 13962) according to the Geomorphic Wetlands of the Swan Coastal Plain Database (Landgate, 2018) (Figure 5). Areas mapped as wetland on the site generally correspond to areas also mapped as having a subsurface profile of peaty clay and sandy silt.

Multiple use wetlands pose no constraint to the proposed development.

The Johnson Rd Wetland is partially located within the south western corner of the site and extends south beyond the site boundary. Within the site it is classified as conservation but south of the site part of the wetland is classified as multiple use. Within the multiple use portion is a Main Roads detention basin designed to take runoff from the Kwinana Fwy. The basin has an outflow point to the Peel Sub O drain which travels westward under the Kwinana Fwy.

The Jandakot DWMP (DoW, 2009) includes water levels within the wetland at 11.0 mAHD.

Resource enhancement wetland (6670) located on the eastern boundary of the site has been largely cleared for rural uses. Hyd2o understands that the functionality and mapping of the wetland will be considered as part of the environmental approvals process in order to facilitate the proposed structure plan.

4.6 Surface Water

There are no natural watercourses within the site. The site has four topographic surface water catchments as shown in Figure 6. In three of the catchments (Johnson Rd East, Nicolas Rd, and Lugg Rd Nth), runoff travels as diffuse overland flow towards topographic low points. In the Landgren Rd catchment runoff is directed towards the Peel Sub P1A drain located in the north eastern area of the site.

A local arterial drainage strategy is presented in the *Jandakot Drainage and Water Management Plan* (DoW, 2009) which provides allowable discharges from each catchment post development. Extracts from DoW (2009) are contained as Appendix C.

The Johnson Rd East catchment has an allowable discharge of 0.03 m^3/s for a 1 in 100 year ARI event. This discharge is very small, likely due to the naturally compensating effect of the existing wetlands.

The Peel Sub P1A drain commences within the site and directs flow in an eastward direction to outside the site boundary prior to crossing Orton and travelling northwards to join the Peel Sub P Drain.

Water Corporation pre-development flow estimates in the Sub P1A drain are 0.21 m^3/s in the 1 in 100 year ARI event and 0.12 m^3/s in the 1 in 10 year ARI event.

The DoW (2009) Landgren Rd post development catchments are completely contained within the site area and contribute to the Peel Sub1A with a combined allowable discharge of 0.16 m^3/s post development for a 1 in 100 year ARI event. Modelling also shows that the 1 in 100 year ARI top water level in the drain upstream of Landgren Rd is 16.35 mAHD.

4.7 Groundwater

4.7.1 Groundwater Levels

The second edition of the Perth Groundwater Atlas (Department of Environment, 2004) indicates the superficial aquifer base at the site is approximately -15 mAHD and indicates a saturated thickness of approximately 26 m. Groundwater levels in the Atlas are representative of typical end of summer groundwater levels and estimate groundwater levels ranging from 11 mAHD to 16 mAHD across the site, with groundwater flow in a westerly direction.

360 Environmental installed 11 groundwater monitoring bores within the site and its immediate surrounds in 2017. Water levels in all bores were measured monthly from July 2017 to July 2018 with water quality samples taken quarterly. Groundwater monitoring data is included as Appendix D.

The estimated average annual maximum groundwater levels (AAMGL) for the site are shown in Figure 7 based on this data. Hyd2o have calculated the AAMGL by adjusting levels at site bores based on the recorded level in DWER bore T200 on 29/9/2017 referenced to its long term historical data (Table 4). DWER bore T200's long-term hydrograph is shown in Figure 8.

The AAMGL for each groundwater bore is shown in Table 5. Depth to groundwater for the site varies from at surface in the Johnson Rd wetland area to 15 m below surface in elevated areas.

The maximum groundwater level (MGL) recorded at DWER bore T200 was 20.16mAHD in 1991 which is 1.14m above the recorded water levels on site in September 2017. It should be noted that since 2000 the maximum recorded groundwater level in T200 was19.80 mAHD which is considered representative of present day rainfall trends.

Table 4: AAMGL DWER BoreT200

Bore	Period of Record	Groundwater Level (mAHD) 29/09/2017	AAMGL (mAHD)	Correction Factor (m)	MGL (mAHD)	Correction Factor (m)
T200	1990 - 2017	19.02	19.43	+0.11	20.16	+1.14
Correction Factors for Site Bores				+0.11		+1.14

Table 5: AAMGL Site Bores

Bore	Natural Surface (mAHD)	Groundwater Level (mAHD) 29/09/17	Applied Correction Factor (m)	AAMGL (mAHD)	Depth Below Natural Surface (m)
CS01	14.97	14.59	+0.11	15.00	At surface
CS02	16.31	15.07	+0.11	15.48	0.83
CS03	17.62	15.87	+0.11	16.28	1.34
CS04	18.25	15.03	+0.11	15.44	2.81
CS05	18.23	15.75	+0.11	16.16	2.07
CS06	19.02	15.01	+0.11	15.42	3.6
CS07	18.50	15.81	+0.11	16.22	2.28
CS08	22.40	13.28	+0.11	13.69	8.71
CS09	17.71	14.80	+0.11	15.21	2.5
CS10	19.82	15.63	+0.11	16.04	3.78
CS11	20.76	15.78	+0.11	16.19	4.57

4.7.2 Groundwater Quality

Groundwater quality samples were taken from bore CS03, CS06, CS09, and CS11 quarterly between July 2017-July 2018. A total of four groundwater quality sampling occasions were undertaken. Detailed groundwater quality results are included in Appendix D and summarised in Table 6 and below comparison to ANZECC (2000) guidelines for lowland rivers in the southwest of Australia:

- Mean pH ranged from 4.66 to 5.77, below the ANZECC guideline range of 6.5 to 8.0 pH.
- Mean EC ranged from 0.28 mS/cm to 0.57 mS/cm which is above the ANZECC guideline range of 0.12 mS/cm to 0.30 mS/cm. Groundwater within the site is considered as fresh.

- Mean TN ranged from 3.45 mg/L to 5.58 mg/L which is above the ANZECC guideline concentration of 1.2 mg/L.
- Mean TP ranged from 0.08 mg/L to 0.4 mg/L. These values exceed the ANZECC guideline of 0.065 mg/L.

Whilst TN and TP concentrations are above the ANZECC guidelines, they represent typical groundwater nutrient values for the Swan Coastal Plain for land that has been historically used for farming purposes.

Table 6: Predevelopment Groundwater Quality

		Groundwater Bores			
Parameter	**ANZECC**	**CS03**	**CS06**	**CS09**	**CS11**
EC (mS/cm)	0.12 – 0.30	0.57	0.31	0.44	0.28
pH	6.5 – 8.0	5.77	4.66	5.00	5.64
TN (mg/L)	1.2	3.85	3.45	4.10	5.58
TP (mg/L)	0.065	0.23	0.08	0.40	0.10
TKN (mg/L)	-	3.73	1.0	3.65	0.93
Ammonia (mg/L)	0.08	0.19	0.08	0.08	0.03
Nitrite as N (mg/L)	-	0.01	0.01	0	0.01
Nitrate as N (mg/L)	-	0.14	0.65	0.13	4.98

5. Water Use Sustainability Initiatives

5.1 Water Efficiency Measures

Water conservation measures will be implemented within the development and will be consistent with Water Corporation's "Waterwise" land development criteria, and include:

- Promotion of use of waterwise practices including water efficient fixtures and fittings (taps, showerheads, toilets and appliances, rainwater tanks, waterwise landscaping).
- Water efficiency consistent with Building Codes of Australia.
- Use of groundwater bores for irrigation of public open space.
- Maximising on site retention of stormwater.

Agreed water conservation measures and locations will be detailed at the UWMP stage.

5.2 Water Supply

The Water Corporation's Integrated Water Supply System (IWSS) will supply potable water to the future homes on the site.

Landscape planning undertaken by Emerge Associates is included as Appendix E. The site is located within the Serpentine (Superficial-Swan) Groundwater Management Area (GMA), Jandakot Mound 1 groundwater sub area. DoW's online Water Register for Licence and Water Availability Information indicates that the superficial aquifer is not fully allocated within this sub area and therefore water is available should this be required for irrigation or construction purposes.

The development proposes 5.8ha of public open space and will require a maximum of 39,500 kL/annum of groundwater for irrigation.

The following groundwater licences are already operational within the site and will be investigated for transfer to the future urban development.

Table 7: Current Groundwater Allocations with the Site

GW Licence	Property	Allocation kL	Expiry	Location
163411	41 Landgren Rd Casuarina	4920 (1 bore)	20/9/2027	Within Boundary
108183	Lot 33 On Plan 8390 Volume/Folio 1308/437 Lot 33 Landgren Rd Casuarina	36500 (1 bore)	7/4/2024	Within Boundary
48591	Lot 32 On Plan 8390 Volume/Folio 1411/394 Lot 32 Orton Rd Casuarina	18000 (3 bores)	29/5/2023	On Boundary

5.3 Wastewater Management

Wastewater will be deep sewerage (reticulated) with management by Water Corporation.

6. Stormwater Management Strategy

Stormwater management will be undertaken consistent with DWER water sensitive design practices. The system will consist of lot soakwells, piped road drainage system, biofiltration areas, and stormwater storage detention and infiltration areas.

Key elements of the system which are reflected in the local structure plan include:

- Maintenance of existing conservation category wetlands within the site with all stormwater infrastructure located outside of the wetland buffers.
- Promotion of infiltration through the soil profile.
- Discharge of 1 in 100 year events consistent with the Jandakot DWMP (DoW, 2009).

The stormwater management concept and post development catchment mapping for the site is shown in Figure 9. Six main stormwater catchments have been identified in consultation with project engineers Cossill & Webley, five of which are catchments which infiltrate and one which discharges towards the Peel Sub P1A drain.

6.1 Stormwater Modelling

Stormwater modelling for the site was performed using XP-Storm and PONDS to determine flood storage requirements and provide an assessment of local structure plan areas required for drainage purposes.

Recent updates to Australian Rainfall and Runoff (Ball et al, 2016) have resulted in changes in terminology being recommended to describe design rainfalls. Generally, Exceedance per Year (EY) terminology is recommended to be used for very frequent design rainfalls, Annual Exceedance Probability (AEP, %) terminology used for frequent and infrequent design rainfalls, and AEP (1 in x) terminology used for rare design rainfalls. For the purpose of this report however, Average Rainfall Interval (ARI) terminology has been used for all design rainfalls to align the report and its assessment against existing local authority and state government agency criteria and publications.

It should be noted Australian Rainfall and Runoff 1987 (as per Institution of Engineers Australia, 2003) was used in the stormwater modelling for this report rather than the recently released Australian Rainfall and Runoff 2016 (Ball et al., 2016). This approach has been adopted as flows and levels from the Jandakot DWMP (DoW, 2009) were based on Australian Rainfall and Runoff 1987 in its preparation. Design rainfalls for AR&R 2016 are broadly similar to the 1987 design rainfalls.

The design storms modelled by XP-Storm were based on methodology in Australian Rainfall & Runoff (Institution of Engineers Australia, 1987) and the Bureau of Meteorology Computerised Design IFD Rainfall System. The rainfall temporal pattern was assumed to be spatially uniform, and storm durations modelled ranged from 1 to 72 hours

Runoff rate adopted for modelling are based on Hyd2o's CURRV runoff rate generator and is attached as Appendix F.

6.2 Flood Protection (100 year ARI)

Modelled storage volumes, areas, flood rise and inverts are detailed in Table 8 and Figure 9 for the 100 year ARI flood events.

Stormwater storage is proposed as follows:

- Catchments A & C will infiltrate all events on site within POS.
- Catchment B will retain the 100 year ARI to outflow rates specified in the Jandakot DWMP (DoW,2009) prior to discharge to the Peel Sub P1A drain.
- Catchment D will infiltrate and retain the first 15mm on site within POS and discharge the remaining to the powerline easement for infiltration.
- Catchment E & F infiltrate the first 15mm in POS outside the wetland buffer prior to discharging greater events towards the wetland.

The minimum habitable building floor levels will comply with requirements for a 0.5 m clearance above estimated 100 year ARI flood levels as shown in Table 8.

Table 8: Stormwater Management

Catchments	A	B	C	D		E	F
Lots (ha)	4.90	9.08	0.22	17.85		6.28	0.00
Non Residential (ha)	0.00	0.00	0.00	0.00		0.00	6.29
Road Reserve (ha)	2.32	5.02	0.20	8.48		2.87	2.34
POS (ha)	0.37	2.56	0.00	3.78		0.32	0.16
Total Contrib Area (ha)	7.59	16.66	0.42	30.11		9.47	8.79
100 year ARI EIA (ha)	4.07	8.44	0.26	15.22		5.10	5.77
15mm EIA(ha)	1.60	3.46	0.14	5.85		1.98	1.62
Storage Parameters				1 year	5 &100 year		
AAMGL	16.2	16.2	16.0	15.0	15.0	14.0	14.2
Base RL (mAHD)	17.2	16.9	17.6	15.5	15.5	16.1	15.2
Base Area (m^2)	1050	2875	50	1650	9540	500	170
Side slopes	6	6	6	6	6	6	6
15mm							
TWL (mAHD)	17.53	17.20	17.72	15.80	-	16.40	15.50
Volume (m^3)	149	538	7.4	542	-	175	145
TWL Area (m^2)*	450	1750	74	1969	-	675	799
5 year ARI							
TWL (mAHD)	17.67	17.83	17.99	Overflow to powerline	15.92	Overflow to Wetland	Overflow to Wetland
Volume (m^3)	585	4198	36		4282		
TWL Area (m^2)	1448	6570	142		10861		
Critical Storm (hrs)	12	36	3		72		
Peak Outflow (m^3/s)	-	0.17	-		-		
100 year ARI							
TWL (mAHD)	18.18	18.16	18.16	Overflow to powerline	16.49	Overflow to wetland	Overflow to wetland
Volume (m^3)	1448	5671	64		11002		
TWL Area (m^2)	1952	7343	196		12734		
Critical Storm (hrs)	12	24	1		24		
Peak Outflow (m^3/s)	-	0.19	-	-	-	-	-

***** 15mm modelled in steep side basin with 0.3m depth

6.3 Ecological Protection (15 mm)

Storm volumes for ecological protection based on the first 15 mm event are provided in Table 8 to provide a guide for storage requirements. Volumes will be refined at UWMP stage on the basis of more detailed modelling in parallel with engineering design.

Table 9 details a summary from the Stormwater Management Manual for Western Australia (DoW, 2007) of expected pollutant removal efficiencies for various WSUD measures in relation to water quality design criteria contained in WAPC (2008).

While DoW (2007) does not provide expected pollutant removal efficiencies for all best management practices (BMPs), application of a treatment train approach using a combination of the non-structural and structural measures will therefore clearly achieve the design objectives for water quality for the site.

Table 9: BMP Water Quality Performance in Relation to Design Criteria

Water Quality Parameter	WAPC (2008) Design Criteria (required removal as compared to a development with no WSUD)	Structural Controls Nutrient Output Reduction [1]	
		Bioretention Systems	Detention/ Retention Storages
Total Suspended Solids	80%	80%	65-99%
Total Phosphorus	60%	60%	40-80%
Total Nitrogen	45%	50%	50-70%
Gross Pollutants	70%	-	>90%

1. Typical Performance Efficiencies via DoW (2007)

7. Groundwater Management Strategy

7.1 Fill and Subsoil Drainage

Development levels in the site will be largely dominated by fill requirements to achieve adequate separation to groundwater, given the proximity of groundwater levels to natural surface. Current available engineering earthworks drawings are included as Appendix G.

While it is not envisaged that subsoil drainage will be required within the development, should localised subsoil drainage be required to manage groundwater within the stormwater storage areas this will be investigated at detailed design stage.

Finished lot levels and fill requirements are a detailed design issue to be addressed during the preparation of detailed engineering design drawings and preparation of the UWMP and will be ultimately submitted for council approval at that stage.

7.2 Acid Sulphate Soils

Acid sulphate soil mapping has been previously discussed in Section 3.2.1 as ranging from a high to low risk with mapping shown on Figure 4.

Management of acid sulphate soils (ASS) will be addressed by a separate study to this LWMS if required depending on excavation depths for engineering services. Details regarding the outcomes of any ASS studies required will be included as part of the UWMP.

All assessment and management of ASS will be conducted in accordance with the Acid Sulphate Soil Guideline Series Identification and Investigation of Acid Sulphate Soils (DoE, 2004).

8. Urban Water Management Plans

Consistent with processes defined in WAPC (2008), an Urban Water Management Plan (UWMP) will be developed and submitted to support subdivision applications for various stages of development within the site. UWMP's will address:

- Demonstrated compliance with LWMS criteria and objectives to the satisfaction of City of Kwinana and DWER.
- Agreed/approved measures to achieve water conservation and efficiencies of water use.
- Detailed stormwater management design including refining stormwater modelling detailed in the LWMS.
- Management of groundwater levels including proposed fill levels.
- Specific structural and non-structural BMPs and treatment trains to be implemented including their function, location, maintenance requirements, expected performance and agreed on going management arrangements.
- Management of subdivisional works.
- Implementation plan including roles, responsibilities, funding and maintenance arrangements.
- Specific monitoring and reporting to be undertaken consistent with the monitoring program defined in the LWMS.
- Contingency plans (where necessary).

More detail of the POS and stormwater storage integration will be provided during the development of the UWMP, including refinement of stormwater modelling, preparation of landscape plans (species selection and treatments), and detailed design drawings.

Preparation of the UWMP will be the responsibility of the developer.

9. Monitoring

9.1 Pre Development

Additional predevelopment monitoring is not anticipated for the purpose of informing the UWMP and subdivision process. If any further monitoring is required this will serve to inform engineering design rather than to satisfy government agency requirements.

9.2 Post Development

Post development groundwater monitoring locations and parameters are detailed in Figure 10 and Table 10.

Department of Water (2012) indicates a minimum of 3 years post development monitoring is required, and defines post development as "*from completion of first subdivision to five years after 80 per cent of the development (by land area) has been completed*".

The program is therefore designed to operate over a three year post development period, with the timing for commencement of the program to be negotiated at UWMP stage with DWER and the City of Kwinana.

The program may need to be modified as data is collected to increase or decrease the monitoring effort in a particular area, or to alter the scope of the program itself. Any modification to the program would be identified through review of the collected data and would require the agreement of all parties (DWER, City of Kwinana, and developer).

All water quality testing will be conducted by a NATA approved laboratory.

Table 10: Post Development Monitoring Program

Monitoring	Parameter	Location	Method	Frequency and Timing
Groundwater	Water Level (m AHD)	4 site bores + DoW bore	Electrical depth probe or similar	Quarterly
	pH, EC, Nitrogen, Phosphorus	4 site bores	Pumped bore sample	Quarterly (Jan, Apr, Jul & Oct)
Stormwater	pH, EC, TSS Nitrogen Phosphorus	1 location in retention storage	Collected grab sample	Nominally 2 times per year in winter when/if water present.
Stormwater	Performance Assessment-	5 location in infiltration storages	Visual Inspection	Nominally 2 times per year in winter.

10. Implementation

Table 11 details the roles, responsibilities and funding to implement the LWMS for this site.

Any modification required to the LWMS would be identified through the UWMP process and would require the agreement of all parties (DWER, City of Kwinana, and developer).

Given the size of the site and likely development timeframes, monitoring outcomes will be used in a continual improvement capacity to review the implemented WSUD within the site with outcomes used to inform future planning and design approaches for subsequent developments in the area.

Specific maintenance responsibilities will be detailed at the UWMP stage. It is envisaged that the schedule for maintenance works will be consistent with typical requirements of the City of Kwinana.

Table 11: Implementation Responsibility

Implementation Action	Responsibility & Funding	
	Developer	**City of Kwinana**
Preparation of UWMP	☑	
Review & Approval of UWMP		☑
Construction of Stormwater System	☑	
Post Development Monitoring Program	☑	
Operation & Maintenance		
a) Prior to Handover	☑	
b) Following Handover		☑

11. References

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FIGURES

Date: 13/11/2018 Job No. H180I9Av1



Site

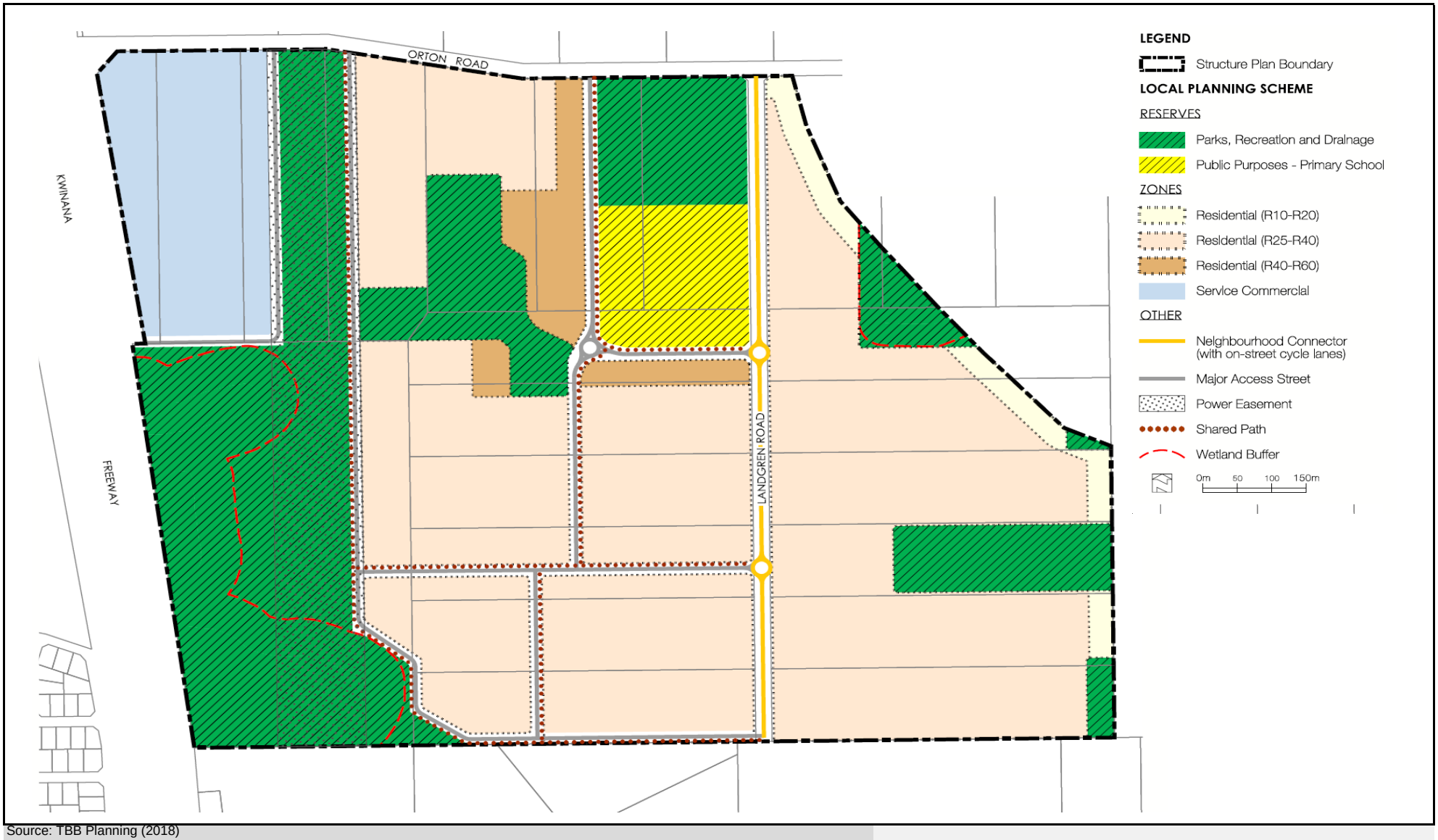
hyd2o

Casuarina Central Precinct LWMS

Location Plan

Figure 1

Date : 3/12/2018 Job No: H18019



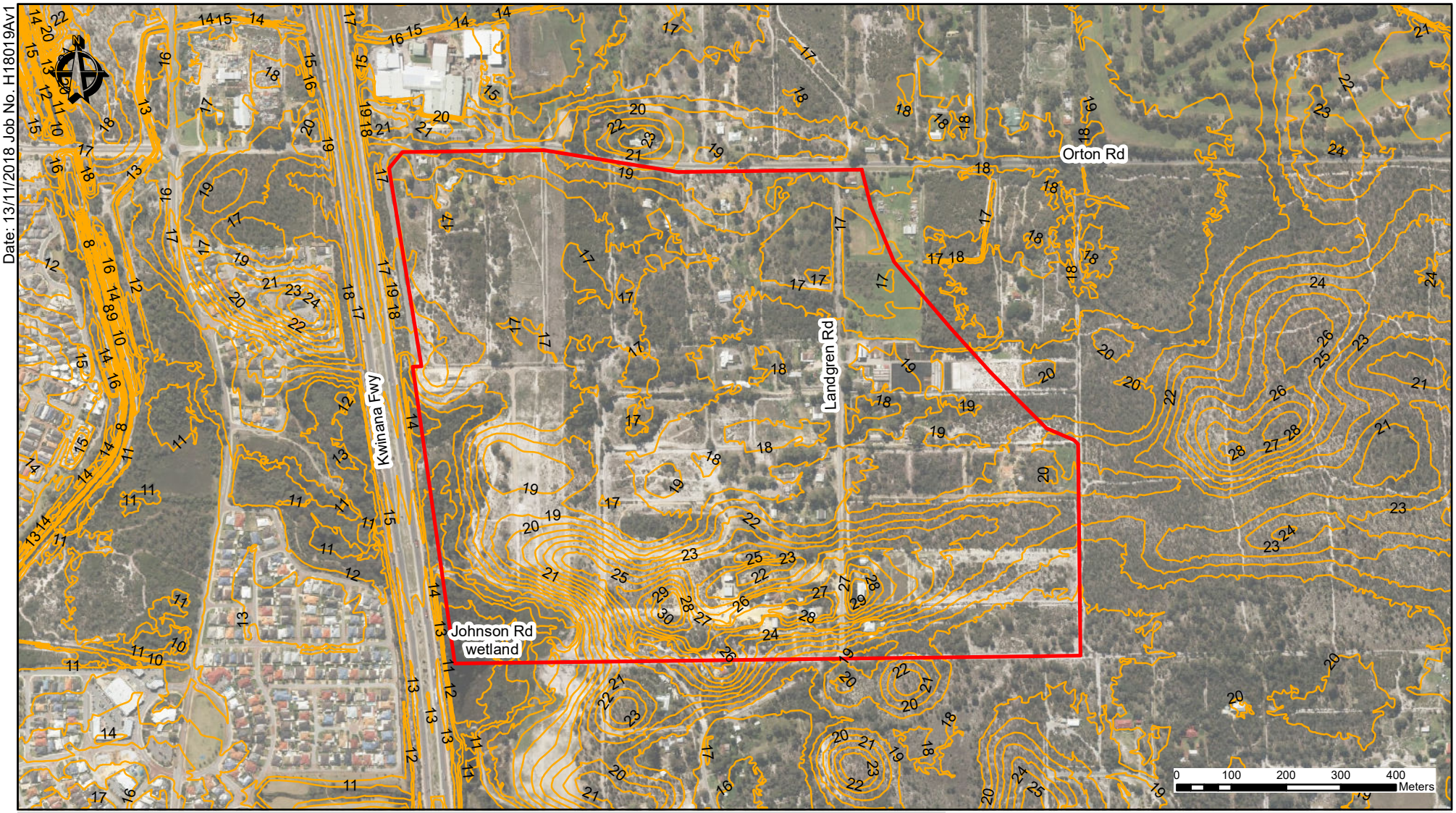
Source: TBB Planning (2018)

hyd2o

Casuarina Central Precinct LWMS

Local Structure Plan

Figure 2



Site

Topography (mAHD)

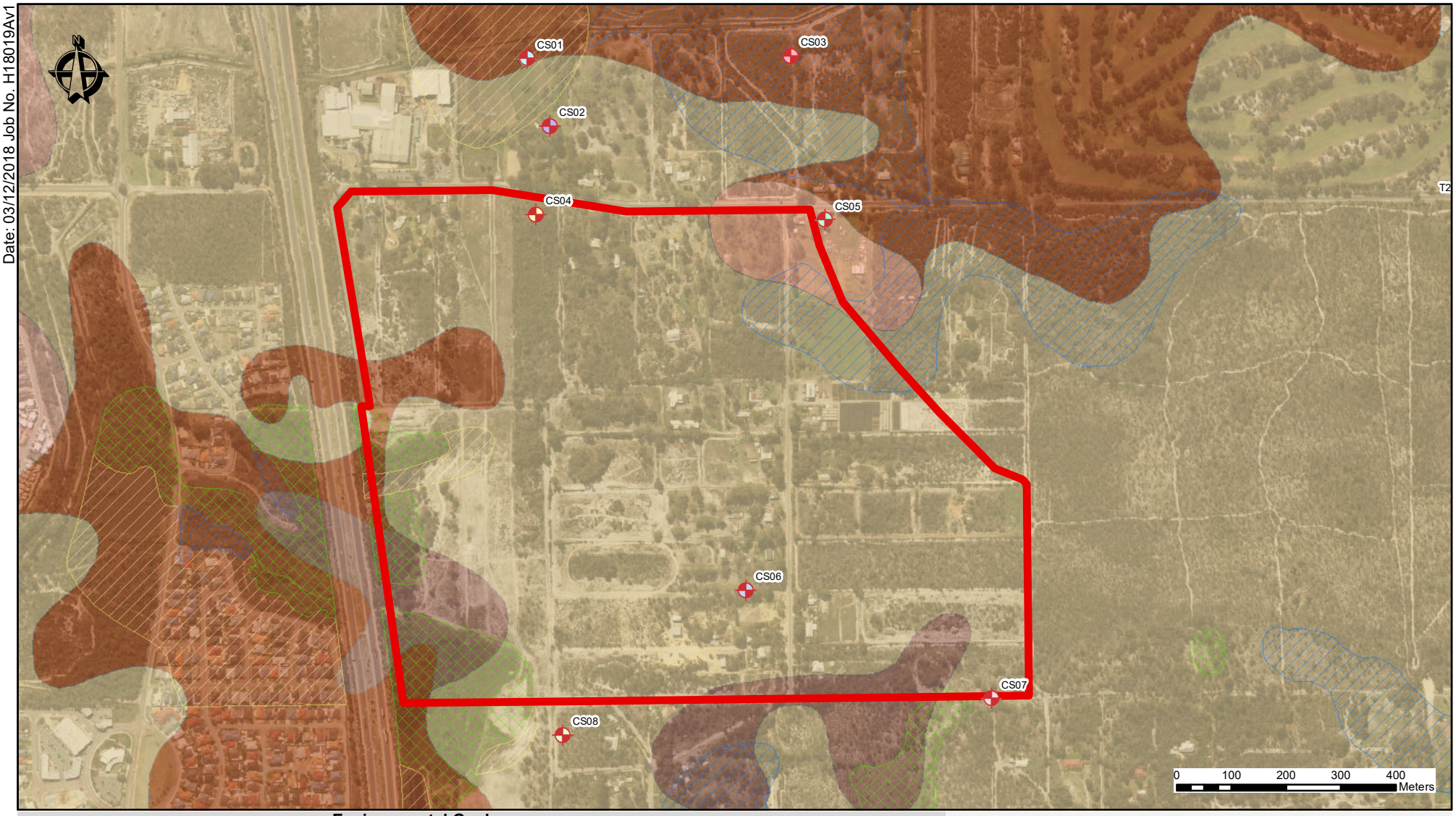
hyd2o

Casuarina Central Precinct LWMS

Site Conditions

Figure 3

Date: 03/12/2018 Job No. H180019Av1



Site

Wetlands

- Conservation
- Multiple Use
- Resource Enhancement

Environmental Geology

- S8 - Sand
- S10 - Sand over Sandy Clay
- Cps - Peaty clay (lacustrine origin)
- Ms5 - Sandy Silt

Groundwater Monitoring Bore

hyd2o

Casuarina Central Precinct LWMS

Environmental Geology Plan

Figure 4

Date: 3/12/2018 Job No. H18019Av1



Wetlands

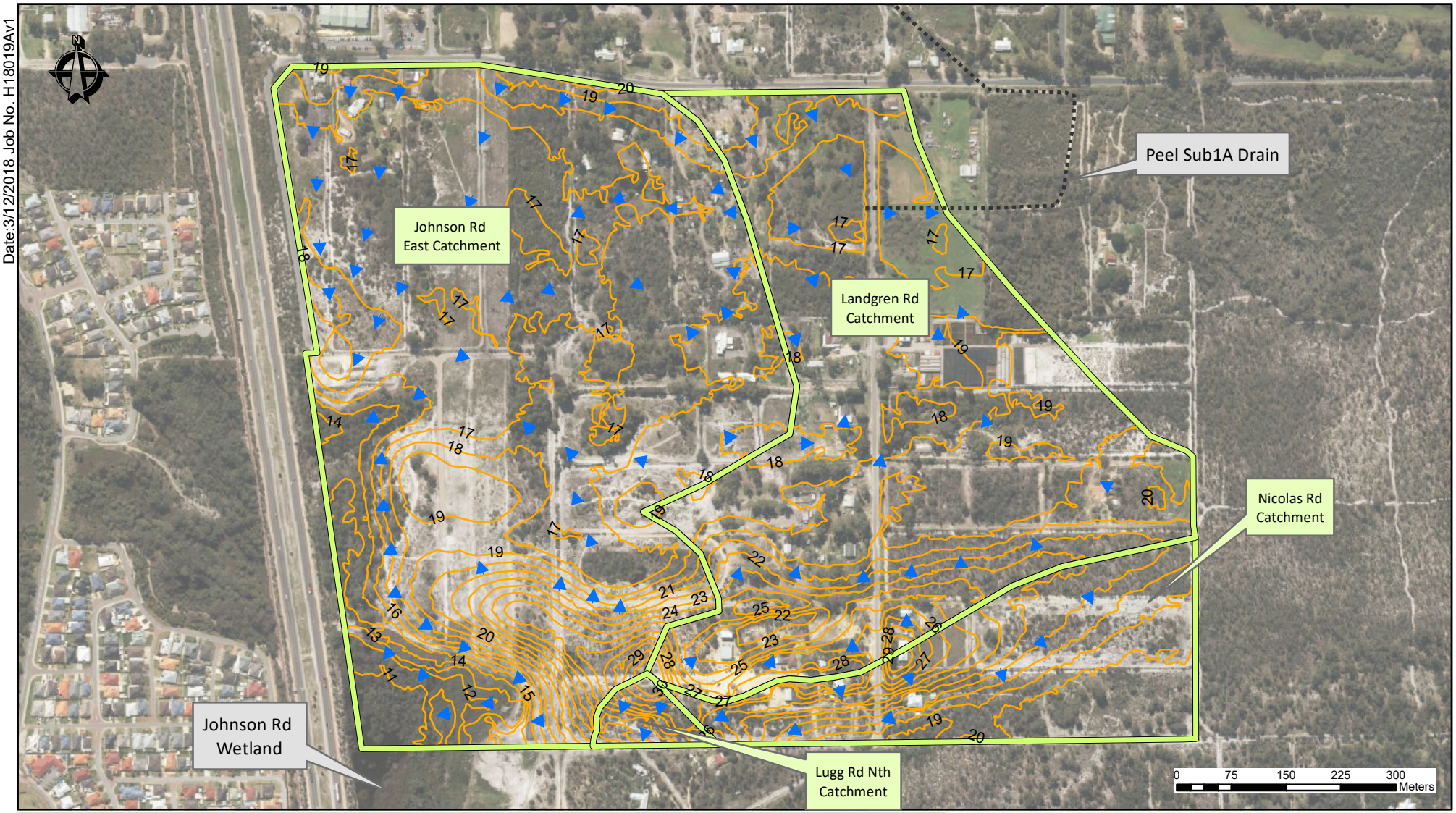
- Conservation
- Multiple Use
- Resource Enhancement

hyd2o

Casuarina Central Precinct LWMS

Wetland Plan

Figure 5



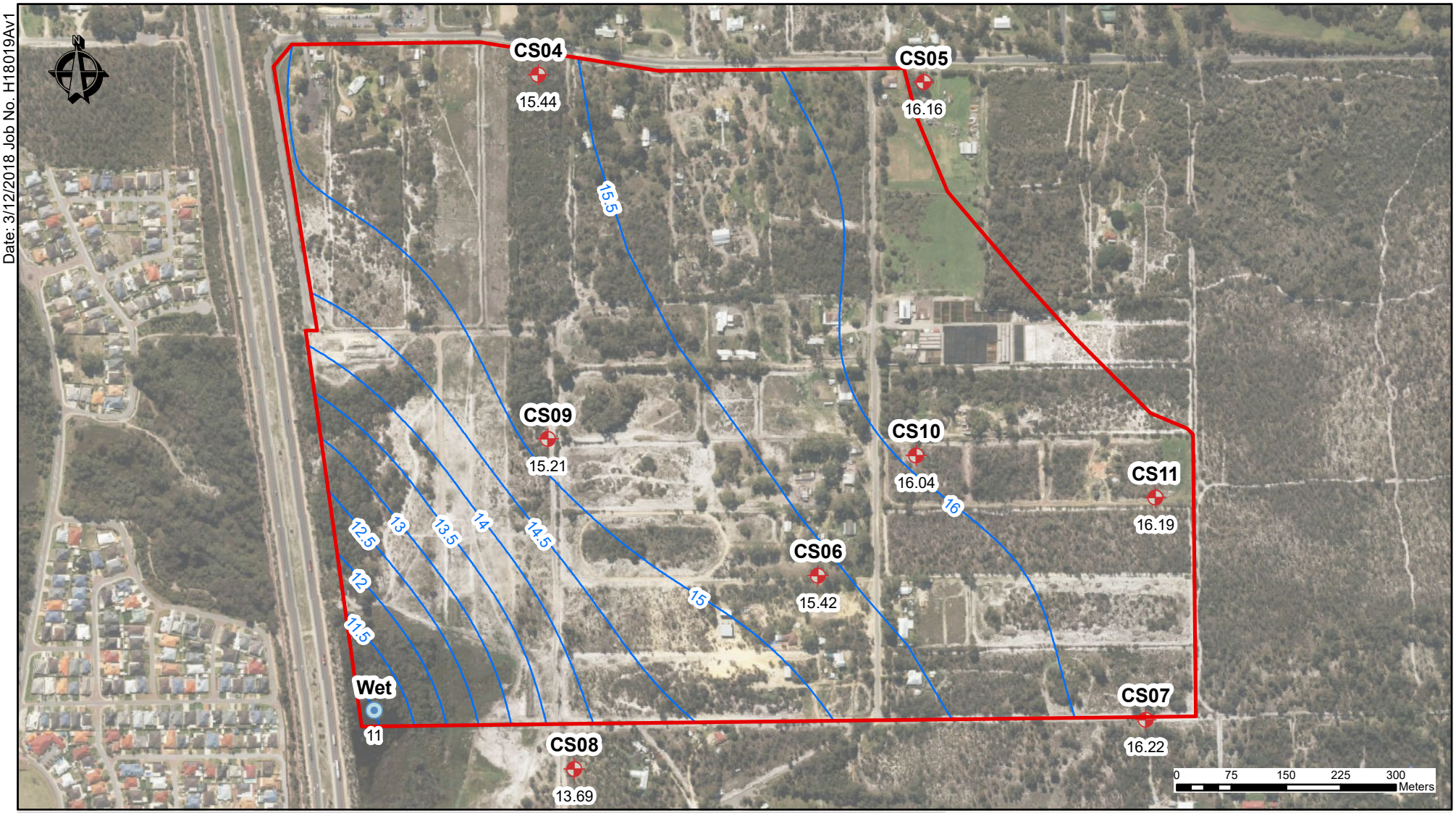
hyd2o

Casuarina Central Precinct LWMS

Surface Water Plan

Figure 6

Date: 3/12/2018 Job No. H18019Av1



Site

Groundwater Monitoring Bores

Wetland Water Level (DoW, 2009)

AAMGL

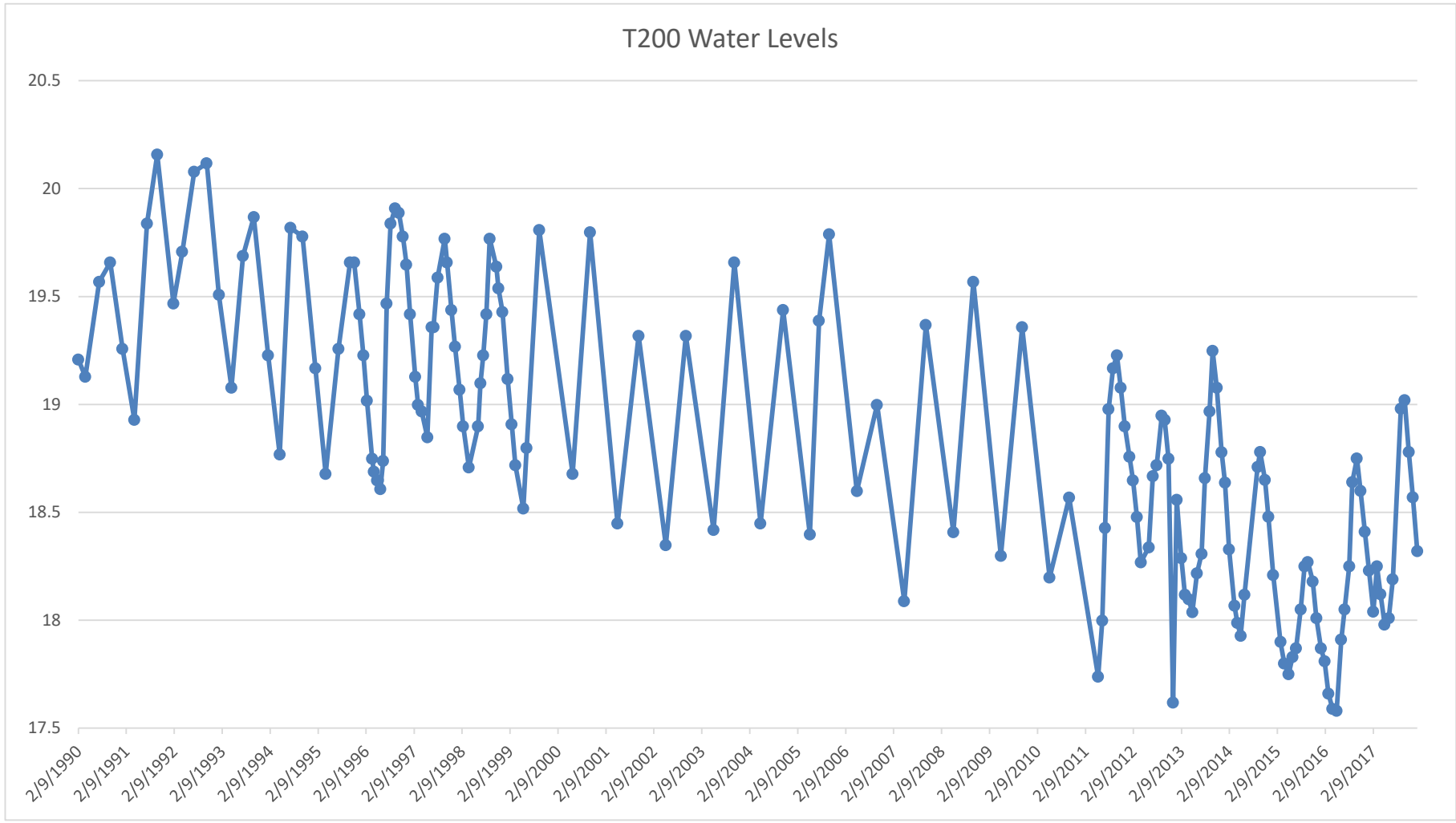
hyd2o

Casuarina Central Precinct LWMS

Groundwater Plan

Figure 7

Date : 13/11/2018 Job No: H18019



Source: DWER (2018)

