LOT 55 CHAPMAN ROAD, GLENFIELD

ACTIVITY CENTRE PLAN

August 2017

715-528

tpg PLACE MATCH

Activity Centre Plan

Lot 55 Chapman Road, Glenfield

August 2017

Prepared for:	**ASDC Pty Ltd**
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Endorsement Page

This Activity Centre Plan is prepared under the provisions of the City of Greater Geraldton Local Planning Scheme No. 1.

IT IS CERTIFIED THAT THIS STRUCTURE PLAN WAS APPROVED BY RESOLUTION OF THE WESTERN AUSTRALIAN PLANNING COMMISSION ON:

27/10/2017 Date

Signed for and on behalf of the Western Australian Planning Commission:

An officer of the Commission duly authorised by the Commission pursuant to section 16 of the *Planning and Development Act 2005* for that purpose, in the presence of:

Witness

27/10/2017 Date

27/10/2027 Date of Expiry

Table of Amendments

Amendment No.	Summary of the Amendment	Amendment Type	Date approved by WAPC

Executive Summary

Overview

This Activity Centre Plan (ACP) has been prepared to guide the development of land totalling 12,2397 hectares in area, and encompasses Lot 55 (No. 871) Chapman Road, Glenfield (the Activity Centre Plan area) within the City of Greater Geraldton.

The ACP area is located approximately 9.3 kilometres north of the Geraldton Town Centre and is within 350 metres of the coastline to the west. The subject site is located in the centre of the growing residential catchments for both Glenfield to the north and Sunset Beach to the south. The subject site is located within a wastewater treatment plant special control area relating to a Water Corporation Waste Water Treatment Plant (WWTP) situated approximately 300 metres west of the Activity Centre Plan area.

This ACP has been prepare on behalf of the landowner ASDC Pty Ltd and has been informed by investigations undertaken by the following consultant team:

- TPG + Place Match – town planning, urban design
- Strategen – environmental, local water management, bushfire management
- Pritchard Francis – engineering, servicing
- Transcore – traffic assessment
- Pracsys – retail format needs analysis

Purpose

The intent of this ACP is to provide a statutory framework to guide and facilitate the development of land for a limited range of service commercial purposes including the potential for showroom/bulky goods, service station, liquor store, car wash and other showroom and service commercial relates land uses.

Although this ACP does not supersede or overlap any approved Structure Plan, the orientation of development associated with this ACP is to take advantage of the Glenfield District Activity Centre to the north of the ACP area. This ACP should be read in conjunction with the Activity Centre Structure Plan for Lot 9000 Chapman Road, Glenfield to ensure that development of the entire District Activity Centre area is done so in a coordinated and integrated manner.

Design Approach

The design of this ACP is a product of a multidisciplinary approach which was predicated on the need to respond to a number of site issues and constraints in order to deliver a balanced and better environmental outcome for the site to that currently documented. This ACP has been informed by the following studies:

1. Preparation of a Retail Analysis (Pracsys) to analyse the market capacity for bulky goods development at this location.
2. Preparation of a servicing and infrastructure report (Pritchard Francis) to identify strategic engineering opportunities and constraints within the ACP area.
3. Preparation of an Environment Assessment and Management Strategy (Strategen) to identify any potential impacts to the environment resulting from the development of the ACP area and identify management actions.
4. Preparation of a Transport Assessment (Transcore) to accommodate the modeled traffic movement that would be generated by the resultant bulky goods development within the ACP area.

Executive Summary Table

Item	Data	Activity Centre Plan Ref
Total area covered by the Activity Centre Plan	12.2397 ha	Part 2 – Section 1.2.2
Estimated Area of each land use proposed: <u>Zones</u> • Service Commercial zone <u>Reserves</u> • Road Reserves	 11.5328 ha 1.9948 ha	 N/A Part 2 – Section 4.6.1
Total estimated lot yield	Not applicable	Part 2 – Section 4.3
Estimated service commercial floor space	33,660 m^2	Part 2 – Section 4.5
Estimated number of dwellings	Nil	N/A
Estimated jobs provided	340 Jobs	Part 2 – Section 4.5
Estimated population	Nil	N/A
Number of primary schools	Nil	N/A
Number of high schools	Nil	N/A
Public open space	Nil	N/A

Contents

Part One - Implementation

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1. Activity Centre Plan Area

(a) This Activity Centre Plan shall apply to Lot 55 (No. 871) Chapman Road, Glenfield, being the land contained within the inner edge of the line denoting the Activity Centre Plan boundary on Activity Centre Plan Map (Plan 1).

2. Staging

(a) The development of the ACP area will be implemented in stages due to the size of the ACP area and the service commercial nature of the land uses. The staging in terms of timing and composition will be dependent upon a number of factors, including market demand and servicing and infrastructure considerations.

