PLANNING FEASIBILITY STUDY

WATTLE GROVE SOUTH

CITY OF KALAMUNDA

24 MAY 2018

Issue 4

BURGESS DESIGN GROUP
TOWN PLANNING + URBAN DESIGN

Wattle Grove South

City of Kalamunda

PLANNING FEASIBILITY STUDY

Issue 4: 24 May 2018

Prepared for: **City of Kalamunda**

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TABLE OF CONTENTS

LIST OF PLANS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

1. INTRODUCTION & PURPOSE

Burgess Design Group has been appointed by City of Kalamunda for the provision of town planning and urban design consultancy services to undertake a Planning Feasibility Study for Wattle Grove South (the subject "site" or "land").

1.1 PURPOSE

The Western Australian Planning Commission's (WAPC) North-East Sub-Regional Planning Framework has identified Wattle Grove South as an area to be investigated for the purposes of future urban development.

The purpose of this Planning Feasibility Study is to determine the optimum location, size, opportunities, constraints and risks involved in progressing the rezoning and planning of the Wattle Grove South area for the purposes of urban development.

The Planning Feasibility Study has been formulated by Burgess Design Group, in collaboration with a team of specialist consultants, who have provided technical input in relation to matters as follows:

KCTT	Infrastructure Servicing Report & Transport Impact Assessment
360 Environmental	Environmental Assessments and Hydrology

1.2 SCOPE OF WORKS

The study has addressed the following agreed Scope of Works:

1. Phase 1 – Introduction and Purpose
    - Determine the optimum boundary, size and location of proposed development
    - Identify major elements for consideration to guide future urban development
2. Phase 2 – Regional Contextual Analysis and Map
    - Analyse the planning framework
    - Land supply and demand
    - Major access points, including the proximity of Tonkin Highway (Primary Regional Road) and Welshpool Road East (Other Regional Road)
    - Existing land uses in vicinity of the proposed development area
    - Environmental factors and constraints
3. Phase 3 – Local Contextual Analysis and Map
    - Population and employment self-sufficiency
    - City/civic requirements
    - Local Planning Strategy context
4. Phase 4 – Site Analysis and Map
    - Identify the opportunities / constraints presented by the development and propose investigations / recommendations in the following key areas:
        - Environmental

- Hydrological
- Servicing and Infrastructure (particular focus on deep sewer)
- Forrestfield > Thornlie rail extension and station at Wattle Grove
- Indicative Land Use / Retail Demand

5. Phase 5 – Statutory Process Recommendations

   - MRS rezoning
   - Land resumption requirements
   - LSP3 rezoning
   - District Structure Plan/Local Structure Plan
   - Developer Contributions arrangements

This is a comprehensive research analysis aimed to inform future rezoning and structure planning elements.

This Planning Feasibility Study represents the first element in progressing one of the Urban Expansion Areas originally identified by the Western Australian Planning Commission (WAPC) in its draft North-East Sub-regional Planning Framework and subsequently adopted in an extended form in the final version of this Framework, as released in March 2018.

One of the key elements of the Wattle Grove Urban Expansion Precinct area is the fragmented land ownership. This area is primarily characterised by a range of rural lifestyle lots ranging in area from as small as 1ha. This element will require specific consideration as part of this Planning Feasibility Study process.

1.3 ABBREVIATIONS

Abbreviations used in this report are summarised below for ease of reference:

AHD	Australian Height Datum (AHD)
CCW	Conservation Category
DBCA	Department of Biodiversity, Conservation and Attractions
DRF	Declared Rare Flora
DRF	Declared, Rare and Priority Flora
DSP	District Structure Plan
DWER	Department of Water and Environment Regulation
DWMS	District Water Management Strategy
LPS3	City of Kalamunda Local Planning Scheme No.3
LSP	Local Structure Plan
LWMS	Local Water Management Strategy (LWMS)
MKSEA	Maddington Kenwick Strategic Employment Area
MRS	Metropolitan Region Scheme
PECs	Priority Ecological Communities
POS	Public Open Space
REW	Resource Enhancement wetlands
TECs	Threatened Ecological Communities
TOD	Transit Oriented Development
WAPC	Western Australian Planning Commission

2. REGIONAL CONTEXTUAL ANALYSIS

2.1 SITE DESCRIPTION/DETAILS

2.1.1 Location

The subject land is located within the municipality of the City of Kalamunda, approximately 15 kilometres south-east of the Perth CBD and 14km south of Midland Strategic Metropolitan Centre (refer **Figure 1 – Location Plan**). The land has direct access to Brentwood Road, Victoria Road, Crystal Brook Road, and Welshpool Road East.

2.1.2 Existing and Historical Use and Development

Most of the lots within the study area are rural residential properties or are vacant land (refer **Figure 2 –Aerial Photograph**).

2.1.3 Study Area Boundary

The study area for Wattle Grove South was determined using the North East Sub-regional Planning Framework prepared by the WAPC, as it applies within the municipal boundary of the City of Kalamunda. The total area is approximately 310ha.

A key requirement of this Planning Feasibility Study is to review the appropriateness of the study area in response to the following considerations:

- Demand for developable land within locality
- Existing reports and strategies
- Consideration of opportunities and constraints

This Planning Feasibility Study examined three (3) study area boundaries (refer **Figure 3**):

- Option 1: Boundary as shown on the draft North East Sub-regional Planning Framework.
- Option 2: Reduction in the originally identified 'Urban Expansion' area, reducing this to include only the land south of Crystal Brook Road.
- Option 3: Extension of the 'Urban Expansion' boundary to Fontano Road & Judith Road (eastern boundary), Welshpool Road (northern boundary), and towards the intersection of Tonkin Highway/Welshpool Road East (western boundary).

Option 3 is considered to be the optimal study area boundary.

The final North East Sub-regional Planning Framework was released on 23 March 2018. This Framework amends the 'Urban Expansion' boundary to the extent that it essentially aligns with Option 3 (as outlined further below), confirming the suitability of this adopted study area boundary.

Notwithstanding the above, further discussion is provided below in relation to the alternate study area boundaries.

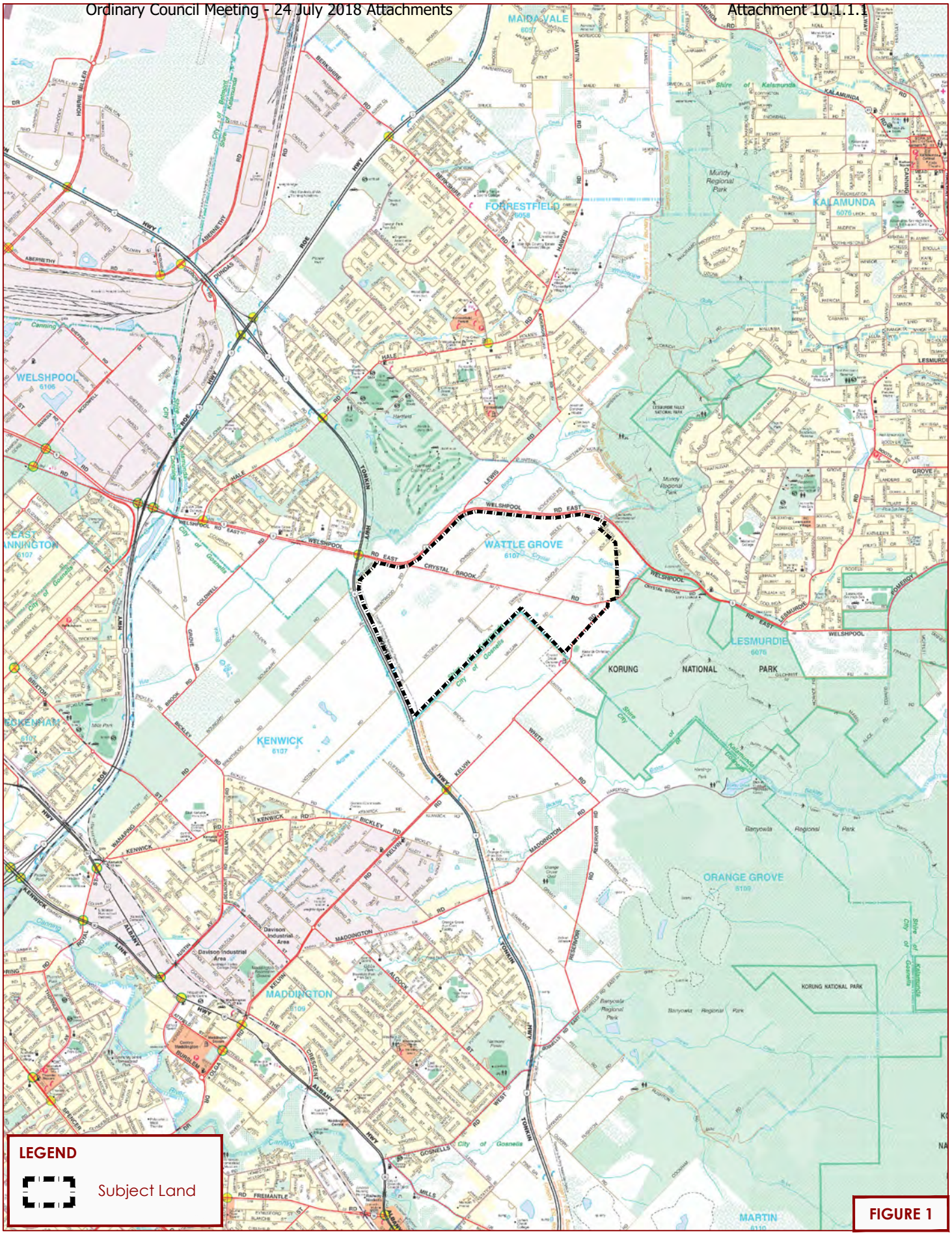

FIGURE 1

NORTH

0 0.5 0.75 1 1.5k

SCALE 1:50,000 (A4)

Client: City of Kalamunda
Date: 24.05.18
Plan No: KAL WAT 7-02c-01

LOCATION PLAN
WATTLE GROVE SOUTH
CITY OF KALAMUNDA

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FIGURE 2

NORTH

0 100 200 300 400 500m

SCALE 1:15,000 (A4)

Client: City of Kalamunda
Date: 24.05.18
Plan No: KAL WAT 7-02c-05

AERIAL PHOTOGRAPH
WATTLE GROVE SOUTH
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Option 1: Boundary as shown on the draft North East Sub-regional Planning Framework.

The site has a total land area of approximately 209ha.

The 'Urban Expansion' boundary shown on the draft North East Sub-regional Planning Framework was illogical and traversed a number of lots, rather than following specific lot boundaries. It is unclear why certain lots were excluded from the 'Urban Expansion' area and why the WAPC determined that the eastern boundary of the area should follow the existing powerline easement. Nonetheless, electing to progress the future planning and rezoning of the study area in the manner as shown in the WAPC draft would have been the simplest option given this would then show consistency with the overall (draft) strategic framework.

Given the illogical boundary presented in this option, two alternative study area boundaries were considered to more efficiently round-off the study area, as described below.

Option 2: Reduce the 'Urban Expansion' area to include only the land south of Crystal Brook Road.

Option 2 has a total land area of approximately 162ha.

Option 2 would have resulted in a reduced total site area. This option was conceived to create a more logical northern boundary for the study area, being Crystal Brook Road, as opposed to the illogical boundary identified in the draft Framework.

This option was not considered to be the optimum outcome for the City nor for those landowners with land identified as 'Urban Expansion' under the draft North East Sub-regional Planning Framework located on the north side of Crystal Brook Road. Under this approach, a separate planning process would have been needed, as some future time, to pursue any development of this northern area. It is reasonable to assume that the City and landowners would have had an expectation that future planning of the area would be generally consistent with the draft North-East Sub-regional Planning Framework boundary.

This option was thus not recommended.

Option 3: Extension of the 'Urban Expansion' boundary to Fontano Road & Judith Road (eastern boundary), Welshpool Road (northern boundary), and towards the intersection of Tonkin Highway/Welshpool Road East (western boundary).

Option 3 has a total land area of approximately 310ha.

Option 3 is considered to be the optimum size for future development. The proposed boundary is logical as it is bound by existing roads and is informed by the topographical and environmental characteristics of the site. It has been conceived on a site specific basis.

Extending the boundary in this way would also ensure there are no small rural pockets of land excluded from the rezoning. It is noted that not all lots included within the study area will have increased development potential; however it is favourable for the City of Kalamunda to include the smaller existing 'Special Rural' zoned lots in the 'Residential' zone to assist with applying appropriate development controls.

This larger site area will also incorporate the recently rezoned 'Special Use – Residential Aged Care' site at Lot 500 Gavour Road, Wattle Grove, ensuring that the overall area is considered in a coordinated fashion to facilitate orderly and proper planning.

The timing of development of the eastern most part of the study area (based on anticipated local supply/demand) is anticipated to be longer term, however, the notion of residential development being ultimately bound by the Scarp is logical. Inclusion of this area in overall planning now will ensure that it is approached in a co-ordinated manner, including the long term provision of services and infrastructure.

Additionally, the proposed boundary is consistent with the City's Local Planning Strategy 'Investigation Area' and the recently adopted North-East Sub-regional Planning Framework, as discussed in Sections 2.2.2 & 2.2.6.

The Option 3 study area boundary has thus been adopted for this Planning Feasibility Study.

Opportunities for Conservation

The broadening of the study area boundary will result in additional pockets of remnant vegetation being included within the study area.

Based on a desktop review by 360 Environmental these pockets of remnant vegetation have been identified as being potential Black Cockatoo habitat and Forrestfield Complex, which has less than 30% remaining. There are a number of Environmentally Sensitive Areas (ESA) mapped within and adjacent to the current study area.

These ESA appear to be associated with known occurrences of threatened / priority flora that occur within and adjacent to the site.

The desktop review has also identified that Bush Forever Site 50, which occurs north of Welshpool Road is mapped as an ESA and includes a 500m buffer that that covers a significant portion of the area identified for inclusion. This element will require further investigation during any District Structure Plan formulation process.

Threatened Ecological Community (TEC) 20a – *Banksia attenuata* woodland over species rich dense shrublands is identified as potentially occurring within this Bush Forever site. Another key environmental consideration is Crystal Brook, which transects the northern portion of study area. Therefore any future development will need to consider appropriate foreshore setbacks, reservation and future management, together with stormwater management and water quality.

Whilst, there are a number of key environmental constraints associated with broadening the study area, it may lead to the following significant environmental outcomes for the City:

- Provide the City with an opportunity to identify and prioritise these natural assets for future conservation and protection in the long-term, as opposed to leaving these areas in private property
- Developing and implementing various town planning mechanisms, through scheme provisions and future structure plans, that will allow for these areas to be acquired, set aside for conservation and appropriately managed
- Acknowledging that future urbanisation of the current study area will inevitably lead to increased pressure and edge effects on these natural areas if left

unmanaged, inclusion of the broader area can lead to these natural areas also being appropriately managed to ensure potential impacts from future urbanisation are minimised. This can be done through future environmental management plans, community education and/or funding being allocated to provide controlled access and rehabilitation where required.

2.1.4 Consultation

At a meeting with Department of Planning, Lands and Heritage; City of Kalamunda; and Burgess Design Group on 8 January 2018 the overall planning feasibility of Wattle Grove South was considered and discussed. A summary of the meeting is provided below.

Framework Timing (2022+)

- DPLH officers commented that MRS Amendments/release of urban land should occur in a sequential manner in accordance with Frameworks timeframes
- The timeframes within the Frameworks are not based on constraints such as land assembly/land co-ordination (as assumed by BDG/City). The Department has confirmed it is mostly based on urban land supply and demand
- Justification will be required to progress an MRS Amendment ahead of the Medium-Long Term (2022+) timeframe, as outlined in the Frameworks document

Project Boundary

- The boundary in the Frameworks could be modified if it is supported by technical studies/merit *(we note this has now been adjusted)*
- The Department officers advised that there is a possibility that the boundary can be refined as that document is broad scale
- No further information/justification was given for the current boundary alignment
- Limited feedback occurred on the different boundary options
- The Department officers raised the possibility of an MRS Amendment also including adjacent land within the City of Gosnells. The City/BDG advised that whilst the broader context will be examined, the scope of the works for the planning feasibility study is to solely focus within the City's municipal boundary. This is primarily as any MRS Amendment will also seek to concurrently rezone the land under the City's Local Planning Scheme

Given the above, selection of the Option 3 boundary was considered to be orderly and proper planning.

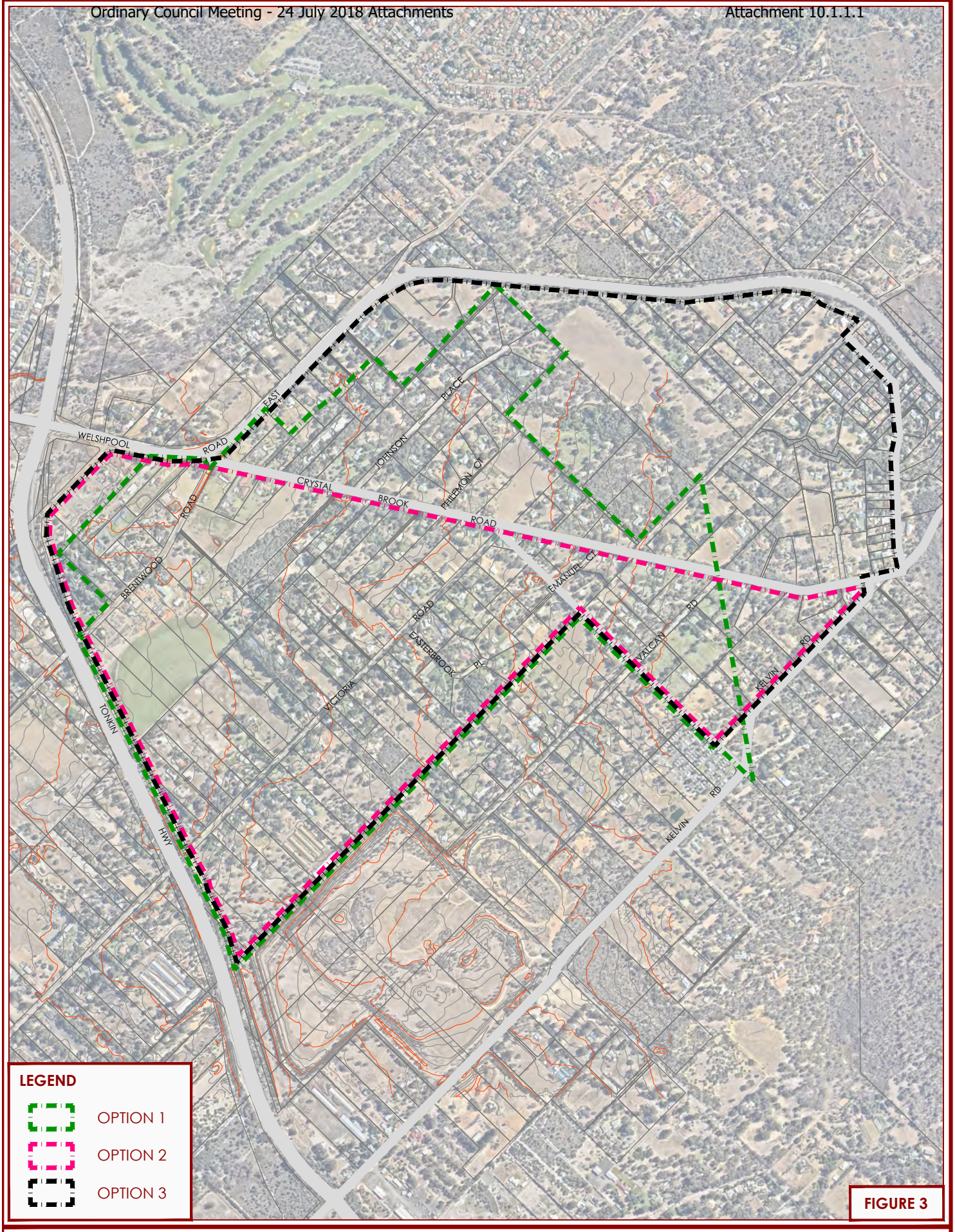

FIGURE 3

NORTH

0 100 200 300 400 500m

SCALE 1:15,000 (A4)

STUDY AREA BOUNDARY OPTIONS

WATTLE GROVE SOUTH

Client: City of Kalamunda
Date: 24.05.18
Plan No: KAL WAT 7-02c-10

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2.1.5 Surrounding Land Use and Development

The subject site is situated within close proximity to established and future residential, commercial, public open space (POS) areas and services including:

- Residential development within the suburb of Forrestfield, located approximately 2km north of the subject site
- Beckenham Train Station located approximately 4.5km south west of the subject site
- Westfield Carousel located approximately 5km south west of the subject site
- Hartfield Park Recreation Centre located approximately 700m north
- Lesmurdie National Park located 1.2km to the north east; and,
- The site is located approximately 6km south of the future Forrestfield Train Station

Development of the site for urban purposes represents the most efficient use of the land given the subject land's strategic location in close proximity to the urban front, the capacity of existing infrastructure and services, the future Forrestfield Train Station and nearby major arterial routes (e.g. Tonkin Highway and Roe Highway).

The subject land abuts the City of Gosnells Maddington Kenwick Strategic Employment Area (MKSEA) a future general industrial/business area.

2.2 PLANNING FRAMEWORK

2.2.1 Metropolitan Region Scheme

The subject site is zoned 'Rural' under the Metropolitan Region Scheme (MRS) (refer **Figure 4 – MRS Map**). The Scope of Works for this Planning Feasibility Study includes preparation of a simple request for the MRS to be rezoned to facilitate the future development of the area.

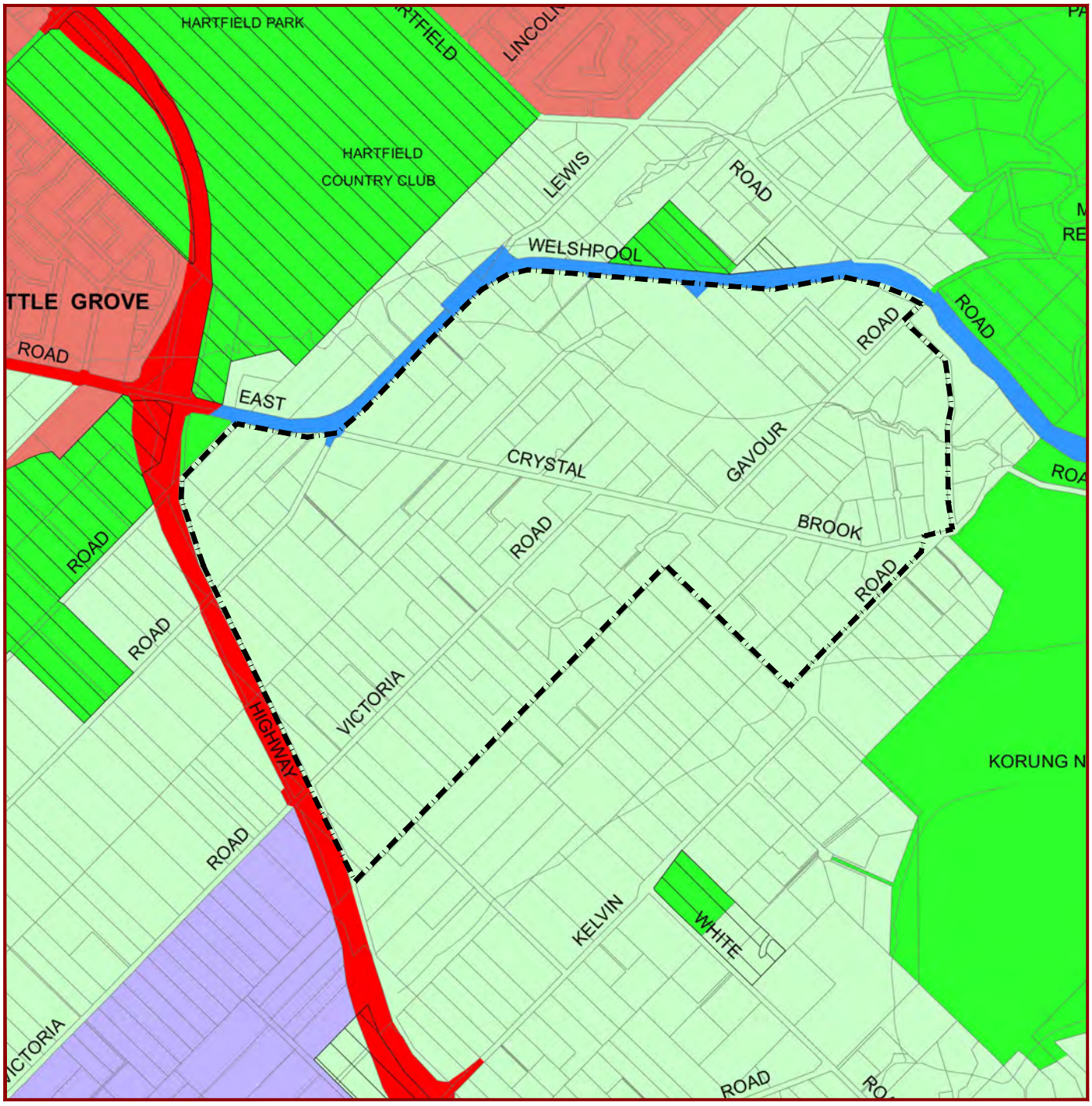
2.2.2 City of Kalamunda Local Planning Scheme No.3

The subject site is zoned 'Special Rural' under the City of Kalamunda Local Planning Scheme No.3 (LPS3) (refer **Figure 5 – LPS3 Map**).

Pursuant to LPS3 clause 4.2.2 the objectives of the 'Special Rural' zone are:

- To enable smaller lot subdivision to provide for uses compatible with rural development
- To retain amenity and the rural landscape in a manner consistent with orderly and proper planning

Rezoning of the land for urban development purposes under LPS3 is proposed to run concurrently with the MRS amendment.



Legend

Reserved lands
- parks and recreation
- primary regional roads
- other regional roads

Zones
- industrial
- rural
- urban

FIGURE 4

LEGEND

Subject Land

NORTH

0 200 400 600 800 1000m

SCALE 1:20,000 (A4)

Client: City of Kalamunda
Date: 24.05.18
Plan No: KAL WAT 7-02c-04

METROPOLITAN REGION SCHEME

WATTLE GROVE SOUTH

CITY OF KALAMUNDA

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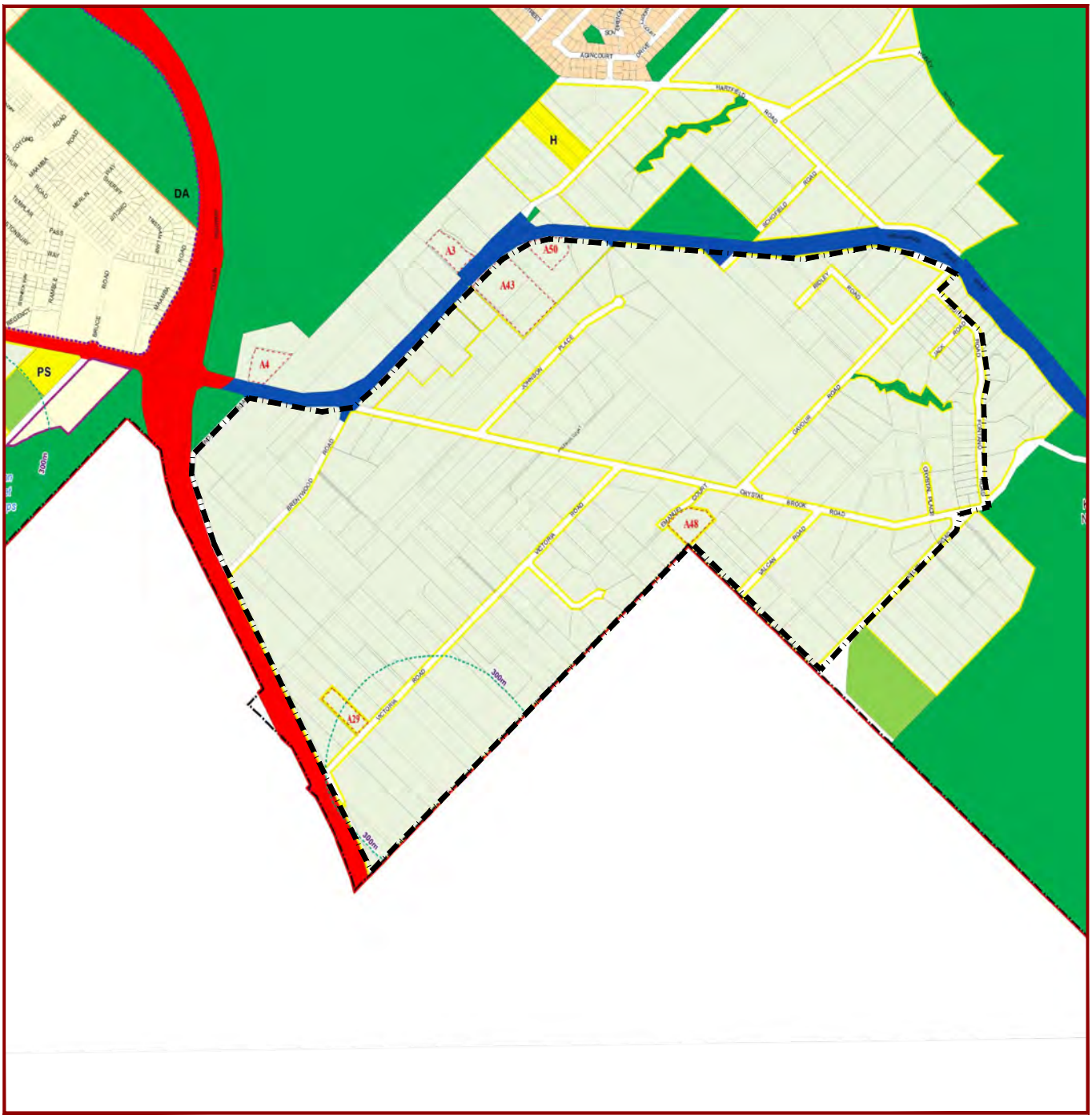

FIGURE 5

LEGEND

Subject Land

LEGEND

REGION SCHEME RESERVES (MRS)
- Other regional roads
- Primary regional roads
- Parks and recreation

LOCAL SCHEME RESERVES
- H Public purposes : Hall / community centre
- PS Public purposes : Primary school

LOCAL SCHEME ZONES
- Residential
- Special rural
- Private clubs and institutions
- Industrial development
- Urban development

OTHER CATEGORIES
(see scheme text for additional information)
- Scheme boundary
- A1 Additional uses
- Local Government boundary
- DA1 Development area

NORTH

0 200 400 600 800 1000m

SCALE 1:20,000 (A4)

Client: City of Kalamunda
Date: 24.05.18
Plan No: KAL WAT 7-02c-03

LOCAL PLANNING SCHEME NO.3
WATTLE GROVE SOUTH
CITY OF KALAMUNDA

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2.2.3 Draft North-East Sub-regional Planning Framework

The draft North East Sub-regional Planning Framework (the Framework) formed part of the draft Towards Perth and Peel @ 3.5 Million strategic suite of planning documents. The draft Framework aimed to establish a long-term and integrated framework for land use and infrastructure provision. The majority of the subject site was identified as 'Urban Expansion' under the draft Framework. The draft Framework stipulated that 'Urban Expansion' land had been identified for potential urban development in preceding planning studies and plans, and represented a 'rounding off' of existing urban areas (refer **Figure 6 – draft North-East Sub-regional Planning Framework**).

Staging and Sequencing

The draft Framework also provided broad guidance in relation to the staged provision/development of urban land based on timeframes as shown on Plan 9 of the draft Framework document. The site was identified as 'Medium-Long Term (2022+)'. BDG prepared a submission in 2015 requesting that part of the Wattle Grove South area be identified as 'Short Term (2015-2021)' given that the site is located only 15 kilometres east of the Perth CBD (connected directly by Welshpool Road/Orrong Road/Graham Farmer Freeway) and represented a logical expansion and consolidation of the existing urban form.

2.2.4 Final North-East Sub-regional Planning Framework

The final North-East Sub-regional Planning Framework was released on 23 March 2018. Most of the subject site is identified under the adopted Framework as 'Urban Expansion' with a portion of the study area identified as 'Urban Investigation' (refer **Figure 7 – Final North-East Sub-regional Planning Framework**).

Urban Expansion

The proposed 'Urban Expansion' areas for residential development include all of the land previously identified in the draft Frameworks document for this purpose. The Frameworks state that this proposal represents a consolidation and 'rounding off' of existing urban areas.

Urban Investigation

The final Frameworks plan expands the previously identified future development area by including a portion of the site as 'Urban Investigation'. This increase in area essentially aligns the Frameworks with our recommended Study Area boundary (being Option 3). The Frameworks state that the 'Urban Investigation' land is not to be construed as a commitment by the WAPC to support any rezoning as this will depend upon the outcome of further planning investigations.

The Framework specifies the following key considerations for the 'Urban Investigation' land:

- Geotechnical analysis/land suitability to provide connections to reticulated wastewater services
- Bushfire risk
- Protection of significant environmental attributes

Staging and Sequencing

The Frameworks set out staging of urban development. The subject land is identified as 'Medium-Long (2022+)'. The Frameworks state as follows:

"the timeframes depicted on the urban staging plan set out the anticipated timing for commencement of development, aligned with planned service provision and should not be construed as preventing further detailed planning from occurring in the interim."

This is important, as detailed planning and approval processes take time. Commencing detailed investigation now will ensure that the planning of this area can be considered within an overall servicing context by the various government assessment agencies (particularly in preparing forward-planning for reticulated water and sewer infrastructure) and formal planning processes can be undertaken, including community consultation.

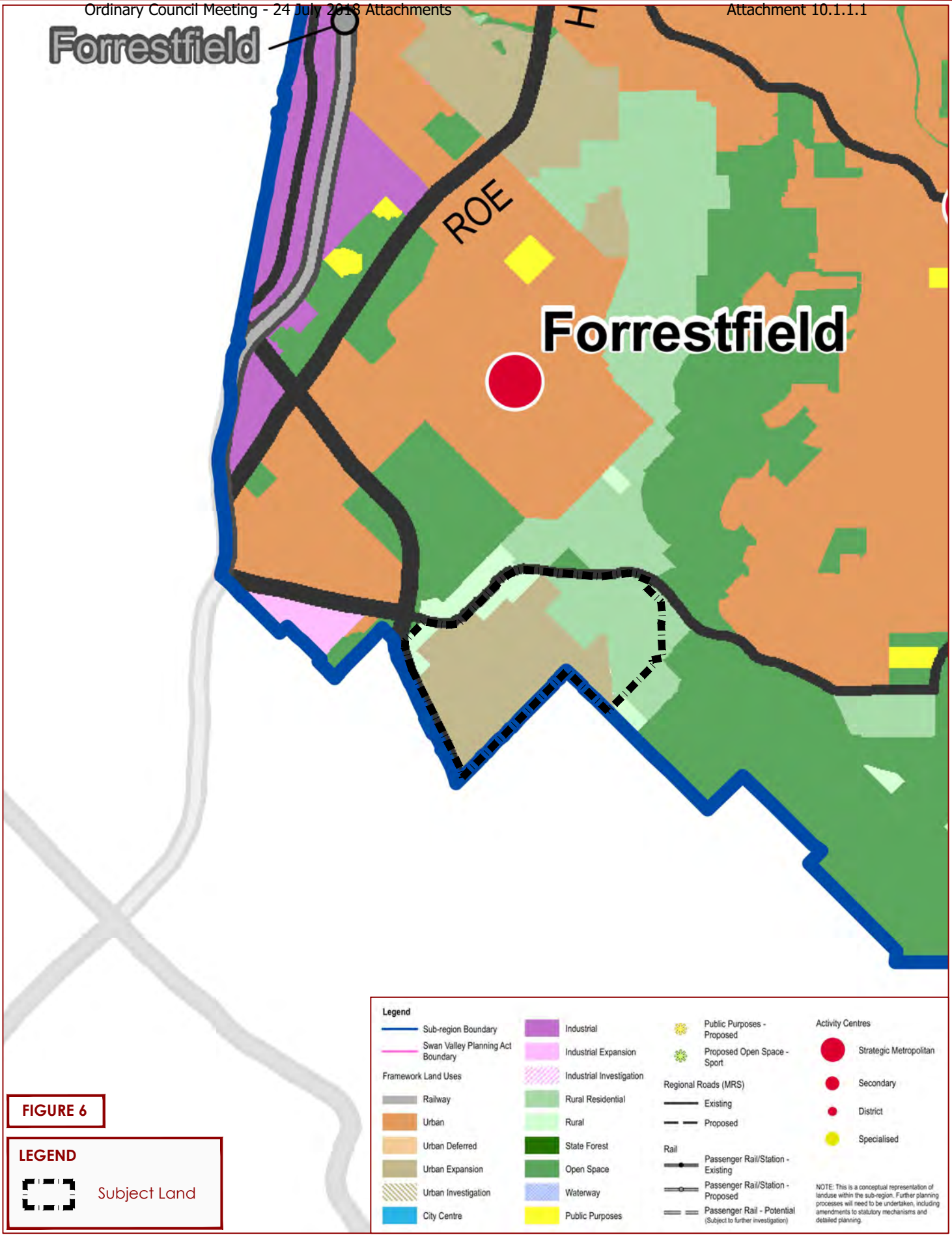

FIGURE 6

LEGEND

Subject Land

NORTH

0 0.5 0.75 1 1.5k

SCALE 1:50,000 (A4)

DRAFT NORTH-EAST SUB-REGIONAL PLANNING FRAMEWORK

WATTLE GROVE SOUTH

CITY OF KALAMUNDA

Client: City of Kalamunda
Date: 24.05.18
Plan No: KAL WAT 7-02c-02

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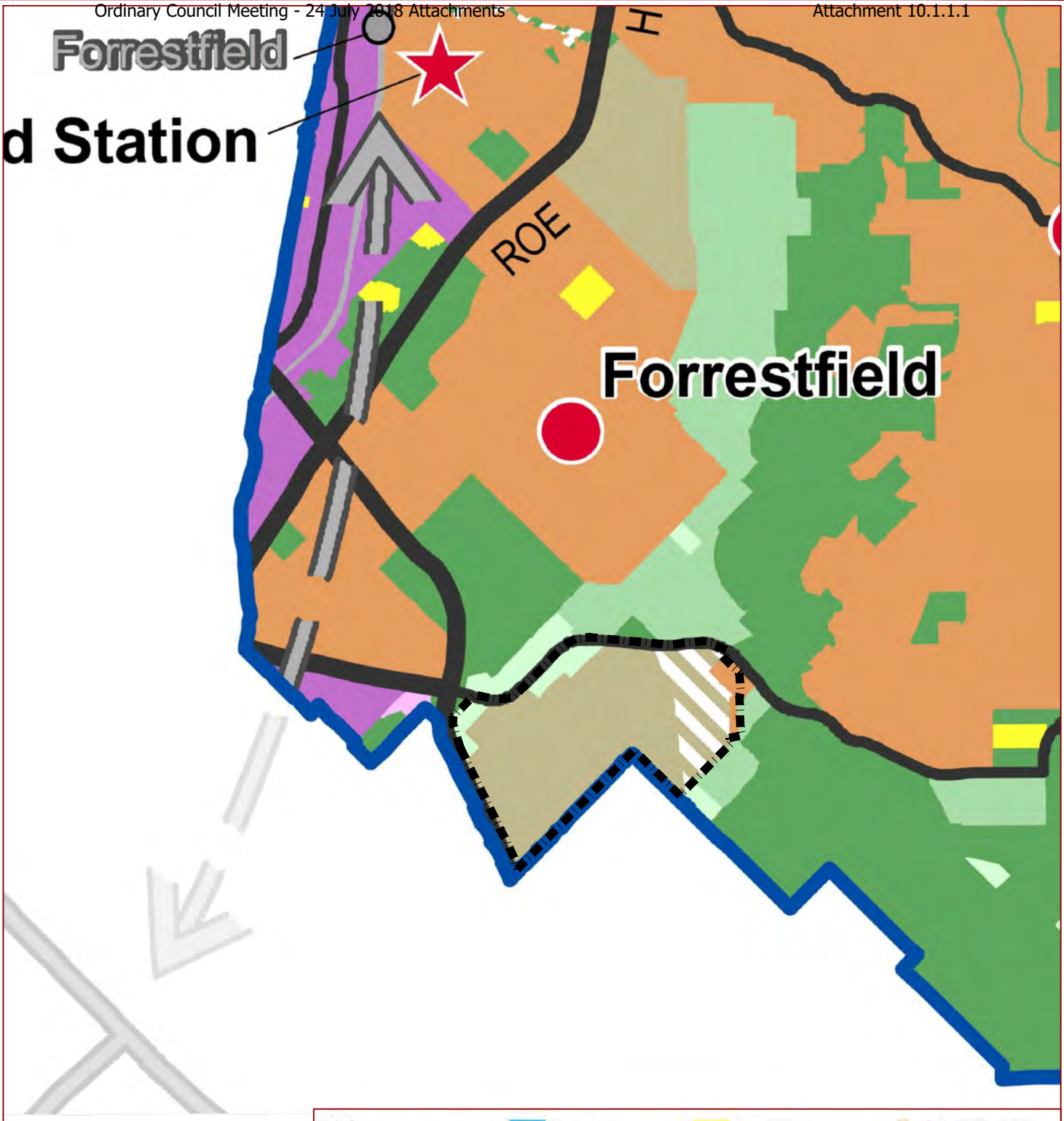

FIGURE 7

LEGEND

Subject Land

Legend

Sub-region boundary

Swan Valley Planning Act boundary

Framework land uses

Railway

Urban

Urban deferred

Urban expansion

Urban investigation (Refer to Table 2 for key considerations)

City centre

Industrial

Industrial expansion

Industrial investigation (Refer to Table 6 for key considerations)

Rural residential

Rural

State forest

Open space

Open space investigation

Public purposes

Waterway

Planning investigation (Refer to Table 3 for key considerations)

Regional roads (MRS)

Existing

Proposed

Rail

Passenger rail/station - existing

Passenger rail/station - proposed Stage 1 METRONET

Passenger rail - further investigation

Freight rail - proposed

NOTE: Transit corridors are shown on Plan 5

Public purposes - proposed

Proposed open space - sport

Activity centres

Strategic metropolitan

Secondary

District

Other (Classification to be determined by more detailed planning)

Specialised

NOTE: This is a conceptual representation of broad planning intentions within the sub-region. Further planning processes and decision-making under relevant legislation will need to be undertaken, including with reference to amendment of statutory instruments and detailed planning.

NORTH

0 0.5 0.75 1 1.5k

SCALE 1:50,000 (A4)

FINAL NORTH-EAST SUB-REGIONAL PLANNING FRAMEWORK WATTLE GROVE SOUTH CITY OF KALAMUNDA

Client: City of Kalamunda
Date: 24.05.18
Plan No: KAL WAT 7-02c-11

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2.2.5 Draft Perth and Peel Green Growth Plan for 3.5 Million

The draft Green Growth Plan for 3.5 million (GGP) was a whole-of government initiative to provide an unprecedented degree of certainty in relation to future environmental protection and approvals. A portion of the site was mapped in the draft as 'Specific Commitments'. Specific commitments indicate areas to protect, including:

- Threatened flora and threatened ecological communities;
- Conservation category wetlands and wetlands of international importance;
- Vegetation complexes with less than 10 per cent remaining;
- Bush forever areas (excluding those within the 'rural complementary');
- 'Negotiated planning solution' categories;
- Short tongued bee (leioproctus douglasiellus) distribution

A preliminary environmental assessment report has been prepared by 360 Environmental to confirm that these specific commitments can be appropriately dealt with through the structure planning process.

We note that the Draft Perth and Peel Green Growth Plan for 3.5 Million has now been suspended by government.

2.2.6 City of Kalamunda: Local Planning Strategy

The City of Kalamunda's Local Planning Strategy provides a vision and strategic planning direction for the municipality over next 20 years. Scenario 3 is the recommended scenario for the Local Planning Strategy. The subject land is identified in the Strategy as an 'Investigation Area' (refer **Figure 8 – Local Planning Strategy**).

Population Scenario 3:

'Growth by 25,000 people accommodated as in scenarios 1 and 2 plus Residential Bushland development R5 (R2.5) of Special Rural land to the east of Hawtin Road/Lewis Road (R5) and Wattle Grove south of Welshpool Road to a range of densities (R2.5, R5, R20 and R30 in centre) and including a Neighbourhood Centre in Wattle Grove. At current development rates the final part of this scenario (Special Rural land to Urban) would be required by 2025.'

The possible urban development of the subject site is consistent with the City's Local Planning Strategy. Future residential densities will need to be compliant with Liveable Neighbourhoods, and Directions 2031 density targets.

Local Planning Strategy - Spatial Plan: 2031

POPULATION SCENARIO 3 - 25k Growth

Figure 21; Scenario 3; Additional 25,000 Population

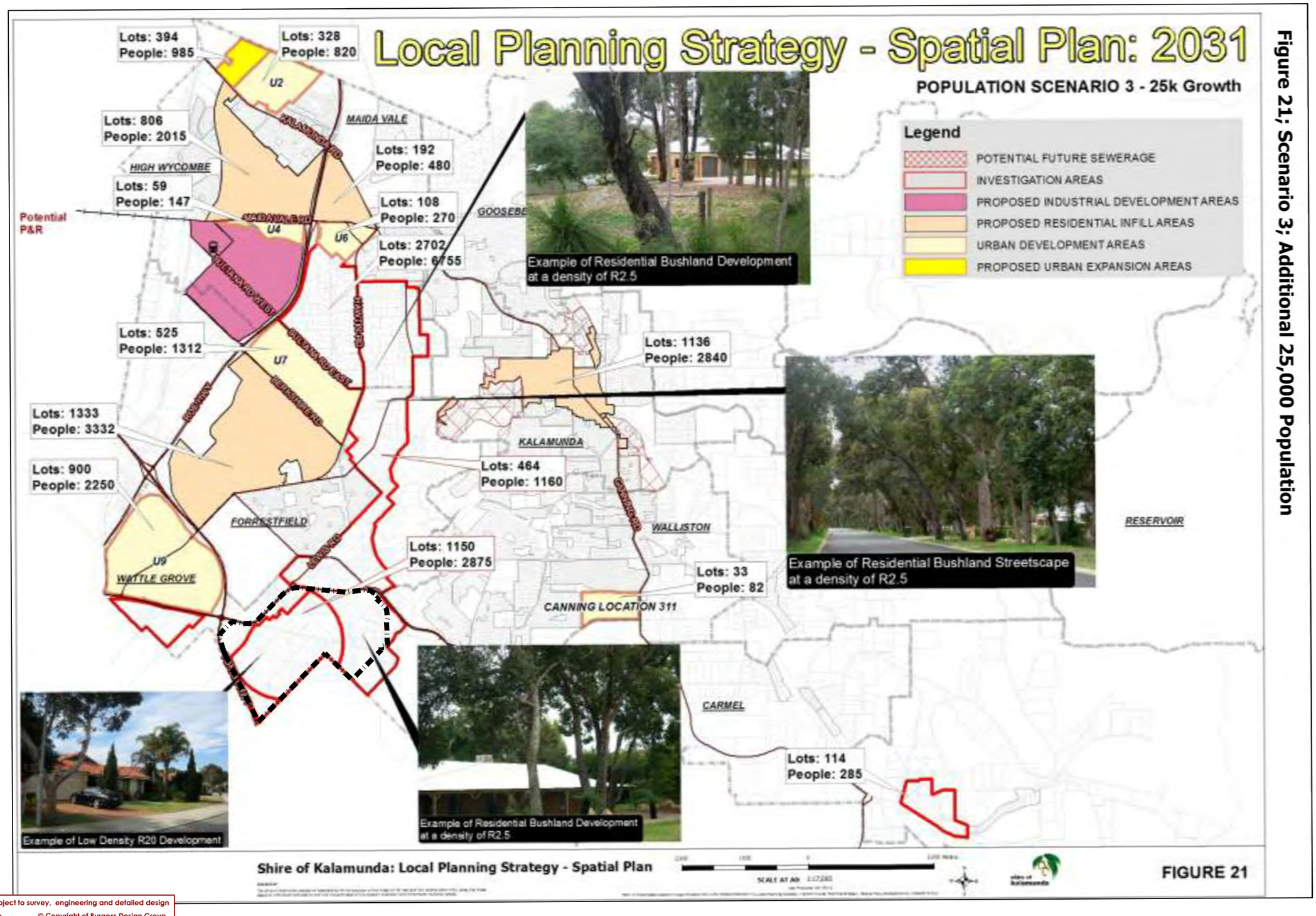

FIGURE 8

LEGEND

Subject Land
Wattle Grove South

Client: City of Kalamunda
Date: 24.05.18
Plan No: KAL WAT 7-02c-07

NORTH
SCALE:NTS

LOCAL PLANNING STRATEGY - SPATIAL PLAN 2031

WATTLE GROVE SOUTH

CITY OF KALAMUNDA

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2.2.7 City of Kalamunda: Local Housing Strategy

The Local Housing Strategy adopted by the City of Kalamunda outlines the future housing needs of current and future residents. The Local Housing Strategy has reviewed State Government policies and strategies, to ensure density and dwelling targets are met by the City.

The objectives of the strategy are to ensure new development and infill development is implemented in a manner which complements the amenity of the local region, while providing diverse housing for the community. The strategy outlines areas suitable for an increase in housing stock, as well as promoting affordable housing and the natural landscape. Wattle Grove is specifically mentioned as having strong potential for increased residential development.

2.3 URBAN LAND SUPPLY AND DEMAND

The North-East Sub-regional Planning Framework sets out the minimum infill dwelling targets to 2050. The City of Kalamunda is expected to deliver an additional 11,450 infill dwellings and 25,190 new residents by 2050.

Table 1: Existing and Projected Dwellings and Populations 2011-50

Local government	Existing dwelling (2011)	Existing Population (2011)	Additional dwellings (2050)	Additional population (2050)	Total dwellings (2050)	Total population (2050)
Kalamunda	21,180	56,490	21,040	46,770	42,220	103,260
Source: North-East Sub-Regional Planning Framework						

The Framework projected 21,040 additional dwellings, and a total population of 103,260 by 2050. The Wattle Grove South area is only one 'Urban Expansion' area within the sub-region. The forecast population for the City of Kalamunda is set out in Table 2 below.

Table 2: Forecast population and Residential Development, 2016 to 2036

Kalamunda (S), WA(LGA)	Existing dwelling (2016)	Existing Population (2016)	Additional dwellings (2036)	Additional population (2036)	Total dwellings (2036)	Total population (2036)
ABS Statistics	22,758	57,449	-	-	-	-
.id Statistics	22,996	59,340	6,860 (+29.8%)	16,839	29,856	76,179
Source: .id September 2017						

Residential development forecasts assume the number of dwellings in City of Kalamunda will increase by an average of 343 dwellings per annum to 29,856 in 2036. It should be noted

that this forecast is based on the earlier draft Framework and does not reflect the modified 'Urban Expansion' areas identified within the final Framework.

Table 3: Summary of New Residential Land Supply

Year	Lots Released	Year End Stock	Median Lot Size m^2	Median Lot Price	Land Price $/m^2$
2014	13,373	2,544	420	$262,000	624
2015	11,052	3,074	379	$249,000	657
2016	8,464	3,376	375	$229,250	611
Source: National Land Survey Program					

Current Housing Supply

In accordance with the 2016 National Land Survey Program 8,464 lots were released, and the medium lot size was 375m^2. Whilst market growth has decreased in recent months there is limited new housing supply within the locality. At present, lots are for sale in various small residential estates including:

- Brookside Wattle Grove & Woodlupine Brook Estate on Hale Road, Wattle Grove
- Acacia Parklands Wattle Grove on Welshpool Road East, Wattle Grove

Future Housing Supply

Forrestfield North District Structure Plan

- The State Government instructed the City to prepare a DSP over part of Forrestfield/High Wycombe, in order to identify new land use opportunities arising from the planned Forrestfield Train Station.
- The estimated number of dwellings in Forrestfield North DSP is 4,250 - 5,250 ranging from medium density (R30-R60) to high density (R60+)
- Detailed development yields in Forrestfield North will be established as part of subsequent local structure planning processes

Draft Forrestfield North Residential Precinct Local Structure Plan

- The draft Forrestfield North Residential Precinct LSP proposes a variety of residential densities ranging from Residential R40 – Residential R100
- The outer areas of the LSP are proposed to contain medium residential densities ranging from R40 – R60 representing lot sizes between 120m^2 – 180m^2
- The central areas within close proximity to the proposed Forrestfield Train Station and retail/commercial precinct contain medium/high residential densities ranging from R60 – R100 and represent lot sizes between 100m^2 – 120m^2
- The total estimated number of dwellings in Forrestfield North residential precinct is 3,576
- It is expected that the future Forrestfield Station TOD Precinct will also deliver high density residential development

Maida Vale South

- Maida Vale South has been identified as an 'Urban Expansion Area' in the Western Australian Planning Commission's (WAPC) North-East Sub-Regional Structure Plan
- Burgess Design Group is currently working to progress a Metropolitan Region Scheme (MRS) amendment to rezone the subject land from 'Rural' to 'Urban', and a concurrent amendment to the Shire of Kalamunda Local Planning Scheme No.3 (LPS3), from 'Special Rural' to 'Urban Development' to facilitate the ultimate residential development of the land
- The estimated number of dwellings in Maida Vale South is 2,000 – 2,700 ranging from low density (R20) to high density (R60+)

Dual Density Coded Areas

Council at its OCM Meeting of 27 June 2016 adopted Scheme Amendment 82 – Dual Density Code. The intent of the dual density code is to allow the City to reward landowners/developers with the ability to develop at higher densities where they propose high quality developments that are consistent with criteria specified in LPS3 and Local Planning Policy DEV 54 – Dual Density Design Guidelines.

The dual density codes aim to increase residential densities in strategic locations throughout the City, specifically, in Forrestfield, High Wycombe/Maida Vale and Kalamunda.

The dual density codes are expected to result in approximately 10,000 new dwellings. This increase in infill development represents 87% of the North-East Sub-regional Planning Framework minimum infill target of 11,450 additional dwellings by 2050.

The uptake rate of the higher density development is unknown. It is expected that some dual coded lots will not be subdivided and redeveloped at a higher density. As such, the abovementioned estimated number of new dwellings is likely to be lower. Nonetheless, the dual density codes will deliver new dwellings that will assist the City in achieving the minimum infill targets for the North-East sub-region.

Summary

It is projected that Forrestfield North, Maida Vale South and the dual density coded areas will result in approximately 16,250 – 17,950 new dwellings. In this regard, the City is expected to exceed the minimum infill target of 11,450 additional dwellings by 2050 set by the North-East Sub-regional Planning Framework.

2.4 COMMERCIAL/ INDUSTRIAL LAND SUPPLY

There is limited service commercial/light industrial land available within the City of Kalamunda. This shortage is partially related to the State Government announcement of a rail station in Forrestfield.

The now superseded Economic and Employment Lands Strategy: Non-Heavy Industrial (EELS) identified:

- 71ha of land in Forrestfield Stage 1 as 'Potential non-heavy industrial area – short term'
- 130ha of land in Forrestfield Stages 2 & 3 as a 'Potential non-heavy industrial area – medium term'

However, following the State Government announcement of the Forrestfield Train Station the WAPC requested the City prepare a District Structure Plan that reflected new land use opportunities (such as residential and commercial land uses) to take advantage of the planned train station.

Subsequently, the Forrestfield North District Structure Plan only designates approximately 69ha of land (Forrestfield Stage 1) as 'Light Industry', resulting in a loss of 130ha (Forrestfield Stages 2 & 3) of strategically planned industrial land within the City.

This Planning Feasibility Study provides an opportunity to consider the potential of creating a new service commercial/light industry/mixed business area for bulky goods within Wattle Grove South, given the significant loss of planned future service commercial/light industry land within the City. Service commercial/light industry/mixed business land uses may provide a suitable transition between industrial development (Maddington Kenwick Strategic Employment Area – MKSEA) and the established/future residential areas further north and east.

These land uses would also provide an ideal interface with Tonkin Highway, as they are less noise and vibration sensitive. They would also benefit from the significant exposure provided to business uses along this corridor.

Further investigation is required to determine major access points to confirm the viability of the commercial/light industrial uses.

2.5 MAJOR ACCESS POINTS

Existing major access points and road reserves are shown on **Plan 1 - KCTT Existing Traffic Counts and Figure 9**.

The key existing road and movement features are summarised as follows:

- Access to the subject land is currently available via the existing roads of Tonkin Highway (classified as a Primary Regional Road), Welshpool Road East (classified as a Distributor A road), and Kelvin Road (classified as a Distributor Broad).

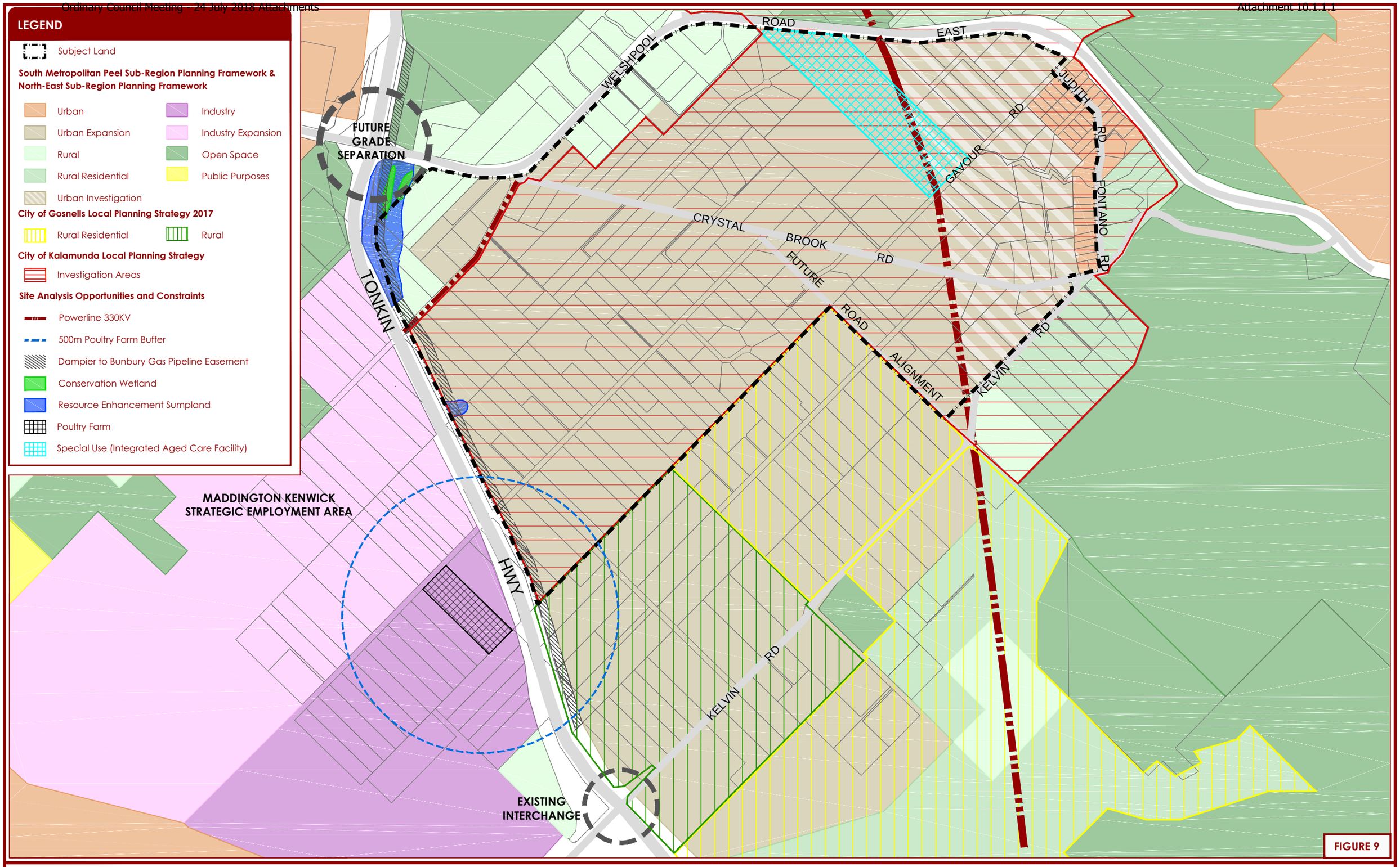

FIGURE 9

Client: City of Kalamunda
Date: 24.05.18
Plan No: KAL WAT 7-02c-06c

NORTH
0 50 100 200 300 400 500
SCALE 1:12,500 (A3)

SITE ANALYSIS
OPPORTUNITIES AND CONSTRAINTS
WATTLE GROVE SOUTH

BURGESS DESIGN GROUP
TOWN PLANNING URBAN DESIGN
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CITY OF KALAMUNDA

3. LOCAL CONTEXTUAL ANALYSIS

3.1 POPULATION GENERATION AND EMPLOYMENT SELF-SUFFICIENCY

Table 4: Age Demographics 2016

Age	Kalamunda (S)	%	Western Australia	%
0-4 years	3,523	6.1	161,727	6.5
5-9 years	3,889	6.8	164,153	6.6
10-14 years	3,763	6.5	150,806	6.1
15-19 years	3,906	6.8	149,997	6.1
20-24 years	3,315	5.8	160,332	6.5
25-29 years	3,350	5.8	184,908	7.5
30-34 years	3,734	6.5	194,267	7.9
35-39 years	3,761	6.5	173,041	7.0
40-44 years	3,916	6.8	171,996	7.0
45-49 years	4,078	7.1	172,520	7.0
50-54 years	3,895	6.8	162,438	6.6
55-59 years	3,593	6.3	149,899	6.1
60-64 years	3,326	5.8	132,145	5.3
65-69 years	3,246	5.6	116,755	4.7
70-74 years	2,313	4.0	82,911	3.4
75-79 years	1,721	3.0	61,509	2.5
80-84 years	1,211	2.1	42,590	1.7
85 years and over	922	1.6	42,420	1.7
Source: Australian Bureau of Statistics - Kalamunda (S) (Local Government Area)				

The median age of the population in Kalamunda (S) (Local Government Areas) was 39 years. Children aged 0 - 14 years made up 19.4% of the population and people aged 65 years and over made up 16.4% of the population.