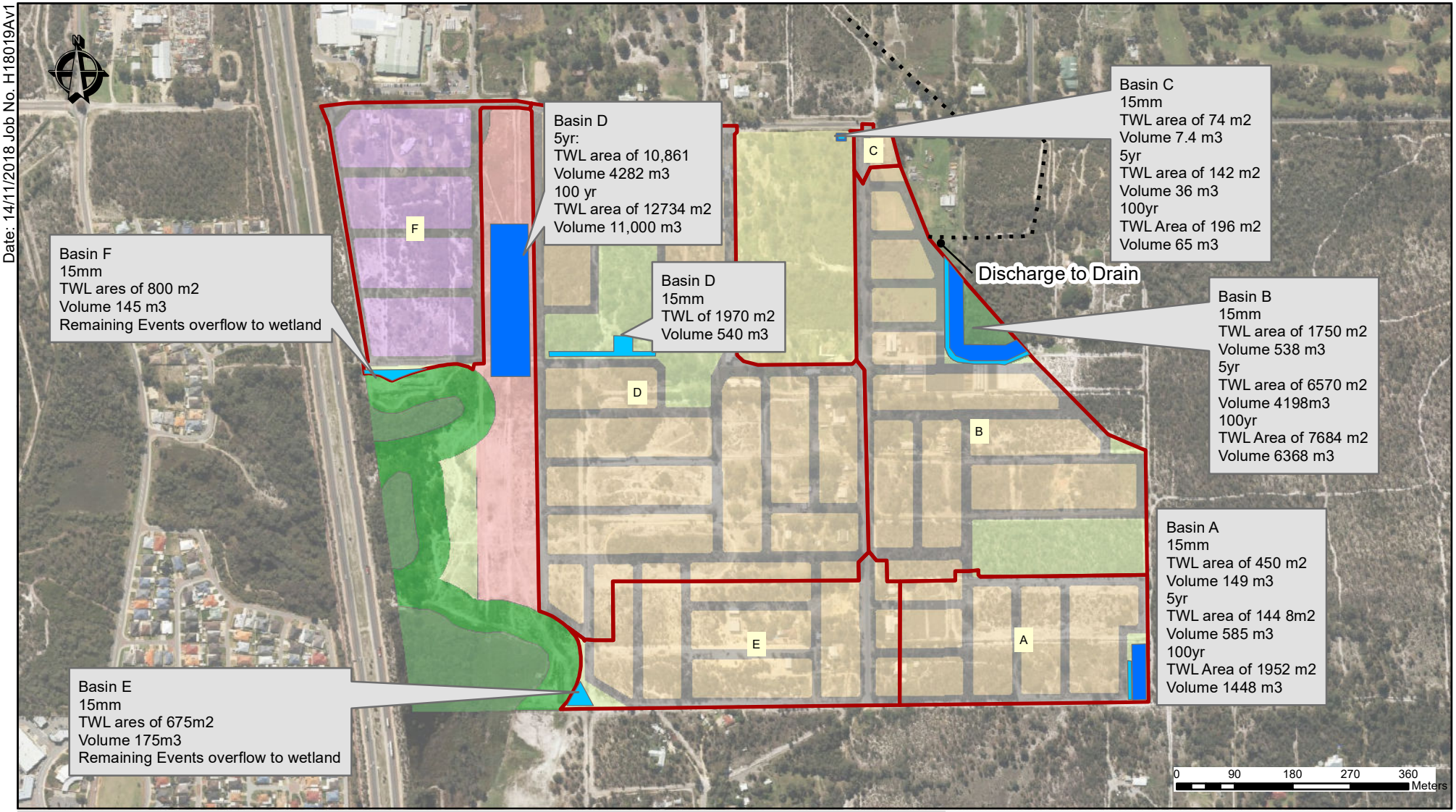
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Casuarina Central Precinct: LWMS

T200 DWER Bore Hydrograph

Figure 8

Date: 14/11/2018 Job No. H18019Av1



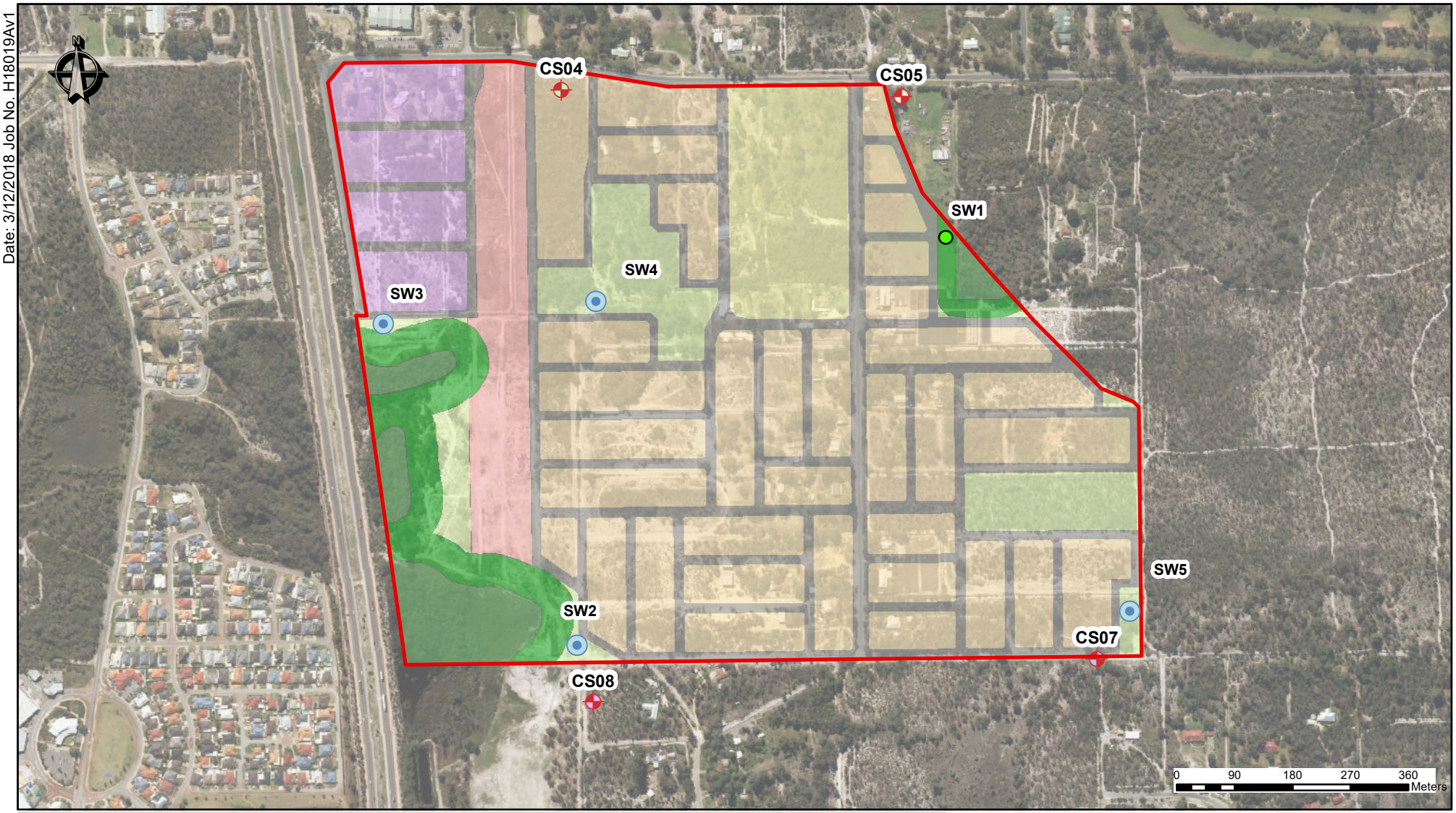
15mm Stormwater areas
100yr Stormwater Areas
Catchments (C&W)

Landuse

Easement
NonResidential
POS
Residential
Road
School
Wetland
Wetland Buffer

hyd2o
Casuarina Central Precinct LWMS
Stormwater Management Plan
Figure 9

Date: 3/12/2018 Job No. H18019Av1



Site

Post- Development Groundwater Bores

Post Development Stormwater Quality

Post Development Stormwater Performance Inspection

hyd2o

Casuarina Central Precinct LWMS

Post Development Monitoring Plan

Figure 10

APPENDIX A
LWMS Checklist for Developers

APPENDIX B
Lithological Logs

GROUNDWATER MONITORING WELL

PROJECT: Casuarina Monitoring	Bore Identification: *CS01*	Sheet: ***1*** *of 1*
PROJECT #: *2332*	AOPC:	Date Logged: *20170728*
Project Manager: *JJ*	PROJECT Location: *Casuarina*	
Client:	Zone: *MGA94 50* Easting: *392183*	Northing: *6432923*
Drilled by: *SWD*	Casing Diameter (mm):	Top of Casing (mAHD):
Drill Type: *HSA*	Drilling Method: *HSA*	

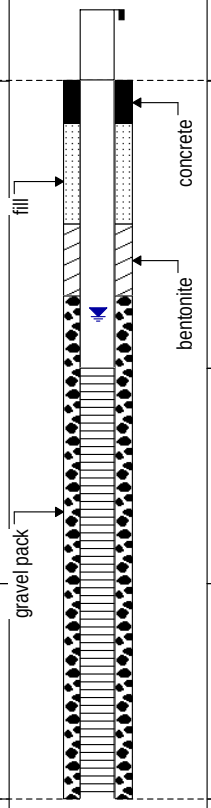
SOIL DESCRIPTION	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	WELL CONSTRUCTION	MOISTURE	FIELD MONITORING	SAMPLE INTERVALS
Ground Surface	0.0						
SC clayey SAND, dark Brown, fine to medium grained, well graded, subangular			SC	concrete, bentonite	M	organic matter	
CH sandy CLAY, Brown, fine to medium grained, high plasticity	1.0		CH				
SC clayey SAND, Brown, fine to medium grained, well graded	2.0		SC	gavel pack	W		
SC clayey SAND, light Grey, fine to medium grained, well graded, subangular	3.0						
SC clayey SAND, dark Brown, fine to medium grained, well graded	4.0						
End of Log	5.0						
	6.0						
	7.0						

Logged by: *LZ*
Checked by: *JJ*

GROUNDWATER MONITORING WELL

PROJECT: Casuarian Monitoring	Bore Identification: *CS02*	Sheet: ***1*** *of 1*
PROJECT #: *2332*	AOPC:	Date Logged: *20170728*
Project Manager: *JJ*	PROJECT Location: *Casuarina*	
Client:	Zone: *MGA94 50* Easting: *392220*	Northing: *6432796*
Drilled by: *SWD*	Casing Diameter (mm):	Top of Casing (mAHD):
Drill Type: *HSA*	Drilling Method: *HSA*	

SOIL DESCRIPTION	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	WELL CONSTRUCTION	MOISTURE	FIELD MONITORING	SAMPLE INTERVALS
Ground Surface	0.0						
SW SAND, dark Brown, fine to medium grained, well graded						roots	
SW SAND, light Grey, fine to medium grained, well graded, subrounded	1.0				M		
SW SAND, dark Grey, fine to medium grained, well graded, subrounded	2.0		SW				
SW SAND, light Grey, fine to medium grained, well graded, subrounded	3.0				M/W		
SC clayey SAND, dark Brown, fine to medium grained, well graded	4.0		SC		W		
End of Log	5.0						
	6.0						
	7.0						



Logged by: *LZ*
Checked by: *JJ*

GROUNDWATER MONITORING WELL

PROJECT: Casuarina Monitoring	Bore Identification: *CS03*	Sheet: ***1*** *of 1*
PROJECT #: *2332*	AOPC:	Date Logged: *20170728*
Project Manager: *JJ*	PROJECT Location: *Casuarina*	
Client:	Zone: *MGA94 50* Easting: *392659*	Northing: *6432950*
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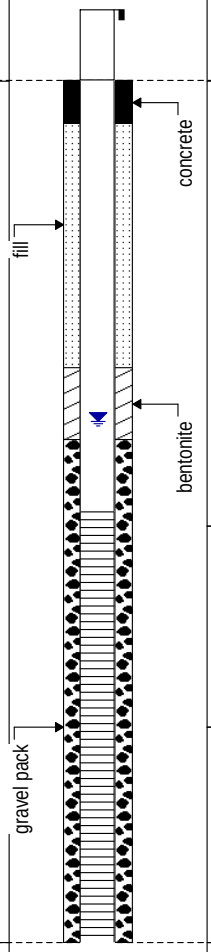
SOIL DESCRIPTION	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	WELL CONSTRUCTION	MOISTURE	FIELD MONITORING	SAMPLE INTERVALS
Ground Surface	0.0						
SW SAND, dark Brown, white mottling,fine to medium grained, well graded					M	roots to 5cm	
SW SAND, brown/grey, fine to medium grained, well graded, subrounded	1.0 2.0 3.0 4.0 5.0 6.0		SW	concrete fill bentonite gravel pack	M/W W		
End of Log	7.0						

Logged by: *LZ*
Checked by: *JJ*

GROUNDWATER MONITORING WELL

PROJECT: Casuarian Monitoring	Bore Identification: *CS04*	Sheet: ***1*** *of 1*
PROJECT #: *2332*	AOPC:	Date Logged: *20170728*
Project Manager: *JJ*	PROJECT Location: *Casuarina*	
Client:	Zone: *MGA94 50* Easting: *392191*	Northing: *6432630*
Drilled by: *SWD*	Casing Diameter (mm):	Top of Casing (mAHD):
Drill Type: *HSA*	Drilling Method: *HSA*	

SOIL DESCRIPTION	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	WELL CONSTRUCTION	MOISTURE	FIELD MONITORING	SAMPLE INTERVALS
Ground Surface	0.0						
SW SAND, dark Grey, fine to medium grained, well graded, subrounded							
SW SAND, light Grey, fine to medium grained, well graded, subrounded	1.0						
SW SAND, white, grey mottling, fine to medium grained, well graded, subrounded	2.0				M		
SW SAND, dark Brown, fine to medium grained, well graded, subrounded	3.0		SW				
	4.0				M/W		
SW SAND, light Grey, fine to medium grained, well graded, subrounded	5.0				W		
	6.0						
End of Log	7.0						

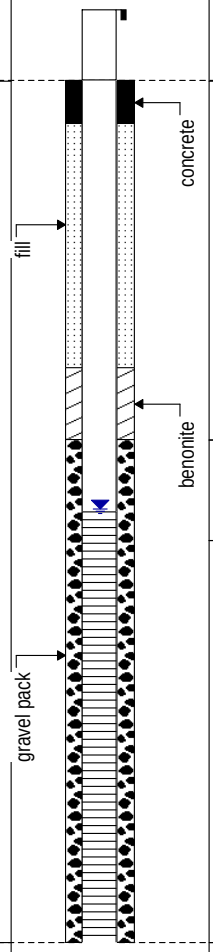


Logged by: *LZ*
Checked by: *JJ*

GROUNDWATER MONITORING WELL

PROJECT: Casuarina Monitoring	Bore Identification: *CS05*	Sheet: ***1*** *of 1*
PROJECT #: *2332*	AOPC:	Date Logged: *20170728*
Project Manager: *JJ*	PROJECT Location: *Casuarina*	
Client:	Zone: *MGA94 50* Easting: *392725*	Northing: *6432639*
Drilled by: *SWD*	Casing Diameter (mm):	Top of Casing (mAHD):
Drill Type: *HSA*	Drilling Method: *HSA*	

SOIL DESCRIPTION	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	WELL CONSTRUCTION	MOISTURE	FIELD MONITORING	SAMPLE INTERVALS
Ground Surface	0.0						
SW SAND, dark Grey, white mottling, fine to medium grained, well graded, subrounded							
SW SAND, light Grey, fine to medium grained, well graded, subrounded	1.0				M		
SW SAND, dark Grey, fine to medium grained, well graded, subrounded	2.0						
SW SAND, Brown, fine to medium grained, well graded, subrounded	3.0		SW		M/W		
	4.0				W		
	5.0						
	6.0						
End of Log	7.0						

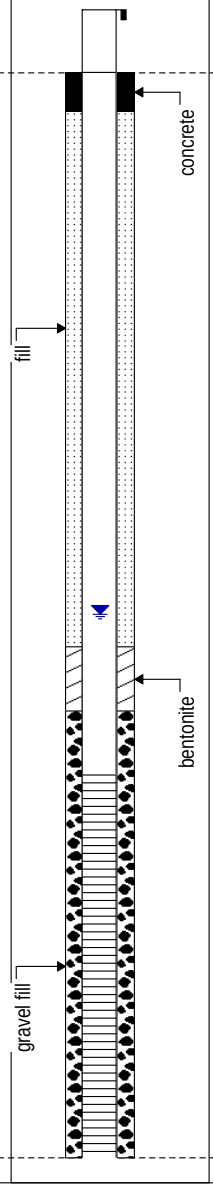


Logged by: *LZ*
Checked by: *JJ*

GROUNDWATER MONITORING WELL

PROJECT: Casuarina Monitoring	Bore Identification: *CS06*	Sheet: ***1 of 1***
PROJECT #: *2332*	AOPC:	Date Logged: *20170908*
Project Manager: *JJ*	PROJECT Location: *Casuarina*	
Client:	Zone: *MGA94* Easting: *392576*	Northing: *6431950*
Drilled by: *SWD*	Inner Diameter (mm):	Elevation (mAHD): *0*
Drill Type: *HSA*	Drilling Method:	

SOIL DESCRIPTION	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	WELL CONSTRUCTION	MOISTURE	FIELD MONITORING	SAMPLE INTERVALS / PID (ppm)
Ground Surface	0.0						



Logged by:
Checked by:

GROUNDWATER MONITORING WELL

PROJECT: Casuarina Monitoring	Bore Identification: *CS07*	Sheet: ***1*** *of 1*
PROJECT #: *2332*	AOPC:	Date Logged: *20170728*
Project Manager: *JJ*	PROJECT Location: *Casuarina*	
Client:	Zone: *MGA94 50* Easting: *393018*	Northing: *6431746*
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Drill Type: *HSA*	Drilling Method: *HSA*	

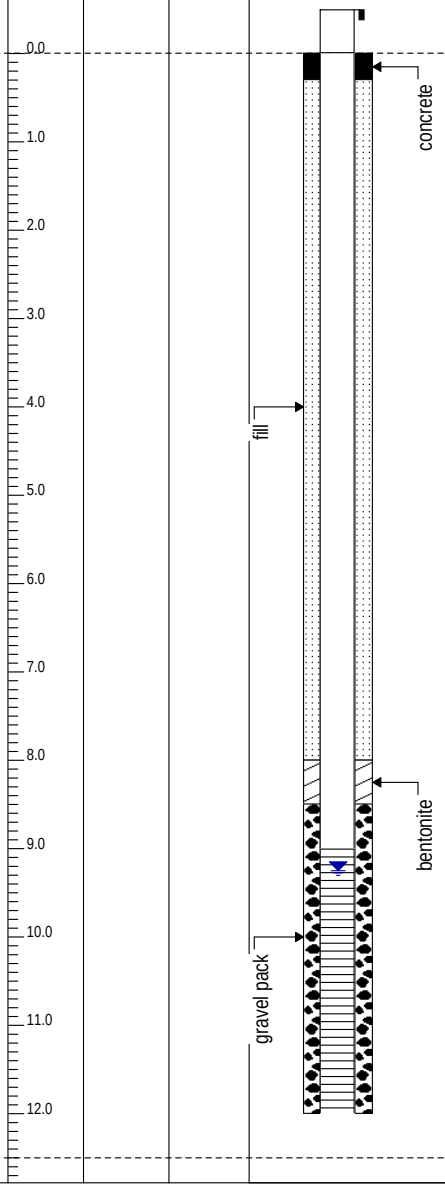
SOIL DESCRIPTION	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	WELL CONSTRUCTION	MOISTURE	FIELD MONITORING	SAMPLE INTERVALS
Ground Surface	0.0						
SW SAND, dark Brown, fine to medium grained, well graded, subrounded							
SW SAND, light Grey, fine to medium grained, well graded, subrounded	1.0						
SW SAND, dark Brown/brown, fine to medium grained, well graded, subrounded	2.0 3.0 4.0 5.0 6.0		SW	concrete fill bentonite gravel pack	M M/W W		
End of Log	7.0						

Logged by: *LZ*
Checked by: *JJ*

GROUNDWATER MONITORING WELL

PROJECT: Casuarina Monitoring	Bore Identification: *CS08*	Sheet: ***1 of 1***
PROJECT #: *2332*	AOPC:	Date Logged: *20170908*
Project Manager: *JJ*	PROJECT Location: *Casuarina*	
Client:	Zone: *MGA94* Easting: *392242*	Northing: *6431685*
Drilled by: *SWD*	Inner Diameter (mm):	Elevation (mAHD): *0*
Drill Type: *HSA*	Drilling Method: *HSA*	

SOIL DESCRIPTION	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	WELL CONSTRUCTION	MOISTURE	FIELD MONITORING	SAMPLE INTERVALS / PID (ppm)
Ground Surface	0.0						



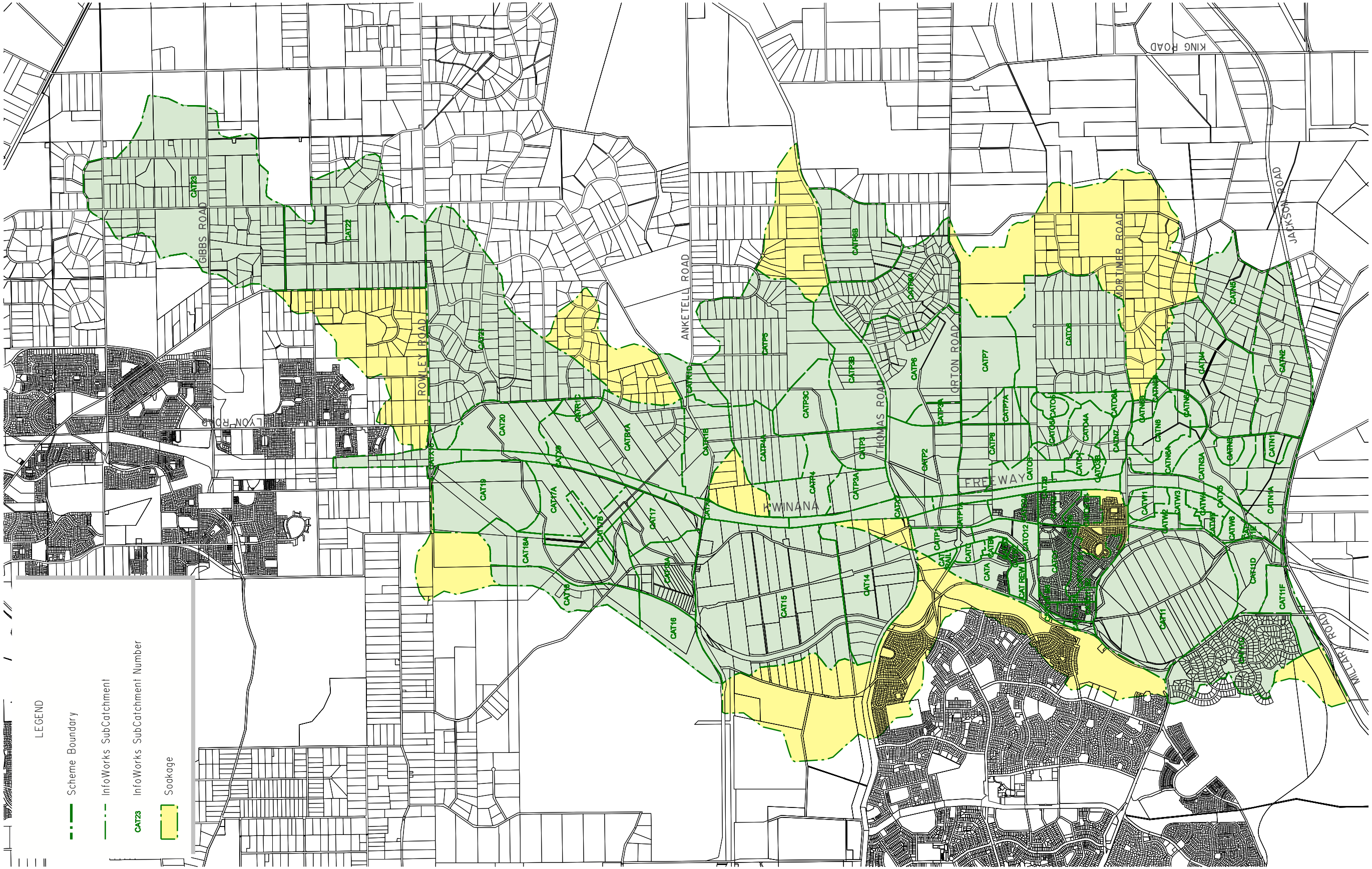
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Checked by:

APPENDIX C
Jandakot DWMP (DoW,2009) Extracts

THE INFORMATION CONTAINED HEREIN IS SUBJECT TO ONGOING REVIEW AND AMENDMENTS AND SHOULD BE READ IN CONJUNCTION WITH THE ASSOCIATED REPORT.

SUBCATCHMENTS

N



AUTHOR: SLee DESIGN FILE: Figure_A3.1_PreDev_SubCatch.dgn

WATER CORPORATION

PROJECT N°: 6116977 DATE: 27/06/2008 COORDINATE SYSTEM: MGA94 - Zone 50

Figure A3.1

AUTHOR: SLee DESIGN FILE: Figure_4.1_ExistingSystem.dgn

PROJECT N°: 6116977 DATE: 26/06/2008 COORDINATE SYSTEM: MGA94 - Zone 50

WATER CORPORATION

N

LEGEND

- Catchment Boundary
- Water Corporation Open Drain
- Water Corporation Piped Drain
- Local Authority Open and Piped Drains
- Gauging Station
- ② Flow Station locations in Table 4.1
- Model Predicted Flooding

GIBBS ROAD
LYON ROAD
ROWLEY ROAD
ANKETELL ROAD
THOMAS ROAD
ORTON ROAD
MORTIMER ROAD
KWINANA FREEWAY
KING ROAD
JACKSON ROAD
MILLAR ROAD

Peel Main Drain
Peel Sub Q Drain
Peel Sub R Drain
Peel Sub P Drain
Peel Sub P1 Drain
Peel Sub P1A Drain
Peel Sub O Drain
Peel Sub N2 Drain
Peel Sub N Drain
Peel Sub N1 Drain

Banjup Swamp
Mandogalup Swamp North
Mandogalup Swamp South
Spectacles Wetland North
Spectacles Wetland South
Treeby Rd Lake
Sandy Lake
Johnson Rd Wetland
Mortimer Rd Wetland
Bollard Bulrush

Banjup Swamp		
CGL	=	23.9 mAHD
TWL_{10}	=	24.3 mAHD
S_{10}	=	900 m^3
TWL_{100}	=	24.5 mAHD
S_{100}	=	2,700 m^3

Mandogalup Swamp North		
CGL	=	12.8 mAHD
TWL_{10}	=	13.3 mAHD
S_{10}	=	32,200 m^3
TWL_{100}	=	13.5 mAHD
S_{100}	=	85,900 m^3

Mandogalup Swamp South		
CGL	=	12.7 mAHD
TWL_{10}	=	13.2 mAHD
S_{10}	=	1,100 m^3
TWL_{100}	=	13.4 mAHD
S_{100}	=	1,500 m^3

Spectacles Wetland North		
CGL	=	9.2 mAHD
TWL_{10}	=	9.3 mAHD
S_{10}	=	268,600 m^3
TWL_{100}	=	9.4 mAHD
S_{100}	=	372,900 m^3

Spectacles Wetland South		
CGL	=	9.2 mAHD
TWL_{10}	=	9.2 mAHD
S_{10}	=	67,900 m^3
TWL_{100}	=	9.3 mAHD
S_{100}	=	91,600 m^3

Treeby Rd Lake		
CGL	=	15.5 mAHD
TWL_{10}	=	15.8 mAHD
S_{10}	=	23,100 m^3
TWL_{100}	=	16.0 mAHD
S_{100}	=	31,400 m^3

Sandy Lake		
CGL	=	13.8 mAHD
TWL_{10}	=	14.6 mAHD
S_{10}	=	3,000 m^3
TWL_{100}	=	14.6 mAHD
S_{100}	=	5,500 m^3

Johnson Road Wetland		
CGL	=	11 mAHD
TWL_{10}	=	11.0 mAHD
S_{10}	=	3,700 m^3
TWL_{100}	=	11 mAHD
S_{100}	=	4,500 m^3

Mortimer Road Wetland		
CGL	=	10 mAHD
TWL_{10}	=	10 mAHD
S_{10}	=	30,100 m^3
TWL_{100}	=	10.1 mAHD
S_{100}	=	34,100 m^3

Bollard Bulrush Swamp		
CGL	=	4.8 mAHD
TWL_{10}	=	5.5 mAHD
S_{10}	=	715,700 m^3
TWL_{100}	=	5.6 mAHD
S_{100}	=	1,835,500 m^3

0 500 1000 1500 2000
SCALE OF METRES

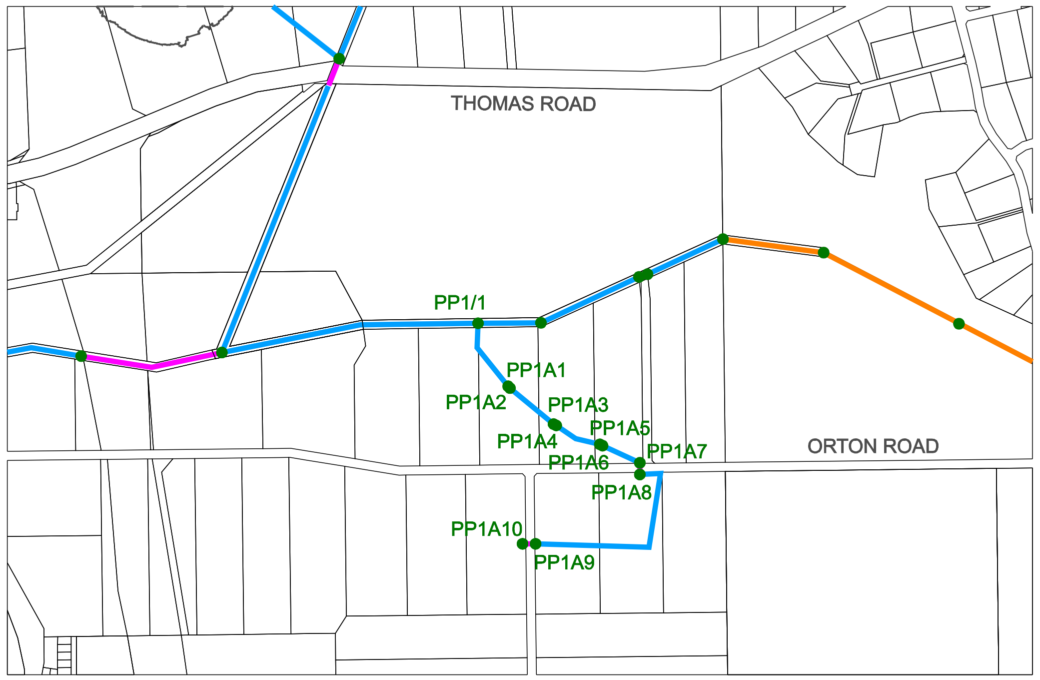
Figure 4.1

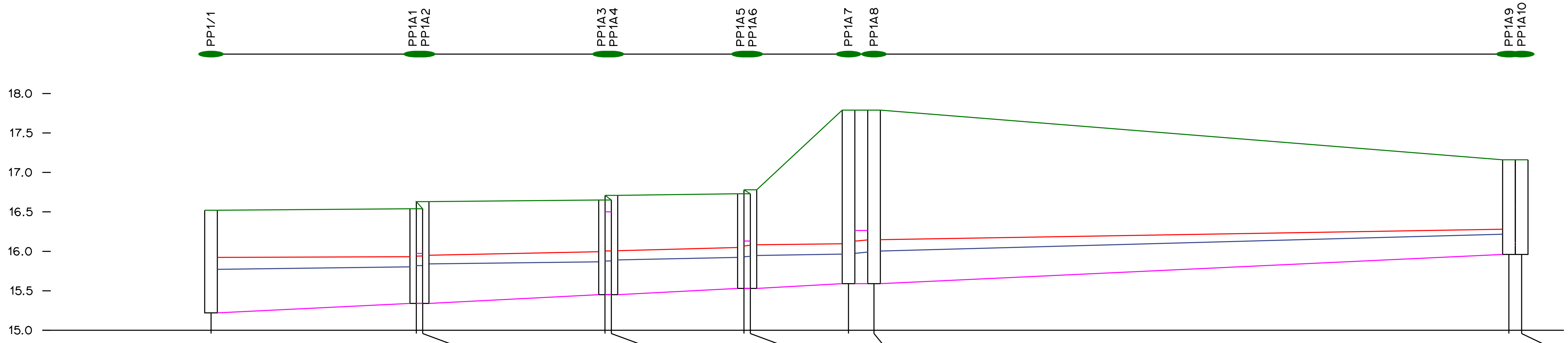
EXISTING SYSTEM

THE INFORMATION CONTAINED HEREIN IS SUBJECT TO ONGOING REVIEW AND AMENDMENTS AND SHOULD BE READ IN CONJUNCTION WITH THE ASSOCIATED REPORT.

THE INFORMATION CONTAINED HEREIN IS SUBJECT TO ONGOING REVIEW AND AMENDMENTS AND SHOULD BE READ IN CONJUNCTION WITH THE ASSOCIATED REPORT.

N





Chainage (m)	Ground level (m AHD)	10 year ARI HGL level (m AHD)	100 year ARI HGL level (m AHD)	Invert level (m AHD)	
0	16.52	15.82	15.96	-	15.22
161	16.54	15.84	15.98	15.34	15.34
166	16.63	15.86	16.05	15.34	15.34
309	16.65	15.89	16.67	15.45	15.45
314	16.71	15.90	16.08	15.45	15.45
418	16.73	15.93	16.11	15.53	15.53
423	16.78	15.97	16.18	15.53	15.53
500	17.79	16.00	16.20	15.59	15.59
520	17.79	16.03	16.25	15.59	15.59
1018	17.16	16.27	16.39	15.96	15.96
1028	17.16	16.32	16.46	15.96	-

Segment (chainage, m)	Size (mm)	Max 10 year ARI flow (m3/s)	Max 100 year ARI flow (m3/s)
0–161	4500x1200	0.16	0.27
161–166	600	0.16	0.27
166–309	4500x1200	0.16	0.27
309–314	1050	0.16	0.27
314–418	4500x1200	0.16	0.27
418–423	600	0.16	0.27
423–500	4500 x1200	0.16	0.27
500–520	675	0.16	0.27
520–1018	4500x1200	0.12	0.20
1018–1028	600	0.12	0.21

AUTHOR: SLee DESIGN FILE: Figure 4.3c SubDrain P Pt 3 of 4

WATER CORPORATION

Peel Sub P1A Drain

LONGITUDINAL SECTION

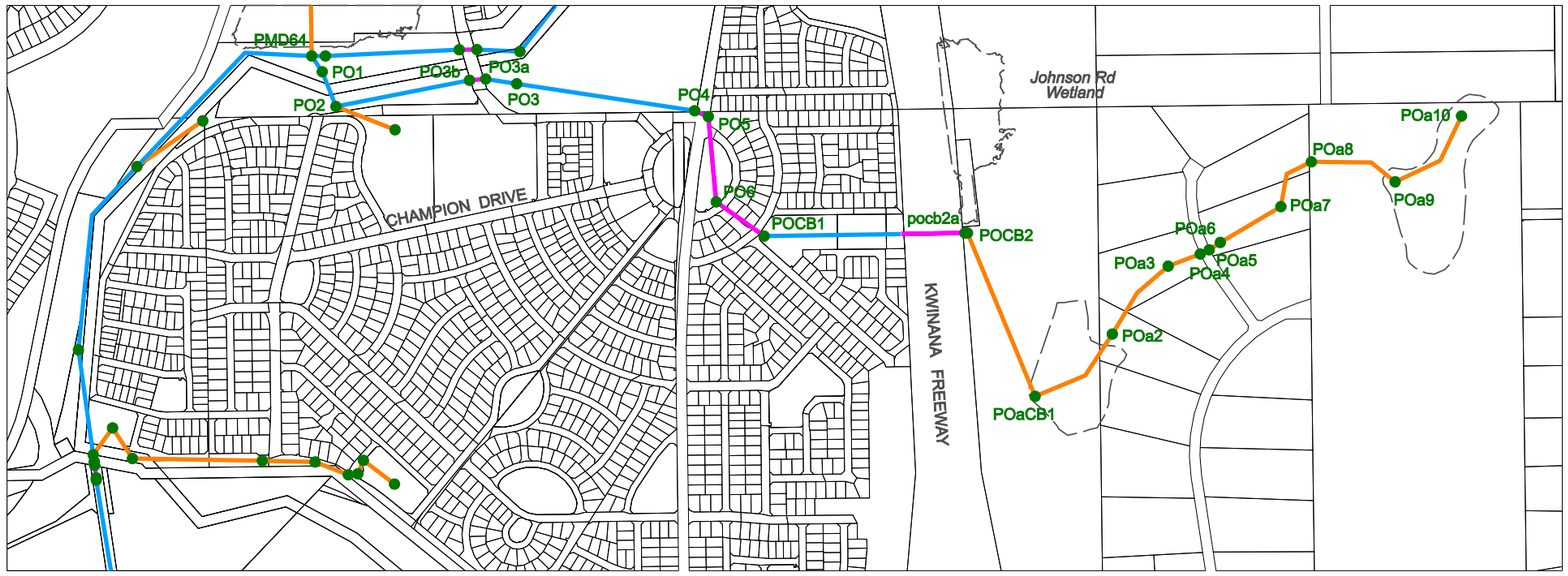
Existing System HGLs & Flows

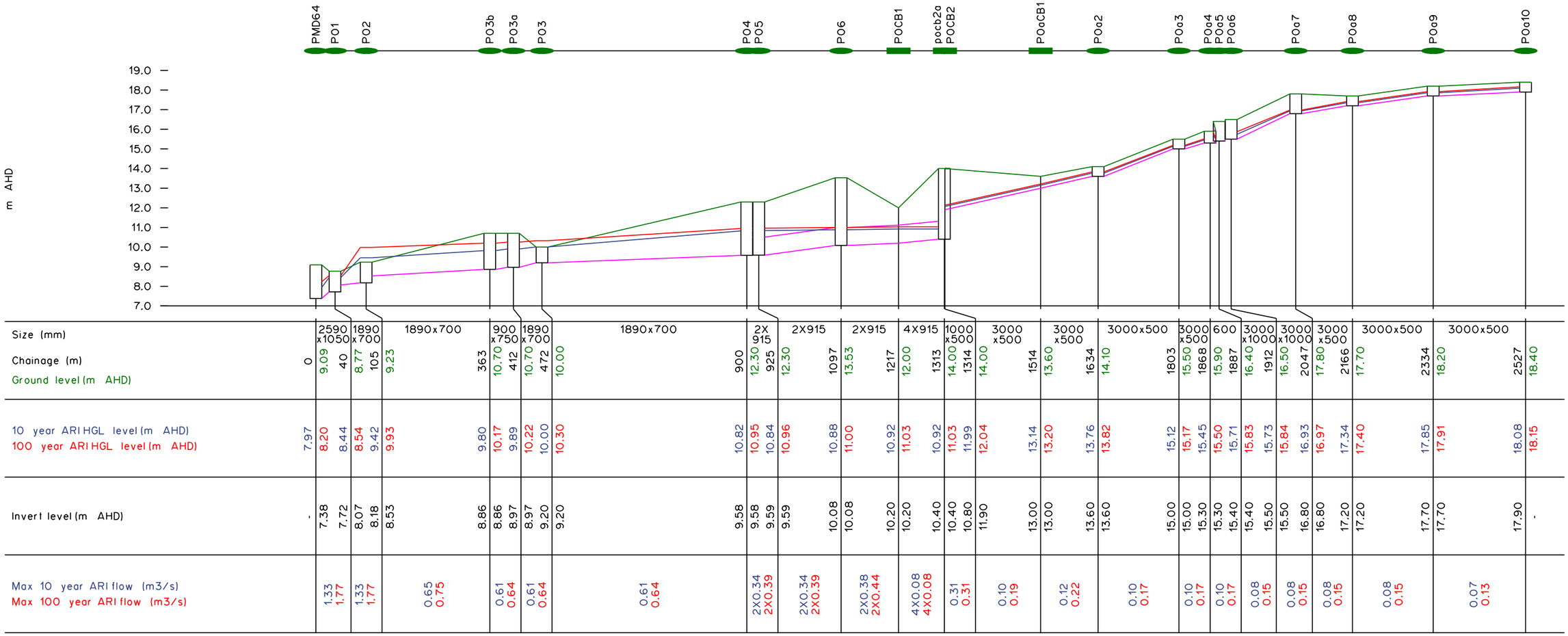
Figure 4.3c

PROJECT N°: DP2 DATE: 24/04/2009

THE INFORMATION CONTAINED HEREIN IS SUBJECT TO ONGOING REVIEW AND AMENDMENTS AND SHOULD BE READ IN CONJUNCTION WITH THE ASSOCIATED REPORT.