3. Operation

(a) This Activity Centre Plan commences operation on the day on which it is endorsed by the Western Australian Planning Commission (WAPC).

4. Subdivision and Development Requirements

4.1 Land Use Permissibility

(a) The Activity Centre Plan Map (Plan 1) outlines land use, zones and reserves within the ACP area. The intention of zones and land use permissibility within the ACP area shall be in accordance with the corresponding zone or reserve under the Scheme, except as follows.

(b) Land use permissibility shall be in accordance with the 'Service Commercial' zone in the Scheme with the exception of the following restricted uses, which are NOT PERMITTED:

- Child Care Premises
- Civic Use
- Club Premises
- Convenience Store
- Community Purpose
- Consulting Rooms
- Convenience Store
- Exhibition Centre
- Fast Food Outlet
- Funeral Parlour
- Hotel
- Market
- Medical Centre
- Motel
- Office
- Office – Small Scale
- Place of Worship
- Reception Centre
- Recreation Private
- Restaurant / Café
- Shop
- Supermarket
- Tavern

(c) In addition, the following additional uses may be approved at the discretion of the City:

- Fuel Depot (D)

4.2 Minimum Lot Size

(a) Notwithstanding Table 6 of Clause 3.5.2 of the Scheme, the minimum lot size within the ACP area shall be 2,500m^2.

5. Local Development Plans

(LDP) are required for the following:

(a) Any development or subdivision that proposes retaining in excess of 2 metres. The LDP must address the finish of the retaining wall(s), slope, gradients and access for both vehicles and pedestrians in accordance with the relevant Australian Standard.

(b) Any lot that proposes land uses that require specific management of any aspect of the development to ensure its compatibility with the WWTP buffer requirements.

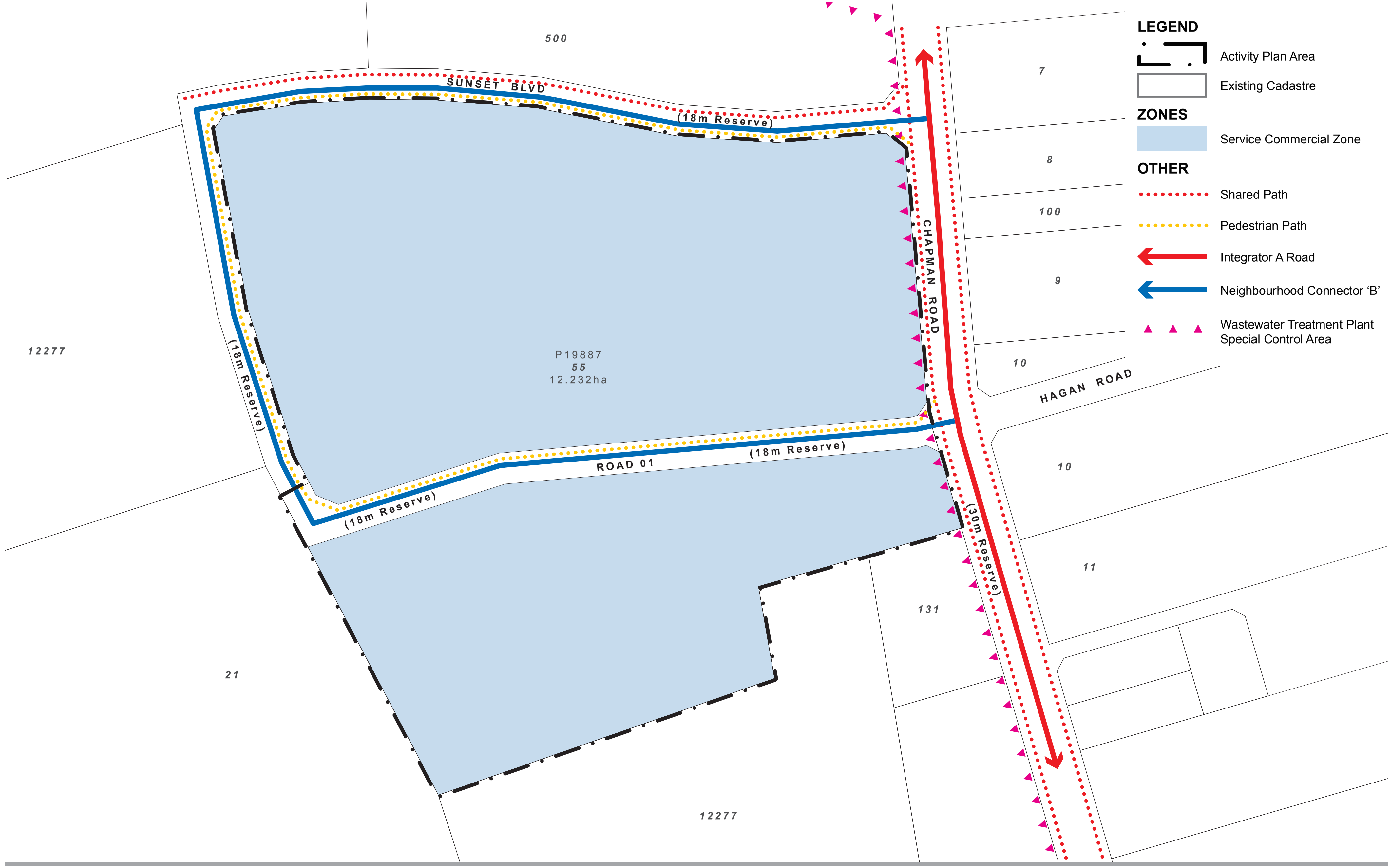
(c) Any development over the area with 'Good' vegetation (as depicted on Figure 8: Vegetation Condition, of Appendix B – Environmental Assessment and Management Strategy). The LDP is to address the potential for the retention and regeneration of the vegetation, where practical.