3.1.1 Employment Self-Sufficiency

Table 5: Employment Self-Sufficiency 2011–50

Indicator	2011	2021	2031	2050	Total change	Total % change
Population	209,156	278,234	339,445	450,590	241,434	115.4%
Labour force	102,612	133,079	163,043	224,860	122,248	119.1%
Jobs	82,79	106,117	134,090	187,986	105,607	128.2%
Employment self-sufficiency	80.3%	79.7%	82.2%	83.6%	3.3%	-
Source: North East Sub-regional Planning Framework						

Overall, there are 29,326 people in the labour force within the City of Kalamunda. The three most popular industry sectors are:

- Health Care and Social Assistance (2,841 people or 10.4%)
- Construction (2,819 people or 10.3%)
- Retail Trade (2,513 people or 9.2%)

In combination, these three industries employed 8,173 people in total or 30.0% of the total employed resident population.

Self-sufficiency is defined as the percentage of an LGA or region's working population (working in the LGA) who also live within the boundaries of the LGA or region.

Of the 14,441 people who work in the City of Kalamunda, 6,757 people also live in the area. This equates to 23% self-sufficiency of the total labour force within the City of Kalamunda.

The Kalamunda Advancing: Strategic Community Plan to 2020 sets a target to increase the employment self-sufficiency every five years. The objective is to support industries and businesses within the LGA.

Providing land for employment activities, such as service commercial/light industry/mixed business will assist in meeting these targets.

3.2 CITY/CIVIC REQUIREMENTS

It is assumed the City of Kalamunda will provide its requirements for civic, community and cultural land uses (if any) into the future planning of the Strategic District Structure Plan.

3.3 INDUSTRIAL DEVELOPMENT

The City's Local Planning Strategy (2010) refers to the *Economic and Employment Lands Strategy (EELS),* which has now essentially been superseded by the adopted WAPC Frameworks. The EELS Strategy identified land bound by Maida Vale Road, Raven Street, Milner Road and Dundas Road to be rezoned to 'Light Industry' to complement existing and proposed industrial areas in Forrestfield and High Wycombe. As discussed in Section 2.5, this area is planned to be mostly medium and high density housing under the North Forrestfield District Structure Plan. As such, there is a shortfall in commercial/light industrial zoned land within the City.

The proposed Wattle Grove South locality is comparable to Forrestfield in terms access to major highways and distance from other metropolitan centres. In this regard, it is considered to be a viable location for these commercial and light industrial uses. As such, there is an opportunity for the City to consider creating a new zone to allow for the development of commercial and bulky goods land uses.

There are examples from other local governments that have created a new zoning under their respective Schemes to facilitate commercial and light industrial development. The table below compares these zones and uses adopted by other Local Councils.

The current 'Light Industry' zone under LPS3 allows the City to consider various uses that may not be suited to the area, such as 'Industry – Rural', 'Salvage Yard', and 'Motor Vehicle Wrecking'. Should the City decide to pursue service commercial/light industry/bulky goods and/or mixed business uses we recommend planning officers review these zones and the permissible uses to develop a new zoning that is suitable for the site.

A key element in establishing the feasibility of such a zone or land use precinct will be access. The study area is afforded high visual exposure to Tonkin Highway and Welshpool Road, however, direct and efficient access from these roads is yet to be determined.

Table 6: Comparable Light Industry/Commercial Zones

LOCAL GOVERNMENT AREA	ZONE	OBJECTIVES OF THE ZONES	RELEVANT PERMITTED AND DISCRETIONARY USES
City of Cockburn	Light and Service Industry	To provide for light and service industries and associated uses which are compatible with and acceptable with close proximity to, residential uses.	'P' uses: ▪ Office ▪ Showroom ▪ Industry - Light ▪ Industry - Service ▪ Warehouse ▪ Transport Depot ▪ Trade Display 'D' uses: ▪ Motor Vehicle Repair ▪ Hardware Store
City of Swan	Highway Service	The objectives of the Highway Service Zone are to – a) secure the development of low intensity commercial uses along selected major arterial roads outside the Strategic Regional Centre which can benefit from the high exposure offered by the major traffic thoroughfares; and car based comparison shopping for bulky goods; b) ensure commercial activity within the zone is complementary to development in other commercial zones and does not detract from the viability or integrity of development in either the Strategic Regional Centre or the Commercial zones; c) ensure development contributes towards the	'D' uses: ▪ Industry- Service ▪ Office ▪ Showroom ▪ Shop ▪ Warehouse

		image of the city through high quality design and development with consistent and well landscaped setbacks from street frontages; d) promote shared use of vehicular access and car parking facilities where such arrangements will result in improved traffic management, more efficient use of land and more attractive development; e) ensure car parking and vehicular access facilities are located, designed and landscaped so as not to detract from the amenities of the road frontages or of adjacent development; f) ensure any on-site advertising is integrated with the overall site development and does not detract from the amenities of the road frontages or of adjacent development.	
City of Gosnells	Highway Commercial	To provide for a range of commercial development, including particularly bulk retailing and open air display, which is suitable for a highway frontage location.	'D' uses: ▪ Industry - Service ▪ Office ▪ Shop ▪ Showroom ▪ Warehouse

This Planning Feasibility Study represents an opportunity for the City to consider future land uses and the ultimate rezoning and structure planning of the land. The opportunities presented by creating a new service commercial/light industry area are discussed in detail in section 6.1, Table 8.

4. ENVIRONMENTAL

An Environmental Assessment Report (EAR) prepared by 360 Environmental provides an overview of the general environmental features of the Study Area and includes an overview of the Site's remaining biological and social environment including:

- Wetlands
- Aboriginal and non-Aboriginal Heritage sites
- Regional soil types
- Hydrology
- Geomorphology
- Flora, vegetation and fauna
- Planning context
- Social environment.

A summary of the report is provided below.

4.1 TOPOGRAPHY

The elevation across the site ranges from 21 m Australian Height Datum (AHD) to 79 m AHD, increasing in elevation from the west to the east and south-east.

4.2 ACID SULPHATE SOILS

The entire Site has a 'Moderate to Low' risk of acid sulphate soils (ASS) risk within 3 m of natural soil surface and 'High to Moderate' risk beyond 3m.

4.3 CONTAMINATED SITES

A review of DWER's Contaminated Sites Database has identified there are no registered contaminated sites within the Study Area, however, there are four contaminated sites within a 1 km radius, located on:

- Lot 804 on Plan 59983, Kenwick
- Lot 9005 on Plan 40777, Maddington
- Lot 7, Former Caltex Service Station, Welshpool Rd, Wattle Grove
- Lot 566 Orchard Road, Maddington

4.4 ENVIRONMENTALLY SENSITIVE AREAS

A number of Environmentally Sensitive Areas (ESAs) impact the Site. DWER's online Clearing Permit System has identified the following Declared Rare Flora (DRF) or a Threatened Ecological Community across the site;

- Wavy Smoke-bush (*Conospermum undulatum*); and,
- Summer Honeypot (*Banksia mimica*).

4.5 BROAD VEGETATION TYPES

Vegetation mapping of the Swan Coastal Plain subregion of WA was completed on a broad scale (1:250,000) by Beard (1980). These vegetation units were re-assessed by Shepherd et al. (2001) to account for clearing in the intensive land use zone, dividing some larger vegetation units into smaller units.

The Site is within three vegetation units as described below:

- Pinjarra 3: Medium forest; Jarrah – Marri;
- West Darling 4: Medium woodland; Marri and Wandoo; and
- Pinjarra 968: Medium woodland; Jarrah, Marri and Wandoo.

Vegetation complexes of the Southwest botanical district have been mapped by Heddle *et al*. (1980). Four vegetation complexes exist across the site which relate to the underlying soil profile:

- Guildford Complex: Open forest to tall open forest and woodland;
- Southern River Complex: Open woodland;
- Forrestfield Complex: Open forest and fringing woodland; and
- Darling Scarp Complex: Low open woodland to lichens.

4.6 DECLARED, RARE AND PRIORITY FLORA

A review of the database searches identified 75 conservation significant flora species as potentially occurring within the site and a likelihood assessment of the species was undertaken.

The results of the assessment indicated that 24 flora species were considered 'Likely' to occur due to the presence of suitable habitat and close proximity to previously recorded sites. 35 species were considered 'Possible' and 4 considered 'Unlikely' to occur within the site. 12 species had an unknown likelihood of occurrence due to the lack of available data.

Several occurrences of the following five (5) DRF species have been identified as occurring within or close to the boundary of the site based on the DBCA Threatened Priority Flora database search:

- Conospermum undulatum;
- Isopogon drummondii;
- Banksia mimica;
- Lasiopetalum glutinosum subsp. glutinosum; and
- Thelymitra magnifica.

Given the above, site specific flora and vegetation surveys would be required to confirm the presence or absence of these DRF species which would provide a better indication of the land available for development. A Flora and Vegetation Management Plan may be required at the subdivision stage.

4.7 THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES

Desktop searches of the DBCA's Threatened and Priority Ecological Communities dataset identified several TECs or TEC buffers occurring within and surrounding the site, including;

- Banksia Dominated Woodlands of the Swan Coastal Plain;
- SCP20a - *Banksia attenuata* woodlands over species rich dense shrublands;
- SCP3a -*Eucalypt calophylla – Kingia australis* woodlands on heavy soils, Swan Coastal Plain;
- SCP3b - *Eucalyptus calophylla – eucalyptus marginata* woodlands on sandy clay soils of the southern Swan Coastal Plain;
- Shrublands and woodlands on Muchea Limestone;
- Herb rich shrublands in clay pans;
- SCP10a - Shrublands on dry clay flats; and
- Central Granite Shrublands Community.

These TECs mapped are based on the DBCA's likelihood of TEC occurrences and are not based on actual recorded data. These TECs appear to correspond with patches of possible remnant vegetation which is likely to be associated with the Banksia Woodlands TEC, Eucalyptus calophylla-Kingia australis woodlands and Shrublands TEC and Woodlands on Muchea Limestone TEC.

Flora and vegetation surveys of these patches of vegetation will be required to determine the presence or absence of these TECs or PECs. Should these TECs be identified as occurring within the site, clearing or potential impacts to the TECs will require approval from the DBCA and DWER. A Flora and Vegetation Management Plan may be required at the subdivision stage.

4.8 THREATENED AND PRIORITY FAUNA

Due to the site being mostly cleared of native vegetation and used for rural purposes, it is not likely that the site would offer large areas of valuable intact habitat.

Some fauna species may utilise the minor watercourse that traverses the site which appears to have intact vegetation along the foreshore area and within remaining patches. However, fauna are more likely to utilise surrounding larger areas of intact vegetation to the east.

4.9 ABORIGINAL HERITAGE

A desktop search has identified two Registered Aboriginal Heritage Sites and one Lodged Aboriginal Heritage Site intersecting the Site, including:

- Brentwood Road Swamp (No.4343)
- Brentwood Road Quarry (No.342)
- Brentwood Road NW (No.4341)

4.10 EUROPEAN HERITAGE

A desktop search of the State Heritage Office has identified there are no State Heritage Sites within the Site.

4.11 LAND USE BUFFERS

The site is constrained by generic or imposed buffers on prescribed premises (Poultry farms, turf farm and kennels). The opportunity for land development within the site is recommended to be split into two separate land uses. The area to the south of Crystal Brook Road may be more suitable for continued rural uses or industrial development. The area to the north of Crystal Brook Road has the potential to be developed for urban residential - should the generic buffers be reduced. Site specific studies and modelling would be required to determine any appropriate buffers.

4.12 HYDROLOGY

There are several tributaries which traverse the site, as well as a wetland located along the western boundary of the site. A DWMS will be required as part of any future rezoning under the MRS, as well as groundwater monitoring to inform the Local Water Management Strategy (LWMS) and local structure planning stage.

4.12.1 Groundwater

Data from the Perth Groundwater Map indicates the groundwater table ranges between 12m Australian Height Datum (AHD) and 17m AHD. Groundwater flows from east to west. The Site is not within a Public Drinking Water Source Area.

4.12.2 Surface Water

Yule Brook, a major tributary, exists 55 m to the north of the site, separated by Welshpool Road East. An un-named minor non-perennial watercourse traverses the northern portion of the site connecting to Yule Brook in the northeast. In addition, another minor perennial watercourse traverses along the boundary in the south-western corner of the site. The site also contains three constructed earth dams and two perennial lakes. A constructed minor drain extends south of Crystal Brook Road to a constructed dam. The site is not within a mapped 100 Year ARI Floodplain Area.

4.12.3 Wetlands

Desktop mapping has identified that small portions along the western boundary of the Site along Tonkin Highway are mapped as Conservation Category (CCW) and Resource Enhancement wetlands (REW). As such, there is the potential for their associated buffers to impinge on the south-western portion of the site. A buffer distance of 30 – 50m is generally imposed on REWs and a minimum 50m buffer is generally imposed on CCWs. However, as the vegetation within the mapped wetlands and the corresponding buffers does not appear to be intact and has been subject to clearing, it is likely that smaller buffer distances from the wetlands could be negotiated.

Alternatively, there is a potential opportunity to reclassify the wetlands within and surrounding the site to increase the developable potential of the site. Site specific surveys would be required to assess the vegetation remaining and the condition of the wetlands. A Wetland and Wetland Buffer Management Plan may be required at subdivision stage.

4.12.4 Foreshore Area

The minor non-perennial watercourse that traverses through the northern portion of the site would likely require a biophysical assessment to identify the extent of the foreshore area. The extent of the foreshore area would impact on the developable potential of the surrounding area. A Foreshore Management Plan may be required at the structure planning or subdivision stage.

4.12.5 District Water Management Strategy

A District Water Management Strategy will be required to support any future urban rezoning under the MRS. The key objective of the DWMS will be to demonstrate that the land is capable of supporting the change in land use and is able to achieve appropriate urban water management outcomes.

It is recommended that following the City's decision on the final boundary of the study area, and prior to the MRS Amendment being initiated, the preparation of a District Water Management Strategy is prepared and submitted with DWER for approval to ensure the project's timeframes are achieved.

5. SERVICING

KCTT has prepared an Infrastructure and Servicing Report to assess the current capacity of services and future servicing requirements for development (refer to **Appendix 2**). The report confirms that there are no identified servicing constraints that prevent the land from being developed for urban purposes. The site is capable of being provided with all essential services and infrastructure. A summary of the report is provided below.

5.1 WATER

The Water Corporation confirmed there are significant water assets which run adjacent to the Study Area inclusive of the Canning Trunk Main, with the Canning Foothills Trunk Main branching off at Hale Road. KCTT consider that a network of local infrastructure can be planned pending detailed future development yields and road layouts at Structure Planning stage.

5.2 POWER

Existing services are present nearby and extensions will be undertaken to service the subject land.

High Voltage overhead 3 phase power infrastructure is currently available through most of the Wattle Grove South area as follows:

- Hale Road to Mundy Regional Park (132kV)
- West of Hawtin Road (330kV) near the Canning Foothills Trunk Main water alignment
- 66kV assets on the south-eastern boundary of the Investigation Area.

From an analysis of Western Power's Network Capacity Mapping Tool, KCTT has indicated that the catchment between Welshpool Road and Tonkin Highway generally has a forecast capacity of 20 to 25MVA in the year 2034.

5.3 GAS

Minimal existing infrastructure is available in Wattle Grove South, however existing services are in reasonable proximity to the study area.

5.4 TELECOMMUNICATIONS

Wattle Grove South has existing telecommunications assets. There are no NBN rollouts currently planned in this area. NBN Co has a charter to work with local governments and developers, particularly for larger scale developments (+100 lots). In this regard, provision of suitable services can be negotiated.

5.5 INFRASTRUCTURE

5.5.1 Bridges (Welshpool Road East / Tonkin Highway Interchange)

The Wattle Grove South Area is reliant on some significant improvements to road connectivity, with consideration needed for the impact of the proposed Welshpool Road East grade separation on the development potential in the western third of the Study Area.

Any bridge over the Tonkin Highway will have the following minimum requirements:

- Min depth of bridge structure = 1.7 metres
- Min clearance to Tonkin Highway carriageways = 6.5 metres

KCTT recommends a Preliminary Concept Design Drawing is completed for the eastern approach on Welshpool Road East, with the area of the bridge approach and the bridge abutment clearly delineated and the area of land impacted calculated for further consideration in the Wattle Grove MRS Amendment Planning.

The cost of this bridge will not be the responsibility of the MRS Amendment Area, however costs to realign Welshpool Road East will need to be considered in the develop of a DCP.

5.6 TRAFFIC

The existing transport network in the vicinity of the site is described in the following sub-sections. KCTT has prepared a Transport Impact Assessment to identify any potential traffic issues, constraints and opportunities to future development (refer **Appendix 3**).

5.6.1 Road Network

Tonkin Highway is classified as a Primary Distributor road under the Main Roads WA (MRWA) Road Hierarchy for Western Australia. Welshpool Road East is classified as a District Distributor A road. Crystal Brook Road is classified as an Access Road, which is the lowest order road.

5.6.2 Existing Traffic Counts

- Tonkin Highway (South of Welshpool Road East) carries approximately 47,882 vehicles per day
- Welshpool Road East (East of Tonkin Highway) carries approximately 20,314 vehicles per day
- Crystal Brook Road (250m east of Brentwood Road) carries approximately 2,168 vehicles per day (refer **Plan 1 - KCTT Existing Traffic Counts**).

Future development and ultimate trip generation would be subject to detailed proposals at Structure Plan or subdivision stages. A more detailed Transport Assessment of the proposed land uses using WAPC guidelines would need to be completed at Structure Planning Stage.

15,116 AM 07:15 – 2,647 PM 15:30 – 1,626 2017
NORTH OF HALE ROAD (SLK 17.27)NB

15,960 AM 08:00 – 875 PM 16:45 – 1,054 2017
EAST OF TONKIN HIGHWAY (SLK 1.76)

11,730 AM 08:00 – 875 PM 16:45 – 1,054 2016
NORTH OF WELSHPOOL ROAD EAST (SLK 0.81)

22,702 AM 07:30 – 1,957 PM 16:45 – 1,721 2016
WEST OF TONKIN HIGHWAY (SLK 9.90)

VPD 17,998
AM 08:00 – 1,386
PM 17:00 – 1,477

40,695 AM 07:15 – 3,410 PM 15:30 – 3,566 2017
NORTH OF WELSHPOOL ROAD EAST (SLK 17.44)

VPD 40,237
AM 08:00 – 3,336
PM 17:00 – 3,380

20,314 AM 07:45 – 1,622 PM 16:45 – 1,917 2015
EAST OF TONKIN HIGHWAY (SLK 0.24)

VPD 16,546
AM 08:00 – 1,501
PM 17:00 – 1,699

2,168 AM 07:00 – 208 PM 15:00 – 215 2017
250M EAST OF BRENTWOOD ROAD

47,882 AM 06:15 – 3,503 PM 16:00 – 3,904 2015
SOUTH OF WELSHPOOL ROAD EAST (SLK 19.45)

VPD 42,791
AM 08:00 – 3,256
PM 17:00 – 3,738

5,290 AM 08:00 – 481 PM 16:00 – 518 2016
460M SOUTH WEST OF CRYSTAL BROOK ROAD

VPD 39,620
AM 08:00 – 3,014
PM 17:00 – 3,594

5,963 AM 07:30 – 535 PM 16:00 – 539 2014
NORTH OF TONKIN HIGHWAY (SLK 3.60)

VPD 39,620
AM 08:00 – 3,014
PM 17:00 – 3,594

VPD 44,716
AM 08:00 – 3,580
PM 17:00 – 3,795

43,124 AM 07:00 – 3,141 PM 16:15 – 3,909 2016
SOUTH OF KELVIN ROAD (SLK 22.51)

17,823 AM 07:30 – 1,433 PM 15:30 – 1,677 2016
WEST OF TONKIN HIGHWAY (SLK 3.02)

VPD 44,716
AM 08:00 – 3,580
PM 17:00 – 3,795

13,392 AM 07:15 – 983 PM 15:15 – 1,131 2014
WEST OF BICKLEY ROAD (SLK 2.38)

PARKS AND RECREATION
WATERWAYS
PUBLIC PURPOSE
ROAD
Hay Street STREET NAME
RAILWAY
ROAD BRIDGE
DISTANCE FROM LOCATION
STRUCTURE PLAN AREA
FORRESTFIELD SUBURB
CITY OF KALAMUNDA LOCAL GOVERNMENT NAME
LOCAL AUTHORITY BOUNDARY

TRAFFIC DATA
5,512 NUMBER OF VEHICLES PER DAY
AM 1145 – 381 NUMBER OF VEHICLES PER AM PEAK HOUR
PM 1630 – 480 NUMBER OF VEHICLES PER PM PEAK HOUR
2014 YEAR
EAST OF HARLOW RD LOCATION

TRAFFIC VOLUMES DERIVED FROM SCATS
VPD 17,998 NUMBER OF VEHICLES PER DAY
AM 08:00 – 1,386 NUMBER OF VEHICLES PER AM PEAK HOUR
PM 17:00 – 1,477 NUMBER OF VEHICLES PER PM PEAK HOUR
ALL DATED - SEPT 2017

Certified System Quality ISO 9001 SAI GLOBAL

LEGEND

No	DATE	AMENDMENT
A	16-10-2017	ISSUED FOR REVIEW

PROJECT: WATTLE GROVE LANDHOLDINGS

TITLE: EXISTING TRAFFIC COUNTS - 2,000M RADIUS

DRAWING NUMBER: KC00381.000_ S05

DRAWN BY: J.S.

Civil & Traffic Engineering Consultants
Suite 7 No 10 Whipple Street Balcatta WA 6021
PH: 08 9441 2700
WEB: www.kctt.com.au

kctt

6. POTENTIAL LAND USES

6.1 WORKSHOP WITH CITY OF KALAMUNDA'S PLANNING OFFICERS

The City of Kalamunda's planning officers, attended a meeting at Burgess Design Group on 31 January 2018. The purpose of this meeting was to discuss different land use options for Wattle Grove South. The project team considered the following two (2) land use options:

- Option 1: Residential Development

Under this option, the whole Wattle Grove South area would be concurrently zoned 'Urban' under the Metropolitan Region Scheme, and 'Urban Development' under the City of Kalamunda Local Planning Scheme No.3 (LPS3) and developed for residential purposes (refer **Figure 10**).

The intent of the 'Urban Development' zone under LPS3 is to provide orderly and proper planning through the requirement to prepare and adopt a Structure Plan to facilitate the development of land for residential purposes and other associated uses.

Option 1 is consistent with the North-East Sub-regional Planning Framework; however the 'Medium-Long Term (2022+)' timeframe set out in the Frameworks is expected to delay the initiation of an MRS Amendment. Officers of the Department of Planning, Lands & Heritage have indicated that this land may not be suitable for development (given the availability of other zoned land within the Perth Metropolitan Region), until beyond 2030. As such, this is not the recommended option.

- Option 2: Residential and Industrial Development

Under this option, two (2) separate MRS amendments would be submitted, one (1) for the land generally north of Crystal Brook Road, and one (1) for land south of Crystal Brook Road. The MRS amendments will seek concurrent amendments to rezone the land to 'Urban Development' and/or 'Industrial Development' under the Local Planning Scheme.

It is envisioned that land generally south of Crystal Brook Road will be designated as commercial/light industry zone under the Structure Plan. Whilst land generally north of Crystal Brook Road will be designated for residential development (refer **Figure 10**). This is the recommended option.

The intent of the 'Industrial Development' zone is to provide for orderly and proper planning through the requirement to prepare and adopt a Local Structure Plan. It should be noted, the permissible land uses set out in LPS3 Table 1 - Zoning Table are not envisioned for Wattle Grove South. It is recommended that a new zone is created and adopted under LPS3, and applied through the Local Structure Plan.

In this context, 'Industrial' development is defined as light and service industries, bulky goods, commercial uses which are compatible with and acceptable with close proximity to, residential uses. Heavy industrial uses are not considered to be acceptable. The creation and approval of a new zone will facilitate the development of these abovementioned uses within this precinct (refer Section 3.3).

6.2 APPROACH

In order to determine the best land use option, a pros and cons analysis was undertaken in collaboration with the City of Kalamunda planning officers. The following elements were considered:

- Planning/Development
- Community
- Infrastructure
- Economic Costs
- Environment

Table 7: Option 1 - Residential Development Pros/Cons

PROS	CONS
▪ The site is well located within 15km of the CBD	▪ Timeframe for development is long term in the context of DPLH feedback (post 2030+)
▪ There is an opportunity for significant areas of vegetation (currently in private ownership) to be set aside for conservation through Public Open Space (POS)	▪ The site has the potential to be impacted by a future flight path. High residential densities are likely to be restricted to minimise public exposure to aircraft noise.
▪ The site has good access to Perth CBD and surrounding highways and Perth Airport	▪ Compatibility/interface issues with Tonkin Highway
▪ Residential development will provide a better interface with Gosnells 'Urban Expansion' area	▪ Setbacks to Dampier-Bunbury gas pipeline will be required ▪ Limited development will be permitted within the pipeline corridor
▪ Improved financial capacity to deliver services and community facilities	▪ Residential population may increase demands on existing services (e.g. libraries, waste, community facilities)
▪ Opportunity for greenfield TOD if station location is realigned in a timely manner	▪ Increased POS areas may have increased associated maintenance costs and liabilities
▪ Assist with increasing active open space areas within the City	
▪ Aligns directly with state government strategic plans for urban development (albeit post 2022+)	
▪ Aligns with City's Local Planning Strategy	
▪ The topography of the site is flat and relatively unconstrained for urban development	
▪ Opportunity for a Neighbourhood Centre	

▪ Primary school for future residents	

Table 8: Option 2 - Industrial Development Pros/Cons

PROS	CONS
▪ Opportunity to make up for the shortfall of industrial land in Forrestfield North precinct (130ha)	▪ Possible community concern and opposition to industrial land uses
▪ Limited alternative locations for industrial development areas within the City	▪ Impact projected resident population growth (although this could be off-set given the increase in the development area with the 'Urban Investigation' land identified under the Frameworks)
▪ The land is well positioned within close proximity to transport infrastructure, including: – Tonkin Highway – Northlink – Gateway – Roe Highway which has access to the port – Direct access to Roe Hwy when the existing Hale Road connection is closed – Welshpool Road – Opportunity at Kelvin / Crystal Brook Road for freight vehicle movements	▪ Fewer opportunities for conservation POS areas given that industrial development has no POS requirements. Noting there will be some conservation in the industrial area given the need to retain some existing vegetation
▪ The study area is within close proximity to Perth airport	▪ Landowner expectation that the area is Urban
▪ The study area is within close proximity to PTA rail yards	▪ Create interface issues with Gosnells future urban expansion area
▪ Opportunity to make up for land environmentally constrained by Yule Brook and wetlands in MKSEA	▪ Lost opportunity for a greenfield TOD as part of Metronet plan. Noting that the rerouting of rail required for a TOD that has not been committed to by the state
▪ Compatible use/ suitable interface with existing landfill site to the south	▪ Access arrangement with Tonkin Hwy / Welshpool Road
▪ Doesn't compete with 'urban supply' ▪ Opportunity to commence development prior to 2022+ timeframe	▪ Visual impacts from the hills and Tonkin Highway
▪ Appropriate interface with Tonkin Highway / future industrial land uses (MKSEA)	
▪ Industrial development is not constrained by the Dampier-Bunbury gas pipeline that	

runs along the southern boundary	
▪ Stimulate economic activity and create employment opportunities	
▪ Industrial rate payers do not require the provision of community infrastructure and resources (e.g. libraries, POS, community facilities and services)	
▪ Will provide goods and services for the broader community	
▪ Opportunity for 'bulky goods' uses	
▪ Located within a growing catchment for employment	
▪ Industrial land use is typically a faster development process	
▪ Industrial land use more compatible with Perth Airport flight path	
▪ Flat and relatively unconstrained for industrial development	
▪ Less infrastructure required by utilising the existing road pattern	

6.3 SUMMARY

It was agreed by the project team that Option 2: 'Urban Development' and 'Industrial Development' is the preferred land use option. Discussions with the City of Kalamunda officers confirmed that this Planning Feasibility Study should provide such an analysis and then make any necessary recommendations on the next steps/implementation based on this option being suitable.

This land use configuration was selected based upon the above pros and cons analysis and primarily due to the following:

1. Need for industrial land within the City of Kalamunda
2. Location/proximity
3. Land use integration/compatibility
4. Land use potential
5. Timing of development
6. Economic sustainability
7. Less demanding on City services
8. Site landform
9. Availability of services
10. Availability of additional land for residential development

6.3.1 Need

The City lost a significant area of future industrial land through the development of a large portion of Forrestfield North for residential purposes. This land was well located adjacent to the Perth Airport, marshalling yards and local highways.

There is limited opportunity in other areas of the municipality for industrial land use with such a high level of access to services and transport.

The City also has limited bulky good/mixed business land use opportunities.

The portion of Wattle Grove South to the south of Crystal Brook Road is of a suitable size to provide for a strategic industrial/bulky good/mixed business area.

6.3.2 Location

Wattle Grove South is very well located in close proximity to:

- Perth CBD
- Perth airport
- Forrestfield marshalling yards
- Abutting highways
- Services and infrastructure

The land use exposure provided by Tonkin Highway is also a key opportunity.

6.3.3 Land Use Integration

Located abutting a major highway and high capacity gas pipeline, being impacted by a poultry farm buffer and being situated in close proximity to services and infrastructure, confirms that the use of the land for industrial purposes represents an ideal integration with surrounding development.

Crystal Brook Road also provides an ideal northern boundary to the industrial precinct, creating a clear delineation between this land use and the future residential development area to the north.

6.3.4 Land Use Potential

Creation of an industrial precinct also provides the City with potential to introduce a range of other land uses to the area, including:

- Light industry
- Bulky goods and showrooms
- Mixed business

6.3.5 Timing of Development

Officers of the Department of Planning, Lands & Heritage have indicated that planning approvals (zoning and local structure plan) may not be supported for Wattle Grove South in the short to medium term.

This is based on the timeframes shown in the adopted Frameworks (2022+) and the officers specifically suggesting that development may not be appropriate prior to 2030 – based upon the availability of other zoned residential land within the Perth Metropolitan Region.

Dividing the Study Area into a southern 'industrial' precinct and a northern 'residential' precinct addresses this timing issue.

Industrial land can be progressed more quickly to meet perceived demands, with the residential land being longer term – if required. It is also important to note that demand for the residential land will increase as larger areas of the site are developed for business activities, creating employment opportunities.

An MRS 'Urban' zoning can be progressed over both the industrial and residential precincts concurrently, together with 'Industrial Development' and 'Urban Development' zoning under the Local Planning Scheme No.3.

6.3.6 Economic Sustainability

Planning for economic development is an important aspect when building strong, sustainable local economies. The City has an important role in facilitating economic development and supporting its residents through the provision of jobs and services. The recommended development Option 2 to create an industrial development precinct is consistent with the City's goals set out in the Kalamunda Advancing 2027: Strategic Community Plan to increase employment self-sufficiency, and achieve greater economic sustainability.

6.3.7 City Services

The City has also advised that industrial land uses create less of a demand for community services and facilities, thus reducing the financial burden placed on the City in comparison to a residential use of the land.

6.3.8 Site Landform

The portion of the Study Area south of Crystal Brook Road is generally flat or only slightly undulating, with little vegetation of any value. Further, it has good access to existing roads. It is thus ideally suited for industrial development.

It is also likely that less land fill will be required for industrial development of the land, resulting in environmental and economic cost savings.

6.3.9 Availability of Services

The engineering services report included within this Planning Feasibility Study indicates that services and infrastructure are available to the site to support the land uses as proposed.

Given the high level of access to the site and its proximity to such services, it is considered ideally suited for land uses of an industrial nature.

6.3.10 Additional Residential Land

The adopted WAPC Framework shows additional land in the north-eastern part of the Study Area for 'Urban Investigation'.

This is land that we considered ideally suited for inclusion within the 'Urban Expansion' area as it generally represented a rounding off of the precinct, bound by Welshpool Road, the Darling Scarp, the municipal boundary to the south and Tonkin Highway to the west.

Burgess Design Group recommended the inclusion of this land to the City and in turn both parties made the same suggestion to the WAPC.

Inclusion of this land in the adopted WAPC Frameworks increases the total land area to be considered for residential development, as outlined below:

Original area of 'Urban Expansion' land in draft Framework	196ha
'Urban Expansion'/'Urban Investigation'/'Urban' land in adopted Framework	287ha
Original area of 'Urban Expansion' land north of Crystal Brook Road	80ha
Final area of 'Urban Expansion/Investigation' north of Crystal Brook Road	170ha

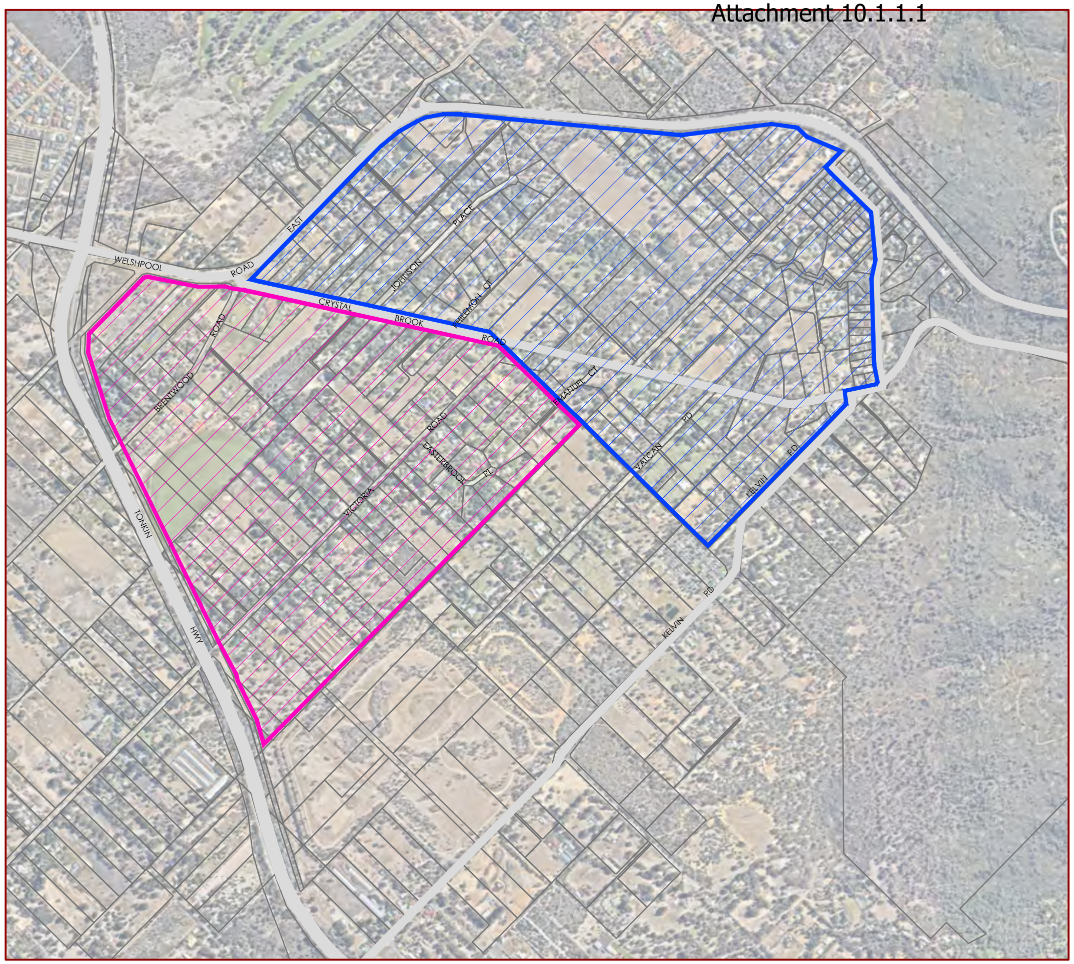
Thus, the potential zoning of approximately 135ha of industrial land within Wattle Grove South has only reduced the total (original) area of 'Urban Expansion' land by 26ha.

This is important, as the City's housing/population estimates for Wattle Grove South based on the original Frameworks (assuming 122.5ha developable land) were in the order of 4,777.5 persons (assuming 15 lots per ha).

The proposal to develop part of the Study Area for industrial purposes reduces the land available for residential development to 156ha (net), however, this still provides for a potential residential population of 3,802.5 persons (assumes 15 lots per ha), which is only 975 less than originally proposed, or approximately 20%. A greater yield per hectare could also be used to reduce this deficit.

Thus the impact of integrating an industrial precinct within the Study Area on future population growth is marginal, yet the benefits (as outlined above) are significant.

The City is supporting increased residential infill with adopted Amendment 82 – Dual Density Code, Forrestfield North and Maida Vale South areas (refer Section 2.3). In this regard, the reduction in residential land within Wattle Grove South is considered to be inconsequential given the City is likely to exceed the additional dwellings infill target of 11,450 specified in the Framework.



DEVELOPMENT OPTION 1: RESIDENTIAL DEVELOPMENT

- Residential

DEVELOPMENT OPTION 2: RESIDENTIAL & LIGHT INDUSTRY DEVELOPMENT

- Residential
- Commercial / Light Industry

FIGURE 10

All areas and dimensions are subject to survey, engineering and detailed design and may change without notice.

NORTH

0 0.25 0.5 0.75 1km

SCALE 1:25,000 (A4)

DEVELOPMENT OPTIONS
WATTLE GROVE SOUTH

BURGESS DESIGN GROUP
TOWN PLANNING + URBAN DESIGN
PO Box 8779 Perth Business Centre 6849
www.burgessdesigngroup.com.au
P (08) 9328 6411
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Date: 24.05.18
Plan No: KAL WAT 7-02c-12
Client: City of Kalamunda

CITY OF KALAMUNDA

6.4 DEVELOPMENT POTENTIAL

Option 1: Residential Development

The development potential of the subject land is calculated based on the following assumptions:

- Total land area (excludes existing roads): 292ha
- 10% POS + 2.5% drainage: 36.5ha
- 25% roads: 73ha
- Total developable area: 182.5ha

Estimated Population

- @15 lots per ha and 2.6 persons per dwelling: 2,737.5 lots = 7,117.5 persons
- @20 households per hectare and 2.6 person per dwelling: 3,650 lots = 9,490 persons
- @450m^2 lots (developable area) and 2.6 persons per dwelling = 4,055.56 lots = 10,544.4 persons

The total projected dwellings and population projections above are based on the assumption that the whole area will be residential. It does not exclude land required for a future commercial uses (neighbourhood centres), community facilities, or any schools (at least 1 primary school site will be required). It also assumes only 10% public open space. More land for recreation and conservation may be required pending further environmental analysis.

Primary and High Schools

Burgess Design Group met with the Department of Education in 2015 to discuss the future urban development of Wattle Grove South area. The Department advised that:

- Primary school sites are provided based on the standard requirement of one site per 1,500-1,800 dwellings for government schools (thus likely two schools required)
- The future school sites would ideally centrally located to each catchment (potentially one north and one south of Crystal Brook Road
- No high school site is required due to the study areas proximity to Darling Range College

Option 2: Residential and Industrial Development

- Total land area (excludes existing roads): 292ha

Residential Development (generally north of Crystal Brook Road)

- Total residential area: 156ha
- 10% POS + 2.5% drainage: 19.5ha
- 25% roads: 39ha
- Total developable area: 97.5ha

Estimated Population

- @15 lots per ha and 2.6 persons per dwelling: 1,462.5 lots = 3,802.5 persons
- @20 households per hectare and 2.6 person per dwelling: 1,950 lots = 5,070 persons
- @450m^2 lots (developable area) and 2.6 persons per dwelling = 2,166.67 lots = 4,333.33 persons

Industrial Development (generally south of Crystal Brook Road)

- Industrial area: 136ha

7. STATUTORY PROCESS RECOMMENDATIONS

7.1 PREPARATION OF CONCURRENT MRS/LPS3 AMENDMENTS

Scenario 1: Urban Development Zone

Prepare two (2) separate MRS amendments, one (1) for the residential area generally north of Crystal Brook Road and one (1) for the commercial/light industrial area south of Crystal Brook Road. Both MRS Amendments to the Metropolitan Region Scheme (MRS), will rezone the subject land from the 'Rural' zone to 'Urban' zone with a concurrent amendment to the City of Kalamunda Local Planning Scheme No.3 (LPS3) to rezone the land from 'Special Rural' and 'Rural' to 'Urban Development'.

Section 126 (3) of the Planning and Development Act 2005 allows for the concurrent amendment of a LPS where land is to be transferred to the 'Urban' zone in the MRS.

These amendments will facilitate the ultimate development of the Study Area for residential and/or light industrial uses following subsequent detailed structure planning and development approval.

Separate MRS amendment requests are proposed given the feedback received from the DPLH that the 'medium-long term (2022+)' timeframe for residential development will likely delay the initiation, advertising and consideration of the MRS amendment. It is expected that separate amendment processes will ensure that the commercial/light industrial area is not unduly delayed by the 'medium-long term (2022+)' residential timeframe.

Scenario 2: Urban and Industrial Development Zones

Prepare two (2) separate MRS amendments, one (1) for the residential area generally north of Crystal Brook Road and one (1) for the commercial/light industrial area south of Crystal Brook Road.

The first MRS Amendment will seek to rezone the a portion of the study area from the 'Rural' zone to 'Urban' zone, and a concurrent amendment and land generally south of Crystal Brook Road to 'Industrial Development'.

The second Metropolitan Region Scheme (MRS) amendment will seek to rezone the a portion of the study area from the 'Rural' zone to 'Urban' zone, and request a concurrent amendment to the City of Kalamunda Local Planning Scheme No.3 (LPS3) to rezone land generally north of Crystal Brook Road from 'Special Rural' and 'Rural' to 'Urban Development',

Under LPS3 separate development zones are proposed to give the WAPC and the City increased certainty that the land generally south of Crystal Brook Road (refer to Figure 10) will be developed for light industrial/commercial uses, as recommended. The 'Industrial Development' zone will provide for orderly and proper planning through the preparation and adoption of a Structure Plan, and allow the City to consider uses in accordance with LPS3 zoning table in the interim. The ultimate preparation of a structure plan and creation of a new zone (through a local planning scheme amendment process) for this area will ensure that heavy industrial uses are not permitted.

The 'Urban Development' zone will require the preparation and adoption of a Structure Plan over the proposed residential area (refer to Figure 10). This Structure Plan will facilitate the ultimate subdivision and/or development of land for residential purposes and for commercial and other uses normally associated with residential development.

7.2 TECHNICAL REPORTS/STUDIES

The following reports/studies will be required to support the rezoning of the site to 'Urban' under the MRS and to 'Urban Development' under the LPS3. They will also support the preparation of the Strategic District Structure Plan.

- Environmental Assessment (including Spring Flora and Fauna Survey)
- District or local water management strategy (monitoring for two (2) winters)
- Bushfire hazard assessment and management plans
- Civil Engineering
- Traffic Engineering
- Acoustic Assessment
- Economic/Retail Strategy

7.2.1 Environmental Assessment

A spring Flora and Fauna Survey is required to support the concurrent MRS/LPS amendment and subsequent District Structure Plan (DSP). The purpose of the Flora and Fauna Survey is to identify major vegetation, flora and fauna constraints within the Study Area to inform the DSP. The commencement of this scope of works is imperative to progress development. To meet EPA requirements surveys and assessments need to be undertaken during spring (September – November).

7.2.2 District or Local Water Management Strategy

A District Water Management Strategy (DWMS) is required to support a concurrent MRS/LPS amendment and subsequent District Structure Plan (DSP). The purpose of the DWMS is to demonstrate that the site is suitable for the change in land use and identify areas that require further investigations as part of future land use planning and/or development. To meet the Department of Water and Environment Regulation standard requirements for two (2) winters of pre-development monitoring the appointment of a sub-consultant to undertake this work is critical to progress future development.

7.2.3 Bushfire Hazard Level Assessment and Management Plan

A Bushfire Hazard Level Assessment and Management Plan will be required in accordance with State Planning Policy 3.7 - Planning in Bushfire Prone Areas (SPP 3.7). A Bushfire Hazard Level Assessment will determine if the site has a low, moderate or extreme bushfire hazard level. If the site contains a moderate or extreme hazard level a Bushfire Management Plan will be required. The BMP will need to address how the hazard level will be initially reduced and subsequently maintained for the life of the development.

7.2.4 Economic/Retail Analysis

There are limited retail/bulky goods uses within the City of Kalamunda. To determine the optimal size of the future commercial/light industrial area an economic or retail analysis may be required and is recommended.

7.3 LSP3 AMENDMENTS

A Scheme Amendment will need to be prepared to designate the land on the scheme map as a 'Development Contribution Area' and include the area in Schedule 12 – Development Contribution Areas.

A separate Scheme Amendment will be required create a new Service Commercial/Light Industry zone (the exact name and details are still to be determined). This Amendment will need to be prepared concurrently with the Local Structure Plan given that a Structure Plan must be consistent with the Local Planning Scheme zones.

7.4 DISTRICT STRUCTURE PLAN

We recommend the City of Kalamunda prepares a Strategic District Structure Plan (defined under the 'Guidelines') to support the MRS amendments. This District Structure Plan (DSP) will need to address any 'fatal flaws' of a potential development area and provide for the major structural elements, including major roads, open space networks, commercial and industrial areas, and environmental conditions. Additionally, the District Structure Plan will address timing of development, specifically in relation to the area for residential and related uses.

7.5 LOCAL STRUCTURE PLANS

Preparation and adoption of two (2) separate Structure Plans, one (1) for land generally north of Crystal Brook Road, and one (1) for the land generally south of Crystal Brook Road under LPS3 is required. The preparation of two separate structure plans is recommended given the 'medium-long term (2022+)' timeframe under the Sub-regional Planning Framework for residential development within Wattle Grove South. It is recommended that the preparation of Structure Plans be undertaken by proponents. As such, no allowance in the City of Kalamunda's budget is required for these elements.

7.5.1 Effect of a Structure Plan

It should be noted that a Structure Plan is a non-statutory document. The Planning and Development (Local Planning Schemes) Regulations 2015 Schedule 2, Part 4 Cl. 27 (1) states: *'A decision-maker for an application for development approval or subdivision approval in an area that is covered by a structure plan that has been approved by the Commission is to have due regard to, but is not bound by, the structure plan when deciding the application.'*

7.6 STATE AND LOCAL LAND RESUMPTION REQUIREMENTS PRE-ZONING

It is considered highly unlikely that there will be any state and/or local land resumption requirements pre-zoning. Any land resumptions required for development will be either included in the Development Contribution Plan, or be part of a separate acquisition process (e.g. high schools site, primary school sites etc.).

7.7 DEVELOPER CONTRIBUTIONS ARRANGEMENTS

A Development Contribution Plan will need to be prepared in accordance with the provisions of S*tate Planning Policy 3.6 Development Contributions for Infrastructure* and the provisions of clause 6 of LPS3.

This will need to be prepared at the Local Structure Plan phase of the project in consultation with the proponent of the Structure Plan.

It is recommended that the City commence preliminary analysis of the elements associated with a DCP for Wattle Grove South to continue to inform the planning approval process.

7.8 BUDGET

The following budget has been prepared to provide preliminary guidance to the City for the next phases of the planning process. It is an estimate only for budgeting purposes.

TECHNICAL REPORTS/STUDIES	COST ESTIMATES
– Planning report for concurrent MRS/LPS amendments and technical team coordination – Preparation of a Strategic District Structure Plan (DSP)	$60,000.00
District Water Management Strategy (DWMS)	$45,000.00
Water monitoring	$50,000.00
Environmental Assessment Report	$50,000.00
Bushfire Management Plan	$20,000.00
Civil Engineering Services	$25,000.00
TIA And Transport / Traffic Modelling	$35,000.00
Acoustic Consultants (Noise Modelling)	$15,000.00
TOTAL	**$300,000.00**

8. CONCLUSION

The Western Australian Planning Commission's (WAPC) North-East Sub-Regional Planning Framework identified Wattle Grove South as an area to be investigated for the purposes of future urban development. The draft Framework identified approximately 196ha of land for 'Urban Expansion'. The final adopted Framework includes an expanded development area, with land shown as both 'Urban Expansion' and 'Urban Investigation' totalling approximately 287ha.

The purpose of this Planning Feasibility Study was to determine the optimum location, size, opportunities, constraints and risks involved in progressing the rezoning and planning of the Wattle Grove South area for the purposes of urban development.

The Study was undertaken by Burgess Design Group, in collaboration with specialist consultants 360 Environmental and KCTT (civil and traffic engineering).

8.1 SCOPE OF WORKS

The Study has addressed the following agreed Scope of Works:

1. Phase 1 – Introduction and Purpose

    - Determine the optimum boundary, size and location of a future development area
    - Identify major elements for consideration to guide future urban development

2. Phase 2 – Regional Contextual Analysis and Map

    - Analyse the planning framework
    - Land supply and demand
    - Major access points, including the proximity of Tonkin Highway (Primary Regional Road) and Welshpool Road East (Other Regional Road)
    - Existing land uses in vicinity of the proposed development area
    - Environmental factors and constraints
    - Land assembly matters and those related to fragmented land ownership

3. Phase 3 – Local Contextual Analysis and Map

    - Population and employment self-sufficiency
    - City/civic requirements
    - Local Planning Strategy context

4. Phase 4 – Site Analysis and Map

    - Identify the opportunities / constraints presented by future development and propose investigations / recommendations in the following key areas:

        - Environmental
        - Hydrological
        - Servicing and Infrastructure (particular focus on deep sewer)
        - Forrestfield > Thornlie rail extension and station at Wattle Grove
        - Indicative Land Use / Retail Demand

5. Phase 5 – Statutory Process Recommendations

   - MRS rezoning
   - Land resumption requirements
   - LSP3 rezoning
   - District Structure Plan/Local Structure Plan
   - Developer contribution arrangements

8.2 OUTCOMES

8.2.1 Study Area

Phase One of this Study was focussed on determining a suitable location 'area' and 'size' for potential future development within Wattle Grove South. The results of the initial analysis recommended that the area shown in the WAPC draft Framework should be expanded to include additional land to the north and east, generally bound by Welshpool Road.

This recommendation was presented to the City's planning officers and then jointly to the planning officers of the Department of Planning, Lands & Heritage. Ultimately, the final adopted WAPC Framework includes the larger extended area for future development, with 287ha of land identified. This is generally consistent with our recommended Study Area boundary.

8.2.2 Regional Context

The subject land is ideally located for future urban development, given its proximity to:

- Perth CBD
- Airports
- Forrestfield marshalling yards
- Major highway and freight routes
- Existing employment centres
- Recreational areas (both active and passive)
- Retail and commercial areas

The land is also relatively flat and unconstrained for development purposes.

The Site Analysis Map included herewith at Figure 9 illustrates the high connectivity of the site, surrounding land uses and the primary environmental factors.

The investigations also note that the Study Area is characterised by fragmented land ownership. Coordination of landowners will be an important element of the planning and development process. Burgess Design Group specialises in landowner coordination and can assist with this element as required.

8.2.3 Opportunities and Constraints

The Study provides an overview of the area's opportunities and constraints from planning, engineering and environmental perspectives and has determined that the Wattle Grove South area is ideally suited for urban development purposes.

One of the constraints identified in the analysis was the anticipated timing of development included in the WAPC Frameworks. This potentially puts development of the area around 2030 or beyond (2022+ in the document, with Department officers suggesting this could mean 2030+).

The increase in size of the Study Area, combined with the location of the site and the need for additional employment land has created an opportunity to incorporate a non-residential component within the development footprint.

The Study recommends the area generally south of Crystal Brook Road be utilised for 'industrial development' purposes, which could include bulky goods/showrooms and mixed business uses. The high level of exposure to Tonkin Highway, the site's landform and the availability of services support this potential land use. Such uses also represent an appropriate interface to the highway.

The creation of such an employment activity area, particularly given the loss of such land in Forrestfield North, represents a significant opportunity for Wattle Grove South.

This land use opportunity may also address the timing constraint raised by the WAPC. The industrial land could be developed in the short term, then supporting the future residential development of the remainder of the Study Area, north of Crystal Brook Road.

This Study also provides technical input to inform any discussion with the WAPC on the 'Urban Investigation' area. The WAPC specifically advised that the technical analysis of 'Urban Investigation' land was to be undertaken by the Department, or potentially a local government, but could not be 'proponent' (or developer) driven. Given this Study has been prepared for the City, it should form part of any such investigation process.

8.3 RECOMMENDATIONS

This Study makes the following recommendations.

8.3.1 Study Area

1. Adopt the Study Area boundary shown in the final WAPC Frameworks

8.3.2 Land Uses

2. Land proposed for industrial development generally south of Crystal Brook Road

3. Land proposed for residential development generally north of Crystal Brook Road

8.3.3 Zoning

4. Propose an amendment to the MRS to rezone the area south of Crystal Brook Road to 'Urban', and concurrently rezone this area to 'Industrial Development' zone under Local Planning Scheme No.3.

5. Propose an amendment to the MRS to rezone the area north of Crystal Brook Road to 'Urban', and concurrently rezone this area to 'Urban Development' zone under Local Planning Scheme No.3.

Two separate amendments are recommended, as it is possible the development of the industrial land may be supported earlier than the residential land, given the timing indicated in the WAPC Frameworks and that part of the residential land is shown in the Frameworks as 'Urban Investigation'.

6. Propose an amendment to create a Developer Contribution Area (DCA) under Local Planning Scheme No.3.

8.3.4 District Structure Plan

7. Propose the preparation of a Strategic District Structure Plan (DSP) over the whole Study Area to guide future development. This should be prepared for submission concurrently with the MRS amendment requests, as it will also guide these zoning processes.

The DSP will also provide some clarity on land uses, particularly within the area south of Crystal Brook Road.

8.3.5 Local Structure Plans

8. It is recommended that the preparation of Local Structure Plans be driven/undertaken by existing or prospective landowners/developers. The DSP may include indicative Local Structure Plan boundaries.

8.3.6 Developer Contributions Plan

Future development of the Wattle Grove South area will require a Developer Contributions Plan (DCP) to provide for the equitable provision of services and infrastructure.

9. It is recommended that a DCP be prepared and that consideration of the elements to be included in any DCP be undertaken as part of the District Structure Planning process.

8.4 IMPLEMENTATION

The recommended steps for implementation of the outcomes of this Study are as follows:

1. Council review, assess and adopt this Study (with or without modifications) to guide future planning of the area

2. The Study be presented to the Department of Planning, Lands & Heritage for review and comment

3. Community consultation with landowners within the Study Area be undertaken to discuss the elements raised herein, including the final WAPC Frameworks, extended development area and various land use proposals

4. Preparation of a Strategic District Structure Plan to guide potential rezoning amendments and future development

5. Preparation of two (2) separate amendments to the MRS, with concurrent rezoning of the Local Planning Scheme

6. Preparation of an amendment to the Local Planning Scheme to include the area within a Development Contributions Area

7. Preparation of a Developer Contributions Plan for the Study Area

8. Local Structure Plans to be prepared by proponents (landowners/developers)

This Planning Feasibility Study has successfully addressed the Scope of Works provided by the City of Kalamunda and outlined the Outcomes and Recommendations necessary to implement the broad proposals for the Study Area included within the adopted WAPC Frameworks.

APPENDIX 1:
360 Environmental, Environmental Assessment Report

360 environmental

Various Lots, Wattle Grove

Environmental Assessment Report

Prepared for:
Burgess Design Group

April 2018

people • planet • professional

Document Reference	Revision	Prepared by	Reviewed by	Admin Review	Submitted to Client	
					Copies	Date
2188AB	1 INTERNAL DRAFT	CM	KC	-	1x electronic	12/03/18
2188AB	2 CLIENT DRAFT	CM	-	NL	1x electronic	13/03/18
2188AB	3 CLIENT FINAL	CM	KC	NL	1x electronic	24/04/18

Table of Contents

List of Tables

List of Figures

List of Appendices

1 Introduction

1.1 Background

360 Environmental Pty Ltd was commissioned by Burgess Design Group Pty Ltd on behalf of the City of Kalamunda to prepare an environmental assessment report (EAR) for various lots bound by Tonkin Highway, Kelvin Road, Welshpool Road East, Fontano Road, Judith Road and Crystal Brook Road in Wattle Grove ('the site').

The purpose of this EAR is to inform a feasibility study on the future rezoning of the site from 'Rural' to 'Urban' under the Metropolitan Region Scheme (MRS).

The site is approximately 325 ha in size and is located approximately 14.75 km southeast of Perth's Central Business District (CBD). The site is situated within the City of Kalamunda local government area and is zoned 'Special Rural' and 'Rural Composite' under the City's Local Planning Scheme No. 3 (LPS 3).

1.2 Environmental Assessment Objectives

This Environmental Assessment Report (EAR) provides an overview of the general environmental features of the Site and includes an overview of the Site's remaining biological and social environment including wetlands, Aboriginal and non-Aboriginal Heritage sites, regional soil types, hydrology, geomorphology, flora, vegetation and fauna, planning context and social environment as determined through a review of existing information.

1.3 Scope of Works

The scope of works for this study is as follows:

- Literature review of relevant environmental and planning documents;
- Desktop review of geology, regional surface hydrology and groundwater information using databases and digital mapping information;
- Preliminary acid sulfate soils (ASS) assessment, including review of ASS risk mapping and local soil types;
- Desktop site assessment of contamination and review of historical and current land uses;
- Detailed desktop assessment of flora, vegetation, fauna from searches of the Department of Biodiversity, Conservation and Attractions' (DBCAs) Threatened and Priority searches, NatureMap and the Commonwealth's Protected Matters Search Tool;
- Review of mapped conservation areas;

- Desktop heritage (Aboriginal and non-Aboriginal) assessment;
- Identification of other environmental issues associated with proposed rezoning; and
- Formulation of a report detailing the above.

2 Key Environmental Legislation and Policies

2.1 Commonwealth Legislation

2.1.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the central piece of environmental legislation which protects Matters of National Environmental Significant (MNES) and broadly, to conserve Australia's biodiversity. If a proposed action is likely to have a significant impact on any MNES, a referral to the Commonwealth Department of the Environment and Energy (DEE) is required.

2.2 State Legislation

2.2.1 Environmental Protection Act 1986

The *Environmental Protection Act 1986* (EP Act) is the key legislative tool for environmental protection in Western Australia. It is administered by the Environmental Protection Authority (EPA) and the Minister for Environment. Under Part IV of the EP Act, the EPA undertakes environmental impact assessment of proposals and schemes to provide advice on environmental acceptability of developments. The environment impact assessment process provides an orderly and systematic evaluation of a proposal and its potential impact on the environment. A critical component of the assessment is the consideration of ways in which the implemented proposal could avoid or reduce any potential impact on the environment.