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		PMD64	PO1	PO2	PO3b	PO3a	PO3	PO4 PO5	PO6	POCB1	pocb2a POCB2	POoCB1	POo2	POo3	POo4 POo5 POo6	POo7	POo8	POo9	POo10
Size (mm)			2590 x1050	1890 x700	1890x700	900 x750	1890 x700	1890x700		2X 915	2X915	2X915	4X915	1000 x500	3000 x500	3000 x500	3000x500	3000 x500	600	3000 x1000	3000 x1000	3000 x500	3000x500	3000x500	
Chainage (m)	0	40	105	363	412	472	900	925	1097	1217	1313	1314	1514	1634	1803	1868	1887	1912	2047	2166	2334	2527	
Ground level (m AHD)	9.09	9.23	8.77	10.70	10.70	10.00	12.30	12.30	13.53	12.00	14.00	14.00	13.60	14.10	15.50	15.90	16.40	16.50	17.80	17.70	18.20	18.40	
10 year ARI HGL level (m AHD)	7.97	8.20	8.44	8.54	9.80	10.17	10.22	10.30	10.82	10.95	10.84	10.96	10.88	11.00	10.92	11.03	10.92	11.03	11.99	12.04	13.14	13.20	13.76	13.82	15.12	15.17	15.45	15.50	15.71	15.83	15.73	15.84	16.93	16.97	17.34	17.40	17.85	17.91	18.08	18.15	
100 year ARI HGL level (m AHD)	9.09	9.42	9.93	10.00	10.30																																				
Invert level (m AHD)	-	7.38	7.72	8.07	8.18	8.53	8.86	8.86	8.97	9.20	9.20	9.58	9.58	9.59	9.59	10.08	10.08	10.20	10.20	10.40	10.40	10.80	11.90	13.00	13.00	13.60	13.60	15.00	15.00	15.30	15.40	15.40	15.50	15.50	16.80	16.80	17.20	17.20	17.70	17.70	17.90	-
Max 10 year ARI flow (m3/s)		1.33	1.33	0.65	0.61	0.61	0.61	2X0.34	2X0.34	2X0.38	4X0.08	0.31	0.10	0.12	0.10	0.10	0.10	0.08	0.08	0.08	0.08	0.08	0.07																		
Max 100 year ARI flow (m3/s)		1.77	1.77	0.75	0.64	0.64	0.64	2X0.39	2X0.39	2X0.44	4X0.08	0.31	0.19	0.22	0.17	0.17	0.17	0.15	0.15	0.15	0.15	0.15	0.13																		

AUTHOR: SLee DESIGN FILE: Figure 4.4 SubDrain 0 Pt 1 of 1

WATER CORPORATION

PROJECT N°: DP2 DATE: 24/04/2009

Peel Sub 0 Drain and Local Authority Drain

LONGITUDINAL SECTION

Existing System HGLs & Flows

Figure 4.4

AUTHOR: SLee DESIGN FILE: Figure_5.1_PostDevelopmentSystemDetails.dgn

PROJECT N°: 6116977 DATE: 26/06/2008 COORDINATE SYSTEM: MGA94 - Zone 50

WATER CORPORATION

N

LEGEND

- Catchment Boundary
- Water Corporation Open Drain
- Water Corporation Piped Drain
- Local Authority Open and Piped Drains
- Gauging Station
- ② Flow Station locations in Table 5.1

GIBBS ROAD
LYON ROAD
ROWLEY ROAD
ANKETELL ROAD
THOMAS ROAD
ORTON ROAD
MORTIMER ROAD
KING ROAD
JACKSON ROAD
MILLAR ROAD
FREEWAY
KWINANA

Peel Main Drain
Peel Sub Q Drain
Peel Sub R Drain
Peel Sub P Drain
Peel Sub P1 Drain
Peel Sub P1A Drain
Peel Sub O Drain
Peel Sub N2 Drain
Peel Sub N Drain
Peel Sub N1 Drain

Banjup Swamp
Mandogalup Swamp North
Mandogalup Swamp South
Spectacles Wetland North
Spectacles Wetland South
Treeby Rd Lake
Sandy Lake
Johnson Rd Wetland
Mortimer Rd Wetland
Bollard Bulrush

Banjup Swamp		
CGL	=	23.9 mAHD
TWL_{10}	=	24.3 mAHD
S_{10}	=	900 m³
TWL_{100}	=	24.5 mAHD
S_{100}	=	2,700 m³

Mandogalup Swamp North		
CGL	=	12.8 mAHD
TWL_{10}	=	13.5 mAHD
S_{10}	=	31,700 m³
TWL_{100}	=	13.7 mAHD
S_{100}	=	68,500 m³

Mandogalup Swamp South		
CGL	=	12.7 mAHD
TWL_{10}	=	13.4 mAHD
S_{10}	=	1,500 m³
TWL_{100}	=	13.7 mAHD
S_{100}	=	2,000 m³

Spectacles Wetland North		
CGL	=	9.3 mAHD
TWL_{10}	=	9.4 mAHD
S_{10}	=	368,000 m³
TWL_{100}	=	9.6 mAHD
S_{100}	=	502,800 m³

Spectacles Wetland South		
CGL	=	9.3 mAHD
TWL_{10}	=	9.3 mAHD
S_{10}	=	98,900 m³
TWL_{100}	=	9.5 mAHD
S_{100}	=	153,400 m³

Treeby Rd Lake		
CGL	=	15.5 mAHD
TWL_{10}	=	15.8 mAHD
S_{10}	=	23,600 m³
TWL_{100}	=	16.0 mAHD
S_{100}	=	31,500 m³

Sandy Lake		
CGL	=	14.5 mAHD
TWL_{10}	=	14.6 mAHD
S_{10}	=	3,000 m³
TWL_{100}	=	14.6 mAHD
S_{100}	=	5,500 m³

Johnson Road Wetland		
CGL	=	11 mAHD
TWL_{10}	=	11 mAHD
S_{10}	=	3,700 m³
TWL_{100}	=	11 mAHD
S_{100}	=	4,100 m³

Bollard Bulrush Swamp		
CGL	=	5.5 mAHD
TWL_{10}	=	4.8 mAHD
S_{10}	=	705,900 m³
TWL_{100}	=	5.6 mAHD
S_{100}	=	1,826,800 m³

Mortimer Road Wetland		
CGL	=	10 mAHD
TWL_{10}	=	10 mAHD
S_{10}	=	31,100 m³
TWL_{100}	=	10.1 mAHD
S_{100}	=	34,900 m³

0 500 1000 1500 2000
SCALE OF METRES

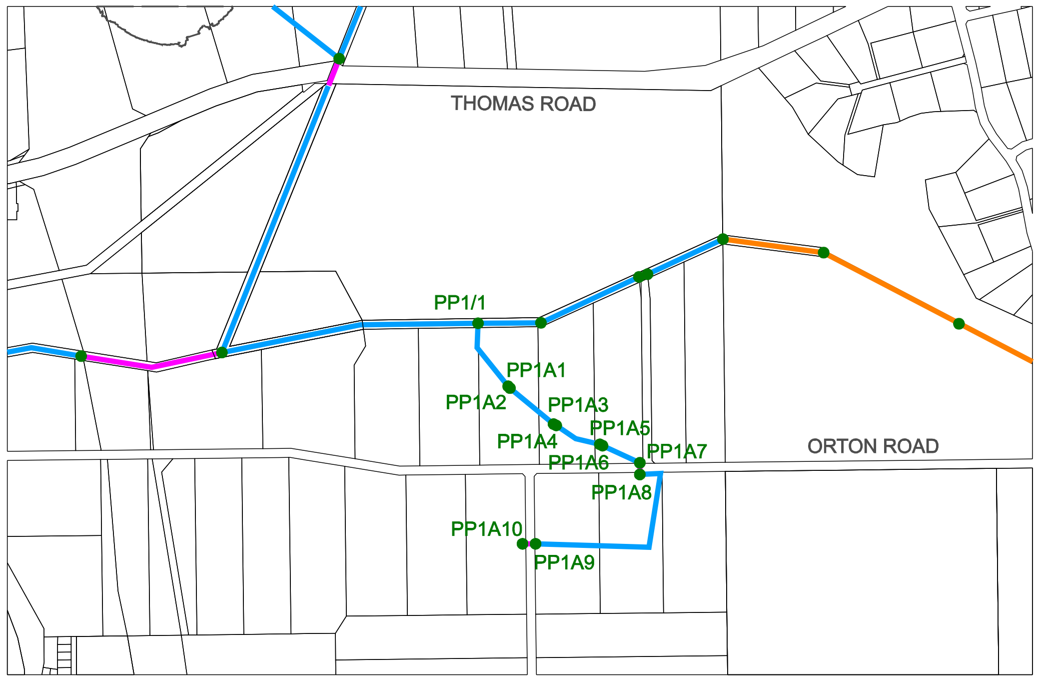
Figure 5.1

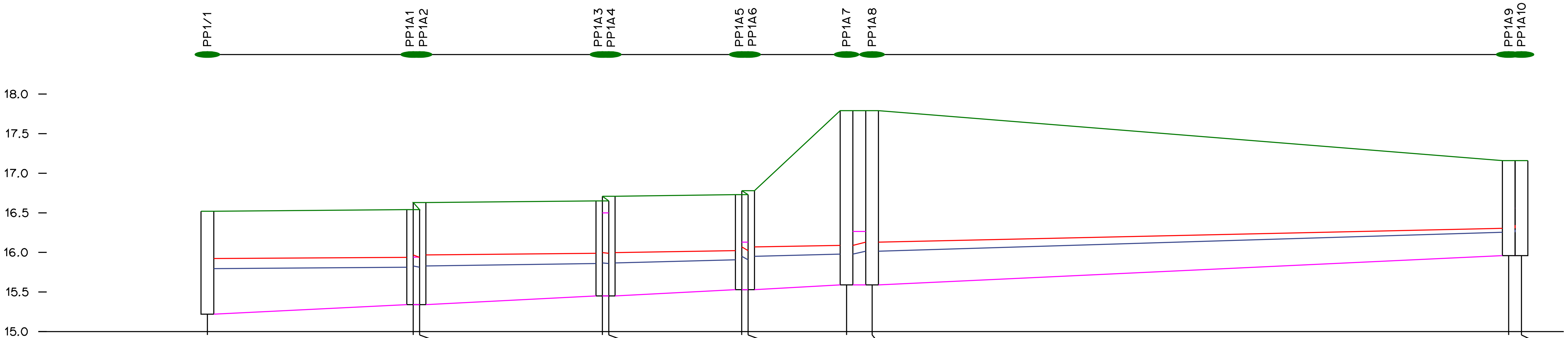
POST DEVELOPMENT SYSTEM

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THE INFORMATION CONTAINED HEREIN IS SUBJECT TO ONGOING REVIEW AND AMENDMENTS AND SHOULD BE READ IN CONJUNCTION WITH THE ASSOCIATED REPORT.

N





Chainage (m)	Ground level (m AHD)	10 year ARI HGL level (m AHD)	100 year ARI HGL level (m AHD)	Invert level (m AHD)
0	16.52	15.81	15.93	- / 15.22
161	16.54	15.82	15.95	15.34 / 15.34
166	16.63	15.84	15.98	15.34 / 15.34
309	16.65	15.87	16.00	15.45 / 15.45
314	16.71	15.87	16.01	15.45 / 15.45
418	16.73	15.91	16.03	15.53 / 15.53
423	16.78	15.95	16.08	15.53 / 15.53
500	17.79	15.98	16.10	15.59 / 15.59
520	17.79	16.02	16.14	15.59 / 15.59
1018	17.16	16.26	16.31	15.96 / 15.96
1028	17.16	16.29	16.35	15.96 / -

Chainage (m)	Size (mm)	Max 10 year ARI flow (m3/s)	Max 100 year ARI flow (m3/s)
0–161	4500x1200	0.15	0.22
161–166	600	0.15	0.21
166–309	4500x1200	0.15	0.21
309–314	1050	0.15	0.21
314–418	4500x1200	0.15	0.21
418–423	600	0.15	0.21
423–500	4500 x1200	0.15	0.21
500–520	675	0.15	0.21
520–1018	4500x1200	0.11	0.15
1018–1028	600	0.10	0.13

AUTHOR: SLee DESIGN FILE: Figure 5.3c SubDrain P Pt 3 of 4

WATER CORPORATION

PROJECT N°: DP2 DATE: 24/04/2009

Peel Sub P1A Drain

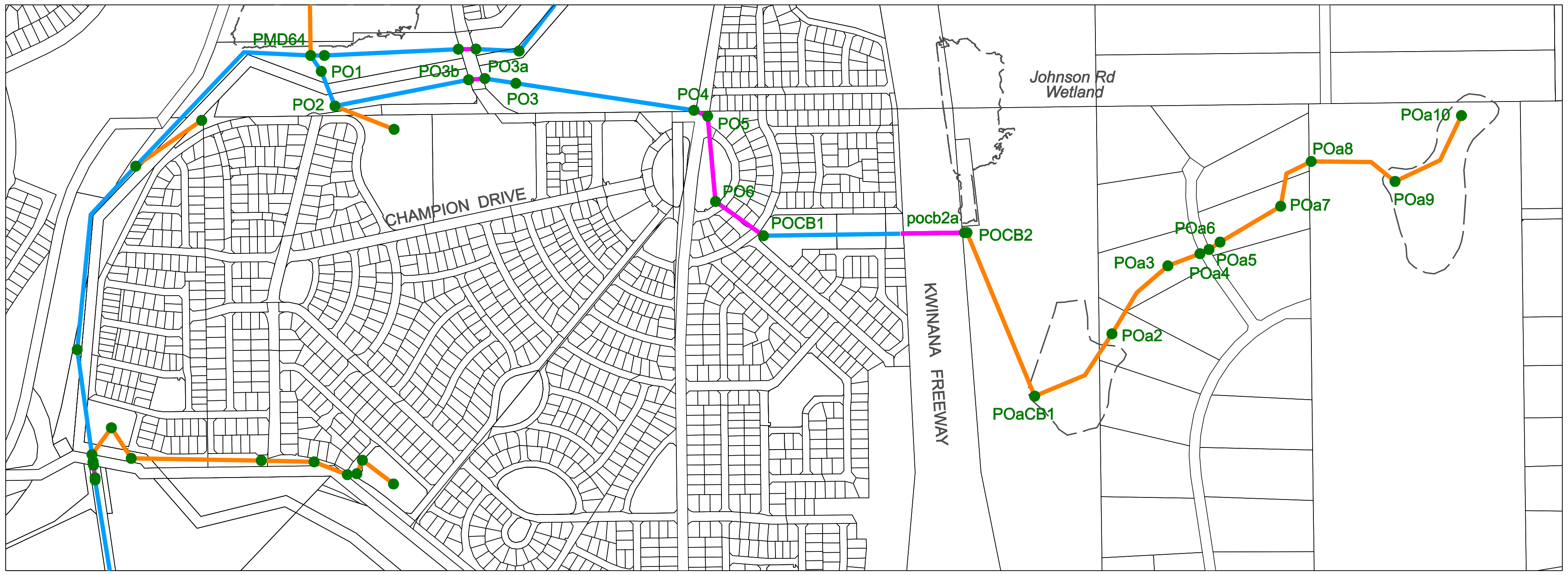
LONGITUDINAL SECTION

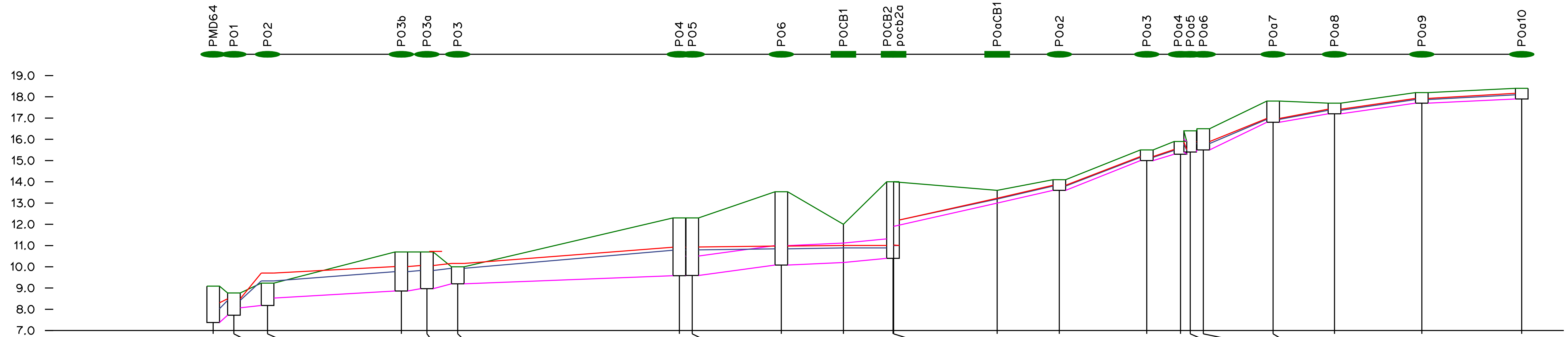
Post Development HGLs & Flows

Figure 5.3c

THE INFORMATION CONTAINED HEREIN IS SUBJECT TO ONGOING REVIEW AND AMENDMENTS AND SHOULD BE READ IN CONJUNCTION WITH THE ASSOCIATED REPORT.

N





Chainage (m)	10 year ARI HGL level (m AHD)	Invert level (m AHD)	Ground level (m AHD)	100 year ARI HGL level (m AHD)	Invert level (m AHD)
0	8.04	-	9.09	8.31	7.38
40	8.41	7.72	8.77	8.49	8.07
105	9.31	8.18	9.23	9.66	8.53
363	9.76	8.86	10.70	10.00	8.86
412	9.81	8.97	10.70	10.05	8.97
472	9.92	9.20	10.00	10.15	9.20
900	10.78	9.58	12.30	10.92	9.58
925	10.80	9.59	12.30	10.93	9.59
1097	10.85	10.08	13.53	10.97	10.08
1217	10.89	10.20	12.00	11.01	10.20
1313	10.89	10.40	14.00	11.01	10.40
1314	12.03	10.80	14.00	12.06	11.90
1514	13.18	13.00	13.60	13.22	13.00
1634	13.79	13.60	14.10	13.83	13.60
1803	15.14	15.00	15.50	15.18	15.00
1868	15.47	15.30	15.90	15.51	15.30
1887	15.76	15.40	16.40	15.86	15.40
1912	15.78	15.50	16.50	15.87	15.50
2047	16.93	16.80	17.80	16.97	16.80
2166	17.35	17.20	17.70	17.41	17.20
2334	17.86	17.70	18.20	17.92	17.70
2527	18.08	17.90	18.40	18.15	-

Size (mm)	Max 10 year ARI flow (m3/s)	Max 100 year ARI flow (m3/s)
2590 x1050	1.23	1.54
1890 x700	1.23	1.54
1890x700	0.63	0.70
900 x750	0.61	0.64
1890 x700	0.61	0.64
1890x700	0.61	0.63
2X 915	2X0.33	2X0.37
2X915	2X0.33	2X0.37
2X915	2X0.35	2X0.41
4X915	4X0.08	4X0.08
1000 x500	0.31	0.31
3000x500	0.16	0.22
3000 x500	0.16	0.23
3000x500	0.12	0.19
3000 x500	0.12	0.19
600	0.12	0.19
3000 x1000	0.12	0.19
3000 x1000	0.09	0.15
3000 x500	0.09	0.15
3000x500	0.09	0.15
3000x500	0.07	0.12

AUTHOR: SLee DESIGN FILE: Figure 5.4 SubDrain O Pt 1 of 1

WATER CORPORATION

Peel Sub O Drain and Local Authority Drain

LONGITUDINAL SECTION

Post Development HGLs & Flows

Figure 5.4

PROJECT N°: DP2 DATE: 24/04/2009

AUTHOR: SLee DESIGN FILE: Figure 7.2 Local Arterial Design.dgn

PROJECT N°: 6116977 DATE: 16/06/2008 COORDINATE SYSTEM: MGA94 - Zone 50

WATER CORPORATION

N

LEGEND

- Scheme Boundary
- Water Corporation Open Drain
- Water Corporation Piped Drain
- Local Authority Open and Piped Drain
- Sub-catchment Boundary
- Local Authority Compensating Basin
- 20m Drainage Reserve

ANKETELL ROAD

Treeby Rd CB

CGL	=	17 mAHD
LWL	=	18 mAHD
TWL_{10}	=	18.4 mAHD
S_{10}	=	16700 m^3
TWL_{100}	=	18.8 mAHD
S_{100}	=	30300 m^3
Existing GL	=	19 mAHD

Treeby Rd Lake

Thomas Rd CB

CGL	=	14 mAHD
LWL	=	15.7 mAHD
TWL_{10}	=	16.2 mAHD
S_{10}	=	8000 m^3
TWL_{100}	=	16.5 mAHD
S_{100}	=	14100 m^3
Existing GL	=	16.7 mAHD

Sandy Lake

KWINANA FREEWAY

THOMAS ROAD

Orton Rd CB

CGL	=	13.2 mAHD
LWL	=	14.9 mAHD
TWL_{10}	=	15.4 mAHD
S_{10}	=	26000 m^3
TWL_{100}	=	15.6 mAHD
S_{100}	=	42600 m^3
Existing GL	=	15.9 mAHD

20m

Peel Main Drain

Peel Sub P Drain

Peel Sub P1 Drain

Peel Sub P1A Drain

ORTON ROAD

Holden Close CB

CGL	=	11.8 mAHD
LWL	=	14.4 mAHD
TWL_{10}	=	15.0 mAHD
S_{10}	=	6000 m^3
TWL_{100}	=	15.4 mAHD
S_{100}	=	11100 m^3
Existing GL	=	15.4 mAHD

LandgrenRd Nth CB

CGL	=	15.2 mAHD
LWL	=	16.4 mAHD
TWL_{10}	=	16.9 mAHD
S_{10}	=	14800 m^3
TWL_{100}	=	17.1 mAHD
S_{100}	=	24300 m^3
Existing GL	=	17.4 mAHD

LandgrenRd Sth CB

CGL	=	15.4 mAHD
LWL	=	16.4 mAHD
TWL_{10}	=	17.0 mAHD
S_{10}	=	5200 m^3
TWL_{100}	=	17.4 mAHD
S_{100}	=	8800 m^3
Existing GL	=	17.4 mAHD

0 200 400 600 800
SCALE OF METRES

LOCAL ARTERIAL DRAINAGE CONCEPTUAL DESIGN ANKETELL

Figure 7.2

THE INFORMATION CONTAINED HEREIN IS SUBJECT TO ONGOING REVIEW AND AMENDMENTS AND SHOULD BE READ IN CONJUNCTION WITH THE ASSOCIATED REPORT.

AUTHOR: SLee DESIGN FILE: Figure 7.3 Local Arterial Design South.dgn

PROJECT N°: 6116977 DATE: 30/06/2008 COORDINATE SYSTEM: MGA94 - Zone 50

WATER CORPORATION

N

Centennial Ave CB (Existing)
CGL = 10.8 mAHD
LWL = 10.2 mAHD
TWL10 = 10.9 mAHD
S10 = 1500 m³
TWL100 = 11.0 mAHD
S100 = 2400 m³
Existing GL = 12 mAHD
Area = 1.6 ha
Fill GL = - mAHD

Johnson Rd East CB
CGL = 13 mAHD
LWL = 13.3 mAHD
TWL10 = 13.6 mAHD
S10 = 3100 m³
TWL100 = 13.8 mAHD
S100 = 5200 m³
Existing GL = 14.3 mAHD

Lugg Rd Nth CB
CGL = 15.5 mAHD
LWL = 15.9 mAHD
TWL10 = 16.5 mAHD
S10 = 6400 m³
TWL100 = 16.9 mAHD
S100 = 11700 m³
Existing GL = 16.9 mAHD

Nicolas Rd CB
CGL = 16 mAHD
LWL = 18 mAHD
TWL10 = 18.6 mAHD
S10 = 3400 m³
TWL100 = 19.0 mAHD
S100 = 5800 m³
Existing GL = 19 mAHD

Johnson Rd Wetland

Bertram Swamp
CGL = 7.3 mAHD
LWL = 8.5 mAHD
TWL10 = 8.9 mAHD
S10 = 4600 m³
TWL100 = 9.1 mAHD
S100 = 8800 m³
Existing GL = 9.8 mAHD

Peel Sub O Drain

Wellard 2 CB
CGL = 8 mAHD
LWL = 8.1 mAHD
TWL10 = 8.5 mAHD
S10 = 1000 m³
TWL100 = 8.9 mAHD
S100 = 2100 m³
Existing GL = 9.1 mAHD

Lugg Rd Sth CB
CGL = 13 mAHD
LWL = 14 mAHD
TWL10 = 14.6 mAHD
S10 = 10000 m³
TWL100 = 15.0 mAHD
S100 = 17500 m³
Existing GL = 15 mAHD

Wellard 3 CB
CGL = 8.2 mAHD
LWL = 8.4 mAHD
TWL10 = 9.4 mAHD
S10 = 3700 m³
TWL100 = 9.5 mAHD
S100 = 3800 m³
Existing GL = 9.4 mAHD

Johnson Rd Nth CB
CGL = 13 mAHD
LWL = 13.6 mAHD
TWL10 = 14.0 mAHD
S10 = 1800 m³
TWL100 = 14.3 mAHD
S100 = 3300 m³
Existing GL = 14.6 mAHD

Wake Way Nth CB
CGL = 11 mAHD
LWL = 11.3 mAHD
TWL10 = 11.9 mAHD
S10 = 6000 m³
TWL100 = 12.3 mAHD
S100 = 10000 m³
Existing GL = 12.3 mAHD

Wellard 4 CB
CGL = 8 mAHD
LWL = 8.2 mAHD
TWL10 = 9.3 mAHD
S10 = 3500 m³
TWL100 = 9.3 mAHD
S100 = 3700 m³
Existing GL = 9.2 mAHD
Area = 0.4 ha
Fill GL = 9.6 mAHD

Bollard Bullrush

Peel Sub N1 Drain

Wellard 1 CB
CGL = 8 mAHD
LWL = 8.5 mAHD
TWL10 = 9.5 mAHD
S10 = 5000 m³
TWL100 = 9.6 mAHD
S100 = 5100 m³
Existing GL = 9.5 mAHD

Mortimer Rd Wetland

Wake Way Sth CB
CGL = 10.2 mAHD
LWL = 10.5 mAHD
TWL10 = 11.1 mAHD
S10 = 1700 m³
TWL100 = 11.5 mAHD
S100 = 3300 m³
Existing GL = 11.5 mAHD

Wellard 5 CB
CGL = 8 mAHD
LWL = 8.3 mAHD
TWL10 = 9.3 mAHD
S10 = 2100 m³
TWL100 = 9.4 mAHD
S100 = 2100 m³
Existing GL = 9.3 mAHD

Peel Main Drain

FREEWAY

KWINANA

Peel Sub N Drain

Millar Rd Nth CB
CGL = 8 mAHD
LWL = 8.2 mAHD
TWL10 = 8.8 mAHD
S10 = 6900 m³
TWL100 = 9.1 mAHD
S100 = 11600 m³
Existing GL = 9.2 mAHD

Wellard 6 CB
CGL = 8 mAHD
LWL = 8.1 mAHD
TWL10 = 8.3 mAHD
S10 = 500 m³
TWL100 = 8.9 mAHD
S100 = 2200 m³
Existing GL = 9.1 mAHD

Peel Sub N1A Drain

Wellard Rd CB
CGL = 4.9 mAHD
LWL = 5.6 mAHD
TWL10 = 6.1 mAHD
S10 = 7700 m³
TWL100 = 6.6 mAHD
S100 = 15100 m³
Existing GL = 6.6 mAHD

Millar Rd West CB
CGL = 5 mAHD
LWL = 8.1 mAHD
TWL10 = 8.7 mAHD
S10 = 200 m³
TWL100 = 9.0 mAHD
S100 = 400 m³
Existing GL = 9.1 mAHD

Millar Rd Sth CB
CGL = 7.2 mAHD
LWL = 8.1 mAHD
TWL10 = 8.7 mAHD
S10 = 10700 m³
TWL100 = 9.0 mAHD
S100 = 17300 m³
Existing GL = 9.1 mAHD

LEGEND
- Scheme Boundary
- Water Corporation Open Drain
- Water Corporation Piped Drain
- Local Authority Open and Piped Drain
- Sub-catchment Boundary
- Local Authority Compensating Basin
- 20m Drainage Reserve

0 200 400 600 800
SCALE OF METRES

LOCAL ARTERIAL DRAINAGE CONCEPTUAL DESIGN WELLARD

Figure 7.3

THE INFORMATION CONTAINED HEREIN IS SUBJECT TO ONGOING REVIEW AND AMENDMENTS AND SHOULD BE READ IN CONJUNCTION WITH THE ASSOCIATED REPORT.

AUTHOR: SLee DESIGN FILE: Figure_ES1_UltimateDrainageSystem.dgn

PROJECT N°: 6116977 DATE: 30/06/2008 COORDINATE SYSTEM: MGA94 - Zone 50

WATER CORPORATION

N

LEGEND

- Catchment Boundary
- Water Corporation Open Drain
- Water Corporation Piped Drain
- Local Authority Open and Piped Drains
- Drains to be transferred to Local Auth.
- (1) Flow Station locations in Table 5.1
- Gauging Station

GIBBS ROAD
LYON RD
ROWLEY ROAD
Peel Main Drain
Banjup Swamp
CGL = 23.9 mAHD
TWL10 = 24.3 mAHD
S10 = 900 m³
TWL100 = 24.5 mAHD
S100 = 2,700 m³
Mandogalup Swamp North
CGL = 12.8 mAHD
TWL10 = 13.5 mAHD
S10 = 31,700 m³
TWL100 = 13.7 mAHD
S100 = 68,500 m³
Mandogalup Swamp North
Mandogalup Swamp South
CGL = 12.7 mAHD
TWL10 = 13.4 mAHD
S10 = 1,500 m³
TWL100 = 13.7 mAHD
S100 = 2,000 m³
Incorporate drainage requirements into ERIC DSP
Peel Sub Q Drain
Peel Sub R Drain
ANKETELL ROAD
Spectacles Wetland North
CGL = 9.3 mAHD
TWL10 = 9.4 mAHD
S10 = 368,000 m³
TWL100 = 9.6 mAHD
S100 = 502,800 m³
Spectacles Wetland North
Peel Main Drain
KWINANA
Treeby Rd Lake
Treeby Rd Lake
CGL = 15.5 mAHD
TWL10 = 15.8 mAHD
S10 = 23,600 m³
TWL100 = 16.0 mAHD
S100 = 31,500 m³
Spectacles Wetland South
Sandy Lake
Sandy Lake
CGL = 14.5 mAHD
TWL10 = 14.6 mAHD
S10 = 3,000 m³
TWL100 = 14.6 mAHD
S100 = 5,500 m³
THOMAS ROAD
Spectacles Wetland South
CGL = 9.3 mAHD
TWL10 = 9.3 mAHD
S10 = 98,900 m³
TWL100 = 9.5 mAHD
S100 = 153,400 m³
Peel Sub P Drain
Peel Sub P1 Drain
Transfer Sub Drains to Town of Kwinana
ORTON ROAD
Peel Sub P1A Drain
FREEWAY
Johnson Road Wetland
CGL = 11 mAHD
TWL10 = 11 mAHD
S10 = 3,700 m³
TWL100 = 11 mAHD
S100 = 4,100 m³
Develop Operating Regimes for Wetlands with Environmental Regulators
Peel Sub O Drain
Peel Sub N2 Drain
MORTIMER ROAD
Mortimer Rd Wetland
Mortimer Road Wetland
CGL = 10 mAHD
TWL10 = 10 mAHD
S10 = 31,100 m³
TWL100 = 10.1 mAHD
S100 = 34,900 m³
KING ROAD
Bollard Bulrush Swamp
CGL = 5.5 mAHD
TWL10 = 4.8 mAHD
S10 = 705,900 m³
TWL100 = 5.6 mAHD
S100 = 1,826,800 m³
Peel Main Drain
Bollard Bulrush
Peel Sub N Drain
Peel Sub N1 Drain
JACKSON ROAD
MILLAR ROAD

0 500 1000 1500 2000
SCALE OF METRES

Figure ES1

ULTIMATE DRAINAGE SYSTEM

THE INFORMATION CONTAINED HEREIN IS SUBJECT TO ONGOING REVIEW AND AMENDMENTS AND SHOULD BE READ IN CONJUNCTION WITH THE ASSOCIATED REPORT.

Where a proposed development forms a part of one or more of the subcatchments presented in Figure 5.1 in Appendix B, the storage volume to be provided by that development should be calculated based on the subcatchment surface area as a percentage of the total subcatchment surface area.

It is proposed that existing drainage routes are retained and, in general, the route of the Peel main drain has been followed. Possible main drainage realignments and a number of the local arterial drainage conceptual designs will necessitate changes to the drainage corridors and public open space provisions within the *Jandakot district structure plan* (WAPC, 2007). Discussions with the local authorities and the Department of Planning to accommodate these changes will be necessary at the local structure planning stage.

Table 6.1 Subcatchment drainage planning criteria – ultimate development

Subcatchment ID	Peak discharge flow (m^3/s)		Detention volume (m^3)	
Subdivisional storage basins	**10-year**	**100-year**	**10-year**	**100-year**
CAT A, CAT B2, CAT B3, CAT B4 and CAT C – Bertram north Subdivision (includes use of Bertram Swamp REW)	0.05	0.14	11,000	15,500
CAT11D	0.09	0.16	7,700	15,100
CAT16A	0.03	0.05	18,700	32,700
CAT17	0.09	0.16	6,300	10,700
CAT17A	0.09	0.16	9,400	18,200
CAT17B (Mandogalup north)	0.05	0.09	31,800	68,500
CAT18A	0.17	0.30	14,400	24,300
CAT19	0.05	0.10	26,100	43,500
CAT20	0.04	0.07	14,500	23,800
CATN1A	0.07	0.13	10,700	17,300
CATN3A	0.07	0.13	6,900	11,600
CATN6A	0.05	0.09	1,700	3,300
CATN6B	0.05	0.07	200	400
CATN7	0.02	0.04	6,000	10,000
CATO3	0.02	0.03	3,100	5,200
CATO3B	0.01	0.01	1,800	3,300
CATO4A	0.02	0.04	10,000	17,500
CATO5A	0.02	0.03	6,400	11,700
CATO6A	0.01	0.02	3,400	5,800
CATP1A	0.01	0.03	6,000	11,100
CATP2	0.12	0.20	26,000	42,600
CATP3	0.02	0.04	8,000	14,100
CATP4A	0.04	0.08	16,700	30,300
CATP7A	0.01	0.02	5,200	8,800
CATP8	0.08	0.14	14,800	24,300
CATR1A	0.08	0.14	36,000	58,900
CATR1B	0.04	0.07	21,500	39,800

With the development of Peel sub P drain catchment, the drainage design must be such that flows into Peel main drain are maintained at pre-development levels.

Modelling indicates that in the existing system, the Peel P sub drain overtops during minor storm events to flood areas upstream of Thomas Road and the Kwinana Freeway culverts. In the post-development scenario, this regional storage is no longer available. However, modelling of the post-development system has shown that this will have little impact on the performance of the downstream main drainage system. Additionally, the 1500 mm culvert under the Kwinana Freeway can be choked off to limit the discharge into the Peel main drain to pre-development levels.

Peel Sub P1 and P1A drain catchment

Detention basin		Landgren Road north compensating basin	Landgren Road south compensating basin	Orton Road compensating basin
100y peak discharge	m^3/s	0.14	0.02	0.20
100y peak downstream tailwater	m	16.4	16.3	14.6
Catchment area	ha	51.2	17.7	74.7
100y surface area	ha	3.7	1.1	6.4

A.5.3 Town of Kwinana—Peel sub O drain and Peel sub N drain catchments

Peel sub O drain catchment

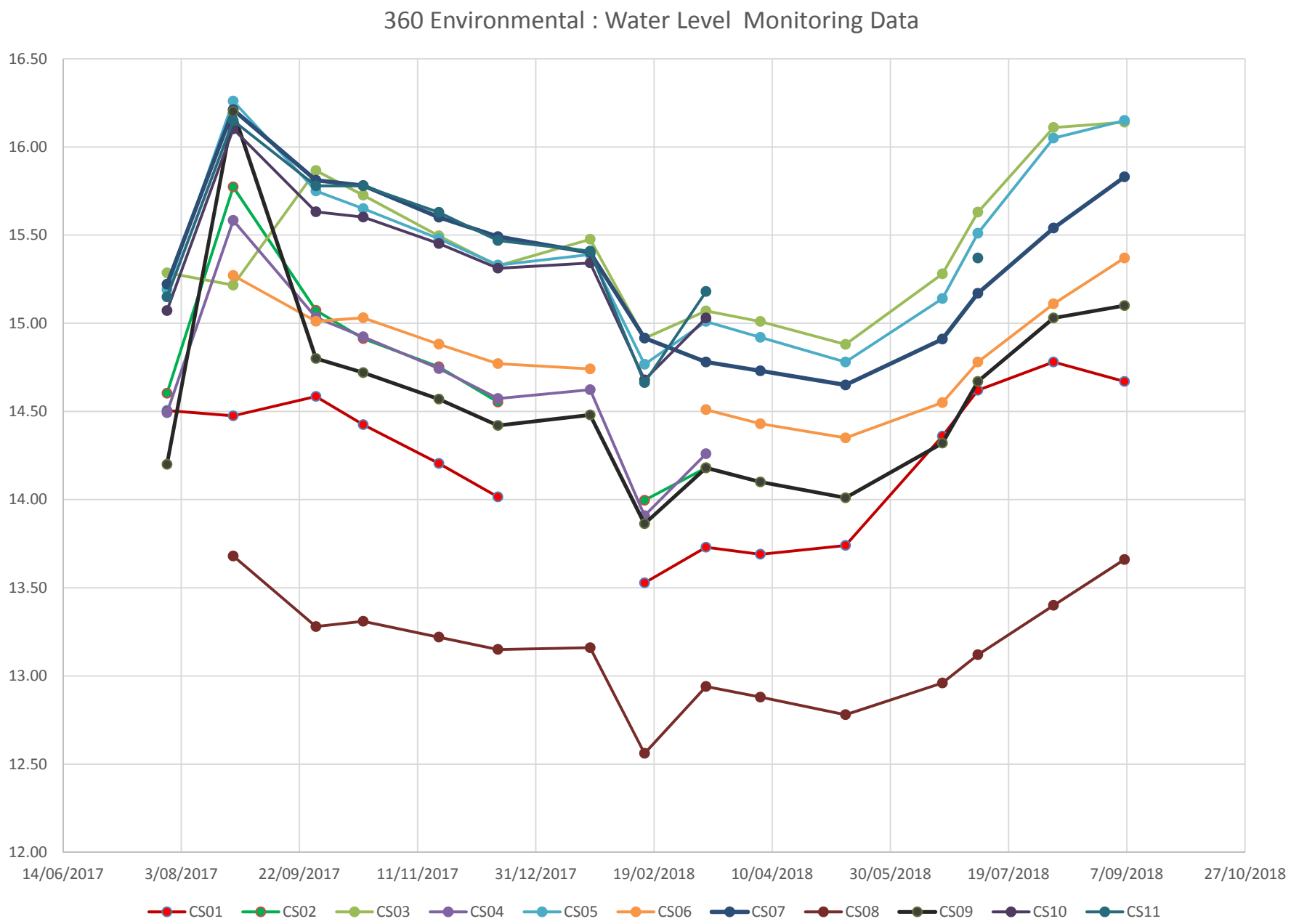
Figure 7.3 provides details of compensating basins proposed within Peel sub O drain catchment, as well as showing proposed arterial drainage routes that, in general, follow the routes of existing drains. Generally, the design of this area ensures that post-development flows are similar to pre-development flows.

Detention basin		Nicolas Road compensating basin	Lugg Road north compensating basin	Lugg Road south compensating basin
100y peak discharge	m^3/s	0.02	0.03	0.04
100y peak downstream tailwater	m	17.9	15.9	13.8
Catchment area	ha	13.3	25.6	32.8
100y surface area	ha	0.7	1.4	2.0
Detention basin		**Johnson Road east compensating basin**	**Johnson Road north compensating basin**	**Centennial Avenue compensating basin**
100y peak discharge	m^3/s	0.03	0.01	0.82 (online)
100y peak downstream tailwater	m	11.9	0.0	11.0
Catchment area	ha	25.7	7.3	29.2
100y surface area	ha	1.2	0.6	1.6

APPENDIX D
Groundwater Monitoring Results (360 Environmental)

Groundwater Monitoring: Water Level Data

Site Bores												DWER
	CS01	CS02	CS03	CS04	CS05	CS06	CS07	CS08	CS09	CS10	CS11	T200
Easting	392177	392218	392659	392193	392721	392576	393025	392242	392206	392711	393039	393826
Northing	6432921	6432798	6432927	6432637	6432627	6431950	6431753	6431686	6432137	6432115	6432057	6432661
Top of Case (mAHD)	15.40	16.69	17.97	18.80	18.67	19.42	18.86	22.93	18.19	20.34	21.44	21.85
Nat Surf (mAHD)	14.97	16.31	17.62	18.25	18.23	19.02	18.50	22.40	17.71	19.82	20.76	20.31
Installed	360 Env	360 Env	360 Env	360 Env	360 Env	360 Env	360 Env	360 Env	360 Env	360 Env	360 Env	DWER
Water Levels (mAHD)												
Date	CS01	CS02	CS03	CS04	CS05	CS06	CS07	CS08	CS09	CS10	CS11	T200
28-07-17	14.51	14.60	15.29	14.49	15.19	-	15.22	-	14.20	15.07	15.15	-
25-08-17	14.48	15.77	15.22	15.58	16.26	15.27	16.21	13.68	16.20	16.10	16.15	-
29-09-17	14.59	15.07	15.87	15.03	15.75	15.01	15.81	13.28	14.80	15.63	15.78	19.02
19-10-17	14.43	14.91	15.73	14.92	15.65	15.03	15.78	13.31	14.72	15.60	15.78	-
20-11-17	14.21	14.75	15.50	14.74	15.48	14.88	15.60	13.22	14.57	15.45	15.63	-
15-12-17	14.02	14.55	15.33	14.57	15.33	14.77	15.49	13.15	14.42	15.31	15.47	-
23-01-18	-	-	15.48	14.62	15.39	14.74	15.40	13.16	14.48	15.34	15.41	-
15-02-18	13.53	14.00	14.92	13.91	14.77	-	14.92	12.56	13.86	14.68	14.66	-
13-03-18	13.73	14.18	15.07	14.26	15.01	14.51	14.78	12.94	14.18	15.03	15.18	-
05-04-18	13.69	-	15.01	-	14.92	14.43	14.73	12.88	14.10	-	-	-
11-05-18	13.74	-	14.88	-	14.78	14.35	14.65	12.78	14.01	-	-	-
21-06-18	14.36	-	15.28	-	15.14	14.55	14.91	12.96	14.32	-	-	-
06-07-18	14.62	-	15.63	-	15.51	14.78	15.17	13.12	14.67	-	15.37	-
07-08-18	14.78	-	16.11	-	16.05	15.11	15.54	13.40	15.03	-	-	-
06-09-18	14.67	-	16.14	-	16.15	15.37	15.83	13.66	15.10	-	-	-


360 Environmental : Water Level Monitoring Data
16.50
16.00
15.50
15.00
14.50
14.00
13.50
13.00
12.50
12.00
14/06/2017
3/08/2017
22/09/2017
11/11/2017
31/12/2017
19/02/2018
10/04/2018
30/05/2018
19/07/2018
7/09/2018
27/10/2018
CS01
CS02
CS03
CS04
CS05
CS06
CS07
CS08
CS09
CS10
CS11

Bore ID	CS03

Parameter	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18	Jul-18	Aug-18	Sep-18	Oct-18	Summary Statistics			
																	Count	Min	Max	Mean
Field Parameters																				
Temp (celcius)			20.40			20.00				21.40			18.80				4	18.80	21.40	20.15
pH			8.20			4.54				5.10			5.22				4	4.54	8.20	5.77
Spec. Cond. (us/cm)						772.00				676.00			640.00				3	640.00	772.00	696.00
EC (us/cm)			366.4			700.0				630.0			564.0				4	366.40	700.00	565.10
Salinity (PSS)			0.2			0.4				0.3			0.3				4	0.19	0.38	0.30
TDS (mg/L)			260.05			500.50				442.00			416.00				4	260.05	500.50	404.64
Redox (mV)			88.30			-61.20				-62.70			-34.60				4	-62.70	88.30	-17.55
DO(%)			17.00			14.30				55.70			20.00				4	14.30	55.70	26.75
DO (mg/L)			1.500			0.970				3.750			1.600				4	0.97	3.75	1.96
Nutrients (mg/L)																				
NH3 (Ammonia as N) (mg/L)			0.10			0.17				0.31			0.18				4	0.10	0.31	0.19
NO2 (Nitrite) (mg/L)						**0.01**				**0.01**			**0.01**				3	0.01	0.01	0.01
NO3 (Nitrate) (mg/L)						0.14				0.17			0.10				3	0.10	0.17	0.14
NOx (NO3 + NO2) (mg/L)			0.08			0.14				0.17			0.10				4	0.08	0.17	0.12
TKN (mg/L)			3.00			4.40				4.60			2.90				4	2.90	4.60	3.73
TN (mg/L)			3.10			4.50				4.80			3.00				4	3.00	4.80	3.85
TP (mg/L)			0.14			0.23				0.28			0.28				4	0.14	0.28	0.23
OrthoP (mg/L)			0.13			0.22				0.27			0.25				4	0.13	0.27	0.22
Dissolved Metals (groundwater) (mg/L)																				
Aluminium			1.24														1	1.24	1.24	1.24
Asenic			**0.001**														1	0.00	0.00	0.00
Cadmium			**0.0001**														1	0.00	0.00	0.00
Chromium			0.004														1	0.00	0.00	0.00
Copper			0.001														1	0.00	0.00	0.00
Lead			**0.001**														1	0.00	0.00	0.00
Nickel			0.001														1	0.00	0.00	0.00
Zinc			0.015														1	0.02	0.02	0.02
Iron			0.3														1	0.30	0.30	0.30
Mercury			**0.0001**														1	0.00	0.00	0.00

less than detectable limit (calculation of statistics use detectable limit as measured value, hence min,max and mean are conservative estimates where limit of detection readings exist)

Bore ID	CS06

Parameter	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18	Jul-18	Aug-18	Sep-18	Oct-18	Summary Statistics			
																	Count	Min	Max	Mean
Field Parameters																				
Temp (celcius)			16.70			19.70											2	16.70	19.70	18.20
pH			5.17			4.14											2	4.14	5.17	4.66
Spec. Cond. (us/cm)						230.10											1	230.10	230.10	230.10
EC (us/cm)			422.0			206.7											2	206.70	422.00	314.35
Salinity (PSS)			0.2			0.1											2	0.11	0.24	0.18
TDS (mg/L)			325.65			149.85											2	149.85	325.65	237.75
Redox (mV)			146.20			160.20											2	146.20	160.20	153.20
DO(%)			21.00			22.60											2	21.00	22.60	21.80
DO (mg/L)			2.000			1.700											2	1.70	2.00	1.85
Nutrients (mg/L)																				
NH3 (Ammonia as N) (mg/L)			0.07			0.08											2	0.07	0.08	0.08
NO2 (Nitrite) (mg/L)						0.01											1	0.01	0.01	0.01
NO3 (Nitrate) (mg/L)						0.65											1	0.65	0.65	0.65
NOx (NO3 + NO2) (mg/L)			4.23			0.66											2	0.66	4.23	2.45
TKN (mg/L)			1.50			0.50											2	0.50	1.50	1.00
TN (mg/L)			5.70			1.20											2	1.20	5.70	3.45
TP (mg/L)			0.10			0.06											2	0.06	0.10	0.08
OrthoP (mg/L)			**0.01**			**0.01**											2	0.01	0.01	0.01
Dissolved Metals (groundwater) (mg/L)																				
Aluminium			8.25														1	8.25	8.25	8.25
Asenic			**0.001**														1	0.00	0.00	0.00
Cadmium			**0.0001**														1	0.00	0.00	0.00
Chromium			**0.001**														1	0.00	0.00	0.00
Copper			**0.001**														1	0.00	0.00	0.00
Lead			0.001														1	0.00	0.00	0.00
Nickel			0.013														1	0.01	0.01	0.01
Zinc			0.22														1	0.22	0.22	0.22
Iron			0.94														1	0.94	0.94	0.94
Mercury			**0.0001**														1	0.00	0.00	0.00

less than detectable limit (calculation of statistics use detectable limit as measured value, hence min,max and mean are conservative estimates where limit of detection readings exist)