6. Other Requirements

(a) Prior to any subdivision or development application being lodged in excess of 4 years from the operation date of the ACP (as defined in section 2), an updated Transport Impact Assessment (TIA) shall be prepared. Thereafter, any further subdivision or development application shall be accompanied by a TIA less than 4 years from publication.

7. Additional Information

Additional Information	Approval Stage	Consultation Required
Urban Water Management Plan (inclusive of detailed permeability testing and the collection of 6 months, potentially up to 12 months, of groundwater monitoring data including a winter peak as well as an Acid Sulfate Soils investigation).	Development application or subdivision.	City of Greater Geraldton in conjunction with the Department of Water.
Site works and finished floor / lot levels.	Development application or subdivision.	City of Greater Geraldton.
Chapman Road upgrades (detailing the extent of upgrades, the ultimate road construction standard and any staging of upgrades).	Development application or subdivision.	City of Greater Geraldton.



Plan 1 - Activity Centre Plan

Lot 55 Chapman Road, Glenfield

Date: 28 October 2016

Scale: 1:2,000 @ A3

Drawing No. 715-528 ST-1 A

Staff: MD_GW

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Part Two - Explanatory Section

Figures

Abbreviations

ACP	Activity Centre Plan
AHD	Australian Height Datum
ARI	Average Recurrence Interval
AAMGL	Annual Average Maximum Groundwater Levels
BPZ	Building Protection Zone
CoGG	City of Greater Geraldton
DoW	Department of Water
DPaW	Department of Parks and Wildlife
DSI	Detailed Site Investigation
EPA	Environmental Protection Authority
LSP	Local Structure Plan
LWMS	Local Water Management Strategy
POS	Public Open Space
Scheme	City of Greater Geraldton Local Planning Scheme No. 1
UWMP	Urban Water Management Plan
WAPC	Western Australian Planning Commission

1. Planning Background

1.1 Introduction and Purpose

This Activity Centre Plan (ACP) has been prepared by TPG + Place Match on behalf of the landowner ASDC Pty Ltd to guide the development of land on Lot 55 (No. 871) Chapman Road, Glenfield (the ACP area).

This non-statutory (explanatory) section constitutes Part 2 of the proposed ACP to facilitate the development of the ACP area to allow for a restricted range of service commercial land uses. This ACP has been prepared for the ACP area to fulfill the requirements of SPP 4.2 and the City of Greater Geraldton Commercial Activity Centres Strategy as a District Centre.

This ACP will be used by the Western Australian planning Commission (WAPC), the Department of Planning, City of Greater Geraldton, State government agencies, landowners and the local community to inform further detailed planning and provide certainty and future development over Lot 55.

Supporting documentation in the form of separate technical reports have been prepared to inform this ACP and are appended to this document. These documents include:

- Environmental Assessment and Management Strategy (2016) prepared by Strategen;
- Opportunities and Constraints Report (2016) prepared by Pritchard Francis;
- Transport Assessment (2016) prepared by Transcore; and
- Retail Analysis (2016) prepared by Pracsys.

This ACP comprises a Part 1 Statutory section and Part 2 Explanatory Section and technical appendices.

Part 1 - Implementation Section sets out the provisions that apply to the Activity Centre Plan.

Part 2 - Explanatory Section provides supporting information and explanation as background to the Part 1 provisions. The content and format of Part 2 responds to the requirements of the WAPC's Structure Plan Preparation Guidelines, the Model Centre Framework and SPP 4.2.