2.2.2 Relevant Legislation and Regulations

All future rezoning and development will be required to comply with the requirements of other relevant state legislation and regulations. Table 1 provides a summary of the key state legislation and regulations relevant to the proposed residential development.

Table 1. Key State Legislation

Key Legislation	Responsible Government Agency	Aspect
Aboriginal Heritage Act 1972	Department of Planning, Lands and Heritage	Archaeological and ethnographic heritage
Aboriginal Heritage Regulations 1974	Department of Planning, Lands and Heritage	Archaeological and ethnographic heritage

KEY LEGISLATION	RESPONSIBLE GOVERNMENT AGENCY	ASPECT
Agricultural and Related Resources Protection Act 1976	Department of Primary Industries and Regional Development	Weeds and feral animals
Biosecurity and Agriculture Management Act 2007	Department of Primary Industries and Regional Development	Weeds / pests / diseases
Bush Fires Act 1954	Department of Fires and Emergency Services	Bush fire control
Conservation and Land Management Act 1984	Department of Biodiversity Conservation and Attractions Department of Agriculture	Flora and fauna / habitat / weeds / pests / diseases
Conservation and Land Management Regulations 2002	Department of Biodiversity Conservation and Attractions Department of Agriculture	Flora and fauna / habitat / weeds / pests / diseases
Contaminated Sites Act 2003	Department of Water and Environmental Regulation	Management of contaminated soils and water
Environmental Protection Act 1986	Environmental Protection Authority Department of Water and Environmental Regulation	Part IV – Environmental Impact Assessment Part V – Works Approvals and Licences
Environmental Protection (Clearing of Native Vegetation) Regulations 2004	Department of Water and Environmental Regulation	Clearing of native vegetation
Planning and Development Act 2005	Department of Planning, Lands and Heritage	Structure planning and subdivision approval
Rights in Water and Irrigation Act 1914	Department of Water and Environmental Regulation	Governs management of the use, service and health of water and watercourses (including beds and banks). Water licensing is required in all proclaimed areas and for all artesian groundwater wells throughout the state.

KEY LEGISLATION	RESPONSIBLE GOVERNMENT AGENCY	ASPECT
Wildlife Conservation Act 1950	Department of Biodiversity Conservation and Attractions	Wildlife conservation and protection

2.2.3 Relevant Standards, Guidelines and Policies

Future development is subject to compliance with applicable standards, guidelines and policies developed by the State's regulators to assist proponents in understanding the minimum requirements for environmental protection. The following table details the key standards, guidelines and State Planning Policies relevant to future residential development of the site (Table 2).

Table 2. Relevant Standards, Guidelines and Policies

DOCUMENT	DESCRIPTION
EPA Policies and Guidance	
Statement of Environmental Principles, Factors and Objectives (EPA 2016a)	This statement communicates the EPA considers the object and principles of the EP Act, uses environmental factors and objectives to organise and systemise environmental impact assessment, taking a holistic view of the environment and considering significance of a proposal.
Environmental Factor Guideline – Flora and Vegetation (EPA 2016b)	Provides guidance to protect flora and vegetation so that biological diversity and ecological integrity are maintained.
Environmental Factor Guideline – Terrestrial Environmental Quality (EPA 2016c)	Provides guidance with the objective to maintain the quality of land and soils so that environmental values are protected.
Environmental Factor Guideline – Terrestrial Fauna (EPA 2016d)	Provides guidance with the objective to protect terrestrial fauna so that biological diversity and ecological integrity at maintained.
Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016e)	Provides technical guidance to ensure adequate flora and vegetation data of an appropriate standard are obtained and used in environmental impact assessment.
Technical Guidance – Terrestrial Fauna Surveys (EPA 2004)	Provides technical on the direction and information on general standards and protocols for terrestrial fauna surveys for environmental impact assessment.
Guidance Statement No. 3: *Separation Distances between Industrial and Sensitive Land Uses* (EPA 2005)	Provides guidance on the generic separation (buffer) distances between Industrial and Sensitive land uses to avoid conflicts between these land uses.
Guidance Statement No. 6: *Rehabilitation of Terrestrial Ecosystems* (EPA 2006)	Provides guidance to ensure the return of biodiversity in rehabilitated areas by increasing the quality, uniformity, and efficiency of standards and processes for rehabilitation of native vegetation in Western Australia and to allow more effective monitoring and auditing of outcomes.
Guidance Statement No. 33: *Environmental Guidance for Planning and Development* (EPA	Provides information and advice to assist land use planning and development processes to protect, conserve and enhance the environment.

DOCUMENT	DESCRIPTION
2008)	Describes the processes the EPA may apply under the EP Act to land use planning and development in Western Australia, and the environmental impact assessment process applied by the EPA to schemes.
Guidance Statement No. 41: *Aboriginal Heritage Assessment* (EPA 2004b)	Provides guidance on the EPA's position on the assessment of Aboriginal heritage and information that the EPA will consider when assessing proposals where Aboriginal heritage is a relevant environmental factor.
Guidance Statement No. 56: *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004d)	Provides guidance and information on the EPA's expected standards and protocols for terrestrial flora and vegetation surveys to environmental consultants and proponents.
WA Environmental Offsets Policy (EPA 2011)	Seeks to protect and conserve environmental and biodiversity values for present and future generations. The policy ensures that economic and social development may occur while supporting long term environmental and conservation values.
EPA Bulletins	
Environmental Protection Bulletin No. 1: *Environmental Offsets* (EPA 2014b)	Clarifies how the EPA will consider offsets through the environmental impact assessment process.
State Planning Policies	
State Planning Policy 2.8: *Bushland Policy for the Perth Metropolitan Region* (WAPC 2010)	Provide policy and implementation framework that will ensure bushland protection and management issues in the Perth Metropolitan Region are appropriately addressed and integrated with broader land use planning and decision making. Ensure the long-term protection of biodiversity and associated environmental values.
State Planning Policy 2.9: *Water Resources* (WAPC 2006)	Provides clarification and additional guidance to planning decision-makers for consideration of water resources identified as having significant economic, social, cultural or environmental values.
State Planning Policy 3.7: *Planning in Bushfire Prone Areas* (WAPC 2015)	Provides guidance on the implementation of effective risk-based land use planning and development to preserve life and reduce the impact of bushfire on property and

DOCUMENT	DESCRIPTION
	infrastructure.
Road and Rail Transport Noise and Freight Considerations in Land Use Planning (WAPC 2009)	Provides guidance to promote a system in which sustainable land use and transport are mutually compatible.
Department of Water and Environmental Regulation (DWER) Guidelines	
Assessment and management of contaminated sites Guideline (DER 2014)	Provides guidance on the assessment and management of contaminated sites in Western Australian within legislative framework of the Contaminated Sites Act 2003 and the Contaminated Sites Regulations 2006.
Identification and investigation of acid sulfate soils and acidic landscapes (DER 2013)	Provides guidance to assist with the identification, assessment and management of acid sulfate soils in Western Australia.

3 Planning Context

3.1.1 Shire of Kalamunda Local Planning Scheme No. 3

Under the City of Kalamunda's LPS 3, the site is zoned 'Special Rural' or 'Rural Composite'.

3.1.2 Draft Perth and Peel @3.5 Million Sub-regional Planning Framework

The draft Perth and Peel @ 3.5 million suite of strategic land use planning documents aim to accommodate 3.5 million people by the year 2050. The WAPC identified part of the Site as 'Urban Expansion' in the draft Metropolitan Perth and Peel Sub-regional Planning Framework (WAPC 2015).

3.1.3 Draft Perth and Peel Green Growth Plan for 3.5 million

In response to the draft Perth and Peel Sub-Regional Frameworks, the draft Perth and Peel Green Growth Plan for 3.5 million (draft GGP) has been prepared. The draft Green Growth Plan proposes to secure upfront Commonwealth environmental approvals and streamline State environmental approvals for development required to support growth to 3.5 million people. The Plan also aims to provide protection of bushland, rivers, wildlife and wetlands through implementation of a strategic conservation plan (DPC 2016).

The site has been identified under the draft GGP as having areas identified within the:

- Urban class of action area; or
- Rural Residential class of action area; or
- Area not within the Urban, Industrial or Rural Residential classes of action (DCP 2016).

The site has also been identified as having areas mapped as Broad and Specific Commitments and Values under the draft GGP (DCP 2016).

The draft Broad Commitments and Values relate to seeking an overall conservation outcome where further work is needed to determine when intervention is required to reach an outcome. Draft Broad Commitments and Values include the following environmental aspects (DoP 2017):

- Threatened fauna habitat;
- Vegetation complexes of more than 10 % and less than 30 % remaining;
- Negotiated planning solution and rural complementary Bush Forever areas with three classes of action mapped;

- Resource Enhancement Wetlands with remnant vegetation and a 50 m buffer; and
- Conservation Category Wetlands 50 m buffer.

The draft Specific commitments relate to draft commitments for protecting a specific occurrence of an environmental value, including (DPC 2016):

- Threatened flora;
- Threatened Ecological Communities;
- Conservation Category Wetlands;
- Vegetation complexes with less than 10 % remaining;
- Bush Forever areas within three classes of action mapped (excluding those within the 'rural complementary' or 'negotiated planning solution' categories); and
- Short-tongued Bee *(Leioproctus douglasiellus*) distribution.

Some areas within the site have known existing approvals where the draft commitments do not apply (while such approvals remain valid). These approvals include Part IV or V Division 2 of the *Environmental Protection Act 1986* or under subdivision approval; or for matters of national environmental significance under Part 9 of the EPBC Act.

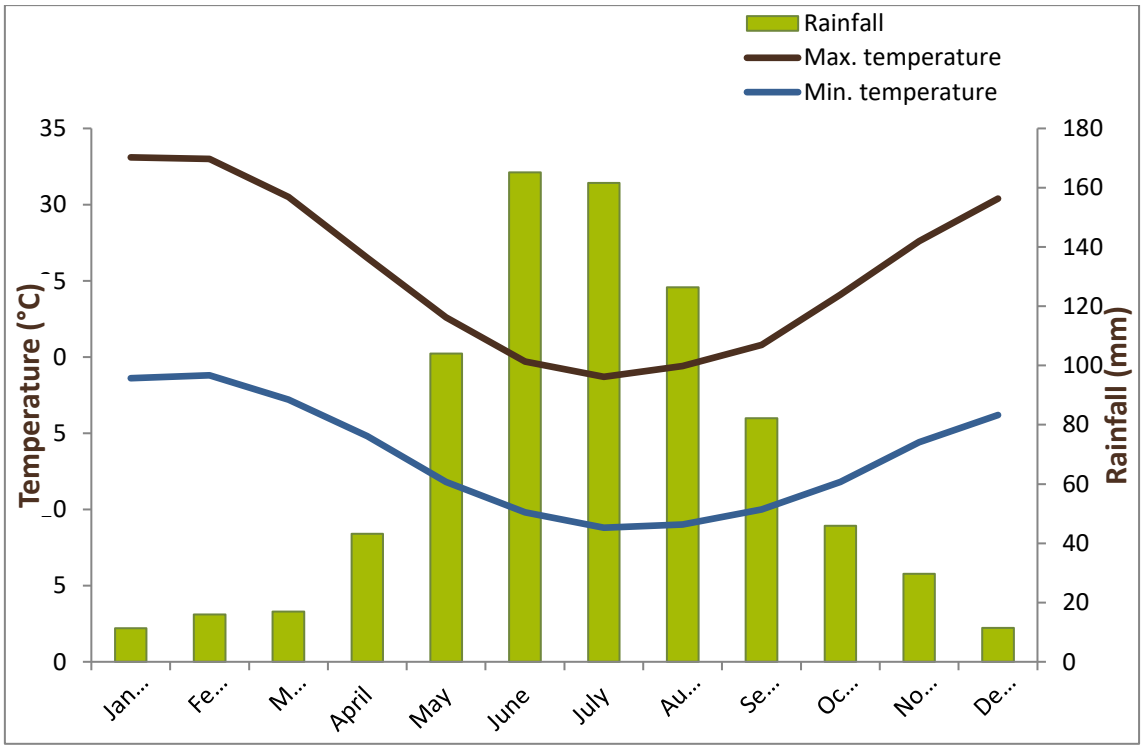
3.1.4 City of Kalamunda Local Biodiversity Strategy

The City of Kalamunda's Local Biodiversity Strategy has been developed in anticipation of future urban development encroaching into natural assets. The Strategy aims to strategically plan natural area protection to ensure biodiversity conservation is incorporated into decision making processes. The Strategy focusses on protection of natural areas containing endemic species or ecological communities that are described as having high biodiversity values (Local Natural Areas (LNAs)). LNAs are natural areas outside of management by the DBCA and Bush Forever Sites, where Local Government Authorities can exercise the most control. The site does not contain any LNAs (Shire of Kalamunda 2008).

4 Site Environmental Features

4.1 Climate

The Site is within a warm Mediterranean climate with warm summers and cool winters. Weather data was collected between 1961 and 2017 from the Gosnells City Station (#009106) located approximately 5.7 km southeast from the Site. The annual mean maximum temperature is 25.5 °C and the annual mean minimum temperature is 13.4 °C. The annual mean rainfall was recorded at 820.3 mm (BoM 2017) (Graph 1).



Graph 1: Climate Statistics for 1961 and 2017 Gosnells City Station (BoM 2017)

4.2 Topography

The elevation across the site ranges from 21 m Australian Height Datum (AHD) to 79 m AHD, falling from the east to the west (Figure 2) (DoW 2010).

4.3 Regional Geology and Soils

Surface geology profile mapping at 1: 250 000 indicates the geology of the Site is typically basal conglomerate overlain by dune quartz with heavy mineral concentrations associated with the Kwinana Group and the Yoganup Formation, and alluvial sand and clay with shallow-marine and estuarine lenses and local basal conglomerate associated with the Guildford formation (GSWA 2008):

Soil Landscapes and Land Systems mapping has identified the Site is within the following land systems (DAFWA 2012):

- **Pinjarra System:** Poorly drained coastal plain with variable alluvial and Aeolian sands; and
- **Forrestfield System:** Duplex sandy gravels, pale deep sands and grey deep sandy duplexes.

The (then) Department of Agriculture and Food (DAFWA) Soil Subsystems mapping indicates the Site is within the following soil subsystems (DAFWA 2008):

- Pinjarra Gf3 Phase: Level to very gently sloping plain. Poorly drained mottled yellow earths with loamy topsoil;
- Pinjarra Gf6 Phase: Seasonally inundated swamps with very poorly drained uniform non-cracking clays;
- Pinjarra Gf7 Phase: Minor rises with deep rapidly drained brownish, siliceous or bleached sands underlain by mottled yellow clay;
- Forrestfield (D Range) F1 Phase: Foot and low slopes (<10%) with deep rapidly drained siliceous yellow brown sands, and pale or bleached sands with yellow-brown subsoil;
- Forrestfield (D Range) F2 Phase: Well drained foot and low slopes. Gravelly yellow or brown duplex soils with sandy topsoil;
- Forrestfield F4 Phase: Incised stream channels within gentle slopes with deep acidic yellow duplex soils and sandy alluvial gradational brown earths; and
- Forrestfield (D Range) F8 Phase: Slopes 3-15%. Moderately well drained gravelly duplex soils with sandy loam to loam topsoil.

4.4 Hydrogeology

4.4.1 Groundwater

Data from the Perth Groundwater Map indicates the groundwater table ranges between 12 m Australian Height Datum (AHD) and 17 m AHD. Groundwater flows from east to west (DWER 2017a).

The Site is not within a Public Drinking Water Source Area (DWER 2017a).

4.4.2 Surface Water

Yule Brook, a major tributary, exists 55 m to the north of the site, separated by Welshpool Road East (Figure 4) (DoW 2012a).

An un-named minor non-perennial watercourse traverses the northern portion of the site connecting to Yule Brook in the northeast. In addition, another minor perennial

watercourse traverses along the boundary in the south-western corner of the site (DoW 2012a)

The site also contains three constructed earth dams and two perennial lakes. A constructed minor drain extends south of Crystal Brook Road to a constructed dam (Figure 4) (DoW 2012a).

The site is not within a mapped 100 Year ARI Floodplain Area (DoW 2015).

4.4.3 Wetlands

A wetland is defined in Schedule 5 of the *Environmental Protection Act 1986* as a 'an area of seasonally, intermittently or permanently waterlogged or inundated land, whether natural or otherwise, and includes a lake, swamp, marsh, spring, dampland, tidal flat or estuary' (Hill *et al.* 1996).

Desktop mapping has identified that small portions along the western boundary of the Site (along Tonkin Highway) are mapped as Conservation Category (CCW) and Resource Enhancement wetlands (Figure 4) (DPaW 2017).

Wetland categories and their management objectives are described within Table 3 below:

Table 3. Wetland Categories and Management Objectives (WAPC 2005)

CATEGORY	CATEGORY DESCRIPTION	MANAGEMENT OBJECTIVES
Conservation Category	High conservation and ecological value	To preserve the wetlands (natural) attributes and functions
Resource Enhancement	Moderate natural and human use attributes that can be restored or enhanced	To restore wetlands through maintenance and enhancement of wetland functions and attributes
Multiple Use	Little remaining important wetland attributes, functions and ecological value	To use, develop and manage wetlands in the context of water, town and environmental planning

4.5 Contamination

4.5.1 Acid Sulfate Soils

Desktop mapping has identified the entire Site as having 'Moderate to Low' risk of acid sulfate soils (ASS) risk within 3 m of natural soil surface and 'High to Moderate' risk beyond 3 m (DER 2014) (Figure 5).

4.5.2 Contaminated Sites

Under the *Contaminated Sites Act 2003*, contaminated sites must be reported to the DWER, investigated and, if necessary, remediated.

Review of DWER's Contaminated Sites Database has identified there are no registered contaminated sites within the Site, however, there are four contaminated sites within a 1 km radius (DWER 2017b) (Table 4) (Figure 5):

Table 4. Contaminated Sites Within the Vicinity of the Site (DWER 2017b)

Lot	Nature and Extent of Contamination	Status	Distance from site (km)
Lot 804 on Plan 59983, Kenwick	Fragments of asbestos containing material (ACM) are present within the soils at the Site	Contaminated – Restricted Us	0.41
Lot 9005 on Plan 40777, Maddington	Landfill gases have been identified along the eastern boundary and the southwest corner of the Site. Hydrocarbon-impacted groundwater was identified across the majority of the Site. Asbestos impacted fill was identified beneath the landfill capping layer across a majority of the Site.	Contaminated – Restricted Use	1.61
Lot 7, Former Caltex Service Station, Welshpool Rd, Wattle Grove.	Surface and subsurface soils are impacted with hydrocarbons. Groundwater beneath the Source and Affected Sites is impacted with hydrocarbons.	Contaminated – remediation required	0.90
Lot 566 Orchard Road, Maddington	Hydrocarbons (such as from petrel or diesel) are present in groundwater beneath the south-western portion of the Site.	Remediated for Restricted Use	1.40

4.6 Reserves and Conservation Areas

Desktop mapping has identified that the Site is not within any conservation areas. However, there are a number of conservation areas abutting the site and within a 2 km radius (Figure 6). Five Bush Forever sites (ID: 50, 51, 53, 320 and 387) exist within 2 km of the site to the north, south and west (DoP 2014).

Several lots outside of the site boundary have been identified as DBCA Managed Lands that are managed and vested under the Conservation and Land Management Act 1984 (CALM Act) (DPaW 2016) (Figure 6).

4.6.1 Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESAs) are identified and protected under the *Environmental Protection (Environmentally Sensitive Areas) Notice 2005*. Under the Notice, it is an offence to kill or destroy vegetation within an ESA without a Native Vegetation Clearing Permit (NVCP).

A number of Environmentally Sensitive Areas (ESAs) impinge the site (Figure 6) (DER 2014b). DWER's online Clearing Permit System has identified that the ESAs across the Site refer to the presence of the following; Declared Rare Flora (DRF) or a Threatened Ecological Community (DWER 2017c).

Cross referencing data obtained from DBCA's Threatened and Priority Flora database and the TEC/PEC database search, these ESA's refer to the location of the following two DRF and the area of vegetation within 50 m of the DRF location:

- Wavy Smoke-bush (*Conospermum undulatum*); and
- Summer Honeypot (*Banksia mimica*).

4.7 Flora and Vegetation

4.7.1 Bioregion

The Site is located within the Swan Coastal Plain and the Jarrah Forest bioregions of the Interim Biogeographic Regionalisation of Australia (IBRA).

The Swan Coastal Plain Perth subregion (SWA02) is a low lying coastal plain composed of colluvial and Aeolian sands, alluvial river flats and coastal limestone rising to duricrusted Mesozoic sediments in the east. Outwash plains are extensive only in the south, while a complex series of seasonal wetlands and swamps extends from north to south. Vegetation comprises heath and/or Tuart woodlands on limestone, Banksia and Jarrah- Banksia woodlands on Quaternary marine dunes of various ages, Marri on colluvial and alluvial soils, *Casuarina obesa* on out-wash plains, and paperbark (*Melaleuca spp*.) in wetland areas (Mitchell *et al.* 2002).

The Northern Jarrah Forest subregion (JF1) incorporates the area east of the Darling Scarp, overlying Archaean granite and metamorphic rocks of an average elevation of 300 m, capped by an extensive lateritic duricrust, dissected by later drainage and broken by occasional granite hills. In the east, the laterite becomes deeply dissected until it compresses isolated remnants. Rainfall is from 1300 mm on the scarp to approximately 700 mm in the east and north. Vegetation comprises Jarrah – Marri forest in the west with Bullich and Blackbutt in the valleys grading to Wandoo and Marri woodlands in the east with Powder bark on breakaways. There are extensive but localised sand sheets

with *Banksia* low woodlands. Heath is found on granite rocks and as a common understorey of forests and woodlands in the north and east. The majority of the diversity in the communities occurs on the lower slopes or near granite soils where there are rapid changes in site conditions (Williams *et al.* 2001).

4.7.2 Broad Vegetation Types

Vegetation mapping of the Swan Coastal Plain subregion of WA was completed on a broad scale (1:250,000) by Beard (1980). These vegetation units were re-assessed by Shepherd et al. (2001) to account for clearing in the intensive land use zone, dividing some larger vegetation units into smaller units.

The Site is within three vegetation units described below (Shepherd *et al. 2001*) (Figure 7):

- **Pinjarra 3:** Medium forest; Jarrah – Marri;
- **West Darling 4:** Medium woodland; Marri and Wandoo; and
- **Pinjarra 968:** Medium woodland; Jarrah, Marri and Wandoo.

Remnant vegetation statistics of the IBRA region and the above vegetation association is detailed in Table 5.

Table 5. Remnant Vegetation Statistics (Government of Western Australia 2016)

	Pre–European (ha)	Current Extent (ha)	% Remaining	% Remaining in DBCA reserves
IBRA Region Swan Coastal Plain	1,501,221.93	578,432.17	38.53	37.85
IBRA Region Jarrah Forest	4,506,660.26	2,416,018.14	53.61	69.17
State wide				
Beard Veg Assoc No. 3	2,661,405.06	1,806,812.23	67.89	81.22
Beard Veg Assoc No. 4	1,054,279.89	293,367.54	27.83	22.78
Beard Veg Assoc No. 968	296,877.84	95,642.43	32.22	57.30
In IBRA Sub-region SWA02				
Beard Veg Assoc No. 3	16,754.96	2,798.11	16.70	12.66
Beard Veg Assoc No. 4	13,107.83	1,903.81	14.52	13.36

	Pre–European (ha)	Current Extent (ha)	% Remaining	% Remaining in DBCA reserves
Beard Veg Assoc No. 968	136,188.20	8,967.05	6.58	21.83
In IBRA Sub-region JF01				
Beard Veg Assoc No. 3	908,099.69	723,075.06	79.63	83.87
Beard Veg Assoc No. 4	614,200.81	198,940.05	32.39	30.36
Beard Veg Assoc No. 968	72,007.43	53,204.08	73.89	60.30
Local Government Authority – City of Kalamunda				
Beard Veg Assoc No. 3	26,414.55	21,061.60	79.73	89.46
Beard Veg Assoc No. 4	2,882.29	2,046.48	71.00	58.89
Beard Veg Assoc No. 968	663.60	95.65	14.41	1.25

The biodiversity conservation goals are based on the national targets for biodiversity conservation as set out in *The National Objectives and Targets for Biodiversity Conservation 2001 – 2005*, which aim to:

- Prevent clearing of ecological communities with **less than 30%** of the original extent remaining;
- Recover ecological communities with **less than 10%** of the original extent remaining; and
- Protect threatened species and ecological communities.

The State Government acknowledges that 30% representation of the original extent of each vegetation type is regarded as the threshold level below which species loss appears to accelerate exponentially at an ecosystem level, and 10% representation of the original extent of each vegetation type is regarded as the level representing 'endangered' (WAPC 2011). Based on the figures provided above for representation across the State, all vegetation types, except **West Darling 4** are above the 30% target. Within the City of Kalamunda, all vegetation types except **Pinjarra 968** are above the 30% target. However, it is important to note that in comparison, there is a small proportion of **Pinjarra 968** within the City of Kalamunda's boundary.

Vegetation complexes of the Southwest botanical district have been mapped by Heddle *et al*. (1980). Four vegetation complexes exist across the site which relates to the underlying soil profile (Figure 7):

- **Guildford Complex:** Open forest to tall open forest and woodland;
- **Southern River Complex:** Open woodland;
- **Forrestfield Complex:** Open forest and fringing woodland; and
- **Darling Scarp Complex:** Low open woodland to lichens.

4.7.3 Declared, Rare and Priority Flora

Database searches were undertaken to identify the conservation significant flora species occurring or potentially occurring within a 5 km radius of the site. The searches included the DEE's Protected Matters Search Tool (PMST), DBCA's NatureMap database and DBCA's Threatened and Priority Flora database request (DEE 2017; DBCA 2017a; DBCA 2017b).

Review of the database searches identified 75 conservation significant flora species as potentially occurring within the site and a likelihood assessment of the species was undertaken (Table 6) (Figure 8).

Table 6. Likelihood Assessment of Conservation Significant Fauna Species Occurring Within the Site (DEE 2017; DBCA 2017a; b)

Taxon	Conservation Status		Likelihood of Occurrence in Site
	EPBC	DBCA	
Calectasia cyanea	Critically Endangered	Threatened	Possible
Grevillea thelemanniana subsp. thelemanniana	Critically Endangered	Threatened	Possible
Ptilotus pyramidatus	Critically Endangered	Threatened	Unknown
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	Critically Endangered	Threatened	Likely
Andersonia gracilis	Endangered	Threatened	Possible
Austrostipa bronwenae	Endangered	Threatened	Likely
Banksia mimica	Endangered	Threatened	Unknown
Caladenia huegelii	Endangered	Threatened	Unknown
Calytrix breviseta subsp. breviseta	Endangered	Threatened	Likely
Chamelaucium sp. Gingin	Endangered	Threatened	Possible
Darwinia apiculata	Endangered	Threatened	Possible
Diuris drummondii	Endangered	Threatened	Unknown
Diuris purdiei	Endangered	Threatened	Unknown
Drakaea elastica	Endangered	Threatened	Likely
Eremophila glabra subsp. chlorella	Endangered	Threatened	Likely
Eucaluptus x balanites	Endangered	Threatened	Likely
Grevilea curviloba subsp. incurva	Endangered	Threatened	Likely
Lasiopetalum pterocarpum	Endangered	Threatened	Possible

Taxon	Conservation Status		Likelihood of occurrence in site
	EPBC	DBCA	
Lepidosperma rostratum	Endangered	Threatened	Likely
Macarthuria keigheryi	Endangered	Threatened	Possible
Thelymitra stellata	Endangered	Threatened	Likely
Acacia anomala	Vulnerable	Threatened	Possible
Acacia aphylla	Vulnerable	Threatened	Possible
Conospermum undulatum	Vulnerable	Threatened	Likely
Diuris micrantha	Vulnerable	Threatened	Possible
Drakaea micrantha	Vulnerable	Threatened	Unknown
Eleocharis keigheryi	Vulnerable	Threatened	Possible
Amanita quenda	-	Priority 1	Possible
Calandrinia sp. Piawaning	-	Priority 1	Likely
Schoenus sp. Beaufort (G.J. Keighery 6291)	-	Priority 1	Possible
Thelymitra magnifica	-	Priority 1	Likely
Comesperma griffinii	-	Priority 2	Likely
Comesperma rhadinocarpum	-	Priority 2	Unknown
Isotropis cuneifolia subsp. glabra	-	Priority 2	Possible
Lepyrodia curvescens	-	Priority 2	Possible
Melaleuca viminalis	-	Priority 2	Possible
Schoenus loliaceus	-	Priority 2	Possible
Acacia horridula	-	Priority 3	Likely
Amanita wadjukiorum	-	Priority 3	Likely
Babingtonia urbana	-	Priority 3	Unlikely
Banksia pteridifolia subsp. vernalis	-	Priority 3	Unlikely
Byblis gigantea	-	Priority 3	Unlikely
Chamaescilla gibsonii	-	Priority 3	Possible
Eryngium pinnatifidum subsp. Palustre (G.J. Keighery 13459)	-	Priority 3	Likely
Eryngium sp. Subdecumbens (G.J. Keighery 5390)	-	Priority 3	Likely
Haemodorum loratum	-	Priority 3	Likely
Isopogon drummondii	-	Priority 3	Possible
Lasiopetalum glutinosum subsp. glutinosum	-	Priority 3	Likely
Meionectes tenuifolia	-	Priority 3	Possible
Myriophyllum echinatum	-	Priority 3	Possible
Pithocarpa corymbulosa	-	Priority 3	Possible
Platysace ramosissima	-	Priority 3	Possible

Taxon	Conservation Status		Likelihood of occurrence in site
	EPBC	DBCA	
Schoenus benthamii	-	Priority 3	Possible
Schoenus capillifolius	-	Priority 3	Possible
Schoenus pennisetis	-	Priority 3	Possible
Stylidium aceratum	-	Priority 3	Possible
Stylidium periscelianthum	-	Priority 3	Possible
Styphelia filifolia	-	Priority 3	Unknown
Thysanotus anceps	-	Priority 3	Possible
Acacia oncinophylla subsp. patulifolia	-	Priority 4	Likely
Aponogeton hexatepalus	-	Priority 4	Likely
Boronia tenuis	-	Priority 4	Unlikely
Centrolepis caespitosa	-	Priority 4	Unknown
Cyanicula ixioides subsp. ixioides	-	Priority 4	Unknown
Drosera occidentalis subsp. occidentalis	-	Priority 4	Unknown
Hibbertia montana	-	Priority 4	Possible
Hydrocotyle lemnoides	-	Priority 4	Likely
Lasiopetalum bracteatum	-	Priority 4	Likely
Ornduffia submersa	-	Priority 4	Unknown
Pimelea rara	-	Priority 4	Possible
Schoenus natans	-	Priority 4	Possible
Senecio leucoglossus	-	Priority 4	Possible
Stylidium longitubum	-	Priority 4	Possible
Stylidium striatum	-	Priority 4	Possible
Verticordia lindleyi subsp. lindleyi	-	Priority 4	Likely

24 flora species were considered Likely to occur due to the presence of suitable habitat and close proximity to previous records. 35 species were considered Possible and four considered Unlikely to occur within the site. 12 species had an unknown likelihood of occurrence due to the lack of available data.

Several occurrences of the following five DRF species have been identified as occurring within or close to the boundary of the site based on the DBCA Threatened Priority Flora database search (DBCA 2017a) (Figure 8):

- *Conospermum undulatum;*
- *Isopogon drummondii;*
- *Banksia mimica;*
- *Lasiopetalum glutinosum subsp. glutinosum;* and

- *Thelymitra magnifica*.

Given the above, site specific flora and vegetation surveys will be required to confirm the presence of DRF within the site.

4.7.4 Threatened and Priority Ecological Communities

Desktop searches of the DBCA's Threatened and Priority Ecological Communities dataset identified several TECs or TEC buffers occurring within and surrounding the site. The dataset provided by the DBCA has generic buffers of 200 m or 500 m surrounding the TECs or PECs (DBCA 2017c) (Figure 9):

- Banksia Dominated Woodlands of the Swan Coastal Plain;
- SCP20a - *Banksia attenuata* woodlands over species rich dense shrublands;
- SCP3a -*Eucalypt calophylla – Kingia australis* woodlands on heavy soils, Swan Coastal Plain;
- SCP3b - *Eucalyptus calophylla – eucalyptus marginata* woodlands on sandy clay soils of the southern Swan Coastal Plain;
- Shrublands and woodlands on Muchea Limestone;
- Herb rich shrublands in clay pans;
- SCP10a - Shrublands on dry clay flats; and
- Central Granite Shrublands Community.

Given the above, site specific flora and vegetation surveys will be required to identify the presence of TECs or PECs within the site.

4.7.5 Weeds

A desktop search of the EPBC PMST has identified a total of 19 introduced species that may occur within a 5 km radius of the Site (Table 7) (DEE 2017).

Of these 19 weed species, nine are Declared under the *Biosecurity and Agriculture Management Act 2007* (BAM Act) and 15 are listed as Weeds of National Significance (WONS).

Table 7. Introduced Flora Recorded in the Survey Area.

TAXON	(COMMON NAME)	DECLARED BAM ACT	WONS
**Anredera cordifolia*	Madeira Vine	-	Yes
**Asparagus asparagoides*	Bridal Creeper	s22(2) C3	Yes
**Brachiaria mutica*	Para Grass	-	-
**Cenchrus ciliaris*	Buffel-grass	-	-
**Chrysanthemoides monilifera*	Bitou Bush	s12 C2	Yes

TAXON	(COMMON NAME)	DECLARED BAM ACT	WONS
**Chrysanthemoides monilifera subsp. monilifera*	Boneseed	s12 C2	Yes
**Eichhornia crassipes*	Water Hyacinth	s12 C2	Yes
**Genista linifolia*	Flax-leaved Broom	-	Yes
**Genista monspessulana*	Cape Broom	-	Yes
**Genista sp. X Genista monspessulana*	Broom	-	Yes
**Lantana camara*	White Sage	s22(2) C3	Yes
**Lycium ferocissimum*	African Boxthorn	-	Yes
**Olea europaea*	Olive	-	-
**Pinus radiata*	Pine	-	-
**Rubus fruticosus aggregate*	Blackberry	-	Yes
**Sagittaria platyphylla*	Slender Arrowhead	s22(2) C3	Yes
**Salix spp. except S. babylonica, S.x calodendron & S. x reichardtii*	Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow	s12 C1	Yes
**Salvinia molesta*	Giant Salvinia	s12 C1	Yes
**Tamarix aphylla*	Athel Pine	s22(2) C3	Yes

*The (then) Department of Agriculture and Food WA (DAFWA) maintains a list of Declared Plants for Western Australia under the Biosecurity and Agriculture Management Act 2007 (BAM Act). If a plant is declared for the whole of the State or for particular Local Government Areas, all landholders are obliged to comply with the relevant species-specific control measures.

*The DAFWA maintains a list of Declared Plants for Western Australia under the BAM Act. If a plant is declared for the whole of the State or for particular Local Government Areas, all landholders are obliged to comply with the relevant species-specific control measures.

[1]Declared Pest - s22(2)

Declared pests must satisfy any applicable import requirements when imported, and may be subject to an import permit if they are potential carriers of high-risk organisms. They may also be subject to control and keeping requirements once within Western Australia.

Under the BAM Act, all declared pests are placed in one of three categories, namely C1 (exclusion), C2 (eradication) or C3 (management).

C1 category (Exclusion) - Pests will be assigned to this category if they are not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.

C2 category (Eradication) – Pests will be assigned to this category if they are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.

C3 category (Management) – Pests will be assigned to this category if they are established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest (DAFWA 2017).

4.8 Fauna

4.8.1 Threatened and Priority Fauna

Conservation significant fauna potentially occurring within a 5 km radius of the Site were determined through desktop searches using DEE's PMST, DBCA's NatureMap search tool and DBCA's Threatened and Priority Fauna databases.

A number of species returned in the databases were historical records of locally extinct species (e.g. Malleefowl) and these have been omitted from further discussion.

A likelihood assessment was undertaken to determine the likelihood of these species occurring within the Site based on suitable habitat present and the species known distribution based on the following criteria:

The Likelihood of each species is based on the following criteria:

- Recorded: Recorded during the field survey or site reconnaissance;
- Likely: Suitable habitat is present in the Survey Area and the Survey Area is in the species' known distribution;
- Possible: Limited or no suitable habitat is present in Survey Area, but is nearby. The species has good dispersal abilities and is known from the general area; and
- Unlikely: No suitable habitat is present in Survey Area but is nearby, the species has poor dispersal abilities, but is known from the general area; or suitable habitat is present, however, the Survey Area is outside of the species' known distribution.

Table 8. Likelihood Assessment of Conservation Significant Fauna Occurring Within the Site (DEE 2017) (DBCA 2017a;d)

Species	Conservation Status		Likelihood of Occurrence
	DBCA	EPBC	
Australasian Bittern (*Botaurus poiciloptilus*)	Threatened	Endangered	Unlikely
Brush-tailed Bettong (*Bettongia penicillata ogilbyi*)	Threatened	Critically Endangered	Unlikely
Eastern Curlew (*Numenius madagascariensis*)	Threatened	Critically Endangered	Unlikely
Curlew Sandpiper (*Calidris ferruginea*)	Threatened	Critically Endangered	Unlikely
Australian Painted Snipe (*Rostratula australis*)	Threatened	Endangered	Possible
Western Ringtail Possum (*Pseudocheirus occidentalis*)	Threatened	Vulnerable	Unlikely
Quokka (*Setonix brachyurus*)	Threatened	Vulnerable	Unlikely

Species	Conservation Status		Likelihood of Occurrence
	DBCA	EPBC	
Baudin's Cockatoo (*Calyptorhynchus baudinii*)	Threatened	Vulnerable	Possible
Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*)	Threatened	Vulnerable	Likely
Carnaby's Cockatoo (*Calyptorhynchus latirostris*)	Threatened	Endangered	Likely
Chuditch (*Dasyurus geoffroii*)	Threatened	Vulnerable	Unlikely
Short-tongued Bee (*Leioproctus douglasiellus*)	Threatened	Critically Endangered	Unlikely
Western Swamp Tortoise (*Pseudemydura umbrina*)	Threatened	Critically Endangered	Unlikely
South Western Phascogale (*Phascogale tapoatafa wambenger*)	Conservation Dependent Fauna	-	Unknown
Great Egret (*Ardea modesta*)	International Agreement	Marine	Possible
Rainbow Bee-eater (*Merops ornatus*)	International Agreement	Marine	Possible
Wood Sandpiper (*Tringa glareola*)	International Agreement	Marine/Migratory	Possible
Common Sandpiper (*Tringa hypoleucos*)	International Agreement	Marine/Migratory	Possible
Common Greenshank (*Tringa nebularia*)	International Agreement	Marine/Migratory	Possible
Marsh Sandpiper (*Tringa stagnatilis*)	International Agreement	Marine/Migratory	Possible
Peregrine Falcon (*Falco peregrinus*)	Other Specially Protected Fauna	-	Unlikely
Western Swamp Tortoise (*Pseudemydura umbrina*)	Threatened	-	Unlikely
Scorpionfly (*Austromerope poultoni*)	Priority 2	-	Unknown
A short-tongued bee (*Leioproctus bilobatus*)	Priority 2	-	Unknown
Southern Death Adder (*Acanthophis antarcticus*)	Priority 3	-	Unlikely
Black Striped Snake (*Neelaps colonotos*)	Priority 3	-	Possible
Water-rat (*Hydromys chrysogaster*)	Priority 4	-	Possible
Southern Brown Bandicoot (*Isoodon obesulus fusciventer*)	Priority 4	-	Likely
Western Brush Wallaby (*Macropus irma)*	Priority 4	-	Possible
Blue billed Duck	Priority 4	-	Unlikely

Species	Conservation Status		Likelihood of Occurrence
	DBCA	EPBC	
(*Oxyura australis*)			

Due to the site being mostly cleared of native vegetation and used for rural purposes, it is not likely that the site would offer large areas of valuable intact habitat. The surrounding environment is also representative of clearing and rural land uses containing limited vegetation to the north, west and south of the site. Large areas of intact vegetation area located to the east of the site and therefore, may provide better fauna habitat than the site itself.

Some fauna species may utilise the minor watercourse that traverses the site which appears to have intact vegetation along the foreshore area and within remaining patches. However, fauna are more likely to utilise surrounding larger areas of intact vegetation to the east.

4.9 Heritage

4.9.1 Aboriginal Heritage

In Western Australia, the *Aboriginal Heritage Act 1972* protects places and objects customarily used by or traditional to the original habitants of Australia or their descendants. A register of such places and objects are maintained under the Act, however, all sites are protected under the Act whether they are registered or not (DPLH 2017).

A desktop search has identified two Registered Aboriginal Heritage Sites and one Lodged Aboriginal Heritage Site intersecting the Site and three Registered sites located within 1 km of the site (Table 9; Figure 10) (DPLH 2017).

Table 9. Aboriginal Heritage Sites Within or in the Vicinity of the Site (DPLH 2017)

Number	Site Name	Type	Status	Distance from site (m)
4343	Brentwood Road Swamp	Artefacts / Scatter	Registered	0
4342	Brentwood Road Quarry	Artefacts / Scatter, Quarry	Registered	0
4341	Brentwood Road NW	Artefacts / Scatter	Lodged	0
3264	White Road, Orange Grove	Artefacts/Scatter, Skeletal Material/Burial	Registered	679

Number	Site Name	Type	Status	Distance from site (m)
3631	Yule Brook A & B	Artefacts/Scatter	Registered	420
3773	Welshpool Reserve	Camp	Registered	275

4.9.2 European Heritage

A desktop search of the State Heritage Office has identified there are no State Heritage Sites within the Site or within a 2 km radius of the Site (SHO 2017). No World Heritage or National Heritage places are located within a 5 km radius of the Site (DEE 2017).

The Site does contain one Shire of Kalamunda Municipal Heritage place, Mrs Wright's Home (former) located at 150 Crystal Brook Road, Wattle Grove. This site is not registered under State Legislation. However, it is graded as Category 4 which states 'Photographically record prior to major development or demolition. Recognise and interpret the site if possible' (SHO 2017) (Figure 10).

The Site contains one heritage site listed as 'Other Heritage Sites', White's home & store located at 80 Crystal Brook Road, Wattle Grove. The site is currently a single storey residence and there are no other details regarding this Site with the State Heritage Office (SHO 2017) (Figure 10).

4.10 Site History

4.10.1 Historical Aerial Imagery

Review of historical aerial imagery was undertaken to identify and assess land use and development changes within the area over time. The earliest available aerial of the site was taken in 1953 and more recent aerial images (from approximately 10 year intervals up to present) were viewed (Figures 11a-h).

The review of historical aerial imagery has identified substantial clearing of majority of vegetation within the site and surrounding areas occurred prior to 1953 and subdivided for rural land uses including market gardens, agricultural/animal grazing and pastures. Portions in the south-west of the site were identified as wet during this time. Some patches of remnant vegetation remained until prior to 1974. It appears potential sand extraction activities were undertaken in the northern and south-eastern portions of the site and adjacent areas which expanded between 1953 and 1974.

Further clearing of remnant native vegetation occurred by 1974 and some rural residential dwellings were constructed. It appears some vegetation regrowth or planting has occurred prior to 1974. Development and rural land uses replaced the sand extraction areas by 1985. During this time, further rural residential development occurred

within the site and surrounding areas. Majority of the clearing within the site occurred by 1995 and some regeneration and plantation occurred between 1995 and 2010.

Urban residential developments began between 2010 and 2017 to the north, north-west and north-east of the site boundary.

4.10.2 WIN Groundwater Bore Database Search

A search of the (then) Department of Water (DoW)'s WIN Groundwater bore database has identified 51 bores within the site boundary (Figure 12) (DoW 2017). These operational statuses and current owners of these bores are unknown. Information on each WIN bore's ID, purpose, status, drill depth, drill date and owner are provided in Appendix C.

4.11 Surrounding Land Uses

The Lesmurdie Reserve exists to the east of the site. Pockets of residential developments exist to the north, west, south-west and east of the site beyond the rural areas. The Hartfield Country Club Golf Course is located 236 m to the north. An industrial and commercial precinct is located to the south-west of the site in Kenwick.

4.12 Industrial Separation Distances

Under the EPA's *Guidance Statement No. 3: Separation Distances between Industrial and Sensitive Land Uses,* all new industries, infrastructure and estates in the vicinity of proposed/existing sensitive land uses, and vice versa, require a suitable separation distance. Sensitive land uses are defined by the EPA as; residential developments, hospitals, hotels, motels, hostels, caravan parks, schools, nursing homes, child care facilities, institutions, shopping centres (EPA 2005). This Guidance Statement outlines the generic buffer distances between sensitive and industrial land uses in the absence of site-specific technical investigations (EPA 2005).

4.12.1 Kennels

Three kennels exist to the west of the site (Figure 13). The EPA's Guidance Statement No. 3 provides a generic buffer distance of 500 m from sensitive land uses within rural zones and a 1000 m buffer in or nearby urban areas in the absence of site specific investigations (EPA 2005). Kennels have associated odour and noise impacts. It is to be noted that separation distances are not required to other industrial land uses under GS3.

Proposed zoning of the site to Urban will require a generic 1000 m buffer distance between the existing kennels and future residential and sensitive land use developments. A buffer of 1000 m from all three kennels will impinge the western portion of the site (Figure 13). Site specific noise and odour modelling would be required to determine a more appropriate buffer distance in negotiation with the City of Kalamunda.

Lots 24, 25, 26 and 36 Welshpool Road East, Wattle Grove have been identified as having an additional use under the LPS 3 for dog kennels. Despite provision within the Scheme, it does not appear the lots are currently used for dog kennels. Current uses of these lots include a garden centre and veterinary hospital.

4.12.2 Poultry Farms

One poultry farm exists within the southern portion of the site (Poultry Farm 1) and two poultry farm exists to the south and west of the site (Poultry Farm 2 and 3 respectively) (Figure 13). Under GS3, the generic buffer distance for Poultry Farms ranges from 300 m – 1000 m (EPA 2005). Under the City of Kalamunda's LSP, a 300 m buffer is mapped from Poultry Farm 1 and 3. Under the City of Gosnell's Town Planning Scheme No. 6 (TSP 6) a buffer of 500 m has been applied to Poultry Farm 2 (Figure 13). Buffers of Poultry Farm 1 and 2 impact the developable potential of the site for sensitive land uses, however, industrial development are unaffected by poultry farm buffers.

4.12.3 Turf Farms

One turf farm is located within the south-western portion of the site (Figure 13). Under GS3, a generic buffer distance of 500 m from turf farm is applicable from sensitive land uses or developments. This buffer distance only impinges the site south of Crystal Brook Road (Figure 13). Industrial development to the south of Crystal Brook Road is unlikely to be affected by the turf farm buffer.

5 Potential Site Environmental Constraints

The potential key environmental issues associated with the existing development include:

- Wetlands and wetland buffers;
- Watercourse and Foreshore Areas;
- Declared Rare Flora;
- Threatened Ecological Communities;
- Water Management; and
- Industrial separation buffers.

5.1 Wetlands and Wetland Buffers

Under the Western Australian Planning Commission's *Guideline for the Determination of Wetland Buffer Requirements* (2005), the consideration of wetlands is required during a change in land use or a proposed development in the immediate vicinity of a wetland where the future land use is likely to conflict with the established wetland management objectives. Under the guidelines, an appropriate buffer distance should be identified to achieve an acceptable planning outcome. Buffer distances determined based on the wetland's category and no development is permitted within buffers (WAPC 2005).

As the site contains and is within the vicinity of wetlands, there is the potential for their associated buffers to impinge on the south-western portion of the site and decrease the developable potential of the site. A minimum buffer distance of 50 m from a CCW and a 30 – 50 m buffer from REWs is generally applicable. Figure 14 identifies the worst case scenario of the area of land onsite that may be impinged by wetland buffers of 50 m. This would equate to approximately 8.44 ha of land within the site to be sterilised from future development.

However, the REW's located within the site appear to have been historically cleared of most vegetation. Reclassification of the REWs to MUWs may be possible and this would remove this wetland area as a constraint to future development (approximately 8.44 ha). Development within MUWs is generally permissible as they have little remaining ecological wetland attributes and function, provided adequate depth to groundwater is established as part of future development.

A CCW located south of the Tonkin Highway and Welshpool Road East intersection, at worst case, would have a minimum 50 m buffer applicable (see Figure 14). However, as the area within the site and within a potential 50 m buffer has already been cleared, developed and is separated by a road reserve, it is considered unlikely that a buffer would be required.

5.1.1 Further Investigations and Management Requirements

The vegetation of the mapped wetlands within the site and the applicable buffers is representative of previous land uses and historical clearing. It is likely that these areas would include patches of non-endemic species and plantings. Ground surveys would be required to assess the vegetation within the site to determine the impacts of mapped wetlands and associated buffers to future urban development.

A Wetland and Wetland Buffer Management Plan (WWBMP) will be required for the lots located within or adjacent to wetlands at the local structure planning or subdivision stage.

5.2 Watercourse and Foreshore Areas

The minor non-perennial stream watercourse that traverses the northern portion of the site is likely to require a defined foreshore area due to the vegetation along the watercourse in accordance with DoW's Operational Policy 4.3: *Identifying and establishing waterways foreshore areas* (2012). Development within the foreshore area of a watercourse is generally not permitted and therefore has the potential to reduce the developable potential of the site.

There are no standard foreshore widths and should be determined in discussion with DWER and other relevant agencies. Generally, the foreshore area can be defined as the furthest extent of riparian vegetation and other associated riverine landforms and functions. Figure 14 identifies a potential foreshore area; however, groundtruthing is required through survey work to identify watercourses, and determine foreshore areas and watercourse buffer zones. Watercourses, foreshore areas and watercourse buffer zones require protection through the creation of easements for drainage and water management purposes, specify approved and un-approved land uses and activities within the zones and providing Watercourse and Foreshore Management Plans detailing these.

5.2.1 Further Investigations and Management Requirements

As part of future structure planning, identification of watercourses and foreshore area, will be undertaken as part of a biophysical assessment. The biophysical assessment will be undertaken in accordance with the (then) Department of Water's (DoW's) *Operational Policy 4.3: Identifying and establishing waterways foreshore areas* (2012) and the (then) Water and Rivers Commission policy *Determining Foreshore Reserves* (2001).

To ensure these watercourses and their associated foreshore area and buffer zone is appropriately protected and managed, the following will be required as part of future development:

- The creation of easements for the purpose of drainage and water management;
- Specifying approved or unapproved activities within the buffer zone; and

- Preparation of a Watercourse and Foreshore Management Plan at the local structure planning or subdivision stage.

5.3 Declared Rare Flora

Several occurrences of the Wavy Smoke Bush (*Conospermum undulatum*) and the Summer Honeypot (*Banksia mimica*) have been identified as occurring within the site based on DBCA database searches. These species and the vegetation within 50 m of the DRF are protected under the EPBC Act.

The occurrences of both these DRFs throughout the site are considered a potential constraint to development as the DRF and vegetation within 50 m of the flora are protected under the EPBC Act (Figure 14).

5.3.1 Further Investigations and Management Requirements

It is likely a Flora and Vegetation survey would be required to confirm the presence and locations of these DRF species to inform future rezoning and structure planning. In addition, an EPBC referral would likely be required at structure planning stage to address potential impacts associated with urban development near DRFs.

A Flora and Vegetation Management Plan may be required at the subdivision stage.

5.4 Threatened Ecological Communities

Portions within the site have been mapped by DBCA as the Banksia Woodlands of the Swan Coastal Plain TEC, *Eucalyptus calophylla-Kingia australis* woodlands and Shrublands and Woodlands on Muchea Limestone listed as Endangered under the EPBC Act (Figure 9). However, the DBCA's mapping is based on the Commonwealth's 'likely to occur' areas and represents broad scale vegetation units that are most likely to contain the ecological communities.

5.4.1 Further Investigations and Management Requirements

Site specific flora and vegetation surveys will be required to identify the presence of TECs or PEC, which will inform the structure planning stage. Depending on the potential impacts, the presence of TECs within the site may require the project to be referred to the DEE under the EPBC Act for an assessment of potential impacts associated with urban development within or nearby TECs.

A Flora and Vegetation Management Plan may be required at the subdivision stage for the protection of identified TECs or PECs.

5.5 Water Management

The Site has a few tributaries which traverse the site and there are small portions of CCW and REW along the western boundary of the site. It should be noted that development proposals within 200 m of the boundary of a CCW or REW should be

referred to DBCA for advice where the quality or volume of water flowing into the wetland may be affected by a development.

5.5.1 Further Investigations and Management Requirements

A District Water Management Strategy (DWMS) will be required to support any future MRS Amendment. The purpose this document will be to provide a coordinating framework that guides the key requirements for water sensitive urban design. It will also demonstrate that Site can support urban and/or industrial development and best practice urban water management.

A groundwater monitoring program will also be required prior to the development of a Local Water Management Strategy at the local structure planning stage.

5.6 Industrial Separation Buffers

The presence of prescribed premises, including poultry farms, kennels and a turf farm, within and adjacent to the site has the potential to impact on the type of future land uses within the site (should these premises remain in operation).

The three surrounding kennels, poultry farms and turf farm buffers impinge on the site. However, the buffers are only applicable for sensitive land uses. Majority of the land use buffers impinge across the southern half of the site (south of Crystal Brook Road) which would identify this portion to be potentially used for future industrial development (Figure 13).

5.6.1 Further Investigations and Management Requirements

The portion of the site to the north of Crystal Brook Road is impinged by fewer buffers and may have a better potential for residential development (Figure 13). However, site specific odour and noise modelling would need to be undertaken to identify opportunities with reduced buffers from surrounding land uses. In addition, management and mitigation measures may be required to support urban residential development in this area.

6 Summary

6.1 Outcome and Key Findings of Assessment

The site is currently used for rural land uses and has been historically cleared of majority of native vegetation. A desktop review of the environmental aspects of the site has determined the following are relevant:

- **Wetlands and Wetland Buffers:** As the site is mapped as containing and within the vicinity of geomorphic wetlands, there is the potential for their associated buffers to impinge on the south-western portion of the site. A buffer distance of 30 – 50 m is generally imposed on REWs and a minimum 50 m buffer is generally imposed on CCWs. However, as the vegetation within the mapped wetlands and the corresponding buffers does not appear to be intact and has been subject to clearing, it is likely that smaller buffer distances from the wetlands could be negotiated. Alternatively, there is a potential opportunity to reclassify the wetlands within and surrounding the site to increase the developable potential of the site. Site specific surveys would be required to assess the vegetation remaining and the condition of the wetlands. A Wetland and Wetland Buffer Management Plan may be required at subdivision.
- **Watercourse and Foreshore Area:** The minor non-perennial watercourse that traverses through the northern portion of the site would likely require a biophysical assessment to identify the extent of the foreshore area. The extent of the foreshore area would impact on the developable potential of the surrounding area. A Watercourse and Foreshore Management Plan may be required at the structure planning or subdivision stage. Additionally, the creation of easements for the foreshore and buffer area for the purpose of drainage and water management, as well as specifying the approved and unapproved activities within the buffer zone will provide further protection and management.
- **Declared Rare Flora:** There are several historical occurrences of DRF within the site. The species and the vegetation within 50 m of the occurrence are protected under Federal legislation. Flora and vegetation surveys would be required to confirm the presence or absence of these DRF species which would provide a better indication of the land available for development. A Flora and Vegetation Management Plan may be required at the subdivision stage.
- **Threatened Ecological Communities:** The site is mapped as having several TECs and associated buffers across the site. These mapped TECs are based on the DEE's likelihood of TEC occurrences and are not based on actual recorded data. These TECs appear to correspond with patches of possible remnant vegetation which is likely to be associated with the Banksia Woodlands TEC, *Eucalyptus*

calophylla-Kingia australis woodlands and Shrublands TEC and Woodlands on Muchea Limestone TEC. Flora and vegetation surveys of these patches of vegetation would be required to determine the presence or absence of these TECs. Should these TECs be identified as occurring within the site, clearing or potential impacts to the TECs will require approval from the DEE and the DWER. A Flora and Vegetation Management Plan may be required at the subdivision stage.

- **Water Management:** There are several tributaries which traverse the site, as well as wetland located along the western boundary of the site. A DWMS will be required as part of any future rezoning under the MRS, as well as groundwater monitoring to inform the LWMS at the local structure planning stage.
- **Land Use Buffers:** The site is constrained by generic or imposed buffers on prescribed premises (Poultry farms, turf farm and kennels). The opportunities for land development within the site is recommended to be split into two land uses, the area to the south of Crystal Brook Road would be more suitable for continued rural uses or industrial development. While the area to the north of Crystal Brook Road has the potential to be developed to urban residential - should the generic buffers be reduced. Site specific studies and modelling would be required to determine appropriate buffers from the surrounding.

7 Limitations

This report is produced strictly in accordance with the scope of services set out in the contract or otherwise agreed in accordance with the contract. 360 Environmental makes no representations or warranties in relation to the nature and quality of soil and water other than the visual observation and analytical data in this report.

In the preparation of this report, 360 Environmental has relied upon documents, information, data and analyses ("client's information") provided by the client and other individuals and entities. In most cases where client's information has been relied upon, such reliance has been indicated in this report. Unless expressly set out in this report, 360 Environmental has not verified that the client's information is accurate, exhaustive or current and the validity and accuracy of any aspect of the report including, or based upon, any part of the client's information is contingent upon the accuracy, exhaustiveness and currency of the client's information. 360 Environmental shall not be liable to the client or any other person in connection with any invalid or inaccurate aspect of this report where that invalidity or inaccuracy arose because the client's information was not accurate, exhaustive and current or arose because of any information or condition that was concealed, withheld, misrepresented, or otherwise not fully disclosed or available to 360 Environmental.

Aspects of this report, including the opinions, conclusions and recommendations it contains, are based on the results of the investigation, sampling and testing set out in the contract and otherwise in accordance with normal practices and standards. The investigation, sampling and testing are designed to produce results that represent a reasonable interpretation of the general conditions of the site that is the subject of this report. However, due to the characteristics of the site, including natural variations in site conditions, the results of the investigation, sampling and testing may not accurately represent the actual state of the whole site at all points.

It is important to recognise that site conditions, including the extent and concentration of contaminants, can change with time. This is particularly relevant if this report, including the data, opinions, conclusions and recommendations it contains, are to be used a considerable time after it was prepared. In these circumstances, further investigation of the site may be necessary.

Subject to the terms of the contract between the Client and 360 Environmental Pty Ltd, copying, reproducing, disclosing or disseminating parts of this report is prohibited (except to the extent required by law) unless the report is produced in its entirety including this page, without the prior written consent of 360 Environmental Pty Ltd.