Bore ID	CS09

Parameter	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18	Jul-18	Aug-18	Sep-18	Oct-18	Summary Statistics			
																	Count	Min	Max	Mean
Field Parameters																				
Temp (celcius)			18.90			20.30				26.80			18.80				4	18.80	26.80	21.20
pH			6.73			3.81				5.54			3.90				4	3.81	6.73	5.00
Spec. Cond. (us/cm)						825.00				651.00			232.80				3	232.80	825.00	569.60
EC (us/cm)			117.0			758.0				675.0			205.0				4	117.00	758.00	438.75
Salinity (PSS)			0.1			0.4				0.3			0.1				4	0.06	0.41	0.22
TDS (mg/L)			84.50			593.50				422.50			151.45				4	84.50	593.50	312.99
Redox (mV)			138.60			120.20				61.60			168.10				4	61.60	168.10	122.13
DO(%)			27.00			27.20				103.00			78.00				4	27.00	103.00	58.80
DO (mg/L)			2.500			1.680				8.190			7.200				4	1.68	8.19	4.89
Nutrients (mg/L)																				
NH3 (Ammonia as N) (mg/L)			0.05			0.06				0.17			0.05				4	0.05	0.17	0.08
NO2 (Nitrite) (mg/L)						**0.01**				**0.01**			**0.01**				3	0.01	0.01	0.01
NO3 (Nitrate) (mg/L)						**0.01**				0.13			0.25				3	0.01	0.25	0.13
NOx (NO3 + NO2) (mg/L)			1.36			**0.01**				0.13			0.25				4	0.01	1.36	0.44
TKN (mg/L)			4.10			2.00				5.20			3.30				4	2.00	5.20	3.65
TN (mg/L)			5.50			2.00				5.30			3.60				4	2.00	5.50	4.10
TP (mg/L)			0.37			0.13				0.78			0.33				4	0.13	0.78	0.40
OrthoP (mg/L)			**0.01**			**0.01**				**0.01**			**0.01**				4	0.01	0.01	0.01
Dissolved Metals (groundwater) (mg/L)																				
Aluminium			2.51														1	2.51	2.51	2.51
Asenic			**0.001**														1	0.00	0.00	0.00
Cadmium			**0.0001**														1	0.00	0.00	0.00
Chromium			0.003														1	0.00	0.00	0.00
Copper			**0.001**														1	0.00	0.00	0.00
Lead			**0.001**														1	0.00	0.00	0.00
Nickel			0.002														1	0.00	0.00	0.00
Zinc			0.006														1	0.01	0.01	0.01
Iron			0.91														1	0.91	0.91	0.91
Mercury			**0.0001**														1	0.00	0.00	0.00

less than detectable limit (calculation of statistics use detectable limit as measured value, hence min,max and mean are conservative estimates where limit of detection readings exist)

Bore ID	CS11

Parameter	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18	Jul-18	Aug-18	Sep-18	Oct-18	Summary Statistics			
																	Count	Min	Max	Mean
Field Parameters																				
Temp (celcius)			19.80			21.40				22.10			19.90				4	19.80	22.10	20.80
pH			6.42			5.49				5.47			5.18				4	5.18	6.42	5.64
Spec. Cond. (us/cm)						348.10				331.10			291.30				3	291.30	348.10	323.50
EC (ms/cm)			237.0			325.4				312.4			262.8				4	237.00	325.40	284.40
Salinity (PSS)			0.1			0.2				0.2			0.1				4	0.13	0.17	0.15
TDS (mg/L)			170.95			227.50				215.15			189.15				4	170.95	227.50	200.69
Redox (mV)			59.70			101.90				107.60			19.90				4	19.90	107.60	72.28
DO(%)			27.00			49.70				87.10			50.00				4	27.00	87.10	53.45
DO (mg/L)			2.500			3.610				7.410			4.500				4	2.50	7.41	4.51
Nutrients (mg/L)																				
NH3 (Ammonia as N) (mg/L)			0.04			**0.01**				0.04			**0.01**				4	0.01	0.04	0.03
NO2 (Nitrite) (mg/L)						0.02				**0.01**			**0.01**				3	0.01	0.02	0.01
NO3 (Nitrate) (mg/L)						4.10				4.48			6.37				3	4.10	6.37	4.98
NOx (NO3 + NO2) (mg/L)			3.56			4.12				4.48			6.37				4	3.56	6.37	4.63
TKN (mg/L)			0.70			1.00				0.90			1.10				4	0.70	1.10	0.93
TN (mg/L)			4.30			5.10				5.40			7.50				4	4.30	7.50	5.58
TP (mg/L)			0.04			0.14				0.08			0.12				4	0.04	0.14	0.10
OrthoP (mg/L)			**0.01**			**0.01**				0.02			**0.01**				4	0.01	0.02	0.01
Dissolved Metals (groundwater) (mg/L)																				
Aluminium			0.26														1	0.26	0.26	0.26
Asenic			**0.001**														1	0.00	0.00	0.00
Cadmium			**0.0001**														1	0.00	0.00	0.00
Chromium			0.001														1	0.00	0.00	0.00
Copper			**0.001**														1	0.00	0.00	0.00
Lead			**0.001**														1	0.00	0.00	0.00
Nickel			**0.001**														1	0.00	0.00	0.00
Zinc			0.011														1	0.01	0.01	0.01
Iron			0.11														1	0.11	0.11	0.11
Mercury			**0.0001**														1	0.00	0.00	0.00

less than detectable limit (calculation of statistics use detectable limit as measured value, hence min,max and mean are conservative estimates where limit of detection readings exist)

APPENDIX E
Landscape Plans (Emerge Associates)

1 PLAYING FIELD
- Shared use by residents and adjoining Primary School
- Irrigated turf and native planting
- 1 yr drainage basin

2 ACTIVE POS
- Shelter and picnic facilities
- Adventure Playground
- Retained trees and vegetation
- Passive POS with 1 yr drainage basin
- Pedestrian links to adjacent residential and POS
- Irrigated native planting and turf

3 DRAINAGE POS
- 1 yr drainage basin
- Pedestrian links to adjoining CCW Buffer tracks
- Non-irrigated native planting

4 PASSIVE POS
- Located between Western Power easement and CCW Buffer
- Irrigated native planting and turf areas
- Connections from residential lots through WPE

5 DRAINAGE POS
- Native non-irrigated planting
- 1 yr drainage basin

6 DRAINAGE POS
- 1 yr drainage basin
- Pedestrian links to adjacent residential lots
- Irrigated native planting and turf

7 POS FOR VEGETATION RETENTION
- Retained trees and vegetation
- Weed eradication and revegetation as appropriate
- Limestone firebreaks
- Located adjacent to Bush Forever site

8 PASSIVE POS
- Irrigated native planting
- No drainage function

9 RESOURCE ENHANCEMENT WETLAND (REW)
- Existing trees to be retained
- Weed eradication and revegetation as required
- 1 yr drainage basin located in 30m wide REW Buffer

D7 CONSERVATION CATEGORY WETLAND (CCW)
- Minimal landscape works to take place
- Weed eradication and revegetation as required

D8 CONSERVATION CATEGORY WETLAND BUFFER
- Native non-irrigated planting and revegetation as required
- Weed eradication
- Limestone footpaths/firebreaks (dual function)

D10 WESTERN POWER EASEMENT
- Typically no trees or planting >1m height
- Non-irrigated native planting and revegetation as required
- Irrigated turf area connection to POS 4 (subject to WP/CoK approvals)
- Limestone access tracks to Western Power towers
- 1:100 basin in this location

LEGEND

STRUCTURE PLAN EXTENTS

RESIDENTIAL LOTS

NON-RESIDENTIAL LAND USE

1 YR 1 HR DRAINAGE BASIN

WESTERN POWER TOWER

PICNIC AND PLAYGROUND NODE

ORTON ROAD

BOMBAY BLVD

KWINANA FREEWAY

LANDGREN ROAD

LUGG PLACE

PLAYING FIELD

PRIMARY SCHOOL

WESTERN POWER EASEMENT

BASIN C: VOLUME 74m3

BASIN B: VOLUME 538m3

RESOURCE ENHANCEMENT WETLAND (REW)

30m REW BUFFER

BASIN F: VOLUME 145m3

BASIN D: VOLUME 542m3

BASIN A: VOLUME 74m3

CONSERVATION CATEGORY WETLAND (CCW)

50m CCW BUFFER

BASIN E: VOLUME 165m3

CASUARINA CENTRAL PRECINCT

LANDSCAPE MASTERPLAN

DWG ORC-01-C01
REV B
DATE NOV 2018
SCALE 1 : 2500 @ A1

0 25 50 75 100 m

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emerge ASSOCIATES

APPENDIX F
Runoff Rate Calculator

CURRV

Calculator for Urban Runoff Rates & Volumes

20/11/2018

hydro HYDROLOGY

Project: PRM Casuarina

	Land Use Description	Area (ha)	Use in Calc	Imperv Initial mm	Perv Initial mm	Perv Contin mm/hr	On Site Soak (mm)	Empty (days)	AR&R EIA/TIA System Connect	Roof %	Ext Imp %	Ext Perv %	Comment
1	Residential Lots	38.33	Yes	1.5	20.0	4.0	15.0	1.00	60%	62	18	20	soakwells
2	Urban Residential Road Reserve	21.22	Yes	1.5	20.0	4.0	0.0	1.00	100%	0	70	30	assuming no raingardens
3	POS Area	7.19	Yes	1.5	20.0	4.0	0.0	1.00	30%	0	5	95	assumes similar to rural res
4	Non Residential	6.29	Yes	1.5	20.0	4.0	15.0	1.00	80%	60	35	5	assumes commercial with soakwells
5	School		No	1.5	20.0	4.0		1.00					assumed to look after own stormwater
6	Powerline Corridor		No	1.5	20.0	4.0		1.00					assumed to look after own stormwater
7	Wetlands & Buffer		No	1.5	20.0	4.0		1.00					assumed to look after own stormwater
8				1.5	20.0	4.0		1.00					
9				1.5	20.0	4.0		1.00					
10				1.5	20.0	4.0		1.00					
		73.03											

Land Use Graph Selector	11

(11 - combined total)

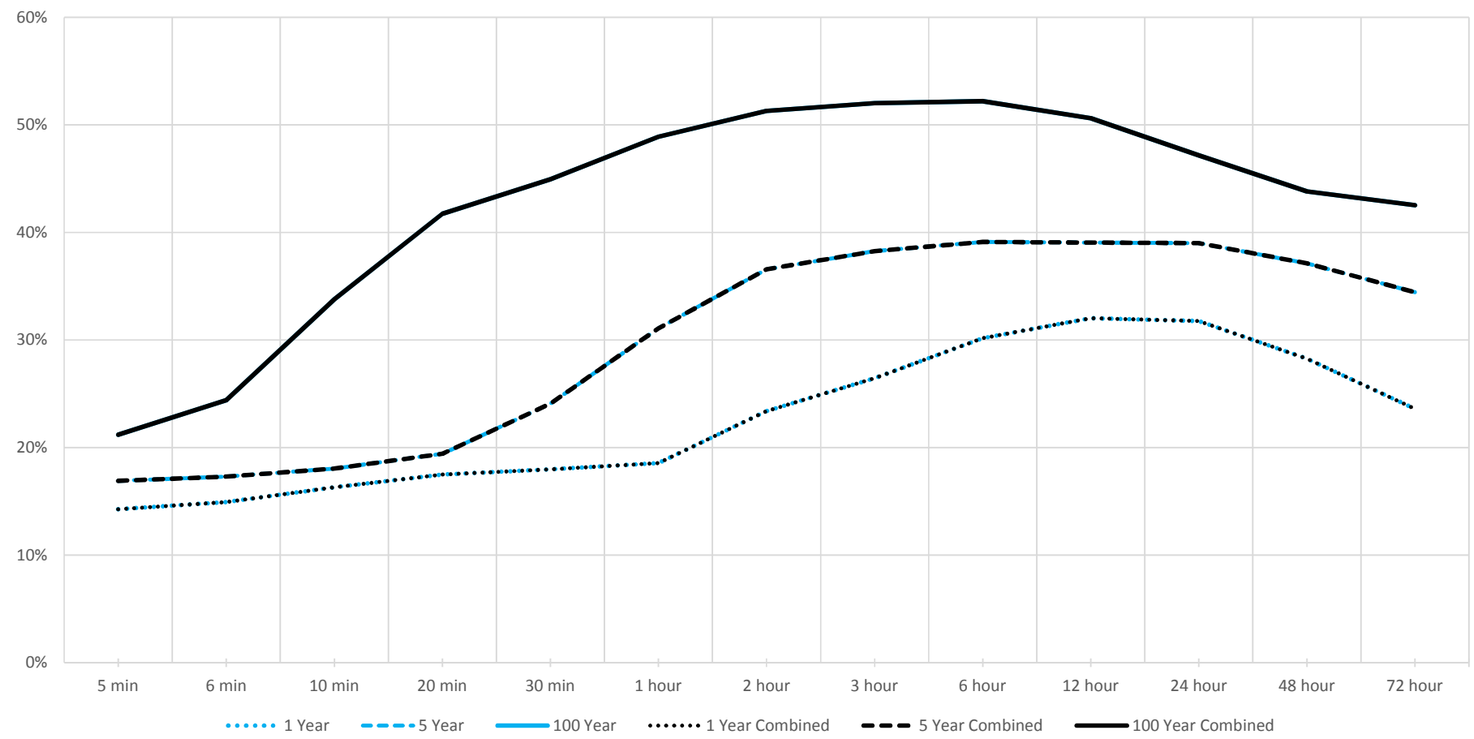
combined total

Rainfall IFD Data (based on ARR87)

	1	2	5	10	20	50	100
5 min	4.9	6.5	8.6	10.1	12.2	15.3	17.9
6 min	5.5	7.3	9.6	11.3	13.6	17.0	20.0
10 min	7.4	9.7	12.6	14.7	17.7	21.8	25.5
20 min	10.3	13.4	17.1	19.7	23.3	28.6	33.1
30 min	12.2	15.9	20.1	22.9	27.0	32.9	37.9
1 hour	16.0	20.6	25.7	29.1	34.1	41.1	47.0
2 hour	20.6	26.4	32.6	36.6	42.4	50.8	57.8
3 hour	23.8	30.6	37.2	41.7	48.3	57.6	65.1
6 hour	30.5	39.0	47.1	52.5	60.6	71.4	81.0
12 hour	39.2	50.0	60.2	67.1	77.0	91.1	102.6
24 hour	50.4	64.3	78.0	87.1	100.6	119.3	135.1
48 hour	62.9	80.6	99.8	112.3	131.0	157.4	179.0
72 hour	69.3	90.0	111.6	126.7	148.3	179.3	204.5

Maximum Estimated Runoff Rates

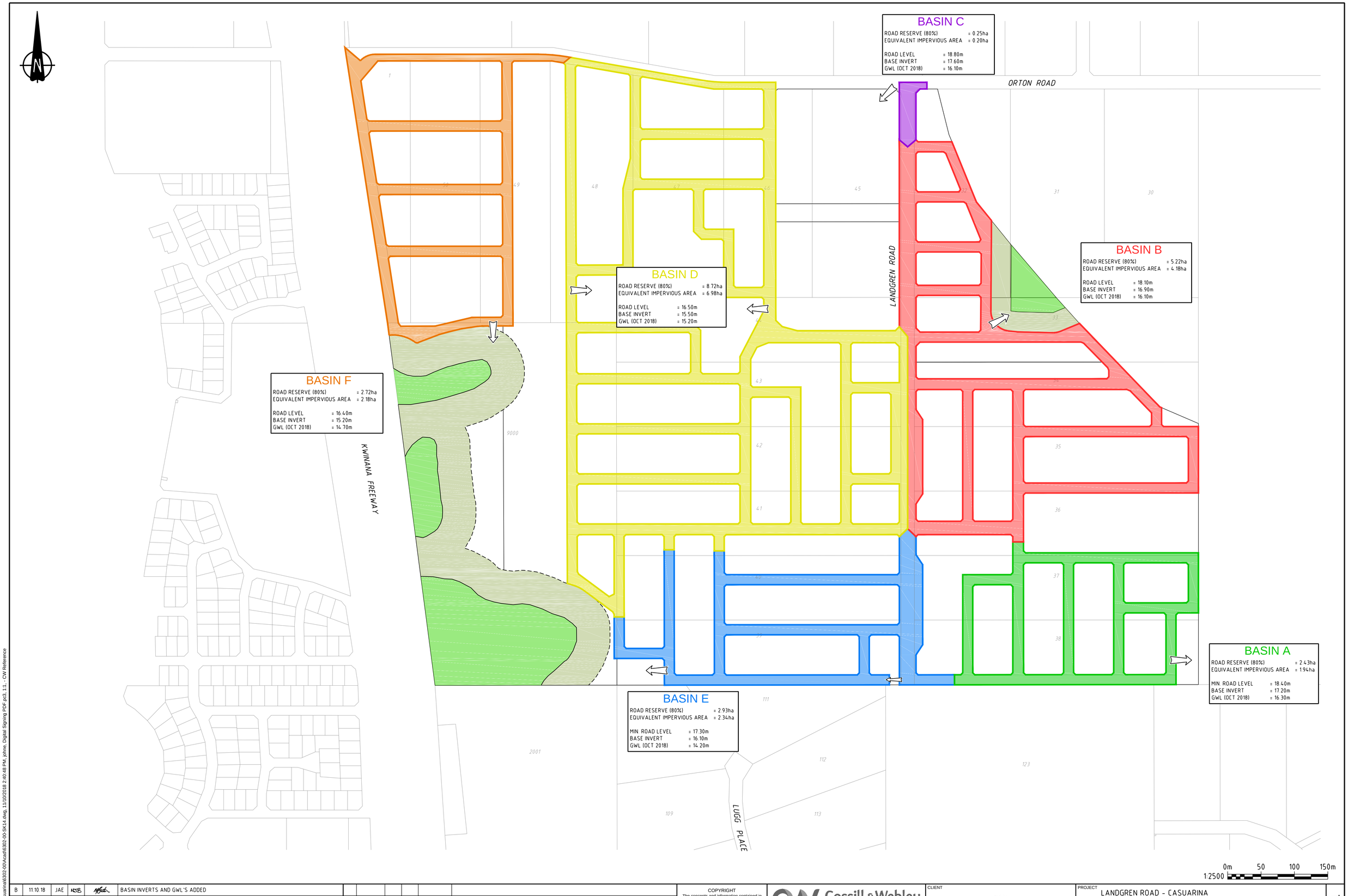
	1	2	5	10	20	50	100
Residential Lots	**19%**	25%	**29%**	**31%**	35%	39%	**41%**
Urban Residential Road Reserve	**68%**	69%	**71%**	**74%**	78%	82%	**84%**
POS Area	**1%**	1%	**5%**	**8%**	11%	14%	**16%**
Non Residential	**30%**	40%	**46%**	**49%**	53%	57%	**60%**
School	**0%**	0%	**0%**	**0%**	0%	0%	**0%**
Powerline Corridor	**0%**	0%	**0%**	**0%**	0%	0%	**0%**
Wetlands & Buffer	**0%**	0%	**0%**	**0%**	0%	0%	**0%**
0	**0%**	0%	**0%**	**0%**	0%	0%	**0%**
0	**0%**	0%	**0%**	**0%**	0%	0%	**0%**
0	**0%**	0%	**0%**	**0%**	0%	0%	**0%**
combined total	**32%**	36%	**39%**	**42%**	46%	50%	**52%**



REVISED 2016 IFD

Duration	63.20%	50%#	20%*	10%	5%	2%	1%
1 min	1.85	2.04	2.66	3.09	3.53	4.13	4.61
2 min	3.26	3.56	4.52	5.21	5.9	6.85	7.6
3 min	4.36	4.77	6.1	7.04	8	9.31	10.3
4 min	5.26	5.77	7.43	8.6	9.8	11.4	12.7
5 min	6.02	6.62	8.57	9.94	11.3	13.2	14.8
10 min	8.71	9.62	12.6	14.7	16.7	19.6	21.9
15 min	10.5	11.6	15.2	17.7	20.2	23.7	26.4
20 min	11.9	13.1	17.1	19.9	22.8	26.6	29.7
25 min	13	14.3	18.7	21.7	24.8	29	32.3
30 min	14	15.4	20	23.3	26.6	31	34.6
45 min	16.3	18	23.2	26.9	30.7	35.9	40.1
1 hour	18.2	20	25.7	29.8	34	39.8	44.5
1.5 hour	21.1	23.1	29.6	34.4	39.3	46.2	51.8
2 hour	23.5	25.6	32.8	38.1	43.6	51.5	57.9
3 hour	27.1	29.6	37.9	44.1	50.7	60.2	68.2
4.5 hour	31.3	34.1	43.8	51.2	59.1	70.7	80.6
6 hour	34.5	37.6	48.5	56.8	65.8	79.1	90.5
9 hour	39.4	43.1	55.8	65.6	76.3	92.1	106
12 hour	43.2	47.3	61.4	72.3	84.1	102	117
18 hour	48.8	53.5	69.7	82.1	95.4	115	132
24 hour	53	58.1	75.8	89.1	103	124	141
30 hour	56.3	61.9	80.5	94.4	109	130	148
36 hour	59.2	65	84.5	98.8	114	135	153
48 hour	64.1	70.4	90.9	106	121	142	159
72 hour	72.2	79.1	101	116	131	152	168

APPENDIX G
Earthworks Plan (Cossill & Webley Engineers)



REV	DATE	DRN	CKD	APP	AMENDMENT
B	11.10.18	JAE	NB		BASIN INVERTS AND GWL'S ADDED
A	10.10.18	JAE	NB	N. BUTSON	ISSUED FOR INFORMATION

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CLIENT: PRM

APPROVED: NATHAN BUTSON 10.10.18

DESIGNED: JAE

SCALE: 1:2500

PROJECT: LANDGREN ROAD - CASUARINA

TITLE: DRAINAGE STRATEGY OPTION E

WAPC No.

DRAWING No.: 6302-00-SK14

REVISION: B

ORIGINAL SIZE: A1

P:\6302 Landgren Road Casuarina\6302-00\Acad\6302-00-SK14.dwg, 11/10/2018 2:40:48 PM, johne, Digital Signing PDF.pc3, 1:1, - CW Reference

APPENDIX G
TRAFFIC ASSESSMENT

LWP PROPERTY GROUP

CASUARINA CENTRAL PRECINCT
STRUCTURE PLAN
TRAFFIC ASSESSMENT

December 2018

Riley Consulting Pty Ltd
PO Box Z5578
Perth WA 6831
0413 607 779 Mobile

Issued on	11 December 2018	Amendment	Date
Version	V1A	A Client name change	11-12-18
Reference	976		

CONTENTS

1. CHECKLIST 3

2. INTRODUCTION AND BACKGROUND 4

3. THE EXISTING TRANSPORT NETWORK 5

4. STRUCTURE PLAN PROPOSAL 9

5. CHANGES TO EXTERNAL TRANSPORT NETWORKS 10

6. INTEGRATION WITH SURROUNDING AREA 10

7. ANALYSIS OF INTERNAL TRANSPORT NETWORK 10

8. ROADS AND INTERSECTIONS 14

9. PEDESTRIAN AND CYCLE NETWORKS 15

10. SAFE WALK/CYCLE TO SCHOOL ASSESSMENT 16

11. PEDESTRIAN PERMEABILITY AND EFFICIENCY 17

12. ACCESS TO PUBLIC TRANSPORT 17

13. TRAFFIC FLOWS ON EXTERNAL ROAD NETWORKS 17

14. STAGING 17

1. CHECKLIST

Item	Included	Comments
Introduction/Background		
Regional context	✔	
Proposed land uses	✔	@990 residential lots + commercial
Table of land uses and quantities	✔	
Major attractors / generators	✔	
Existing situation		
Existing land uses within structure plan	✔	
Existing land uses within 800 metres of structure plan area	✔	
Existing road network within structure plan area	✔	
Existing pedestrian/cycle networks within structure plan area	✔	
Existing public transport services within structure plan area	✔	
Existing road network within 2 (or 5) km of structure plan area	✔	
Traffic flows on roads within structure plan area (peak hours)	✔	
Traffic flows on roads within 2 (or 5) km (peak hours)	✔	
Existing pedestrian/cycle networks within 800m	✔	
Existing public transport services within 800m	✔	
Proposed internal transport networks		
Changes/additions to existing road network	✔	
proposed new road network	✔	
Road reservation widths	✔	
Road cross-sections & speed limits	✔	
Intersection controls	✔	
Pedestrian/cycle networks and crossing facilities	✔	
Public transport routes	✔	
Changes to external transport networks		None proposed
Integration with surrounding area		
Trip attractors/generators within 800 metres	✔	
Proposed changes to land uses within 800 metres	✔	
Travel desire lines to attractors/generators	✔	
Adequacy of external transport networks	✔	
Deficiencies in external transport networks	✔	
Remedial measures to address deficiencies	✔	
Analysis of internal transport networks		
Assessment year(s) and time period(s)	✔	
Structure plan generated traffic	✔	
Extraneous (through) traffic	✔	
Design traffic flows (total traffic)	✔	
Road cross-sections	✔	
Intersection controls	✔	
Access strategy	✔	
Pedestrian/cycle networks	✔	
Safe routes to schools	✔	
Pedestrian permeability & deficiency	✔	
Access to public transport	✔	
Analysis of external transport network		
Extent of analysis	✔	
Base flows for assessment year(s)	✔	
Total traffic flows	✔	
Road cross-sections	✔	
Intersection layouts & controls	✔	
Pedestrian/cycle networks	✔	

2. INTRODUCTION AND BACKGROUND

2.1. Riley Consulting has been commissioned by LWP Property Group to prepare a structure plan traffic report for the development of land in the locality of Casuarina, referred to as the Casuarina central precinct.

2.2. The area of interest to this report lies to the south of Orton Road and north of Mortimer Road, adjacent to the Kwinana Freeway.

2.3. The land area covered by the structure plan is currently rural in nature with some residential dwellings. Figure 1 indicatively shows the site location.

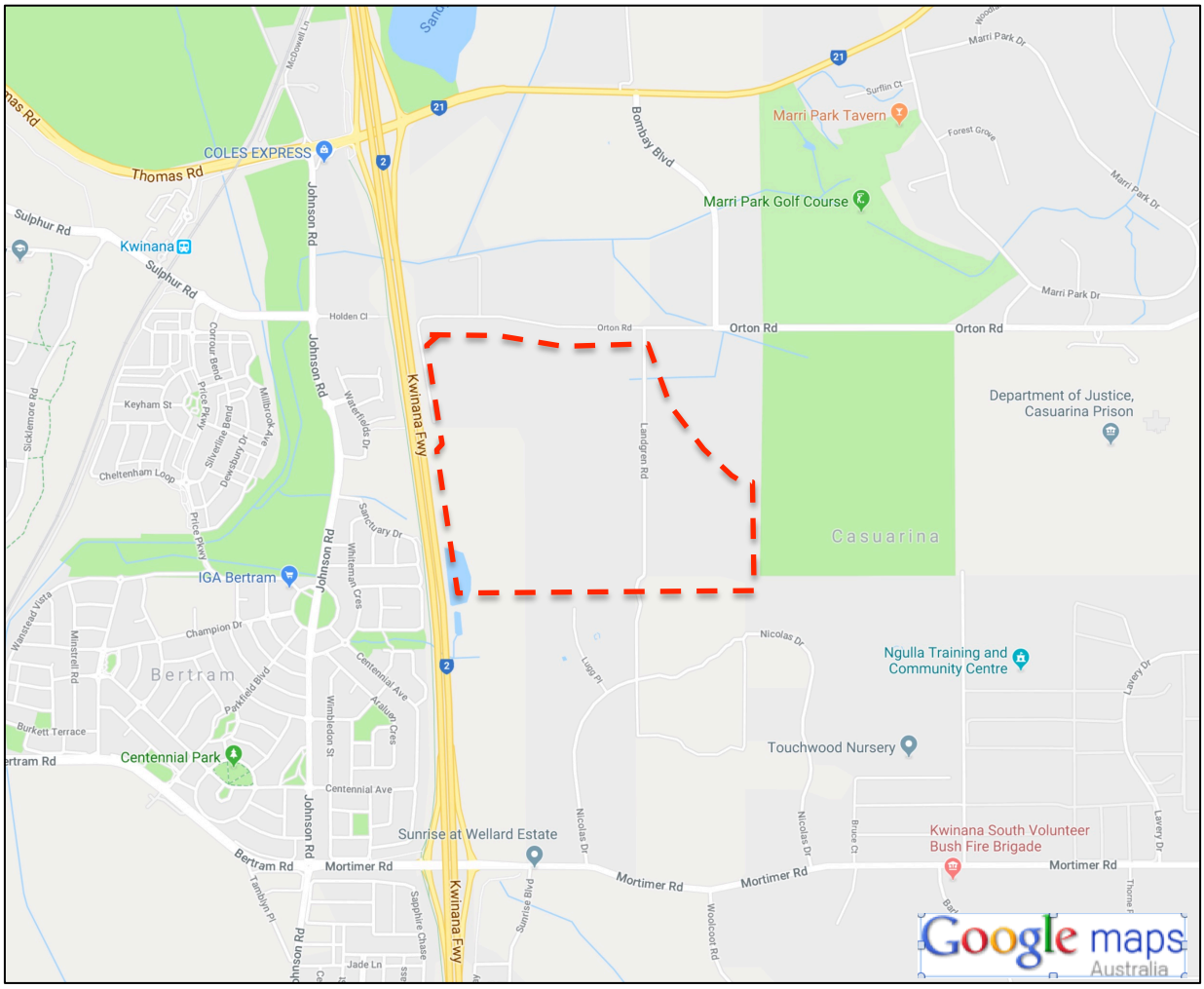


Figure 1 Site Location (Area Indicative)

3. THE EXISTING TRANSPORT NETWORK

3.1. The existing transport network is discussed below and considers the road network and public transport.

3.2. Due to the rural nature of the land holding there are no bus routes, footpaths or cycle paths in close proximity. Roads of importance are discussed below.

Landgren Road

3.3. Landgren Road is classified as an access street in the Main Roads *Functional Road Hierarchy south of Orton Road.* It is constructed with a single pavement of approximately 6.0 metres and is subject to the residential speed limit of 50kph.

3.4. Landgren Road is constructed to the southern boundary of the subject land.

3.5. No traffic data is available for Landgren Road, but as a cul-de-sac a daily flow of less than 500 vehicles can be expected. As a result of the structure plan, Landgren Road will be created as a main link between Thomas Road and Mortimer Road.

Orton Road

3.6. Orton Road is classified as an access street in the Main Roads *Functional Road Hierarchy* between Bombay Boulevard and the Kwinana Freeway. East of Bombay Boulevard it is classified as a local distributor road. It is constructed with a single pavement of approximately 7.0 metres and is subject to a 70kph speed limit west of Bombay Road. East of Bombay Road the limit is 90kph. However as a road within a rural environment higher traffic speeds could be anticipated.

3.7. Traffic data is available for the section of Orton Road within the study area and show 533 vehicles per day (vpd) to the west of Bombay Boulevard.

3.8. Current land uses include 9 rural residential lots and a food factory (Costa Mushrooms). The 9 dwellings would generate about 90 trips per day, indicating the factory would be anticipated to generate about 450 vehicle movements per day).

3.9. MRWA traffic data for Orton Road to the east of the study area indicates 700vpd.

3.10. As a single lane road it would have capacity to carry up to 13,500vpd at Level of Service D.

Bombay Boulevard

3.11. Bombay Boulevard is classified as an access street in the Main Roads *Functional Road Hierarchy* and is constructed with a single rural standard pavement of about 7.0 metres.

3.12. It provides a link between Thomas Road and Orton Road where access to the structure plan area will be taken.

3.13. Traffic data available for Bombay Boulevard indicates 1,446vpd. The traffic flow fits well with the expectations of current use.

3.14. As a single lane road it would have capacity to carry up to 13,500vpd at Level of Service D.

Mortimer Road

3.15. Mortimer Road is classified as a regional distributor road Main Roads *Functional Road Hierarchy*. It is constructed with a single pavement of about 8.5 metres. It provides an east west connection to the Kwinana Freeway. Traffic data on the Main Roads website indicates 4,9143vpd (2017) refer Appendix A.

3.16. As a single lane road it would have capacity to carry up to 13,500vpd at Level of Service D refer Appendix B.

Thomas Road

3.17. Thomas Road is a Primary Regional Road under the control of Main Roads WA. It provides a regional link between Armadale in the east to Kwinana in the west. It is constructed with a single pavement of about 7.5 metres and would have capacity to carry up to 22,000vpd (13,500vpd at Level of Service D) refer Appendix B.

3.18. Traffic data on the Main Roads website indicates a daily traffic demand of 17,622vpd (2017) refer Appendix A.

Kwinana Freeway

3.19. The Kwinana Freeway is a Primary Regional Road under the control of Main Roads WA. It provides a regional link between Perth and the South West of the State. It is constructed with four lanes adjacent to Casuarina and carries 75,851vpd (2017) between Thomas Road and Mortimer Road.

Public Transport

3.20. There are no existing public transport services within the study area.

3.21. The subject land holding is approximately 1.6km from Kwinana railway station as the crow flies. However by public road it is just over 3km.

3.22. Figure 3 shows the current public transport routes in the locality.

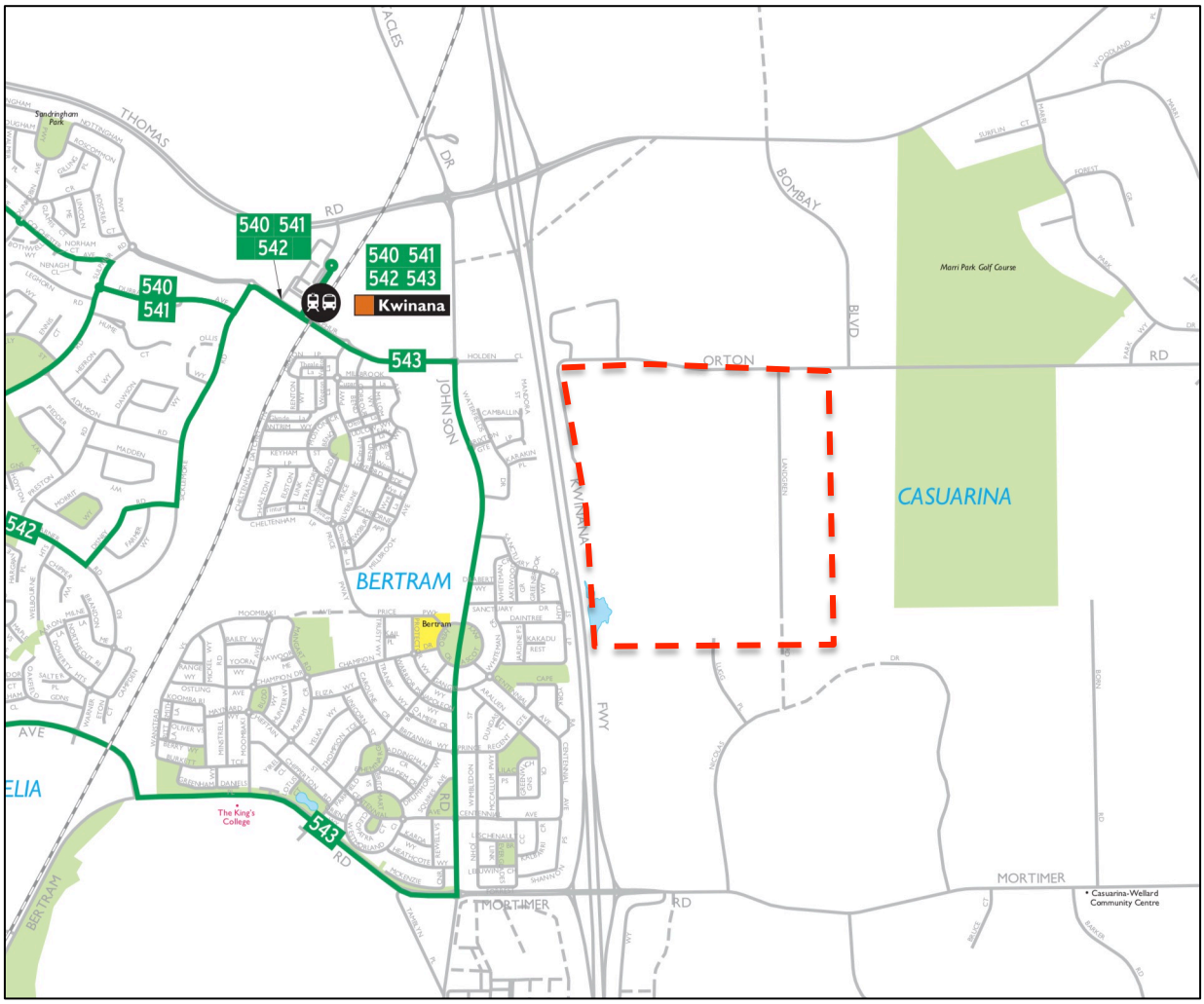


Figure 3 **Public Transport Network** (land area indicative)

Cycling

3.23. There are no cycle facilities in the local area at present.

3.24. A regional cycle path is provided to the west side of the Kwinana Freeway that can be accessed at Thomas Road and Mortimer Road.

3.25. The Western Australian Bicycle Network Plan (2014-2031) set out to provide a principal shared route along Orton Road to connect Byford / Mundijong to Rockingham. Figure 4 shows the future planning.

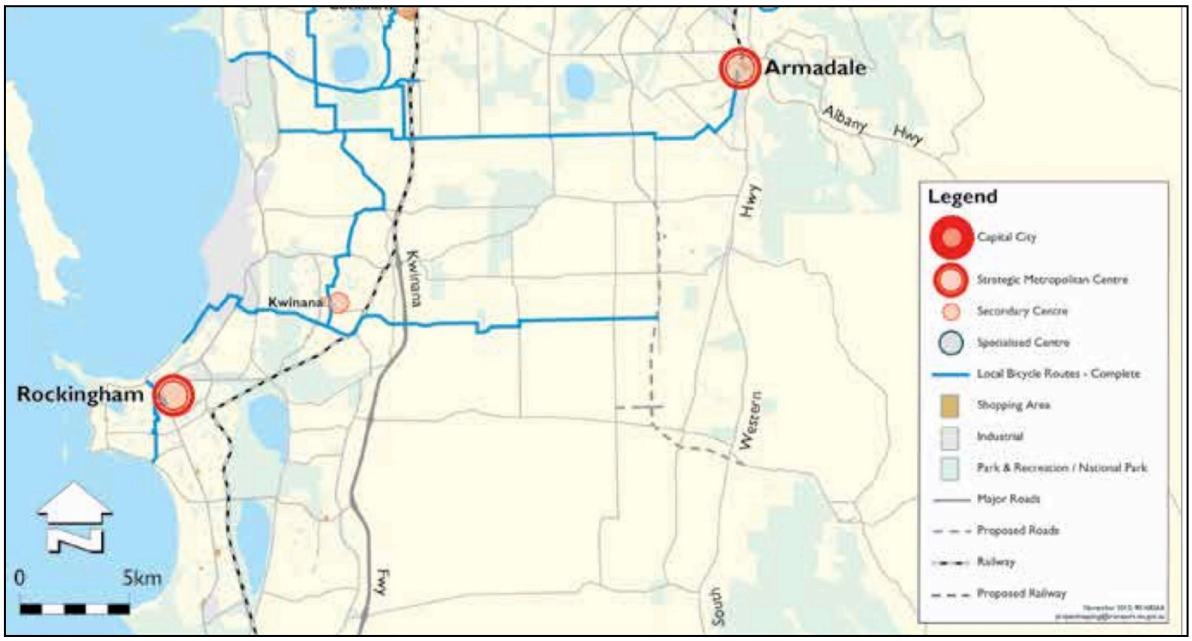


Figure 4 The Western Australian Bicycle Network Plan (2014-2031

4. STRUCTURE PLAN PROPOSAL

4.1. The area of the structure plan lies to the south of Orton Road and north of Mortimer Road. Figure 5 shows the structure plan.

4.2. The structure plan sets out to create residential dwellings with a small pocket of commercial activity. A single public oval and primary school is shown in the concept plan.

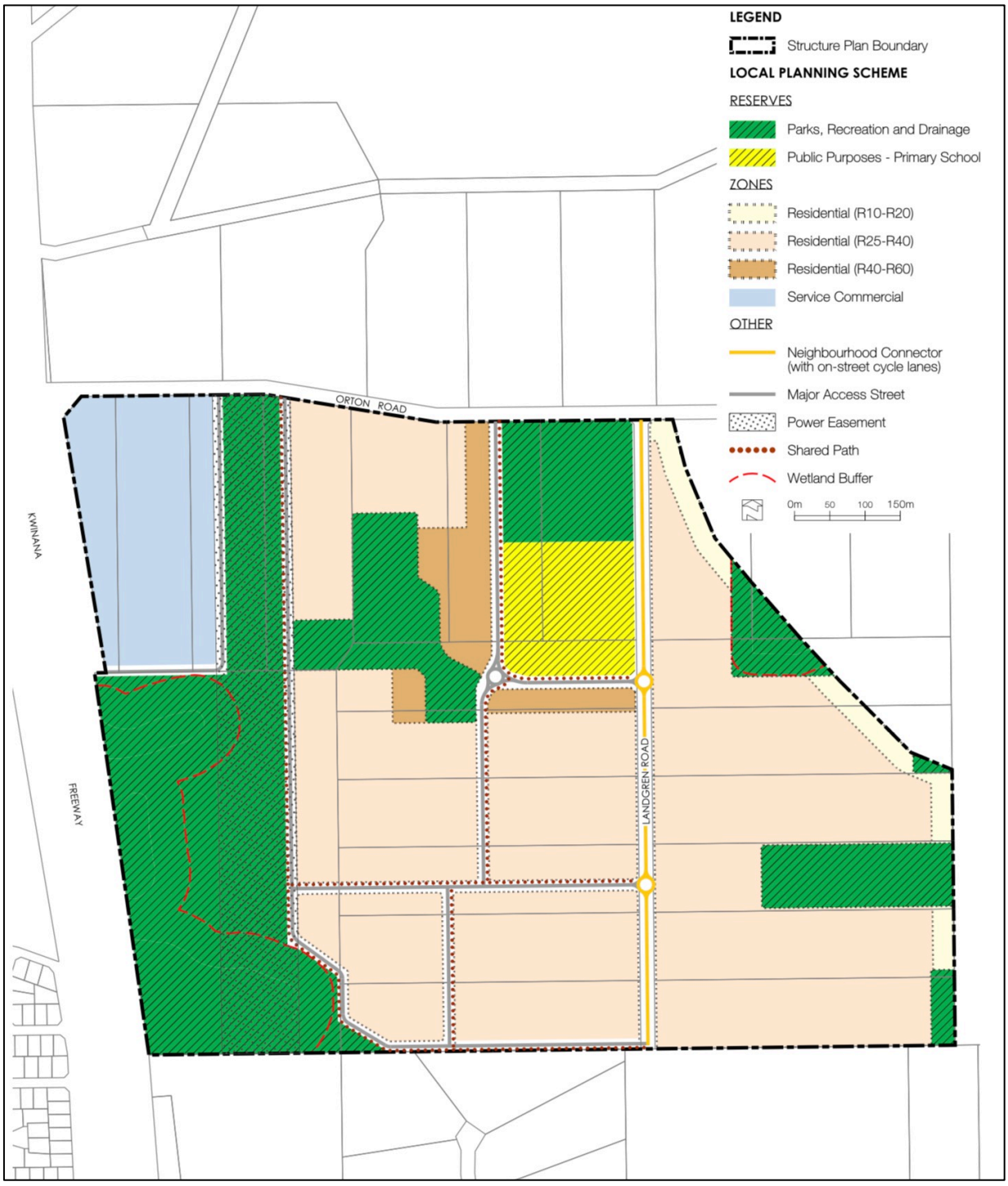


Figure 5 **Development Concept Plan** (reference only)

5. CHANGES TO EXTERNAL TRANSPORT NETWORKS

5.1. There are no current proposals to amend the external road network as part of this structure plan.

5.2. Future development to the north and south will require structure planning and this report is cognisant of potential future development.