1.2 Land Description

1.2.1 Location

The are subject to this ACP comprises solely Lot 55 Chapman Road, Glenfield (the ACP area) and is located within the City of Greater Geraldton local government area. The ACP area is located approximately 450 kilometres north of Perth, nine kilometres north of the Geraldton Town Centre.

The ACP area is bound by vacant land subject to the Glenfield District Activity Centre to the north, Chapman Road to the east, land reserved 'Public Open Space' and 'Foreshore' to the south and to the west, and a Water Corporation Waste Water Treatment Plant (WWTP) approximately 300 metres to the west. The ACP area is strategically located adjacent to Chapman Road and achieves direct access onto the North West Coastal Highway through Hagan Road. The ACP area is currently vacant and existing vegetation, broadly described as a degraded mid-open shrubland.

The recently prepared Glenfield District Activity Centre Plan for land immediately to the north incorporates residential, retail and commercial land uses and is designated to accommodate a future district activity centre.

Refer to Figure 1 – Location Plan

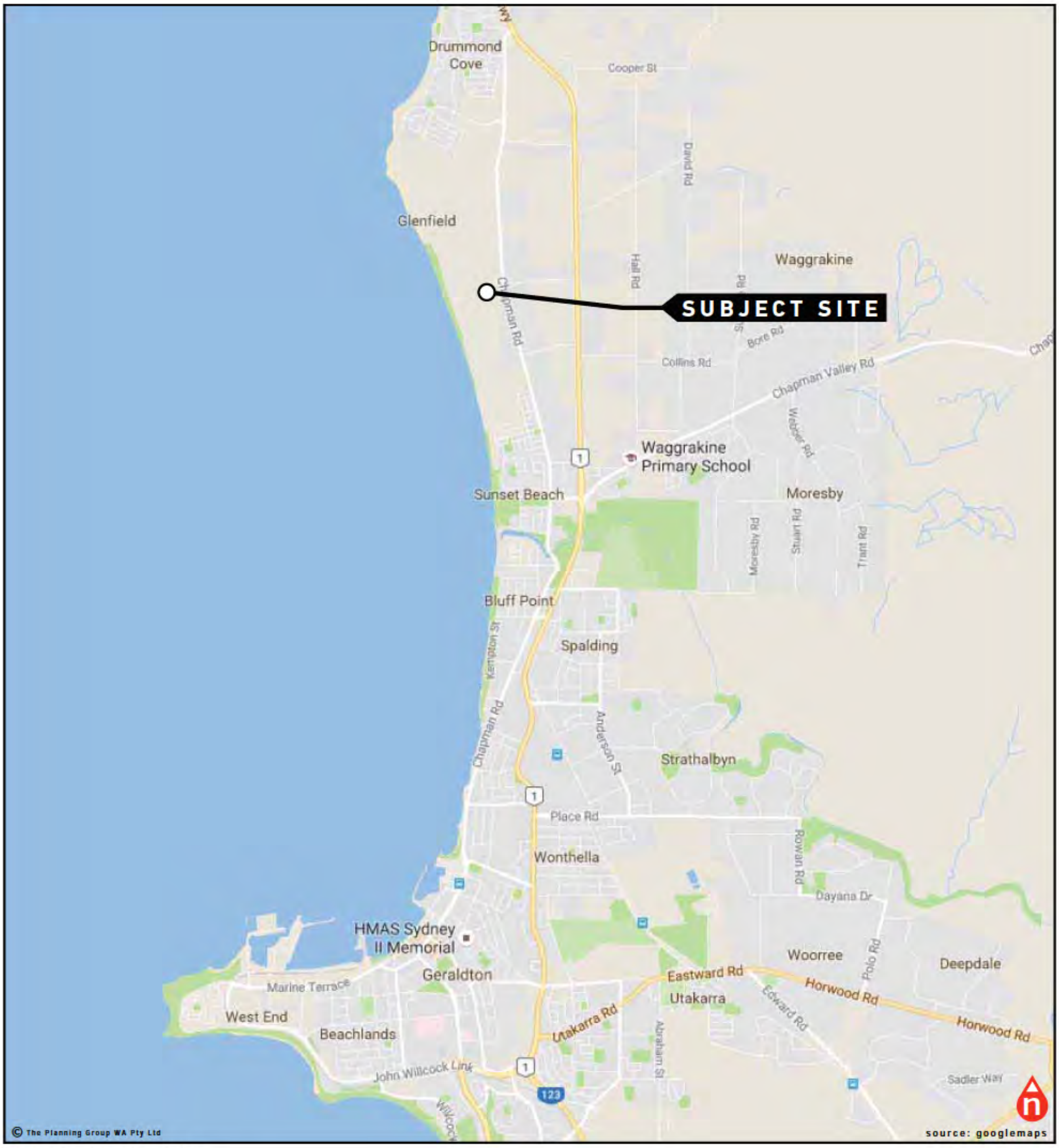

Figure 1. Location Plan

The ACP area has a total of 12.2320 ha of land and comprises a vacant site which accommodates existing coastal vegetation. Historically, the ACP area has remained vacant and is set aside for future development pursuant to various strategic planning documents for the area. In addition to this, a number of structure plans have been prepared or are in the process of being prepared over land surrounding the ACP area. Throughout the past 20 years, residential development has occurred to the north of the ACP area and has been the catalyst for the designation of land to accommodate a future district activity centre.

Refer to Figure 2 – Aerial Plan

Refer to Figure 3 – Context Plan

1.2.2 Legal Description and Ownership

The ACP area comprises Lot 55 Chapman Road, Glenfield. The details of the relevant Certificate of Title are provided in the following table.

Table 1 – Certificate of Title Details

Lot No.	Street Address	Volume/ Folio	Plan	Area	Owner
55	Lot 55 Chapman Road, Glenfield	2009/981	P19887	12.232ha	ASDC Pty Ltd

Refer to Figure 4 – Site Plan

1.2.3 Limitations and Encumbrances on Title

There are no limitations or encumbrances listed on the current certificate of title.

1.3 Planning Framework

1.3.1 Regional Planning

1.3.1.1 Geraldton Region Plan 1999

The Geraldton Region Plan (GRP) provides a broad regional planning framework for the growth and development of the greater Geraldton urban area. It seeks to provide a framework for the future management, protection and coordination of regional planning in the region and allocates the general location and extent of land uses at a broad scale.

The GRP identifies the ACP area as ‘Future Urban’, however it is noted that the Greater Geraldton Structure Plan 1999 is now superseded by the Greater Geraldton Structure Plan 2011 (GGSP).