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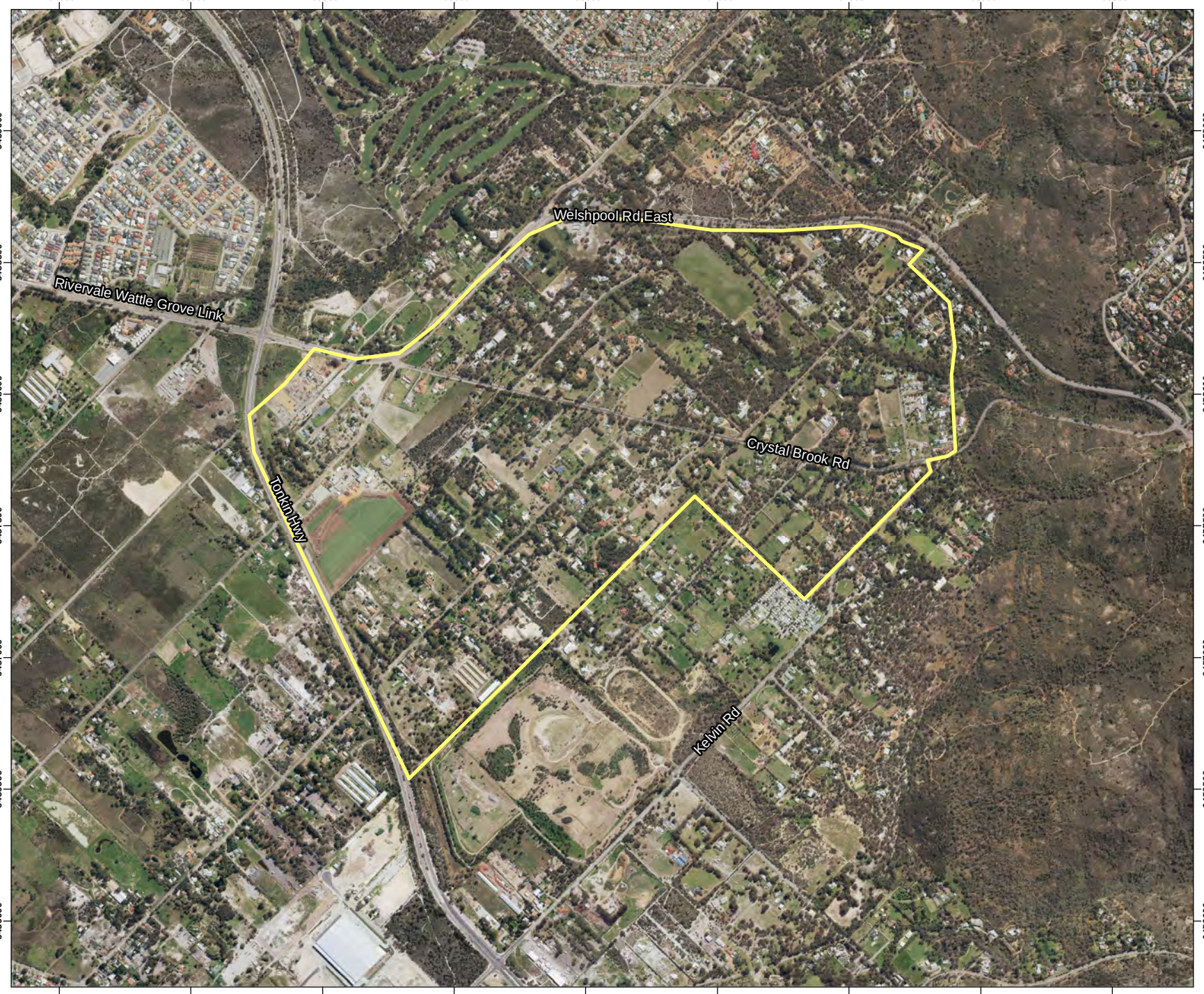
FIGURES



Legend

Site Location (325 ha)

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2118	6/03/2018

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GDA 1994 MGA Zone 50

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SL	CM	KC	1

Burgess Design Group
Various Lots, Wattle Grove

Environmental Assessment Report

Figure 1
Site Location

K:\Projects\9.0 APP\2118 Wattle Grove MRS Amend EAR\Figures\2118 F1 Site Location.mxd

Legend

- Site Location
- Topographical Contours 1m

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- ELEVATION SOURCED DOW 2012
- LOCALITY MAP SOURCED LANDGATE 2017
- AERIAL PHOTOGRAPHY SOURCED LANDGATE 2017
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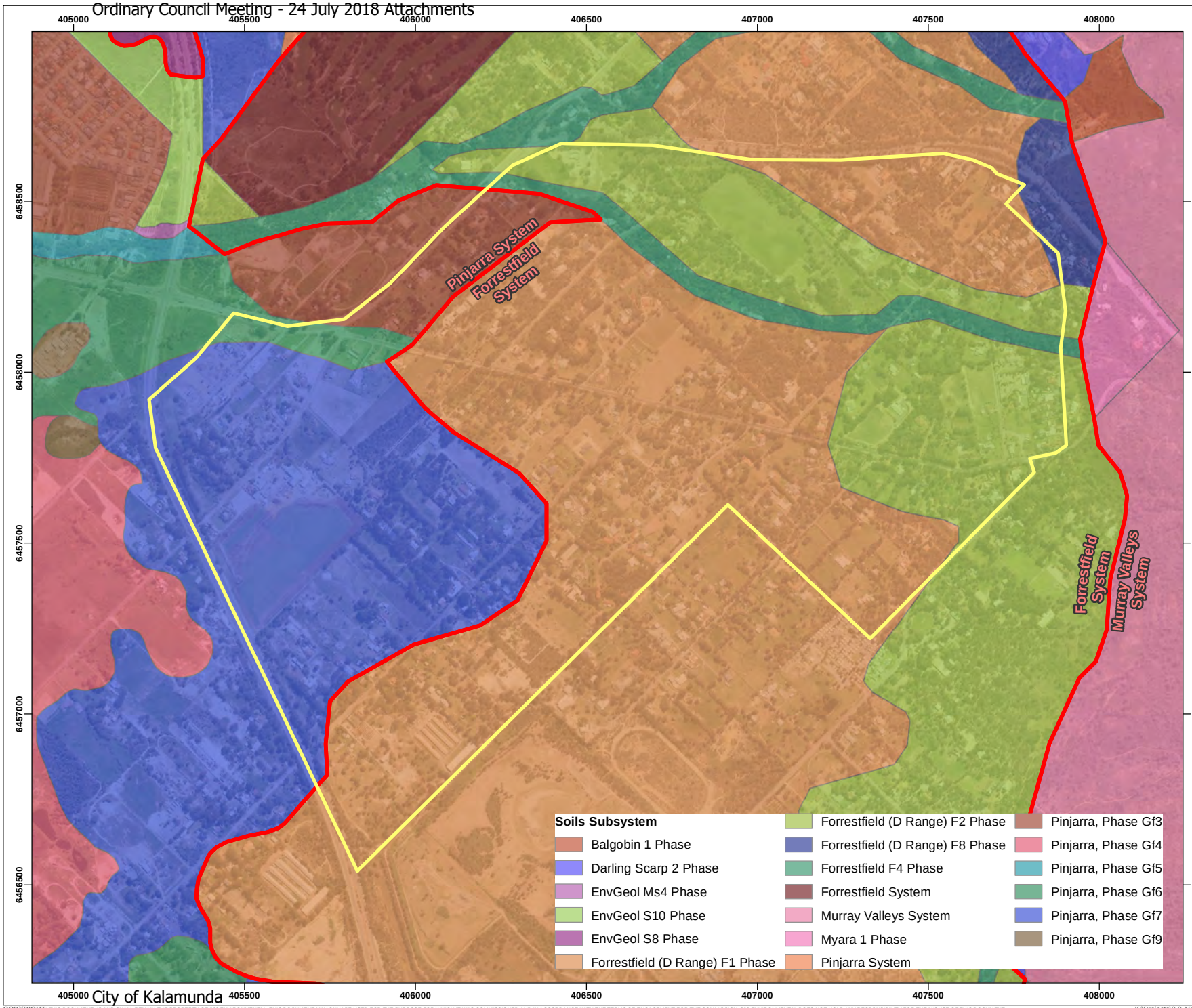
Various Lots, Wattle Grove

Environmental Assessment Report

Figure 2
Topography

K:\Projects\9.0 APP\2118 Wattle Grove MRS Amend EAR\Figures\2118 F2 Topography.mxd



Legend

- Site Location
- Soil Landscapes and Land Systems

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- SOIL SYSTEM SOURCED DAFWA 2012
- LOCALITY MAP SOURCED LANDGATE 2017
- AERIAL PHOTOGRAPHY SOURCED LANDGATE 2017
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GDA 1994 MGA Zone 50

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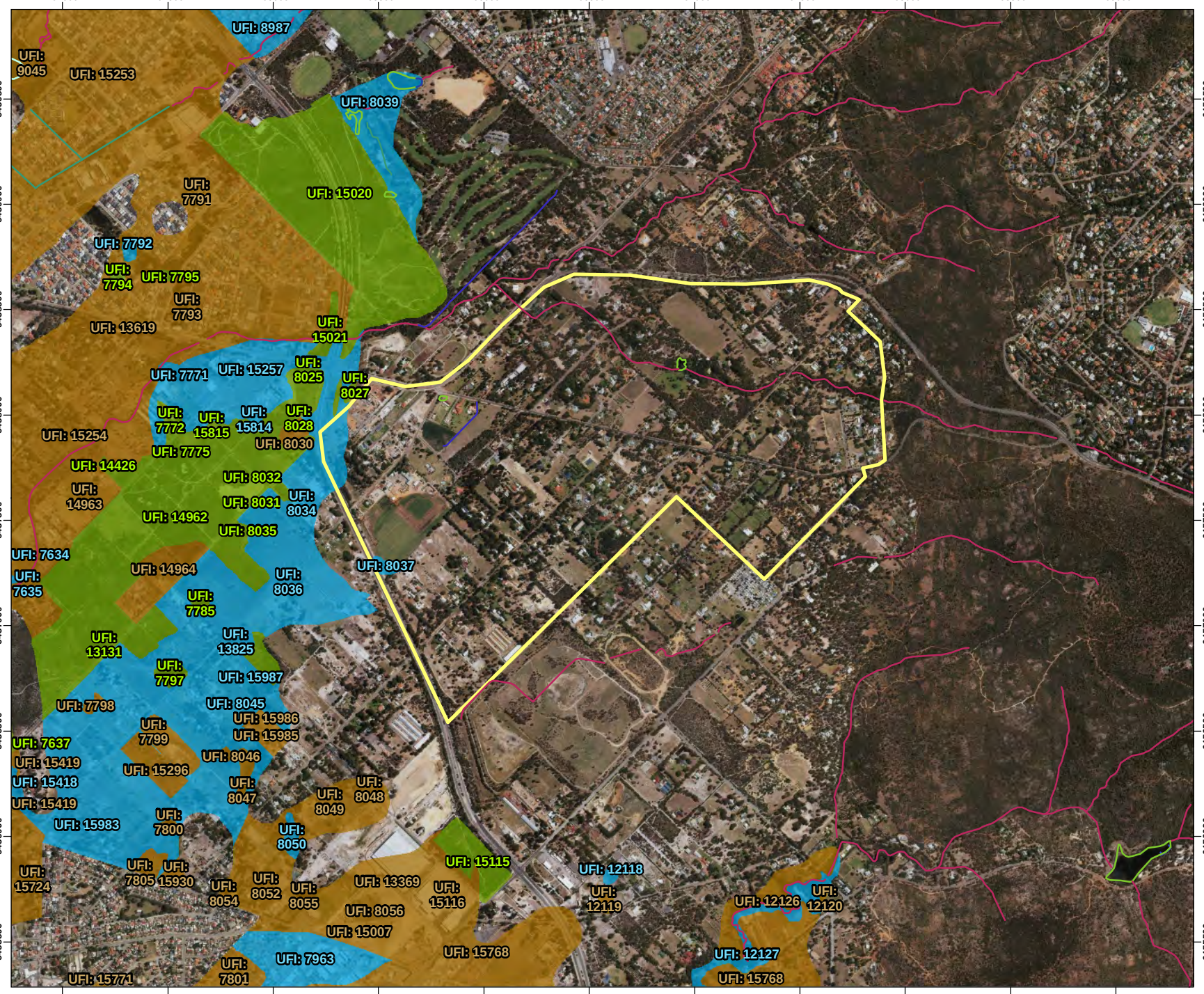
Various Lots, Wattle Grove

Environmental Assessment Report

Figure 3
Geology and Soils

K:\Projects\9.0 APP\2118 Wattle Grove MRS Amend EAR\Figures\2118 F3 Geology and Soils.mxd



Legend

- Site Location

Geomorphic Wetlands

- Conservation
- Resource Enhancement
- Multiple Use

Hydrography

- Drain - major
- Drain - minor
- Lake - perennial
- Marine Construction - wharf/jetty
- Swamp - perennial
- Watercourse - minor, non-perennial
- Watercourse - minor, perennial

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- SURFACE WATER DATA SOURED DOW 2018
- LOCALITY MAP SOURCED LANDGATE 2017
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GDA 1994 MGA Zone 50

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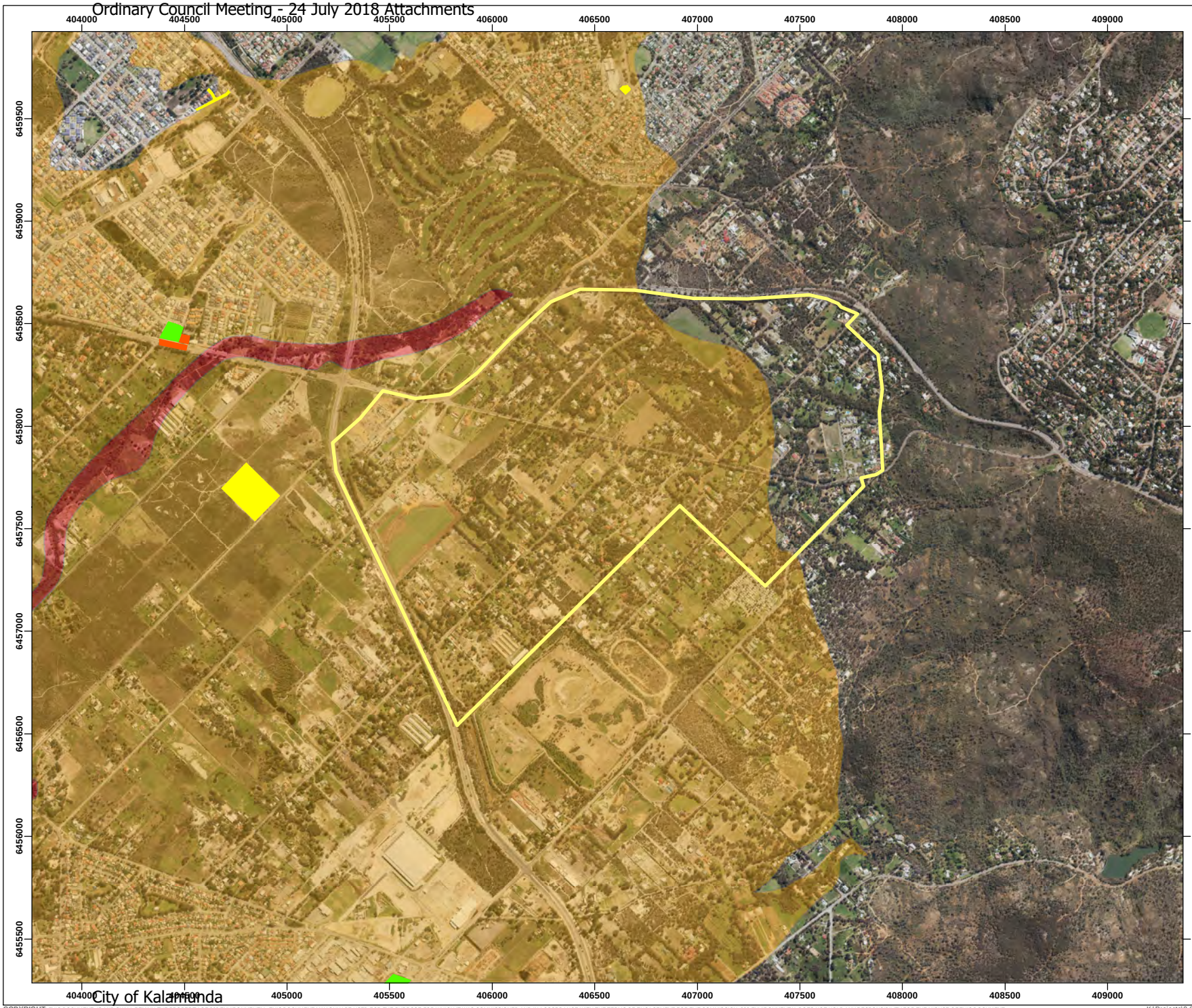
Environmental Assessment Report

Figure 4
Surface Hydrology 111

K:\Projects\9.0 APP\2118 Wattle Grove MRS Amend EAR\Figures\2118 F5 Surface Water.mxd



Legend

Site Location

Contaminated Sites

- Remediated for Restricted Use
- Contaminated: Restricted Use
- Contaminated: Remediation Required

Acid Sulfate Soils

- High to Moderate risk
- Moderate to Low risk

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- ASS AND CONTAMINATED SITES SOURCED DWER 2018
- LOCALITY MAP SOURCED LANDGATE 2017
- AERIAL PHOTOGRAPHY SOURCED LANDGATE 2017
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GDA 1994 MGA Zone 50

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Various Lots, Wattle Grove

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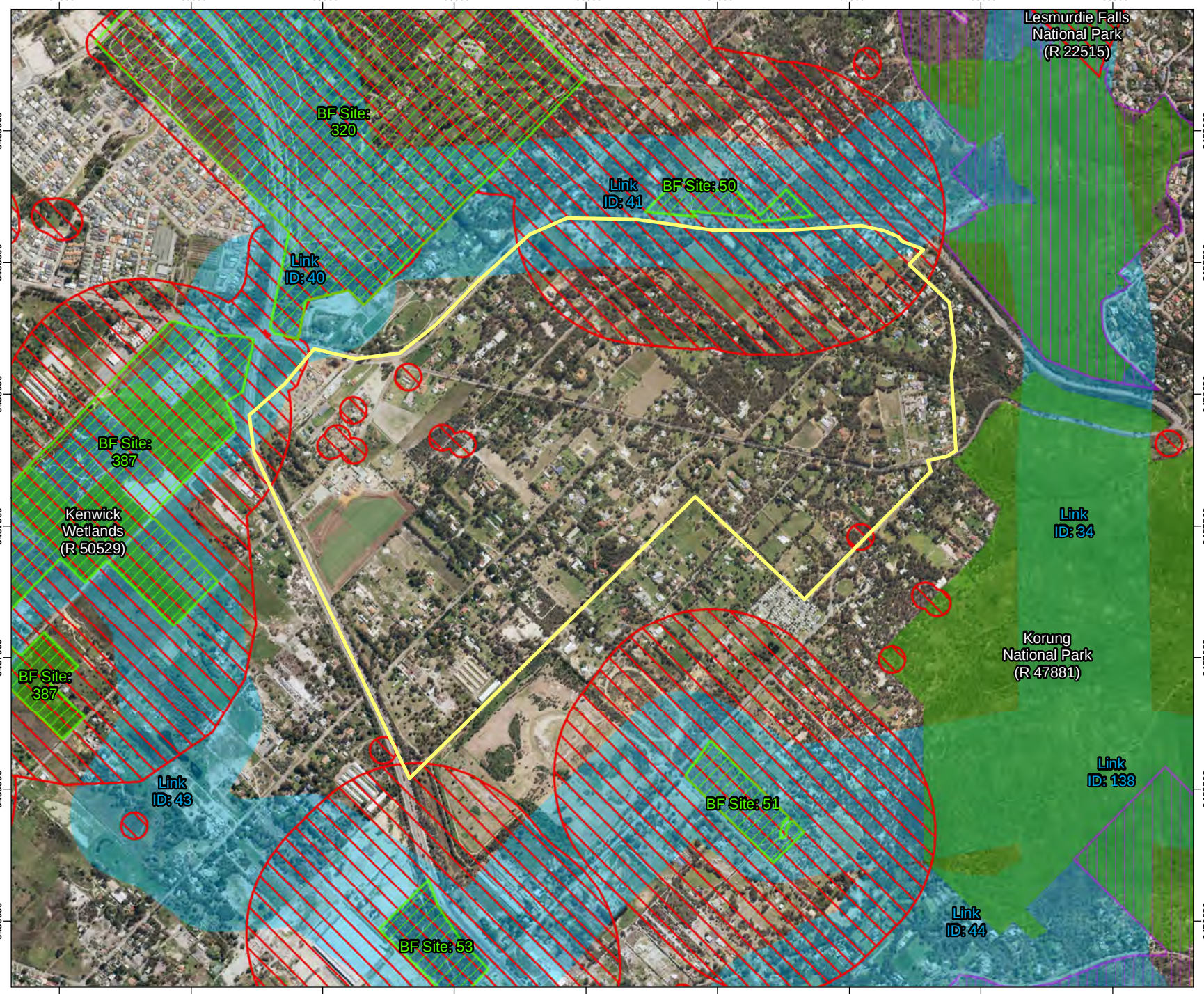
Figure 5
Contamination

K:\Projects\9.0 APP\2118 Wattle Grove MRS Amend EAR\Figures\2118 F6 Contamination.mxd



Legend

- Site Location
- Bush Forever Sites
- Environmentally Sensitive Areas
- DBCA Managed Lands
- Regional Parks
- Perth Regional Ecological Linkages

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- CONSERVATION SOURCED DBCA 2018
- LOCALITY MAP SOURCED LANDGATE 2017
- AERIAL PHOTOGRAPHY SOURCED LANDGATE 2017
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GDA 1994 MGA Zone 50

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Figure 6
Conservation Areas

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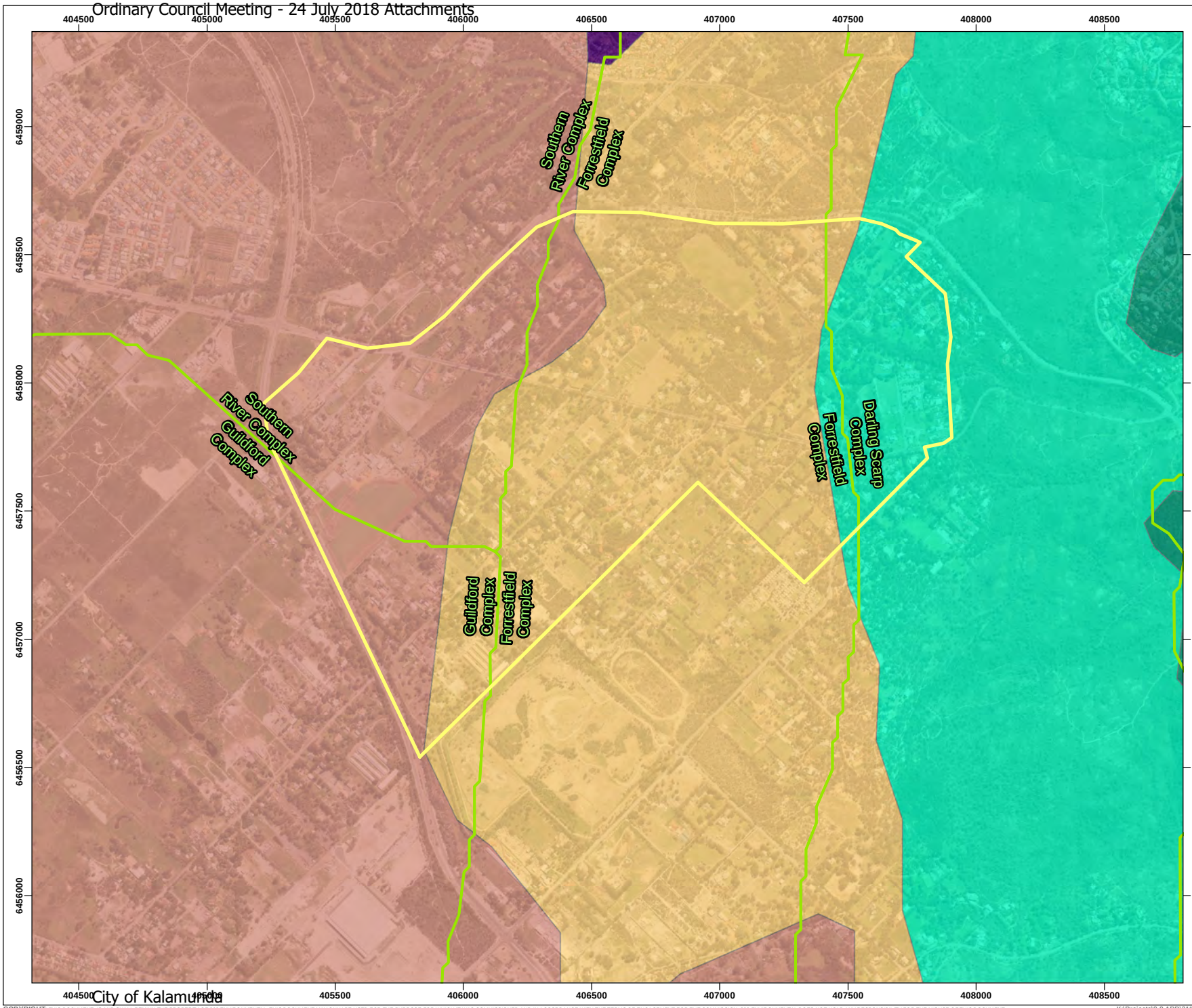

Legend

- Site Location
- Heddle Vegetation Complexes

Pre European Vegetation Types

- BASSENDEAN_1009
- PINJARRA_3
- PINJARRA_968
- WEST DARLING_3
- WEST DARLING_4

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- CONSERVATION SOURCED DBCA 2018
- LOCALITY MAP SOURCED LANDGATE 2017
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LOCALITY MAP

PROJECT ID	DATE
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HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

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SL	CM	KC	1

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Various Lots, Wattle Grove

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Figure 7
Broad Vegetation Types

K:\Projects\9.0 APP\2118 Wattle Grove MRS Amend EAR\Figures\2118 F8 Broad Vegetation Types.mxd

Legend

- *Banksia mimica*
- *Conospermum undulatum*
- *Isopogon drummondii*
- *Lasiopetalum glutinosum* subsp. *glutinosum*
- *Thelymitra magnifica*

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- FLORA SOURCED DBCA 2018
- LOCALITY MAP SOURCED LANDGATE 2017
- AERIAL PHOTOGRAPHY SOURCED LANDGATE 2017
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HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

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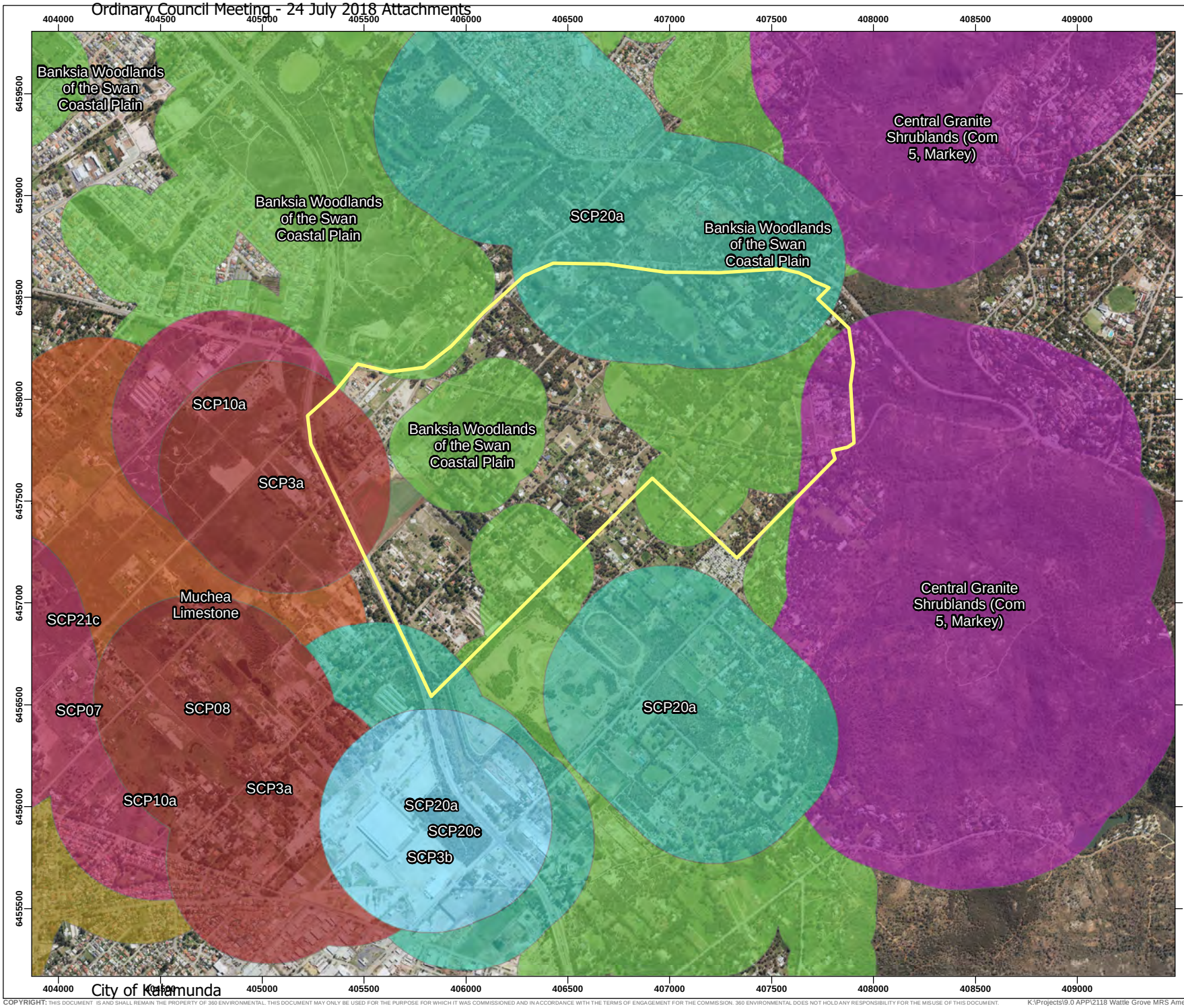
Figure 8
Declared Rare Flora 115

K:\Projects\9.0 APP\2118 Wattle Grove MRS Amend EAR\Figures\2118 F9 Declared Rare Flora.mxd



Legend

- Site Location

TECs and PECs

- Banksia Woodlands of the Swan Coastal Plain
- Central Granite Shrublands (Com 5, Markey)
- Muchea Limestone
- SCP07
- SCP08
- SCP10a
- SCP20a
- SCP20c
- SCP21c
- SCP3a
- SCP3b

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- HERITAGE SOURCED DAA AND SHO 2018
- LOCALITY MAP SOURCED LANDGATE 2017
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LOCALITY MAP

PROJECT ID	DATE
2118	8/03/2018

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

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SL	CM	KC	1

Burgess Design Group
Various Lots, Wattle Grove

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Figure 9

Threatened and Priority Ecological Communities

K:\Projects\9.0 APP\2118 Wattle Grove MRS Amend EAR\Figures\2118 F10 Threatened and Priority Ecological Communities.mxd

Legend

- Site Location
- State Heritage Office Registered Sites
- Aboriginal Heritage Sites - Registered
- Aboriginal Heritage Sites - Lodged

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- HERITAGE SOURCED DAA AND SHO 2018
- LOCALITY MAP SOURCED LANDGATE 2017
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LOCALITY MAP

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HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
SL	CM	KC	1

Burgess Design Group
Various Lots, Wattle Grove

Environmental Assessment Report

Figure 10
Heritage

K:\Projects\9.0 APP\2118 Wattle Grove MRS Amend EAR\Figures\2118 F11 Heritage.mxd

Legend

Site Location

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LOCALITY MAP

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HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
SL	CM	KC	1

Burgess Design Group
Various Lots, Wattle Grove

Environmental Assessment Report

Figure 11a
Historical Aerial - 1953

City of Kalamunda

K:\Projects\9.0 APP\2118 Wattle Grove MRS Amend EAR\Figures\2118 F12 Historical Aerials.mxd

Legend

Site Location

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
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LOCALITY MAP

PROJECT ID	DATE
2118	6/03/2018

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
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Burgess Design Group
Various Lots, Wattle Grove

Environmental Assessment Report

Figure 11b
Historical Aerial - 1965

K:\Projects\9.0 APP\2118 Wattle Grove MRS Amend EAR\Figures\2118 F12 Historical Aerials.mxd

Legend

Site Location

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LOCALITY MAP

PROJECT ID	DATE
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HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
SL	CM	KC	1

Burgess Design Group
Various Lots, Wattle Grove

Environmental Assessment Report

Figure 11c
Historical Aerial -1974

City of Kalamunda

K:\Projects\9.0 APP\2118 Wattle Grove MRS Amend EAR\Figures\2118 F12 Historical Aerials.mxd

Legend

Site Location

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
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LOCALITY MAP

PROJECT ID	DATE
2118	6/03/2018

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
SL	CM	KC	1

Burgess Design Group
Various Lots, Wattle Grove

Environmental Assessment Report

Figure 11d
Historical Aerial -1985

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Legend

Site Location

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LOCALITY MAP

PROJECT ID	DATE
2118	6/03/2018

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

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SL	CM	KC	1

Burgess Design Group
Various Lots, Wattle Grove

Environmental Assessment Report

Figure 11e
Historical Aerial - 1995

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Legend

Site Location

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
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LOCALITY MAP

PROJECT ID	DATE
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HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

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SL	CM	KC	1

Burgess Design Group
Various Lots, Wattle Grove

Environmental Assessment Report

Figure 11f
Historical Aerial - 2002

City of Kalamunda

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Legend

Site Location

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
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LOCALITY MAP

PROJECT ID	DATE
2118	6/03/2018

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
SL	CM	KC	1

Burgess Design Group
Various Lots, Wattle Grove

Environmental Assessment Report

Figure 11g
Historical Aerial - 2012

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Legend

Site Location

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
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LOCALITY MAP

PROJECT ID	DATE
2118	6/03/2018

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

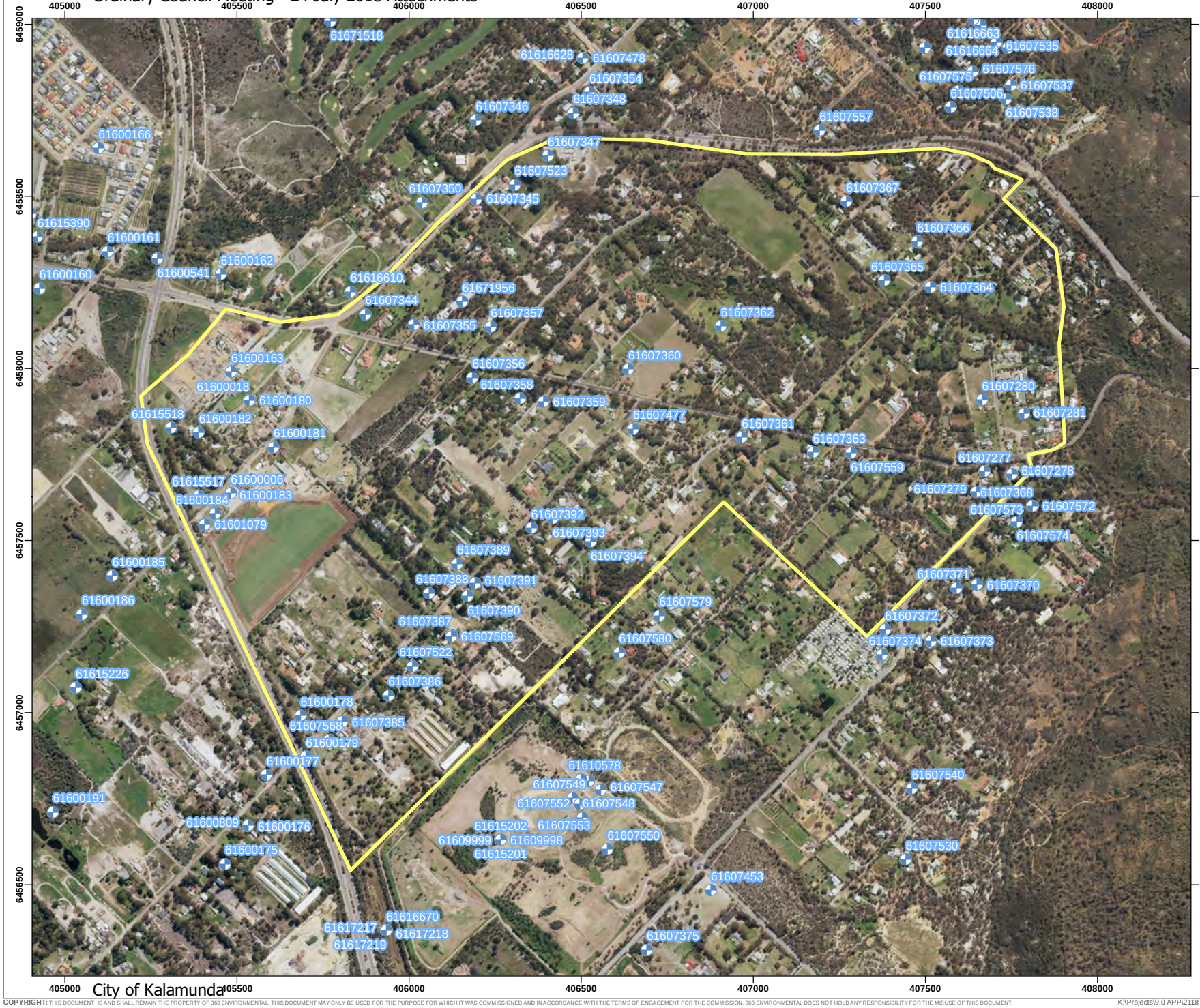
CREATED	CHECKED	APPROVED	REVISION
SL	CM	KC	1

Burgess Design Group
Various Lots, Wattle Grove

Environmental Assessment Report

Figure 11h
Historical Aerials 2017

K:\Projects\9.0 APP\2118 Wattle Grove MRS Amend EAR\Figures\2118 F12 Historical Aerials.mxd



Legend

- Site Location
- WIN Groundwater Bores

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- WIN BORES SOURCED DOW 2018
- LOCALITY MAP SOURCED LANDGATE 2017
- AERIAL PHOTOGRAPHY SOURCED LANDGATE 2017
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LOCALITY MAP

PROJECT ID	DATE
2118	6/03/2018

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

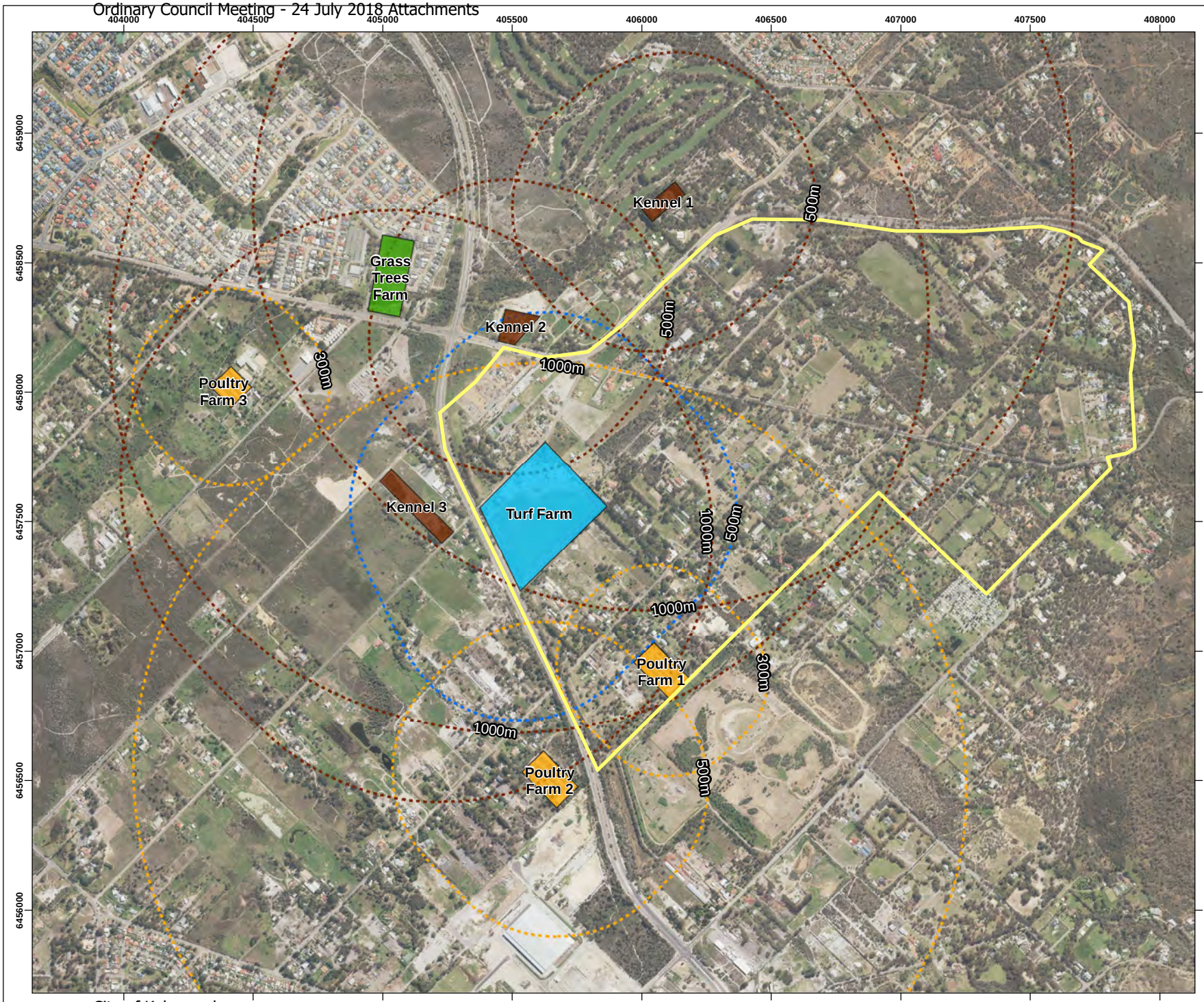
CREATED	CHECKED	APPROVED	REVISION
SL	CM	KC	1

Burgess Design Group
Various Lots, Wattle Grove

Environmental Assessment Report

Figure 12
WIN Groundwater Bores

K:\Projects\9.0 APP\2118 Wattle Grove MRS Amend EAR\Figures\2118 F13 WIN Groundwater Bores.mxd



Legend

- Site Boundary
- Grass Trees Farm
- Kennels
- Poultry Farms
- Turf Farm

Land Use Buffers

- Kennel
- Poultry Farm
- Turf Farm

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- LOCALITY MAP SOURCED LANDGATE 2017
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LOCALITY MAP

PROJECT ID	DATE
2118	12/03/2018

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
SL	CM	KC	1

Burgess Design Group
Various Lots, Wattle Grove

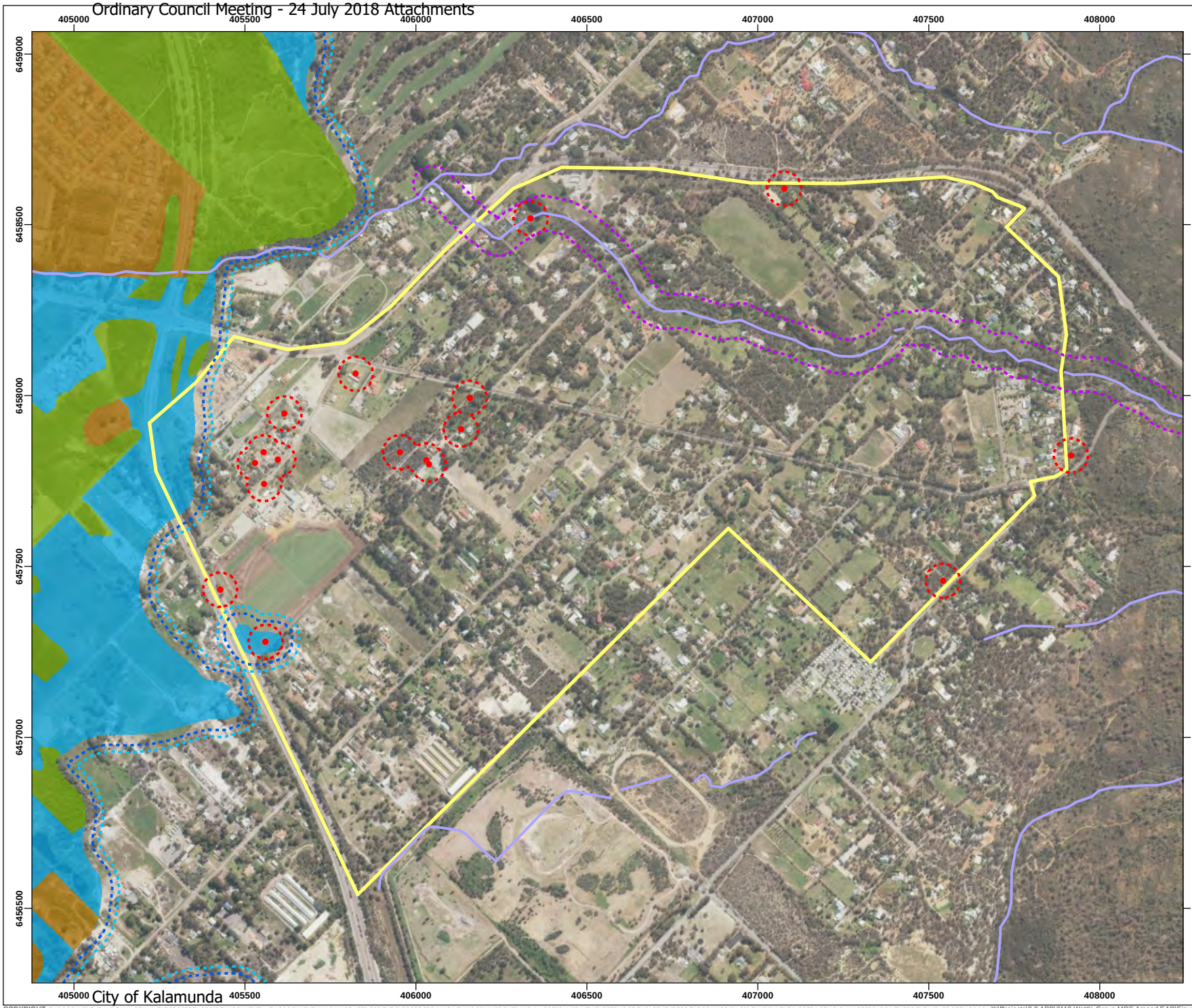
Environmental Assessment Report

Figure 13

Land Use Opportunities and Constraints

City of Kalamunda

K:\Projects\9.0 APP\2118 Wattle Grove MRS Amend EAR\Figures\2118 FX Environmental Opportunities and Constraints.mxd



Legend

- Site Boundary
- Declared Rare Flora
- Declared Rare Flora 50m Buffer
- Watercourse - minor, perennial
- Potential Foreshore Area

Geomorphic Wetlands

- Conservation
- Resource Enhancement
- Multiple Use
- Not Assessed

Wetland Buffers

- 30m Buffer
- 50m Buffer

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
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LOCALITY MAP

PROJECT ID	DATE
2118	23/04/2018

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
SL	CH	KC	2

Burgess Design Group
Various Lots, Wattle Grove

Environmental Assessment Report

Figure 14

Environmental Opportunities and Constraints

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APPENDIX A

EPBC Protected Matters Report

Australian Government
Department of the Environment and Energy

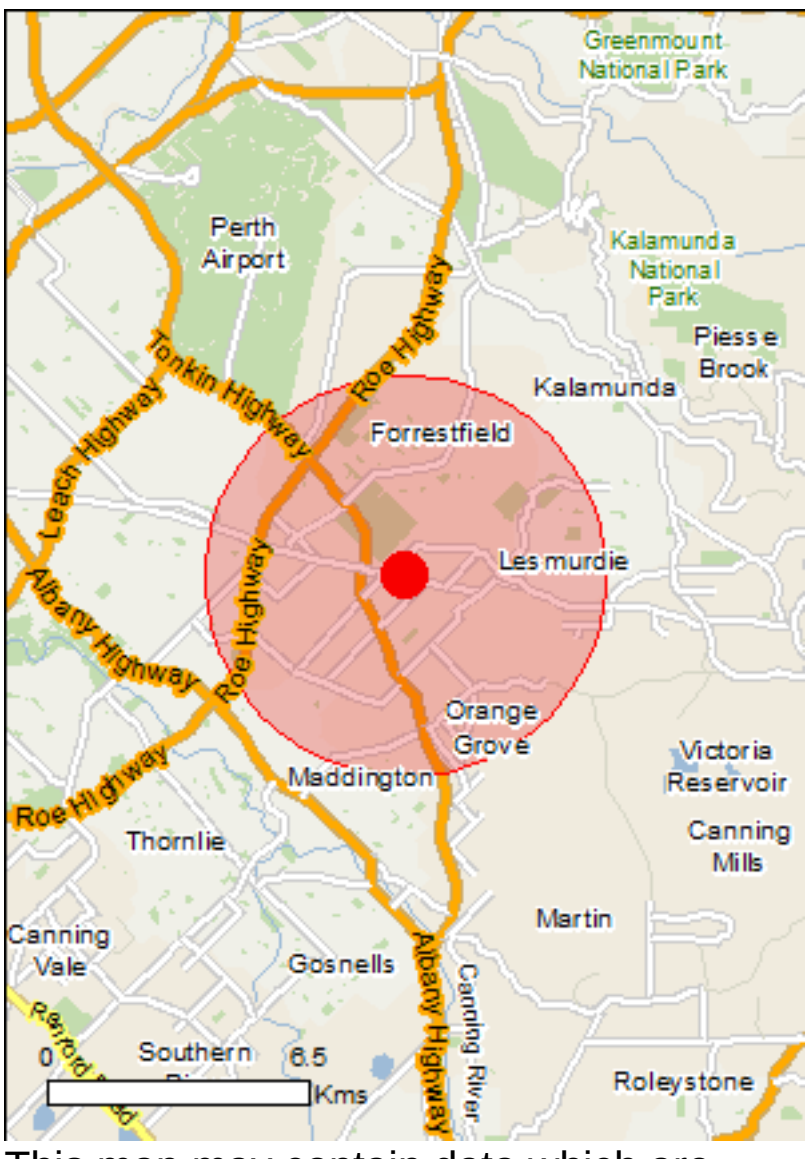
EPBC Act Protected Matters Report

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

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

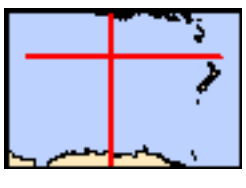
Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 25/10/17 19:14:08



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

Coordinates
Buffer: 5.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	3
Listed Threatened Species:	38
Listed Migratory Species:	9

Other Matters Protected by the EPBC Act

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

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

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	15
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

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

State and Territory Reserves:	7
Regional Forest Agreements:	1
Invasive Species:	43
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

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

Name	Status	Type of Presence
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Community likely to occur within area
Clay Pans of the Swan Coastal Plain	Critically Endangered	Community likely to occur within area
Corymbia calophylla - Kingia australis woodlands on heavy soils of the Swan Coastal Plain	Endangered	Community known to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat known to occur within area
Calyptorhynchus baudinii Baudin's Cockatoo, Long-billed Black-Cockatoo [769]	Vulnerable	Roosting known to occur within area
Calyptorhynchus latirostris Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat known to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Insects		
Leioproctus douglasiellus a short-tongued bee [66756]	Critically Endangered	Species or species habitat known to occur within area
Mammals		

Name	Status	Type of Presence
Bettongia penicillata		
Brush-tailed Bettong, Woylie [213]	Endangered	Species or species habitat may occur within area
Dasyurus geoffroii		
Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat known to occur within area
Pseudocheirus occidentalis		
Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Vulnerable	Species or species habitat may occur within area
Setonix brachyurus		
Quokka [229]	Vulnerable	Species or species habitat likely to occur within area
Plants		
Acacia anomala		
Grass Wattle, Chittering Grass Wattle [8153]	Vulnerable	Species or species habitat known to occur within area
Andersonia gracilis		
Slender Andersonia [14470]	Endangered	Species or species habitat known to occur within area
Anthocercis gracilis		
Slender Tailflower [11103]	Vulnerable	Species or species habitat likely to occur within area
Banksia mimica		
Summer Honeypot [82765]	Endangered	Species or species habitat likely to occur within area
Caladenia huegelii		
King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat likely to occur within area
Calytrix breviseta subsp. breviseta		
Swamp Starflower [23879]	Endangered	Species or species habitat known to occur within area
Chamelaucium sp. Gingin (N.G.Marchant 6)		
Gingin Wax [88881]	Endangered	Species or species habitat may occur within area
Conospermum undulatum		
Wavy-leaved Smokebush [24435]	Vulnerable	Species or species habitat likely to occur within area
Darwinia apiculata		
Scarp Darwinia [8763]	Endangered	Species or species habitat likely to occur within area
Diuris drummondii		
Tall Donkey Orchid [4365]	Vulnerable	Species or species habitat likely to occur within area
Diuris micrantha		
Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat likely to occur within area
Diuris purdiei		
Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat known to occur within area
Drakaea elastica		
Glossy-leafed Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid [16753]	Endangered	Species or species habitat likely to occur within area
Drakaea micrantha		
Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
Eleocharis keigheryi Keighery's Eleocharis [64893]	Vulnerable	Species or species habitat known to occur within area
Eucalyptus x balanites Cadda Road Mallee, Cadda Mallee [87816]	Endangered	Species or species habitat may occur within area
Grevillea curviloba subsp. incurva Narrow curved-leaf Grevillea [64909]	Endangered	Species or species habitat likely to occur within area
Lasiopetalum pterocarpum Wing-fruited Lasiopetalum [64922]	Endangered	Species or species habitat may occur within area
Lepidosperma rostratum Beaked Lepidosperma [14152]	Endangered	Species or species habitat likely to occur within area
Macarthuria keigheryi Keighery's Macarthuria [64930]	Endangered	Species or species habitat likely to occur within area
Ptilotus pyramidatus Pyramid Mulla-mulla [18216]	Critically Endangered	Species or species habitat known to occur within area
Synaphea sp. Fairbridge Farm (D. Papenfus 696) Selena's Synaphea [82881]	Critically Endangered	Species or species habitat known to occur within area
Synaphea stenoloba Dwellingup Synaphea [66311]	Endangered	Species or species habitat may occur within area
Thelymitra dedmaniarum Cinnamon Sun Orchid [65105]	Endangered	Species or species habitat likely to occur within area
Thelymitra stellata Star Sun-orchid [7060]	Endangered	Species or species habitat known to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

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

Name
Commonwealth Land -

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Kenwick Wetlands	WA
Korung	WA
Lesmurdie Falls	WA
Unnamed WA23076	WA
Unnamed WA24657	WA
Unnamed WA29815	WA
Unnamed WA37997	WA

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
South West WA RFA	Western Australia

Invasive Species [Resource Information]

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

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Funambulus pennantii Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and		Species or species

Name	Status	Type of Presence
Sterile Pussy Willow [68497]		habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area
Ramphotyphlops braminus Flowerpot Blind Snake, Brahminy Blind Snake, Cacing Besi [1258]		Species or species habitat likely to occur within area

Nationally Important Wetlands	[Resource Information]
Name	State
Brixton Street Swamps	WA

Caveat

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

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

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

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

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

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

Coordinates

-32.00957 116.00676

Acknowledgements

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

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

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

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

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APPENDIX B

DBCA Naturemap Report

NatureMap Species Report

Created By Guest user on 26/10/2017

Current Names Only Yes
Core Datasets Only Yes
Method 'By Circle'
Centre 116° 00' 26" E,32° 00' 41" S
Buffer 5km
Group By Kingdom