5.3. The northern precinct has recently lodged a structure plan to create a commercial precinct adjacent to Thomas Road. Figure 6 shows an extract of the planned northern road connections. New connections to Thomas Road are proposed, but at this time the subject land cannot access these new roads.

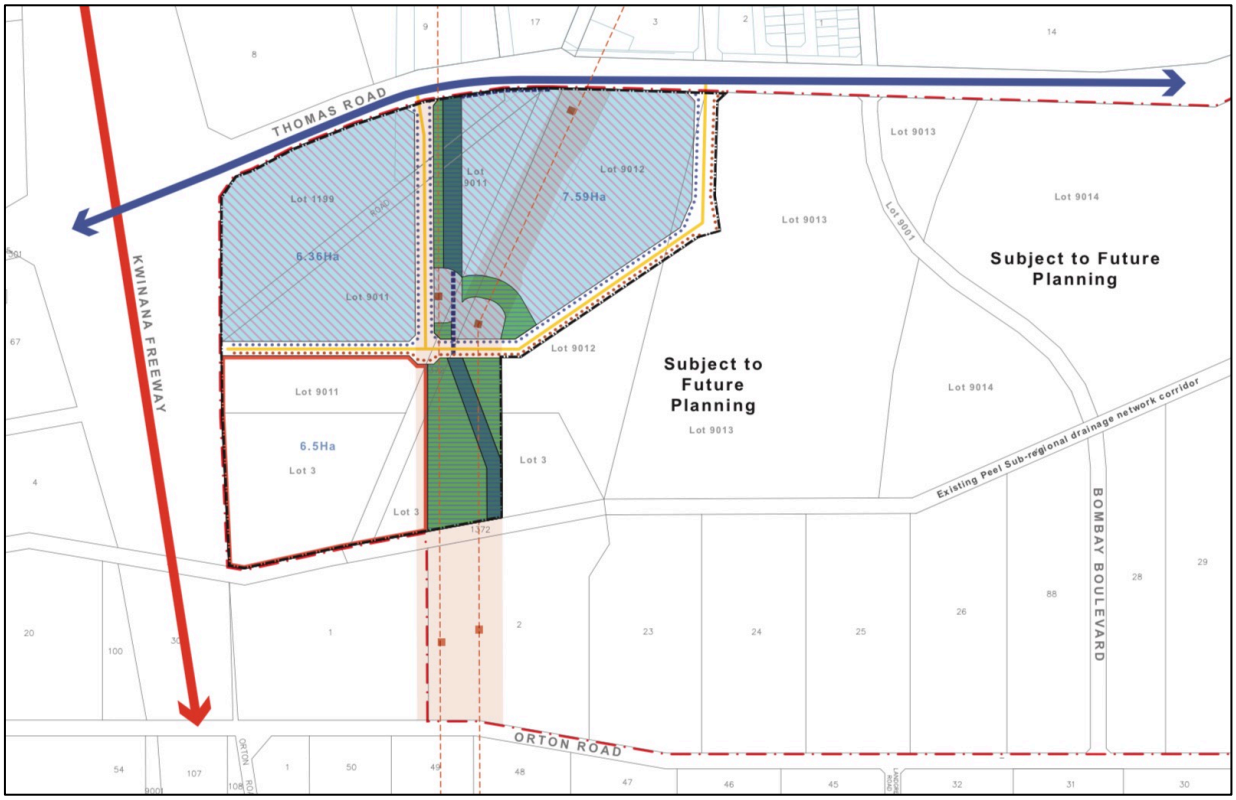


Figure 6 Northern Precinct Structure Plan

6. INTEGRATION WITH SURROUNDING AREA

6.1. This structure plan is the first of three possible residential based structure plans dealing with the land area between Thomas Road and Mortimer Road. The locality has been identified for residential development.

7. ANALYSIS OF INTERNAL TRANSPORT NETWORK

7.1. The structure plan for Casuarina central precinct assumes full development of the precinct and is based on a future forecast year of, indicatively, 2031.

7.2. The structure plan has been modelled using a Saturn traffic model that assigns traffic to the local road network based on road capacity, speed and length.

7.3. Development to the north and south is included in the Saturn traffic model to ensure future development impacts are assessed on the internal road network.

Traffic Generation

7.4. The Casuarina central precinct structure plan area is predominantly residential in nature with a small pocket of commercial uses adjacent to the Kwinana Freeway. Given the location of the commercial activity it is anticipated that the land would be used for warehousing / manufacturing opportunities. The provision of retail type activities is highly unlikely. Trip rates for the commercial activities are based on the Road Traffic Authority (NSW) *Guide to Traffic Generating Developments.*

7.5. The traffic generation of the locality is based on typical structure planning traffic assumptions of 9 trips per dwelling per day. With a forecast yield of 990 dwellings within the subject land, the Casuarina central precinct structure plan is forecast to generate 8,910 residential trips and 2,100 commercial trips. In total the subject land is assessed to generate 11,010 trips per day.

Distribution

7.6. The distribution of traffic to the external road network is based on trip purpose. Historical research suggests the following trip purposes and proportions:

- Work trips 32%
- Home based other 24%
- Home based evening 20%
- Non homed based 14%

7.7. Education trips are based on 0.35 primary students per dwelling with a typical school trip rate of 2.6 trips per child (as per the Education Departments schools brief).

Non Structure Plan Traffic

7.8. The Casuarina central precinct traffic modelling is cognisant of the future development potential to the north and south.

7.9. Land to the north is estimated to provide 492 dwellings in addition to the commercial traffic generation indicated in the Element *Casuarina – East of Freeway Local Structure Pla*n (April 2018). Structure planning of the northern precinct will include the extension of Landgren Road through to Thomas Road.

7.10. Land to the south is estimated to provide 1,124 dwellings. Traffic from this locality can access Mortimer Road and thence the Kwinana Freeway / Bertram Road to

reach destinations to the north, south and west. Mortimer Road continues to the east to access existing residential development.

7.11. Modelling of the adjacent land areas is included in the Saturn traffic model and traffic is routed to Mortimer Road and Thomas Road based on time, distance and road speeds. The traffic report for the structure plan is a long-term assessment of the ultimate future road requirements.

Design Traffic Flows

7.12. Appendix C shows the Saturn model output for the whole area modelled. As would be expected the model shows traffic generated by the three land areas accessing Thomas Road and Mortimer Road.

7.13. Appendix D shows the modelling for the local area structure plan road traffic demands based on *Liveable Neighbourhoods* thresholds. The plans show roads passing <1,000vpd, 1,000vpd to 3,000vpd, 3,000vpd to 5,000vpd and those roads forecast to carry more then 5,000vpd.

7.14. Based on the plans attached at Appendix D, Figure 8 shows the recommended road hierarchy.

7.15. All roads within the Casuarina central precinct structure plan area are shown to attract generally less than 1,000 vehicle movements per day. The road hierarchy is discussed further below.

Neighbourhood Connectors

7.16. Landgren Road is shown to carry less then 5,000vpd through the subject land area. Landgren Road is therefore to be classified as a neighbourhood connector.

7.17. Landgren Road will provide the main north-south spine through the subject land and will also provide access to the future primary school. However, direct school access will not be taken to Landgren Road.

7.18. A 25 metres wide road reservation is proposed for Landgren Road to provide a boulevard style treatment. The road treatment is similar to that used on Honeywood Boulevard in the suburbs of Aubin Grove / Wandi to the north.

7.19. Appendix D shows a typical cross section for neighbourhood connector type A.

7.20. Nine metre corner radii should be used at all intersections with neighbourhood connectors. This will provide appropriate access for larger vehicles whilst maintaining lane discipline on the busier roads.



Figure 8 **Recommended Road Hierarchy** (road network indicative)

Access Streets Type C

7.21. The higher order residential streets within the structure plan area will be classified as Access Road type C as traffic demands are well below the threshold of 3,000vpd. Access Street type C cross sections aim to encourage a 40kph traffic speed to the local road network, whilst allowing ample with for traffic to pass.

7.22. A 6.5 metre to 7.0[1] metre road pavement is suited to these residential streets with a residual verge of a minimum 4.5 metres. A minimum road reservation width of 16 metres is suited to these streets. A typical cross section is shown in Appendix D.

7.23. However, a slightly wider reservation of 18 metres for a 20 metre approach to neighbourhood connectors is recommended to provide for median treatments at the intersections. A cross section is also included at Appendix D.

7.24. A 6 metre corner radii should be used at all intersections between access streets to restrict traffic turning speeds.

[1] Standard road design is 7.2m. In a residential street with no bus service the additional 200mm is superfluous

Access Streets Type D

7.25. Access street type D will be the most used road classification within the structure plan. These roads are quiet residential streets and predominantly provide access to frontage properties.

7.26. A 5.5 metre wide pavement is suited to these streets to ensure traffic is not encouraged to drive at inappropriate speeds. The density of the future development would not be expected to result in a significant on-street parking demand. However, it is more common to provide a 6 metre pavement.

7.27. Combined with 4.5 metre residual verges, the minimum road reservation would be 15 metres. A typical cross section is shown in appendix D.

7.28. *Liveable Neighbourhoods* recommends the use of 4.5 metre corner radii where access streets meet. A maximum corner radii of 6 metres is advise for access streets to ensure higher traffic speed do not occur at intersections.

7.29. Reference to *Liveable Neighbourhoods* recommendation of lot truncations should be made to reduce road reservation maintenance.

8. ROADS AND INTERSECTIONS

8.1. All roads within the structure plan have low traffic demands, with no street shown to carry more than 5,000vpd.

8.2. The Saturn model has been interrogated to determine the forecast traffic demands at each intersection. It is generally recognised that four way priority intersections (yield or give way conditions) should not be used when greater than 2,000vpd pass though the intersection.

8.3. The modelling shows that no four-way intersection between access streets will require control. Give way markings are appropriate at all internal road intersections.

Access To Frontage Properties

8.4. There are no roads within the subject land holding that would require control of access to frontage properties. However, properties fronting Landgren Road will be restricted to left-in / left-out movements due to the median.

Location of Intersections

8.5. All internal road intersections have been located in accordance with the principles of *Liveable Neighbourhoods*.

8.6. Two roundabouts are proposed on Landgren Road to provide U-turn opportunity for frontage properties and to provide speed management. Figure 9 shows the recommended intersection controls.

8.7. The northern roundabout will provide safe access to the primary school.

8.8. Figure 9 shows a potential third roundabout to the southern end of the subject land. With the wide road reservation proposed an easy U-turn facility is provided with the Tee intersection formed. When land to the south is developed sufficient land is provided at this intersection to allow for a future roundabout.



Figure 9 Intersection Treatments

9. PEDESTRIAN AND CYCLE NETWORKS

9.1. The layout of the Casuarina central precinct structure plan is based on the principles set out in *Liveable Neighbourhoods* to provide a pedestrian friendly environment.

9.2. Internal to the structure plan area there are no requirements to provide pedestrian crossings. All roads have low traffic flows and pedestrian will not be restricted in crossing any internal road as a result of the passing traffic.

9.3. Figure 10 shows the minimum recommended requirements for paths and cycle facilities.

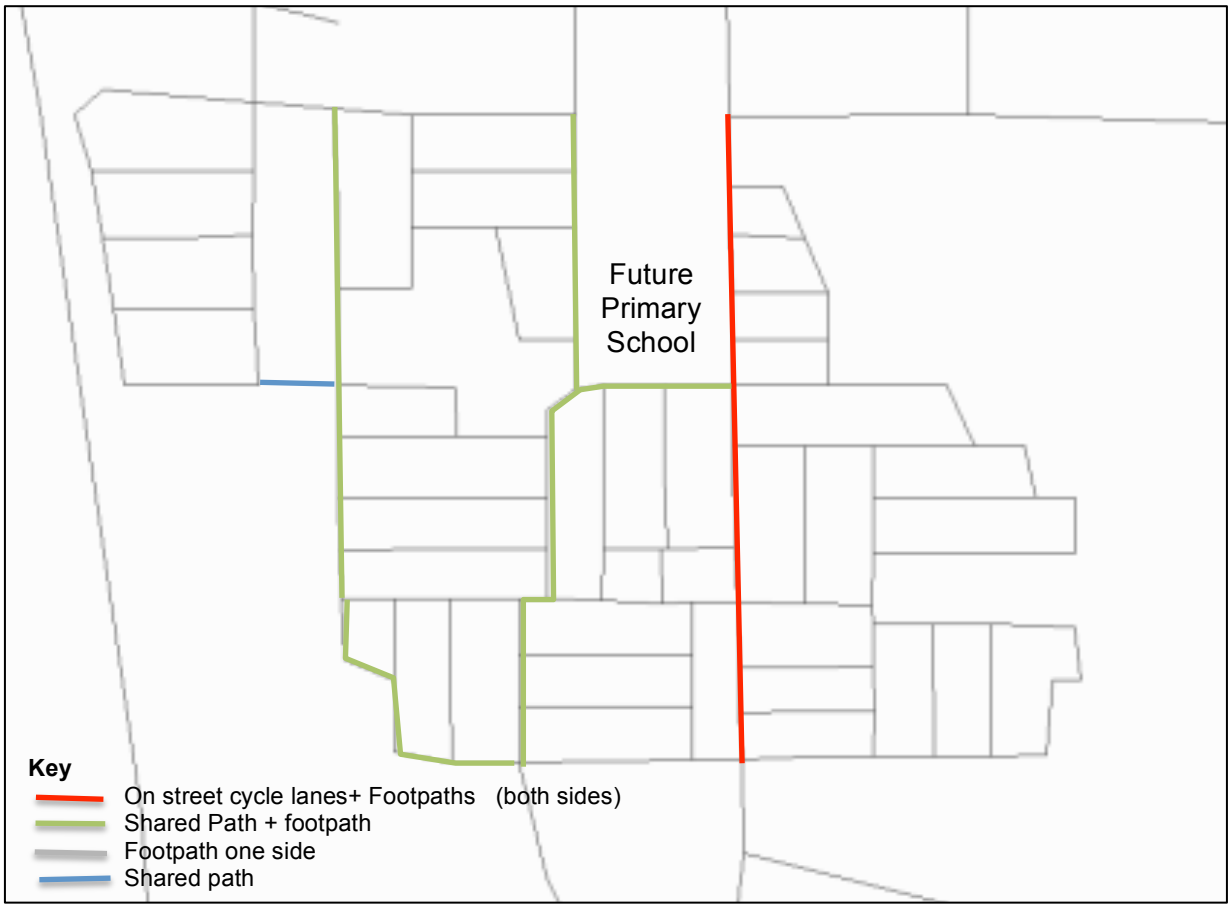


Figure 10 Cycle and Footpaths

10. SAFE WALK/CYCLE TO SCHOOL ASSESSMENT

10.1. A primary school is proposed within the Casuarina central precinct structure plan and will be located central to the locality adjacent to Orton Road and Landgren Road.

10.2. The school is walkable and the central median to Landgren Road will provide refuge for pedestrians with children.

10.3. The local road network traffic forecast is cognisant of the likelihood of parents driving children to school.

10.4. A shared path network is proposed to provide safe an appropriate access to the primary school. All streets are shown to have low traffic demands and a footpath to all streets is proposed. A safe walking environment to the future primary school is achieved.

10.5. A future secondary school is proposed to the south of the subject land and is included in the traffic modelling.

11. PEDESTRIAN PERMEABILITY AND EFFICIENCY

11.1. Casuarina central precinct is designed in accordance with the *Liveable Neighbourhoods* policies and as such a permeable and walkable environment is provided.

12. ACCESS TO PUBLIC TRANSPORT

12.1. The majority of dwellings will be within 400 metres of Landgren Road where bus service can be expected to operate. The route would eventually pass through the northern and southern land holdings and link to Kwinana railway station.

13. TRAFFIC FLOWS ON EXTERNAL ROAD NETWORKS

13.1. The development of the subject land has been identified in local government planning documentation and the future traffic increase to both Thomas Road and Mortimer Road have been recognised.

13.2. As a result of structure planning of the locality it is anticipated that both Thomas Road and Mortimer Road would be duplicated.

13.3. Appendix E shows an extract of the traffic model based on the dull development of the central precinct. Access to the subject land is restricted to Orton Road and Bombay Boulevard. The appendix indicates that Bombay Boulevard could expect an increase of about 9,900vpd. Bombay Boulevard would continue to operate within capacity (although its intersection with Thomas Road would be expected to fail).

13.4. Thomas Road is shown to experience an increase of 9,100vpd and with a present day demand of 17,622vpd would require duplication to cater for the full development of the subject land.

13.5. Although the external road network is shown to require upgrading to cater for the full development of the Casuarina central precinct, development in the northern precinct would be expected to result in the need for duplication well before full development of the subject land is anticipated.

14. STAGING

14.1. The development of the subject land can progress by taking access to Bombay Boulevard, which has capacity to carry over 13,500vpd at acceptable Levels of Service.

14.2. The subject land is shown to generate 9,900 external trips per day and when added to the current traffic demands, the capacity at Level of Service D may be

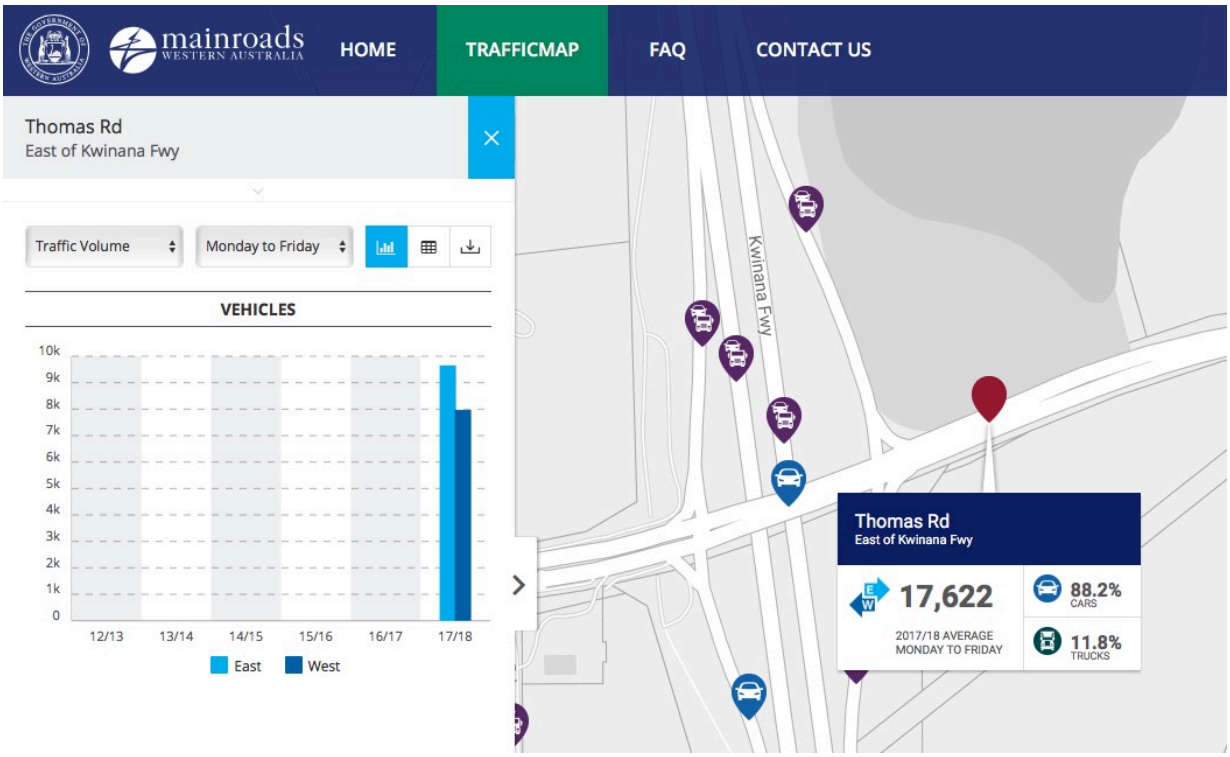
met. Therefore it is considered that Bombay Boulevard has the ability to cater for the full development of the subject land area should additional access through the northern precinct not mature in a timely manner.

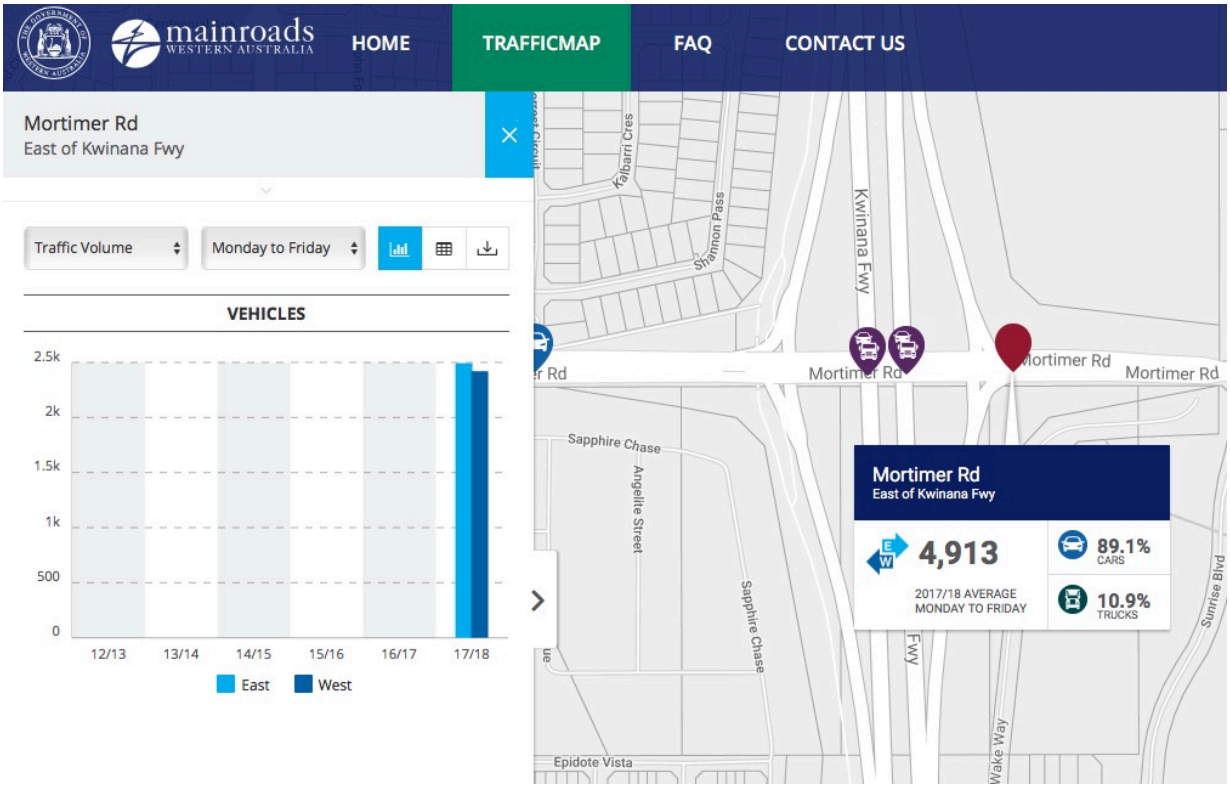
14.3. As approvals for subdivision are progressed, the intersection of Bombay Boulevard and Thomas Road will need to be assessed to ensure safe and appropriate operation is maintained.

14.4. Assessment of the change in traffic demands indicates that current structure planning for the external road network is not affected.

14.5. The forecast traffic movements within Casuarina central precinct may exceed the desirable threshold for the road networks hierarchy during the development of the Casuarina precinct. The modelling provided in this report considers the long term traffic demands to create a road network that will provide good residential amenity and accessibility.

APPENDIX A MRWA TRAFFIC DATA





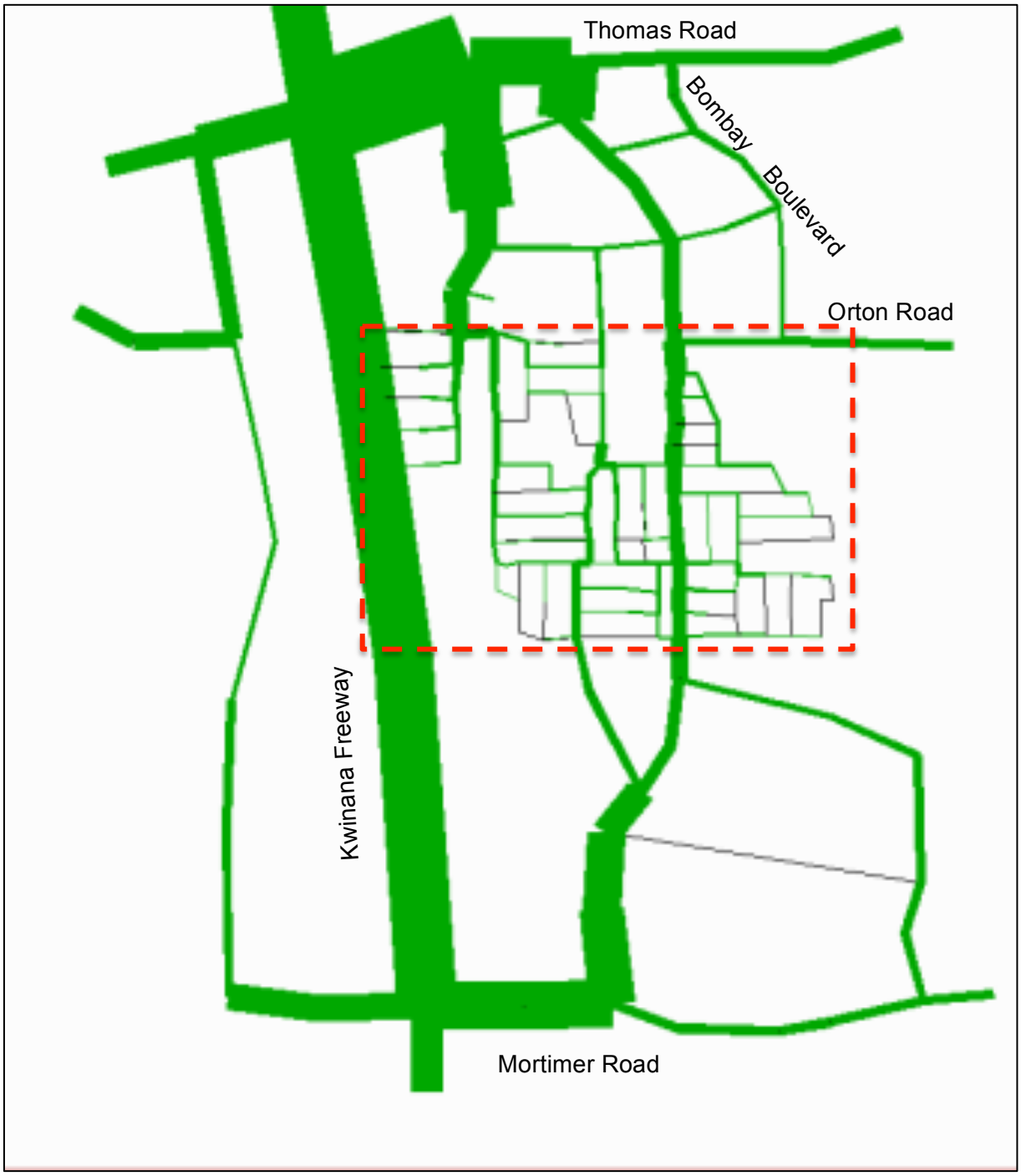
APPENDIX B Levels of Service by Road Type

LOS	Single Carriageway[1]	2-Lane Boulevard[2]	Dual Carriageway (4-Lanes)[3]	Dual Carriageway (4-lane Clearway)[3]
A	2,400vpd	2,600vpd	24,000vpd	27,000vpd
B	4,800vpd	5,300vpd	28,000vpd	31,500vpd
C	7,900vpd	8,700vpd	32,000vpd	36,000vpd
D	13,500vpd	15,000vpd	36,000vpd	40,500vpd
E	22,900vpd	25,200vpd[4]	40,000vpd	45,000vpd
F	>22,900vpd	>25,200vpd[4]	>40,000vpd	>45,000vpd

[1] Based on Table 3.9 Austroads - Guide to Traffic Engineering Practice Part 2
[2] Based on single carriageway +10% (supported by Table 3.1 Austroads - Guide to Traffic Engineering Practice Part 3) – Boulevard or division by medians.
[3] Based on RRR Table 3.5 - mid-block service flow rates (SF.) for urban arterial roads with interrupted flow. Using 60/40 peak split.
[4] Note James Street Guildford passes 28,000vpd.

For the purposes of planning, the capacity of a road can be taken as the value between Level of Service E and F. However, a Level of Service D is the lowest preferred operational Level of Service.

APPENDIX C SATURN MODEL TRAFFIC DEMANDS

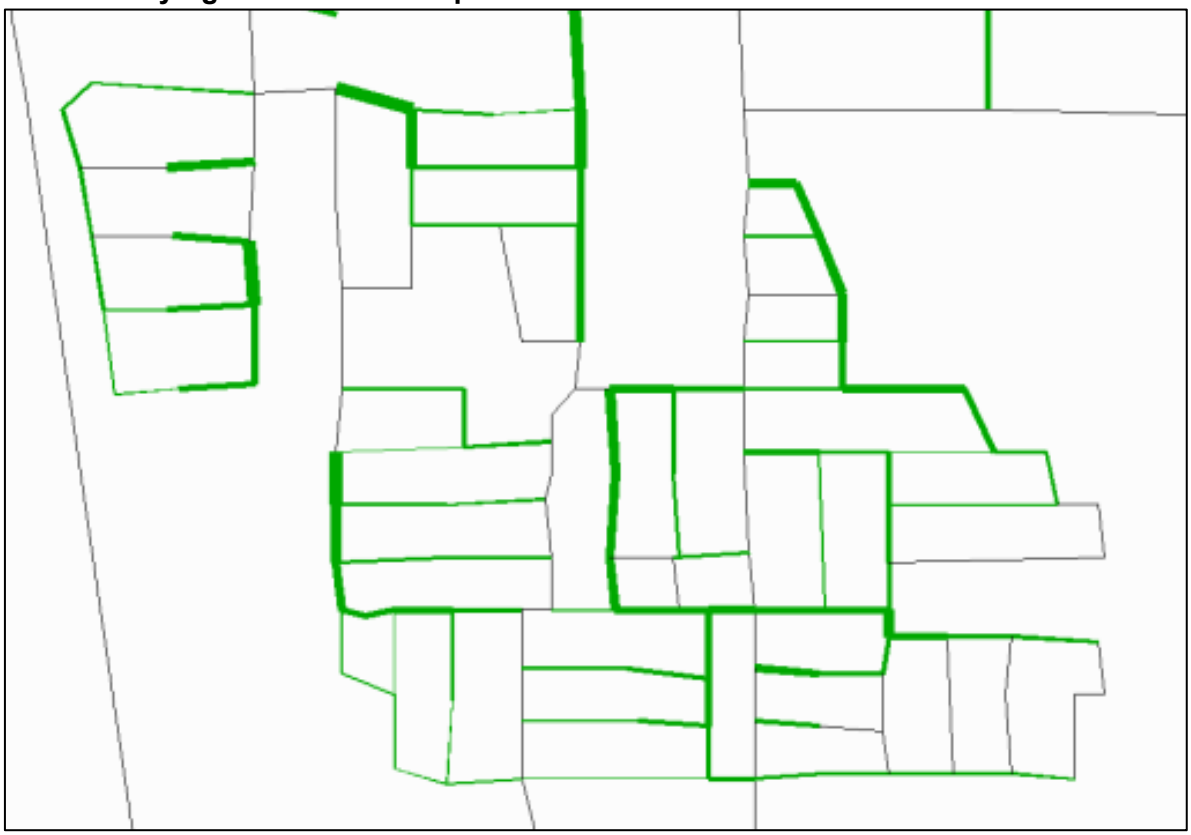


Full development of land between Thomas Road and Mortimer Road.

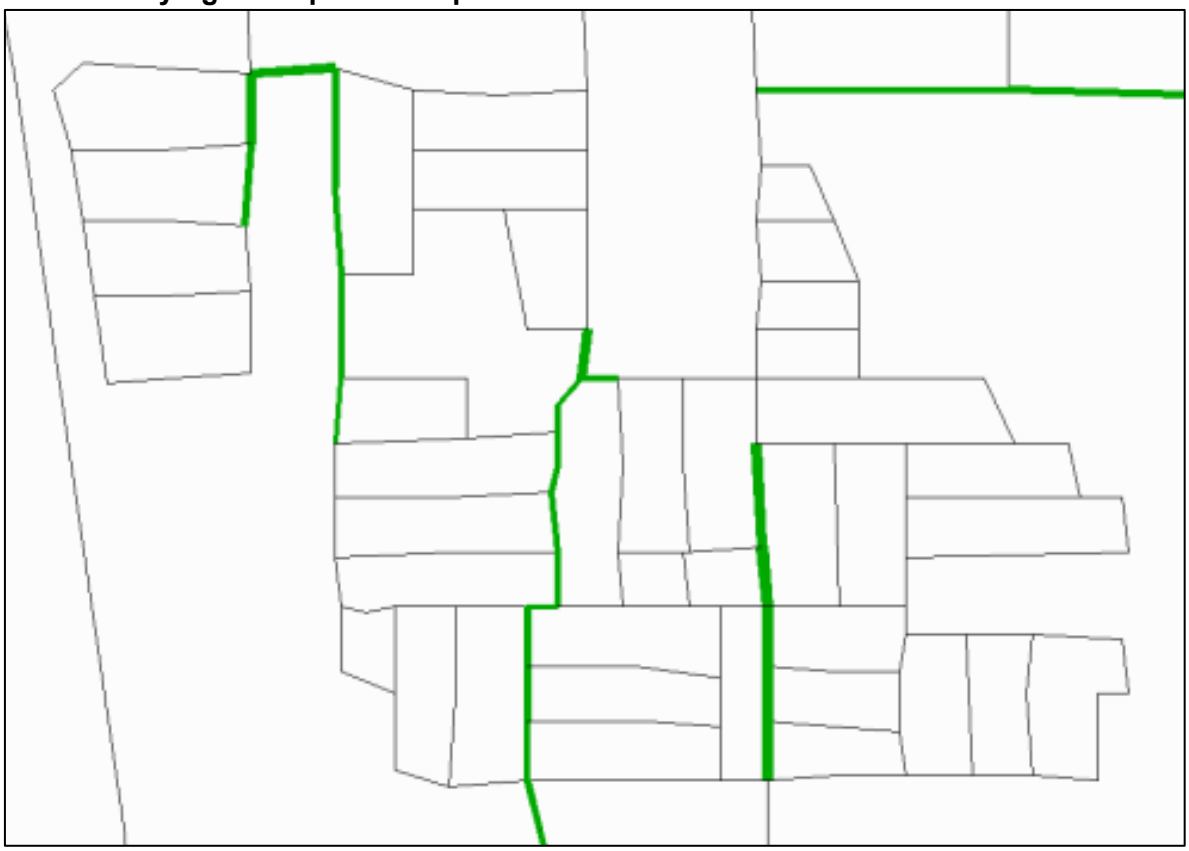
Note road layouts outside of subject land to be planned by relevant structure plans.