The GRP is still relevant to the planning framework of the region and it is intended that it be used in conjunction with the Greater Geraldton Structure Plan until local governments have prepared a new local planning strategy and/or district structure plans.

1.3.1.2 Greater Geraldton Structure Plan 2011

The Greater Geraldton Structure Plan 2011 (GGSP) is an update to the existing Greater Geraldton Structure Plan 1999, which forms Part 3 of the Geraldton Region Plan. The GGSP focuses on urban areas and areas likely to experience pressure from development within the City of Geraldton-Greenough and the Shire of Chapman Valley. The GGSP reflects a number of land use changes that have occurred since the inception of the previous 1999 version of the Structure Plan.

Pursuant to the GGSP, the ACP area is shown as ‘Urban’. Areas shown as Urban provide for a range of activities, including residential, commercial, recreational and light industry.

1.3.1.3 State Planning Policy 4.1 – Industrial State Buffer

State Planning Policy 4.1 – Industrial State Buffer (SPP4.1) provides a consistent statewide approach for the protection and long-term security of industrial zones, transport terminals (including ports) other utilities and special uses, and provides for the safety and amenity of surrounding land uses while having regard to the rights of landowners who may be affected by residual emissions and risk.

The objectives of SPP4.1 are:

- *To provide a consistent statewide approach for the definition and securing of buffer areas around industry, infrastructure and some special uses.*
- *To protect industry, infrastructure and special uses from the encroachment of incompatible land uses.*

Figure 2. Aerial Plan

Figure 3. Context Plan

Figure 4. Site Plan

- *To provide for the safety and amenity of land uses surrounding industry, infrastructure and special uses.*
- *To recognise the interests of existing landowners within buffer areas who may be affected by residual emissions and risks, as well as the interests, needs and economic benefits of existing industry and infrastructure which may be affected by encroaching incompatible land uses.*

This ACP addresses the objectives of SPP4.1 by prohibiting land uses that are not considered to be suitable land uses within the odour buffer. Further justification is provided in Section 4.4 of this report.

1.3.1.4 Guidance Statement No. 3 - Separation Distances Between Industrial and Sensitive Land Uses

In 2005, the Environmental Protection Authority (EPA) has prepared Guidance Statement 3: Separation Distances between Industrial and Sensitive Land Use (GS3). GS3 relates to the EPA's environmental factors of human health and amenity which may be impacted by gaseous and particulate emissions, noise, dust and odour generated from industry, and makes reference to a range of industries which require separation from sensitive land uses, and provides the recommended separation distance.

The purpose of GS3 is to

- Identify the need for specific separation distance or buffer definition studies; and
- Provide general guidance on separation distances in the absence of site- specific technical studies.