Kingdom	Species	Records
Animalia	395	9190
Fungi	23	45
Plantae	1063	3808
Protozoa	4	5
TOTAL	**1485**	**13048**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Animalia					
1.	24260	*Acanthiza apicalis (Broad-tailed Thornbill, Inland Thornbill)*			
2.	24261	*Acanthiza chrysorrhoa (Yellow-rumped Thornbill)*			
3.	24262	*Acanthiza inornata (Western Thornbill)*			
4.	24265	*Acanthiza uropygialis (Chestnut-rumped Thornbill)*			
5.	25242	*Acanthophis antarcticus (Southern Death Adder)*		P3	
6.	24560	*Acanthorhynchus superciliosus (Western Spinebill)*			
7.	25535	*Accipiter cirrocephalus (Collared Sparrowhawk)*			
8.	25536	*Accipiter fasciatus (Brown Goshawk)*			
9.	24282	*Accipiter fasciatus subsp. fasciatus (Brown Goshawk)*			
10.	42368	*Acritoscincus trilineatus (Western Three-lined Skink)*			
11.	25755	*Acrocephalus australis (Australian Reed Warbler)*			
12.	41323	*Actitis hypoleucos (Common Sandpiper)*		IA	
13.		*Agraptocorixa parvipunctata*			
14.		*Ainudrilus nharna*			
15.		*Alboa worooa*			
16.		*Allodessus bistrigatus*			
17.		*Alona affinis*			
18.		*Alona cf. guttata*			
19.		*Alona rigidicaudis*			
20.		*Alona setigera*			
21.		*Alonella clathratula*			
22.		*Aname mainae*			
23.		*Aname tepperi*			
24.	24312	*Anas gracilis (Grey Teal)*			
25.	24313	*Anas platyrhynchos (Mallard)*			
26.	24315	*Anas rhynchotis (Australasian Shoveler)*			
27.	24316	*Anas superciliosa (Pacific Black Duck)*			
28.	47414	*Anhinga novaehollandiae (Australasian Darter)*			
29.		*Anisops thienemanni*			
30.		*Anopheles annulipes s.l.*			
31.		*Anser anser*			
32.	25241	*Antaresia stimsoni subsp. stimsoni (Stimson's Python)*			
33.	24561	*Anthochaera carunculata (Red Wattlebird)*			
34.	24562	*Anthochaera lunulata (Western Little Wattlebird)*			
35.	24991	*Aprasia repens (Sand-plain Worm-lizard)*			
36.		*Apsectrotanypus nr maculosa*			
37.	24285	*Aquila audax (Wedge-tailed Eagle)*			
38.		*Arachnura higginsi*			
39.		*Araneus cyphoxis*			
40.		*Araneus eburnus*			
41.	41324	*Ardea modesta (great egret, white egret)*		IA	
42.	24340	*Ardea novaehollandiae (White-faced Heron)*			
43.	24341	*Ardea pacifica (White-necked Heron)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
44.		*Arrenurus (Micruracarus) sp. 1 (SAP)*			
45.	25566	*Artamus cinereus (Black-faced Woodswallow)*			
46.	24353	*Artamus cyanopterus (Dusky Woodswallow)*			
47.		*Artoria linnaei*			
48.		*Artoriopsis joergi*			
49.		*Austracantha minax*			
50.		*Austrolestes analis*			
51.		*Austrolestes io*			
52.	24318	*Aythya australis (Hardhead)*			
53.		*Backobourkia heroine*			
54.		*Ballarra longipalpus*			
55.		*Barnardius zonarius*			
56.		*Bennelongia sp.*			
57.		*Berosus approximans*			
58.		*Berosus australiae*			
59.	24162	*Bettongia penicillata subsp. ogilbyi (Woylie, Brush-tailed Bettong)*		T	
60.		*Bezzia sp.*			
61.		*Bezzia sp. 2 (SAP)*			
62.	24319	*Biziura lobata (Musk Duck)*			
63.		*Boeckella bispinosa*			
64.		*Brachionus quadridentatus*			
65.	42381	*Brachyurophis semifasciatus (Southern Shovel-nosed Snake)*			
66.	25713	*Cacatua galerita (Sulphur-crested Cockatoo)*			
67.	25714	*Cacatua pastinator (Western Long-billed Corella)*			
68.	25715	*Cacatua roseicapilla (Galah)*			
69.	25716	*Cacatua sanguinea (Little Corella)*			
70.	24729	*Cacatua tenuirostris (Eastern Long-billed Corella)*	Y		
71.	25598	*Cacomantis flabelliformis (Fan-tailed Cuckoo)*			
72.	42307	*Cacomantis pallidus (Pallid Cuckoo)*			
73.	25717	*Calyptorhynchus banksii (Red-tailed Black-Cockatoo)*			
74.	24731	*Calyptorhynchus banksii subsp. naso (Forest Red-tailed Black-Cockatoo)*		T	
75.	24733	*Calyptorhynchus baudinii (Baudin's Cockatoo (long-billed black-cockatoo), Baudin's Cockatoo)*		T	
76.	24734	*Calyptorhynchus latirostris (Carnaby's Cockatoo (short-billed black-cockatoo), Carnaby's Cockatoo)*		T	
77.	48400	*Calyptorhynchus sp. (white-tailed black cockatoo)*		T	
78.		*Candonocypris novaezelandiae*			
79.		*Ceinidae sp.*			
80.		*Cephalodella gibba*			
81.		*Ceratopogonidae sp.*			
82.		*Cercophonius granulosus*			
83.		*Cercophonius sulcatus*			
84.		*Ceriodaphnia sp.*			
85.	24186	*Chalinolobus gouldii (Gould's Wattled Bat)*			
86.		*Chaoboridae sp.*			
87.	43380	*Chelodina colliei (South-western Snake-necked Turtle)*			
88.	24321	*Chenonetta jubata (Australian Wood Duck, Wood Duck)*			
89.	33939	*Cherax cainii (Marron)*			
90.		*Cherax destructor*			
91.		*Cherax quinquecarinatus*			
92.		*Chironominae sp.*			
93.	24980	*Christinus marmoratus (Marbled Gecko)*			
94.		*Chroicocephalus novaehollandiae*			
95.		*Chydorus sp.*			
96.	24288	*Circus approximans (Swamp Harrier)*			
97.		*Coenagrionidae sp.*			
98.	25675	*Colluricincla harmonica (Grey Shrike-thrush)*			
99.	24399	*Columba livia (Domestic Pigeon)*	Y		
100.	24361	*Coracina maxima (Ground Cuckoo-shrike)*			
101.	25568	*Coracina novaehollandiae (Black-faced Cuckoo-shrike)*			
102.	24363	*Coracina novaehollandiae subsp. subpallida (Black-faced Cuckoo-shrike)*			
103.		*Corixidae sp.*			
104.		*Cormocephalus aurantiipes*			
105.		*Cormocephalus rubriceps*			
106.		*Cormocephalus strigosus*			
107.	25592	*Corvus coronoides (Australian Raven)*			
108.	24417	*Corvus coronoides subsp. perplexus (Australian Raven)*			
109.		*Corynoneura sp. (V49) (SAP)*			
110.	24420	*Cracticus nigrogularis (Pied Butcherbird)*			
111.	25595	*Cracticus tibicen (Australian Magpie)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
112.	24422	*Cracticus tibicen subsp. dorsalis (White-backed Magpie)*			
113.	25596	*Cracticus torquatus (Grey Butcherbird)*			
114.		*Cricotopus 'brevicornis'*			
115.	25398	*Crinia georgiana (Quacking Frog)*			
116.	25399	*Crinia glauerti (Clicking Frog)*			
117.	25400	*Crinia insignifera (Squelching Froglet)*			
118.	25401	*Crinia pseudinsignifera (Bleating Froglet)*			
119.	30893	*Cryptoblepharus buchananii*			
120.		*Cryptochironomus griseidorsum*			
121.	24883	*Ctenophorus ornatus (Ornate Crevice-Dragon)*			
122.	25027	*Ctenotus australis*			
123.	25039	*Ctenotus fallens*			
124.		*Culex (Culex) annulirostris*			
125.		*Culicoides sp.*			
126.	24322	*Cygnus atratus (Black Swan)*			
127.		*Cypretta sp.*			
128.		*Cyprinotus cingalensis*			
129.	30901	*Dacelo novaeguineae (Laughing Kookaburra)*	Y		
130.	25673	*Daphoenositta chrysoptera (Varied Sittella)*			
131.	24092	*Dasyurus geoffroii (Chuditch, Western Quoll)*		T	
132.		*Delena cancerides*			
133.	25766	*Delma fraseri (Fraser's Legless Lizard)*			
134.	24999	*Delma grayii*			
135.	25296	*Demansia psammophis subsp. reticulata (Yellow-faced Whipsnake)*			
136.		*Diaphanosoma sp.*			
137.	25607	*Dicaeum hirundinaceum (Mistletoebird)*			
138.		*Dingosa serrata*			
139.		*Dinocambala ingens*			
140.	24939	*Diplodactylus polyophthalmus*			
141.		*Diptera sp.*			
142.		*Dolichopodidae sp.*			
143.		*Dunhevedia crassa*			
144.		*Dytiscidae sp.*			
145.	25096	*Egernia kingii (King's Skink)*			
146.		*Egretta novaehollandiae*			
147.		*Elanus axillaris*			
148.	47937	*Elseyornis melanops (Black-fronted Dotterel)*			
149.		*Eolophus roseicapillus*			
150.	24652	*Eopsaltria georgiana (White-breasted Robin)*			
151.		*Ephydridae sp.*			
152.		*Eriophora biapicata*			
153.	24379	*Erythrogonys cinctus (Red-kneed Dotterel)*			
154.		*Euchlanis sp.*			
155.		*Eupograpta kottae*			
156.		*Eylais sp.*			
157.	25621	*Falco berigora (Brown Falcon)*			
158.	25622	*Falco cenchroides (Australian Kestrel, Nankeen Kestrel)*			
159.	24472	*Falco cenchroides subsp. cenchroides (Australian Kestrel, Nankeen Kestrel)*			
160.	25623	*Falco longipennis (Australian Hobby)*			
161.	25624	*Falco peregrinus (Peregrine Falcon)*		S	
162.	24041	*Felis catus (Cat)*	Y		
163.	25727	*Fulica atra (Eurasian Coot)*			
164.	24761	*Fulica atra subsp. australis (Eurasian Coot)*			
165.	30916	*Funambulus pennanti (Indian Palm Squirrel)*	Y		
166.	34028	*Galaxias occidentalis (Western Minnow)*			
167.	25729	*Gallinula tenebrosa (Dusky Moorhen)*			
168.	24763	*Gallinula tenebrosa subsp. tenebrosa (Dusky Moorhen)*			
169.	25730	*Gallirallus philippensis (Buff-banded Rail)*			
170.	24765	*Gallirallus philippensis subsp. mellori (Buff-banded Rail)*			
171.		*Gallus gallus*			
172.	25530	*Gerygone fusca (Western Gerygone)*			
173.	24271	*Gerygone fusca subsp. fusca (Western Gerygone)*			
174.		*Glacidorbidae sp.*			Y
175.	47962	*Glyciphila melanops (Tawny-crowned Honeyeater)*			
176.		*Glyptophysa sp*			
177.	24443	*Grallina cyanoleuca (Magpie-lark)*			
178.		*Gripopterygidae sp.*			
179.	24295	*Haliastur sphenurus (Whistling Kite)*			
180.		*Haliplus gibbus*			
181.		*Hebridae sp.*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
182.	25409	*Heleioporus barycragus (Hooting Frog)*			
183.	25410	*Heleioporus eyrei (Moaning Frog)*			
184.		*Hemianax papuensis*			
185.		*Hemicordulia tau*			
186.		*Hemicorduliidae sp.*			
187.	25115	*Hemiergis initialis subsp. initialis*			
188.	25119	*Hemiergis quadrilineata*			
189.	24961	*Heteronotia binoei (Bynoe's Gecko)*			
190.	47965	*Hieraaetus morphnoides (Little Eagle)*			
191.	25734	*Himantopus himantopus (Black-winged Stilt)*			
192.	24491	*Hirundo neoxena (Welcome Swallow)*			
193.		*Holasteron perth*			
194.	24215	*Hydromys chrysogaster (Water-rat, Rakali)*		P4	
195.		*Hydrophilidae sp.*			
196.		*Idiommata blackwalli*			
197.		*Ilyocryptus sp.*			
198.		*Ilyodromus sp.*			
199.		*Isidorella sp.*			
200.	25478	*Isoodon obesulus (Southern Brown Bandicoot)*		P4	
201.	24153	*Isoodon obesulus subsp. fusciventer (Quenda, Southern Brown Bandicoot)*		P4	
202.		*Isopeda leishmanni*			
203.		*Isopedella cana*			
204.		*Lacrimicypris "drummondi" n.sp. (SAP)*			
205.		*Latonopsis brehmi*			
206.		*Latrodectus hasseltii*			
207.		*Leberis aenigmatosa*			
208.	33981	*Leioproctus bilobatus (short-tongued bee)*		P2	
209.	33983	*Leioproctus douglasiellus (short-tongued bee)*		T	
210.		*Leptoceridae sp.*			
211.	25131	*Lerista distinguenda*			
212.	25133	*Lerista elegans*			
213.	25005	*Lialis burtonis*			
214.		*Libellulidae sp.*			
215.	25661	*Lichmera indistincta (Brown Honeyeater)*			
216.	24582	*Lichmera indistincta subsp. indistincta (Brown Honeyeater)*			
217.		*Limbodessus shuckhardi*			
218.		*Limnadia sp.*			
219.		*Limnochares australica*			
220.		*Limnophyes vestitus (V41)*			
221.	25378	*Litoria adelaidensis (Slender Tree Frog)*			
222.	25388	*Litoria moorei (Motorbike Frog)*			
223.		*Longepi woodman*			
224.		*Lophoictinia isura*			
225.		*Lycidas chlorophthalmus*			
226.		*Lycosa leuckartii*			
227.		*Lynceus sp.*			
228.	24132	*Macropus fuliginosus (Western Grey Kangaroo)*			
229.	24133	*Macropus irma (Western Brush Wallaby)*		P4	
230.		*Macrothrix sp.*			
231.	24326	*Malacorhynchus membranaceus (Pink-eared Duck)*			
232.	25650	*Malurus elegans (Red-winged Fairy-wren)*			
233.	24551	*Malurus pulcherrimus (Blue-breasted Fairy-wren)*			
234.	25654	*Malurus splendens (Splendid Fairy-wren)*			
235.	24552	*Malurus splendens subsp. splendens (Splendid Fairy-wren)*			
236.	24583	*Manorina flavigula (Yellow-throated Miner)*			
237.		*Maraura macracantha (formerly Alona macrocantha)*			
238.		*Masasteron maini*			
239.	25758	*Megalurus gramineus (Little Grassbird)*			
240.		*Megaporus sp.*			
241.	25663	*Melithreptus brevirostris (Brown-headed Honeyeater)*			
242.	24587	*Melithreptus chloropsis (Western White-naped Honeyeater)*			
243.	25184	*Menetia greyii*			
244.	24598	*Merops ornatus (Rainbow Bee-eater)*		IA	
245.		*Mesocyclops brooksi*			
246.		*Microcarbo melanoleucos*			
247.		*Microcyclops varicans*			
248.		*Microvelia sp.*			
249.		*Missulena granulosa*			
250.		*Missulena occatoria*			
251.		*Mitzoruga insularis*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
252.		*Monohelea sp. 1 (SAP)*			
253.		*Monohelea sp. 2 (SAP)*			
254.	25240	*Morelia spilota subsp. imbricata (Carpet Python)*			
255.	24223	*Mus musculus (House Mouse)*	Y		
256.		*Myandra bicincta*			
257.	25420	*Myobatrachus gouldii (Turtle Frog)*			
258.		*Nannoperca vittata*			
259.	25248	*Neelaps bimaculatus (Black-naped Snake)*			
260.	25249	*Neelaps calonotos (Black-striped Snake, black-striped burrowing snake)*		P3	
261.		*Nematoda sp.*			
262.	25686	*Neochmia temporalis (Red-browed Finch)*	Y		
263.	24738	*Neophema elegans (Elegant Parrot)*			
264.	24739	*Neophema petrophila (Rock Parrot)*			
265.		*Nicodamus mainae*			
266.	25747	*Ninox connivens (Barking Owl)*			
267.	25252	*Notechis scutatus (Tiger Snake)*			
268.		*Notiasemus glauerti*			
269.		*Notonectidae sp.*			
270.	25564	*Nycticorax caledonicus (Rufous Night Heron)*			
271.	24194	*Nyctophilus geoffroyi (Lesser Long-eared Bat)*			
272.		*Occiperipatoides gilesii*			
273.	24407	*Ocyphaps lophotes (Crested Pigeon)*			
274.		*Oligochaeta sp.*			
275.		*Ommatoiulus moreletii*			
276.		*Onychohydrus sp.*			
277.		*Oribatida sp.*			
278.		*Orthocladiinae sp.*			
279.		*Orthocladiinae sp. C = V44 Gymnometriocnemus (SAP)*			
280.		*Oxyopes gracilipes*			
281.	24328	*Oxyura australis (Blue-billed Duck)*		P4	
282.	25680	*Pachycephala rufiventris (Rufous Whistler)*			
283.	24624	*Pachycephala rufiventris subsp. rufiventris (Rufous Whistler)*			
284.		*Palaemonidae sp.*			
285.		*Paramerina levidensis*			
286.		*Paramphisopus palustris*			
287.	25253	*Parasuta gouldii*			
288.	25681	*Pardalotus punctatus (Spotted Pardalote)*			
289.	25682	*Pardalotus striatus (Striated Pardalote)*			
290.	24628	*Pardalotus striatus subsp. murchisoni (Striated Pardalote)*			
291.	24648	*Pelecanus conspicillatus (Australian Pelican)*			
292.	48060	*Petrochelidon ariel (Fairy Martin)*			
293.	48061	*Petrochelidon nigricans (Tree Martin)*			
294.	48066	*Petroica boodang (Scarlet Robin)*			
295.	24659	*Petroica goodenovii (Red-capped Robin)*			
296.	25697	*Phalacrocorax carbo (Great Cormorant)*			
297.	25698	*Phalacrocorax melanoleucos (Little Pied Cormorant)*			
298.	24667	*Phalacrocorax sulcirostris (Little Black Cormorant)*			
299.	25699	*Phalacrocorax varius (Pied Cormorant)*			
300.	24409	*Phaps chalcoptera (Common Bronzewing)*			
301.	48070	*Phascogale tapoatafa subsp. wambenger (South-western Brush-tailed Phascogale, Wambenger)*		T	
302.		*Phreatoicidae sp.*			
303.		*Phryganoporus gausapatus subsp. occidentalis*			Y
304.	48071	*Phylidonyris niger (White-cheeked Honeyeater)*			
305.	24596	*Phylidonyris novaehollandiae (New Holland Honeyeater)*			
306.		*Physidae sp.*			
307.		*Planicirclus alticarinatus*			
308.		*Planorbidae sp.*			
309.	24841	*Platalea flavipes (Yellow-billed Spoonbill)*			
310.	24842	*Platalea regia (Royal Spoonbill)*			
311.	25720	*Platycercus icterotis (Western Rosella)*			
312.	24745	*Platycercus icterotis subsp. icterotis (Western Rosella)*			
313.	25721	*Platycercus zonarius (Australian Ringneck, Ring-necked Parrot)*			
314.	24751	*Platycercus zonarius subsp. zonarius (Port Lincoln Parrot)*			
315.	25007	*Pletholax gracilis subsp. gracilis (Keeled Legless Lizard)*			
316.	25703	*Podargus strigoides (Tawny Frogmouth)*			
317.	24679	*Podargus strigoides subsp. brachypterus (Tawny Frogmouth)*			
318.	25510	*Pogona minor (Dwarf Bearded Dragon)*			
319.	24907	*Pogona minor subsp. minor (Dwarf Bearded Dragon)*			
320.	24681	*Poliocephalus poliocephalus (Hoary-headed Grebe)*			

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321.		*Poltys laciniosus*			
322.		*Polygonarea repanda*			Y
323.	25731	*Porphyrio porphyrio (Purple Swamphen)*			
324.	24767	*Porphyrio porphyrio subsp. bellus (Purple Swamphen)*			
325.	24771	*Porzana tabuensis (Spotless Crake)*			
326.		*Procladius paludicola*			
327.		*Procladius sp. (normal claws)*			
328.	25261	*Pseudechis australis (Mulga Snake)*			
329.	25345	*Pseudemydura umbrina (Western Swamp Tortoise, Western Swamp Turtle)*		T	
330.	25259	*Pseudonaja affinis subsp. affinis (Dugite)*			
331.	25433	*Pseudophryne guentheri (Crawling Toadlet)*			
332.	25710	*Pterodroma macroptera (Great-winged Petrel)*			
333.	24173	*Pteropus scapulatus (Little Red Flying-fox)*			
334.		*Purpureicephalus spurius*			
335.	24245	*Rattus rattus (Black Rat)*	Y		
336.		*Raveniella cirrata*			
337.		*Raveniella peckorum*			
338.		*Rhantus suturalis*			
339.	48096	*Rhipidura albiscapa (Grey Fantail)*			
340.	25614	*Rhipidura leucophrys (Willie Wagtail)*			
341.	24199	*Scotorepens balstoni (Inland Broad-nosed Bat)*			
342.	25534	*Sericornis frontalis (White-browed Scrubwren)*			
343.		*Simocephalus elizabethae*			
344.		*Simuliidae sp.*			
345.	30948	*Smicrornis brevirostris (Weebill)*			
346.		*Spencerhydrus sp.*			Y
347.	24645	*Stagonopleura oculata (Red-eared Firetail)*			
348.		*Steatoda grossa*			
349.		*Sternopriscus sp.*			
350.	25655	*Stipiturus malachurus (Southern Emu-wren)*			
351.		*Storena formosa*			
352.	24426	*Strepera versicolor subsp. plumbea (Grey Currawong)*			
353.	25589	*Streptopelia chinensis (Spotted Turtle-Dove)*	Y		
354.	25590	*Streptopelia senegalensis (Laughing Turtle-Dove)*	Y		
355.	24943	*Strophurus spinigerus subsp. inornatus*			
356.	24942	*Strophurus spinigerus subsp. spinigerus*			
357.		*Supunna funerea*			
358.		*Tabanidae sp.*			
359.	25705	*Tachybaptus novaehollandiae (Australasian Grebe, Black-throated Grebe)*			
360.	24682	*Tachybaptus novaehollandiae subsp. novaehollandiae (Australasian Grebe, Black-throated Grebe)*			
361.	24331	*Tadorna tadornoides (Australian Shelduck, Mountain Duck)*			
362.		*Tanypodinae sp.*			
363.		*Tanytarsus fuscithorax*			
364.	24167	*Tarsipes rostratus (Honey Possum, Noolbenger)*			
365.		*Tasmanicosa leuckartii*			
366.		*Testudinella patina*			
367.	24845	*Threskiornis spinicollis (Straw-necked Ibis)*			
368.	25519	*Tiliqua rugosa*			
369.	25204	*Tiliqua rugosa subsp. aspera*			
370.	25207	*Tiliqua rugosa subsp. rugosa*			
371.		*Tipulidae sp.*			
372.	25549	*Todiramphus sanctus (Sacred Kingfisher)*			
373.	24309	*Todiramphus sanctus subsp. sanctus (Sacred Kingfisher)*			
374.	48141	*Tribonyx ventralis (Black-tailed Native-hen)*			
375.		*Trichocerca similis*			
376.	25723	*Trichoglossus haematodus (Rainbow Lorikeet)*			
377.	24755	*Trichoglossus haematodus subsp. moluccanus (Rainbow Lorikeet)*	Y		
378.	24806	*Tringa glareola (Wood Sandpiper)*		IA	
379.	24808	*Tringa nebularia (Common Greenshank, greenshank)*		IA	
380.		*Triplectides australis*			
381.		*Turbellaria sp.*			
382.	48147	*Turnix varius (Painted Button-quail)*			
383.	24852	*Tyto alba subsp. delicatula (Barn Owl)*			
384.	24983	*Underwoodisaurus milii (Barking Gecko)*			
385.		*Urodacus novaehollandiae*			
386.		*Urodacus planimanus*			
387.	25218	*Varanus gouldii (Bungarra or Sand Monitor)*			
388.	25225	*Varanus rosenbergi (Heath Monitor)*			
389.	25526	*Varanus tristis (Racehorse Monitor)*			

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390.		*Venator immansueta*			
391.		*Venatrix arenaris*			
392.		*Venatrix pullastra*			
393.	24206	*Vespadelus regulus (Southern Forest Bat)*			
394.	34113	*Westralunio carteri (Carter's Freshwater Mussel)*		T	
395.	25765	*Zosterops lateralis (Grey-breasted White-eye, Silvereye)*			
Fungi					
396.	45014	*Amanita quenda*		P1	
397.	43542	*Amanita wadjukiorum*		P3	
398.	38757	*Amanita xanthocephala*			
399.		*Boletus sp.*			
400.	38774	*Cortinarius archeri*			
401.		*Cortinarius sublargus*			Y
402.		*Dermocybe clelandii*			
403.	38784	*Descomyces albus*			
404.	27748	*Flavoparmelia rutidota*			
405.		*Fomitopsis lilacinogilva*			
406.		*Gymnopilus purpuratus*			
407.		*Hygrocybe astatogala*			Y
408.	38800	*Labyrinthomyces varius*			
409.		*Lactarius clarkeae*			
410.	38804	*Lactarius eucalypti*			
411.		*Phytophthora cinnamomi*			
412.	38825	*Pluteus pauperculus*			
413.	38836	*Russula erumpens*			
414.		*Scleroderma cepa*			
415.		*Tubaria rufofulva*			
416.	45896	*Ustilago bromivora*			
417.	45902	*Ustilago nuda*			
418.	45906	*Ustilago tepperi*			
Plantae					
419.	19708	*Abutilon grandifolium*	Y		
420.	15429	*Acacia alata var. alata*			
421.	3219	*Acacia anomala (Grass Wattle)*		T	
422.	3220	*Acacia aphylla (Leafless Rock Wattle)*		T	
423.	15466	*Acacia applanata*			
424.	3233	*Acacia barbinervis*			
425.	3294	*Acacia dentifera*			
426.	11926	*Acacia drewiana subsp. drewiana*			
427.	3373	*Acacia horridula*		P3	
428.	3374	*Acacia huegelii*			
429.	3382	*Acacia incrassata*			
430.	3409	*Acacia lasiocarpa (Panjang)*			
431.	11611	*Acacia lasiocarpa var. lasiocarpa*			
432.	3454	*Acacia nervosa (Rib Wattle)*			
433.	3464	*Acacia obovata*			
434.	14131	*Acacia oncinophylla subsp. patulifolia*		P4	
435.	17860	*Acacia podalyriifolia*	Y		
436.	3502	*Acacia pulchella (Prickly Moses)*			
437.	15481	*Acacia pulchella var. glaberrima*			
438.	15483	*Acacia pulchella var. pulchella*			
439.	30033	*Acacia saligna subsp. lindleyi*			
440.	3541	*Acacia sessilis*			
441.	3557	*Acacia stenoptera (Narrow Winged Wattle)*			
442.	3574	*Acacia teretifolia*			
443.	3602	*Acacia willdenowiana (Grass Wattle)*			
444.	1205	*Acanthocarpus canaliculatus*			
445.	7811	*Acanthospermum hispidum (Starburr)*	Y		
446.	6205	*Actinotus leucocephalus (Flannel Flower)*			
447.	14970	*Adenanthos barbiger*			
448.	1775	*Adenanthos cygnorum (Common Woollybush)*			
449.	11837	*Adenanthos cygnorum subsp. cygnorum (Common Woollybush)*			
450.	18396	*Aeonium haworthii*	Y		
451.	1505	*Agave americana (Century Plant)*	Y		
452.	5316	*Agonis flexuosa (Peppermint, Wonil)*			
453.	179	*Agrostis gigantea (Redtop Bent)*	Y		
454.	23474	*Agrostocrinum hirsutum*			
455.	1261	*Agrostocrinum scabrum (Blue Grass Lily)*			
456.	23501	*Agrostocrinum scabrum subsp. scabrum*			

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457.	184	*Aira caryophyllea (Silvery Hairgrass)*	Y		
458.	185	*Aira cupaniana (Silvery Hairgrass)*	Y		
459.	1056	*Alexgeorgea nitens*			
460.	1374	*Allium ampeloprasum*	Y		
461.	1728	*Allocasuarina fraseriana (Sheoak, Kondil)*			
462.	1732	*Allocasuarina humilis (Dwarf Sheoak)*			
463.	1734	*Allocasuarina microstachya*			
464.	2648	*Alternanthera denticulata (Lesser Joyweed)*			
465.	7820	*Ambrosia artemisiifolia (Annual Ragweed, Bitterweed, Hay-feverweed, Hog-weed)*	Y		
466.	7821	*Ambrosia psilostachya (Perennial Ragweed)*	Y		
467.	13380	*Amphibromus nervosus*			
468.	197	*Amphipogon debilis*			
469.	199	*Amphipogon strictus (Greybeard Grass)*			
470.	200	*Amphipogon turbinatus*			
471.	1058	*Anarthria gracilis*			
472.	1059	*Anarthria humilis*			
473.	1060	*Anarthria laevis*			
474.	6300	*Andersonia aristata (Rice Flower)*			
475.	6309	*Andersonia gracilis*		T	
476.	6312	*Andersonia involucrata*			
477.	6314	*Andersonia lehmanniana*			
478.	11471	*Andersonia lehmanniana subsp. lehmanniana*			
479.	7833	*Angianthus preissianus*			
480.	1406	*Anigozanthos bicolor (Little Kangaroo Paw)*			
481.	11470	*Anigozanthos bicolor subsp. bicolor*			
482.	1409	*Anigozanthos humilis (Catspaw)*			
483.	11434	*Anigozanthos humilis subsp. humilis*			
484.	1411	*Anigozanthos manglesii (Mangles Kangaroo Paw, Kurulbrang)*			
485.	11261	*Anigozanthos manglesii subsp. manglesii*			
486.	1416	*Anigozanthos viridis (Green Kangaroo Paw, Kurulbardang)*			
487.	11566	*Anigozanthos viridis subsp. viridis*			
488.	6946	*Anthocercis gracilis (Slender Tailflower)*		T	
489.	12724	*Anthotium junciforme*			
490.	202	*Anthoxanthum odoratum (Sweet Vernal Grass)*	Y		
491.	3686	*Aotus cordifolia*			
492.	1116	*Aphelia brizula*			
493.	1117	*Aphelia cyperoides*			
494.	1118	*Aphelia drummondii*			
495.	43548	*Aphelia sp. Albany (B.G. Briggs 596)*			
496.	141	*Aponogeton hexatepalus (Stalked Water Ribbons)*		P4	
497.	32314	*Archidium rehmannii*			
498.	7838	*Arctotheca calendula (Cape Weed, African Marigold)*	Y		
499.	1264	*Arnocrinum preissii*			
500.	28288	*Artemisia arborescens (Silver Wormwood)*	Y		
501.	1364	*Asphodelus fistulosus (Onion Weed)*	Y		
502.	20350	*Astartea affinis (West-coast Astartea)*			
503.	20283	*Astartea scoparia (Common Astartea)*			
504.		*Asterella drummondii*			
505.	6323	*Astroloma ciliatum (Candle Cranberry)*			
506.	6327	*Astroloma foliosum (Candle Cranberry)*			
507.	6334	*Astroloma pallidum (Kick Bush)*			
508.	6337	*Astroloma stomarrhena (Red Swamp Cranberry)*			
509.	38480	*Austrostipa bronwenae*		T	
510.	17233	*Austrostipa campylachne*			
511.	17234	*Austrostipa compressa*			
512.	17241	*Austrostipa hemipogon*			
513.	17245	*Austrostipa mollis*			
514.	17254	*Austrostipa tenuifolia*			
515.	17257	*Austrostipa variabilis*			
516.	231	*Avellinia michelii*	Y		
517.	233	*Avena barbata (Bearded Oat)*	Y		
518.	20013	*Axonopus fissifolius*	Y		
519.	18279	*Babiana angustifolia*	Y		
520.	36441	*Babingtonia camphorosmae (Camphor Myrtle)*			
521.	45403	*Babingtonia pelloeae (Pelloe's Babingtonia)*			
522.	45402	*Babingtonia urbana (Coastal Plain Babingtonia)*		P3	
523.	1382	*Baeometra uniflora*	Y		
524.	32682	*Banksia armata var. armata*			
525.	1800	*Banksia attenuata (Slender Banksia, Piara)*			
526.	32580	*Banksia dallanneyi var. dallanneyi*			

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527.	32577	*Banksia dallanneyi var. mellicula*			
528.	1819	*Banksia grandis (Bull Banksia, Pulgarla)*			
529.	1822	*Banksia ilicifolia (Holly-leaved Banksia)*			
530.	1823	*Banksia incana*			
531.	33399	*Banksia incana var. incana*			
532.	1834	*Banksia menziesii (Firewood Banksia)*			
533.	32211	*Banksia mimica (Summer Honeypot)*		T	
534.	32202	*Banksia nivea (Honeypot Dryandra, Pudjarn)*			
535.	32138	*Banksia pteridifolia subsp. vernalis*		P3	
536.	32080	*Banksia sessilis var. sessilis*			
537.	1852	*Banksia telmatiaea (Swamp Fox Banksia)*			
538.	32031	*Banksia vestita (Summer Dryandra)*			
539.	1855	*Banksia victoriae (Woolly Orange Banksia)*			
540.	32315	*Barbula calycina*			
541.	32321	*Bartramia breutelii*			
542.	32323	*Bartramia pseudostricta*			
543.	15037	*Bartsia trixago*	Y		
544.	740	*Baumea arthrophylla*			
545.	743	*Baumea juncea (Bare Twigrush)*			
546.	747	*Baumea rubiginosa*			
547.	5387	*Beaufortia macrostemon (Darling Range Beaufortia)*			
548.	5393	*Beaufortia squarrosa (Sand Beaufortia, Sand Bottlebrush, Puno)*			
549.	4413	*Boronia crenulata (Aniseed Boronia)*			
550.	16636	*Boronia crenulata subsp. viminea*			
551.	11503	*Boronia crenulata var. crenulata*			
552.	4414	*Boronia cymosa (Granite Boronia)*			
553.	4432	*Boronia ovata*			
554.	4438	*Boronia ramosa*			
555.	11381	*Boronia ramosa subsp. anethifolia*			
556.	11564	*Boronia ramosa subsp. ramosa*			
557.	4444	*Boronia tenuis (Blue Boronia)*		P4	
558.	1272	*Borya scirpoidea*			
559.	1273	*Borya sphaerocephala (Pincushions)*			
560.	3710	*Bossiaea eriocarpa (Common Brown Pea)*			
561.	3714	*Bossiaea ornata (Broad Leaved Brown Pea)*			
562.	7867	*Brachyscome bellidioides*			
563.	3000	*Brassica tournefortii (Mediterranean Turnip)*	Y		
564.	244	*Briza maxima (Blowfly Grass)*	Y		
565.	245	*Briza minor (Shivery Grass)*	Y		
566.	249	*Bromus diandrus (Great Brome)*	Y		
567.	250	*Bromus hordeaceus (Soft Brome)*	Y		
568.	1366	*Bulbine semibarbata (Leek Lily)*			
569.	1383	*Burchardia bairdiae*			
570.	12770	*Burchardia congesta*			
571.	1385	*Burchardia multiflora (Dwarf Burchardia)*			
572.	3178	*Byblis gigantea (Rainbow Plant)*		P3	
573.	1276	*Caesia micrantha (Pale Grass Lily)*			
574.	1277	*Caesia occidentalis*			
575.	15330	*Caladenia arenicola*			
576.	44900	*Caladenia denticulata subsp. rubella*			
577.	1590	*Caladenia ferruginea (Rusty Spider Orchid)*			
578.	1592	*Caladenia flava (Cowslip Orchid)*			
579.	15348	*Caladenia flava subsp. flava*			
580.	13859	*Caladenia longicauda subsp. clivicola*			
581.	15365	*Caladenia longicauda subsp. longicauda*			
582.	17760	*Caladenia nobilis*			
583.	15503	*Caladenia paludosa*			
584.	2854	*Calandrinia granulifera (Pygmy Purslane)*			
585.	2856	*Calandrinia liniflora (Parakeelya)*			
586.	20096	*Calandrinia sp. Piawaning (A.C. Beauglehole 12257)*		P1	
587.	1213	*Calectasia cyanea (Blue Tinsel Lily)*		T	
588.	1214	*Calectasia grandiflora (Blue Tinsel Lily)*			
589.	19309	*Calectasia narragara*			
590.	4717	*Callitriche stagnalis (Common Starwort)*	Y		
591.	36520	*Callitris acuminata (Dwarf Cypress)*			
592.	36600	*Callitris pyramidalis (Swamp Cypress)*			
593.	5411	*Calothamnus hirsutus*			
594.	5426	*Calothamnus quadrifidus (One-sided Bottlebrush, Kwowdjard)*			
595.	35816	*Calothamnus quadrifidus subsp. quadrifidus*			
596.	5428	*Calothamnus rupestris (Mouse Ears)*			

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597.	5431	*Calothamnus torulosus*			
598.	5437	*Calytrix acutifolia*			
599.	5439	*Calytrix angulata (Yellow Starflower)*			
600.	5441	*Calytrix aurea*			
601.	13653	*Calytrix breviseta subsp. breviseta*		T	
602.	5458	*Calytrix flavescens (Summer Starflower)*			
603.	5460	*Calytrix fraseri (Pink Summer Calytrix)*			
604.	5461	*Calytrix glutinosa*			
605.	5485	*Calytrix variabilis*			
606.	19713	*Campsis radicans*	Y		
607.	32461	*Campylopus bicolor var. bicolor*			
608.	32338	*Campylopus introflexus*	Y		
609.	11351	*Cassytha aurea var. hirta*			
610.	2951	*Cassytha flava (Dodder Laurel)*			
611.	2952	*Cassytha glabella (Tangled Dodder Laurel)*			
612.	11501	*Cassytha glabella forma casuarinae*			
613.	2956	*Cassytha pomiformis (Dodder Laurel)*			
614.	2957	*Cassytha racemosa (Dodder Laurel)*			
615.	11242	*Cassytha racemosa forma pilosa*			
616.	11799	*Cassytha racemosa forma racemosa*			
617.	760	*Caustis dioica*			
618.	6539	*Centaurium erythraea (Common Centaury)*	Y		
619.	7918	*Centipeda cunninghamii (Common Sneezewood, Gukwonderuk, Old Man Weed)*			
620.		*Centratherum punctatum*			
621.	1121	*Centrolepis aristata (Pointed Centrolepis)*			
622.	1123	*Centrolepis caespitosa*		P4	
623.	1125	*Centrolepis drummondiana*			
624.	1129	*Centrolepis glabra (Smooth Centrolepis)*			
625.	1131	*Centrolepis inconspicua*			
626.	43642	*Centrolepis sp. Kalannie (B.J. Lepschi et al. BJL 3517)*			
627.	17685	*Chaetanthus aristatus*			
628.	1280	*Chamaescilla corymbosa (Blue Squill)*			
629.	11299	*Chamaescilla corymbosa var. corymbosa*			
630.	19338	*Chamaescilla gibsonii*		P3	
631.	8788	*Chamaescilla versicolor*			
632.	1513	*Chasmanthe floribunda (African Cornflag)*	Y		
633.	31	*Cheilanthes austrotenuifolia*			
634.	3169	*Cheiranthera preissiana*			
635.	17706	*Chordifex sinuosus*			
636.	763	*Chorizandra enodis (Black Bristlerush)*			
637.	764	*Chorizandra multiarticulata*			
638.	3753	*Chorizema dicksonii (Yellow-eyed Flame Pea)*			
639.	11900	*Chrysanthemoides monilifera subsp. monilifera*	Y		
640.	6543	*Cicendia filiformis (Slender Cicendia)*	Y		
641.	7370	*Citrullus lanatus (Pie Melon)*	Y		
642.	2929	*Clematis pubescens (Common Clematis)*			
643.	32999	*Colocasia esculenta var. esculenta*	Y		
644.	4550	*Comesperma calymega (Blue-spike Milkwort)*			
645.	4551	*Comesperma ciliatum*			
646.	14663	*Comesperma griffinii*		P2	
647.	4560	*Comesperma rhadinocarpum (Slender-fruited Comesperma)*		P2	
648.	4564	*Comesperma virgatum (Milkwort)*			
649.	40864	*Commersonia cygnorum*			
650.	15607	*Conospermum acerosum subsp. acerosum*			
651.	15041	*Conospermum canaliculatum*			
652.	16853	*Conospermum capitatum subsp. glabratum*			
653.	1875	*Conospermum huegelii (Slender Smokebush)*			
654.	1882	*Conospermum stoechadis (Common Smokebush)*			
655.	1885	*Conospermum triplinervium (Tree Smokebush)*			
656.	13999	*Conospermum undulatum*		T	
657.	6347	*Conostephium minus (Pink-tipped Pearl flower)*			
658.	6348	*Conostephium pendulum (Pearl Flower)*			
659.	6349	*Conostephium preissii*			
660.	11826	*Conostylis aculeata subsp. aculeata*			
661.	12109	*Conostylis aculeata subsp. preissii*			
662.	1420	*Conostylis androstemma (Trumpets)*			
663.	1423	*Conostylis aurea (Golden Conostylis)*			
664.	1429	*Conostylis caricina*			
665.	12035	*Conostylis caricina subsp. caricina*			
666.	1434	*Conostylis festucacea*			

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667.	11695	*Conostylis festucacea subsp. festucacea*			
668.	1436	*Conostylis juncea*			
669.	1437	*Conostylis latens*			
670.	11388	*Conostylis pauciflora subsp. euryrhipis*		P4	
671.	1454	*Conostylis setigera (Bristly Cottonhead)*			
672.	11597	*Conostylis setigera subsp. setigera*			
673.	1455	*Conostylis setosa (White Cottonhead)*			
674.	5502	*Conothamnus trinervis*			
675.	20074	*Conyza sumatrensis*	Y		
676.	48259	*Cortaderia selloana subsp. selloana*	Y		
677.	17104	*Corymbia calophylla (Marri)*			
678.	7945	*Cotula coronopifolia (Waterbuttons)*	Y		
679.	13354	*Craspedia variabilis*			
680.	17701	*Crassula closiana*			
681.	3137	*Crassula colorata (Dense Stonecrop)*			
682.	11563	*Crassula colorata var. colorata*			
683.	3138	*Crassula decumbens (Rufous Stonecrop)*			
684.	3142	*Crassula natans*	Y		
685.	18397	*Crassula tetragona subsp. robusta*	Y		
686.	29054	*Crepis foetida subsp. foetida (Stinking Hawksbeard)*	Y		
687.	35838	*Cristonia biloba subsp. biloba*			
688.	13470	*Cryptandra arbutiflora var. arbutiflora*			
689.	4809	*Cryptandra pungens*			
690.	11021	*Cuscuta planiflora*	Y		
691.	15114	*Cyanicula gemmata*			
692.	15404	*Cyanicula sericea*			
693.	51	*Cyathea cooperi*	Y		
694.	768	*Cyathochaeta avenacea*			
695.	769	*Cyathochaeta clandestina*			
696.	17618	*Cyathochaeta equitans*			
697.	40661	*Cycnogeton lineare*			
698.	283	*Cynodon dactylon (Couch)*	Y		
699.	285	*Cynosurus echinatus (Rough Dogstail)*	Y		
700.	783	*Cyperus congestus (Dense Flat-sedge)*	Y		
701.	18198	*Cyperus papyrus*	Y		
702.	815	*Cyperus tenellus (Tiny Flatsedge)*	Y		
703.	816	*Cyperus tenuiflorus (Scaly Sedge)*	Y		
704.	17692	*Cytogonidium leptocarpoides*			
705.	7420	*Dampiera alata (Winged-stem Dampiera)*			
706.	7428	*Dampiera coronata (Wedge-leaved Dampiera)*			
707.	7454	*Dampiera linearis (Common Dampiera)*			
708.	7462	*Dampiera pedunculata*			
709.	5505	*Darwinia apiculata (Scarp Darwinia)*		T	
710.	5508	*Darwinia citriodora (Lemon-scented Darwinia)*			
711.	18193	*Darwinia thymoides subsp. thymoides*			
712.	1218	*Dasypogon bromeliifolius (Pineapple Bush)*			
713.	1220	*Dasypogon obliquifolius*			
714.	6218	*Daucus glochidiatus (Australian Carrot)*			
715.	3793	*Daviesia angulata*			
716.	3799	*Daviesia cordata (Bookleaf)*			
717.	3805	*Daviesia decurrens (Prickly Bitter-pea)*			
718.	19747	*Daviesia decurrens subsp. decurrens*			
719.	18560	*Daviesia divaricata subsp. divaricata*			
720.	3815	*Daviesia horrida (Prickly Bitter-pea)*			
721.	3824	*Daviesia nudiflora*			
722.	3832	*Daviesia physodes*			
723.	3834	*Daviesia polyphylla*			
724.	3839	*Daviesia rhombifolia*			
725.	3845	*Daviesia triflora*			
726.	17336	*Dennstaedtia davallioides*	Y		Y
727.	17663	*Desmocladus asper*			
728.	17691	*Desmocladus fasciculatus*			
729.	11636	*Dianella revoluta var. divaricata*			
730.	1287	*Dichopogon capillipes*			
731.	32345	*Didymodon australasiae*			
732.	17838	*Dielsia stenostachya*			
733.	311	*Digitaria ciliaris (Summer Grass)*	Y		
734.	316	*Digitaria longiflora*			
735.	320	*Digitaria sanguinalis (Crab Grass)*	Y		
736.	1509	*Dioscorea hastifolia (Warrine, Wararn)*			

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737.	18589	*Diplopeltis huegelii subsp. lehmannii*			
738.	3867	*Dipogon lignosus (Dolichos Pea)*	Y		
739.	19649	*Disa bracteata*	Y		
740.	32347	*Ditrichum difficile*			
741.	7961	*Dittrichia graveolens (Stinkwort)*	Y		
742.	12943	*Diuris brumalis*			
743.	11049	*Diuris corymbosa*			
744.	1634	*Diuris laxiflora (Bee Orchid)*			
745.	1637	*Diuris purdiei (Purdie's Donkey Orchid)*		T	
746.	4757	*Dodonaea ceratocarpa*			
747.	15406	*Drakaea gracilis*			
748.	3095	*Drosera erythrorhiza (Red Ink Sundew)*			
749.	13211	*Drosera erythrorhiza subsp. collina*			
750.	3097	*Drosera gigantea (Giant Sundew)*			
751.	15453	*Drosera gigantea subsp. gigantea*			
752.	3098	*Drosera glanduligera (Pimpernel Sundew)*			
753.	13195	*Drosera helodes*			
754.	3101	*Drosera heterophylla (Swamp Rainbow)*			
755.	13197	*Drosera hyperostigma*			
756.	3106	*Drosera macrantha (Bridal Rainbow)*			
757.	14298	*Drosera macrantha subsp. macrantha*			
758.	3109	*Drosera menziesii (Pink Rainbow)*			
759.	11853	*Drosera menziesii subsp. menziesii*			
760.	13216	*Drosera menziesii subsp. penicillaris*			
761.	3110	*Drosera microphylla (Golden Rainbow)*			
762.	3115	*Drosera occidentalis (Western Sundew)*			
763.	13191	*Drosera occidentalis subsp. occidentalis*		P4	
764.	3118	*Drosera pallida (Pale Rainbow)*			
765.	3123	*Drosera platystigma (Black-eyed Sundew)*			
766.	3125	*Drosera pycnoblasta (Pearly Sundew)*			
767.	8911	*Drosera rosulata*			
768.	3131	*Drosera stolonifera (Leafy Sundew)*			
769.	3135	*Drosera zonaria (Painted Sundew)*			
770.	33500	*Dysphania ambrosioides (Mexican Tea)*	Y		
771.	7374	*Ecballium elaterium (Squirting Cucumber)*	Y		
772.	32351	*Eccremidium pulchellum*			
773.	328	*Echinochloa colona (Awnless Barnyard Grass)*	Y		
774.	11105	*Echinochloa crus-galli*	Y		
775.	329	*Echinochloa crus-pavonis (South American Barnyard Grass)*	Y		
776.	16093	*Echinochloa esculenta*	Y		
777.	8450	*Eclipta prostrata*	Y		
778.	347	*Ehrharta calycina (Perennial Veldt Grass)*	Y		
779.	349	*Ehrharta longiflora (Annual Veldt Grass)*	Y		
780.	5187	*Elatine gratioloides (Waterwort)*			
781.	822	*Eleocharis acuta (Common Spikerush)*			
782.	17605	*Eleocharis keigheryi*		T	
783.	352	*Eleusine coracan (Indian Millet)*	Y		
784.	353	*Eleusine indica (Crowsfoot Grass)*	Y		
785.	1644	*Elythranthera emarginata (Pink Enamel Orchid)*			
786.	32353	*Entosthodon apophysatus*			
787.	32354	*Entosthodon productus*			
788.	374	*Eragrostis cilianensis (Stinkgrass)*	Y		
789.	376	*Eragrostis curvula (African Lovegrass)*	Y		
790.	379	*Eragrostis elongata (Clustered Lovegrass)*			
791.		*Eragrostis sp.*			
792.	5540	*Eremaea fimbriata*			
793.	5541	*Eremaea pauciflora*			
794.	14103	*Eremaea pauciflora var. calyptra*			
795.	14104	*Eremaea pauciflora var. pauciflora*			
796.	17150	*Eremophila glabra subsp. chlorella*		T	
797.	15414	*Eriochilus helonomos*			
798.	6219	*Eryngium pinnatifidum (Blue Devils)*			
799.	41801	*Eryngium pinnatifidum subsp. Palustre (G.J. Keighery 13459)*		P3	
800.	15446	*Eryngium pinnatifidum subsp. pinnatifidum*			
801.	41810	*Eryngium sp. Subdecumbens (G.J. Keighery 5390)*		P3	
802.	18299	*Erythrina x sykesii*	Y		
803.	5580	*Eucalyptus camaldulensis (River Gum, Yabalinyba)*			
804.	5708	*Eucalyptus marginata (Jarrah, Djara)*			
805.	13547	*Eucalyptus marginata subsp. marginata (Jarrah)*			
806.	13548	*Eucalyptus marginata subsp. thalassica (Blue-leaved Jarrah)*			

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807.	5763	*Eucalyptus rudis (Flooded Gum, Kulurda)*			
808.	5797	*Eucalyptus wandoo (Wandoo, Wondu)*			
809.	12906	*Eucalyptus wandoo subsp. wandoo*			
810.	3872	*Euchilopsis linearis (Swamp Pea)*			
811.	3880	*Eutaxia virgata*			
812.	32367	*Fissidens megalotis*			
813.	32368	*Fissidens taylorii*			
814.	32469	*Fissidens taylorii var. taylorii*			
815.		*Fossombronia altilamellosa*			
816.	2969	*Fumaria capreolata (Whiteflower Fumitory)*	Y		
817.	31532	*Fumaria muralis subsp. muralis*	Y		
818.		*Fumaria sp.*			
819.	32370	*Funaria hygrometrica*			
820.	900	*Gahnia aristata*			
821.	907	*Gahnia trifida (Coast Saw-sedge)*			
822.	7321	*Galium divaricatum*	Y		
823.	3887	*Gastrolobium acutum*			
824.	20475	*Gastrolobium capitatum*			
825.	20483	*Gastrolobium linearifolium*			
826.	3912	*Gastrolobium oxylobioides (Champion Bay Poison)*			
827.	3923	*Gastrolobium spathulatum (Poison Bush)*			
828.	16311	*Gazania linearis*	Y		
829.	32374	*Gemmabryum cheelii*			
830.	32375	*Gemmabryum chrysoneuron*			
831.	32379	*Gemmabryum inaequale*			
832.	32380	*Gemmabryum pachythecum*			
833.	32381	*Gemmabryum preissianum*			
834.	32383	*Gemmabryum sullivanii*			
835.	3936	*Genista linifolia (Flaxleaf Broom)*	Y		
836.	32384	*Gigaspermum repens*			
837.	18298	*Gladiolus carneus*	Y		
838.	1520	*Gladiolus caryophyllaceus (Wild Gladiolus)*	Y		
839.	6143	*Glischrocaryon aureum (Common Popflower)*			
840.	6587	*Gomphocarpus fruticosus (Narrowleaf Cottonbush)*	Y		
841.	11051	*Gomphocarpus physocarpus*	Y		
842.	10909	*Gompholobium confertum*			
843.	3950	*Gompholobium knightianum*			
844.	3951	*Gompholobium marginatum*			
845.	3954	*Gompholobium polymorphum*			
846.	3955	*Gompholobium preissii*			
847.	3956	*Gompholobium shuttleworthii*			
848.	3957	*Gompholobium tomentosum (Hairy Yellow Pea)*			
849.	6149	*Gonocarpus cordiger*			
850.	6159	*Gonocarpus nodulosus*			
851.	6160	*Gonocarpus paniculatus*			
852.	6161	*Gonocarpus pithyoides*			
853.	29362	*Goodenia coerulea*			
854.	12520	*Goodenia fasciculata*			
855.	7517	*Goodenia incana (Hoary Goodenia)*			
856.	12551	*Goodenia micrantha*			
857.	7538	*Goodenia pulchella*			
858.	19286	*Goodenia pulchella subsp. Coastal Plain A (M. Hislop 634)*			
859.	19284	*Goodenia pulchella subsp. Coastal Plain B (L.W. Sage 2336)*			
860.	14282	*Gratiola pubescens*			
861.	1964	*Grevillea bipinnatifida (Fuchsia Grevillea)*			
862.	19628	*Grevillea bipinnatifida subsp. bipinnatifida*			
863.	1997	*Grevillea endlicheriana (Spindly Grevillea)*			
864.	13450	*Grevillea manglesii subsp. manglesii*			
865.	2066	*Grevillea pilulifera (Woolly-flowered Grevillea)*			
866.	15839	*Grevillea preissii subsp. preissii*			
867.	2080	*Grevillea quercifolia (Oak-leaf Grevillea)*			
868.	2101	*Grevillea synapheae (Catkin Grevillea)*			
869.	2107	*Grevillea thelemanniana (Spider Net Grevillea)*			
870.	2122	*Grevillea wilsonii (Native Fuchsia)*			
871.	1465	*Haemodorum discolor*			
872.	1468	*Haemodorum laxum*			
873.	1469	*Haemodorum loratum*		P3	
874.	1472	*Haemodorum simplex*			
875.	1474	*Haemodorum sparsiflorum*			
876.	2128	*Hakea amplexicaulis (Prickly Hakea)*			

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877.	2136	*Hakea candolleana*			
878.	2137	*Hakea ceratophylla (Horned Leaf Hakea)*			
879.	2143	*Hakea conchifolia (Shell-leaved Hakea)*			
880.	2152	*Hakea cyclocarpa (Ramshorn)*			
881.	2158	*Hakea erinacea (Hedge-hog Hakea)*			
882.	2166	*Hakea incrassata (Marble Hakea)*			
883.	2175	*Hakea lissocarpha (Honey Bush)*			
884.	2185	*Hakea myrtoides (Myrtle Hakea)*			
885.	2197	*Hakea prostrata (Harsh Hakea)*			
886.	2203	*Hakea ruscifolia (Candle Hakea)*			
887.	31793	*Hakea sp. Eastern coastal plain (G.J. Keighery 8014)*			
888.	2206	*Hakea stenocarpa (Narrow-fruited Hakea)*			
889.	2212	*Hakea sulcata (Furrowed Hakea)*			
890.	2214	*Hakea trifurcata (Two-leaf Hakea)*			
891.	2215	*Hakea undulata (Wavy-leaved Hakea)*			
892.	2216	*Hakea varia (Variable-leaved Hakea)*			
893.	3961	*Hardenbergia comptoniana (Native Wisteria)*			
894.	3016	*Heliophila pusilla*	Y		
895.	6838	*Hemiandra linearis (Speckled Snakebush)*			
896.	6839	*Hemiandra pungens (Snakebush)*			
897.	6856	*Hemigenia incana (Silky Hemigenia)*			
898.	41020	*Hemiphora bartlingii (Woolly Dragon)*			
899.	1526	*Hesperantha falcata*	Y		
900.	5108	*Hibbertia acerosa (Needle Leaved Guinea Flower)*			
901.	5112	*Hibbertia aurea*			
902.	5114	*Hibbertia commutata*			
903.	19778	*Hibbertia glomerata subsp. darlingensis*			
904.	5134	*Hibbertia huegelii*			
905.	5135	*Hibbertia hypericoides (Yellow Buttercups)*			
906.	45534	*Hibbertia hypericoides subsp. hypericoides*			
907.	5146	*Hibbertia montana*		P4	
908.	5148	*Hibbertia mylnei*			
909.	5152	*Hibbertia ovata*			
910.	5155	*Hibbertia pilosa (Hairy Guinea Flower)*			
911.	5162	*Hibbertia racemosa (Stalked Guinea Flower)*			
912.	5169	*Hibbertia serrata (Serrate Leaved Guinea Flower)*			
913.		*Hibbertia sp.*			
914.	5171	*Hibbertia spicata*			
915.	11481	*Hibbertia spicata subsp. spicata*			
916.	48381	*Hibbertia striata*			
917.	444	*Holcus lanatus (Yorkshire Fog)*	Y		
918.	6222	*Homalosciadium homalocarpum*			
919.	451	*Hordeum vulgare (Barley)*	Y		
920.	3964	*Hovea chorizemifolia (Holly-leaved Hovea)*			
921.	3966	*Hovea pungens (Devil's Pins, Puyenak)*			
922.	3968	*Hovea trisperma (Common Hovea)*			
923.	12859	*Hovea trisperma var. trisperma*			
924.	18296	*Humulus lupulus*	Y		
925.	12741	*Hyalosperma cotula*			
926.	5216	*Hybanthus calycinus (Wild Violet)*			
927.	6223	*Hydrocotyle alata*			
928.	6226	*Hydrocotyle callicarpa (Small Pennywort)*			
929.	6229	*Hydrocotyle diantha*			
930.	6233	*Hydrocotyle lemnoides (Aquatic Pennywort)*		P4	
931.	452	*Hyparrhenia hirta (Tambookie Grass)*	Y		
932.	5817	*Hypocalymma angustifolium (White Myrtle, Kudjid)*			
933.	35070	*Hypocalymma angustifolium subsp. Swan Coastal Plain (G.J. Keighery 16777)*			
934.	5825	*Hypocalymma robustum (Swan River Myrtle)*			
935.	8086	*Hypochaeris glabra (Smooth Catsear)*	Y		
936.	1070	*Hypolaena exsulca*			
937.	17841	*Hypolaena pubescens*			
938.	910	*Isolepis cernua (Nodding Club-rush)*			
939.	20199	*Isolepis cernua var. cernua*			
940.	20200	*Isolepis cernua var. setiformis*			
941.	912	*Isolepis cyperoides*			
942.	14540	*Isolepis hystrix*	Y		
943.	917	*Isolepis marginata (Coarse Club-rush)*			
944.	919	*Isolepis oldfieldiana*			
945.	2221	*Isopogon asper*			
946.	29775	*Isopogon drummondii*		P3	

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947.	2229	*Isopogon dubius (Pincushion Coneflower)*			
948.	2237	*Isopogon sphaerocephalus (Drumstick Isopogon)*			
949.	7396	*Isotoma hypocrateriformis (Woodbridge Poison)*			
950.	7398	*Isotoma pusilla (Small Isotome)*			
951.	3992	*Isotropis cuneifolia (Granny Bonnets)*			
952.	16317	*Isotropis cuneifolia subsp. glabra*		P2	
953.	1533	*Ixia paniculata*	Y		
954.	1534	*Ixia polystachya (Variable Ixia)*	Y		
955.	3997	*Jacksonia alata*			
956.	3998	*Jacksonia angulata*			
957.	4010	*Jacksonia floribunda (Holly Pea)*			
958.	4012	*Jacksonia furcellata (Grey Stinkwood)*			
959.	4018	*Jacksonia lehmannii*			
960.	4025	*Jacksonia restioides*			
961.	4029	*Jacksonia sternbergiana (Stinkwood, Kapur)*			
962.	1298	*Johnsonia pubescens (Pipe Lily)*			
963.	19632	*Johnsonia pubescens subsp. pubescens*			
964.	1177	*Juncus articulatus (Jointed Rush)*	Y		
965.	1180	*Juncus capitatus (Capitate Rush)*	Y		
966.	1188	*Juncus pallidus (Pale Rush)*			
967.	4037	*Kennedia coccinea (Coral Vine)*			
968.	4044	*Kennedia prostrata (Scarlet Runner)*			
969.	4045	*Kennedia stirlingii (Bushy Kennedia)*			
970.	1221	*Kingia australis (Kingia, Pulonok)*			
971.	5832	*Kunzea ericifolia (Spearwood, Pondil)*			
972.	15498	*Kunzea glabrescens (Spearwood)*			
973.	5835	*Kunzea micrantha*			
974.	17461	*Kunzea micrantha subsp. micrantha*			
975.	3669	*Labichea punctata (Lance-leaved Cassia)*			
976.	20019	*Lachnagrostis filiformis*			
977.	19955	*Lachnagrostis plebeia*			
978.	29046	*Lactuca serriola forma serriola*	Y		
979.	2249	*Lambertia multiflora (Many-flowered Honeysuckle)*			
980.	14083	*Lambertia multiflora var. darlingensis*			
981.	28342	*Landoltia punctata (Thin Duckweed)*			
982.	5025	*Lasiopetalum bracteatum (Helena Velvet Bush)*		P4	
983.	45081	*Lasiopetalum glutinosum subsp. glutinosum*		P3	
984.	4047	*Lathyrus tingitanus (Tangier Pea)*	Y		
985.	4959	*Lawrencia squamata*			
986.	1307	*Laxmannia ramosa (Branching Lily)*			
987.	11911	*Laxmannia ramosa subsp. ramosa*			
988.	11464	*Laxmannia sessiliflora subsp. australis*			
989.	1309	*Laxmannia squarrosa*			
990.	7568	*Lechenaultia biloba (Blue Leschenaultia)*			
991.	1051	*Lemna disperma (Duckweed)*			
992.	925	*Lepidosperma angustatum*			
993.	42741	*Lepidosperma apricola*			
994.	936	*Lepidosperma leptostachyum*			
995.	937	*Lepidosperma longitudinale (Pithy Sword-sedge)*			
996.	940	*Lepidosperma pubisquameum*			
997.	942	*Lepidosperma rostratum*		T	
998.	944	*Lepidosperma scabrum*			
999.		*Lepidosperma sp.*			
1000.	29150	*Lepidosperma sp. Margaret River (B.J. Lepschi 1841)*			
1001.	16284	*Lepidosperma sp. P1 small head (M.D. Tindale 166A)*			
1002.	949	*Lepidosperma tuberculatum*			
1003.	118	*Lepilaena australis (Austral Water Mat)*			
1004.	1653	*Leporella fimbriata (Hare Orchid)*			
1005.	1077	*Leptocarpus canus (Hoary Twine-rush)*			
1006.	1078	*Leptocarpus coangustatus*			
1007.	46375	*Leptocarpus decipiens*			
1008.	1080	*Leptocarpus scariosus*			
1009.	2342	*Leptomeria cunninghamii*			
1010.	5850	*Leptospermum laevigatum (Coast Teatree)*	Y		
1011.	19241	*Lepyrodia curvescens*		P2	
1012.	1085	*Lepyrodia glauca*			
1013.	1088	*Lepyrodia macra (Large Scale Rush)*			
1014.	1090	*Lepyrodia muirii*			
1015.	6367	*Leucopogon capitellatus*			
1016.	6374	*Leucopogon conostephioides*			