APPENDIX D STRUCTURE PLAN TRAFFIC DEMANDS

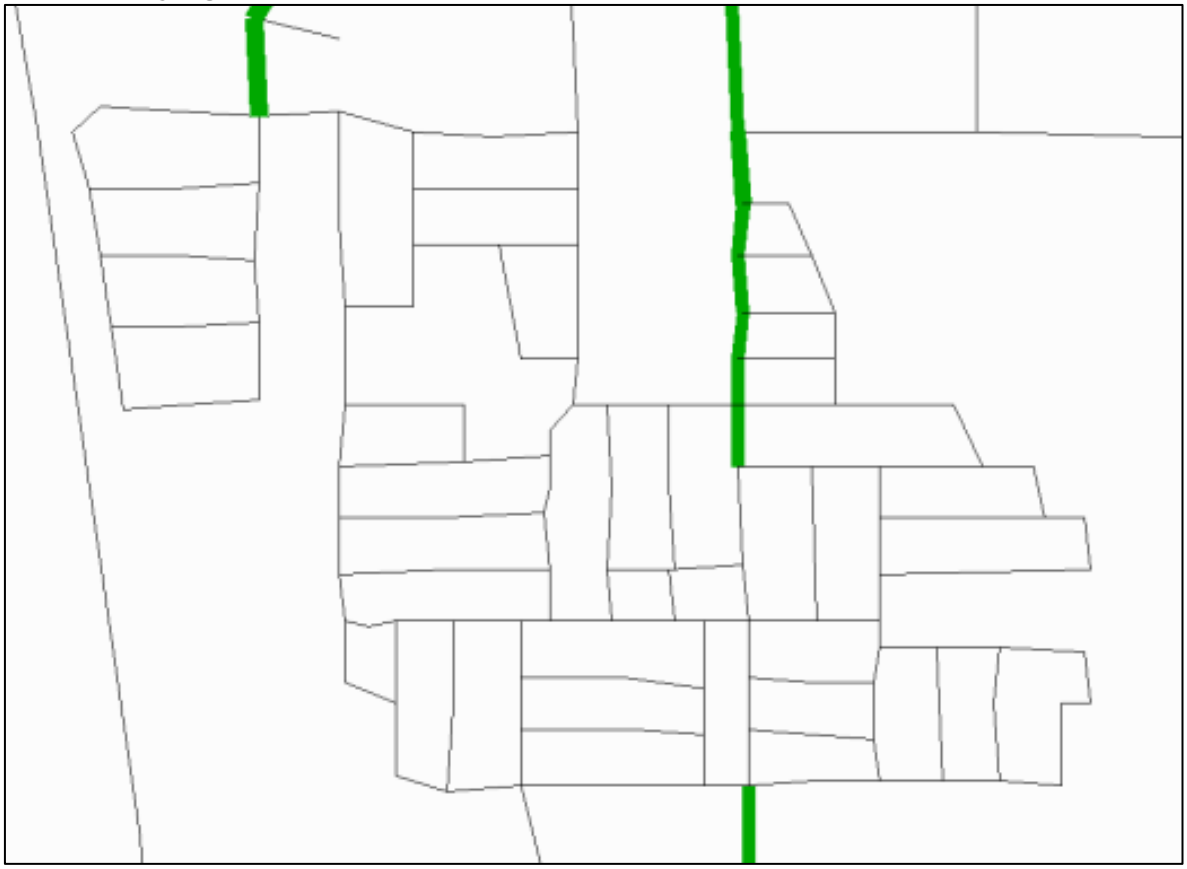
Roads Carrying Less than 1000vpd



Roads Carrying 1000vpd - 3000vpd



Roads Carrying 3000vpd – 5000vpd

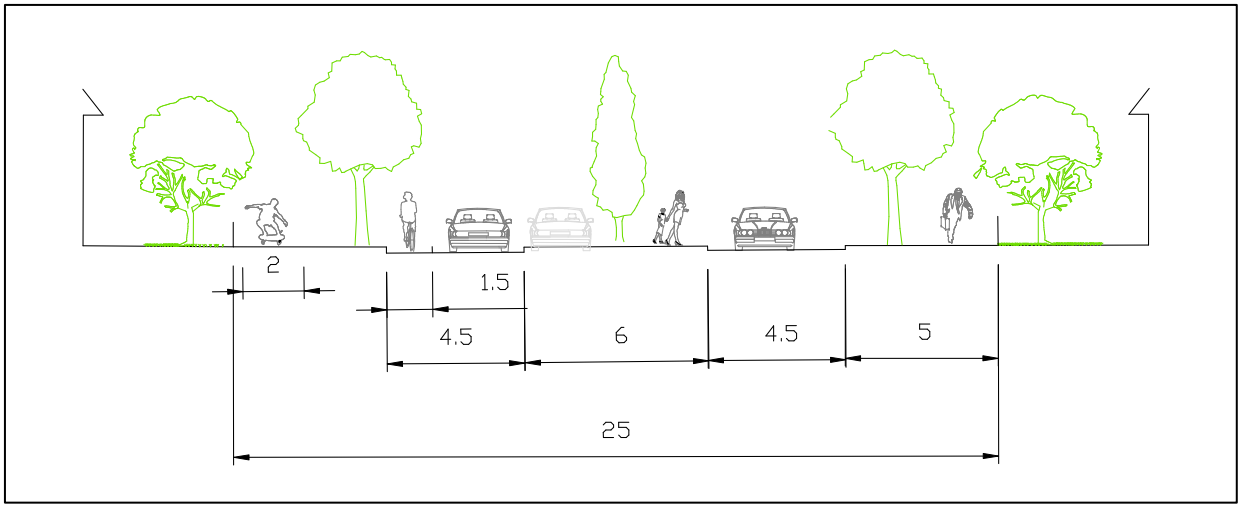


Roads Carrying >5,000vpd

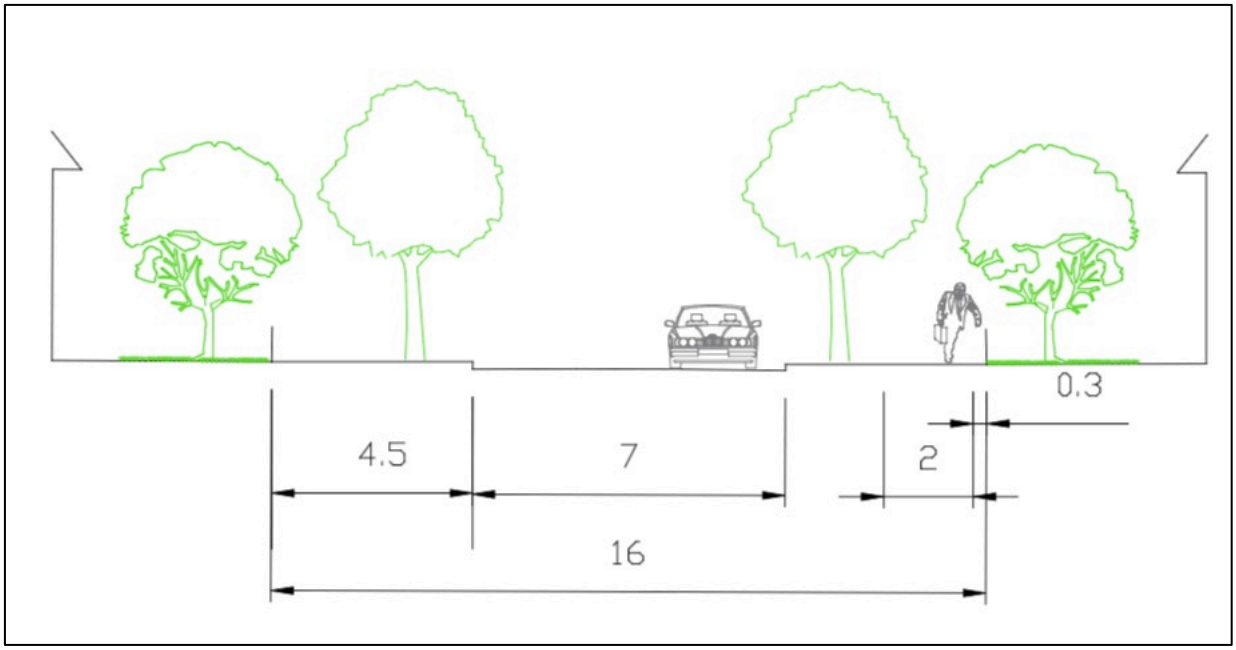


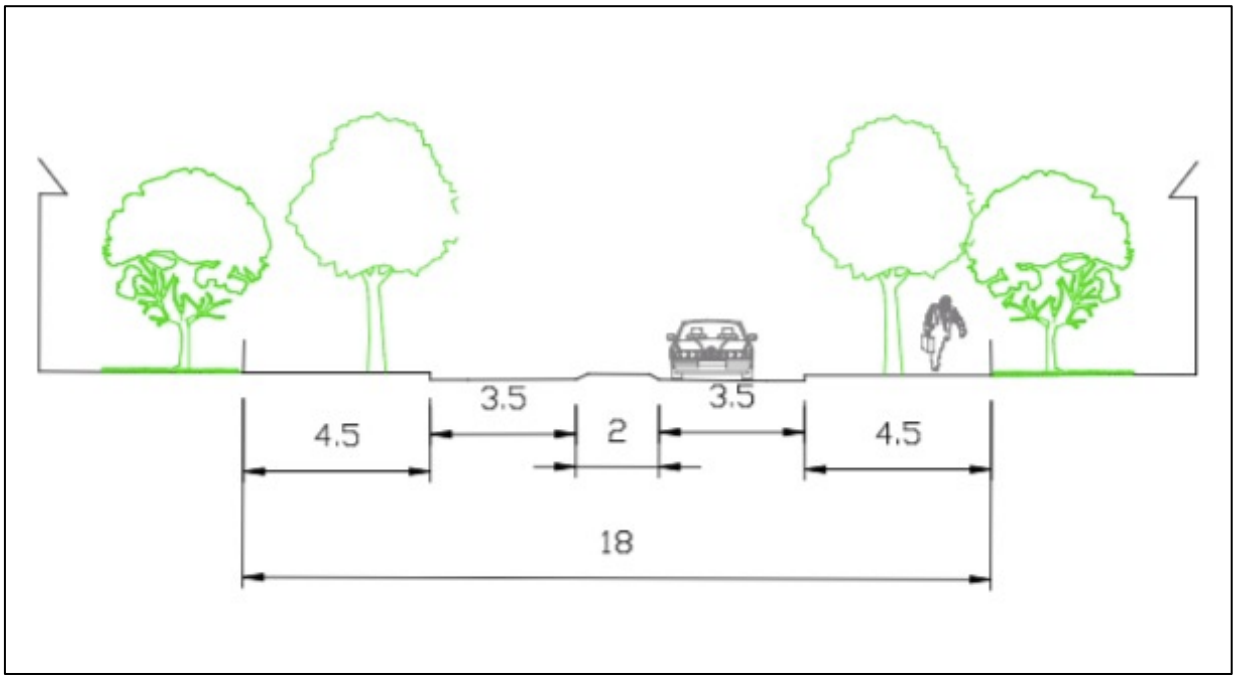
APPENDIX D INDICATIVE ROAD CROSS SECTIONS

NEIGHBOURHOOD CONNECTOR



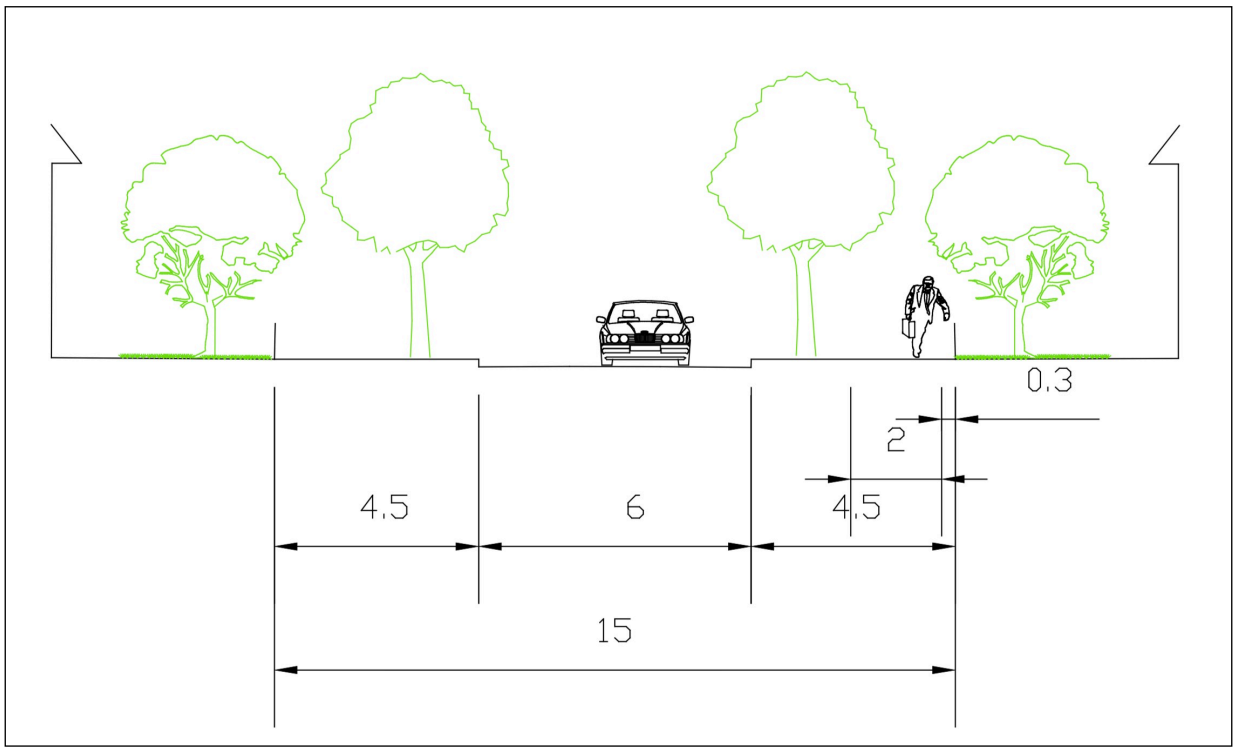
ACCESS STREET TYPE C



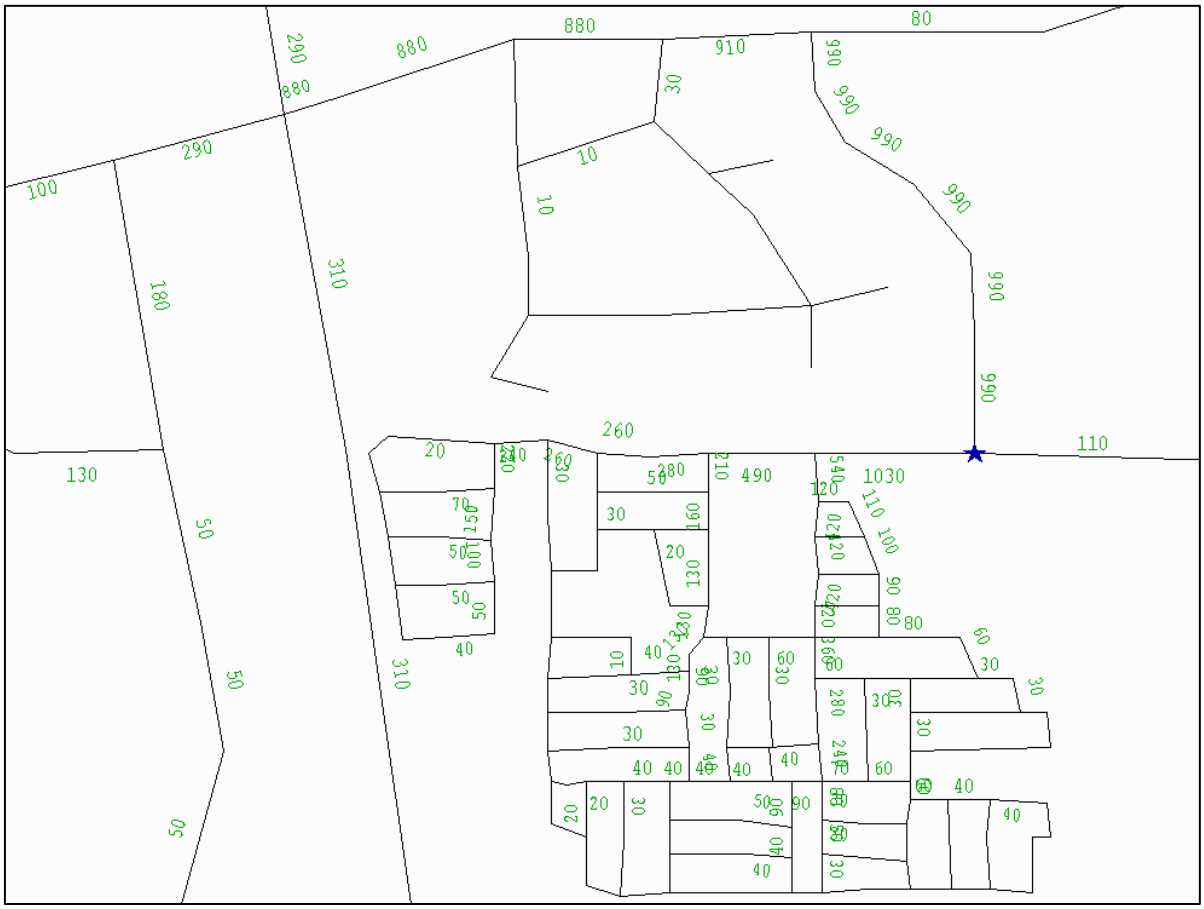


Treatment at intersections with neighbourhood connectors for 20m approach.

ACCESS STREET TYPE D



APPENDIX E FULL DEVELOPMENT IN ISOLATION



Forecast traffic demands of full central precinct development in isolation to other development.

APPENDIX H
RETAIL NEEDS ASSESSMENT

Taktics4
Casuarina Central
Local Structure Plan

Retail Needs Assessment & Mixed Business Assessment

LWP Property Group
December 2018

Contact

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Document Name	Date	Distribution	Format	Delivery
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CONTENTS

1 EXECUTIVE SUMMARY 4
1.1 Retail Activity 4
1.2 Mixed Business/Service Centre Area 4

2 INTRODUCTION 5
2.1 Purpose 5
2.2 Location 5

3 POLICY CONTEXT 8
3.1 State Planning Policy – Activity Centres Perth and Peel 8
3.2 Jandakot Structure Plan 8
3.3 Draft District Structure Plan - Eastern Residential Intensification Concept 9
3.4 City of Kwinana – Local Commercial Activity Centres Strategy 11
3.5 Anketell South Local Structure Plan 12
3.6 Casuarina North Local Structure Plan 14
3.7 Casuarina Central Local Structure Plan 16
3.8 Policy Implications 17

4 RETAIL NEEDS ASSESSMENT 19
4.1 Casuarina Central Local Centre - Intended Catchment 19
4.2 Dwelling and Population Growth 19
4.3 Retail Spending Profile 20
4.4 Casuarina Central Local Centre Options 21
4.5 Implications for Policy 22
4.6 Implications for Community 23

5 MIXED BUSINESS / SERVICE COMMERCIAL ASSESSMENT 24
5.1 Employment Self Sufficiency 25
5.2 Location 25
5.3 Conclusions 26

1 EXECUTIVE SUMMARY

This Retail Needs Assessment outlines the demand for retail activity and service commercial / mixed business activity within the Casuarina Central Local Structure Plan. Broader regional and district planning initiatives for the area provide the following activity within the LSP.

- A single 800sqm local centre
- 7.5 Ha service commercial / mixed business precinct

The RNA conclusively finds:

1.1 Retail Activity

That the resident community created by the development of dwellings within the Casuarina Central LSP will not be capable of supporting the retail provision of a local centre of 800sqm currently allocated as part of the LCACS.

There is subsequently no market demand for the local centre to be developed within the LSP.

The community will be well served by future planned neighbourhood activity centres to the immediate north and south of the LSP.

The provision of a local centre in the LSP has the potential to detrimentally impact the performance of the Anketell South Neighbourhood Centre on Thomas Road. The removal of the local centre from the LSP would improve the viability of the Anketell South Neighbourhood Centre and improve the overall planning for retail activity in the area.

1.2 Mixed Business/Service Centre Area

The planned service commercial / mixed business area within the Casuarina Central LSP is intended to form part of a wider service commercial / mixed business area located north of the LSP.

Service commercial / mixed business activity is also located within Wandi District Centre and Casuarina North LSP. Both locations are better suited to the exposure and accessibility required for business activity in these areas to be viable.

The service commercial / mixed business precinct currently intended for the Casuarina Central LSP does not have the exposure and accessibility to be viable and should be reconsidered.

The over provision of this activity in the corridor may result in the detrimental impact of this activity in both Wandi District Centre and Casuarina North LSP.

2 INTRODUCTION

2.1 Purpose

Taktics4 was commissioned by LWP Property Group and Taylor Burrell Barnett – Town Planning and Design to provide detailed market and policy analysis and findings in relation to guiding the planning and design of retail and service commercial / mixed business activity within the Casuarina Central - Local Structure Plan (LSP). The findings in this report are incorporated within and should be read in conjunction with the Casuarina Central - Local Structure Plan report. Regional and district planning initiatives in the area currently incorporate the following non-residential land uses within the Casuarina Central LSP:

1. 800sqm local retail centre
2. 7.5 Ha service commercial / mixed business precinct

The report considers and analyses the implications of policy and market influences on the sustainability of retail and service commercial / mixed business activity specifically in relation to the Casuarina Central – Local Structure Plan (Casuarina Central LSP).

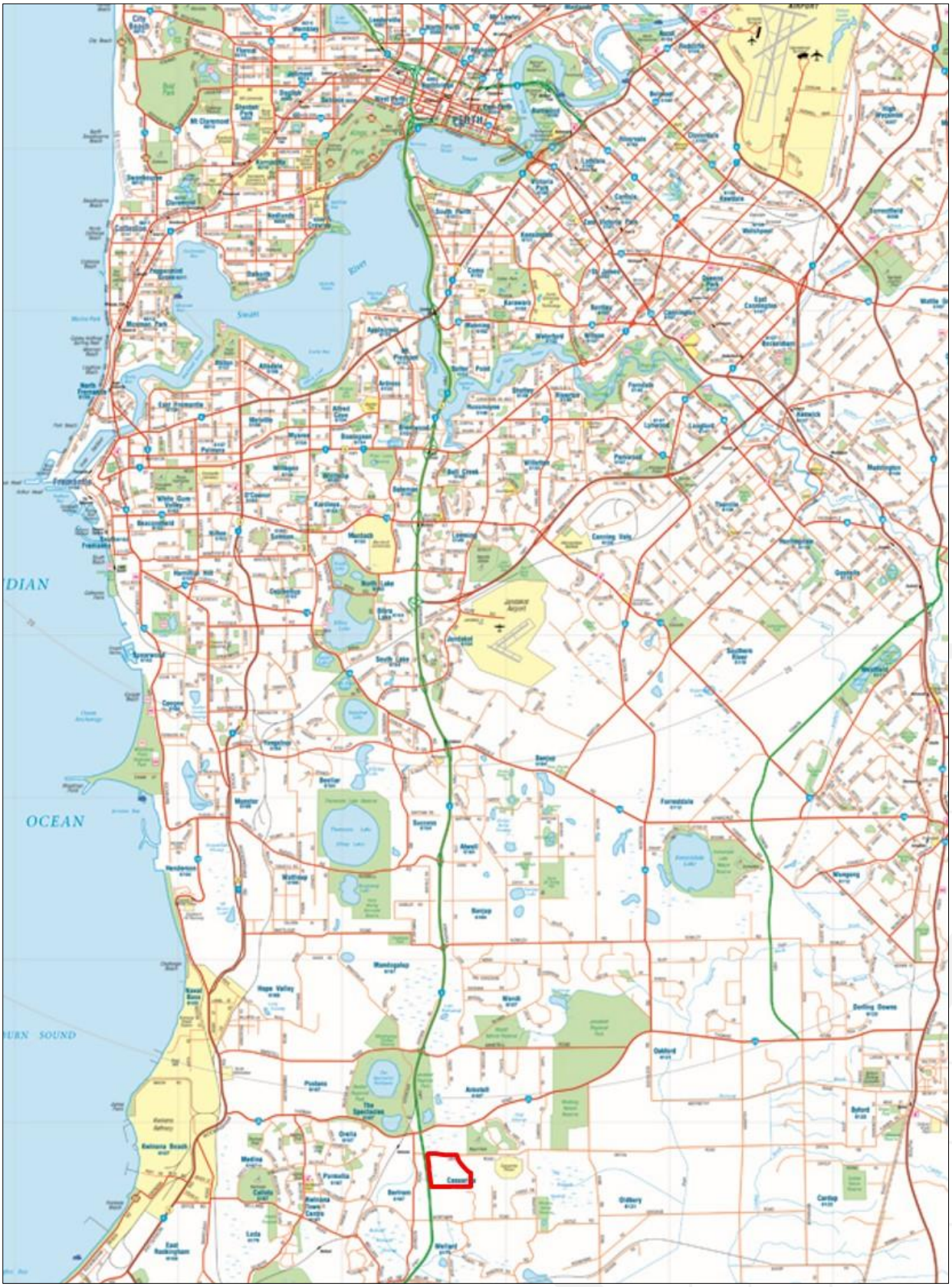
It subsequently assesses the market demand and implications for providing a local retail centre within the LSP and the market demand and implications of providing for an expansion to Precinct 23 mixed business area currently planned for in Casuarina North LSP immediately north of casuarina Central LSP.

The Retail Needs Assessment component of the paper has been prepared in accordance with the guidelines for preparing Retail Needs Assessments as outlined in State Planning Policy 4.2 – Activity Centres - Perth and Peel.

2.2 Location

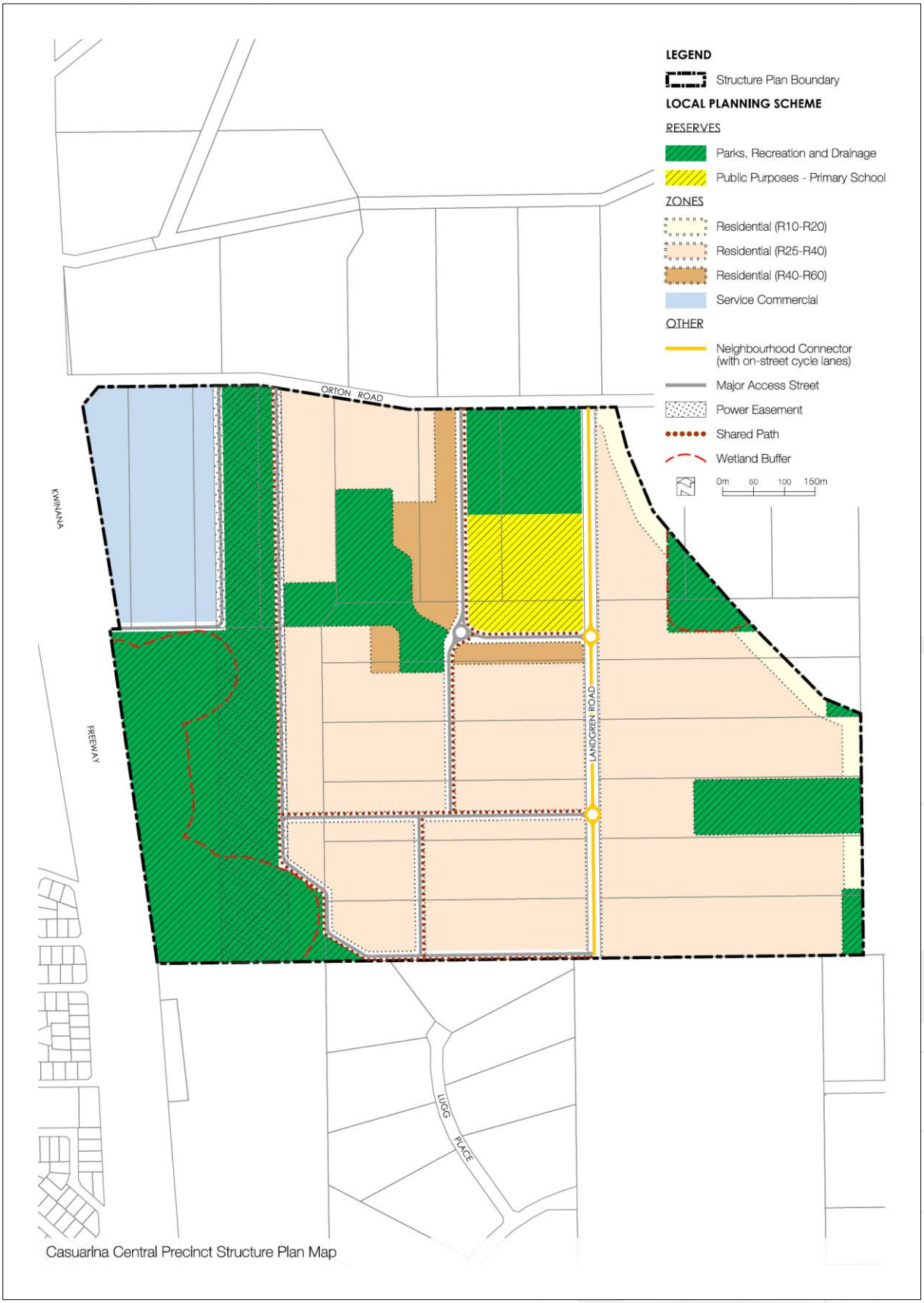
The Casuarina Central LSP is located approximately 30 km south of Perth. It incorporates land immediately south of Orton Road and East of the Kwinana Freeway in the City of Kwinana. The location and site are more definitively outlined in Figure 1 and Figure 2.

FIGURE 1 – LOCALITY PLAN



Taktics4

FIGURE 2 - CASUARINA CENTRAL – LOCAL STRUCTURE PLAN



TBB

3 POLICY CONTEXT

Planning, provision and design of retail activity and service commercial / mixed business land uses within the Casuarina Central LSP is guided by a range of state and local government policy initiatives.

3.1 State Planning Policy – Activity Centres Perth and Peel

State Planning Policy 4.2 - Activity Centres Perth and Peel (SPP4.2) was adopted by the WAPC in August 2010. It guides the planning for higher order centres in the retail and commercial network. It introduces the hierarchy for centres in Perth and Peel, including Strategic Metropolitan Centres, Secondary Centres and District Centres.

SPP4.2 allocates a District Centre (Wandi District Centre) in or around the Anketell Road and Kwinana Freeway interchange. SPP4.2 also acknowledges and substantiates the role and characteristics for neighbourhood and local centres within the hierarchy, however, it promotes the spatial planning and administration of these two lower centre types in the hierarchy to the responsible local authority.

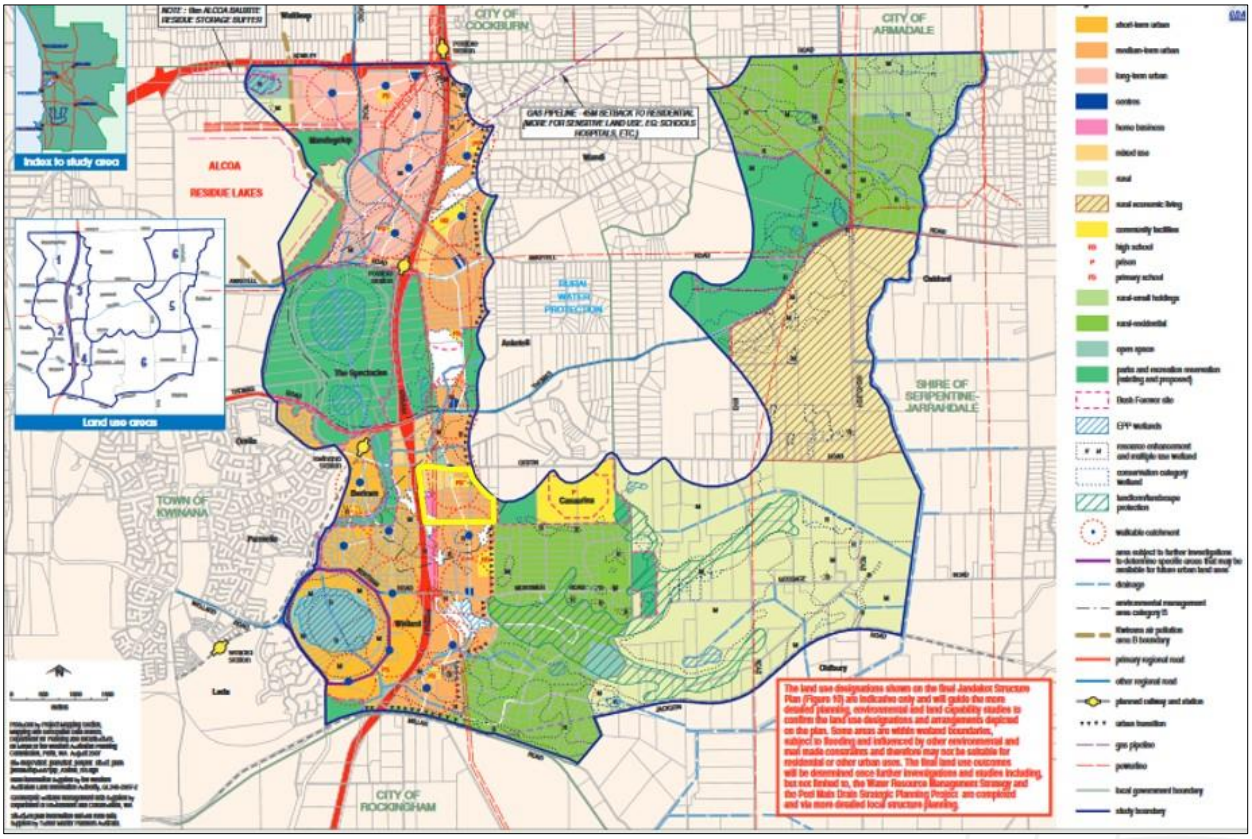
The spatial planning for retail and commercial activity in and around the Casuarina Central LSP beyond the Wandi District Centre is therefore founded on planning initiatives at a district and local level.

3.2 Jandakot Structure Plan

The Jandakot Structure Plan (JSP) was adopted in August 2007. The JSP sets the broad strategic planning framework for land generally surrounding the 'Jandakot Proclaimed Underground Water Pollution Control Area' which includes land in several different local governments. The JSP provides for a population projection of around 40,000 residents. In the City of Kwinana, it covers an area of land from Rowley Road to the north down to Mortimer Road in the south.

The JSP (Figure 3) outlines the general location of several centres, including 'Neighbourhood Centres' on Thomas Road and Mortimer Road and four local centres including a local centre on Orton Road within the Casuarina Central LSP. The JSP also provides for an area of 'mixed business' adjacent to the freeway extending south of Thomas Road to beyond Orton Road. The JSP does not allocate the role, function or size of the various centres and no formal justification or analysis has been completed to support the spatial planning for these centres and mixed business area. The land use designations shown on the final Jandakot Structure Plan are indicative only and are intended to guide the more detailed planning, environmental and land capability studies to confirm the land use designations and arrangements depicted on the plan. The final land use outcomes are intended to be determined via more detailed local structure planning.

FIGURE 3 – JANDAKOT STRUCTURE PLAN

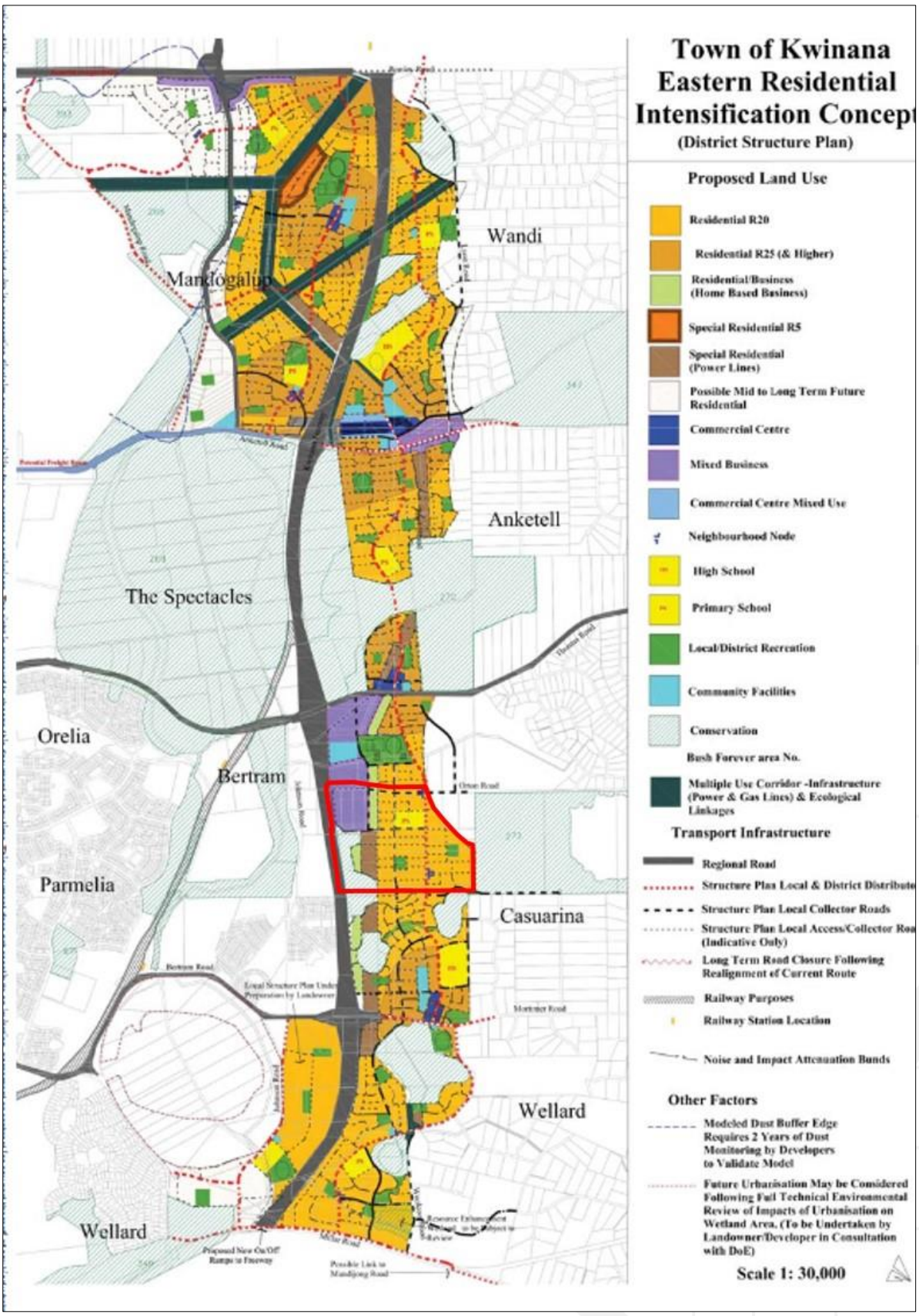


Jandakot Structure Plan WAPC

3.3 Draft District Structure Plan - Eastern Residential Intensification Concept

The Draft District Structure Plan - Eastern Residential Intensification Concept (ERIC) was prepared by the then Town of Kwinana in 2005. ERIC builds on the planning completed in the JSP. It broadly reconfirms the general location for commercial centres and mixed business areas previously adopted by the JSP, including the neighbourhood centres planned in Thomas Road and Mortimer Road and the smaller local centre in Orton Road. As per the JSP, ERIC (Figure 4) does not allocate roles or sizes to any of the centres and provides no evidence, justification or documentation to support the spatial planning and role for these centres and mixed business area.

FIGURE 4 – EASTERN RESIDENTIAL INTENSIFICATION CONCEPT



City of Kwinana

3.4 City of Kwinana – Local Commercial Activity Centres Strategy

The City of Kwinana Local Commercial Activity Centres Strategy (LCACS) was prepared for the City in September 2014. It more formally details the spatial distribution and role and function of the commercial centres and mixed business area. It specifically identifies the centres in the vicinity of the Casuarina Central LSP.

Retail Activity

TABLE 1 – ACTIVITY CENTRES IN LCACS

Centre Name	**Centre identification**	**Floor space allocation**
Wandi District Centre	Centre 2 – Anketell Road	20,000sqm Shop 10,000sqm Other Retail
Thomas Road Neighbourhood Centre	Centre 6 – Thomas Road	3,500sqm Shop 500sqm other retail
Mortimer Road Neighbourhood Centre	Centre 7 – Mortimer Road	5,500sqm shop 500sqm other retail
Orton Road Local Centre	Centre 14 – Casuarina 2	800sqm (2031)
Casuarina 3 - Local Centre	Centre 15 - Casuarina 3	800sqm (2031)

City of Kwinana – Local Commercial Activity Centres Strategy (Kwinana LCACS)

Mixed Business

TABLE 2 – BUSINESS PRECINCTS IN LCACS

Precinct Name	**Precinct identification**	**Floor space allocation**
Thomas/Holden Cl	Precinct 23	20,000sqm Other Retail
Orton Road	Precinct 24	15,000sqm Other Retail
Spectacles 01	Precinct 26	5,000sqm Other Retail
Combined	**Precincts 23,24,26**	**40,000 sqm Other Retail**

City of Kwinana – Local Commercial Activity Centres Strategy (Kwinana LCACS)

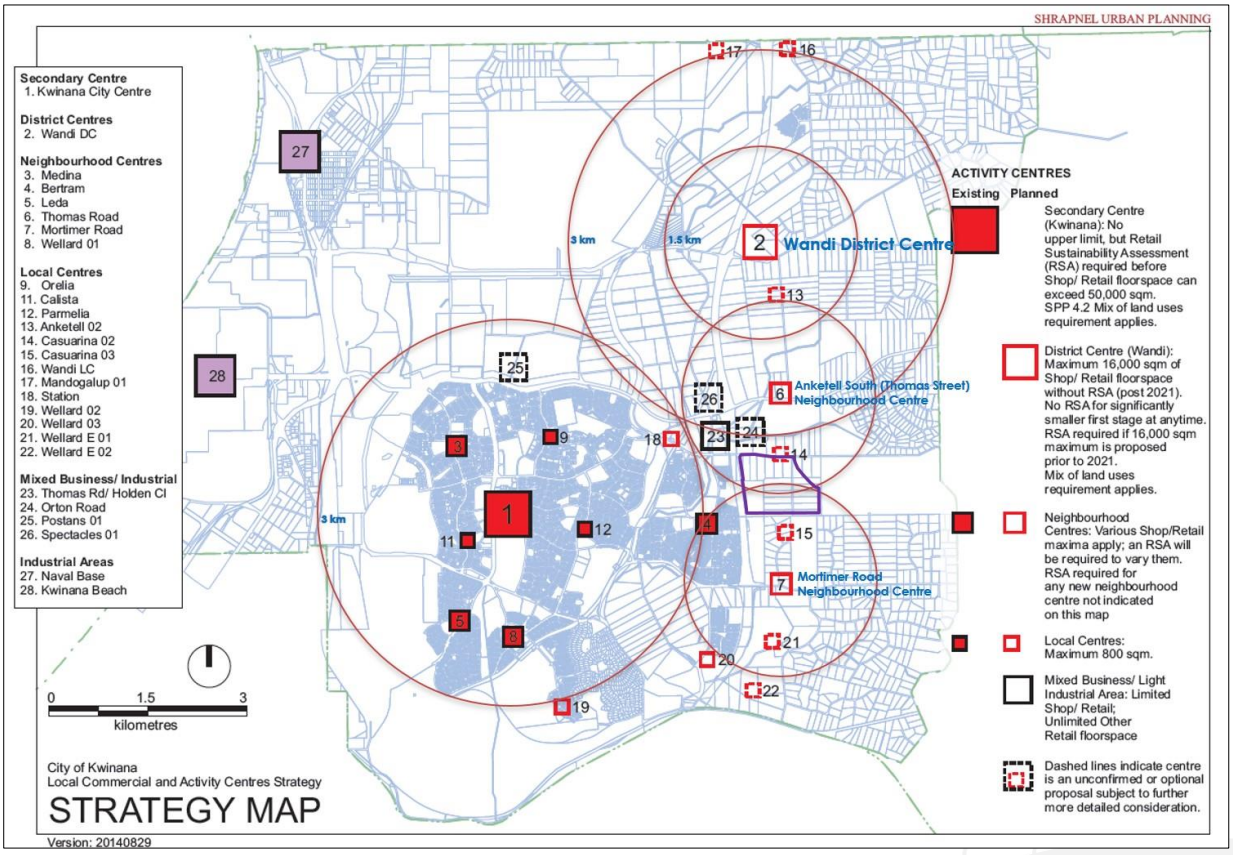
The tables and Figure 5 highlight that the Wandi DC is expected to generate enough floor space to comfortably deliver two full line supermarkets (3,500sqm each), a Discount Department Store (7,000sqm) and supporting specialty shops.

Despite a difference in floor space allocation, neighbourhood centres at Thomas (3,500sqm) and Mortimer (5,500sqm) are both expected to generate enough floor space to support a single full line supermarket (2,500sqm-3,500sqm) and supporting convenience shopping.

Local centres at Orton Road and Casuarina 03 are expected to generate 800sqm which is only capable of supporting a small number of convenience-based shops without an anchor supermarket.

The service commercial / mixed business area allocated within the LCACS are expected to capable of generating up to 40,000 sqm of other retail activity (along with non-retail uses). Most of this space is expected to be provided on the eastern side of the Kwinana freeway.

FIGURE 5 – LOCAL COMMERCIAL ACTIVITY CENTRES STRATEGY



City of Kwinana – Local Commercial Activity Centres Strategy (Kwinana LCACS)

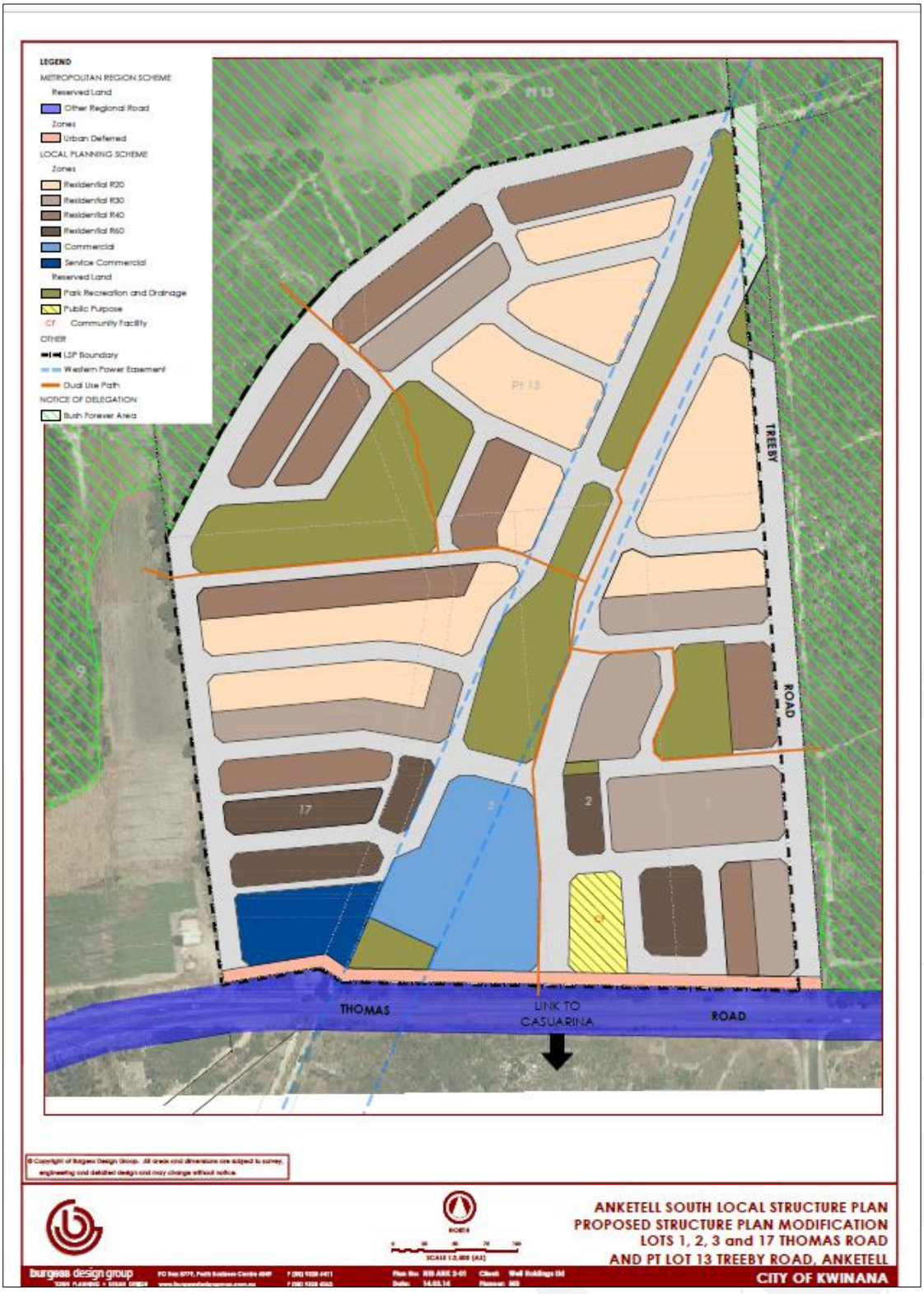
The commercial centres and mixed business areas are being planned in more detail on Local Structure Plans.

3.5 Anketell South Local Structure Plan

The Anketell South LSP details the land area allocated for commercial centre activity in accordance with the broader district and regional planning initiatives. The Anketell South LSP provides a land area of 1.35 Ha for the commercial activity site which is comfortably capable of physically accommodating the allocated 3,500sqm of retail floor space.

The Anketell South LSP yields about 420 dwellings capable of supporting a population of 1,300 residents. This centre therefore has a very limited catchment on the north of Thomas Road and will rely heavily on the catchment to the south of Thomas Road in order to be commercially sustainable.

FIGURE 6 – ANKETELL SOUTH LSP



BDG/WAPC

3.6 Casuarina North Local Structure Plan

The Casuarina North LSP has been prepared over the planned service commercial / mixed business area only. This area reflects precinct number 24 in the LCACS. Precinct 24 is expected to double the provision of mixed business area in the area planned by Precinct 23 on the western side of the Kwinana Freeway.

The Casuarina North LSP intends to generate 13.9Ha of service commercial area and 6.5Ha of Special Use. The service commercial zone is intended to primarily provide for showroom and bulky goods retail type uses. It is understood that this will typically fall under a 'showroom' land use definition under the City of Kwinana's LPS 2. Land use permissibly within the service commercial zone is to generally be in accordance with the zoning table and any associated provisions contained within LPS 2. It is noted that a 'Showroom' is a (P) permitted land use in the service commercial zone, consistent with the development intent for the precinct.

The special use zone falls under 'Division 11 – Special Use Zones': Land within a Special Use Zone may be used for the purposes specified on the Scheme Map and in the Third Schedule and for purposes incidental thereto and for no other purpose. The following uses are permitted (P) within the 'Special Use' zone:

- Bulky goods showroom
- Car park
- Consulting rooms
- Eating house
- Liquor store
- Motor repair station
- Petrol filling station
- Service station
- Warehouse

The following use is incidentally permitted (IP) within the 'Special Use' zone:

- Shop
- Fish shop

Potential employment opportunities for the northern part of precinct 23 are likely to be confined predominantly to the LSP area once fully developed and operational. It is estimated that the LSP area will have a maximum potential floorspace of approximately 127,750sqm. Due to the nature of showrooms and bulky goods retailing requiring a higher degree of car dependence, there is typically a need to dedicate around half the site for car parking. In this case an assumed plot ratio of 0.7 has been used to calculate potential floorspace, as a result of the likely need to offset a portion of the required car parking to be within the high voltage powerline easement. Accordingly, based on this developable site area and the assumed maximum plot ratio of 0.7 an estimated maximum employment figure of approximately 2,555 jobs will be accommodated within the LSP area.

The concept plan provided as part of the Casuarina North LSP includes a showroom floor space allocation closer to 63,000sqm – almost half of the 127,750sqm listed in the supporting documentation. Showroom activity typically generates an average floor space to employment ratio of 35 sqm per employee. The employment generated by the service commercial and special use will therefore be expected to be 1,800 employees instead of 2,550 employees.