GS3 specifically references a 'Wastewater Treatment Plant', which is to have a recommended separation distance to be determined on a 'Case by Case' basis.

With regard to the existing Water Corporation Waste Water Treatment Plant, the EPA expects the City of Greater Geraldton to seek advice of the Office of the Environmental Protection Authority (OEPA), as required by the above.

1.3.1.5 Draft Environmental Assessment for Separation Distances Between Industrial and Sensitive Land Uses

The Environmental Protection Authority (EPA) has prepared the draft Environmental Assessment Guideline for Separation Distances between Industrial and Sensitive Land Uses (EAG), which is expected to replace the existing Guidance Statement 3: Separation Distances between Industrial and Sensitive Land Use (GS3).

Further to GS3, the purpose of draft EAG is to:

- *Provide advice on which land uses require separation, and recommend the appropriate separation distances;*
- *Outline the EPA's expectations on the application of separation distances for schemes and scheme amendments in the environmental impact assessment process; and*
- *Support strategic and statutory land use planning and development decisions by planning authorities where proposed land uses have the potential to adversely impact on human health and amenity.*

Unlike GS3, a wastewater treatment plant is not specifically referenced under the draft EAG. In this regard, the draft EAG stipulates that the local authority is to seek advice where an industry is not listed, or is to be determined on a case by case basis.

Whilst the draft EAG is yet to be endorsed, it is anticipated that the EPA will have due regard to the provisions contained within the draft EAG, when determining the separation distance between the ACP area and the existing Water Corporation Waste Water Treatment Plant.

A buffer has been identified for a Waste Water Treatment Plant, and is identified in Figure 5 of this ACP.

1.3.1.6 Water Corporation Land Use Compatibility Matrix

Water Corporation has prepared the Water Corporation Land Use Compatibility Matrix (LUCM) which systematically lists a range of land use categories and the compatibility of those land uses with various buffers.

Water Corporation stipulates that odour buffers be provided to all Water Corporation waste water treatment plants to protect from the impacts of odour and help prevent land use conflict.

The table below outlines those relevant land uses as part of this ACP, in line with the LUCM.

Land Use	Water Corporation Permissibility
Amusement Parlour	Not Supported
Car Park	Supported
Child Care Premises	Not Supported
Civic Use	Not Supported
Club Premises	Not Supported
Convenience Store	Not Supported
Consulting Rooms	Not Supported
Community Purposes	Not Supported
Exhibition Centre	Not Supported
Fast Food Outlet	Not Supported
Fuel Depot	Supported
Hotel	Not Supported
Industry - Light	Discretionary Use
Industry - Service	Discretionary Use
Liquor Store	Use Not Listed
Market	Not Supported
Medical Centre	Not Supported
Motel	Not Supported
Motor Vehicle Wash	Supported
Office	Not Supported
Place of Worship	Not Supported
Reception Centre	Not Supported
Restaurant / Cafe	Not Supported
Service Station	Not Supported
Shop	Not Supported
Showroom	Not Supported
Supermarket	Use Not Listed
Tavern	Not Supported

1.3.1.7 Local Biodiversity Strategy

The City of Greater Geraldton prepared the Local Biodiversity Strategy (LBS) to provide a process for assessing the ecological significance of local natural areas.

The LBS is based on the following goals:

1. **Retention** - Retain natural areas. Aim to retain at least 3334ha of the remaining 6041ha of natural areas remaining.
2. **Protection** - Protect natural areas and specific biodiversity features, targeting at least 5% of the original extent of natural areas, leading to the protection of an additional 1058ha of areas of conservation value.
3. **Management** - Manage protected natural areas for conservation. Active management of 100% of LGA natural areas of conservation value.
4. **Engagement** – Increased community contributions to biodiversity conservation. Decrease in behaviours identified as threats to biodiversity values.
5. **Regeneration** - Ensure the rate of regeneration exceeds the rate of degradation. E.g. restore more than 1500 ha of natural areas in CGG.

Given that the ACP area comprises existing vegetation, the goals of the LBS are applicable to this ACP. It is proposed that future Local Development Plans will contain provisions encouraging the retention of ‘good’ pockets of vegetation where possible and practical and/or transplanting vegetation to future landscaping areas to ensure retention of individual stands of vegetation.

1.3.1.8 Geraldton Regional Flora and Vegetation Survey

The Department of Planning prepared the Geraldton Regional Flora and Vegetation Survey (GRFVS) in 2010 as a key information source to help minimise the environmental impact of future development in the Geraldton region, and to meet the EPA’s expectation on regional flora and vegetation information in the Geraldton region. GRFVS covers 40,737 hectares in the City of Geraldton-Greenough and the Shire of Chapman Valley and identifies a broad scale vegetation types within a broad study area encompassing Geraldton and its surrounds.