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1017.	6397	*Leucopogon glaucifolius*			
1018.	6427	*Leucopogon parviflorus (Coast Beard-heath)*			
1019.	6434	*Leucopogon polymorphus*			
1020.	6436	*Leucopogon propinquus*			
1021.	6439	*Leucopogon pulchellus (Beard-heath)*			
1022.	14637	*Leucopogon sp. Coujinup (M.A. Burgman 1085)*			
1023.	6444	*Leucopogon sprengelioides*			
1024.	6445	*Leucopogon squarrosus*			
1025.	40803	*Leucopogon squarrosus subsp. squarrosus*			
1026.	6447	*Leucopogon strictus*			
1027.	7676	*Levenhookia pusilla (Midget Stylewort)*			
1028.	7677	*Levenhookia stipitata (Common Stylewort)*			
1029.	4363	*Linum trigynum (French Flax)*	Y		
1030.	36160	*Liparophyllum capitatum*			
1031.	7406	*Lobelia rhombifolia (Tufted Lobelia)*			
1032.	7407	*Lobelia rhytidosperma (Wrinkled-seeded Lobelia)*			
1033.	475	*Lolium multiflorum (Italian Ryegrass)*	Y		
1034.	11073	*Lolium x hybridum*	Y		
1035.	1223	*Lomandra caespitosa (Tufted Mat Rush)*			
1036.	1228	*Lomandra hermaphrodita*			
1037.	1229	*Lomandra integra*			
1038.	1232	*Lomandra micrantha (Small-flower Mat-rush)*			
1039.	14542	*Lomandra micrantha subsp. micrantha*			
1040.	1234	*Lomandra nigricans*			
1041.	1236	*Lomandra odora (Tiered Matrush)*			
1042.	1239	*Lomandra preissii*			
1043.	1240	*Lomandra purpurea (Purple Mat Rush)*			
1044.	1243	*Lomandra sericea (Silky Mat Rush)*			
1045.	1245	*Lomandra spartea*			
1046.	1246	*Lomandra suaveolens*			
1047.	7365	*Lonicera japonica (Japanese Honeysuckle)*	Y		
1048.	8564	*Lotus subbiflorus*	Y		
1049.	4063	*Lotus uliginosus (Greater Lotus)*	Y		
1050.	4067	*Lupinus luteus (Yellow Lupin)*	Y		
1051.	1097	*Lyginia barbata*			
1052.	18049	*Lyginia imberbis*			
1053.	36375	*Lysimachia arvensis (Pimpernel)*	Y		
1054.	36373	*Lysimachia minima*	Y		
1055.	6456	*Lysinema ciliatum (Curry Flower)*			
1056.	34736	*Lysinema pentapetalum*			
1057.	5281	*Lythrum hyssopifolia (Lesser Loosestrife)*	Y		
1058.	2839	*Macarthuria australis*			
1059.	17106	*Macarthuria keigheryi*		T	
1060.	85	*Macrozamia riedlei (Zamia, Djiridji)*			
1061.	17636	*Marianthus coeruleopunctatus (Blue-spotted Marianthus)*			
1062.	4079	*Medicago polymorpha (Burr Medic)*	Y		
1063.	4080	*Medicago sativa (Alfalfa)*	Y		
1064.	33638	*Meionectes tenuifolia*		P3	
1065.	37580	*Melaleuca acutifolia*			
1066.	36296	*Melaleuca armillaris subsp. armillaris*	Y		
1067.	5881	*Melaleuca brevifolia*			
1068.	13273	*Melaleuca incana subsp. incana*			
1069.	5926	*Melaleuca lateritia (Robin Redbreast Bush)*			
1070.	5932	*Melaleuca leucadendra*			
1071.	20297	*Melaleuca osullivanii*			
1072.	18394	*Melaleuca parviceps*			
1073.	5958	*Melaleuca radula (Graceful Honeymyrtle)*			
1074.	5959	*Melaleuca rhaphiophylla (Swamp Paperbark)*			
1075.	5961	*Melaleuca scabra (Rough Honeymyrtle, Wurru Bush)*			
1076.	5983	*Melaleuca trichophylla*			
1077.	37683	*Melaleuca viminalis*		P2	
1078.	5987	*Melaleuca viminea (Mohan)*			
1079.	4516	*Melia azedarach (White Cedar)*			
1080.	14985	*Melinis repens*	Y		
1081.	953	*Mesomelaena graciliceps*			
1082.	955	*Mesomelaena pseudostygia*			
1083.	957	*Mesomelaena tetragona (Semaphore Sedge)*			
1084.	485	*Microlaena stipoides (Weeping Grass)*			
1085.	15419	*Microtis media subsp. media*			
1086.	8106	*Millotia tenuifolia (Soft Millotia)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1087.	14344	*Millotia tenuifolia var. tenuifolia (Soft Millotia)*			
1088.	4097	*Mirbelia ramulosa*			
1089.	4100	*Mirbelia spinosa*			
1090.	7410	*Monopsis debilis*	Y		
1091.	37440	*Monopsis debilis var. depressa*	Y		
1092.	4662	*Monotaxis grandiflora (Diamond of the Desert)*			
1093.	19585	*Monotaxis grandiflora var. grandiflora*			
1094.	19179	*Moraea flaccida (One-leaf Cape Tulip)*	Y		
1095.	19178	*Moraea lewisiae*	Y		
1096.	19438	*Moraea ochroleuca*	Y		
1097.	14187	*Myriocephalus occidentalis*			
1098.	6189	*Myriophyllum crispatum*			
1099.	6193	*Myriophyllum echinatum*		P3	
1100.	44496	*Narcissus tazetta subsp. italicus*	Y		
1101.	492	*Neurachne alopecuroidea (Foxtail Mulga Grass)*			
1102.	1381	*Nothoscordum gracile*	Y		
1103.	2401	*Nuytsia floribunda (Christmas Tree, Mudja)*			
1104.	6138	*Oenothera drummondii (Beach Evening Primrose)*	Y		
1105.	20052	*Oenothera jamesii*	Y		
1106.	16347	*Oenothera laciniata*	Y		
1107.	6140	*Oenothera mollissima*	Y		
1108.	14292	*Oenothera stricta subsp. stricta*	Y		
1109.	2365	*Olax benthamiana*			
1110.	2367	*Olax scalariformis*			
1111.	8127	*Olearia axillaris (Coastal Daisybush)*			
1112.	8143	*Olearia paucidentata (Autumn Scrub Daisy)*			
1113.	18254	*Opercularia apiciflora*			
1114.	18255	*Opercularia vaginata (Dog Weed)*			
1115.	5227	*Opuntia stricta (Common Prickly Pear)*	Y		
1116.	46207	*Opuntia tomentosa*	Y		
1117.	36200	*Ornduffia submersa*		P4	
1118.	4113	*Ornithopus compressus (Yellow Serradella)*	Y		
1119.	7122	*Orobanche minor (Lesser Broomrape)*	Y		
1120.	11749	*Orthrosanthus laxus var. laxus (Morning Iris)*			
1121.	168	*Ottelia ovalifolia (Swamp Lily)*			
1122.	14531	*Ottelia ovalifolia subsp. ovalifolia*			
1123.	4348	*Oxalis caprina*	Y		
1124.	4349	*Oxalis corniculata (Yellow Wood Sorrel)*	Y		
1125.	4352	*Oxalis glabra*	Y		
1126.	4355	*Oxalis perennans*			
1127.	4356	*Oxalis pes-caprae (Soursob)*	Y		
1128.	4358	*Oxalis purpurea (Largeflower Wood Sorrel)*	Y		
1129.	20101	*Paragonis grandiflora*			
1130.	7089	*Parentucellia latifolia (Common Bartsia)*	Y		
1131.	7090	*Parentucellia viscosa (Sticky Bartsia)*	Y		
1132.	527	*Paspalum dilatatum*	Y		
1133.	528	*Paspalum distichum (Water Couch)*	Y		
1134.	5225	*Passiflora filamentosa*	Y		
1135.	1542	*Patersonia babianoides*			
1136.	1546	*Patersonia juncea (Rush Leaved Patersonia)*			
1137.	1550	*Patersonia occidentalis (Purple Flag, Koma)*			
1138.	1551	*Patersonia pygmaea (Pygmy Patersonia)*			
1139.	43765	*Pauridia glabella var. glabella*			
1140.	43761	*Pauridia occidentalis var. occidentalis*			
1141.	43762	*Pauridia occidentalis var. quadriloba*			
1142.	10828	*Pavonia hastata*	Y		
1143.	40424	*Pentameris airoides subsp. airoides*	Y		
1144.	40422	*Pentameris pallida*	Y		
1145.	6245	*Pentapeltis peltigera*			
1146.	16477	*Pericalymma ellipticum var. ellipticum*			
1147.	16478	*Pericalymma ellipticum var. floridum*			
1148.	13911	*Persicaria decipiens*			
1149.	2255	*Persoonia angustiflora*			
1150.	2262	*Persoonia elliptica (Spreading Snottygobble)*			
1151.	2273	*Persoonia saccata (Snottygobble)*			
1152.	2284	*Petrophile biloba (Granite Petrophile)*			
1153.	20391	*Petrophile juncifolia*			
1154.	2299	*Petrophile linearis (Pixie Mops)*			
1155.	2301	*Petrophile macrostachya*			
1156.	2308	*Petrophile seminuda*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1157.	2312	*Petrophile striata*			
1158.	19825	*Petrorhagia dubia*	Y		
1159.	547	*Phalaris angusta*	Y		
1160.	551	*Phalaris minor (Lesser Canary Grass)*	Y		
1161.	552	*Phalaris paradoxa (Paradoxa Grass)*	Y		
1162.	20460	*Pheladenia deformis*			
1163.	32409	*Philonotis australiensis*			
1164.	18529	*Philotheca spicata (Pepper and Salt)*			
1165.	1172	*Philydrella drummondii*			
1166.	1173	*Philydrella pygmaea (Butterfly Flowers)*			
1167.	14306	*Philydrella pygmaea subsp. pygmaea*			
1168.	1478	*Phlebocarya ciliata*			
1169.	1479	*Phlebocarya filifolia*			
1170.	16825	*Phyllangium divergens*			
1171.	4675	*Phyllanthus calycinus (False Boronia)*			
1172.	17794	*Phyllanthus tenellus*	Y		
1173.	4	*Phylloglossum drummondii (Pigmy Clubmoss)*			
1174.	6983	*Physalis peruviana (Cape Gooseberry)*	Y		
1175.	2408	*Pilostyles hamiltonii*			
1176.	78	*Pilularia novae-hollandiae (Austral Pillwort)*			
1177.	5231	*Pimelea angustifolia (Narrow-leaved Pimelea)*			
1178.	5238	*Pimelea ciliata (White Banjine)*			
1179.	11928	*Pimelea ciliata subsp. ciliata*			
1180.	11404	*Pimelea imbricata var. major*			
1181.	11402	*Pimelea imbricata var. piligera*			
1182.	5260	*Pimelea rara (Summer Pimelea)*		P4	
1183.	12041	*Pimelea suaveolens subsp. suaveolens*			
1184.	5268	*Pimelea sulphurea (Yellow Banjine)*			
1185.	8163	*Pithocarpa corymbulosa (Corymbose Pithocarpa)*		P3	
1186.	8165	*Pithocarpa pulchella (Beautiful Pithocarpa)*			
1187.	18352	*Pithocarpa pulchella var. melanostigma*			
1188.	7303	*Plantago lanceolata (Ribwort Plantain)*	Y		
1189.	6253	*Platysace filiformis*			
1190.	6255	*Platysace juncea*			
1191.	11132	*Platysace ramosissima*		P3	
1192.	32478	*Pleuridium nervosum var. nervosum*			
1193.	571	*Poa annua (Winter Grass)*	Y		
1194.	573	*Poa drummondiana (Knotted Poa)*			
1195.	8175	*Podolepis gracilis (Slender Podolepis)*			
1196.	8177	*Podolepis lessonii*			
1197.	8182	*Podotheca angustifolia (Sticky Longheads)*			
1198.	8183	*Podotheca chrysantha (Yellow Podotheca)*			
1199.	8188	*Pogonolepis stricta*			
1200.	8395	*Polygala myrtifolia (Myrtleleaf Milkwort)*	Y		
1201.	4578	*Polygala virgata*	Y		
1202.	2416	*Polygonum arenastrum (Sand Wireweed)*	Y		
1203.	2419	*Polygonum aviculare (Wireweed)*	Y		
1204.	582	*Polypogon monspeliensis (Annual Beardgrass)*	Y		
1205.	583	*Polypogon tenellus*			
1206.	4691	*Poranthera microphylla (Small Poranthera)*			
1207.	2884	*Portulaca oleracea (Purslane, Wakati)*			
1208.	1670	*Prasophyllum drummondii (Swamp Leek Orchid)*			
1209.	1672	*Prasophyllum fimbria (Fringed Leek Orchid)*			
1210.	1674	*Prasophyllum giganteum (Bronze Leek Orchid)*			
1211.	16688	*Prasophyllum gracile*			
1212.	1680	*Prasophyllum parvifolium (Autumn Leek Orchid)*			
1213.	10853	*Prasophyllum plumiforme*			
1214.	17211	*Prunus cerasifera*	Y		
1215.	4155	*Psoralea pinnata (African Scurfpea)*	Y		
1216.	13255	*Pterochaeta paniculata*			
1217.	1686	*Pterostylis barbata (Bird Orchid)*			
1218.	12217	*Pterostylis sanguinea*			
1219.	1698	*Pterostylis vittata (Banded Greenhood)*			
1220.	2716	*Ptilotus declinatus (Curved Mulla Mulla)*			
1221.	2720	*Ptilotus esquamatus*			
1222.	2742	*Ptilotus manglesii (Pom Poms, Mulamula)*			
1223.	2753	*Ptilotus pyramidatus*		T	Y
1224.	4172	*Pultenaea ericifolia*			
1225.	16367	*Pyrorchis nigricans (Red beaks, Elephants ears)*			
1226.	8195	*Quinetia urvillei*			

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1227.	13312	*Rhodanthe pyrethrum*			
1228.		*Riccia multifida*			
1229.	6020	*Rinzia crassifolia (Darling Range Rinzia)*			
1230.	17020	*Robinia pseudoacacia*	Y		
1231.	14485	*Romulea flava var. minor*	Y		
1232.	1556	*Romulea rosea (Guildford Grass)*	Y		
1233.	11151	*Rostraria pumila*	Y		
1234.	44608	*Rosulabryum billarderii*			
1235.	20506	*Rubus anglocandicans*	Y		
1236.	2432	*Rumex conglomeratus (Clustered Dock)*	Y		
1237.	40431	*Rytidosperma acerosum*			
1238.	40425	*Rytidosperma caespitosum*			
1239.	79	*Salvinia molesta (Salvinia)*	Y		
1240.	6483	*Samolus junceus*			
1241.	2356	*Santalum acuminatum (Quandong, Warnga)*			
1242.	7368	*Scabiosa atropurpurea (Purple Pincushion)*	Y		
1243.	7602	*Scaevola calliptera*			
1244.	7613	*Scaevola glandulifera (Viscid Hand-flower)*			
1245.	7619	*Scaevola lanceolata (Long-leaved Scaevola)*			
1246.	7635	*Scaevola pilosa (Hairy Fan-flower)*			
1247.	7636	*Scaevola platyphylla (Broad-leaved Fanflower)*			
1248.	13182	*Scaevola repens var. repens*			
1249.	32432	*Schizymenium bryoides*			
1250.	6263	*Schoenolaena juncea*			
1251.	971	*Schoenus andrewsii*			
1252.	974	*Schoenus benthamii*		P3	
1253.	975	*Schoenus bifidus*			
1254.	978	*Schoenus brevisetis*			
1255.	979	*Schoenus caespititius*			
1256.	980	*Schoenus capillifolius*		P3	
1257.	984	*Schoenus curvifolius*			
1258.	985	*Schoenus discifer*			
1259.	986	*Schoenus efoliatus*			
1260.	987	*Schoenus elegans*			
1261.	991	*Schoenus grammatophyllus*			
1262.	994	*Schoenus humilis*			
1263.	996	*Schoenus laevigatus*			
1264.	998	*Schoenus latitans*			
1265.	999	*Schoenus loliaceus*		P2	
1266.	1002	*Schoenus nanus (Tiny Bog Rush)*			
1267.	1003	*Schoenus natans (Floating Bog-rush)*		P4	
1268.	1006	*Schoenus odontocarpus*			
1269.	1007	*Schoenus pedicellatus*			
1270.	1008	*Schoenus pennisetis*		P3	
1271.	1009	*Schoenus pleiostemoneus*			
1272.	17614	*Schoenus plumosus*			
1273.	1011	*Schoenus rigens*			
1274.	1013	*Schoenus sculptus (Gimlet Bog-rush)*			
1275.	16280	*Schoenus sp. Beaufort (G.J. Keighery 6291)*		P1	
1276.	17731	*Schoenus sp. Waroona (G.J. Keighery 12235)*		P3	
1277.	1017	*Schoenus subbulbosus*			
1278.	1018	*Schoenus subfascicularis*			
1279.	1019	*Schoenus subflavus (Yellow Bog-rush)*			
1280.	1026	*Schoenus unispiculatus*			
1281.	17409	*Schoenus variicellae*			
1282.	6033	*Scholtzia involucrata (Spiked Scholtzia)*			
1283.	6	*Selaginella gracillima (Tiny Clubmoss)*			
1284.	32433	*Sematophyllum homomallum*			
1285.	8203	*Senecio diaschides*			
1286.	8212	*Senecio leucoglossus*		P4	
1287.	20663	*Senecio multicaulis subsp. multicaulis*			
1288.	609	*Setaria palmifolia (Palm Grass)*	Y		
1289.	19453	*Setaria parviflora*	Y		
1290.	2909	*Silene gallica (French Catchfly)*	Y		
1291.	8225	*Siloxerus humifusus (Procumbent Siloxerus)*			
1292.	14583	*Siloxerus multiflorus*			
1293.	8231	*Sonchus oleraceus (Common Sowthistle)*	Y		
1294.	617	*Sorghum halepense (Johnson Grass)*	Y		
1295.	1312	*Sowerbaea laxiflora (Purple Tassels)*			
1296.	1558	*Sparaxis bulbifera*	Y		

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1297.	4205	*Sphaerolobium linophyllum*			
1298.	4206	*Sphaerolobium macranthum*			
1299.	4207	*Sphaerolobium medium*			
1300.	635	*Sporobolus virginicus (Marine Couch)*			
1301.	4716	*Stachystemon vermicularis*			
1302.	4733	*Stackhousia monogyna*			
1303.	9070	*Stackhousia pubescens (Downy Stackhousia)*			
1304.	13475	*Stenanthemum humile*			
1305.	19403	*Stenopetalum gracile*			
1306.	2316	*Stirlingia latifolia (Blueboy)*			
1307.	2317	*Stirlingia simplex*			
1308.	18564	*Stylidium aceratum*		P3	
1309.	7681	*Stylidium affine (Queen Triggerplant)*			
1310.	7684	*Stylidium amoenum (Lovely Triggerplant)*			
1311.	30278	*Stylidium androsaceum*			
1312.	25831	*Stylidium araeophyllum (Stilt Walker)*			
1313.	7692	*Stylidium breviscapum (Boomerang Triggerplant)*			
1314.	7693	*Stylidium brunonianum (Pink Fountain Triggerplant)*			
1315.	7694	*Stylidium bulbiferum (Circus Triggerplant)*			
1316.	7696	*Stylidium calcaratum (Book Triggerplant)*			
1317.	7698	*Stylidium caricifolium (Milkmaids)*			
1318.	7702	*Stylidium ciliatum (Golden Triggerplant)*			
1319.	7712	*Stylidium despectum (Dwarf Triggerplant)*			
1320.	7713	*Stylidium dichotomum (Pins-and-needles)*			
1321.	7716	*Stylidium diuroides (Donkey Triggerplant)*			
1322.	7717	*Stylidium divaricatum (Daddy-long-legs)*			
1323.	7721	*Stylidium emarginatum (Biddy-four-legs)*			
1324.	19251	*Stylidium eriopodum*			
1325.	7734	*Stylidium guttatum (Dotted Triggerplant)*			
1326.	7736	*Stylidium hispidum (White Butterfly Triggerplant)*			
1327.	7742	*Stylidium inundatum (Hundreds and Thousands)*			
1328.	7745	*Stylidium junceum (Reed Triggerplant)*			
1329.	7756	*Stylidium longitubum (Jumping Jacks)*		P4	
1330.	7768	*Stylidium obtusatum (Pinafore Triggerplant)*			
1331.	7771	*Stylidium periscelianthum (Pantaloon Triggerplant)*		P3	
1332.	7772	*Stylidium perpusillum (Tiny Triggerplant)*			
1333.	7773	*Stylidium petiolare (Horn Triggerplant)*			
1334.	7774	*Stylidium piliferum (Common Butterfly Triggerplant)*			
1335.	7782	*Stylidium pulchellum (Thumbelina Triggerplant)*			
1336.	7783	*Stylidium pycnostachyum (Downy Triggerplant)*			
1337.	33106	*Stylidium recurvum*			
1338.	7785	*Stylidium repens (Matted Triggerplant)*			
1339.	7790	*Stylidium roseoalatum (Pink-wing Triggerplant)*			
1340.	25806	*Stylidium scariosum*			
1341.	7798	*Stylidium schoenoides (Cow Kicks)*			
1342.	7803	*Stylidium striatum (Fan-leaved Triggerplant)*		P4	
1343.	45594	*Stylidium tenue subsp. majusculum (Showy Fountain Triggerplant)*			
1344.	23511	*Stylidium thesioides (Delicate Triggerplant)*			
1345.	7806	*Stylidium utricularioides (Pink Fan Triggerplant)*			
1346.	40947	*Stylidium xanthellum*			
1347.	1260	*Stypandra glauca (Blind Grass)*			
1348.	48297	*Styphelia filifolia*		P3	
1349.	6476	*Styphelia tenuiflora (Common Pinheath)*			
1350.	2321	*Synaphea acutiloba (Granite Synaphea)*			
1351.	2323	*Synaphea gracillima*			
1352.	2324	*Synaphea petiolaris (Synaphea)*			
1353.	16864	*Synaphea petiolaris subsp. petiolaris*			
1354.	2325	*Synaphea pinnata (Helena Synaphea)*			
1355.	18590	*Synaphea sp. Fairbridge Farm (D. Papenfus 696)*		T	
1356.	2329	*Synaphea spinulosa*			
1357.	15532	*Synaphea spinulosa subsp. spinulosa*			
1358.	32438	*Syntrichia pagorum*			
1359.	20135	*Taxandria linearifolia*			
1360.	4251	*Templetonia drummondii*			
1361.	4256	*Templetonia retusa (Cockies Tongues)*			
1362.	32441	*Tetrapterum cylindricum*			
1363.	1034	*Tetraria capillaris (Hair Sedge)*			
1364.	1036	*Tetraria octandra*			
1365.	667	*Tetrarrhena laevis (Forest Ricegrass)*			
1366.	4535	*Tetratheca hirsuta (Black Eyed Susan)*			

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1367.	48342	*Tetratheca hirsuta subsp. hirsuta*			
1368.	4537	*Tetratheca nuda*			
1369.	4544	*Tetratheca setigera*			
1370.	1701	*Thelymitra antennifera (Vanilla Orchid)*			
1371.	10856	*Thelymitra benthamiana (Leopard Orchid)*			
1372.	1705	*Thelymitra crinita (Blue Lady Orchid)*			
1373.	1707	*Thelymitra flexuosa (Twisted Sun Orchid)*			
1374.	11053	*Thelymitra macrophylla*			
1375.	20729	*Thelymitra magnifica (Crystal Brook Star Orchid)*		P1	
1376.	1715	*Thelymitra spiralis (Curlylocks)*			
1377.	10862	*Thelymitra stellata (Star Orchid)*		T	
1378.	1718	*Thelymitra villosa (Custard Orchid)*			
1379.	20731	*Thelymitra vulgaris*			
1380.	673	*Themeda triandra*			
1381.	5080	*Thomasia foliosa*			
1382.	5084	*Thomasia grandiflora (Large Flowered Thomasia)*			
1383.	5087	*Thomasia macrocarpa (Large Fruited Thomasia)*			
1384.	1317	*Thysanotus anceps*		P3	
1385.	1318	*Thysanotus arbuscula*			
1386.	1319	*Thysanotus arenarius*			
1387.	1328	*Thysanotus dichotomus (Branching Fringe Lily)*			
1388.	1338	*Thysanotus manglesianus (Fringed Lily)*			
1389.	1339	*Thysanotus multiflorus (Many-flowered Fringe Lily)*			
1390.	1343	*Thysanotus patersonii*			
1391.	46055	*Thysanotus sp. Coastal plain (N.H. Brittan 66/63)*			
1392.	1351	*Thysanotus sparteus*			
1393.	1354	*Thysanotus tenellus*			
1394.	1357	*Thysanotus thyrsoideus*			
1395.	1358	*Thysanotus triandrus*			
1396.	8248	*Tolpis barbata (Yellow Hawkweed)*	Y		
1397.		*Tortula recurvata*			
1398.	6280	*Trachymene pilosa (Native Parsnip)*			
1399.	17684	*Tremulina tremula*			
1400.	11112	*Tribolium uniolae*	Y		
1401.	1481	*Tribonanthes australis*			
1402.	1482	*Tribonanthes brachypetala*			
1403.	1483	*Tribonanthes longipetala*			
1404.	1485	*Tribonanthes violacea*			
1405.	4383	*Tribulus terrestris (Caltrop)*	Y		
1406.	8251	*Trichocline spathulata (Native Gerbera)*			
1407.	1361	*Tricoryne elatior (Yellow Autumn Lily)*			
1408.	1362	*Tricoryne humilis*			
1409.	1363	*Tricoryne tenella*			
1410.	43207	*Tricostularia exsul*			
1411.	17145	*Trifolium angustifolium var. angustifolium*	Y		
1412.	4291	*Trifolium arvense (Hare's Foot Clover)*	Y		
1413.	17542	*Trifolium arvense var. arvense*	Y		
1414.	4292	*Trifolium campestre (Hop Clover)*	Y		
1415.	4295	*Trifolium dubium (Suckling Clover)*	Y		
1416.	4298	*Trifolium hirtum (Rose Clover)*	Y		
1417.	17788	*Trifolium pratense var. sativum*	Y		
1418.	15509	*Trifolium tomentosum var. tomentosum*	Y		
1419.	33676	*Triglochin calcitrapa*			
1420.	146	*Triglochin minutissima*			
1421.	147	*Triglochin mucronata*			
1422.	148	*Triglochin muelleri*			
1423.	18587	*Triglochin nana*			
1424.	150	*Triglochin stowardii*			
1425.	151	*Triglochin striata*			
1426.	4737	*Tripterococcus brunonis (Winged Stackhousia)*			
1427.	1139	*Trithuria bibracteata*			
1428.	1141	*Trithuria submersa*			
1429.	38401	*Tritonia gladiolaris (Lined Tritonia)*	Y		
1430.	13479	*Trymalium ledifolium var. rosmarinifolium*			
1431.	33418	*Trymalium odoratissimum subsp. odoratissimum*			
1432.	8255	*Ursinia anthemoides (Ursinia)*	Y		
1433.	38388	*Ursinia anthemoides subsp. anthemoides*	Y		
1434.	7138	*Utricularia inaequalis*			
1435.	7148	*Utricularia multifida*			
1436.	7153	*Utricularia tenella*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1437.	17868	*Vallisneria nana*			
1438.	7665	*Velleia trinervis*			
1439.	8257	*Vellereophyton dealbatum (White Cudweed)*	Y		
1440.	6070	*Verticordia acerosa*			
1441.	15431	*Verticordia acerosa var. acerosa*			
1442.	12388	*Verticordia acerosa var. preissii*			
1443.	6076	*Verticordia densiflora (Compacted Featherflower)*			
1444.	15432	*Verticordia densiflora var. densiflora*			
1445.	6088	*Verticordia huegelii (Variegated Featherflower)*			
1446.	15433	*Verticordia huegelii var. huegelii*			
1447.	15434	*Verticordia insignis subsp. insignis*			
1448.	14714	*Verticordia lindleyi subsp. lindleyi*		P4	
1449.	6107	*Verticordia pennigera*			
1450.	6110	*Verticordia plumosa (Plumed Featherflower)*			
1451.	12449	*Verticordia plumosa var. brachyphylla*			
1452.	15618	*Verticordia plumosa var. plumosa*			
1453.	4322	*Vicia sativa (Common Vetch)*	Y		
1454.	12070	*Vicia sativa subsp. sativa*	Y		
1455.	4325	*Viminaria juncea (Swishbush, Koweda)*			
1456.	6575	*Vinca major (Blue Periwinkle)*	Y		
1457.	17042	*Vitis vinifera*	Y		
1458.	722	*Vulpia bromoides (Squirrel Tail Fescue)*	Y		
1459.	11018	*Vulpia muralis*	Y		
1460.	724	*Vulpia myuros (Rat's Tail Fescue)*	Y		
1461.	7384	*Wahlenbergia capensis (Cape Bluebell)*	Y		
1462.	7389	*Wahlenbergia preissii*			
1463.	13103	*Watsonia borbonica*	Y		
1464.	1566	*Watsonia marginata*	Y		
1465.	18108	*Watsonia meriana var. bulbillifera*	Y		
1466.	18118	*Watsonia meriana var. meriana*	Y		
1467.	1569	*Watsonia versfeldii*	Y		
1468.	32456	*Weissia rutilans*			
1469.	12072	*Wurmbea dioica subsp. alba*			
1470.	1401	*Wurmbea pygmaea*			
1471.	1249	*Xanthorrhoea acanthostachya*			
1472.	1251	*Xanthorrhoea brunonis*			
1473.	14544	*Xanthorrhoea brunonis subsp. brunonis*			
1474.	1252	*Xanthorrhoea drummondii*			
1475.	1253	*Xanthorrhoea gracilis (Graceful Grass Tree, Mimidi)*			
1476.	1256	*Xanthorrhoea preissii (Grass tree, Palga)*			
1477.	6283	*Xanthosia atkinsoniana*			
1478.	6284	*Xanthosia candida*			
1479.	6289	*Xanthosia huegelii*			
1480.	44861	*Xerochrysum macranthum*			
1481.	2331	*Xylomelum occidentale (Woody Pear, Djandin)*			
Protozoa					
1482.	38969	*Arcyria minuta*			
1483.	38976	*Badhamia foliicola*			
1484.	39030	*Enerthenema papillatum*			
1485.	39097	*Trichia decipiens*			

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

APPENDIX C

WIN Groundwater Bores

WIN Bore ID	Owner	Current Purpose	Status	Drill Date	Drill Depth (m below ground level)
61600006	No Current Owner	-	Unknown	01-01-1900 - Unknown	9.14
61600018	No Current Owner	-	Unknown	01-01-1900 - Unknown	9.75
61600163	No Current Owner	-	Unknown	01-01-1900 - Unknown	3.35
61600178	No Current Owner	-	Unknown	01-01-1900 - Unknown	2.74
61600179	No Current Owner	Garden Irrigation	Unknown	01-01-1900 - Unknown	4.57
61600180	No Current Owner	-	Unknown	01-01-1900 - Unknown	5.18
61600181	No Current Owner	Garden Irrigation	Unknown	01-01-1900 - Unknown	4.88
61600182	No Current Owner	Livestock; Garden Irrigation	Unknown	30-06-1958 - Known year	8.23
61600183	No Current Owner	Garden Irrigation; Livestock	Unknown	01-01-1900 - Unknown	24.38
61600184	No Current Owner	-	Unknown	01-01-1900 - Unknown	2.74
61601079	No Current Owner	Irrigation	Unknown	19-06-1998 - Known day	63.00
61607277	No Current Owner	-	Unknown	01-01-1900 - Unknown	10.67
61607278	No Current Owner	-	Unknown	30-06-1950 - Known year	31.09
61607279	No Current Owner	Domestic/Household	Unknown	30-06-1955 - Known year	34.14
61607280	No Current Owner	-	Unknown	30-06-1962 - Known year	40.23
61607281	No Current Owner	-	Unknown	30-06-1962 - Known year	31.09
61607344	No Current Owner	Garden Irrigation	Unknown	01-01-1900 - Unknown	8.84
61607345	No Current Owner	-	Unknown	01-01-1900 - Unknown	11.58
61607347	No Current Owner	Garden Irrigation	Unknown	01-01-1900 - Unknown	8.53
61607355	No Current Owner	-	Unknown	01-01-1900 - Unknown	12.50
61607356	No Current Owner	Garden Irrigation	Unknown	01-01-1900 - Unknown	13.72
61607357	No Current Owner	-	Unknown	01-01-1900 - Unknown	6.10
61607358	No Current Owner	Garden Irrigation	Unknown	01-01-1900 - Unknown	11.58
61607359	No Current Owner	-	Unknown	30-06-1961 - Known year	27.13

WIN Bore ID	Owner	Current Purpose	Status	Drill Date	Drill Depth (m below ground level)
61607360	No Current Owner	-	Unknown	30-06-1961 - Known year	22.25
61607361	No Current Owner	Domestic/Household; Garden Irrigation	Unknown	01-01-1900 - Unknown	25.91
61607362	No Current Owner	Domestic/Household; Garden Irrigation	Unknown	01-01-1900 - Unknown	-
61607363	No Current Owner	Livestock; Garden Irrigation	Unknown	30-06-1962 - Known year	33.83
61607364	No Current Owner	Garden Irrigation	Unknown	01-01-1900 - Unknown	36.58
61607365	No Current Owner	Garden Irrigation	Unknown	30-06-1962 - Known year	34.75
61607366	No Current Owner	Orchard	Unknown	30-06-1958 - Known year	33.53
61607367	No Current Owner	Garden Irrigation	Unknown	01-01-1900 - Unknown	36.58
61607385	No Current Owner	-	Unknown	01-01-1900 - Unknown	3.05
61607386	No Current Owner	-	Unknown	30-06-1970 - Known year	30.48
61607387	No Current Owner	Garden Irrigation	Unknown	01-01-1900 - Unknown	7.92
61607388	No Current Owner	Garden Irrigation	Unknown	30-06-1962 - Known year	13.41
61607389	No Current Owner	Orchard	Unknown	30-06-1971 - Known year	22.86
61607390	No Current Owner	Garden Irrigation	Unknown	30-06-1950 - Known year	6.10
61607391	No Current Owner	Garden Irrigation; Livestock	Unknown	01-01-1900 - Unknown	-
61607392	No Current Owner	Garden Irrigation	Unknown	01-01-1900 - Unknown	-
61607393	No Current Owner	Garden Irrigation	Unknown	01-01-1900 - Unknown	15.24
61607394	No Current Owner	-	Unknown	30-06-1962 - Known year	28.04
61607477	No Current Owner	-	Unknown	15-12-1977 - Known day	30.48
61607522	No Current Owner	Irrigation	Unknown	15-02-1978 - Known day	21.03
61607523	No Current Owner	-	Unknown	30-01-1979 - Known day	25.00
61607559	No Current Owner	-	Unknown	04-05-1989 - Known day	26.00
61607568	No Current Owner	Garden Irrigation	Unknown	01-01-1900 - Unknown	6.00
61607569	No Current Owner	Garden Irrigation	Unknown	30-06-1990 - Known year	24.38

WIN Bore ID	Owner	Current Purpose	Status	Drill Date	Drill Depth (m below ground level)
61615517	No Current Owner	-	Unknown	08-11-1991 - Known day	-
61615518	No Current Owner	-	Unknown	08-11-1991 - Known day	-
61671956	No Current Owner	-	Unknown	Unknown	-

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APPENDIX 2:
KCTT, Infrastructure Servicing Report

INFRASTRUCTURE SERVICING REPORT

Wattle Grove Landholdings

Wattle Grove, Western Australia

April 2018

Rev B

HISTORY AND STATUS OF THE DOCUMENT

Revision	Date issued	Approved by	Issued To	Revision type
Rev A	19.02.18	C Kleyweg	Jon Burgess / Mitchell Brooks	Draft for Review
Rev B	11.04.18	C Kleyweg	Jon Burgess / Mitchell Brooks	Final for coordination

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Table of Contents

1. KCTT Infrastructure Servicing Report

1.1 Executive Summary

The Wattle Grove MRS Amendment area has a series of challenges from an infrastructure perspective, however each of these can be managed with each of the servicing authorities (City of Kalamunda, Water Corporation, Western Power, Telstra / NBN and ATCO Gas) through development of infrastructure strategies for future potential planning outcomes. The key items in this Executive Summary include: -

- Major road network upgrade requirements (i.e. interchange design requirements at the intersection of Welshpool Road and Tonkin Highway, with consideration that Welshpool Road will be grade separated above the Tonkin Highway).
- Geometrical design improvements are required to Welshpool Road which will cause the realigning of a section of this road into the current Crystal Brook Road alignment. We believe the logical outcome is for this section of road to then deviate to a major roundabout intersection at Kelvin Road to the east, forming a natural separation between industrial / commercial traffic to the south and residential traffic to the north.
- We believe that consideration should be given to either future rail connectivity in the long term at the corner of Tonkin Highway and Welshpool Road linking a future rail alignment between Forrestfield North and Thornlie. This could provide excellent opportunities for increased industrial / commercial business densities in the south western quadrant and for increased residential densities in the north-western quadrant of the MRS area.
- In the short to medium term bus linkages should be provided from this location to Forrestfield North Railway Station. These discussions can be commenced with the Planning Team at Transperth, with potential for minor amendments to existing services catering for the MRS Amendment area.
- The provision of a public transport node provides a logical centre for development and therefore provides logical connectivity for pedestrian and cyclist infrastructure.
- Drainage design requirements need to be looked at in detail with the future layout for residential and industrial outcomes as the site generally grades toward the west where development is intended to be denser. This provides opportunities for innovation and will need to be discussed in detail with City of Kalamunda Engineers.
- The interface between Crystal Brook (lying midway between Welshpool Road East and Crystal Brook Road in the Residential Zone of the MRS Amendment Area needs to be strongly considered in the urban design and planning processes. Existing 1 in 100-year overland drainage flows will need to be maintained into this creek system. Wherever drainage interfaces from the future development, treatment of 1 in 1 year events will need to be provided prior to any direct discharge into the creek.

Power & Communication

The existing adjacent network consists of a High Voltage overhead Transmission line that runs along Brentwood Road, as well as High Voltage overhead 3 phase distribution lines also running along Brentwood Road, Crystal Brook Road and Victoria Road. The likely supply scenario would consist of High Voltage cable from an appropriate point on the HV transmission line, up to a new High Voltage substation (High Voltage Switch and Transformer) within the development site. From here, Low Voltage distribution cables supplied underground and street light poles as normal would service the development of industrial to the south and residential development to the north of Crystal Brook

Road. Existing distribution lines that run along Brentwood Road, Crystal Brook Road, Gavour Road, Victoria Road and Valcan Road would need to be removed and replaced with underground infrastructure as part of the development as development moves incrementally through the MRS Amendment area.

At this stage there are no NBN rollouts currently planned for this area, however NBN Co has a charter to work with local governments and developers to develop their infrastructure in new areas. For a development of this size, with a large amount of future expected development surrounding it, there would be a high probability that NBN would develop infrastructure to service the development.

Detailed information on power and communication infrastructure to develop the site should be co-ordinated with an electrical engineer for the most relevant and up to date information.

Water

Water mains currently run in the road reserve of Crystal Brook Road, Victoria Road, Valcan Road, Gavour Road and Brentwood Road, generally sized at 100mm to 150mm diameter to service the current rural residential development of the area. The area forms part of the larger Foothills Gravity Water Supply Scheme and is supplied by several Pressure Releasing Valves (PRV's) off the south-north Foothills Trunk Main. Current planning has allowed for some industrial land use to the west of the site under investigation as part of the MKSEA developments, however, no provision has currently been allowed to this site. Substantial reticulation upgrades would be required as part of urban development of the subject site, which would be investigated by the Water Corporation as development continues in the area. KCTT have completed preliminary discussions with the Water Corporation and at this stage we believe the requirements for development centre on a local network of mains, as opposed to extensions of major trunk infrastructure, however this would depend on the density of development proposed. The Water Corporation have informed us that detailed planning will be required in the next 1 to 2 years to determine a design concept for the area.

Wastewater

The site forms part of a larger area that is planned to be established as a new sewer district in Water Corporation planning, called the Wattle Grove Sewer District. This district is bounded by Bickley Road to the south, Roe Highway to the west, Welshpool Road to the north and the Mundy Regional Park to the east. Long term conceptual planning has been conducted by the Water Corporation with a general layout of infrastructure provided.

The current planning is based on the discharge of wastewater from the newly formed Wattle Grove SD to be via a gravity feed to a 900mm diameter wastewater pipe running westward along Bickley Road. This collection sewer currently terminates at the intersection of Bickley Road and Dulwich Street, Beckenham, however this is a long-term ultimate design model. It is very important to understand that none of these works will be required to commence development within Wattle Grove as the Water Corporation usually allow the development of interim scenarios utilising available capacities in existing systems. The key point with the allowance of this use of existing system capacities is that the design of the overall network must not prejudice the future ultimate network. Therefore, all designs developed will need to consider both the ultimate planning and interim availabilities, with developers who construct interim solutions understanding that the cost for those works will be borne solely by the developer.

Long term service planning by the Water Corporation is predicated on the development of the MKSEA area to the west and south-west of the site under investigation, however development has commenced in the MKSEA area without the construction of the ultimate sewer network reinforcing the points made above.

We believe the following methodologies need to be considered and negotiated with the Water Corporation: -

1. Enter into a Performance Agreement / Tankering Agreement

Reference: Water Corporation Development Services Information Sheet No 58A

Where infrastructure assets are located a long distance from a potential development site, and where the planning for the development of the assets which will connect the site in the future are known and relatively risk-free for the Water Corporation, the Water Corporation can enter into agreements with developers for the tankering of early release stages to allow the developer to fund studies and the extension of infrastructure. Generally tankering will only be agreed in situations where the design and construction of the sections of sewer required for connection are being managed by the same developer (therefore the Water Corporation has the power to enforce elements of the Contract). If the design of downstream assets are not committed to, it will be more difficult to arrange a Performance Agreement.

2. Developer Constructed Headworks Asset Process

Reference: Water Corporation: Developer Constructed Headworks Process Document

Landowners have the opportunity to construct works on and behalf of the Water Corporation. The Water Corporation has a 5-year Capital Investment Programme (CIP), which is developed in consultation with the land development industry to determine the required timing for major infrastructure. The process needs to commence with submission of a letter with the following information: -

- Intended timing of development
- Staging options for development
- Ownership / control of the land
- Zoning / Structure Planning / Subdivision Approvals
- Demand projection (number of lots / projected flows etc)
- Known constraints to development
- Relevant other impacts

The Water Corporation will respond to this information with a Development Services Review. In this phase discussions will commence relating to potential staging, acceptance of tankering and other requirements.

Our understanding is that generally the Water Corporation will fund wastewater infrastructure works of diameter 450mm or greater for gravity networks. Given the planned network shows a series of 450mm to 900mm-diameter pipes between Brentwood Road (south of Tonkin Highway) and the corner of Bickley Road and Brixton Road there is strong potential for these works being negotiated and agreed under the Water Corporation's future Capital Works Program or being the subject of a detailed pre-fund arrangement.

3. Construction of a temporary Pumping Station

KCTT will discuss with the Water Corporation the potential for staging sections of the Wattle Grove district with a temporary or private pressure main and pumping station. This option will form part of the discussions referred to above.

Gas

Currently there are no ATCO Gas assets in the vicinity of the subject site. The nearest connection points are located to the west, on the western side of Tonkin Highway and to the north, on the northern side of Welshpool Road. ATCO Gas however, do install new infrastructure and extend or upgrade existing infrastructure when new development becomes apparent to them, and such that there may be current planning for the installation of new Atco Gas Assets in the vicinity of the site.

The Dampier-Bunbury gas pipeline runs along the southern end of the site parallel to the southern boundary, as shown on the planning by Burgess Design Group. This will require special attention during the planning, engineering and approvals phase of the project to ensure a smooth and timely project delivery. KCTT have previous experience with projects requiring Risk Assessment considerations regarding the pipeline and so have a strong understanding of what is required with regards to the planning and approval associated with works in the vicinity of the pipeline.

Topography and Drainage

As taken from Water Corporation planning, ground water starts at RL 12m in the western corner and rises gradually across the site to a height of RL 16m in the eastern corner of the site. This also follows the slope of the ground level with a low point in the western corner of approximately RL 22m, gradually rising to the highest point of the site toward the north eastern corner of RL 36m.

Currently the drainage network consists of roadside swales which would require major upgrade into a pit and pipe network potentially discharging into basins within future Public Open Space Areas, as well as co-ordination with the relevant local government authorities. As discussed earlier, the existing topography means drainage catchments are generally flowing toward the west, where the density of development is likely to be higher. This provides the opportunity for the development of innovative drainage solutions in the heart of Wattle Grove which can assist in local irrigation requirements. The development of linear treatment solutions in the eastern portion of the MRS area will also be very important due to steeper grades and to limit the impact of 1 in 100-year floods on the denser development areas to the west of the MRS area.

Finally, the existing Crystal Brook, located midway between Crystal Brook Road and Welshpool Road East is located centrally within the future residential precinct. The interface between development and the creek is very important. Existing overland flows will need to be maintained into the Crystal Brook with all flows through roads and residential areas to be treated up to and including the 1 in 1 year event prior to discharge into downstream environmental systems.

Roads

Amendments to the future road network will be very important given the future requirements for grade separation at the Tonkin Highway / Welshpool Road East interchange. Coupled with some tight existing horizontal geometry in Welshpool Road East immediately to the east of the proposed interchange, the existing near 3-way intersection between Welshpool Road East / Crystal Brook Road and Brentwood Road and tight road geometry and steep grades in Crystal Brook Road east of Kelvin Road, significant amendments to the existing road network will be required to

ensure proper access / egress is developed for industrial traffic to the south and future residential traffic to the north of Crystal Brook Road.

We therefore believe the logical configuration is to realign the Welshpool Road East alignment into Crystal Brook Road. This provides the following advantages: -

- It provides a clear delineation between residential zoning to the north and industrial zoning to the south
- It removes the sharp change in horizontal geometry in Welshpool Road East which commences just west of the current intersection of Welshpool Road East / Crystal Brook Road
- It removes the clash between the above intersection and the intersection of Crystal Brook Road / Brentwood Road
- Straightening this section of access to Tonkin Highway improves vertical design criteria and safety because current Main Roads WA planning shows Welshpool Road East interchange will be designed to bridge Welshpool Road East over Tonkin Highway. The removal of the sharp change in horizontal geometry therefore allows the bridge abutments and approaches to the bridge to be designed as a direct approach, therefore improving road safety considerably.

Consideration needs to be given to the RAV network and commodity route to the east, the connection of Welshpool Road East to Lesmurdie, and the large mature trees on Crystal Brook Road that would need to be retained and protected from road widening, with Kelvin Road at the northern end having significant trees and vegetation. This would need to be reviewed in a conceptual design phase which should follow this MRS Amendment.

The Welshpool Road East / Crystal Brook Road approach to the Tonkin Highway will need to be designed at a maximum approaching grade of 5%. This will require considerable amendment to existing road levels from a location near the intersection of Crystal Brook Road / Brentwood Road. This realignment of the road network also enables the deviation of the Crystal Brook Road alignment to form a perpendicular intersection with Kelvin Road to the east. This alignment is logical and provides the following strong benefits: -

- It provides a neat, enclosed triangular shaped industrial zone bounded by Tonkin Highway to the south, Welshpool Road East / Crystal Brook alignment to the north and Kelvin Road to the east.
- It focuses future industrial traffic directly toward Tonkin Highway to the west or Kelvin Road and Tonkin Highway to the east.
- It focuses higher volumes of traffic onto a new major spine road that can be designed to suit the future requirements better than the existing alignment in Welshpool Road East.
- It removes regional traffic vehicular loading onto sections of Welshpool Road East and Crystal Brook Road that have tight horizontal and vertical geometries. These sections of road should not provide greater regional / industrial functions.

1.2 Location

Structure Plan	Suburb	Locality (Shire, City etc.)
Wattle Grove District Structure Plan	Wattle Grove	City of Kalamunda

Brief Description of Site:

The Wattle Grove MRS Amendment Area is bounded by Tonkin Highway to the south and west, Welshpool Road East generally to the north and west and the City of Gosnells local government boundary and landholdings in Gavour Road generally to the east toward Kelvin Road.

The proposed amendment area is divided into two catchments: -

- Residential land-uses north of Crystal Brook Road; and
- Industrial land-uses south of Crystal Brook Road.

1.3 Proposed Development

The proposed development entails a Residential precinct of approximately 120 hectares and a potential Industrial area of 146 hectares. The general options considered in the MRS Amendment are to run two residential development scenarios at averages of R20, R30 and R40. The R30 option allows for some increase in development densities in the western third of the MRS Amendment area, with an R40 option allowing for stronger development with a potential railway station option to be considered in the long-term under agreement with the Western Australia state government.

Table 1 – Wattle Grove MRS Amendment Indicative Yields

Development Type	Total Area (m^2)	Equivalent Area	Yield Notes	Yield
Industrial	1,460,000	Assume 65% = 949,000	Assume average 20,000m^2 lots	Approx 47 Industrial Lots
Residential (R20 Avg)	1,200,000	Assume 65% = 780,000	R20 average option	1,560
Residential (R30 Avg)	As above	As above	R30 average option	2,340
Residential (R40 Avg)	As above	As above	R40 average option	3,120
Total Development	2,660,000	1,729,000		47 industrial lots, plus between 1,560 to 3,120 residential

While there are significant variations in the proposed yields, it is important at the MRS Amendment phase to test wider development potential, particularly for residential as the increased densities impact flows from various sites. For industrial / commercial the sizing of the lots is less relevant as the sizing of infrastructure is based on area of development, not yield. The development of 2 hectare industrial lots foresees the majority of each future landholding developed.

Recent research completed by Savills (Reference http://pdf.savills.asia/asia-pacific-research/australian-research/australia-industrial/savillsresearch-briefing-perth-industrial-q4-2017.pdf) shows that there has been improved recent demand for prime quality industrial land, particularly in the premier eastern suburbs developments in Forrestfield and Maddington. This information is provided for general review purposes only, and is not a formal recommendation on thee proposed quantum of industrial land shown in this MRS Amendment. We recommend that the City of Kalamunda engages a qualified consultant in this area to determine the potential for the quantum of industrial land shown in this MRS Amendment.

1.4 Existing Buildings

Does the feature existing buildings? If YES nominate.	YES, existing residential dwellings, populated sparsely throughout the proposed MRS Amendment Area.
Approximate age of buildings?	10-35 years, some potentially older. The likelihood of keeping existing residences and developing homesteads around them is lower south of Crystal Brook Road given the proposed potential for Industrial landholdings.
Is asbestos likely to be an issue? YES / NO	YES Desktop studies show that some existing buildings are at least 10-20 years old and thus asbestos could have been used in the construction of eaves fencing and other areas where asbestos was commonly used. Further investigation required to confirm.
Are septic tanks present? YES / NO	YES Wastewater plans for the precinct sourced from EsiNet show that there are minimal existing wastewater services in the MRS Amendment Area. Thus, the presence of septic tanks within the precinct should be considered on each private landholding.
Likely issues associated with remediation?	Key issues are likely to be asbestos in some buildings and structures to be demolished, and de-commissioning of septic tank / leach drain setups. These issues are local in nature and will be the responsibility of future land developers, therefore these issues do not pose a risk under any future Developer Contribution Plan except for lots with structures within future Public Open Space / Bush Forever.

2. Infrastructure Servicing

The area of study for this ISR is the Wattle Grove MRS Amendment as previously described in Section 1.2 and 1.3 of this report.

This section on Infrastructure Servicing includes the following discussion points: -

- Section 2.1 – Topography and Environment
- Section 2.2 – Geotechnical Conditions
- Section 2.3 – Building and Earthworks
- Section 2.4 – Roadworks
- Section 2.5 – Stormwater Drainage
- Section 2.6 – Wastewater (Sewerage)
- Section 2.7 – Water
- Section 2.8 – Power, Telecommunications and Gas Supply
- Section 2.9 – Earthworks
- Section 2.10 – Bridgeworks

2.1 Topography and Environment

As taken from Water Corporation planning, ground water starts at RL 12m in the western corner and rises gradually across the site to a height of RL 16m in the eastern corner of the Wattle Grove MRS Amendment Area. This also follows the slope of the ground level with a low point in the western corner of approximately RL 22m, gradually rising to the highest point of the site toward the north eastern corner of RL 36m.

The existing Crystal Brook, located midway between Crystal Brook Road and Welshpool Road East is located centrally within the future residential precinct. The interface between development and the creek is very important. Existing overland flows will need to be maintained into the Crystal Brook with all flows through roads and residential areas to be treated up to and including the 1 in 1-year event prior to discharge into downstream environmental systems.

We therefore believe that interface to groundwater should not pose excessive risk to the project, however there can be localised issues with perching of groundwater when combined with presence of cemented rock formations such as “coffee rock”.

2.2 Geotechnical Conditions

The Foothills Investigation area is located within the Swan Coastal Plain formation. The area features soils equally split between Bassendean Sands and Guildford clays in pockets around the site. Yoganup formations are present in the southern portion of the Investigation area. Colluvium is also present in the eastern and northern portions of the site, most likely due to being at the base of hills within the Mundy Regional Park. This information is observed from the Perth Groundwater Atlas.

In areas where significant new works are required, (such as new roads, stormwater drainage infrastructure etc.) detailed geotechnical reporting should be undertaken prior to the commencement of the design phase as the presence of hard rock, soft clays and other deleterious materials will impact the design intent. This information should be available in detail to inform the general design.

Mapping for the area shows that the western portion of the Investigation area has a low to moderate risk of encountering acid sulphate soils within 3 metres of the natural ground level. The remainder of the area has not been determined to pose a risk of encountering acid sulphate soils however where deeper works are required, for instance for sewer and stormwater infrastructure, more in-depth geotechnical reporting should be conducted to manage the risk of any exposure to acid sulphate soils, in accordance with standard industry practices.

2.3 Building and Earthworks

All development in the area should be staged where possible to follow the natural surface level of the land. Sewer and stormwater drainage should be designed to follow the natural contours of the land, to minimise earthworking required for the provision and installation of services. This is discussed in further detail in Sections 2.5 and 2.6. This should allow for land development in the area to follow the general natural surface levels and therefore limit the amount of import fill required. The use of imported fill in an area such as Wattle Grove is likely to be expensive and further, the use of import fill is a finite resource and should be considered in terms of its sustainability. In the current market we estimate the cost of imported fill to be in the region of $22.50 to $25.00 per m^3, (pending the size of each respective project to be developed). Earthworks in the Investigation area should therefore be confined to: -

- Replacement of local materials which are not suitable as sub-grades in the development of residential urban landholdings;
- Removal of material for the construction of stormwater drainage infrastructure including basins and the like;

- Importation of fill for areas of road construction which sit directly above hard rock, bed rock or similar and in particular in the proposed realignment of Welshpool Road East into Crystal Brook Road for the future bridge flyover for the Tonkin Highway interchange.
- Replacement of existing material in trenches for wastewater, water, power, gas and telco services (import select fill).

2.4 Roadworks

The Wattle Grove MRS Amendment area is currently special rural land within a general location bounded by Vulcan Road / Gavour Road to the east, Tonkin Highway to the south and Welshpool Road East to the north. The internal road layout has not been formalised at this stage, however will be developed in further iterations as part of more detailed investigation in the planning phases.

The proposed road cross sections and intersections are to be designed to meet the change in traffic conditions as a result of the development of the MRS Amendment Area. The design of the road network in particular should consider the external conditions on roads at the boundary of the Investigation Area. The key points to consider are: -

- The future Main Roads WA design requirements for the Tonkin Highway / Welshpool Road East Interchange;
- The existing horizontal geometry design of Welshpool Road near the intersection of Crystal Brook Road being inappropriate for increased vehicular volumes and for industrial traffic;
- The proximity of the intersection of Crystal Brook Road / Brentwood Road being highly inappropriate for any additional traffic loading, or industrial traffic of any size or type;
- The existing geometry of Crystal Brook Road east of Gavour Road and at the intersection of Kelvin Road being inappropriate for industrial traffic and heavier volumes of regional traffic.

The opportunity existing however to improve each of these issues simply as follows: -

- Realign the main spine access by aligning Welshpool Road East directly into Crystal Brook Road, thereby providing a straight access direct to Tonkin Highway in an east / west direction;
- Realign the existing Brentwood Road intersection to create a Left-In / Left-Out at Welshpool Road East / Crystal Brook Road;
- Realign the existing Welshpool Road East (east of Crystal Brook Road intersection) to a new intersection approximately 200 metres east of the intersection of Welshpool Road / Crystal Brook Road / Brentwood Road;
- Realign the new Welshpool Road East / Crystal Brook Road alignment to an improved location at Kelvin Road to the east so that industrial traffic has a simple, direct and circuitous path into and out of the MRS

Amendment Area. This route also provides a clear access / egress for all new traffic into the area for residential purposes north of the existing Crystal Brook Road and will reduce traffic loading for regional traffic from the Foothills on Welshpool Road East (west of Crystal Brook Road).

Consideration will need to be given to existing RAV Networks and protection of existing trees in Crystal Brook Road and the northern end of Kelvin Road. This should be reviewed in detail in a Conceptual Design phase.

2.5 Stormwater Drainage Considerations

The Investigation Area has a simple overland flow-path with the overland flow generally directed westerly within the Wattle Grove MRS Amendment Area. In the northern portion (residential) some flow will be directed toward the Crystal Brook. Specific locations of any detention structures which will be required will need to be determined. This can either be provided within a formalised road reserve, or it can be included in private landholdings with a specific area for easement purposes to the benefit of the City of Kalamunda. Given the goal density targets of R30, it is also important to note that connection to the City's main stormwater drainage lines may be required for lots with not enough space for on-site detention. These requirements are likely to play a key role in the stormwater drainage design process in the Investigation Area. As a general rule of thumb for R20 to R40 development (which needs to be confirmed through the DWMS / LWMS and UWMP phases): -

- 2% of the total land area will be needed for the 1 in 1-year event;
- 5% of the total land area will be needed for the 1 in 5-year event;
- 8% of the total land area will be needed for the 1 in 100-year event;

Based on these general principles, KCTT have determined that the following approximate areas will be required for stormwater drainage requirements: -

- Industrial Catchment = 146 hectares
    - 1 in 1-year = 2% or 29,200m^3 at approx. 0.3m depth
    - 1 in 5-year = 5% or 73,000m^3 at approx. 0.5m depth
    - 1 in 100-year = 8% or 117,000m^3 at approx. 0.65m to 0.8m depth
- Residential Catchment = 120 hectares
    - 1 in 1-year = 2% or 24,000m^3 at approx. 0.3m depth
    - 1 in 5-year = 5% or 60,000m^3 at approx. 0.5m depth
    - 1 in 100-year = 8% or 96,000m^3 at approx. 0.65m to 0.8m depth

The purpose of the above dot points is to show the approximate land requirements for drainage in a potential development area of this size and scope. The areas nominated above are not proposed to be concentrated in one location. Drainage should be treated locally and at-source as often as possible and our proposed development

approach would seek to maintain pre-development flows into the existing Crystal Brook, which will further reduce the areas quoted above. The areas quoted above however are useful for consideration at this early stage in the planning.

Some drainage may be able to be withheld within future proposed lots, however this will be determined by the ultimate lot sizing. The drainage design criteria should be carefully considered in the development of the Wattle Grove MRS Amendment Area because the lower-lying areas where drainage will likely accumulate coincide with the potential for higher density development landholdings near the intersection of Tonkin Highway / Welshpool Road East, particularly if there is success with the development of a future public transport node (either rail or high transit bus to the nearest railway station) in this location.

The capture of all storm events on-site for R30 and greater densities (lots less than 300m^2) promotes the concept of stormwater as a resource. Developers will have the choice of: -

- Using stormwater for flushing toilets/ irrigation etc.
- Planting roof top gardens
- Providing drainage detention on-site and allowing post-storm release into the City of Kalamunda Network.

Considerations for Drainage Re-Use

The key drainage re-use schemes considered in this report include: -

- At-Surface Treatment / Bio-Retention Drainage Swales
- At-source infiltration and cleaning systems

Below are KCTT schematics for the proposed potential WSUD systems: -

Bio-Retention Swales

Bio-retention swales are a key component of the drainage design strategy for Wattle Grove to maintain the bushland feel of the Wattle Grove area. All medians are proposed to treat surface water, with all roads adjacent to POS and near the Crystal Brook featuring bio-retention swales to treat and clean water prior to its entry to downstream environments. Consideration will need to be given to provision of rock riffle structures and other velocity-slowing measures where road grades exceed 3%, and particularly where any existing grades exceed 5%.

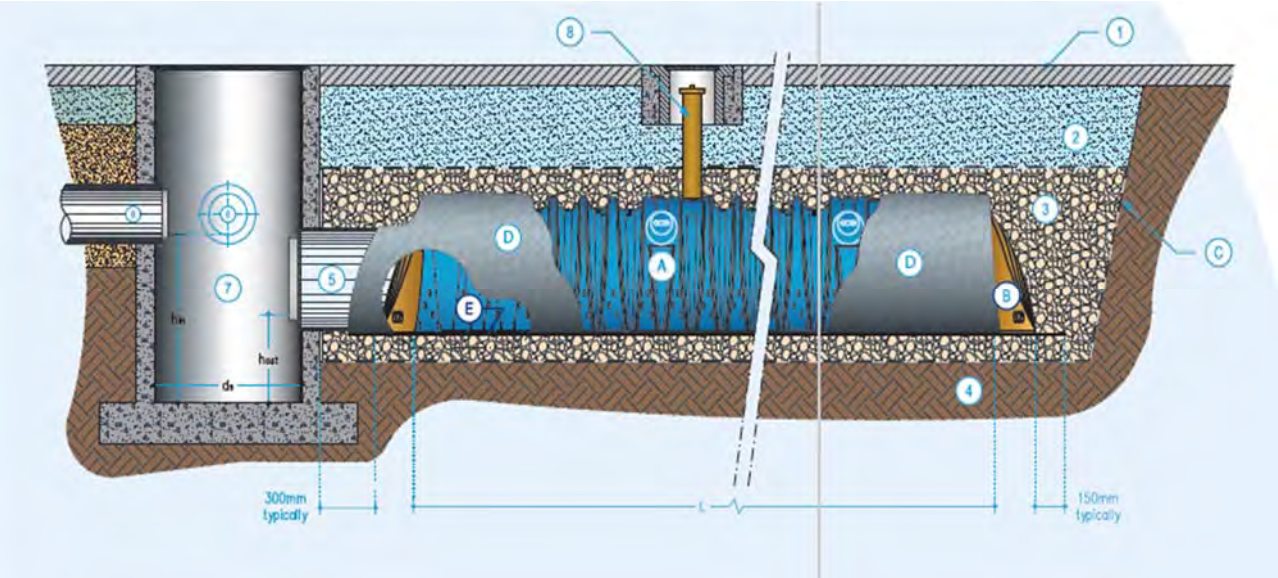
At-source Infiltration and Cleaning Systems

The capture of and reduction of stormwater pollutants, which remove the gross pollutants (GP) at source should be considered from the MRS Amendment phase as a requirement of good design. At-source cleaning systems provide the opportunity for improvements such as allowing the base of the Side Entry Pit, which is designed to infiltrate

water to be protected from sand rolling onto the new road surface picking up hydrocarbons and then entering the drain and causing localised pollution at the base of the side entry where the infiltration is intended.