FIGURE 7 – CASUARINA NORTH LSP

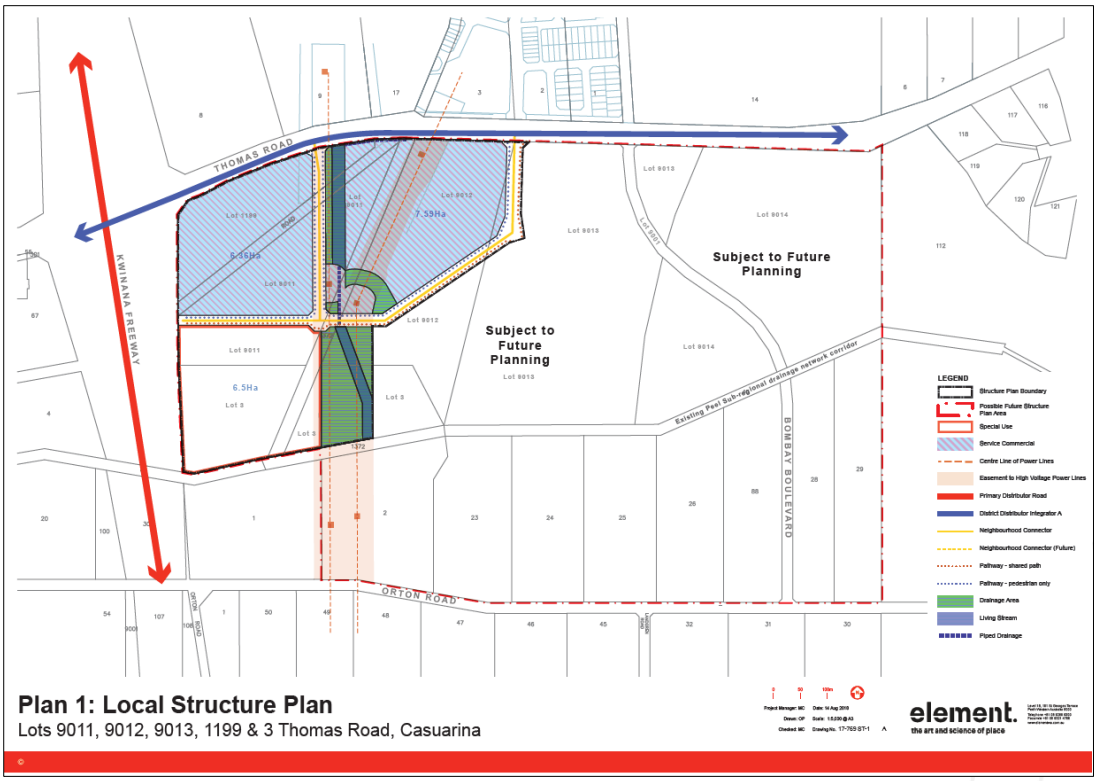


FIGURE 8 – CASUARINA NORTH INDICATIVE CONCEPT PLAN



3.7 Casuarina Central Local Structure Plan

The Casuarina Central LSP is the subject of this report. Based on the regional and district planning initiatives the LSP is currently expected to incorporate:

- local retail centre of 800sqm
- part of the mixed-use precinct 23

This report subsequently assesses the market demand and implications for providing a local retail centre within the LSP and the market demand and implications of providing for an expansion to Precinct 23 mixed business area currently planned for in Casuarina North LSP. The following chapters assess the market demand and implications of providing these uses and activities within the Casuarina Central LSP.

FIGURE 9 – CASUARINA CENTRAL – DEVELOPMENT CONCEPT



TBB

3.8 Policy Implications

The planning initiatives at a regional and district level have been consistent in the desire and intent for a retail centre and mixed business/service commercial area within the Casuarina Central LSP. However, there is very little documented supporting evidence within these initiatives that these uses are sustainable. Based on these policy initiatives, it is more than likely that the commercial market will respond in the following manner.

Wandi DC

The Wandi District Centre could initially be expected to develop as a single and possibly double supermarket-based neighbourhood centre in the short term as residential development occurs in its immediate catchment. Wandi's initial catchment would incorporate the residents within a 1.5km radius. This catchment includes the areas of Wandi to the north of Thomas Road and Anketell North to the south of Thomas Road.

It remains unclear as to whether the residential catchment for Wandi DC will ultimately be capable of attracting and sustaining a Discount Department Store to this location even when the residential catchment becomes fully developed. If Wandi DC catchment ultimately did support a DDS it would be capable of trading to a wider 3km catchment.

Anketell South NC

The Anketell South Neighbourhood Centre allocated to Thomas Road has a limited residential catchment to the north (420 dwellings) and south (large tracts of non-residential land). It is located only 2.5km south of Wandi DC and will subsequently be operating within the immediate trade shadow of the Wandi DC catchment. This may hinder the attraction of a supermarket operator to this location. The Anketell South NC would ultimately be expected to serve the Anketell South LSP community and the Casuarina North and Central LSP communities. The centre may subsequently only attract a smaller supermarket operator and may ultimately function as a small neighbourhood or local centre.

Mortimer Road NC

The Mortimer Road neighbourhood centre is ultimately expected to serve the Casuarina South LSP and the Wellard East LSP area. The NC is located approximately 3km south of the Anketell South NC, providing a dedicated 1.5km catchment for both centres. This Casuarina South to Wellard East SP area is yet to be fully planned and do not impact the findings in this RNA.

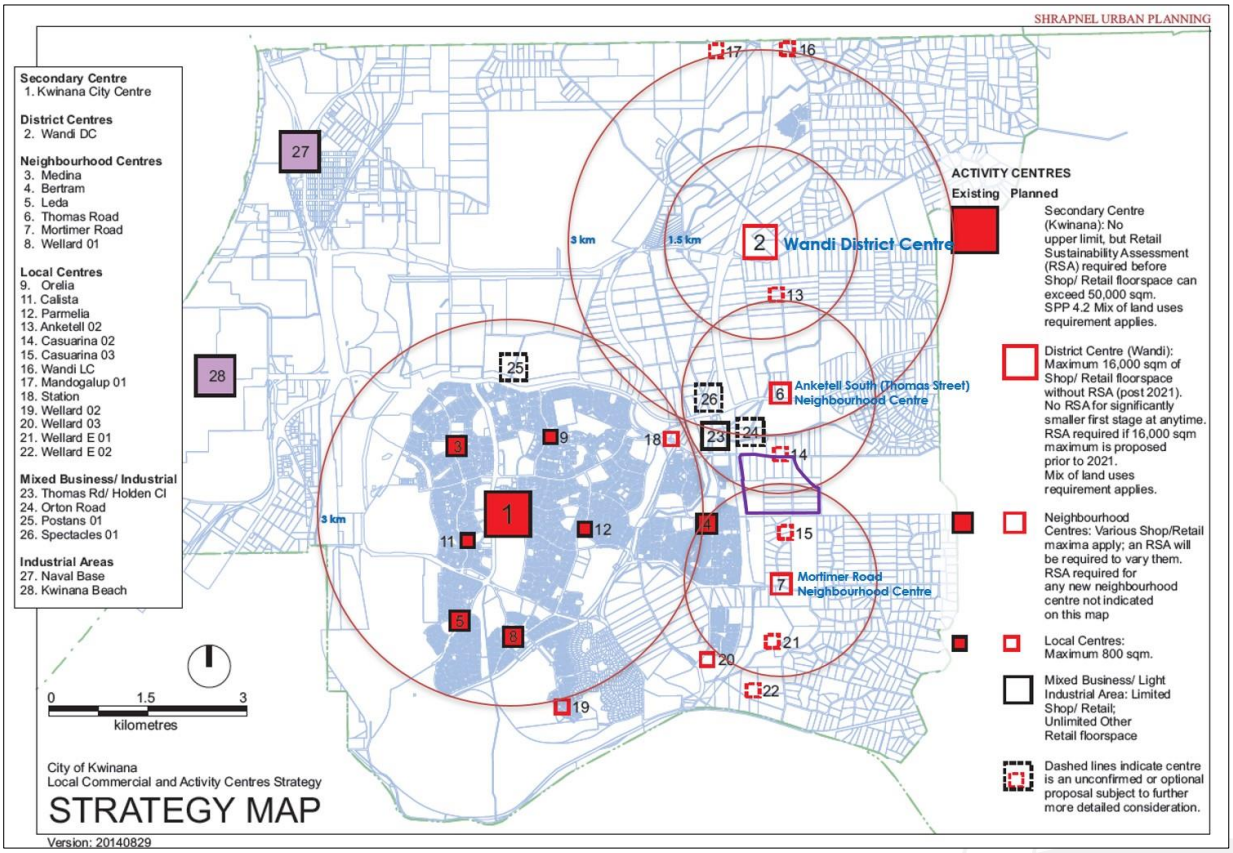
The narrow and elongated nature of the residential development area east of the Freeway promoted by ERIC and the Jandakot SP limits the size of the catchments available for the planned NC.

Local Centres

The local convenience centres allocated within ERIC and Jandakot SP are all located within 1km of higher order convenience-based neighbourhood or District centres. This proximity to larger convenience centres will hinder the local centres ability to capture sustainable amount of retail sales to be viable centres.

The community formed by the dwellings developed in Casuarina Central LSP will be served by both the Anketell South NC and the Mortimer Road NC.

FIGURE 10 – POTENTIAL CENTRE FUNCTION AND CATCHMENTS



City of Kwinana

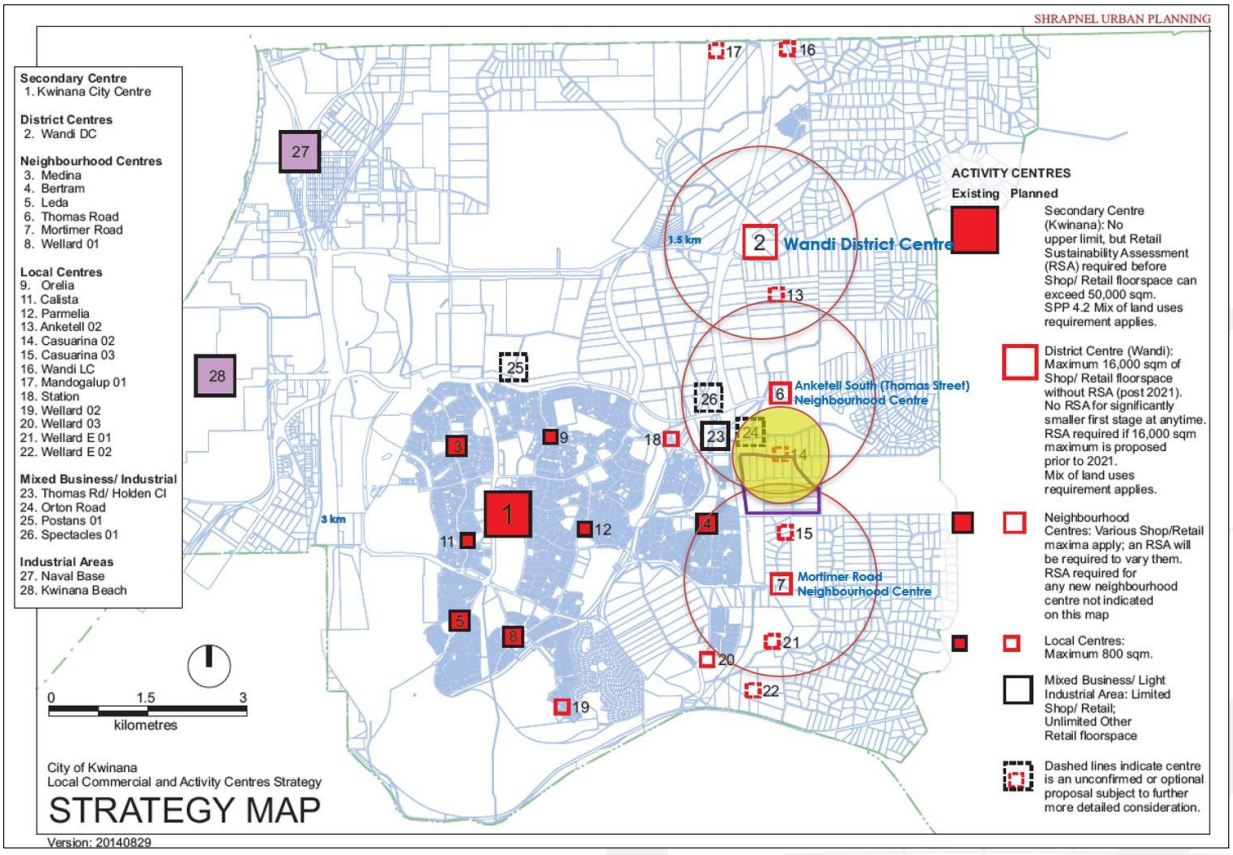
4 RETAIL NEEDS ASSESSMENT

The commercial sustainability of any retail centre will depend on its accessibility to a sufficient catchment and the impact of the competitive commercial environment also trading to the same catchment. The following sections will therefore assess the extent and nature of the planned catchments and the impact that these commercial centre function will have on the sustainability of any planned retail activity in the Casuarina Central LSP.

4.1 Casuarina Central Local Centre - Intended Catchment

The policy initiatives surrounding planned commercial centres in the vicinity of the Casuarina Central LSP will restrict the catchment of any local retail centre in the LSP to a walkable catchment of 400 metres. A local centre comprising 800sqm of floor space would usually represent about 6-8 shops without an anchor tenant (Figure 11).

FIGURE 11 – LOCAL CENTRE CATCHMENT



City of Kwinana (Taktics4)

4.2 Dwelling and Population Growth

The residential area formed by the ERIC and the Jandakot SP is expected to produce approximately 7,600 dwellings and accommodate approximately 22,800 residents. The breakdown for the region includes:

- 4,500 residents west of the freeway in Mandogalup
- 8,400 residents in Wandi and Anketell North (the catchment for the Wandi DC)

- 4,800 residents in Anketell South and Casuarina North and Central (the catchment for the Anketell South NC)
- 5,100 residents in Casuarina South to Wellard East (the catchment for the Mortimer Road NC)

TABLE 3 – POPULATION BY LSP (ERIC/JSP)

LSP	Dwellings	Population
Mandogalup (west of Kwinana Freeway)	1,500	4,500
Wandi (north of Anketell Road)	1,700	5,100
Anketell North LSP	1,100	3,300
Anketell South LSP	400	1,200
Casuarina North - Central	1,200	3,600
Casuarina South - Wellard East	1,700	5,100
Total ERIC Residential Area	**7,600**	**22,800**

Taktics4

A full line supermarket in a suburban environment would typically require a population of around 8,500 residents to be attracted to a site. As indicated the Wandi DC can therefore fully expect to attract a full line supermarket (3,500sqm) to its centre. The Anketell South NC and Mortimer NC catchments do not appear to achieve a catchment of 8,500 residents. These centres may subsequently attract smaller supermarkets (1,500sqm) rather than full line supermarkets.

4.3 Retail Spending Profile

To further place the potential level of market demand and sustainability into perspective it is possible to highlight the potential sales and trading performance for both supermarket-based NC in Anketell South (Thomas Road) and Mortimer Road. And the subsequent impact it has on a local centre at Orton Road.

The average residents spend approximately $6,000 per annum on supermarket and convenience-based retail goods and services. This spending profile generates a total supermarket and convenience retail spending capacity of $59.4 M p.a. across the catchments catering to the two NC and potential local Orton Road centre.

TABLE 4 – POPULATION by LSP

LSP	Population	Spending Capacity
Anketell South LSP	1,200	$ 7,200,000
Casuarina North - Central	3,600	$ 21,600,000
Casuarina South - Wellard East	5,100	$ 30,600,000
Combined	**9,900**	**$ 59,400,000**

Taktics4

The neighbourhood centres are expected to capture a total of 77% of this retail spending capacity – resulting in total sales of $45.6M p.a. ($17.5M for Anketell South NC and $28.1M p.a. for Mortimer Road NC).

The Mortimer Road NC is expected to have a larger market capture rate due to its larger catchment size and further proximity from Wandi and Kwinana Centres. These market capture rates and sales potential generate

A typical supermarket-based neighbourhood centre operating in an urban environment generally requires an average of $7,500/sqm p.a. in retail sales. This represents an industry average for sustainability of a supermarket-based centre. Using this sales productivity across both NC would result in a sustainable floor space of 2,350sqm for Anketell South NC and 3,750sqm for the Mortimer Road NC.

The balance of this supermarket and convenience retail spending capacity is typically captured by higher order centres, in this case likely to be Wandi DC and Kwinana Town Centre, as well as local centres.

The Wandi DC and Kwinana Town Centre may be expected to capture at least 60% of the remaining convenience-based retail spending due to the trip generation to these centres from the catchment for non-convenience-based activity. This leaves 40% of the balance of the supermarket and convenience-based retail spending to be captured by local centres in the catchment. There are currently three local centres allocated by policy to the catchments in question. Orton Road could expect to capture 20% of the remaining available spending capacity in Casuarina North and Central and would not expect any from the catchments further north and south.

This capture rate would be responsible for supporting up to 115sqm of retail floor space at the Orton Road local centre. A 115sqm of retail floor space is enough to sustain a single shop or café.

4.4 Casuarina Central Local Centre Options

Potential options for The Casuarina Central (Orton Road) Local Centre include:

Option 1 - Reduction of LC to a single tenant café/shop of 115 sqm

However, it has proven unrealistic that a single shop is capable of being sustained in the current market and retail conditions. Very few single retail operators achieve sustainable success in a stand-alone situation. This is due in most part to the nature of the retail industry, especially convenience-based retailing which is dominated by supermarket sector. Supermarkets capture 40% of total retail trade in Australia which equates to 80% of total convenience-based retail trade. This domination of the industry results in other small convenience-based tenants needing to locate near the supermarkets in order to benefit from their exposure and accessibility. The Casuarina Central Local Structure Plan identifies the need to close that section of Orton Road which would further hinder the development opportunity for any retail activity by limiting exposure and access to the already limited catchment. Subsequently any retail activity would be required to be relocated further north or further south to maintain the exposure and accessibility to the wider catchment. This would result in any retail activity relocating closer to the planned supermarket-based neighbourhood centres located north and south to cater for their respective communities/catchments.

Option 2 - Removal of the Casuarina Central Local Centre opportunity from the LSP.

This option would minimise the potential negative impact on potential retail sales on a seemingly economically vulnerable Anketell South NC and remove the perception and subsequent disappointment of the idea of a single café/shop to prospective communities/residents only for this to never eventuate.

Option 3 - Reallocation of the Local Centre at Orton Road to the mixed business service commercial area.

This option would better provide for the local café/convenience store needs for prospective employment within the service commercial / mixed business area. It would appear more to provide more flexibility in planning for the service commercial /mixed business activity and create a higher amenity for the area by providing convenience needs for the area's employees and visitors. This option would not preclude Casuarina Central and North residents accessing the store/centre for any local needs not met by the neighbourhood centre to the north and south.

4.5 Implications for Policy

SPP 4.2

The removal of the local centre from future planning initiatives would have no detrimental impact on SPP4.2. This policy supports the decision making in respect to local centres to be addressed at the more detailed local structure plan level. The analysis in this RNA has proved that a local centre cannot be sustained in the location specified due to the restricted catchment and the proximity to competing commercial activity. Similarly, relocation of the centre to a non-residential area in proximity to its original location would have no detrimental impact on the SPP4.2 principles and objectives.

LCACS

The relocation or removal of the Casuarina Central local centre would not have a detrimental impact on the findings and integrity of the LCACS. The LCACS findings and objectives have adequately allocate a range of centres as best it could, based on the information available during its preparation. It highlights and acknowledges that the retail floor space allocations for the various centres are not fixed and should be able to be altered to better reflect the more detailed planning of the specific areas. Subsequently, this analysis simply responds to the principles and objectives developed by the LCACS to respond to and facilitate changes to the allocated centres resulting from detailed analysis and planning of the area.

Casuarina North LSP

The residential areas within the Casuarina North LSP has not been formally planned. However, the planning for this area will not be impacted due to the knowledge that the future residential communities it ultimately creates will be well served by the planned Anketell South NC in Thomas Road immediate abutting the community. This would not preclude the opportunity for this LSP area to formally introduce a local centre should the land owners see an opportunity to do so.

Casuarina South LSP

The planning for the Casuarina South LSP is not affected by the options to relocate or remove the Casuarina Central (Orton Road) local centre. The Casuarina South LSP area is allocated a local centre of a similar size and nature as the Casuarina Central (Orton Road) local centre in the broader regional planning initiatives.

4.6 Implications for Community

None of the potential options for addressing the need, size and location of the Casuarina Central Local Centre have an impact on the ability of residents to access their day to day convenience-based retail goods and services. The Casuarina Central and North communities will continue to be serviced by direct access to supermarket-based centres less than 1.5 km north and south of their place of residence. Subsequently the Casuarina Central community will have even greater choice than most urban residents by having access to two supermarket-based centres equidistant from each other. The loss of a single shop (as it has been shown that the centre cannot sustain 800sqm) will not have a detrimental impact on this community's access to goods and services.

5 MIXED BUSINESS / SERVICE COMMERCIAL ASSESSMENT

As previously highlighted, broader regional planning initiatives for the area have incorporated a precinct for non-residential uses and activities that spans across the Casuarina North and Central LSP areas. It runs predominantly along the eastern edge of the Kwinana Freeway south from Thomas Road to beyond Orton Road. The planning for this precinct has been commenced through the Casuarina North LSP. The service commercial / mixed business area within the Casuarina North LSP area incorporates 20.4 Ha. Inclusive of 13.9 ha of service commercial zone and 6.5 Ha of special use zone. The Casuarina North LSP text includes the following passage:

Land Use Permissibility

a) The Local Structure Plan Map (Plan 1) outlines zones and reserves within the LSP area. Where applicable the intention of zones and land use permissibility within the LSP area shall be in accordance with the corresponding zone or reserve purpose
b) under the City of Kwinana Local Planning Scheme No. 2 (LPS 2).
c) Land use permissibility for the 'Service Commercial' zone shall be in accordance with the associated LPS 2 provisions.
d) The following uses are permitted (P) within the 'Special Use' zone:
- *Bulky goods showroom*
- *Car park*
- *Consulting rooms*
- *Eating house*
- *Liquor store*
- *Motor repair station*
- *Petrol filling station*
- *Service station*
- *Warehouse*

e) The following use is incidentally permitted (IP) within the 'Special Use' zone:
- *Shop*
- *Fish shop*

The mixed business/service commercial/special use zone in the Casuarina North LSP is shown to accommodate 127,000 sqm of floor space and create 2,500 employment opportunities in the region.

The basis for these figures is born from an assumed plot ratio of 70% on developable land and a floor space to employee ratio of 50 sqm per employee. However, it appears based on the concept plan attached to the LSP that this figure is meant to be closer to 30% plot ratio (which is more likely for this activity type) and subsequently is expected to generate 64,000sqm of floor space and produce 1,800 employment opportunities (based on 35 sqm for this activity type instead of 50sqm in the LSP).

The Casuarina Central LSP intended service commercial / mixed business area will form part of this broader service commercial / mixed business precinct to the north. It is expected to contain 7.5 Ha. Based on the same assumptions as the analysis provided in this RNA (not the assumptions formed by the Casuarina North LSP) the Casuarina Central LSP can accommodate 22,500sqm of floor space and create opportunities for 650 employees.

The overall area incorporating service commercial/mixed business zones in both the Casuarina North and Casuarina Central LSP's is therefore 28.7 Ha and capable of containing 86,000 sqm of floor space and generating 2,450 employees.

There is additional service commercial / mixed business activity planned to accommodate the same activity type in and around Wandi District Centre. This area is expected to generate up to 20,000sqm of other retail including showroom and mixed business activity.

This results in over 107,000sqm of mixed business /service commercial activity located in the ERIC and Jandakot SP area. Creating jobs for over 3,050 employees.

TABLE 5 – SERVICE COMMERCIAL / MIXED BUSINESS FLOOR SPACE

	Land Area (Ha)	Floor space (sqm)	Employment
Casuarina North LSP	21.2	63,510	1,815
Casuarina Central LSP	**7.5**	**22,500**	**643**
Casuarina North and South LSP	28.7	86,010	2,457
Anketell /Wandi	7	21,000	600
Total ERIC	**35.7**	**107,010**	**3,057**

Taktics4

5.1 Employment Self Sufficiency

The resident population east of the Kwinana Freeway is expected to grow from 8,050 in 2018 to 27,100 by 2036, an increase of 19,050 over the next 18 years at an average of 1,000 residents per annum.

The forecast resident population will produce a resident labourforce of 13,550 employees.

The employment generation of within the entire mixed business area will therefore contribute 23% of the broader employment needs of the community. The total employment self-sufficiency in the region is expected to be 44%, meaning that there are jobs for 44% of the total labourforce in this corridor. The service commercial area represents more than half of the total employment in the region. This appears to be an over representation for this activity type in the region.

The area allocated to service commercial / mixed business area will therefore contribute significantly to the levels of employment self-sufficiency in the region and provide opportunities for business activity to cater for this growing regional population corridor.

TABLE 6 – EMPLOYMENT SELF SUFFICIENCY

	Number	Employment Self sufficiency
Forecast Resident labourforce	**13,550**	
Service Commercial (Cas Nth and Central)	2,457	
Service Commercial (Anketell/Wandi)	600	
Service Commercial (All)	**3,057**	**23%**
Activity Centres	1,312	
Schools	200	
Home Business	903	
Sub Total	**5,473**	
Other 10%	547	
Total	**6,020**	**44%**

Taktics4

5.2 Location

Service commercial / mixed business activity is highly dependent on car-based trips. The value of the land within the location is heavily focused on exposure and access to passing trade. The service commercial / mixed business area in Wandi DC provides strong exposure and access for traffic along Anketell Road. Similarly, Casuarina North LSP service commercial / mixed business area has direct exposure and access from Thomas Road.

The value of the precinct to activity diminishes significantly the further activity is located from the high exposure locations. To this end, the service commercial / mixed business area in Casuarina Central LSP is located too far from Thomas Road to facilitate a viable and thriving service commercial / mixed business precinct.

5.3 Conclusions

This Retail Needs Assessment and employment analysis has highlighted that

The local centre currently planned for Casuarina central LSP is not required. That the Local centre could be provided for in several ways without jeopardising the integrity, objectives and principles of the planning initiatives developed for the broader region.

That the provision of the local centre is considered unnecessary and inefficient given the proximity of higher order convenience-based centres to the north and south

As well as the limited catchments available to these centres due to the narrow and elongated nature of the residential corridor.

The planning for the Casuarina Central LSP should therefore consider alternate ways to deal with the planned provision of a local centre in casuarina. Options may include:

- Removal of the local centre from the LSP
- Reduction of the LSP to a single café/shop
- Relocation of the local centre to the service commercial area in the Casuarina Central LSP
- Relocation of the local centre to the service commercial area in the Casuarina North LSP

Each of these options have merit and should be explored.

The service commercial / mixed business area planned in the ERIC corridor /Jandakot SP is located across three locations including the Wandi DC, Casuarina North and Casuarina Central LSP's. The amount of floor space allocated within these areas appears to be excessive for the population it is intended to serve. Planning for the Casuarina Central LSP should explore a reduction or removal of the service commercial area from the LSP.

APPENDIX I
LANDSCAPE STRATEGY

1 PLAYING FIELD
- Shared use by residents and adjoining Primary School
- Irrigated turf and native planting
- 1 yr drainage basin
- Existing trees and vegetation to be retained in consolidated area

2 ACTIVE POS
- Shelter and picnic facilities
- Adventure Playground incorporated with existing trees and vegetation
- Retained trees and vegetation
- Passive POS with 1 yr drainage basin
- Pedestrian links to adjacent residential and POS
- Irrigated native planting and turf

3 DRAINAGE POS
- 1 yr drainage basin
- Pedestrian links to adjoining CCW Buffer tracks
- Non-irrigated native planting

4 PASSIVE POS
- Located between Western Power easement and CCW Buffer
- Irrigated native planting and turf areas
- Connections from residential lots through WPE

5 DRAINAGE POS
- Native non-irrigated planting
- 1 yr drainage basin

6 DRAINAGE POS
- 1 yr drainage basin
- Pedestrian links to adjacent residential lots
- Irrigated native planting and turf

7 POS FOR VEGETATION RETENTION
- Retained trees and vegetation
- Weed eradication and revegetation as appropriate
- Limestone firebreaks
- Located adjacent to Bush Forever site

8 PASSIVE POS
- Irrigated native planting
- No drainage function

9 RESOURCE ENHANCEMENT WETLAND (REW)
- Existing trees to be retained
- Weed eradication and revegetation as required
- 1 yr drainage basin located in 30m wide REW Buffer

D7 CONSERVATION CATEGORY WETLAND (CCW)
- Minimal landscape works to take place
- Weed eradication and revegetation as required

D8 CONSERVATION CATEGORY WETLAND BUFFER
- Native non-irrigated planting and revegetation as required
- Weed eradication
- Limestone footpaths/firebreaks (dual function)

D10 WESTERN POWER EASEMENT
- Typically no trees or planting >1m height
- Non-irrigated native planting and revegetation as required
- Irrigated turf area connection to POS 4 (subject to WP/CoK approvals)
- Limestone access tracks to Western Power towers
- 1:100 basin in this location

LEGEND

STRUCTURE PLAN EXTENTS

RESIDENTIAL LOTS

NON-RESIDENTIAL LAND USE

1 YR 1 HR DRAINAGE BASIN

WESTERN POWER TOWER

PICNIC AND PLAYGROUND NODE

ORTON ROAD
BOMBAY BLVD
KWINANA FREEWAY
LANDGREN ROAD
LUGG PLACE

BASIN C: VOLUME 74m3
BASIN B: VOLUME 538m3
BASIN F: VOLUME 145m3
BASIN D: VOLUME 542m3
BASIN A: VOLUME 74m3
BASIN E: VOLUME 165m3
RESOURCE ENHANCEMENT WETLAND (REW)
30m REW BUFFER
CONSERVATION CATEGORY WETLAND (CCW)
50m CCW BUFFER

PLAYING FIELD
PRIMARY SCHOOL
WESTERN POWER EASEMENT

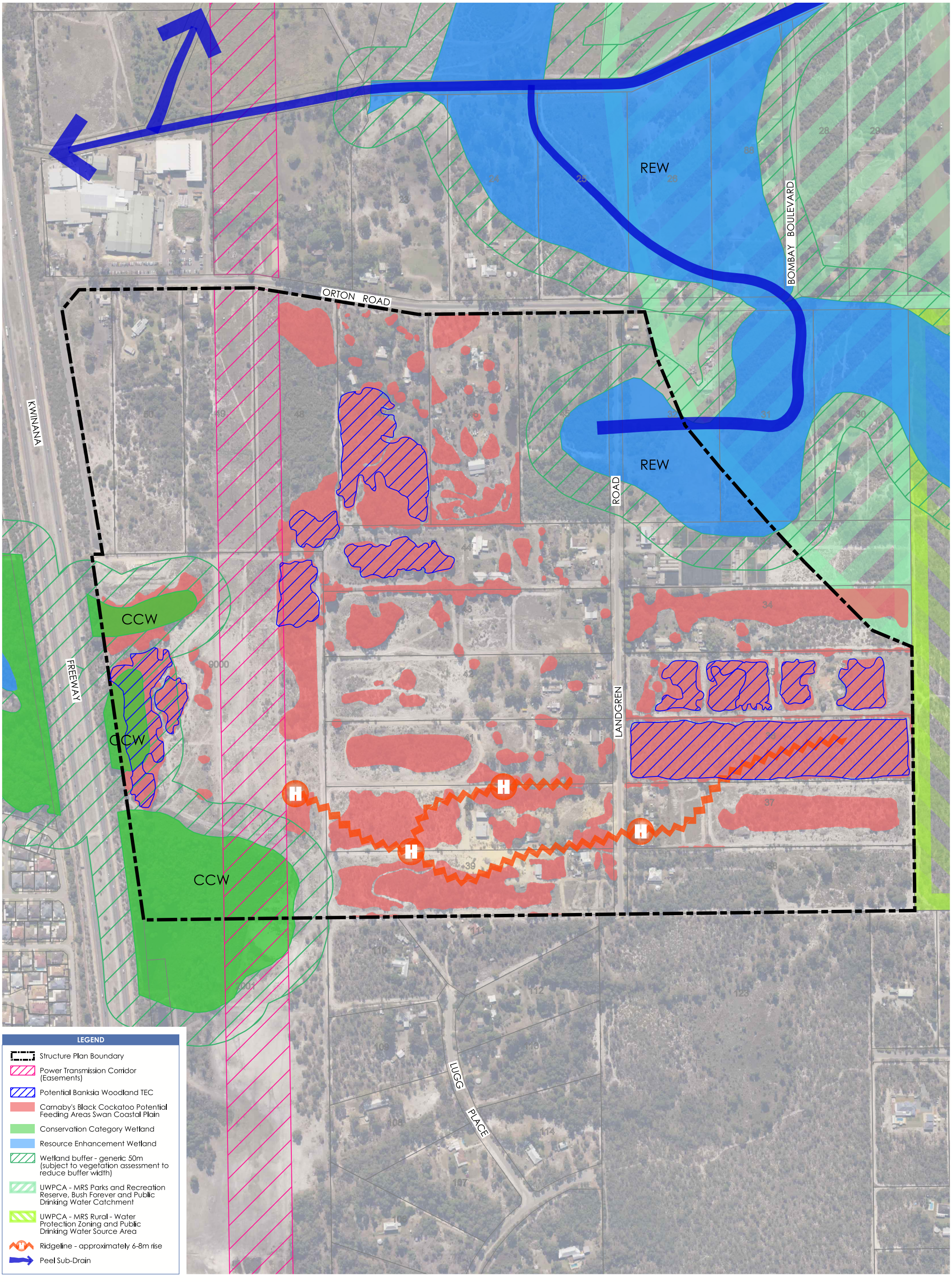
CASUARINA CENTRAL PRECINCT
LANDSCAPE MASTERPLAN

DWG ORC-01-C01
REV D
DATE APRIL 2019
SCALE 1 : 2500 @ A1
0 25 50 75 100 m

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emerge ASSOCIATES

APPENDIX J
LOCAL LANDSCAPE FEATURE AND TREE RETENTION STRATEGY



LEGEND

- Structure Plan Boundary
- Power Transmission Corridor (Easements)
- Potential Banksia Woodland TEC
- Carnaby's Black Cockatoo Potential Feeding Areas Swan Coastal Plain
- Conservation Category Wetland
- Resource Enhancement Wetland
- Wetland buffer - generic 50m (subject to vegetation assessment to reduce buffer width)
- UWPCA - MRS Parks and Recreation Reserve, Bush Forever and Public Drinking Water Catchment
- UWPCA - MRS Rural - Water Protection Zoning and Public Drinking Water Source Area
- Ridgeline - approximately 6-8m rise
- Peel Sub-Drain

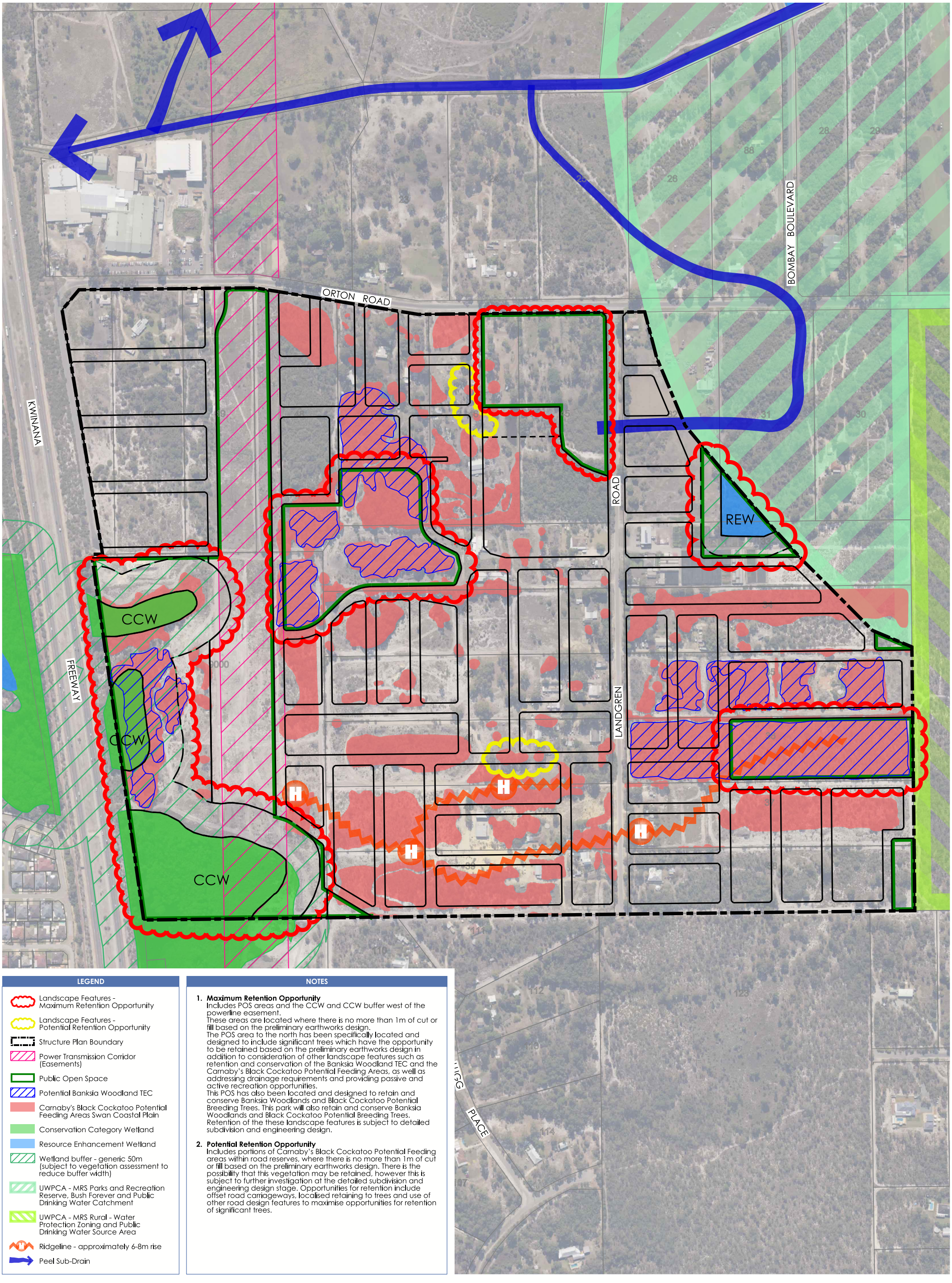
CASUARINA CENTRAL PRECINCT - EXISTING LANDSCAPE FEATURES

Various Lots, Orton Road & Landgren Road CASUARINA

0m 25 50 75m

s: 1:5,000@A3
d: 25/03/2019
p: 17/038/047D

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LEGEND

- Landscape Features - Maximum Retention Opportunity
- Landscape Features - Potential Retention Opportunity
- Structure Plan Boundary
- Power Transmission Corridor (Easements)
- Public Open Space
- Potential Banksia Woodland TEC
- Carnaby's Black Cockatoo Potential Feeding Areas Swan Coastal Plain
- Conservation Category Wetland
- Resource Enhancement Wetland
- Wetland buffer - generic 50m (subject to vegetation assessment to reduce buffer width)
- UWPCA - MRS Parks and Recreation Reserve, Bush Forever and Public Drinking Water Catchment
- UWPCA - MRS Rural - Water Protection Zoning and Public Drinking Water Source Area
- Ridgeline - approximately 6-8m rise
- Peel Sub-Drain

NOTES

1. **Maximum Retention Opportunity**
   Includes POS areas and the CCW and CCW buffer west of the powerline easement.
   These areas are located where there is no more than 1m of cut or fill based on the preliminary earthworks design.
   The POS area to the north has been specifically located and designed to include significant trees which have the opportunity to be retained based on the preliminary earthworks design in addition to consideration of other landscape features such as retention and conservation of the Banksia Woodland TEC and the Carnaby's Black Cockatoo Potential Feeding Areas, as well as addressing drainage requirements and providing passive and active recreation opportunities.
   This POS has also been located and designed to retain and conserve Banksia Woodlands and Black Cockatoo Potential Breeding Trees. This park will also retain and conserve Banksia Woodlands and Black Cockatoo Potential Breeding Trees.
   Retention of the these landscape features is subject to detailed subdivision and engineering design.

2. **Potential Retention Opportunity**
   Includes portions of Carnaby's Black Cockatoo Potential Feeding areas within road reserves, where there is no more than 1m of cut or fill based on the preliminary earthworks design. There is the possibility that this vegetation may be retained, however this is subject to further investigation at the detailed subdivision and engineering design stage. Opportunities for retention include offset road carriageways, localised retaining to trees and use of other road design features to maximise opportunities for retention of significant trees.

CASUARINA CENTRAL PRECINCT - LANDSCAPE FEATURES TO BE RETAINED

Various Lots, Orton Road & Landgren Road CASUARINA

0m 25 50 75m

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ORTON ROAD
BOMBAY BOULEVARD
KWINANA FREEWAY
LANDGREN ROAD
LUGG PLACE

LEGEND

- Structure Plan Boundary
- Western Power Easement
- Public Open Space
- Unsurveyed Area
- Development Concept

Significant Trees with >500 mm Diameter at breast height

Species

- Jarrah (Eucalyptus marginata)
- Tuart (Eucalyptus gomphocephala)
- Marri (Corymbia callophylla)
- Coastal Blackbutt (Eucalyptus todtiana)

Source: Strategen (15/03/2019)

CASUARINA CENTRAL PRECINCT - SIGNIFICANT TREES - EXISTING

Various Lots, Orton Road & Landgren Road CASUARINA

N

0m 25 50 75m

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LEGEND

- Maximum Retention Opportunity
- Potential Retention Opportunity
- Structure Plan Boundary
- Western Power Easement
- Public Open Space
- Unsurveyed Area
- Development Concept

Significant Trees with >500 mm Diameter at breast height

Species

- Jarrah (Eucalyptus marginata)
- Tuart (Eucalyptus gomphocephala)
- Marri (Corymbia callophylla)
- Coastal Blackbutt (Eucalyptus todtiana)

Source: Strategen (15/03/2019)

ORTON ROAD

BOMBAY BOULEVARD

KWINANA FREEWAY

LANDGREN ROAD

NOTES

1. **Maximum Retention Opportunity**
   Includes significant trees located within POS areas and within the CCW and CCW buffer west of the powerline easement.
   These trees are also located where there is no more than 1m of cut or fill based on the preliminary earthworks design.
   The POS area to the north has been specifically located and designed to include significant trees which have the opportunity to be retained based on the preliminary earthworks design, in addition to consideration of other landscape features such as retention and conservation of the Banksia Woodland TEC and the Carnaby's Black Cockatoo Potential Feeding Areas, as well as addressing drainage requirements and providing passive and active recreation opportunities.
   The POS area on the eastern edge of the site has also been designed to include significant trees which have the opportunity for retention, as well as providing a regional ecological linkage with the adjacent Bush Forever site. This POS has also been located and designed to retain and conserve Banksia Woodlands and Black Cockatoo Potential Breeding Trees.
   Retention of the significant trees is subject to detailed subdivision and engineering design, and in particular retention of the trees located near the perimeter of the POS is dependent on the final levels of the surrounding roads.
2. **Potential Retention Opportunity**
   Includes significant trees located outside of POS areas within road reserves, or adjacent to the proposed playing field, where there is potentially no more than 1m of cut or fill based on the preliminary earthworks design. There is the possibility that these trees may be retained, however they are subject to further investigation at the detailed subdivision and engineering design stage. Opportunities for retention include offset road carriageways, localised retaining to trees and use of other road design features to maximise opportunities for retention of significant trees.

TREE PROTECTION METHODS AND ONGOING MAINTENANCE MEASURES

- All trees identified for retention at the detailed subdivision and engineering design stage should be clearly marked and a tree protection zone (TPZ) prepared prior to the commencement of subdivision works.
- Construction management plans should be prepared in compliance with the tree protection plan.
- Protective fencing should be erected around tree protection zones for trees proposed to be retained.
- No building materials are to be stored or disposed of within the tree protection zone.
- Placement of fill should not be stored or built up around the trunk of retained trees.
- Preparation of chemicals, refuelling and washing down and cleaning equipment should not occur within tree protection zones.
- Use of vehicles / machinery including parking should be prohibited within the tree protection zone.
- Seek arborist advice for proposed level changes or excavation within the tree protection zones.
- Where roots within the tree protection zone are exposed by excavation, temporary root protection should be installed to prevent them drying out. It is not acceptable for roots within the tree protection zone to be pruned with machinery such as backhoes or excavators.
- Pruning wounds should not be treated with dressings or paints. Seek arborist advice prior to pruning.
- Seek arborist advice for remedial works for any tree damage that has occurred during the construction process.
- Maintain mulch to a depth of 50-100mm around base of tree. Where existing landscape within the tree protection zone remains unaltered mulch may not be required.
- Monitor soil moisture levels during and post construction works.
- Supplementary watering to retained trees may be required where works are in proximity of the trees.
- All weeds should be removed by hand or controlled with appropriate use of herbicide to minimise disturbance to soil.
- Continue to monitor tree health during maintenance period.