GRFVS identifies existing vegetation within the ACP area as *Acacia rostellifera shrublands* and *Eucalyptus camaldulensis subsp. obtusa, Casuarina obesa* and *Melaleuca rhaphiophylla*.

The GRFVS is adequately addressed in Section 2.1.2.

1.3.1.9 City of Greater Geraldton Integrated Transport Strategy

The City of Greater Geraldton Integrated Transport Strategy (ITS) has been prepared to direct the expansion of the City's transport system to service a growing population.

The goal of the City's ITS is to "provide a transport infrastructure network capable of supporting a Greater Geralton population of up to 100,000 people prosperously, equitable and safety that promotes City vibrancy"

Chapman Road is currently a identified as a 'District Distributor' road, and as identified under the ITS, is subject to the transition from a 'Rural Road' to an 'Urban Road' between Sunset Beach and Drummonds Cove, through the Glenfield District Activity Centre, incorporating kerbing, stormwater, shared pathways and on-road cycle lanes.

Given that the ACO is to comprise a restricted range of Service Commercial uses only over a single lot only, the provisions of the ITS is not considered to have an advantageous impact on the future outcomes of this ACP.

1.3.2 Local Planning Framework

1.3.2.1 City of Greater Geraldton Local Planning Scheme No. 1

Service Commercial Zone

The ACP area is zoned 'Urban Development' pursuant to the City of Greater Geraldton Local Planning Scheme No. 1 (LPS1). Pursuant to LPS1, the objectives of the 'Urban Development' zone are to:

- *Identify areas that require comprehensive planning in order to provide for the coordination of subdivision, land use and development; and*
- *Provide for the orderly and proper planning and development through a structure planning process.*

LPS1 stipulates that the City is not to consider the recommendation for subdivision of land or approve development on land located on or within the Urban Development zone unless a structure plan in respect to the area the subject to the application, is endorsed and generally in accordance with the structure plan.

Refer to Figure 5 – Local Planning Scheme No. 1

This ACP designates a 'Service Commercial' zone over the ACP area. On this basis, any development over the ACP area shall meet the objectives and general requirements in accordance with the 'Service Commercial' zone, pursuant to LPS 1. The objectives of the 'Service Commercial' zone are to:

a) accommodate commercial activities which, because of the nature of the business, require good vehicular access and/or large sites;

b) provide for a range of wholesale sales, showrooms, trades and services, which by reason of their scale, character, operational or land requirements, are not appropriate for industrial or commercial zones; and

c) ensure development achieves relatively high amenity standards based on the level of exposure of the site and proximity to residential areas.

Pursuant to Clause 3.15.14 of LPS1, the City may, in respect of a use that is not specifically referred to in the zoning table, and that cannot reasonably be determined as falling within a use class referred to in the table:, determine that the use is consistent with the objectives of the particular zone and is therefore a use that may be permitted in the zone.

With respect to the above, a Service Commercial zone designation over the ACP area is considered to meet the objectives above on the basis that the ACP will:

a) facilitate the development of land uses which requires good vehicular access and large site areas;

b) provide for a range of showrooms, trades and services which are not appropriate for industrial or commercial zones; and

c) comprise appropriate land uses which facilitate good access and urban design controls so as not to interfere with traffic flow and safety, or detract from the amenity of the locality.