Where greater volumes of flow are required to infiltration at-source events, underground modular stormwater management systems can be used to detain, infiltrate or harvest stormwater run-off, and also provide stormwater treatment by utilizing an internal gross pollutant and sediment trap. KCTT believe this is a great innovation which can be utilized throughout the Wattle Grove MRS Amendment Area.

The below is a figure sourced from the online ECOAID brochure, which outlines all the technical data and benefits of the system as an alternative to standard piping and pits used for stormwater drainage.



Source: https://www.geofabrics.co/sites/default/files/brochures/ecoAID_Brochure.pdf

2.6 Wastewater (Sewer)

The Water Corporation has provided long term planning for wastewater reticulation in this area. The basis of this report therefore, is not to discuss Water Corporation Planning, but to provide an indication of what we believe are the likely requirements of a wastewater system over the MRS Amendment Area. This report is therefore the commencement of an iterative process in developing a future strategy for the provision of wastewater assets.

The Water Corporation's Design and Construction Requirements for Gravity Sewers DN 150 to DN 600 Manual (Design Standard No DS 50) states: -

"Wastewater schemes shall be designed so that land will be sewered by a gravity scheme in preference to a pumping scheme." Ref: Section 4. Design Criteria, Section 4.1 Introduction paragraph 6, page 26 of 75.

The following points in Section 4.2 Sewer Design are of key importance to this assessment: -

Table 2 – Water Corporation Wastewater Design Parameters

Water Corporation Design Parameter	Investigative Area Requirements
a. The design flow in sewers shall include the wastewater flow from the design population contributing to the sewer and an allowance for stormwater and groundwater infiltration and approved industrial flows or special peak flows where appropriate.	Noted.
b. The Local Authority's current of proposed Residential Planning Code (R Code) which indicates the number of dwellings per net hectare in any area, together with the anticipated number of persons per dwelling shall form the basis for the calculation of contributing populations.	Proposed yields Residential north of Crystal Brook Road - R20 to R40 (to be confirmed) in a total land area of 120 hectares. Industrial landholdings south of Crystal Brook Road (potentially around 47 allotments with an average of 2 hectares each) in a total land area of 146 hectares.
c. A Residential Planning Code of R15 shall be used where the Local Authority Code is less than R15 or where no Code exists	Not applicable
d. *Wastewater design flows shall be calculated from the data shown in Tables 4.1, 4.2 and 4.3. The data shown in these tables represent minimum requirements. Where special factors or local information indicate the possibility of higher flows these shall be individually assessed.*	Demonstrated in Table 3 below.
e. The basis for calculating flows from town and city centres other than Perth shall be evaluated in each case.	Not applicable.
f. The Daily Flow from a residential area shall be the product of the population density, the daily flow per person and the net area.	Demonstrated in Table 3 below.
g. The Daily Flow from a non-residential area shall be the product of the flow per net hectare and the net area.	Demonstrated in Table 3 below.
h. The sewer Design Flow shall be 1.5 times the Daily Flow, unless special factors or local information indicate the possibility of higher flows which shall be individually assessed.	Demonstrated in Table 3 below.
i. In areas where there is an existing or proposed subdivision plan the net area shall be the total area of the	Not Applicable. Too early in the planning phase to provide a lot layout.

individual lots that can be connected to the wastewater system.	
j. When broadacre catchments are being evaluated the net area for the application of zoning densities shall be obtained by deducting the area of large recreation reserves and major roads from the gross area and reducing the remaining area by 25% to allow for public open space and minor roads.	KCTT have utilised an equivalent area for residential development representing approximately 65% of the total area for the purposes of this ISR.
k. Sewers serving a gravity area shall be designed to carry the Sewer Design Flow. When pumped flows are discharged into a gravity sewer, the gravity sewer shall be designed to accept the pumped flow rate plus the Sewer Design Flow from any gravity area contributing to the discharge point of the catchment. At these flows the depth of flow in the sewer shall not be more than: - • *Half full for DN 150 pipes.* • *Two thirds full for DN225 and larger pipes.*	To be confirmed by Water Corporation.
l. The minimum size of sewers in residential areas and serving small commercial areas and shopping centres shall be DN 150. Where the Gravity Sewer Design Flow is at least 3 L/second a DN225 sewer at 1:300 grade may be used. Small commercial areas and shopping centres are defined as areas / centres not exceeding 0.5 hectares/	Noted. Industrial landholdings are proposed south of Crystal Brook Road and Residential landholdings are proposed north of Crystal Brook Road.
m. The minimum size of sewers serving industrial, light industrial, large commercial areas and large shopping centres shall be DN225 with the following exceptions: - • *Single lots in industrial and commercial subdivisions can be served by a DN150 sewer.* • *A DN150 sewer can serve two industrial or commercial lots or an industrial and a commercial lot provided that the combined area of the two lots does not exceed 0.5 hectares.*	Noted. All sewers south of Crystal Brook Road to be a minimum of 225mm-diameter.
n. Pipe diameters with corresponding minimum and maximum grades, maximum distances between access chambers and the maximum allowable flows within ranges of grades are shown in Table 4.4. *The flow capacity of pipes is based on the Colebrook-White equation using a roughness coefficient (k) of 1.0mm.*	KCTT expect the majority of wastewater pipe infrastructure to be laid at minimum grades, however there may be some sections of steeper infrastructure which are installed to suit the longitudinal grades that naturally occur in the MRS Amendment Area.

Where the grade is required to be steeper than the minimum because of flow requirements it shall be marked on the drawing as the minimum grade allowable.	
o. The minimum grades shown in Table 4.4 may be varied as follows: - *The minimum grade of a DN150 sewer may be reduced to 1:250 provided that one of the following is achieved: - There is a reduction in the number of permanent pumping stations through which the flow discharges.* *The area is drained to a gravity sewer rather than to a pumping station.* *The number of entries to sewers DN300 and larger is reduced.*	Noted. This item is more applicable for detailed design requirements than the planning phases.
p. The minimum grade of a DN225 sewer may be reduced to 1:350 where a pumping station discharges at least 14L/second into the sewer.	Noted. As above.
q. When servicing industrial, light industrial, large commercial areas and large shopping centres the DN225 sewer shall be constructed at a minimum grade of 1:200 if the Sewer Design Flow is less than 3 L/second.	Noted.
r. The maximum and minimum grades of sewers are shown in Table 4.4	Noted.
s. The minimum size of a sewer receiving discharge from a pressure main shall be DN225 unless otherwise approved by the Water Corporation.	Noted.
t. Where the discharge rate of a pressure main exceeds two thirds of the capacity of a receiving gravity sewer the system design is to be discussed with the Corporation.	Noted
u. The diameter of a sewer downstream of any point should not be reduced.	Noted.
v. The centre lines of all sewers entering or leaving an Access Chamber should intersect at the centre point of the Access Chamber in plan unless the Access Chamber is a re-entrant Access Chamber.	Noted – detailed design procedure.

The MRS Amendment Area falls into the Wattle Grove SD073 catchment. KCTT have calculated the following design requirements for the proposed land uses in the MRS Amendment Area (this information is collated from Tables 4.2 and 4.3 of the design standard): -

Table 3 – Foothills Investigation Area Estimated Wastewater (Sewer) Flows

Development Type	Total Area (ha)	Equivalent Area (ha)	Number of Persons Per Dwelling	Population Density Persons / Net Ha	Flow (Dry Ground)	GSDF (Sewer Design Flow in Dry Ground) L/sec/Net ha	Total Design Flow	Primary Distribution Main
Northern Catchment (Residential R20 Option)	120 ha	78 ha	3.5	70	230**	0.280	21.84 L/sec	300mm-diameter
Northern Catchment (Residential R30 Option)	120 ha	78 ha	3.5	105	230**	0.419	32.7 L/sec	300mm-diameter
Northern Catchment (Residential R40 Option)	120 ha	78 Ha	3.5	120	230**	0.479	37.4 L/sec	300mm-diameter
Southern Catchment Industrial	146 ha	95 Ha	n.a.	n.a.	14,976 l/net ha/ day	0.260	24.7 L/sec	300mm-diameter
Total	**266 ha**	**173 ha**					**52.1 to 46.5 L/sec**	**375mm-diameter**

Note: ** L/person/day.

The Water Corporation have provided two planning diagrams for the wastewater, which show the existing planning through the southern section of the Foothills Investigation Area. A general description of these planning diagrams is provided below: -

- Wattle Grove SD 1 shows a planned series of catchments generally south of Welshpool Road toward Bickley Road. These catchments are required for the development of land east of Tonkin Highway in the Foothills Investigation Area and drain via Brentwood Road in a 375mm-diameter and 450mm-diameter main toward 600mm-diameter mains in Bickley Road in the southwest. Wattle Grove SD1 is located to the

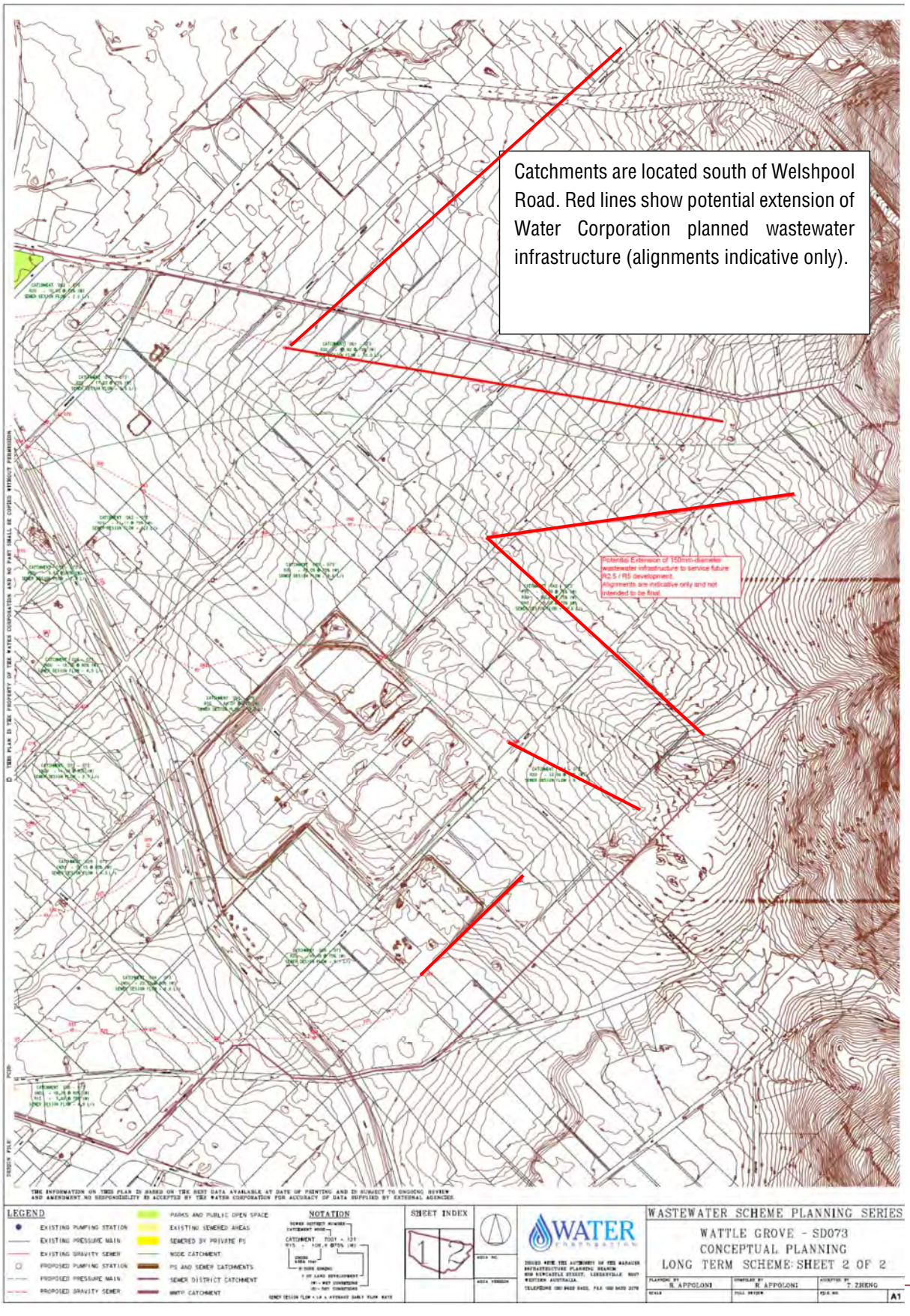
west of the Investigation Area, however the infrastructure is required for the expansion of lands in the south of the Investigation Area

- Wattle Grove SD 2 shows a planned series of catchments generally northeast of Tonkin Highway, south of Crystal Brook Road and west of Victoria Road. This is the southern section of the Investigation Area. These catchments have a rudimentary network of planned primary distribution mains, comprising of 225mm-diameter and 300mm-diameter mains draining toward Brentwood Road with a northern portion draining toward Boundary Road. There is no planning shown north of Welshpool Road.

The information provided above by KCTT in Table 1 therefore complies with the Water Corporation Planning, meaning an average R40 residential coding could be provided to all landholdings north of Crystal Brook Road if support to medium density is given by the Western Australian Planning Commission.

A Water Corporation map of the Wattle Grove planning is shown on the following page.

INFRASTRUCTURE SERVICING REPORT
KC00381.000 Wattle Grove Landholdings



2.7 Water

KCTT have held preliminary discussions with the Water Corporation relating to water design requirements for the MRS Amendment Area. The Water Corporation have confirmed there are significant water assets which run adjacent to the MRS Amendment Area inclusive of the Canning Trunk Main and the Canning Foothills Trunk Main. The Corporation has adopted a long-term water planning strategy for the area, however will only generally review the existing assets in the area and will not commence a formal detailed planning review until they are in receipt of detailed future development yields and road layouts for a Structure Planning phase.

The following table highlights the Water Corporation's design parameters as noted in the Water Reticulation Standard Design Standard DS63: -

Table 4 – Water Corporation Design Parameters and Foothills Investigation Area requirements

Water Corporation Design Parameter	Foothills Investigation Area Requirements
Design Criteria	
Minimum head at the reference ground level of every serviced lot shall be 17m in the Perth Metropolitan Area.	Water head pressure likely to be sufficient. The area is serviced by the Canning Foothills Distribution Main.
Maximum head shall be 100m.	Additional Pressure Reducing Valve's (PRV's) may be required.
Sizing of mains – water reticulation mains shall be sized so that the velocity of flow in pipes is kept below 2m/sec	To be confirmed by Water Corporation in planning.
The largest pipe size for water reticulation shall be DN250.	Noted – all proposed mains for servicing properties in the Foothills Investigation Area shall be between DN100 and DN250. Distribution mains of DN300 and greater will not be used for any direct connection to properties
Minimum size DN150 for industrial development and retail / commercial centres.	Noted.
Improvements to Existing Mains	
Improvements to the hydraulic capacity of existing mains may be necessary as a result of a proposed	To be confirmed as structure planning continues.

development. The nature and extent of the improvements will be determined by the Corporation.	
Sizing of Mains	
The impact of adjoining water supply schemes and high-level supply zone boundaries or operational control zones.	To be considered in planning phase.
The impact of staging the water supply to a development area in the event that all of the distribution mains defined in the Scheme design are not in place at the time of initial supply.	To be considered by the Water Corporation at submission of Subdivision Application
The eventuality of a single distribution main connection being closed.	We believe the network of water mains will be closed given the proposed road improvements.
The eventuality of any one section of the water reticulation being isolated.	Valves to be located in detailed design / construction phases which enable the isolation of sections of line.
All aspects of the overall long-term supply situation.	To be considered by the Water Corporation.
As many services as hydraulically possible be placed on each main to ensure it remains self-cleansing within the limits of minimum supply heads.	The MRS Amendment Area proposes sufficient numbers of services to ensure self-cleansing of the main and replenishment of water supplies.
Reticulation Layout	
The water reticulation shall as far as practicable, form a series of closed loops to minimise dead end mains. Every group of 50 or more properties shall be supplied by more than one pipe route.	Proposed concept planning should offer opportunities for closed loops with minimal use of cul-de-sacs.
Within a subdivision agreement area, mains shall be provided across the full frontage of all lots created except where the future extension of the main will not be required. Every lot shall be served by a reticulation main along one of the street frontages of the property, i.e. in gazetted road reserves.	Mains are already provided across the frontage of all existing “super lots”.
Mains and Services Location	
Mains shall align within the existing or proposed connection points from the distribution system and be located within road reserves on an alignment of 2.1 metres.	Mains shall be placed on standard 2.1 metre alignments.

The following table shows the yields with commentary relating to the minimum pipe sizing in each zone.

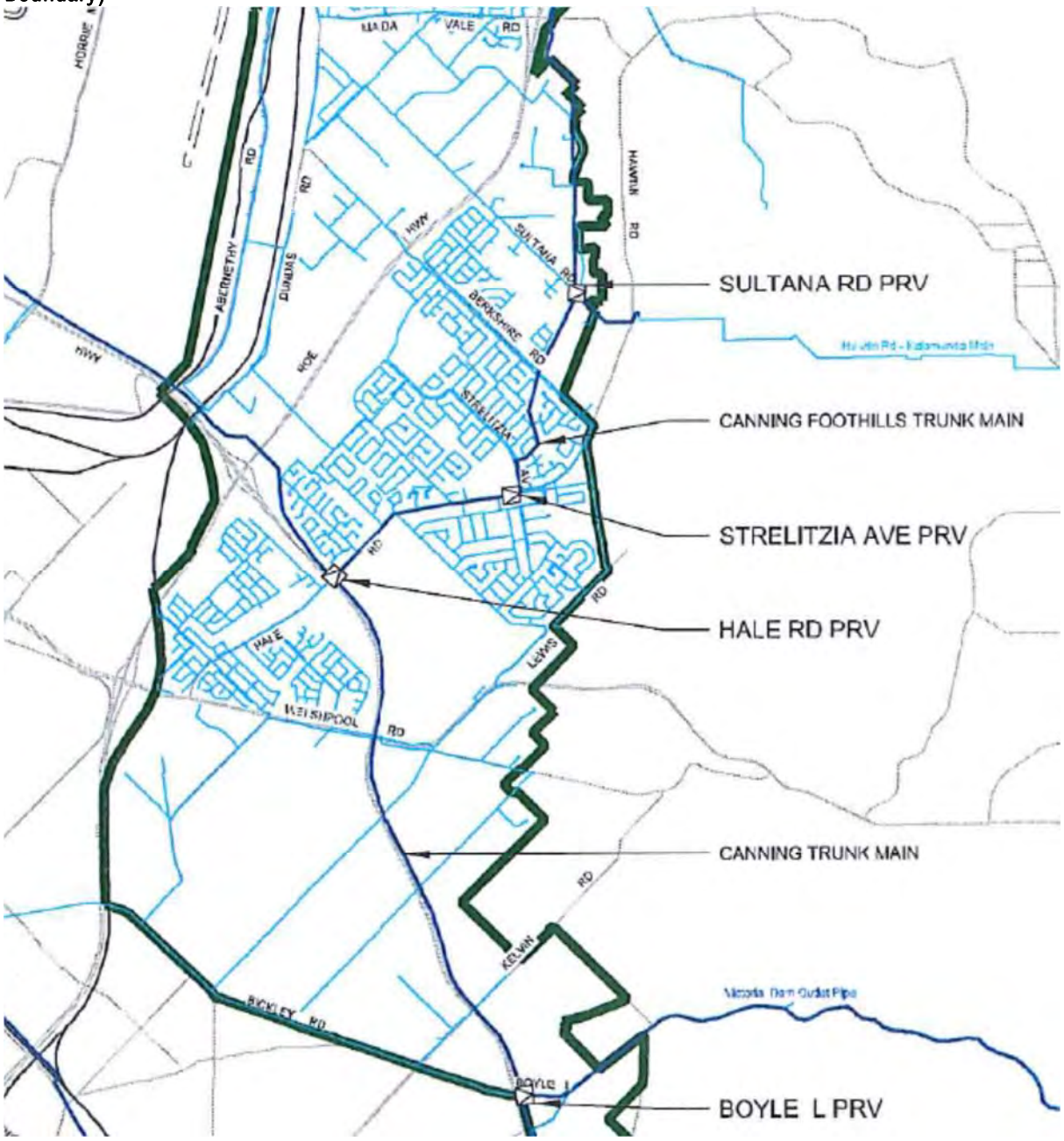
Table 5 – Development Zones and General Minimum Requirements for Water Infrastructure

Development Type	Total Area (Ha)	Equivalent Area	Minimum Pipe Sizing	Notes
Southern Catchment	266	173 Ha	100mm-diameter in residential zone. 150mm-diameter in industrial zone.	Primary Distributor Main at 250mm-diameter Secondary Distributor Main 200mm-diameter
Total	**266 ha**	**173 ha**		

The Water Corporation have major water infrastructure throughout the Foothills Investigation Area. The southern catchment includes the Canning Trunk Main, with the Canning Foothills Trunk Main branching off at Hale Road. In discussions with the Water Corporation, we believe a network of local infrastructure can be planned pending confirmation of road layouts.

Existing water mains are available in most existing road reservations in the catchment.

Figure 1 - Major Water Assets (source: SKM Investigation – modified to suit Foothills Investigation Area Boundary)



2.8 Power, Telecommunications and Gas Supply

The provision of power, telecommunications and gas supply will be a requirement for all future developers in the MRS Amendment Area.

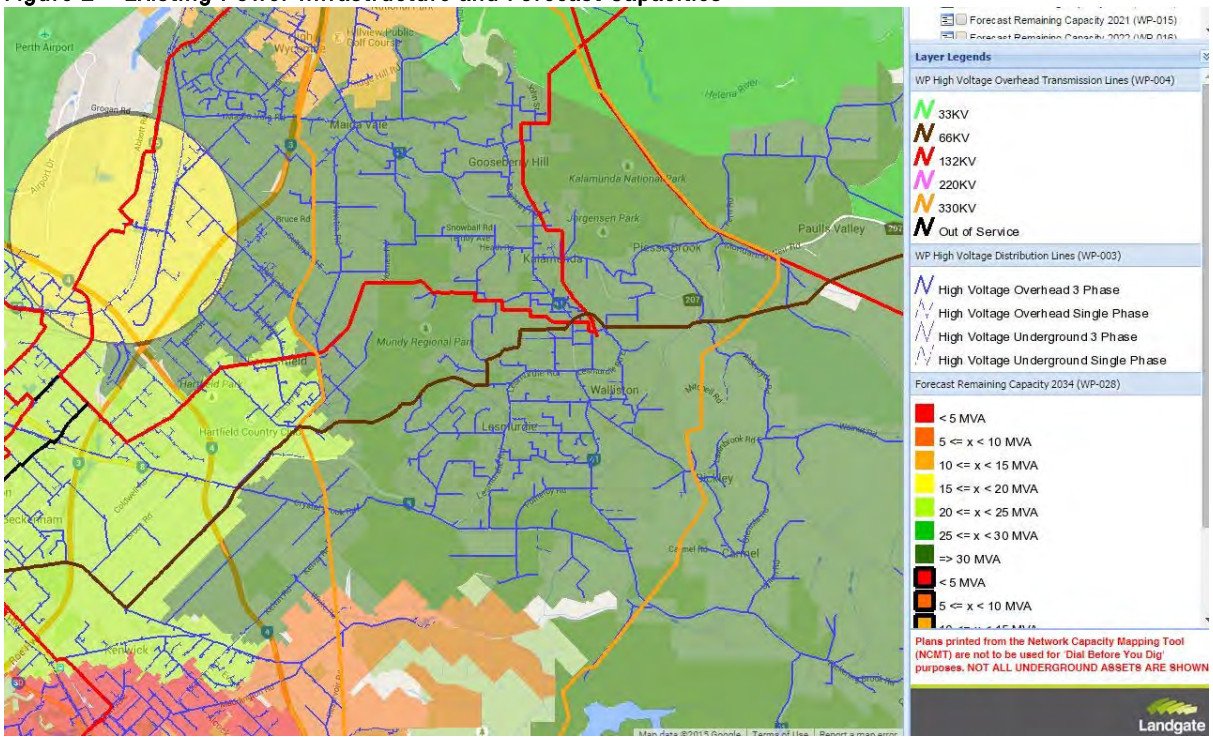
2.8.1 Power

Western Power requires that developers underground all existing overhead power assets which are located on the development side of any road reservation. This cost should be considered in any future development.

Western Power has an online management tool known as the Network Capacity Mapping Tool, or NCMT. Using this tool, we have reviewed the "forecast remaining capacity" and found that: -

- The catchment between Welshpool Road and Tonkin Highway generally has a forecast capacity of 20 to 25MVA in the year 2034.

Figure 2 – Existing Power Infrastructure and Forecast Capacities



High Voltage overhead 3 phase power infrastructure is currently available through most of the DSP Area as follows: -

- Hale Road to Mundy Regional Park (132kV)
- West of Hawtin Road (330kV) near the Canning Foothills Trunk Main water alignment
- 66kV assets on the south-eastern boundary of the Investigation Area.

2.8.2 Telecommunications

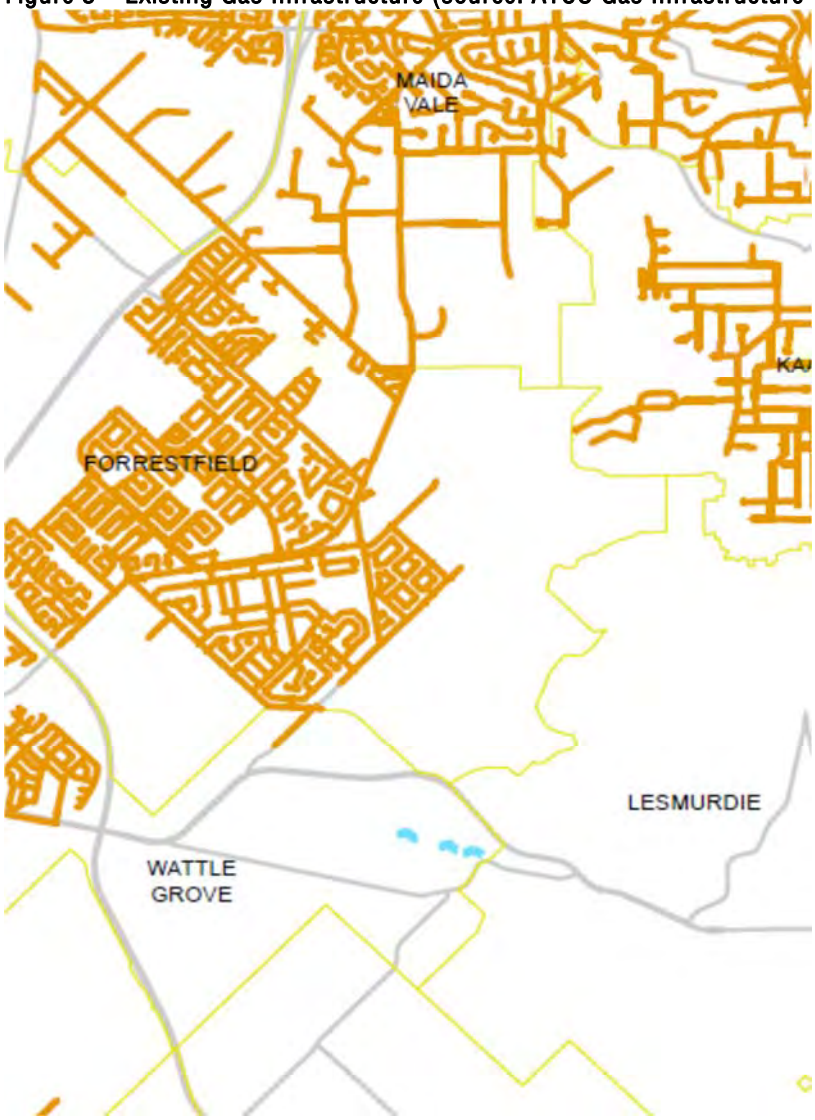
The MRS Amendment Area has existing telecommunications assets which are suitable for general telephony. There are no NBN rollouts currently planned in this area. NBN Co has a charter to work with local governments and developers, particularly for larger scale developments (+100 lots).

For the purposes of this Infrastructure Servicing Report, we believe the provision of suitable services can be negotiated.

2.8.3 Gas

The road network exhibits minimal existing infrastructure is available in Wattle Grove, however existing services are in reasonable proximity to the MRS Amendment Area.

Figure 3 – Existing Gas Infrastructure (source: ATCO Gas Infrastructure – Perth North Map)



2.9 Earthworks

For localised cut to fill (+ / - 1.0 metre) it is highly likely that the existing soils will be suitable for re-use. This is a key component of sustainability and is a key objective in all KCTT-designed projects. In 2016, KCTT completed research on the impact that overfilling land development sites has both economically and environmentally. Apart from the issues associated with difficulties in tree retention on filled developments, we found the following key metrics: -

Table 2– KCTT Key Metrics 1

Lot Size	Fill Depth	Fill Required Per Lot	Distance to Nearest Quarry	CO_2 Emissions Per Lot	Volatile Organic Compound
$80m^2$	1.0m	$230m^3$	40km	952kg	34,007kg
$100m^2$	1.0m	$250m^3$	40km	1035kg	36,964kg
$120m^2$	1.0m	$270m^3$	40km	1110kg	39,921kg
$160m^2$	1.0m	$310m^3$	40km	1283kg	45,835kg
$200m^2$	1.0m	$350m^3$	40km	1450kg	51,750kg

Table 3– KCTT Key Metrics 2

Lot Size	Total Hydrocarbons (THC Per Lot)	Carbon Monoxide Cost Per Lot	Nitrogen Oxides (not per lot)	Particulate Matter Under 2.5 Micron Per Lot
$80m^2$	34,711kg	267,246kg	49,012kg	952kg
$100m^2$	37,730kg	290,485kg	53,214kg	1035kg
$120m^2$	40,748kg	313,724kg	57,536kg	1110kg
$160m^2$	46,785kg	360,201kg	66,060kg	1283kg

$200m^2$	52,822kg	406,679kg	74583kg	1450kg

Importation of fill is therefore a significant contribution to pollution due to its labour-intensiveness in the field of transportation.

2.10 Bridges (Welshpool Road East / Tonkin Highway Interchange)

The Wattle Grove MRS Amendment Area is reliant on some significant improvements to road connectivity, with consideration needed for the impact of the proposed Welshpool Road East grade separation on the development potential in the western third of the MRS Amendment Area.

Any bridge of the Tonkin Highway over Welshpool Road East will have the following minimum requirements: -

- Min depth of bridge structure = 1.7 metres
- Min clearance to Welshpool Road East carriageways = 6.5 metres

The following picture shows the impact of the Benara Road bridge over the Tonkin Highway. The proposed Tonkin Highway Flyover at Welshpool Road East will have a similar visual and land-take impact to this bridge. This impact should be considered on the Wattle Grove MRS Amendment Area.

The cost of this bridge will not be the responsibility of the MRS Amendment Area, however costs to realign Welshpool Road East will need to be considered in the develop of a DCP.

APPENDIX 3:
KCTT,
Transport Impact Assessment

TRANSPORT IMPACT ASSESSMENT

Wattle Grove South

April 2018

Rev A

HISTORY AND STATUS OF THE DOCUMENT

Revision	Date issued	Reviewed by	Approved by	Date approved	Revision type
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Table of Contents

Appendices

1. Executive Summary

KCTT have been commissioned by the City of Kalamunda to prepare a Transport Impact Assessment to inform a Feasibility Study for Wattle Grove South.

Wattle Grove South is located within the City of Kalamunda, approximately 15km from Perth City. The subject site is currently characterised by rural land approximately 320 hectares (ha) in size. It is encompassed by Tonkin Highway to the south, Welshpool East Road to the north and Kelvin Road and City of Kalamunda boundary to the east. The Study Area is proposed to be developed into a residential and service commercial/light industry area. Land generally south of Crystal Brook Road is proposed to be developed for commercial/light industrial uses, whilst land generally north of Crystal Brook Road will be developed for residential purposes.

The purpose of this report is to identify any potential traffic issues, constraints and opportunities for future development. A desktop trip generation, distribution and assignment exercise undertaken establishes the potential future traffic volumes.

KCTT have analysed vehicular crash information in the last 5 years within the Study Area. KCTT believe that the general safety will be improved through urbanisation of the area, by limiting vehicular speeds and improvements to the general road geometry. Additionally, the intersection of Tonkin Highway & Welshpool East Road is planned to be a grade separated interchange with a flyover on Tonkin Highway over Welshpool East Road. These measures should reduce the incidence of killed or seriously injured (KSI) crashes in the Study Area.

The area is currently serviced by bus routes 282, 283 and 279. The Public Transport Authority (PTA) confirmed there are currently no new routes planned unless there is a significant increase in residential development. Subject to increased residential density the existing routes may be improved over time. Introduction of additional routes would require a more detailed plan in the future stage of development.

KCTT assumes that subsequent to a concurrent Metropolitan Region Scheme and Local Planning Scheme Amendment process to rezone the land for urban development the City of Kalamunda will prepare a District Structure Plan (DSP). It is essential to develop an efficient and connected network of pedestrian paths in order to encourage pedestrian and cycling movement to and throughout the future DSP area. It is proposed that every major road within DSP area will have either a shared path or a separate pedestrian path. All pedestrian and shared paths should be designed to be accessible by all members of the community in accordance with the City of Kalamunda's Disability Access and Inclusion Plan 2012-2017 or any other subsequent document of this nature. The exact location of pram ramps and other elements is to be determined at a later stage of development.

The general options considered for the residential development scenarios of this site are averages of R20 (Option 1), R30 (Option 2) and R40 (Option 3). To cater for the proposed land uses KCTT assumes the development of a primary school and neighbourhood centre within the Wattle Grove South area. It's possible that Option 3 would require two primary schools and two neighbourhood centres. However, for purpose of this report and traffic modelling, KCTT have assumed one primary school and one neighbourhood centre in all three scenarios.

Although the cumulative traffic generation of the proposed development is expected to be in range from **38,216 VPD to 45,236 VPD**, it is expected that a total between **29,147 VPD to 36,167 VPD** will be generated into the network external to the Wattle Grove South area. This is the consequence of the fact that traffic attracted to the neighbourhood centre will be predominantly generated by the residents of the area and is already accounted for in the residential traffic. Further to this, KCTT have assumed that the primary school would be a government school with a limited local intake. That means that the traffic attracted by the primary school and neighbourhood centre is approximately

80% local traffic that has already been accounted for in residential traffic. And above all, various land uses will peak at different times with little or no overlap. It should be noted that these calculations represent the rough estimate of both yields and the traffic volumes. Once a precise layout plan of the future structure plan area is provided, a more accurate estimation of traffic generation can be provided.

There are plans for potential Wattle Grove rail realignment with new train lines to connect future Forrestfield North Railway Station and Wattle Grove South future station. The proposed alignment would follow the alignment of Tonkin Highway and continue along Brentwood Road to Roe Highway. If developed, this will be an important strategic connection, resulting in reduced car utilisation.

Traffic calming methods are desirable especially near primary schools and neighbourhood centres. Chicanes, speed humps, wombat crossings and/or other methods should be considered when designing streets to lower operating speeds and improve safety. Posted signs with reduced speed limits should be considered for roads near these facilities.

The internal road layout has not been formalised at this stage, however will be developed in further iterations as part of more detailed investigation in the planning phases.

The proposed road cross sections and intersections are to be designed in accordance with relevant regulatory documents such as Liveable Neighbourhoods and various State and Local Planning policies.

The Study Area and surrounding area, will be well planned to accommodate the major changes that will occur in the next decade. The key will be in monitoring the traffic and intersections performance and upgrading them as necessary and as timely as possible depending on the actual development yields. While some of the major upgrades on Metropolitan network are anticipated, suggestions for upgrade of the existing network are given as a guide only and should be considered with caution.

2. Transport Impact Assessment

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2.1. Location

Study Area	Wattle Grove South
Street Number	N/A
Road Name/s	N/A
Local Government Authority	City of Kalamunda

Description of Site

The Study Area is located within the City of Kalamunda, approximately 15km from the Perth CBD. It is a rural area of about 320ha. It is encompassed by Tonkin Highway to the south, Welshpool East Road to the north and Kelvin Road and City of Kalamunda boundary to the east.

2.2. Technical Literature Used

Type of Development	Residential and Service Commercial/Industrial
Are the R-Codes referenced?	YES
If YES, nominate which:	State Planning Policy 3.1 Residential Design Codes 2015 R-Codes (incorporating amendments gazetted on 23/10/15)
Are other State Planning Policies referenced?	NO
If YES, nominate which:	
Is the NSW RTA Guide to Traffic Generating Developments Version 2.2 October 2002 (referenced to determine trip generation / attraction rates for various land uses) referenced?	YES Guide to Traffic Management – Part 3: Traffic Studies and Analysis, Austroads, 2008 Guide to Traffic Management – Part 11: Parking, Austroads, 2008 Guide to Traffic Management – Part 12: Traffic Impacts of Developments, Austroads, 2008
Which WAPC Transport Impact Assessment Guideline should be referenced?	Volume 2 – Planning Schemes, Structure Plans & Activity Centre Plans Volume 5 – Technical Guidance
Are there applicable LGA schemes for this type of development?	YES
Number of Scheme	No 3
Name of Scheme	City of Kalamunda Local Planning Scheme
Are Austroads documents referenced?	YES

Is the Perth Transport Plan for 3.5 million and beyond referenced?	YES
List of other documents:	• Perth Transport Plan for 3.5 Million People and Beyond • Directions 31 and Beyond • Disability Access and Inclusion Plan 2012-2017, City of Kalamunda

2.3. Land Uses

Are there any existing Land Uses within the Study Area?	YES
If YES, nominate:	Approximately 130 single dwelling lots
What zone is the Study Area included in according to the Metropolitan Region Scheme and LPS / TPS?	Special Rural

Proposed Land Uses

How many types of land uses are proposed?	4 land uses
Nominate land use type and yield	Please refer to the table below:

Development Type	Total Area (m^2)	Equivalent Area	Yield
Industrial	1,460,000	Assume 65% = 949,000	Approximately 47 Industrial Lots
Option 1 Residential – R20	1,200,000	Assume 65% = 780,000	1,560
Option 2 Residential – R30	As above	As above	2,340
Option 3 Residential – R40	As above	As above	3,120
School	Assume 40,000	N/A	450 students
Neighbourhood Centre	Assume 40,000	12,000 m^2 GFA (Equivalent of 30% of total area)	12,000m^2 GFA
Total Development	2,660,000	1,729,000	47 industrial lots + between 1,560 to 3,120 residential lots + primary school and neighbourhood centre

Is there any proposed staging of the Study Area?	Not known at this stage of development
Are the proposed land uses complimentary with the surrounding land-uses?	YES – the wider area is undergoing major changes from rural to urban, this DSP will compliment these changes.

2.4. Local Road Network Information

How many existing roads are there within the Study Area? 15 existing roads

Name of Roads within the Study Area / Road Classification and Description:

Road 1

Road Name	**Crystal Brook Road**
Number of Lanes	One lane per direction
Road Reservation Width	20m
Road Pavement Width	7.2m
Classification	Urban Local Road / Access Road
Speed Limit	70kph (SLK 0.00 – 1.86) 60kph (SLK 1.86 – 3.18)
Bus Route	YES 283 - Perth - Kalamunda Bus Station via Lesmurdie Road
On-street parking	NO

Road 2

Road Name	**Brentwood Road**
Number of Lanes	two-way one lane (no centreline)
Road Reservation Width	20m
Road Pavement Width	6m
Classification	Urban Local Road / Access Road
Speed Limit	50kph
Bus Route	NO
On-street parking	NO

Road 3

Road Name	**Johnson Place**
Number of Lanes	two-way one lane (no centreline)
Road Reservation Width	20m
Road Pavement Width	6m
Classification	Urban Local Road / Access Road
Speed Limit	50kph
Bus Route	NO
On-street parking	NO

Road 4

Road Name	**Philemon Court**
Number of Lanes	two-way one lane (no centreline)
Road Reservation Width	12m
Road Pavement Width	5m
Classification	Urban Local Road / Access Road
Speed Limit	50kph
Bus Route	NO
On-street parking	NO

Road 5

Road Name	**Victoria Road**
Number of Lanes	two-way one lane (no centreline)
Road Reservation Width	20m
Road Pavement Width	6m
Classification	Urban Local Road / Access Road
Speed Limit	50kph
Bus Route	NO
On-street parking	NO

Road 6

Road Name	**Gavour Road**
Number of Lanes	two-way one lane (no centreline)
Road Reservation Width	20m
Road Pavement Width	5m
Classification	Urban Local Road / Access Road
Speed Limit	50 km/h or State Limit
Bus Route	NO
On-street parking	NO

Road 7

Road Name	**Valcan Road**
Number of Lanes	two-way one lane (no centreline)
Road Reservation Width	20m
Road Pavement Width	7m
Classification	Urban Local Road / Access Road
Speed Limit	50kph
Bus Route	NO
On-street parking	NO

Road 8

Road Name	**Judith Road**
Number of Lanes	two-way one lane (no centreline)
Road Reservation Width	20m
Road Pavement Width	6m
Classification	Urban Local Road / Access Road
Speed Limit	50 kph or State Limit
Bus Route	NO
On-street parking	NO

Road 9

Road Name	**Jack Road**
Number of Lanes	two-way one lane (no centreline)
Road Reservation Width	20m
Road Pavement Width	5.5m
Classification	Urban Local Road / Access Road
Speed Limit	50 kph or State Limit

Bus Route	NO
On-street parking	NO

Road 10

Road Name	**Crystal Place**
Number of Lanes	two-way one lane (no centreline)
Road Reservation Width	16m
Road Pavement Width	6m
Classification	Urban Local Road / Access Road
Speed Limit	50 kph or State Limit
Bus Route	NO
On-street parking	NO

Road 11

Road Name	**Ridley Road**
Number of Lanes	two-way one lane (no centreline)
Road Reservation Width	20m
Road Pavement Width	5.5m
Classification	Urban Local Road / Access Road
Speed Limit	50 kph or State Limit
Bus Route	NO
On-street parking	NO

Road 12

Road Name	**Easterbrook Place**
Number of Lanes	two-way one lane (no centreline)
Road Reservation Width	16m
Road Pavement Width	5m
Classification	Urban Local Road / Access Road
Speed Limit	50kph
Bus Route	NO
On-street parking	NO

Road 13

Road Name	**Emanuel Court**
Number of Lanes	two-way one lane (no centreline)
Road Reservation Width	16m
Road Pavement Width	6m
Classification	Urban Local Road / Access Road
Speed Limit	50kph
Bus Route	NO
On-street parking	NO

Road 14

Road Name	**Boundary Road (north of Tonkin Highway)**
Number of Lanes	two-way one lane (no centreline)
Road Reservation Width	20m
Road Pavement Width	5.5m unsealed
Classification	Urban Local Road / Access Road
Speed Limit	50kph
Bus Route	NO
On-street parking	NO

Road 15

Road Name	**Fontano Road**
Number of Lanes	two-way one lane (no centreline)
Road Reservation Width	20m
Road Pavement Width	6m
Classification	Urban Local Road / Access Road
Speed Limit	50 kph or State Limit
Bus Route	NO
On-street parking	NO

Name of Other Roads within 2km radius of site, or roads likely to take increased traffic due to the development:

Road 1

Road Name	**Welshpool Road East**
Number of Lanes	Two lanes per direction
Road Reservation Width	40m
Road Pavement Width	7.0m and 7.4 per direction, with 10.0m median
Classification	Significant Urban Local Road / Distributor A
Speed Limit	80kph
Bus Route	YES
	282 - Perth - Kalamunda Bus Station via Grove Road
On-street parking	NO

Road 2

Road Name	**Kelvin Road**
Number of Lanes	One line per direction
Road Reservation Width	20m
Road Pavement Width	7.2m
Classification	Significant Urban Local Road / Distributor B
Speed Limit	60kph
Bus Route	YES
If YES Nominate Bus Routes	279 - Maddington - Kalamunda Bus Station via Kelvin Road
On-street parking	NO

Road 3

Road Name	**Tonkin Highway**
Number of Lanes	two lanes per direction, with central median
Road Reservation Width	approximately 60 m
Road Pavement Width	9.5m pavement in each direction (2 x 3.5m lanes, plus shoulder)
Classification	Urban Highway / Primary Distributor
Speed Limit	80 kph / 100kph
Bus Route	NO
On-street parking	NO

2.5. Traffic Volumes

Road Name	Location of Traffic Count	Vehicles Per Day (VPD)	Vehicles per Peak Hour (VPH)		Heavy Vehicle %	Year	
			AM Peak Time - AM Peak VPH	PM Peak Time - PM Peak VPH	*If HV count is Not Available, are HV likely to be in higher volumes than generally expected?*	Date of Traffic Count	*If older than 3 years multiply with a growth rate*
Hale Road (Wattle Grove)	North of Welshpool Road East (SLK 0.81)	11,730	08:00 – 875	16:45 – 1,054	5.9%	Dec 2015	–
	East of Tonkin Highway (SLK 1.76)	15,960	08:15 – 994	16:30 – 1,418	6.9%	Aug 2017	–
Welshpool Road East	East of Tonkin Highway (SLK 0.24)	20,314	07:45 – 1,622	16:45 – 1,917	11.1%	Dec 2015	–
	East of Tonkin Highway**	16,546	08:00 – 1,501	17:00 – 1,699	n.a.	Sep 2017	–
	West of Tonkin Highway (SLK 9.90)	22,702	07:30 – 1,957	16:45 – 1,721	10.5%	Jun 2016	–
	West of Tonkin Highway**	17,998	08:00 – 1,386	17:00 – 1,477	n.a.	Sep 2017	–
Crystal Brook Road	250m East of Brentwood Road*	2,168	07:00 – 208	15:00 – 215	n.a.	Sep 2017	–
Tonkin Highway	North of Hale Road (SLK 17.27) North Bound	15,116	07:15 – 2,647	15:30 – 1,626	19.1%	Aug 2017	–
	North of Welshpool	40,695	07:15 – 3,410	15:30 – 3,566	52.3%	Aug 2017	–

	Road East (SLK 17.44)						
	North of Welshpool Road East**	40,237	08:00 – 3,336	17:00 – 3,380	n.a.	Sep 2017	–
	South of Welshpool Road East (SLK 19.45)	47,882	06:15 – 3,503	16:00 – 3,904	15.9%	Dec 2015	–
	South of Welshpool Road East**	42,791	08:00 – 3,256	17:00 – 3,738	n.a.	Sep 2017	–
	North of Kelvin Road**	39,620	08:00 – 3,014	17:00 – 3,594	n.a.	Sep 2017	–
	South of Kelvin Road (SLK 22.51)	43,124	07:00 – 3,141	1615 – 3,909	12.6%	May 2016	–
	South of Kelvin Road**	44,716	08:00 – 3,580	17:00 – 3,795	n.a.	Sep 2017	–
Kelvin Road	West of Bickley Road (SLK 2.38)	13,392	07:15 – 983	15:15 – 1,131	n.a.	Jun 2014	15,073
	West of Tonkin Highway (SLK 3.02)	17,823	07:30 – 1,433	1530 – 1,677	n.a.	Aug 2016	–
	East of Tonkin Highway (SLK 3.60)	5,963	07:30 – 535	16:00 – 539	n.a.	Jun 2014	6,711
	East of Tonkin Highway**	5,043	08:00 – 366	17:00 – 491	n.a.	Sep 2017	–
	West of Tonkin Highway**	14,611	08:00 – 1,066	17:00 – 1,258	n.a.	Sep 2017	–
	460m South West of Crystal Brook Road*	5,290	08:00 – 481	16:00 – 518	n.a.	Mar 2016	–

Note - These traffic data have been received from the City of Kalamunda*

*Note** - These traffic volumes have been derived from SCATS data obtained through Main Roads for the intersection of Tonkin Highway and Kelvin Road and intersection of Tonkin Highway and Crystal Brook Road. Although SCATS should not be used as a sole source of data it is a good tool to verify fluctuations in flow.*

2.6. Vehicular Crash Information

Is Crash Data Available on Main Roads WA website? YES

Analysis period 01/01/2013 – 31/12/2017

Road Name	Functional Classification	Road Hierarchy	Speed Limit	Crash Statistics			
				No of KSI Crashes (Fatal + Hospital)	No of Medical Attention Crashes	No of PDO Major Crashes	No of PDO Minor Crashes
Crystal Brook Road & Welshpool Road East – SLK 0.00	Urban Local Road / Significant Urban Local Road	Access Road / Distributor A	70kph/ 80kph	0	3	0	1
Crystal Brook Road & Welshpool Road East – SLK 3.18	Urban Local Road / Significant Urban Local Road	Access Road / Distributor A	60kph/ 80kph	1	2	2	0
Crystal Brook Road & Brentwood Road	Urban Local Road / Urban Local Road	Access Road / Access Road	70kph/ 50kph	0	0	1	0
Crystal Brook Road & Kelvin Road	Urban Local Road / Significant Urban Local Road	Access Road / Distributor B	60kph/ 60kph	0	1	4	2
Tonkin Highway & Welshpool Road East	Urban Highway	Primary Distributor	80kph/ 80kph	4	27	84	59
No of MVKT Travelled at Location	approximately 65,000*365*5years*0.4km = 47.45 MVKT						
KSI Crash Rate	4 per 47.45 = 8 KSI crashes / 100 MVKT						
Comparison with Crash Density and Crash Rate Statistics	8 KSI crashes / 100 MVKT crash rate is higher than network average of 4.5. *						
Other Crash Rate	174 per 47.45 = 367 other crashes / 100 MVKT						
Comparison with Crash Density and Crash Rate Statistics	367 crashes / 100 MVKT crash rate is significantly higher than network average 67.9. *						
*Note * - Tonkin Highway and Welshpool Road intersection will be a grade separated intersection by 2031, reducing the conflict points and therefore, improving the safety on the future interchange.*							
Crystal Brook Road SLK (0.00-2.10)	Urban Local Road	Access Road	60kph 70kph	0	0	3	1
No of MVKT Travelled at Location	approximately 2,200*365*5years*1.70km = 6.82 MVKT						
KSI Crash Rate	0 per 6.82 = 0.00 KSI crashes / MVKT						
Comparison with Crash Density and Crash Rate Statistics	0.00 crashes / MVKT crash rate is lower than network average of 0.04.						
All Crashes Rate	4 per 6.82 = 0.59 crashes / MVKT						
Comparison with Crash Density and Crash Rate Statistics	0.59 crashes / MVKT crash rate is lower than network average 0.91.						
Welshpool Road East SLK (0.00 – 0.54)	Significant Urban Local Road	Distributor A	80kph	0	1	1	3

The following table shows the Crash Density and Crash Rates on Metropolitan Local Roads as obtained from Main Roads WA on the 21th October 2016 by email request: -

CRASH DENSITY AND CRASH RATE ON METROPOLITAN LOCAL ROADS NETWORK ONLY

	ALL CRASHES		KSI CRASHES (FAT+HOS)	
	DENSITY ALL CRASHES/KM over 5 years	CRASH RATE/MVKT	DENSITY KSI CRASHES/KM over 5 years	CRASH RATE/MVKT
LOCAL - MIDBLOCK	3.29	0.91	0.15	0.04
LOCAL - ALL	7.16	1.99	0.31	0.09

NOTE: BASED ON 5-YEARS DATA FOR THE PERIOD 2011 TO 2015.

The following table shows the Crash Density and Crash Rates on Metropolitan State Roads as obtained from Main Roads WA on the 18th January 2017 by email request: -

METRO CRASH RATE AND CRASH DENSITY ON STATE ROADS FOR ALL CRASHES
2011 TO 2015

	CRASH RATE/100MVKT	CRASH DENSITY
ALL CRASHES	122.4	66.0
KSI CRASHES	4.5	2.4

METRO CRASH RATE AND CRASH DENSITY ON STATE ROADS EXCLUDING MAJOR INTERSECTIONS
2011 TO 2015

	CRASH RATE/100MVKT	CRASH DENSITY
ALL CRASHES	67.9	36.6
KSI CRASHES	3.1	1.7

In order to identify black spots being the locations noted for a high incidence of crashes involving death and injury, it is important to conduct the crash criteria analysis as shown in the table below. If the below crash criteria are met, there is a way to measure the cost-effectiveness of the proposed treatment. It is called BCR and it ensures that the black spot exhibits a significant number of crashes that are correctable by infrastructure treatment.

Table 3.1: Crash criteria for the State Black Spot Program

Crash Criteria	Highways and Main Roads		Local Roads	
	Metro	Rural	Metro	Rural
Intersection or Mid-block or Short road section (< 3 km)	10 crashes over 5 years	3 crashes over 5 years	5 crashes over 5 years	3 crashes over 5 years
Road length (≥ 3km)	Average of 3 Crashes per km over 5 years	Average of 1 crash per km over 5 years	Average of 2 Crashes per km over 5 years	Average of 1 crash per km over 5 years
Benefit-cost ratio (BCR)	1			

(Main Roads/ WALGA 2004)

Based on the comparative analysis, KCTT believe that the general safety can be improved through the urbanisation of the area, limiting of vehicular speeds and improvements to the general road and road geometry. These measures should reduce the incidence of KSI crashes in the future DSP Area.

2.7. Public Transport Accessibility

How many bus routes are within 400 metres of the subject site? 2 bus routes

How many rail routes are within 800 metres of the subject site? no rail routes

Bus / Rail Route	Description	Peak Frequency	Off-Peak Frequency
279	Maddington - Kalamunda Bus Station via Kelvin Road	3 times a day	
282	Perth - Kalamunda Bus Station via Grove Road	20 minutes	2 hours
283	Perth - Kalamunda Bus Station via Lesmurdie Road	1 hour	2 hours

Are high frequency bus routes required to justify a reduction in parking? NO

Walk Score Rating for Accessibility to Public Transport.

24- Minimal Transit. It is possible to get on a bus.

Is the development in a Greenfields area? Partially

Additional information on planned improvements:

PTA confirmed there are currently no new routes planned unless there is a great likelihood of significant changes in residential density. Subject to increased residential density the existing routes may be improved over time. Introduction of additional routes would require a more detailed development proposal.

Forrestfield Station – approximately 5.5km from the proposed development

Public Transport Authority website accessed on 16.10.2017. – 10:26

http://www.pta.wa.gov.au/forrestfieldairportlink/rail-map :

" Forrestfield Station will deliver a significant public transport boost to Perth's growing eastern and south-eastern suburbs by improving the bus feeder network, providing parking for up to 2500 cars, and servicing future residential and business developments.

The location of the railway station, east of Perth Airport, is adjacent to Dundas Road south of Maida Vale Road."

2.8. Pedestrian Infrastructure

Describe existing local pedestrian infrastructure within a 400m radius of the site:

Classification	Road Name
"Other Shared Path (Shared by Pedestrians & Cyclists)"	Crystal Brook Road, Welshpool Road East (west of Lewis Road), Lewis Road, Hartfield Road.
Does the site have existing pedestrian facilities	YES – as classified above
Does the site propose to improve pedestrian facilities?	YES

If YES, describe the measures proposed.

It is essential to develop an efficient and connected network of pedestrian paths in order to encourage pedestrian movement.

Please refer to Section 2.20. Proposed Internal Road Network for cross-sections of existing and proposed roads. Every major road within future structure plan area will have either shared path or a separate pedestrian path.
All pedestrian and shared paths should be designed to be accessible by all members of the community in accordance with the City of Kalamunda's Disability Access and Inclusion Plan 2012-2017 or any other subsequent document of this nature. The exact location of pram ramps and other accessible design elements are to be determined at a later stage in the project.

What is the Walk Score Rating?

1 - Car-Dependent. Almost all errands require a car.

2.9. Cyclist Infrastructure

Are there any PBN Routes within an 800m radius of the subject site?	YES
Classification	**Road Name**
"Bicycle Lanes or Sealed Shoulder Either Side"	Tonkin Highway, Crystal Brook Road (east of Kelvin Road)
"PBN – Continuous Signed Routes"	**SE3 –** Kelvin Road**,** Crystal Brook Road (east of Kelvin Road)
"Good Road Riding Environment"	Brentwood Road, White Road
"Other Shared Path (Shared by Pedestrians & Cyclists)"	Crystal Brook Road, Welshpool Road East (west of Lewis Road), Lewis Road, Hartfield Road.
Are there any PBN Routes within a 400m radius of the subject site?	YES
If YES, describe:	
Classification	**Road Name**
"Bicycle Lanes or Sealed Shoulder Either Side"	Tonkin Highway, Crystal Brook Road (east of Kelvin Road)
"PBN – Continuous Signed Routes"	**SE3 –** Kelvin Road**,** Crystal Brook Road (east of Kelvin Road)
"Good Road Riding Environment"	Brentwood Road, White Road
"Other Shared Path (Shared by Pedestrians & Cyclists)"	Crystal Brook Road, Welshpool Road East (west of Lewis Road), Lewis Road, Hartfield Road.
Does the site have existing cyclist facilities?	YES - as classified above
Does the site propose to improve cyclist facilities?	YES

If YES, describe the measures proposed.

Please refer to Section 2.20. Proposed Internal Road Network for cross-sections of existing and proposed roads. Every major road within future structure plan area should have either shared path or a dedicated cycle lane.