CASUARINA CENTRAL PRECINCT - SIGNIFICANT TREES - PROPOSED RETENTION AND REMOVAL

Various Lots, Orton Road & Landgren Road CASUARINA

0m 25 50 75m

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Casuarina Central Local Structure Plan

Tree Survey Data

FID (360 Environmental 2018)	Tree Reference No. (Strategen 2018)	Significant Tree Reference No. (Strategen 2019)	taxa	latitude	longitude	DBH (mm)	Hollows present	number of hollows	Surveyed by Strategen (2018)	Hollow suitability as determined by Strategen (2018)
180		1	Jarrah (Eucalyptus marginata)	-32.242335	115.861985	1750	yes	5		
156		2	Jarrah (Eucalyptus marginata)	-32.243738	115.862333	1730	potential	3		
176		3	Jarrah (Eucalyptus marginata)	-32.24255	115.862289	1430	yes	3		
513	3	4	Marri (Corymbia calophylla)	-32.241342	115.856143	1420	yes	2	Yes	Potentially suitable
244		5	Marri (Corymbia calophylla)	-32.241706	115.855513	1360	yes - unsuitable for bc	1		
567	4	6	Marri (Corymbia calophylla)	-32.242105	115.85669	1350	yes	5	Yes	Unsuitable
511	5	7	Marri (Corymbia calophylla)	-32.241458	115.85612	1310	yes	1	Yes	Unsuitable
340	6	8	Jarrah (Eucalyptus marginata)	-32.240281	115.857444	1250	yes	4	Yes	Potentially suitable
423		9	Tuart (Eucalyptus gomphocephala)	-32.243642	115.85885	1230	no			
5		10	Marri (Corymbia calophylla)	-32.243677	115.852799	1180	yes	2		
18		11	Marri (Corymbia calophylla)	-32.243306	115.853048	1180	yes	4		
235		12	Jarrah (Eucalyptus marginata)	-32.241666	115.855779	1180	yes	5		
333	10	13	Marri (Corymbia calophylla)	-32.240444	115.856967	1170	yes	2	Yes	Unsuitable
502	11	14	Marri (Corymbia calophylla)	-32.241402	115.858175	1170	yes	2	Yes	Unsuitable
406	12	15	Jarrah (Eucalyptus marginata)	-32.243443	115.856615	1150	yes	3	Yes	Unsuitable
571	13	16	Jarrah (Eucalyptus marginata)	-32.242123	115.855976	1110	yes	1	Yes	Unsuitable
268	14	17	Jarrah (Eucalyptus marginata)	-32.245145	115.856156	1100	yes	5	Yes	Unsuitable
345	15	18	Marri (Corymbia calophylla)	-32.239845	115.856892	1100	yes	1	Yes	Unsuitable
3		19	Marri (Corymbia calophylla)	-32.243917	115.852943	1085	potential	1		
177		20	Jarrah (Eucalyptus marginata)	-32.242525	115.862243	1060	yes	2		
181		21	Marri (Corymbia calophylla)	-32.242885	115.862251	1060	potential	1		
249		22	Jarrah (Eucalyptus marginata)	-32.241191	115.855477	1042	yes	1		
23		23	Marri (Corymbia calophylla)	-32.243135	115.853161	1028	potential	3		
238		24	Marri (Corymbia calophylla)	-32.241635	115.855655	1020	yes	1		
296		25	Jarrah (Eucalyptus marginata)	-32.238108	115.855707	1010	potential	4		
367		26	Tuart (Eucalyptus gomphocephala)	-32.238769	115.859069	1010	no			
20		27	Marri (Corymbia calophylla)	-32.243087	115.852672	1000	yes	3		
158		28	Jarrah (Eucalyptus marginata)	-32.243161	115.86512	1000	yes	2		
331		29	Marri (Corymbia calophylla)	-32.240364	115.856611	1000	no			
369	20	30	Jarrah (Eucalyptus marginata)	-32.238646	115.858375	1000	yes	1	Yes	Unsuitable
147		31	Jarrah (Eucalyptus marginata)	-32.243308	115.86513	990	no			
153		32	Jarrah (Eucalyptus marginata)	-32.243865	115.863339	990	yes - unsuitable for bc	2		
42		33	Marri (Corymbia calophylla)	-32.241981	115.853116	970	yes	5		
208		34	Jarrah (Eucalyptus marginata)	-32.243609	115.854053	970	yes - unsuitable for bc	1		
248		35	Marri (Corymbia calophylla)	-32.241262	115.855592	970	yes	1		
108		36	Jarrah (Eucalyptus marginata)	-32.243901	115.861813	955	yes - unsuitable for bc	2		
40		37	Marri (Corymbia calophylla)	-32.241689	115.852685	940	yes	2		
481	24	38	Jarrah (Eucalyptus marginata)	-32.244107	115.858778	940	yes	1	Yes	Unsuitable
506		39	Marri (Corymbia calophylla)	-32.241383	115.857696	930	no			
274		40	Jarrah (Eucalyptus marginata)	-32.24574	115.856995	920	no			
510	26	41	Jarrah (Eucalyptus marginata)	-32.241445	115.856674	910	yes	2	Yes	Unsuitable
169		42	Jarrah (Eucalyptus marginata)	-32.242587	115.863072	900	yes	3		
170		43	Jarrah (Eucalyptus marginata)	-32.242773	115.863301	900	yes	3		
172		44	Jarrah (Eucalyptus marginata)	-32.242404	115.862725	900	no			
315		45	Jarrah (Eucalyptus marginata)	-32.237796	115.85602	900	yes	3		
504	30	46	Jarrah (Eucalyptus marginata)	-32.241391	115.857923	900	yes	2	Yes	Unsuitable
512	31	47	Jarrah (Eucalyptus marginata)	-32.241317	115.856071	900	yes	1	Yes	Unsuitable
334	32	48	Marri (Corymbia calophylla)	-32.240434	115.856934	890	yes	1	Yes	Potentially suitable
499		49	Marri (Corymbia calophylla)	-32.241389	115.858703	890	no			
14		50	Marri (Corymbia calophylla)	-32.243438	115.853189	880	potential	1		
36		51	Jarrah (Eucalyptus marginata)	-32.242498	115.853146	880	yes - unsuitable for bc	3		
136		52	Jarrah (Eucalyptus marginata)	-32.243223	115.863703	880	yes	1		
155		53	Jarrah (Eucalyptus marginata)	-32.243373	115.863039	880	yes - unsuitable for bc	2		
247		54	Jarrah (Eucalyptus marginata)	-32.241539	115.855632	870	no			
366		55	Tuart (Eucalyptus gomphocephala)	-32.238693	115.858613	860	no			
559	34	56	Jarrah (Eucalyptus marginata)	-32.241718	115.857887	860	yes	1	Yes	Unsuitable
353		57	Tuart (Eucalyptus gomphocephala)	-32.238711	115.857041	850	no			
427		58	Tuart (Eucalyptus gomphocephala)	-32.243844	115.859695	840	no			
48		59	Marri (Corymbia calophylla)	-32.241377	115.853495	830	no			
31		60	Marri (Corymbia calophylla)	-32.242784	115.853133	820	potential	2		
178		61	Jarrah (Eucalyptus marginata)	-32.24253	115.862158	820	yes	2		
344		62	Marri (Corymbia calophylla)	-32.240286	115.856863	820	no			
434		63	Marri (Corymbia calophylla)	-32.242679	115.860345	820	no			
503		64	Marri (Corymbia calophylla)	-32.241548	115.858026	820	no			
555		65	Marri (Corymbia calophylla)	-32.241763	115.860417	820	no			
433		66	Tuart (Eucalyptus gomphocephala)	-32.243437	115.860396	810	no			
498		67	Marri (Corymbia calophylla)	-32.241401	115.858845	810	no			
		68	Marri (Corymbia calophylla)	-32.2458	115.8569	800	yes - unsuitable for bc	2		
359	36	69	Jarrah (Eucalyptus marginata)	-32.237814	115.857194	800	yes	1	Yes	Unsuitable
421		70	Tuart (Eucalyptus gomphocephala)	-32.243988	115.859036	800	no			
474	37	71	Jarrah (Eucalyptus marginata)	-32.24426	115.856528	800	yes	1	Yes	Unsuitable
505		72	Marri (Corymbia calophylla)	-32.24142	115.857942	800	no			
132		73	Jarrah (Eucalyptus marginata)	-32.243145	115.862487	790	yes - unsuitable for bc	2		
556		74	Marri (Corymbia calophylla)	-32.241951	115.860112	790	no			
		75	Marri (Corymbia calophylla)	-32.2419	115.8524	780	yes	3		
4		76	Jarrah (Eucalyptus marginata)	-32.243877	115.85315	780	potential	1		
306		77	Jarrah (Eucalyptus marginata)	-32.240555	115.855446	780	yes	2		
30		78	Marri (Corymbia calophylla)	-32.242817	115.85306	770	potential	1		
245		79	Jarrah (Eucalyptus marginata)	-32.241487	115.855313	770	no			
312		80	Jarrah (Eucalyptus marginata)	-32.239421	115.855472	770	yes	3		
337		81	Marri (Corymbia calophylla)	-32.240397	115.85717	770	no			
532		82	Marri (Corymbia calophylla)	-32.24182	115.86095	770	no			
109		83	Jarrah (Eucalyptus marginata)	-32.243917	115.861781	760	no			
431		84	Tuart (Eucalyptus gomphocephala)	-32.243959	115.859986	760	no			
500		85	Marri (Corymbia calophylla)	-32.241347	115.858576	760	no			
526		86	Marri (Corymbia calophylla)	-32.241016	115.857869	760	no			
		87	Coastal Blackbutt (Eucalyptus todtiana)	-32.2434	115.8635	750	no			
171		88	Jarrah (Eucalyptus marginata)	-32.242614	115.862971	750	no			
307		89	Jarrah (Eucalyptus marginata)	-32.240696	115.85531	750	yes	2		
364		90	Tuart (Eucalyptus gomphocephala)	-32.237825	115.858972	750	no			

448		91	Jarrah (Eucalyptus marginata)	-32.242221	115.858073	750	no			
509		92	Jarrah (Eucalyptus marginata)	-32.241381	115.856921	750	yes - unsuitable for bc	2		
518		93	Marri (Corymbia calophylla)	-32.240836	115.8569	750	potential	1		
544		94	Tuart (Eucalyptus gomphocephala)	-32.241926	115.862537	750	yes - unsuitable for bc	1		
9		95	Marri (Corymbia calophylla)	-32.243532	115.853315	740	no			
403		96	Jarrah (Eucalyptus marginata)	-32.243181	115.856113	740	no			
425		97	Tuart (Eucalyptus gomphocephala)	-32.243629	115.859077	740	no			
37		98	Jarrah (Eucalyptus marginata)	-32.242407	115.854081	730	no			
45		99	Marri (Corymbia calophylla)	-32.241727	115.853191	730	potential	2		
49		100	Marri (Corymbia calophylla)	-32.24169	115.853679	730	no			
209		101	Jarrah (Eucalyptus marginata)	-32.244107	115.854028	730	no			
273		102	Jarrah (Eucalyptus marginata)	-32.24575	115.856647	730	yes - unsuitable for bc	2		
290		103	Jarrah (Eucalyptus marginata)	-32.245708	115.860352	730	yes - unsuitable for bc	1		
335		104	Marri (Corymbia calophylla)	-32.240485	115.857133	730	no			
262		105	Marri (Corymbia calophylla)	-32.245461	115.857707	720	potential	1		
365		106	Tuart (Eucalyptus gomphocephala)	-32.238395	115.858569	720	no			
370		107	Tuart (Eucalyptus gomphocephala)	-32.238722	115.858303	710	no			
35		108	Marri (Corymbia calophylla)	-32.242565	115.853158	705	potential	1		
43		109	Marri (Corymbia calophylla)	-32.24181	115.853143	700	yes	4		
131		110	Jarrah (Eucalyptus marginata)	-32.24319	115.862383	700	no			
291		111	Tuart (Eucalyptus gomphocephala)	-32.245155	115.860361	700	no			
371		112	Tuart (Eucalyptus gomphocephala)	-32.239074	115.858407	700	no			
426		113	Tuart (Eucalyptus gomphocephala)	-32.243654	115.85927	700	no			
461		114	Tuart (Eucalyptus gomphocephala)	-32.244802	115.859891	700	no			
470	42	115	Jarrah (Eucalyptus marginata)	-32.244802	115.856564	700	yes	4	Yes	Unsuitable
514		116	Jarrah (Eucalyptus marginata)	-32.240834	115.856448	700	potential	1		
32		117	Marri (Corymbia calophylla)	-32.242869	115.852872	690	potential	2		
242		118	Marri (Corymbia calophylla)	-32.241703	115.85529	680	no			
319	44	119	Jarrah (Eucalyptus marginata)	-32.237901	115.856244	680	yes	2	Yes	Unsuitable
430		120	Tuart (Eucalyptus gomphocephala)	-32.244002	115.859849	680	no			
501		121	Marri (Corymbia calophylla)	-32.241412	115.858291	670	no			
524		122	Marri (Corymbia calophylla)	-32.241005	115.857464	670	no			
41		123	Marri (Corymbia calophylla)	-32.242064	115.853063	660	no			
523		124	Marri (Corymbia calophylla)	-32.24101	115.857474	660	no			
536		125	Marri (Corymbia calophylla)	-32.241899	115.860888	660	no			
8		126	Marri (Corymbia calophylla)	-32.243488	115.8528	650	yes	2		
12		127	Marri (Corymbia calophylla)	-32.243505	115.853116	650	potential	1		
13		128	Jarrah (Eucalyptus marginata)	-32.243421	115.853161	650	yes	4		
46		129	Marri (Corymbia calophylla)	-32.241523	115.853234	650	no			
321		130	Jarrah (Eucalyptus marginata)	-32.238097	115.856407	650	no			
354		131	Tuart (Eucalyptus gomphocephala)	-32.238635	115.85682	650	no			
391		132	Tuart (Eucalyptus gomphocephala)	-32.24308	115.859695	650	no			
451		133	Jarrah (Eucalyptus marginata)	-32.242387	115.85954	650	no			
530		134	Marri (Corymbia calophylla)	-32.242054	115.860768	650	no			
		135	Coastal Blackbutt (Eucalyptus todtiana)	-32.2424	115.8611	640	no			
44		136	Jarrah (Eucalyptus marginata)	-32.241596	115.853173	640	yes	3		
508	48	137	Jarrah (Eucalyptus marginata)	-32.241434	115.857168	640	yes	2	Yes	Unsuitable
529		138	Jarrah (Eucalyptus marginata)	-32.241055	115.859493	640	potential	1		
565		139	Marri (Corymbia calophylla)	-32.241928	115.85684	640	no			
157		140	Jarrah (Eucalyptus marginata)	-32.243646	115.861612	630	no			
239		141	Marri (Corymbia calophylla)	-32.241692	115.855582	630	no			
332	49	142	Jarrah (Eucalyptus marginata)	-32.240401	115.856812	630	yes	1	Yes	Unsuitable
368		143	Tuart (Eucalyptus gomphocephala)	-32.238994	115.85865	630	no			
522		144	Marri (Corymbia calophylla)	-32.240991	115.857533	630	no			
		145	Marri (Corymbia calophylla)	-32.242	115.8524	620	no			
7		146	Jarrah (Eucalyptus marginata)	-32.243643	115.852876	620	potential	2		
16		147	Marri (Corymbia calophylla)	-32.243263	115.853101	620	no			
28		148	Marri (Corymbia calophylla)	-32.242611	115.853549	620	no			
393		149	Tuart (Eucalyptus gomphocephala)	-32.243202	115.859442	620	no			
415		150	Jarrah (Eucalyptus marginata)	-32.243334	115.858703	620	no			
497	50	151	Jarrah (Eucalyptus marginata)	-32.241401	115.858916	620	yes	2	Yes	Unsuitable
541		152	Marri (Corymbia calophylla)	-32.241805	115.861676	620	no			
6		153	Marri (Corymbia calophylla)	-32.24362	115.852728	610	potential	1		
254		154	Marri (Corymbia calophylla)	-32.24091	115.855669	610	yes - unsuitable for bc	1		
330		155	Marri (Corymbia calophylla)	-32.240336	115.856604	610	no			
339	51	156	Jarrah (Eucalyptus marginata)	-32.240279	115.857599	610	yes	1	Yes	Unsuitable
531		157	Marri (Corymbia calophylla)	-32.241888	115.86079	610	no			
237		158	Marri (Corymbia calophylla)	-32.241699	115.855691	600	no			
241		159	Marri (Corymbia calophylla)	-32.241732	115.855271	600	no			
542		160	Marri (Corymbia calophylla)	-32.242	115.861611	600	no			
34		161	Marri (Corymbia calophylla)	-32.242738	115.852671	590	no			
233		162	Marri (Corymbia calophylla)	-32.241935	115.855662	590	no			
385		163	Jarrah (Eucalyptus marginata)	-32.238875	115.85795	590	yes	1		
563		164	Marri (Corymbia calophylla)	-32.241685	115.856956	590	no			
243		165	Marri (Corymbia calophylla)	-32.241637	115.855404	580	no			
		166	Coastal Blackbutt (Eucalyptus todtiana)	-32.2423	115.8639	570	no			
21		167	Marri (Corymbia calophylla)	-32.242826	115.852664	570	no			
22		168	Marri (Corymbia calophylla)	-32.242694	115.852615	570	no			
535		169	Marri (Corymbia calophylla)	-32.241976	115.860897	570	no			
50		170	Marri (Corymbia calophylla)	-32.241523	115.853581	565	no			
355		171	Jarrah (Eucalyptus marginata)	-32.238241	115.85755	560	no			
357		172	Tuart (Eucalyptus gomphocephala)	-32.238037	115.857292	560	no			
390		173	Jarrah (Eucalyptus marginata)	-32.243205	115.860119	560	no			
0		174	Marri (Corymbia calophylla)	-32.24426	115.853038	550	no			
15		175	Marri (Corymbia calophylla)	-32.243345	115.853119	550	no			
17		176	Marri (Corymbia calophylla)	-32.243261	115.853149	550	no			
33		177	Marri (Corymbia calophylla)	-32.242801	115.852752	550	no			
246		178	Marri (Corymbia calophylla)	-32.241416	115.855387	550	no			
392		179	Tuart (Eucalyptus gomphocephala)	-32.243154	115.859556	550	no			
394		180	Tuart (Eucalyptus gomphocephala)	-32.243177	115.859305	550	no			
422		181	Tuart (Eucalyptus gomphocephala)	-32.243679	115.858787	550	no			
564		182	Marri (Corymbia calophylla)	-32.241737	115.857015	550	no			
174		183	Marri (Corymbia calophylla)	-32.24266	115.862471	540	no			
179		184	Marri (Corymbia calophylla)	-32.242578	115.862187	540	no			
240		185	Marri (Corymbia calophylla)	-32.241717	115.855369	540	no			
253		186	Marri (Corymbia calophylla)	-32.240872	115.855709	540	no			
259		187	Marri (Corymbia calophylla)	-32.245369	115.85797	540	no			
418		188	Jarrah (Eucalyptus marginata)	-32.243902	115.858635	540	no			

424		189	Tuart (Eucalyptus gomphocephala)	-32.243751	115.858921	540	no			
11		190	Marri (Corymbia calophylla)	-32.243529	115.853112	530	no			
314		191	Jarrah (Eucalyptus marginata)	-32.237966	115.856065	530	no			
329		192	Marri (Corymbia calophylla)	-32.240319	115.856593	530	no			
29		193	Marri (Corymbia calophylla)	-32.242993	115.853013	528	no			
19		194	Marri (Corymbia calophylla)	-32.243208	115.852728	520	yes	1		
236		195	Marri (Corymbia calophylla)	-32.241692	115.855817	520	no			
336	53	196	Jarrah (Eucalyptus marginata)	-32.240444	115.857166	520	yes	1	Yes	Unsuitable
533		197	Marri (Corymbia calophylla)	-32.24195	115.860801	520	no			
562		198	Marri (Corymbia calophylla)	-32.241661	115.857061	520	no			
566		199	Jarrah (Eucalyptus marginata)	-32.241997	115.856794	520	no			
207		200	Jarrah (Eucalyptus marginata)	-32.243048	115.861236	510	no			
343		201	Jarrah (Eucalyptus marginata)	-32.240301	115.857141	510	no			
25		202	Marri (Corymbia calophylla)	-32.243031	115.853521	505	no			
47		203	Marri (Corymbia calophylla)	-32.241468	115.853402	500	no			
173		204	Marri (Corymbia calophylla)	-32.242493	115.862413	500	yes	1		
342		205	Marri (Corymbia calophylla)	-32.240262	115.857144	500	no			
387		206	Jarrah (Eucalyptus marginata)	-32.238615	115.857707	500	yes	2		
534		207	Marri (Corymbia calophylla)	-32.241922	115.860943	500	no			



Figure 1: Tree location and significance

N

Scale 1:1,100 at A4

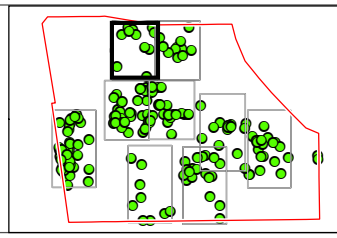
0 10 20 m

Coordinate System:
GDA 1994 MGA Zone 50

Date: 18/03/2019

Legend

- Significant trees
- Project area



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Figure 2: Tree location and significance

N

Scale 1:1,000 at A4

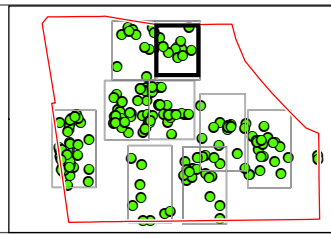
0 10 20 m

Coordinate System:
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Date: 18/03/2019

Legend

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Figure 3: Tree location and significance

N

Scale 1:1,500 at A4

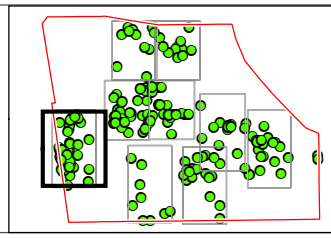
0 10 20 m

Coordinate System:
GDA 1994 MGA Zone 50

Date: 18/03/2019

Legend

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Figure 4: Tree location and significance

N

Scale 1:1,100 at A4

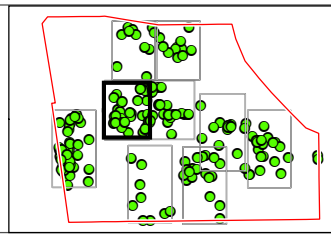
0 10 20 m

Coordinate System:
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Date: 18/03/2019

Legend

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Figure 5: Tree location and significance

N

Scale 1:1,000 at A4

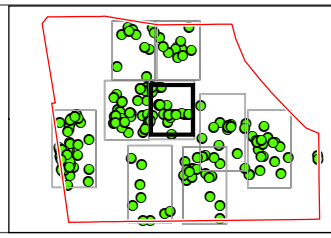
0 10 20 m

Coordinate System:
GDA 1994 MGA Zone 50

Date: 18/03/2019

Legend

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Figure 6: Tree location and significance

N

Scale 1:650 at A4

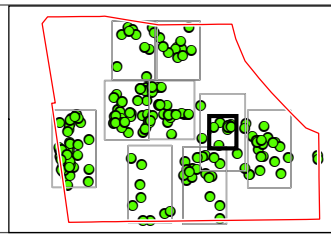
0 10 20 m

Coordinate System:
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Date: 18/03/2019

Legend

- Significant trees
- Project area



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Figure 7: Tree location and significance

N

Scale 1:650 at A4

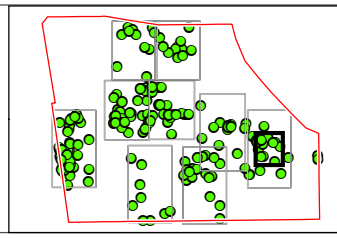
0 10 20 m

Coordinate System:
GDA 1994 MGA Zone 50

Date: 18/03/2019

Legend

- Significant trees
- Project area



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Figure 8: Tree location and significance

N

Scale 1:1,500 at A4

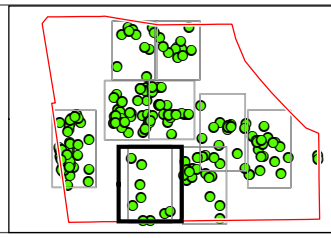
0 10 20 m

Coordinate System:
GDA 1994 MGA Zone 50

Date: 18/03/2019

Legend

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- Project area



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Figure 9: Tree location and significance

N

Scale 1:1,400 at A4

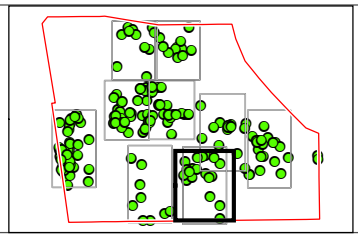
m
0 10 20

Coordinate System:
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Date: 18/03/2019

Legend

- Significant trees
- Project area



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16 Reports – Civic Leadership

16.1 Budget Variations

DECLARATION OF INTEREST:

There were no declarations of interest declared.

SUMMARY:

To amend the 2019/2020 budget to reflect various adjustments to the General Ledger with nil effect to the overall budget as detailed below. Due to the nature of these variations, they fall outside the annual budget review.

OFFICER RECOMMENDATION:

That Council approves the required budget variations to the Adopted Budget for 2019/2020 as outlined in the report.

NOTE: AN ABSOLUTE MAJORITY OF COUNCIL IS REQUIRED

DISCUSSION:

ITEM #	DESCRIPTION	CURRENT BUDGET	INCREASE/ DECREASE	REVISED BUDGET
1	Capital Expense – Building - Economic Services Facility – Margaret Feilman building	Nil	(145,000)	(145,000)
	Reserve Transfer – Building - Economic Services Facility – Margaret Feilman building – Asset Management Reserve	Nil	145,000	145,000

There has been constant water leaks through the roof into the DFES leased area in the Margaret Feilman building. It has been determined the roof materials and associated drainage structures (box drains) have reached end-of-life and require replacement. During the 2018/2019 budget review process Council adopted to transfer $324,000 of the surplus funds identified to the Asset Management Reserve. Additionally, the 2019/2020 budgeted closing balance of the Asset Management Reserve is $114,612 more than the Long Term Financial Plan (LTFP) projected closing balance for 2019/2020. As this project is required to be completed to ensure the ongoing usability of the building it is proposed that Asset Management Reserve funds are used to fund this, having a minimal impact (approximately $30,000) to the City's projections within the current LTFP. A review of the LTFP is currently being completed with the view to be adopted by Council in December 2019.

16.1 BUDGET VARIATIONS

2	Reserve Transfer – Transportation Vehicles – Executive Management - Plant and Equipment Replacement Reserve	Nil	(38,320)	(38,320)
	Capital Revenue– Transportation Vehicle - Executive Management - 1GIW674 – Insurance Reimbursement	Nil	38,320	38,320

An insurance reimbursement has been received for vehicle 1GIW674. It is proposed that these funds are transferred to the Plant and Equipment Replacement Reserve until it is determined if the vehicle will be replaced.

LEGAL/POLICY IMPLICATIONS:

The *Local Government Act 1995* Part 6 Division 4 s 6.8 (1) requires the local government not to incur expenditure from its municipal fund for an additional purpose except where the expenditure-

(b) is authorised in advance by resolution*

“additional purpose” means a purpose for which no expenditure estimate is included in the local government’s annual budget.

*requires an absolute majority of Council.

FINANCIAL/BUDGET IMPLICATIONS:

The financial implications are detailed in this report.

ASSET MANAGEMENT IMPLICATIONS:

The allocation of funds towards the upgrading and purchase of City assets will be included in the City’s Asset Management Strategy.

ENVIRONMENTAL IMPLICATIONS:

No environmental implications have been identified as a result of this report or recommendation.

16.1 BUDGET VARIATIONS

STRATEGIC/SOCIAL IMPLICATIONS:

This proposal will support the achievement of the following outcome and objective detailed in the Corporate Business Plan.

Plan	Outcome	Objective
Corporate Business Plan	Business Performance	5.4 Ensure the financial sustainability of the City of Kwinana into the future

COMMUNITY ENGAGEMENT:

There are no community engagement implications as a result of this report.

PUBLIC HEALTH IMPLICATIONS

There are no public health implications as a result of this report.

RISK IMPLICATIONS:

The risk implications in relation to this proposal are as follows:

Risk Event	The City does not manage its finances adequately and allows budget expenditure to exceed allocation and the City then finds itself unable to fund its services that have been approved through the budget process
Risk Theme	Failure to fulfil statutory regulations or compliance Providing inaccurate advice/information
Risk Effect/Impact	Financial Reputation Compliance
Risk Assessment Context	Operational
Consequence	Moderate
Likelihood	Rare
Rating (before treatment)	Low
Risk Treatment in place	Reduce (mitigate risk)
Response to risk treatment required/in place	Submit budget variation requests to Council as they arise, identifying financial implications and ensuring there is nil effect on the budget adopted
Rating (after treatment)	Low

COUNCIL DECISION

544

MOVED CR S LEE **SECONDED CR W COOPER**

That Council approves the required budget variations to the Adopted Budget for 2019/2020 as outlined in the report.

CARRIED BY AN ABSOLUTE MAJORITY OF COUNCIL
8/0

16.2 Review of Use of City of Kwinana Logos and Branding Policy

DECLARATION OF INTEREST:

There were no declarations of interest declared.

SUMMARY:

The Use of City of Kwinana Logos and Branding Policy (the Policy), as contained in Attachment A, governs the use of the City's primary City of Kwinana brand and its sub-brands by external organisations working in a collaborative arrangement with the City.

The Policy was last reviewed by Council at its Ordinary Council Meeting held on 22 March 2017. While the intention of the Policy primarily remains the same, amendments have been made throughout the document to better align the Policy to the City's Style Guide which defines the hierarchy of the City's branding in terms of the 'parent brand' or the City of Kwinana brand, and its sub-brands. The Policy now better reflects that external organisations may feature either the primary brand or a sub-brand. Amendments were also made to better govern the use of the City's logos by external organisations.

Finally, the Corporate Business Plan reference was removed, as this is no longer captured within the 2019-2024 Corporate Business Plan and has been replaced with an objective from the City's Strategic Community Plan.

It is recommended that the reviewed policy be adopted as contained in Attachment A.

OFFICER RECOMMENDATION:

That Council adopt the amended Use of City of Kwinana Logos and Branding Policy, as contained in Attachment A.

DISCUSSION:

The Use of City of Kwinana Logos and Branding Policy was created to ensure the use of the City's logos and branding by external organisations, was being monitored and controlled by the City to ensure that the City's brand was being applied consistently and professionally.

The Policy ensures that any alignment with external organisations is appropriately considered to ensure that the City is only associated with reputable organisations that have a positive brand alignment for the City.

Lastly, the Policy outlines the process for applying to use one of the City's logos or branding elements, the conditions of use and outlines any potential exclusions/limitations that may apply to organisations wanting to use the City's logos or branding.

16.2 REVIEW OF USE OF CITY OF KWINANA LOGOS AND BRANDING POLICY

LEGAL/POLICY IMPLICATIONS:

There are no legal implications as a result of this report.

FINANCIAL/BUDGET IMPLICATIONS:

There are no additional financial implications as a result of this report.

ASSET MANAGEMENT IMPLICATIONS:

There are no asset management implications as a result of this report.

ENVIRONMENTAL IMPLICATIONS:

There are no environmental implications as a result of this report.

STRATEGIC/SOCIAL IMPLICATIONS:

This proposal will support the achievement of the following outcome and objective detailed in the Strategic Community Plan:

Plan	Outcome	Objective
Strategic Community Plan	A unique identity	1.1 Develop and strengthen community identity to create a sense of belonging.

COMMUNITY ENGAGEMENT:

There are no community engagement implications as a result of this report.

PUBLIC HEALTH IMPLICATIONS

There are no implications on any determinants of health as a result of this report.

RISK IMPLICATIONS:

The risk implications in relation to this proposal are as follows:

Risk Event	Non-authorised organisations use the City's logo on their marketing.
Risk Theme	Providing inaccurate advice/ information
Risk Effect/Impact	Reputation
Risk Assessment Context	Operational
Consequence	Insignificant
Likelihood	Unlikely

16.2 REVIEW OF USE OF CITY OF KWINANA LOGOS AND BRANDING POLICY

Rating (before treatment)	Low
Risk Treatment in place	Accept - do nothing, accept its full impact
Response to risk treatment required/in place	City would contact the organisation and request they remove the City's branding, or seek retrospective approval.
Rating (after treatment)	Low

COUNCIL DECISION

545

MOVED CR D WOOD **SECONDED CR S MILLS**

That Council adopt the amended Use of City of Kwinana Logos and Branding Policy, as contained in Attachment A.

CARRIED
8/0

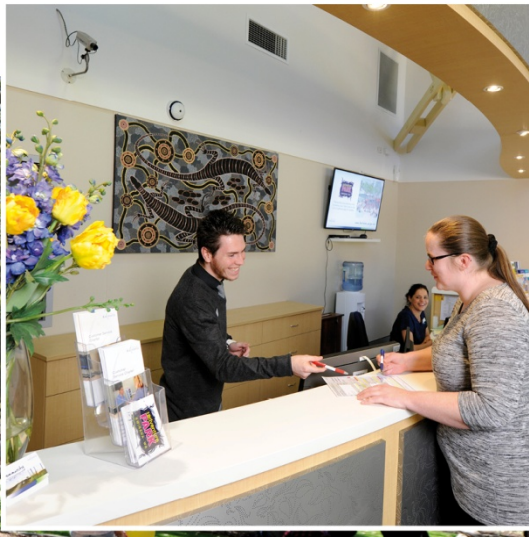
ATTACHMENT A

Council Policy

Use of City of Kwinana Logos and Branding









Council Policy	
Use of City of Kwinana Logos and Branding	D13/68738[v54]

1. Title

Use of City of Kwinana Logos and Branding

2. Purpose

To ensure consistent management and appropriate use of the City's corporate logo, sub-brand logos and other related branding elements by external organisations and groups.

3. Scope

This policy applies to organisations which are external to the City of Kwinana and which seek to utilise any of the City of Kwinana's ~~corporate~~ logo's or branding elements for any purpose.

4. Definitions

Logo means a graphic representation or symbol which acts to identify an organisation. 'Logo', 'Council logo', 'City logo' and 'City of Kwinana logo' refers to both the primary logo used by the City of Kwinana on its printed materials, websites and general correspondence and any other logos, brand marks and/or visual devices which the City has developed at any given time.

Sub-brand means a service that is affiliated with a parent brand (City of Kwinana), but are stand-alone brands due to target audience requirements. The City's sub-brands include Kwinana Recquatic, Zone Youth Space, Lyrik and Bright Futures Children's Services~~Family Daycare~~.

Logos refers to both the City of Kwinana's primary logo and the logo of its sub-brands.

~~**Corporate**~~ **Branding** refers to a wide range of tangible and non-tangible, visual and non-visual elements which contribute to the identity of the ~~organisation~~organisation, its primary brand and sub-brands.

5. Policy Statement

5.1 City of Kwinana logo

The City of Kwinana logo is the organisation's primary corporate brand mark. The consistent and professional application of this logo ensures appropriate recognition for the City while also protecting brand and reputation.

5.2 Sub-brand logos and ~~Corporate~~ branding elements ~~and logos~~

The City also has ~~develops and uses, from time to time,~~ a range of sub-brand logos and ~~corporate~~ branding elements to support each of the individual brands ~~and logos~~ in its official marketing and promotional publications and materials. Such sub-brand logos and ~~corporate~~ branding elements~~and logos~~ remain the property of the City.

5.3 Use of ~~corporate~~ branding elements and logos

Any City of Kwinana ~~corporate~~ branding elements or logos ~~are~~ are not to be used by any person or entity without the express authorisation of the City.

The use of the City's ~~corporate~~ branding or logos ~~will~~may be granted free of charge to organisations who have a formal affiliation with the City, this includes ~~by any organisation is free of charge and is to be authorised under the following circumstances~~:

(a) ~~Used by an~~Any entity that is in partnership with the City. ~~is in partnership with the City, however the~~U ~~u~~sage may only be ~~used in~~for activities and/or functions in direct relation to the partnership.
(b) Used by a person or entity in acknowledgement of the City's provision of sponsorship, ~~or~~ in-kind support or a community grant. Usage ~~, however~~ may only be ~~used in~~for ~~activities directly related to the~~the ~~sponsorship~~activity for which the support was received. ~~.~~
(c) ~~Used by a~~A person or entity in the promotion of a not ~~-~~for ~~-~~profit undertaking that is ~~-~~aligned with the strategic objectives of the City and where the use is considered to have positive benefits for the City of Kwinana brand. ~~the effect of promoting the City.~~

5.4 ~~-~~Applications to use
Applications are to be made prior to any use occurring and are to be made in writing, specifying the planned use of the ~~corporate~~ branding or logos, including but not limited to:

(a) The full text of the materials to which the ~~corporate~~ branding or logos are proposed to be applied.
(b) The manner, volume, reach and format by which the materials are to be distributed or published.
(c) Contact details of the person(s) who will be responsible for the correct usage of the corporate branding or logos as approved by the City. ~~The manner and format by which the materials are to be distributed or published.~~
(d) ~~Contact details of the person(s) who will be responsible for the correct usage of the corporate branding or logos as approved by the City.~~A draft artwork concept depicting the City's logo placement for approval prior to finalising~~visual representation of how the corporate branding or logos will look once published~~.
(e) (If requested) a copy of the final artwork for the City's records.

5.5 ~~-~~Conditions of use
The following criteria is conditional on any authorisation for the use of the City's ~~corporate~~ branding or logos and is to be communicated to the applicant on issue of an authorisation:

(a) Use of the ~~corporate~~ branding or logos is to be in accordance with the City's ~~Branding~~ Style Guide~~lines~~.
(b) The City is to determine a period for which the approval remains valid.
(c) The City retains the right to withdraw its approval, with the applicant subsequently being obligated to remove the City's corporate branding or logos from their materials and circulation.
(d) Any other conditions deemed appropriate to the circumstances of the application.

5.6 ~~-~~Limitations of commercial use
Approval to use City of Kwinana ~~corporate~~ branding or logos will **not** generally be given for suppliers of commercial products or services if such a use could be inferred,

directly or indirectly, as a testimonial or endorsement for said product or service.

6. Financial/budget implications
There are no specific financial or budget implications associated with this Policy.

7. Asset management implications
There are no specific asset management implications associated with this Policy.

8. Environmental implications
There are no specific financial or budget implications associated with this Policy.

9. Strategic/social implications
Strategic Community Plan 2019-2029

Objective 15.1 Develop and strengthen community identity to create a sense of belonging.

10. Occupational safety and health (OSH) implications
There are no specific OSH implications associated with this Policy.

11. Risk assessment
A risk assessment conducted as part of the Policy review has indicated that the risk to the City by the incorrect or unapproved use of the City's logos or branding by external organisations is low.

It is assessed that the risk rating following implementation of this Policy would remain low.

12. References

Name of Policy	Use of City of Kwinana Logos and Branding
Date of Adoption and resolution No	21/01/2015 #369
Review dates and resolution No #	22/03/2017 #452
New review date	22/03/2019
Legal Authority	Local Government Act 1995 - Section 2.7
Directorate	City Business
Department	Marketing and Communications
Related documents	D12/76754[v4] - City of Kwinana Branding Guidelines

Note: Changes to references may be made without the need to take the Policy to Council for review.

17 Urgent Business

Nil

18 Councillor Reports

18.1 Councillor Wendy Cooper

Councillor Wendy Cooper reported that she had attended the Calista Primary School Board Meeting.

Councillor Cooper advised that she had attended the Kwinana Bowling Club Season Opening Day which was a lovely occasion.

Councillor Cooper advised that she had attended the Westport Briefing Breakfast and it was great to receive the updates.

Councillor Cooper mentioned that she had attended the City of Kwinana Compost and Bokashi Workshop and passed on her congratulations and thanks to the City Officers.

18.2 Councillor Sandra Lee

Councillor Sandra Lee reported that she had attended the 27th Governor's Prayer Breakfast which was a very nice occasion.

Councillor Lee advised that she had attended the Westport Briefing Breakfast and advised that she believed that the transport corridors are what makes Kwinana the favoured option.

18.3 Councillor Dennis Wood

Councillor Dennis Wood reported that he had attended the City of Kwinana Annual Bush Fire Brigades Awards Dinner.

Councillor Wood advised that he had attended the Westport Briefing Breakfast which was very informative.

Councillor Wood mentioned that he had attended the Kwinana Bowling Club Season Opening Day which was good.

19 Response to Previous Questions

Nil

20 Mayoral Announcements (without discussion)

Mayor Carol Adams reported that she had attended the following Westport Meetings:

- Meeting with Hon Tjorn Sibma MLC, opposition Minister for Ports
- Westport Reference Group Meeting
- Westport Community Consultation Breakfast – City of Kwinana

The Mayor advised that meetings to note were:

- Meeting with Youthovation
- Meeting with representatives from the Department of Defence in relation to an international training exercise to be conducted in the waters of Rockingham, Cockburn and Kwinana later in the year. There will be a media release on the exercise closer to the date.
- South West Group Mayors and CEO's bi-monthly meeting
- Citizens Advice Bureau

The Mayor mentioned that she had attended the official launch of Tianqui Lithium's Kwinana Lithium Hydroxide Operations.

The Mayor reported that upcoming events of note are:

- Koorliny Arts Centre 2020 Performance Season Launch
- Lolly Run meeting for team leaders

21 Matters Behind Closed Doors

COUNCIL DECISION
546
MOVED CR P FEASEY **SECONDED CR D WOOD**

That in accordance with Sections 5.23(2)(a) of the *Local Government Act 1995*, Council move behind closed doors to allow discussion of the Matters Behind Closed Doors items.

CARRIED
8/0

The gallery, Executive Team, Lawyer and Council Administration Officer exited and the Council Chambers doors were closed at 8:01pm.

21.1 Acting Chief Executive Officer's selection and appointment

COUNCIL DECISION
547
MOVED CR W COOPER **SECONDED CR M ROWSE**

That Council suspend Standing Orders.

CARRIED
8/0

COUNCIL DECISION
548
MOVED CR W COOPER **SECONDED CR P FEASEY**

That Council reinstate Standing Orders.

CARRIED
8/0

COUNCIL DECISION
549
MOVED CR P FEASEY **SECONDED CR M ROWSE**

That Council:

1. **Appoints "candidate number one" as the successful applicant for the position of acting Chief Executive Officer for the period from 21 October 2019 until the Chief Executive Officer's commencement date.**
2. **Endorses that "candidate number one" is suitably qualified for the position in accordance with the curriculum vitae and reference checks provided, as detailed in Confidential Attachment A/B.**
3. **Authorises the Mayor to negotiate the terms of contract of employment with the preferred candidate in line with the proposed employment conditions as detailed in Confidential Attachment C.**

CARRIED
6/2

NOTE – That the Officer Recommendation has been amended at points 1 and 3 to include the appointed candidate number reference and commencement date.

21.2 Appointment of a recruitment agency to undertake the recruitment activity for a new Chief Executive Officer

COUNCIL DECISION
550
MOVED CR P FEASEY **SECONDED CR W COOPER**

That Council suspend Standing Orders.

CARRIED
8/0

COUNCIL DECISION
551
MOVED CR P FEASEY **SECONDED CR W COOPER**

That Council reinstate Standing Orders.

CARRIED
8/0

COUNCIL DECISION
552
MOVED CR C ADAMS **SECONDED CR P FEASEY**

That Council:

1. **Appoints Beilby, as detailed in Confidential Attachment A, as competent recruitment consultants to undertake the recruitment process of a new City of Kwinana CEO.**
2. **Authorises the Mayor to finalise the information package and advertisement.**

CARRIED
8/0

NOTE – That the Officer Recommendation has been amended at point 1 to include the appointed recruitment consultant's name and attachment reference.

COUNCIL DECISION
553
MOVED CR P FEASEY **SECONDED CR M ROWSE**

That Council return from Behind Closed Doors.

CARRIED
8/0

The Council Chambers doors were reopened at 8:30pm and a member of the gallery, Executive Team, Lawyer and Council Administration returned.

22 Meeting Closure

The Mayor declared the meeting closed at 8:33pm.

Chairperson: 25 September 2019