2.10. Calculation of Development Generated / Attracted Trips

What are the likely hours of operation?	For residential land uses, the hours of operation are not applicable. Retail: 09:00h to 17:00h Commercial: 09:00h to 21:00h
What are the likely peak hours of operation?	AM 08:00 to 09:00 PM 17:00 to 18:00
Do the development generated peaks coincide with existing road network peaks?	YES
Guideline Document Used	**WAPC Transport Assessment Guidelines for Developments**
Rates from above document:	**Industrial –** 1 VPH/100 m^2 GFA in the AM and PM peak. A 80% IN / 20% OUT split has been adopted for the AM peak and a 20% IN / 80% OUT split for the PM peak hour; **Residential** – 0.8 vehicle trips per dwelling for the AM and PM peak hours. A 25% IN / 75% OUT split has been adopted for the AM peak and a 67% IN / 33% OUT split for the PM peak hour; **Schools** - The rates are based on data from the PARTS surveys that indicate that around 65% - 70% of children are driven to primary school, with an average occupancy of around 1.4 - 1.5 children per car. This equates to 0.5 trips per child to school and

	0.5 trips per child from school in each of the AM and PM peak hours. For secondary schools the PARTS data indicate that the proportion driven to school is generally a little lower but, to simplify the process of determining the level of assessment required and for the broad assessment of structure plans, it is suggested that the above primary school rates be used for all schools. **Retail / Shopping Centres** - (with significant food retail component) - 10 vehicular trips per 100m2 of GFA for PM Peak and 2.5 trips per 100m² for the AM peak hour. A 50% IN / 50% OUT split has been adopted for the PM peak and an 80% IN / 20% OUT split for the AM peak hour;
Guideline Document Used	**NSW RTA Guide to Traffic Generating Developments**
Rates from above document:	The NSW RTA Guide to Traffic Generating Developments suggest residential developments of this type in Sydney tend to generate between 4 and 5 vehicular trips per dwelling. In Perth, the Department of Planning and Infrastructure conducted a series of studies in the late 1990's / early 2000's which showed that higher density dwellings tended to average closer to 6.7 vehicle movements per day. Given that the proposed study area area is rural KCTT propose a more conservative approach by using an average VPD of 6.5 vehicular trips per day per residence for R40 and an average VPD of 9 vehicular trips per day per residence for R30. **Retail** - (10,000 m^2-20,000 m^2) - 78 vehicular trips per 100m^2 of GFA **Factories** – 5 VPD per 100 m^2 GFA, 1 VPH in the PM peak per 100 m^2 GFA.
Guideline Document Used	**ITE Trip Generation Report (9th Edition)**
Rates from above document:	**Elementary School** • *Students: 1.29 vehicular trips per day per student*
Base data for trip calculation (daily trips)	• **General Industry** - 5 VPD per 100 m^2 GFA • **R20** - 9 VPD per dwelling • **R40** - 6.5 VPD per dwelling • **School** - 1.29 VPD per student • **Neighbourhood Centre** - 121 VPD per 100m^2 of GFA
Base data for trip calculation (AM peak trips)	• **General Industry** - 1 VPH per 100 m^2 GFA • **R20, R40** - 0.8 VPH per dwelling • **School** - 0.5 VPH per child • **Neighbourhood Centre** - 2.5 VPH per 100m^2 of GFA - AM
Base data for trip calculation (PM peak trips)	• **General Industry** - 1 VPH per 100 m^2 GFA • **R20, R40** - 0.8 VPH per dwelling • **School** - 0.5 VPH per child • **Neighbourhood Centre** - 10 VPH per 100m^2 of GFA - PM

Development Type	Rate Above	Yield (Area, Number of Dwellings etc.)	Total VPD	Total VPH
General Industry	5 VPD per 100 m^2 GFA 1 VPH per 100 m^2 GFA	30% of Total Lots Equivalent area = 30% ($949,000m^2$) =$284,700m^2$	14,235	2,847
Option 1 Residential – R20	9 VPD per dwelling 0.8 VPH per dwelling	1,560	14,040	1,248
Option 2 Residential – R30	9 VPD per dwelling 0.8 VPH per dwelling	2,340	21,060	1,872
Option 3 Residential – R40	6.5 VPD per dwelling 0.8 VPH per dwelling	3,120	20,280	2,496
School	1.29 VPD per student 0.5 VPH per child	assumed 450 students	(581) 170*	(225) 45*
Neighbourhood Centre	78 VPD per $100m^2$ of GFA 2.5 VPH per $100m^2$ of GFA - AM 10 VPH per $100m^2$ of GFA - PM	12,000 m^2 GFA (Equivalent of 30% of total area)	(9,360) 1,872*	(300) 60* – AM (1,200) 240* – PM
Total Development		**Option 1**	**(38,216)** **30,317***	**4,200* AM** **4,380* PM**
		Option 2	**(45,236)** **37,337***	**4,824* AM** **5,004* PM**
		Option 3	**(44,456)** **36,557***	**5,448* AM** **5,628* PM**

Does the site have existing trip generation / attraction?	YES – approximately 130 single dwelling lots
No of Daily Trips	9 VPD per dwelling * 130 dwellings = 1,170 VPD
No of AM Peak Hour Trips	0.8 VPH per dwelling * 130 dwellings = 104 VPH
No of PM Peak Hour Trips	0.8 VPH per dwelling * 130 dwellings = 104 VPH
What is the total impact of the new proposed development?	High impact The total expected **additional** traffic generated by the proposed development will be: **Option 1: 29,147 VPD; AM 4,096 VPH; PM 4,276 VPH.** **Option 2: 36,167 VPD; AM 4,720 VPH; PM 4,900VPH.** **Option 3: 35,387 VPD; AM 5,344 VPH; PM 5,524 VPH.**

Justification

*Note** - Traffic attracted to the neighbourhood centre will be predominantly generated by the residents of the area and is already accounted for in the residential traffic. We have assumed that the primary school would be a government school with a limited local intake. That means that the traffic attracted by the primary school and neighbourhood centre is approximately 80% local traffic that has already been accounted for in the residential traffic generation.

Further to this, various land uses will peak at different times with little or no overlap.

Although the cumulative traffic generation of the proposed development is expected to be in range from **38,216 VPD to 45,236 VPD**, it is expected that a total between **29,147 VPD to 36,167 VPD** will be generated into the network external to the Study Area.

It should be noted that the calculations above represent a rough estimate of both yields and the traffic volumes. Once a precise layout plan of the future structure plan area is provided, a more accurate estimation of traffic generation can be provided.

2.11. Trip Purposes

Determine the likely percentage share for different trip purposes based on the land usage.

Land Use	Residential	Neighbourhood Centre	Primary School
Employment	40%	20%	20%
Shopping	25%	60%	n/a
Education	17.5%	n/a	80%
Social / Recreational	17.5%	20%	n/a

2.12. Expected Origin / Destination

Name the closest existing major residential generators and non-residential attractors of traffic and the distance from the boundaries of the Study Area.

Residential — Employment (profile.id)

The economic profile in the City of Kalamunda shows that according to the latest census that 64.8%of the city's resident's travel outside the area for work while the remaining 23.7% both live and work within the area (Work location unknown for 11.5%)

- Kalamunda - 23.7 %
- Canning - 9.7%
- Swan - 9.2%
- Belmont - 8.2%
- Perth - 5.0%
- POW No Fixed Address - 4.2%
- Perth - Remainder - 4.0%
- POW State/Territory undefined - 3.9%
- Victoria Park - 3.7%
- Gosnells - 3.5%
- Other – 13.4%

http://profile.id.com.au/kalamunda/residents?WebID=170

We therefore believe that the following roads will be used for access / egress to the future Structure Plan area:

- Welshpool Road East
- Crystal Brook Road
- Tonkin Highway

Excluding work from home, working in Neighbourhood Centre and Primary School there are no other sources of employment in this Study Area.

Journey to work data:

- Car as Driver – 67.6%
- Did not go to work – 11.2%
- Car as Passenger – 4.9%
- Worked at Home – 4.2%
- Bus – 3.4%
- Train – 2.0%
- Walked only – 1.5%
- Other – 5.2%

KCTT strongly believe that passenger cars will be the primary type of transportation vehicle.

	Shopping	• Wattle Grove Shopping Centre – approximately 1.5km to the west • Lesmurdie Village - approximately 2.0km to the north-east • Hawaiian's Forrestfield – approximately 2.5km to the north-west
	Education	• Skooleez Outside School Hours Care - approximately 1.2km to the north • Pachamama Early Education and Childcare – approximately 1.3km to the east • Forrestfield Primary School - approximately 1.5km to the north • Mazenod College - approximately 1.5km to the north-east • Orange Grove Primary School - approximately 1.5km to the south-east • Wattle Grove Primary School – approximately 2.0km to the west • Fun and Learn Child Care Centre – approximately 2.0km to the south-east • East Kenwick Primary School - approximately 2.5km to the south-west • Lesmurdie Senior High School – approximately 2.5km to the east
	Social / Recreational	• Lesmurdie Falls National Park - immediately to the north-east • Hartfield Park Recreation Centre – approximately 300m to the west • Korung National Park – approximately 500m to the east • Ray Owen Sports Centre – approximately 1.9km to the north-east • Bickley Outdoor Recreation Camp - approximately 2.5km to the south-east
Neighbourhood Centre	Employment	• The Neighbourhood Centre is not expected to be a large attractor for employment purposes.
	Shopping / Social	• The Neighbourhood Centre is treated as retail premises for the purposes of this report.
Primary School	Employment	• The Primary School is not expected to be a large attractor for employment purposes.
	Education	• The Primary School is expected to be a strong attractor for Education purposes.

2.13. Traffic Flow Distribution onto External Road Networks

How many routes are available for access / egress to the site?	Five (5)		
Route 1			
Provide details for Route No 1	**To / from north via Roe Highway – Tonkin Highway – Welshpool Road**		
Percentage of Vehicular Movements via Route No 1	**Option 1**	**Option 2**	**Option 3**
	30%	30%	30%
Route 2			
Provide details for Route No 2	**To/ from west via Welshpool Road**		
Percentage of Vehicular Movements via Route No 2	**Option 1**	**Option 2**	**Option 3**
	30%	29%	29%
Route 3			
Provide details for Route No 3	**To/ from south via Roe Highway - Welshpool Road**		
Percentage of Vehicular Movements via Route No 3	**Option 1**	**Option 2**	**Option 3**
	13%	15%	15%
Route 4			
Provide details for Route No 4	**To/ from south via Tonkin Highway**		
Percentage of Vehicular Movements via Route No 4	**Option 1**	**Option 2**	**Option 3**
	13%	12%	12%

Route 5			
Provide details for Route No 5	**To/ from east via Welshpool Road East**		
Percentage of Vehicular Movements via Route No 5	**Option 1**	**Option 2**	**Option 3**
	10%	11%	11%
Route 6			
Provide details for Route No 5	**To/ from north via Lewis Road**		
Percentage of Vehicular Movements via Route No 5	**Option 1**	**Option 2**	**Option 3**
	4%	3%	3%

2.14. Road Safety

Are sight distances adequate at proposed intersections?	N/A

Justification

All distances between intersections should be according to Liveable Neighbourhoods. To be reviewed in more detailed stages of planning.

Are there any proposed interventions to streets surrounding schools, neighbourhood centres, child and aged person day care facilities etc.?	YES
If YES, nominate which:	Some traffic calming methods are desirable especially near the primary school and neighbourhood centre. Chicanes, speed humps, wombat crossings and/or other methods should be considered when designing streets to lower operating speeds and improve safety. Posted signs with reduced speed limits should be considered for roads near these facilities.

2.15. Proposed Internal Road Network

Guideline Document used as reference	Liveable Neighbourhoods
How many proposed roads are there within the Study Area?	The internal road layout has not been formalised at this stage, however will be developed in further iterations as part of more detailed investigation in the planning phases.

2.16. Proposed Intersection Controls

How many proposed intersections have been analysed?	The proposed road cross sections and intersections are to be designed to meet the change in traffic conditions as a result of the development of the Study Area.

2.17. Proposed Internal Transport Networks

Are there any changes / additions to the existing road network?	YES – Several new roads will be constructed to service the future structure plan development area. The precise number, locations and alignments will be determined at a later planning stage. Furthermore, plans for new railway route alignment along Tonkin Highway with a potential station within the study area were considered.

Were there any discussions / agreements with MRWA regarding intersections with, or direct access onto roads under their jurisdiction?	Not at this stage. However, the intersection of Tonkin Highway & Welshpool Road East is currently a signalised intersection. There are plans for a flyover on Tonkin Highway over Welshpool Road.
Are there any pedestrian / cycle networks and crossing facilities proposed for the roads within the Study Area?	The future Structure Plan should propose construction of pedestrian paths network to cater for pedestrian needs in the area. Most streets in the area will have pedestrian paths on one or both sides of the road. Roads with higher hierarchy level will have shared paths on one side of the road reservation.
Were there any discussions / agreements with the local authority over local road networks and pedestrian and cycle facilities?	Not at the date of this report, however discussions are expected.
Were there any discussions / agreements with PTA / Transperth on new bus services or extensions / alterations to existing bus services to serve the Study Area?	YES PTA confirmed there are currently no new routes planned unless there is likely to be significant changes in residential development. Subject to increased residential density the existing routes may be improved over time. Introduction of additional routes would require a more detailed stage of development.

2.18. Changes to External Transport Networks

Are there any proposed changes of the road network?	• Tonkin Highway will be extended to tie in with the Perth Darwin National Highway in the north and Forrest Highway at Pinjarra in the south. It will be constructed to freeway standard between the Perth Darwin National Highway and Mundijong Road, with freeway-to-freeway interchanges at Reid and Roe Highways. • Planned upgrades include six-lane freeways on Roe and Tonkin Highways interspersed with four-lane highways and traffic signalised intersections. • Existing rail lines will be extended to cater for growing suburbs, with the Armadale line extending to Byford and Thornlie line to Cockburn Central. • Forrestfield Airport Link will be extended to join the Thornlie line. • Potential Wattle Grove rail realignment with new train lines to connect future Forrestfield North Railway Station and Wattle Grove South future station. The proposed alignment would follow the alignment of Tonkin Highway and continue along Brentwood Road to Roe Highway. • Potential Welshpool Road East realignment straight into Crystal Brook Road • Industrial Road Connection through to a major roundabout with Kelvin Road to the east

Are there any proposed changes of the intersection controls?	• Intersection of Tonkin Highway & Welshpool Road East is currently a signalised at grade intersection. There are plans that indicate that Welshpool Road will be grade separated with a flyover above the Tonkin Highway. • It is expected that the intersection of Tonkin Highway and Kelvin Road will also be grade separated in the future. • Industrial Road Connection through to a major round a bout at Kelvin Road to the east • It is expected that the potential realigned Welshpool Road will form a round a bout with Crystal Brook Road.
Are there any proposed changes of the pedestrian / cycle networks and crossing facilities?	Since the area is about to go through significant changes, it is expected that many changes will occur. However, introduction of additional pedestrian / cycle networks and crossing facilities would require a more detailed stage of development.
Are there any proposed changes of the public transport services?	The area is currently serviced by bus routes 282, 283 and 279. PTA confirmed there are currently no new routes planned unless there is likely to be significant changes in residential development. Subject to increased residential density the existing routes may be improved over time. Introduction of additional routes would require a more detailed stage of development.

These changes could be those committed or proposed by others, MRWA or local authority, or by the proponent as part of the future district structure plan.

2.19. Integration with Surrounding Area

Are there any existing major residential generators of traffic within a minimum of 800 metres from the boundaries of the Study Area?	YES
If YES, nominate:	• Wattle Grove Urban Cell to the west • Lesmurdie to the east • Kenwick and Maddington to the south
Are there any existing major non-residential attractors of traffic within a minimum of 800 metres from the boundaries of the Study Area?	YES
If YES, nominate:	• Existing Davison Industrial Area south of Bickley Road • Future Forrestfield North Station
What are the main desire lines between the proposed land uses and these external attractors / generators?	KCTT believe that proposed major changes to the surrounding area and network will be able to match these desire lines.
Will the existing transport networks, plus any proposed changes, adequately match these desire lines, particularly for pedestrians, cyclist and public transport users?	The Study Area, and surrounding areas, are well planned for the major changes that will occur in the next decade. The key will be in monitoring the traffic and intersections performance and upgrading them as necessary and as timely as possible.
Identify any deficiencies or areas for improvement in the surrounding transport networks and/or areas where improvements could be made.	N/A

2.20. Traffic Modelling

Nominate the source(s) for obtaining the traffic data	Main Roads website; Traffic Data from City of Kalamunda Main Roads WA ROM Model – 2031
Annual traffic growth rate used for analysis	N/A No traffic growth rate was used for analysis since the ROM data for 2031 has been provided by the City of Kalamunda.
Determine the year(s) for assessment and the time period(s) for the traffic flow analysis.	2031 Traffic attracted to the neighbourhood centre will be predominantly generated by the residents of the area and is already accounted for in the residential traffic. We have assumed that the primary school would be a government school with a limited local intake. That means that the traffic attracted by the primary school and neighbourhood centre is approximately 80% local traffic that has already been accounted for in residential traffic. Further to this, various land uses will peak at different times with little or no overlap. Although the cumulative traffic generation of the proposed development is expected to be in range from **38,216 VPD to 45,236 VPD**, it is expected that a total between **29,147 VPD to 36,167 VPD** will be generated onto the network external to the Study Area.
Determine additional traffic generated from study area to the surrounding network.	**Option 1: 29,147 VPD; AM 4,096 VPH; PM 4,276 VPH.** **Option 2: 36,167 VPD; AM 4,720 VPH; PM 4,900 VPH.** **Option 3: 35,387 VPD; AM 5,344 VPH; PM 5,524 VPH.**

Determine the total traffic flows on the external road network by adding the development generated traffic to the estimated traffic volumes on these roads in year(s) of assessment.

Road Name	Location of Traffic Counts	Existing Traffic Volumes	Year	Traffic Modelling Passing Traffic*	Passing Traffic + Study Area Generated Traffic		
					Option 1	Option 2	Option 3
Welshpool Road East	East of Tonkin Highway	20,314	2015	30,000	44,000	47,500	46,900
	West of Tonkin Highway	22,702	2016	28,500	35,100	36,400	36,100
Crystal Brook Road	250m East of Brentwood Road	2,168	2017	1,000	10,900	14,600	14,100
Tonkin Highway	North of Welshpool Road East	40,695	2017	92,500	99,200	101,100	100,800
	South of Welshpool Road East	47,882	2015	95,500	96,200	96,500	96,500
	South of Kelvin Road	44,716	2017	89,500**	92,400	93,100	92,900
Kelvin Road	West of Tonkin Highway	17,823	2016	24,000**	26,700	27,900	27,800

	East of Tonkin Highway	5,043	2017	9,300	14,100	15,800	15,500
	460m South West of Crystal Brook Road	5,290	2016	10,000	10,400	10,800	10,800

**Note: The passing traffic was modelled to reflect, as closely as possible, the volumes shown in MRWA ROM24 data received from the City of Kalamunda.*
***Note: The extract of ROM data received from the City of Kalamunda does not include these sections of roads.*

How many zones were created for the model?

19 Zones were created in Paramics software for purpose of trip distribution.

Nominate external zones

6 zones external to the Wattle Grove South area:

- **Zone 1.** To / from the north via Tonkin Highway (north of Welshpool Road East)
- **Zone 2.** To / from the west via Welshpool Road East (west of Tonkin Highway)
- **Zone 3.** To / from the west via Kelvin Road (west of Tonkin Highway)
- **Zone 4.** To / from the south via Tonkin Highway (south of Kelvin Road)
- **Zone 5.** To / from the east via Welshpool Road East (east of Crystal Brook Road)
- **Zone 6.** To / from the north via Lewis Road (north of Welshpool Road)

Nominate internal zones and traffic generation

13 internal zones:		**Traffic generation from the zone (VPD)**		
		Option 1	**Option 2**	**Option 3**
Zone 7.	Residential Zone	2,340	3,510	3,380
Zone 8.	Residential Zone	2,340	3,510	3,380
Zone 9.	Residential Zone	2,340	3,510	3,380
Zone 10.	Residential Zone	2,340	3,510	3,380
Zone 11.	Residential Zone	2,340	3,510	3,380
Zone 12.	Residential Zone	2,340	3,510	3,380
		All Options		
Zone 13.	Neighbourhood Centre	20% (4,680) = 936*		
Zone 14.	Primary School	20% (291) = 58*		
Zone 15.	Industrial Zone	2,847		
Zone 16.	Industrial Zone	2,847		
Zone 17.	Industrial Zone	2,847		
Zone 18.	Industrial Zone	2,847		
Zone 19.	Industrial Zone	2,847		

*Note: 80% of Neighbourhood Centre and Primary School trip generation is deemed to be internal to the Wattle Grove South area.

For more details on trip generation, refer to section 2.15 Calculation of Development Generated Traffic.

Traffic Flow Distribution onto External Road Networks

ZONE	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Wattle Grove Industrial Zones	Internal Trips
Wattle Grove Residential Zones – Option 1	12%	11%	8%	5%	5.5%	0%	5%	53.5%
Wattle Grove Residential Zones – Option 2	16%	15%	12%	7%	7%	0%	5%	38%
Wattle Grove Residential Zones – Option 3	15%	15%	12%	6.5%	7%	0%	5%	39.5%

**Note – Internal trips percentage was calculated starting from assumption that for all three options 80% on neighbourhood centre and primary school traffic will be internal.*

External to External Traffic Distribution

Traffic from external to external zones was modelled to reflect, as close as possible, the obtained data from the latest Main Roads WA ROM Model for 2031. The difference between results may occur due to network level of detail.

Paramics Output

XX – Passing Traffic
XX – Wattle Grove South Traffic

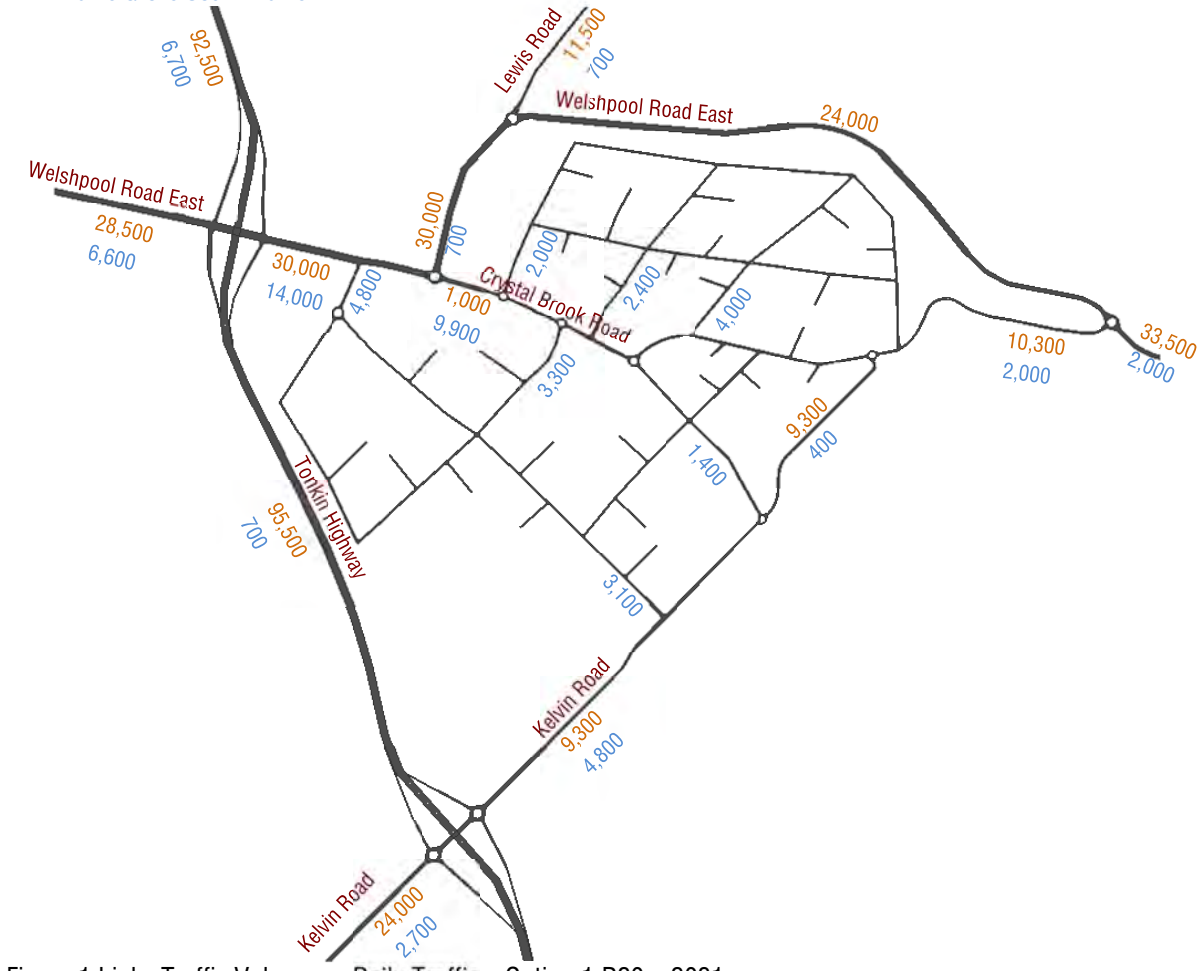


Figure 1 Links Traffic Volumes – Daily Traffic – Option 1 R20 – 2031

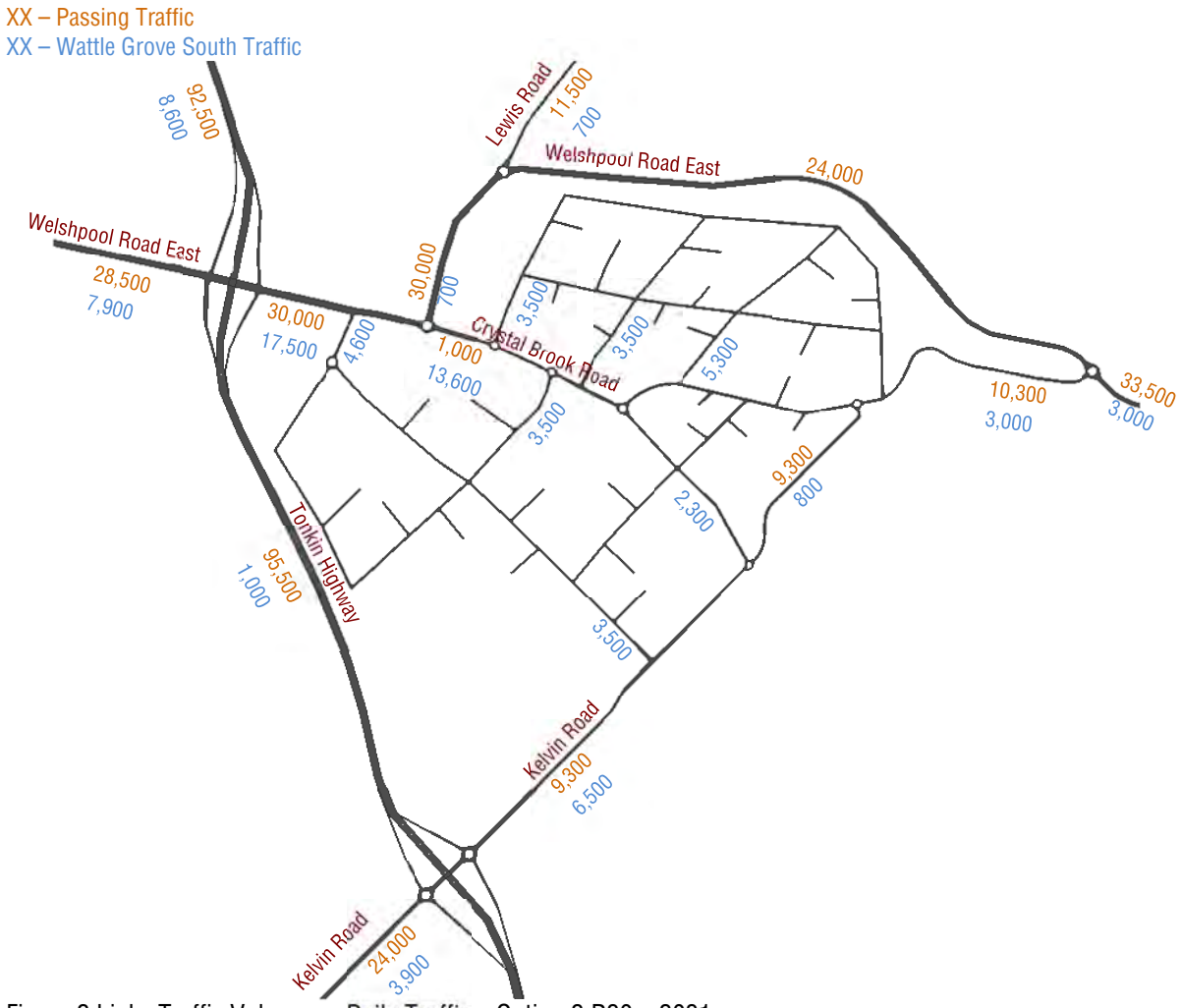


Figure 2 Links Traffic Volumes – Daily Traffic – Option 2 R30 – 2031

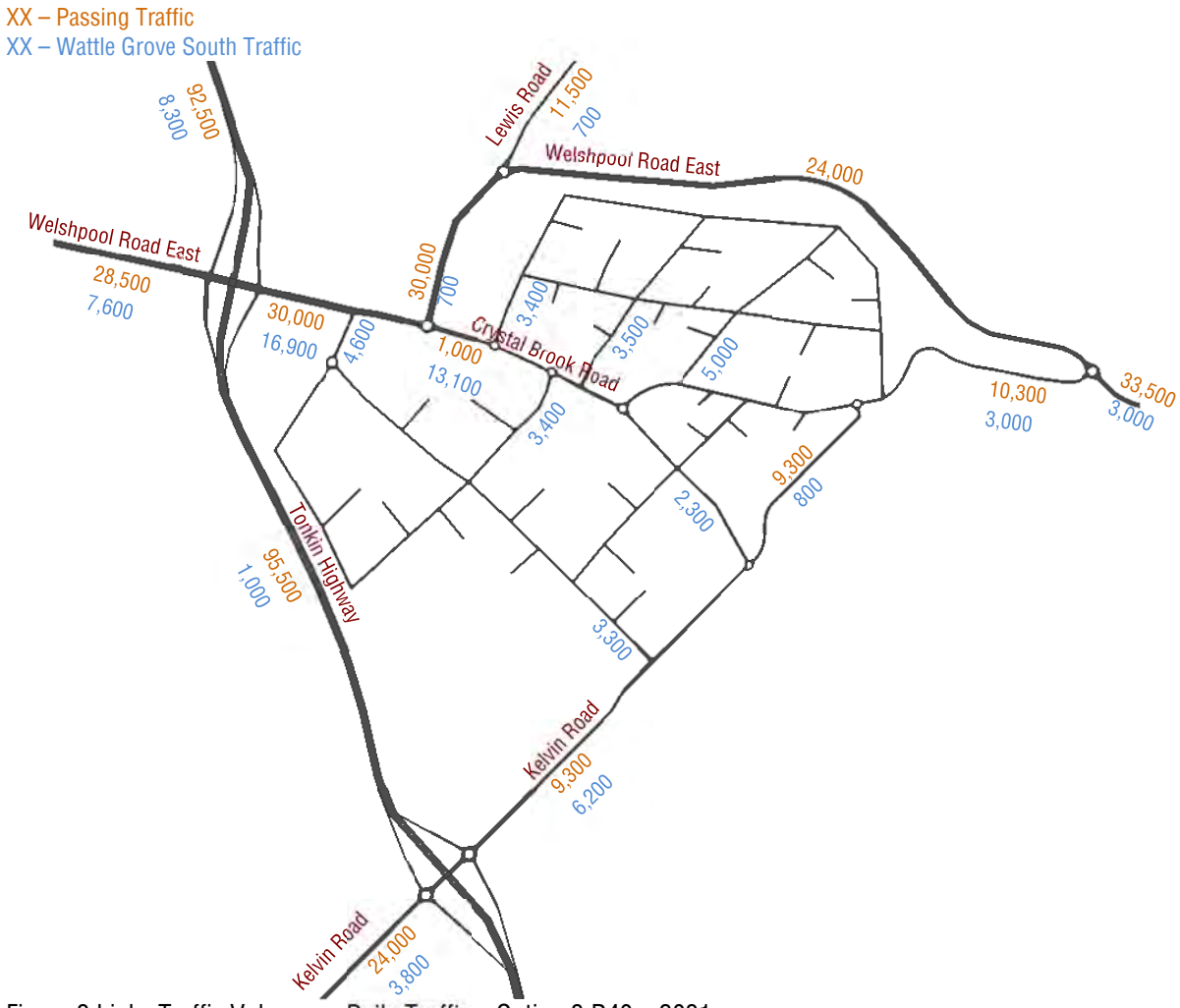


Figure 3 Links Traffic Volumes – Daily Traffic – Option 3 R40 – 2031

2.21. Anticipated Upgrades of the Existing Network

What amendments to the road network were incorporated in the traffic modelling?

- Given the expected grade separation of Tonkin Highway / Welshpool Road East Intersection by 2031, it is assumed that Welshpool Road East will be realigned to form a 90-degree intersection with Crystal Brook Road. This will allow for appropriate distances between the intersection and the proposed interchange. It is expected that the future intersection of Crystal Brook Road and Welshpool Road East will require upgrade to a roundabout.
- Section of Crystal Brook Road (east of Victoria Road) is expected to be realigned and a future Industrial Road Connection will extend to form a 90-degree intersection (roundabout) with Kelvin Road.
- Grade separation is expected for the Kelvin Road and Tonkin Highway Intersection by 2031 and it was incorporated in the traffic modelling.

What are the anticipated road upgrades due to the future DSP area generated traffic?

Should the traffic volumes reach the values shown on the above figures (Section 2.25.) the following upgrades will be required:

- Crystal Brook Road is expected to carry between 10,000 – 15,000 VPD depending on the R-Code option. According to Liveable Neighbourhoods Crystal Brook Road should be upgraded to an Integrator B (one lane each direction, median, bicycle lanes, on-street parking)
- Kelvin Road (north of Tonkin Highway) is expected to carry between 10,000 – 16,000 VPD depending on the R-Code option. According to Liveable Neighbourhoods Kelvin Road should be upgraded to an Integrator B (one lane each direction, median, bicycle lanes).

*Note: The anticipated changes to the road network are likely to occur only when and if the volumes reach the stated values. However, since this is an early stage of planning, the proposed road realignments, road and intersection upgrades should be considered with caution, since they are subject to the later stage planning process inclusive of the proponent, City of Kalamunda and / or Main Roads WA. Only grade separation of Tonkin Highway intersections with Welshpool Road East and Kelvin Road are the only certain change in the road network, as they are incorporated in the MRWA ROM24 model.

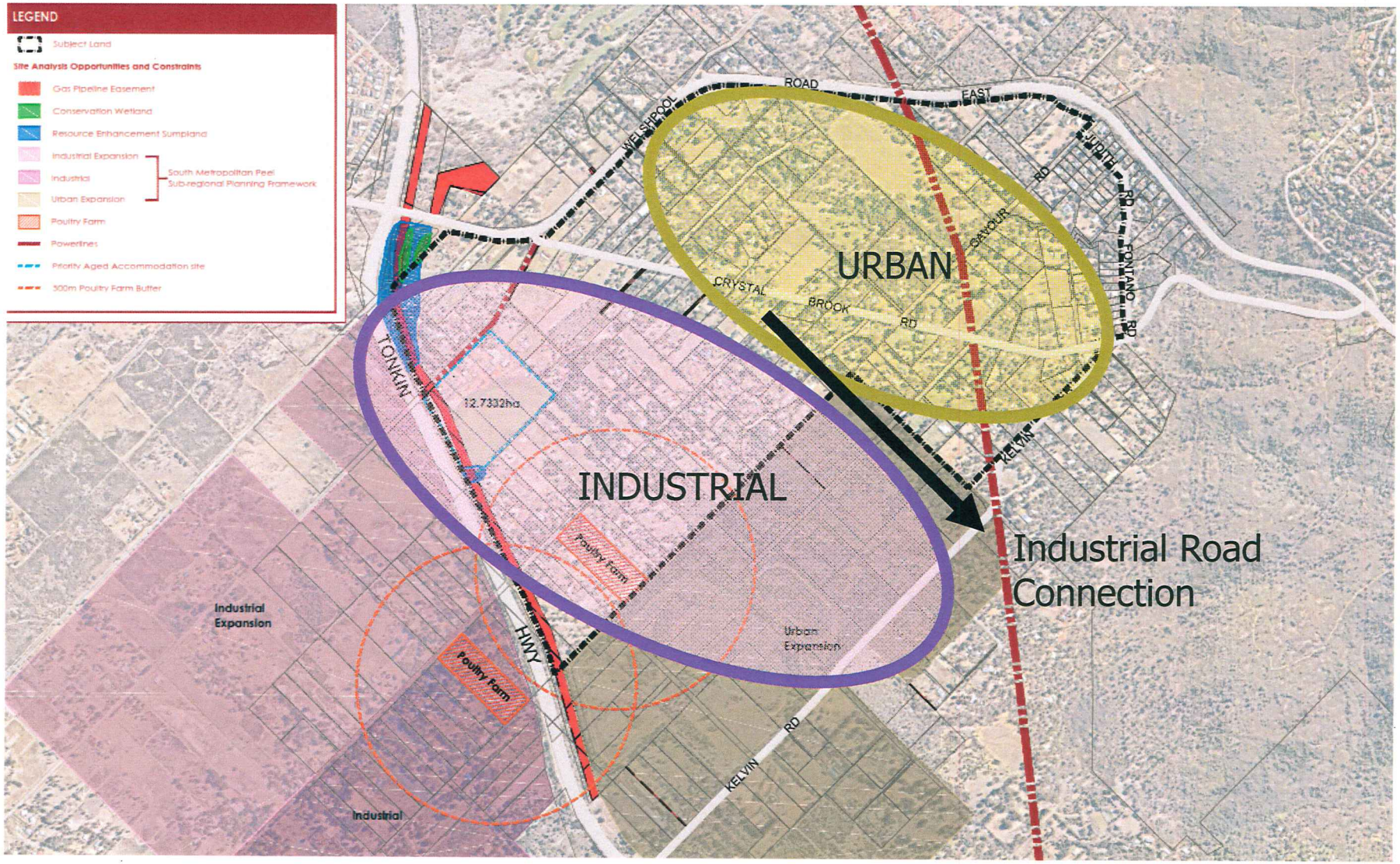
2.22. Site Specific Issues and Proposed Remedial Measures

How many site-specific issues need to be discussed?	One (1)
Site Specific Issue No 1	**Traffic Impact of the Proposed Development**
Remedial Measure / Response	Although the cumulative traffic generation of the proposed development is in range from 38,216 VPD to 45,236 VPD, it is expected that a total between 29,147 VPD to 36,167 VPD will be generated into the network external to the Study Area. The surrounding network is expected to be upgraded to meet the requirements of passing traffic growth (grade separation of intersections of Tonkin Highway with Welshpool Road East and with Kelvin Road; additional lanes on Tonkin Highway etc.); additional upgrades to cater for the impact of the development are expected to be determined at later stages of the planning process. KCTT believe that the future surrounding network will successfully cater for the developments generated traffic.

Appendix 1

The layout of the proposed development

Industrial and Urban



Appendix 2

Transport Planning and Traffic Plans

PARKS AND RECREATION
WATERWAYS
PUBLIC PURPOSE
ROAD
Hay Street — STREET NAME
RAILWAY
ROAD BRIDGE
DISTANCE FROM LOCATION
STRUCTURE PLAN AREA
FORRESTFIELD — SUBURB
CITY OF KALAMUNDA — LOCAL GOVERNMENT NAME
LOCAL AUTHORITY BOUNDARY

LEGEND

Certified System Quality ISO 9001 SAI GLOBAL

No	DATE	AMENDMENT
A	11-04-2018	ISSUED FOR REVIEW

PROJECT: WATTLE GROVE SOUTH

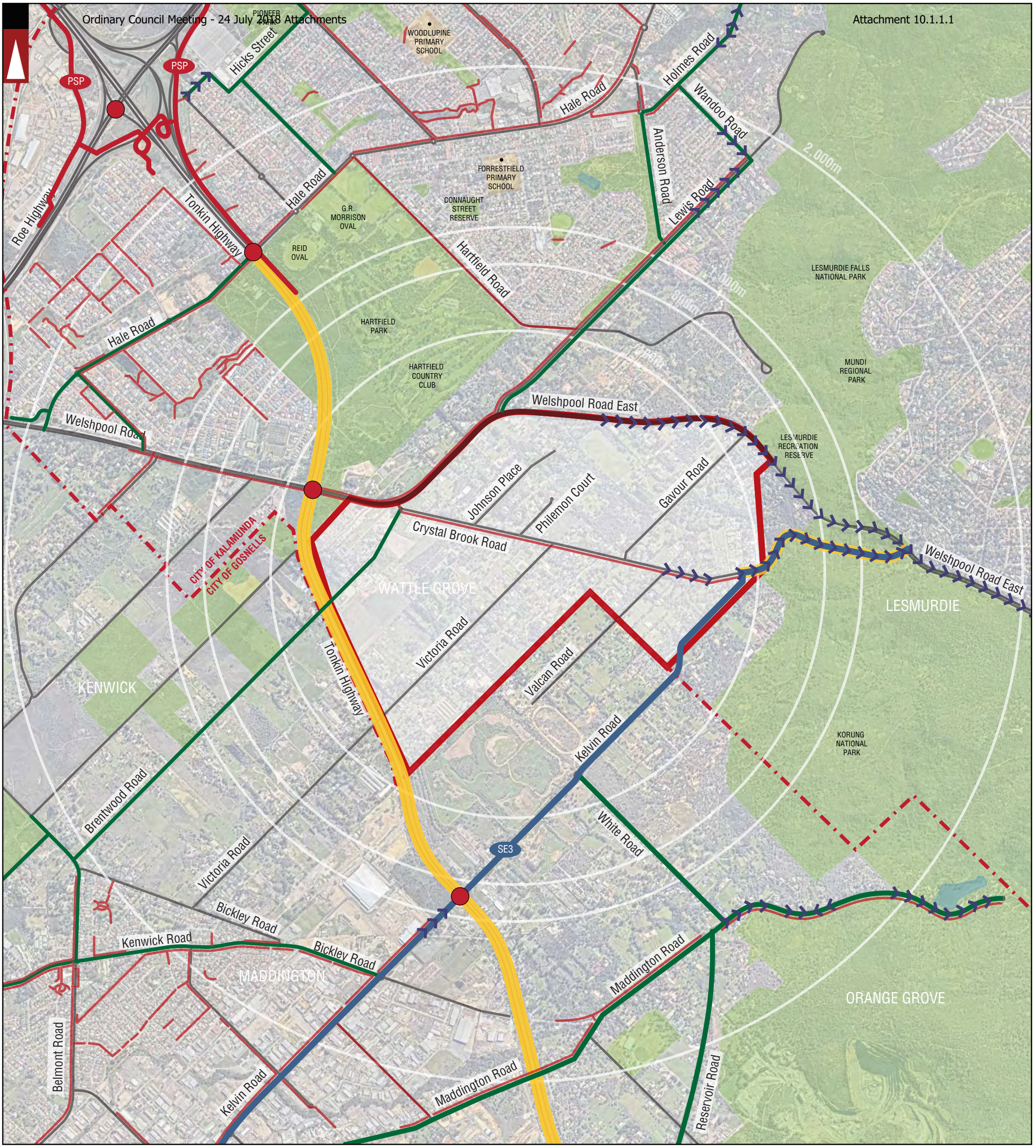
TITLE: LOCALITY PLAN - 2,000M RADIUS

DRAWING NUMBER: KC00381.000_ S01

DRAWN BY: J.S.

Civil & Traffic Engineering Consultants
Suite 7 No 10 Whipple Street Balcatta WA 6021
PH: 08 9441 2700
WEB: www.kctt.com.au

kctt



PARKS AND RECREATION
WATERWAYS
PUBLIC PURPOSE
ROAD
Hay Street STREET NAME
RAILWAY
ROAD BRIDGE
DISTANCE FROM LOCATION
STRUCTURE PLAN AREA
FORRESTFIELD SUBURB
CITY OF KALAMUNDA LOCAL GOVERNMENT NAME
LOCAL AUTHORITY BOUNDARY
PSP PRINCIPAL SHARED PATH (PSP)
OTHER SHARED PATH (SHARED BY PEDESTRIAN & CYCLIST)
GOOD ROAD RIDING ENVIRONMENT
NW12 PERTH BICYCLE NETWORK (PBN) - CONTINUOUS SIGNED ROUTES
BICYCLE LANES OR SEALED SHOULDER EITHER SIDE
GRADIENT ARROW
TRAFFIC LIGHT

LEGEND

Certified System Quality ISO 9001 SAI GLOBAL

No	DATE	AMENDMENT
A	11-04-2018	ISSUED FOR REVIEW

PROJECT: WATTLE GROVE SOUTH

TITLE: BICYCLE NETWORK PLAN - 2,000M RADIUS

DRAWING NUMBER: KC00381.000_ S02

DRAWN BY: J.S.

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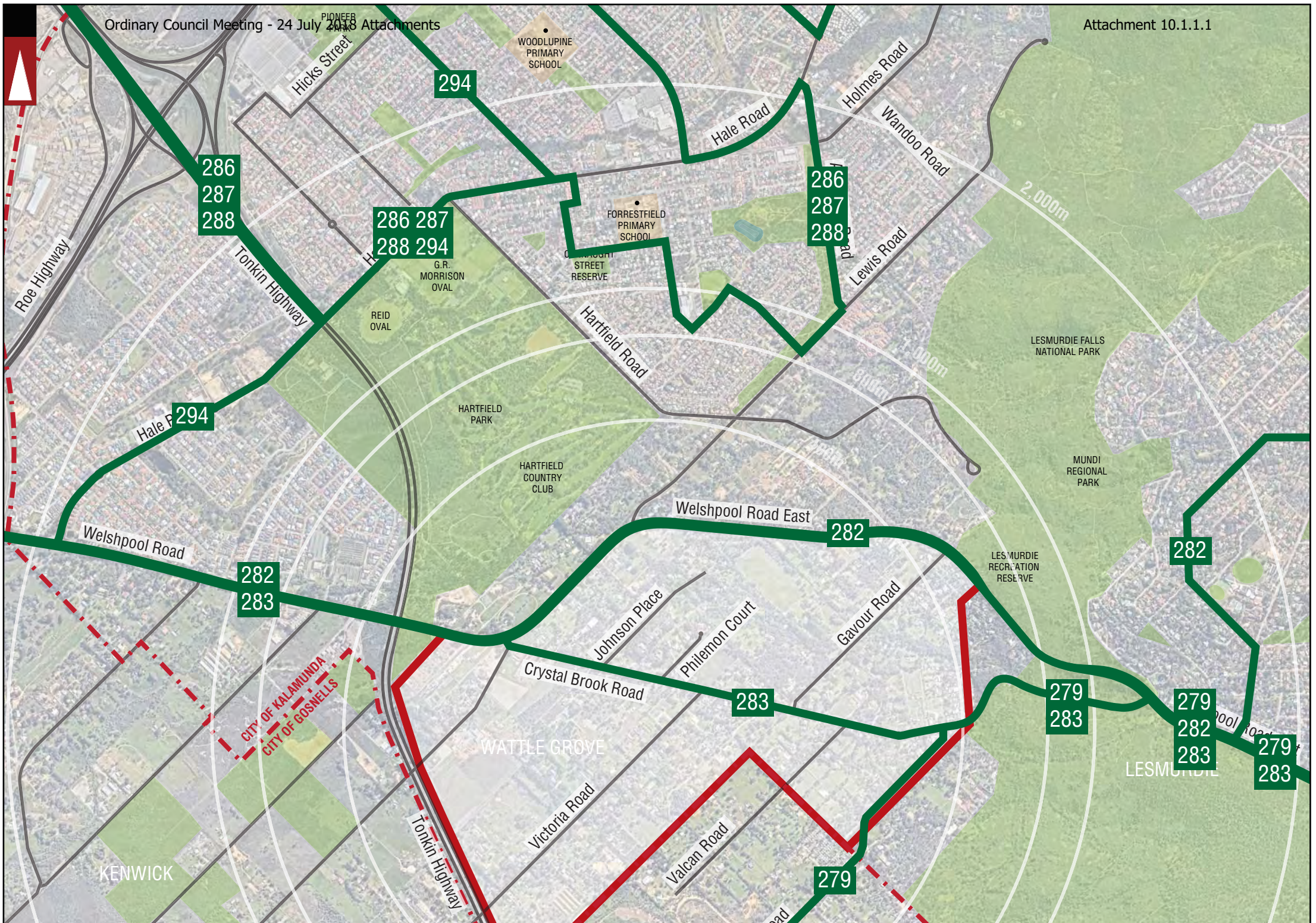

PARKS AND RECREATION
WATERWAYS
PUBLIC PURPOSE
ROAD
Hay Street STREET NAME
RAILWAY
ROAD BRIDGE
DISTANCE FROM LOCATION
STRUCTURE PLAN AREA
FORRESTFIELD SUBURB
CITY OF KALAMUNDA LOCAL GOVERNMENT NAME
LOCAL AUTHORITY BOUNDARY
BUS TERMINUS
BUS ROUTES
103 BUS ROUTE NUMBER

NOTE : FOR MORE INFORMATION REGARDING TO DESCRIPTION OF THE BUS ROUTE AND THEIR INDICATIVE PEAK AND OFF-PEAK FREQUENCIES REFER TO THE REPORT

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LEGEND

No	DATE	AMENDMENT
A	11-04-2018	ISSUED FOR REVIEW

PROJECT: WATTLE GROVE SOUTH

TITLE: PUBLIC TRANSPORT PLAN - 2,000M RADIUS

DRAWING NUMBER: KC00381.000_ S03

DRAWN BY: J.S.

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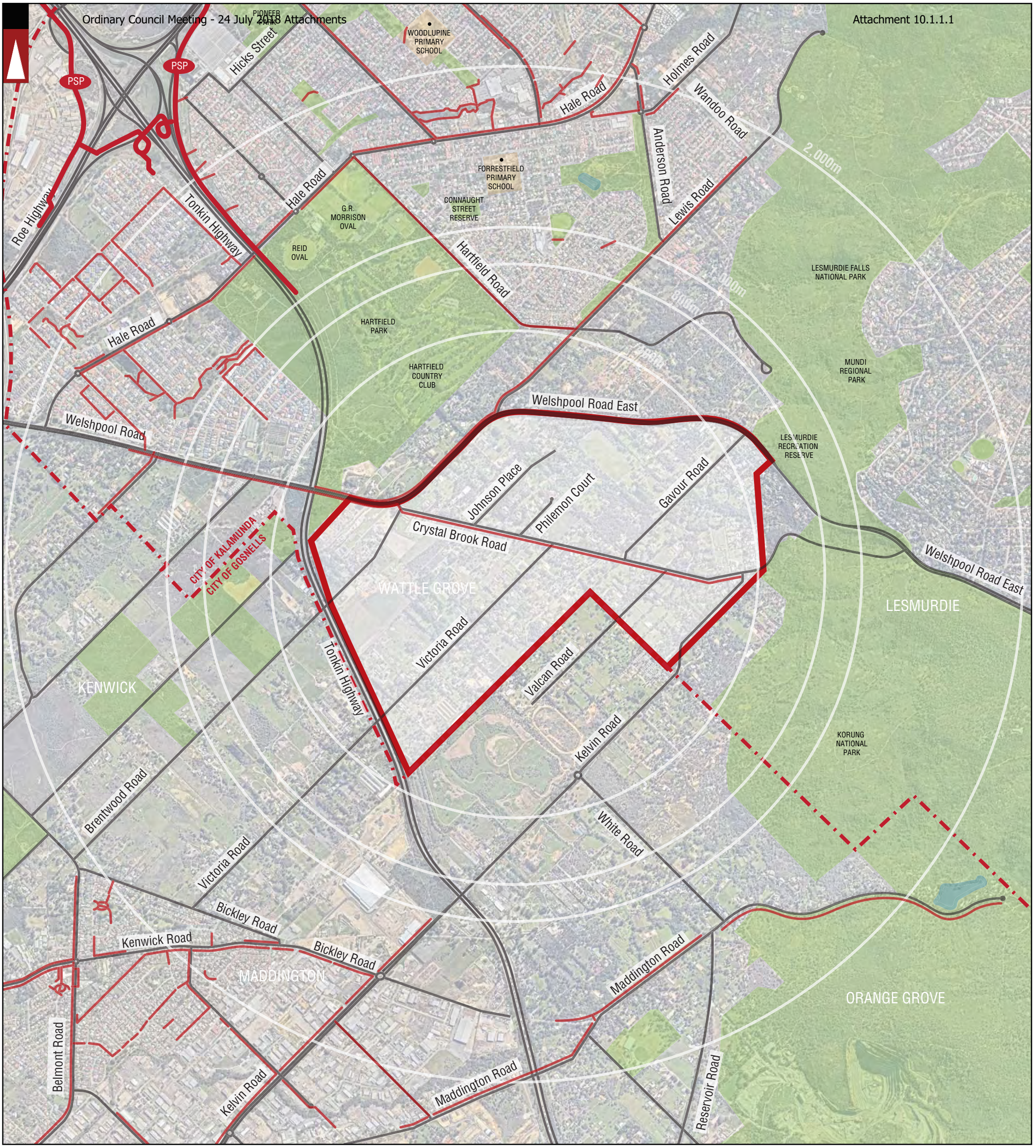

PARKS AND RECREATION
WATERWAYS
PUBLIC PURPOSE
ROAD
Hay Street STREET NAME
RAILWAY
ROAD BRIDGE
DISTANCE FROM LOCATION
STRUCTURE PLAN AREA
FORRESTFIELD SUBURB
CITY OF KALAMUNDA LOCAL GOVERNMENT NAME
LOCAL AUTHORITY BOUNDARY
PSP PRINCIPAL SHARED PATH (PSP)
OTHER SHARED PATH (SHARED BY PEDESTRIAN & CYCLIST)

LEGEND

No	DATE	AMENDMENT
A	11-04-2018	ISSUED FOR REVIEW

PROJECT: WATTLE GROVE SOUTH

TITLE: PEDESTRIAN PATHS PLAN - 2,000M RADIUS

DRAWING NUMBER: KC00381.000_ S04

DRAWN BY: J.S.

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15,116 AM 07:15 – 2,647 PM 15:30 – 1,626 2017
NORTH OF HALE ROAD (SLK 17.27)NB

15,960 AM 08:00 – 875 PM 16:45 – 1,054 2017
EAST OF TONKIN HIGHWAY (SLK 1.76)

11,730 AM 08:00 – 875 PM 16:45 – 1,054 2016
NORTH OF WELSHPOOL ROAD EAST (SLK 0.81)

22,702 AM 07:30 – 1,957 PM 16:45 – 1,721 2016
WEST OF TONKIN HIGHWAY (SLK 9.90)

VPD 17,998
AM 08:00 – 1,386
PM 17:00 – 1,477

40,695 AM 07:15 – 3,410 PM 15:30 – 3,566 2017
NORTH OF WELSHPOOL ROAD EAST (SLK 17.44)

VPD 40,237
AM 08:00 – 3,336
PM 17:00 – 3,380

20,314 AM 07:45 – 1,622 PM 16:45 – 1,917 2015
EAST OF TONKIN HIGHWAY (SLK 0.24)

VPD 16,546
AM 08:00 – 1,501
PM 17:00 – 1,699

2,168 AM 07:00 – 208 PM 15:00 – 215 2017
250M EAST OF BRENTWOOD ROAD

47,882 AM 06:15 – 3,503 PM 16:00 – 3,904 2015
SOUTH OF WELSHPOOL ROAD EAST (SLK 19.45)

VPD 42,791
AM 08:00 – 3,256
PM 17:00 – 3,738

5,290 AM 08:00 – 481 PM 16:00 – 518 2016
460M SOUTH WEST OF CRYSTAL BROOK ROAD

VPD 39,620
AM 08:00 – 3,014
PM 17:00 – 3,594

5,963 AM 07:30 – 535 PM 16:00 – 539 2014
NORTH OF TONKIN HIGHWAY (SLK 3.60)

VPD 39,620
AM 08:00 – 3,014
PM 17:00 – 3,594

VPD 44,716
AM 08:00 – 3,580
PM 17:00 – 3,795

43,124 AM 07:00 – 3,141 PM 16:15 – 3,909 2016
SOUTH OF KELVIN ROAD (SLK 22.51)

17,823 AM 07:30 – 1,433 PM 15:30 – 1,677 2016
WEST OF TONKIN HIGHWAY (SLK 3.02)

VPD 44,716
AM 08:00 – 3,580
PM 17:00 – 3,795

13,392 AM 07:15 – 983 PM 15:15 – 1,131 2014
WEST OF BICKLEY ROAD (SLK 2.38)

PARKS AND RECREATION
WATERWAYS
PUBLIC PURPOSE
ROAD
Hay Street STREET NAME
RAILWAY
ROAD BRIDGE
DISTANCE FROM LOCATION
STRUCTURE PLAN AREA
FORRESTFIELD SUBURB
CITY OF KALAMUNDA LOCAL GOVERNMENT NAME
LOCAL AUTHORITY BOUNDARY

TRAFFIC DATA
5,512 NUMBER OF VEHICLES PER DAY
AM 1145 – 381 PM 1630 – 480 NUMBER OF VEHICLES PER AM PEAK HOUR / NUMBER OF VEHICLES PER PM PEAK HOUR
2014 YEAR
EAST OF HARLOW RD LOCATION

TRAFFIC VOLUMES DERIVED FROM SCATS
VPD 17,998 NUMBER OF VEHICLES PER DAY
AM 08:00 – 1,386 NUMBER OF VEHICLES PER AM PEAK HOUR
PM 17:00 – 1,477 NUMBER OF VEHICLES PER PM PEAK HOUR
ALL DATED - SEPT 2017

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LEGEND

No	DATE	AMENDMENT
A	11-04-2018	ISSUED FOR REVIEW

PROJECT: WATTLE GROVE SOUTH

TITLE: EXISTING TRAFFIC COUNTS - 2,000M RADIUS

DRAWING NUMBER: KC00381.000_ S05

DRAWN BY: J.S.

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PARKS AND RECREATION

WATERWAYS

PUBLIC PURPOSE

ROAD

Hay Street STREET NAME

RAILWAY

ROAD BRIDGE

DISTANCE FROM LOCATION

STRUCTURE PLAN AREA

FORRESTFIELD SUBURB

CITY OF KALAMUNDA LOCAL GOVERNMENT NAME

LOCAL AUTHORITY BOUNDARY

3,219 TOTAL FORECASTED TRAFFIC VOLUMES ON EXISTING ROADS

3,219 TOTAL FORECASTED PASSING TRAFFIC ON EXISTING ROADS

3,219 TOTAL GENERATED TRAFFIC FROM WATTLE GROVE SOUTH

NOTE - TRAFFIC FROM EXTERNAL TO EXTERNAL ZONES WAS MODELLED TO REFLECT, AS CLOSE AS POSSIBLE, THE OBTAINED DATA FROM THE LATEST MAIN ROADS WA ROM MODEL FOR 2031. THE DIFFERENCE BETWEEN RESULTS MAY OCCUR DUE TO NETWORK LEVEL OF DETAIL.

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LEGEND

No	DATE	AMENDMENT
A	11-04-2018	ISSUED FOR REVIEW

PROJECT: WATTLE GROVE SOUTH

TITLE: - 2031 (PARAMICS OUTPUT) FUTURE TRAFFIC COUNTS - DAILY TRAFFIC - OPTION 1(R20)

DRAWING NUMBER: KC00381.000_ S06

DRAWN BY: J.S.

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PARKS AND RECREATION
WATERWAYS
PUBLIC PURPOSE

ROAD
Hay Street STREET NAME
RAILWAY
ROAD BRIDGE
DISTANCE FROM LOCATION

STRUCTURE PLAN AREA
FORRESTFIELD SUBURB
CITY OF KALAMUNDA LOCAL GOVERNMENT NAME
LOCAL AUTHORITY BOUNDARY

3,219 TOTAL FORECASTED TRAFFIC VOLUMES ON EXISTING ROADS
3,219 TOTAL FORECASTED PASSING TRAFFIC ON EXISTING ROADS
3,219 TOTAL GENERATED TRAFFIC FROM WATTLE GROVE SOUTH

NOTE - TRAFFIC FROM EXTERNAL TO EXTERNAL ZONES WAS MODELLED TO REFLECT, AS CLOSE AS POSSIBLE, THE OBTAINED DATA FROM THE LATEST MAIN ROADS WA ROM MODEL FOR 2031. THE DIFFERENCE BETWEEN RESULTS MAY OCCUR DUE TO NETWORK LEVEL OF DETAIL.

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LEGEND

No	DATE	AMENDMENT
A	11-04-2018	ISSUED FOR REVIEW

PROJECT: WATTLE GROVE SOUTH

TITLE: - 2031 (PARAMICS OUTPUT)
FUTURE TRAFFIC COUNTS - DAILY TRAFFIC - OPTION 2(R30)

DRAWING NUMBER: KC00381.000_ S07

DRAWN BY: J.S.

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PARKS AND RECREATION
WATERWAYS
PUBLIC PURPOSE

ROAD
Hay Street STREET NAME
RAILWAY
ROAD BRIDGE
DISTANCE FROM LOCATION

STRUCTURE PLAN AREA
FORRESTFIELD SUBURB
CITY OF KALAMUNDA LOCAL GOVERNMENT NAME
LOCAL AUTHORITY BOUNDARY

3,219 TOTAL FORECASTED TRAFFIC VOLUMES ON EXISTING ROADS
3,219 TOTAL FORECASTED PASSING TRAFFIC ON EXISTING ROADS
3,219 TOTAL GENERATED TRAFFIC FROM WATTLE GROVE SOUTH

NOTE - TRAFFIC FROM EXTERNAL TO EXTERNAL ZONES WAS MODELLED TO REFLECT, AS CLOSE AS POSSIBLE, THE OBTAINED DATA FROM THE LATEST MAIN ROADS WA ROM MODEL FOR 2031. THE DIFFERENCE BETWEEN RESULTS MAY OCCUR DUE TO NETWORK LEVEL OF DETAIL.

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LEGEND

No	DATE	AMENDMENT
A	11-04-2018	ISSUED FOR REVIEW

PROJECT: WATTLE GROVE SOUTH

TITLE: - 2031 (PARAMICS OUTPUT)
FUTURE TRAFFIC COUNTS - DAILY TRAFFIC - OPTION 3(R40)

DRAWING NUMBER: KC00381.000_ S08

DRAWN BY: J.S.

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