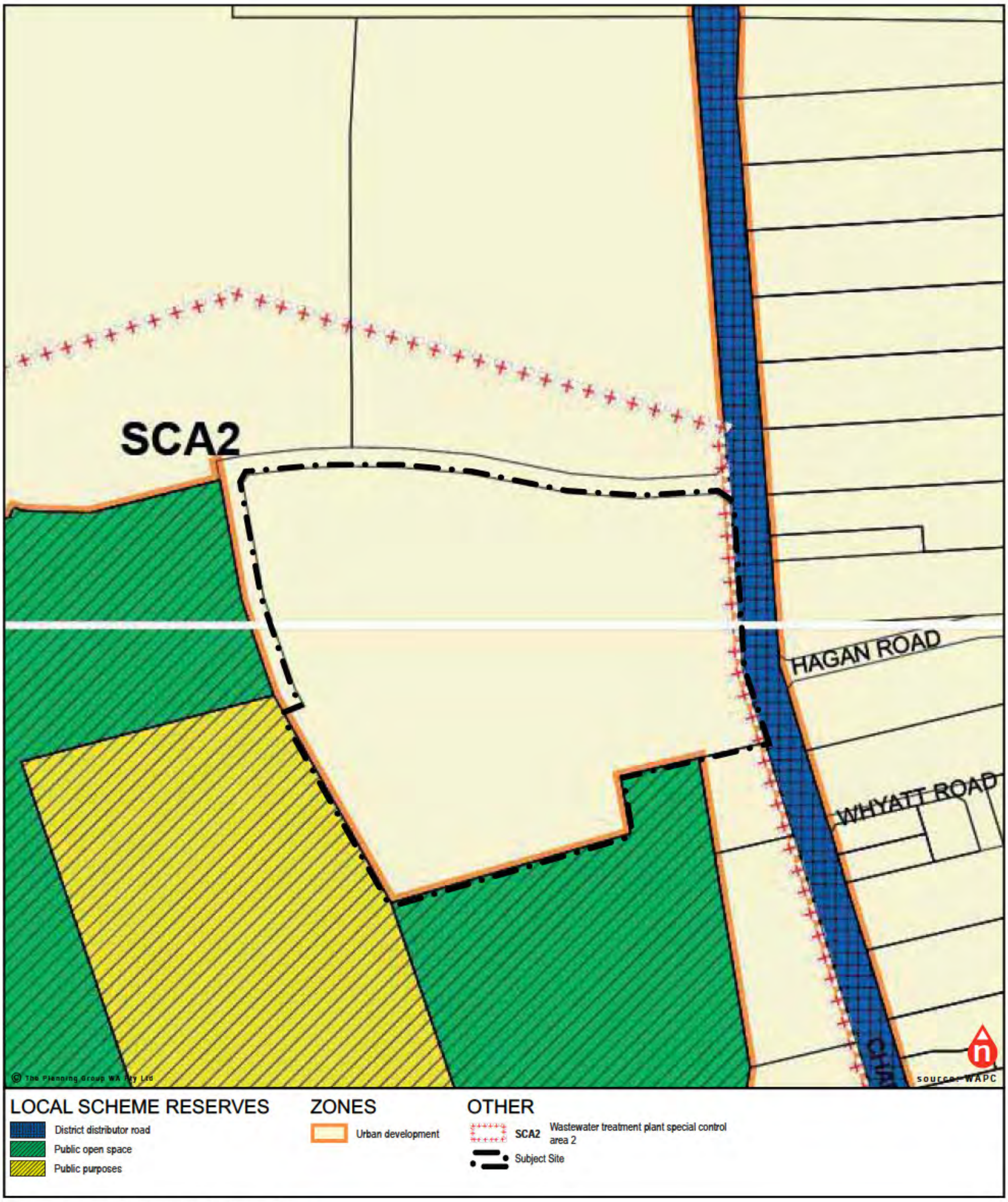

Figure 5. Local Planning Scheme No. 1

Special Control Area 2 – Waste Water Treatment Plant

Pursuant to Schedule 6 – Special Control Areas of LPS1, the ACP area is also identified as being within a Special Control Area 2 - Waste Water Treatment Plant (SCA2) area. The objectives of SCA2 are to:

a) *minimise land use conflict; and*

b) *provide for compatible and beneficial land uses within the buffer.*

Schedule 6 stipulates that in considering any application, the City shall have regard to:

a) *the Water Corporation's advice in relation to compatible and beneficial land uses for buffers; and*

b) *the potential odour impact of the wastewater treatment plant and whether the proposal is compatible with the existing and proposed future use of the plant.*

The potential odour impact in relation to SCA2 and the proposed Service Commercial zone are discussed in detail in Section 2.8 of this report.

1.3.2.2 City of Greater Geraldton Local Planning Strategy

The City of Greater Geraldton Local Planning Strategy (LPS) has been prepared to form the to strategic basis for the preparation of a local planning scheme. The Strategy is an effort to ensure that as the City grows, it keeps pace with not only the cultural development aspects of regional life, but continues to add the necessary vibrancy and uniqueness which will ensure residents continue to retain pride in the community and have a desire for continuous improvement.

Pursuant to the City's LPS, the ACP area is identified as being within the 'Geraldton Urban Area'

Specifically, LPS makes reference for Service Commercial areas within the Geraldton Urban Area which states:

"Service commercial areas capitalise on the movement economy, are predominately car-based and provide a transition between busy roads and industrial areas, adjoining residential and commercial areas. Service commercial areas are generally not appropriate within activity centres, being car based and therefore easily accessible from major traffic routes. Existing service commercial areas have developed adjacent to North West Coastal Highway. This form of development provides an important component of the Commercial Activity Centres Strategy accommodating a range of large format / bulky goods businesses".

This ACP adequately addresses the intent for Service Commercial areas, as identified above.

Furthermore, Part 5.3 of LPS also identifies three strategies for Commercial development within the Geraldton Urban Area. These strategies include:

1) establish a hierarchy of activity centres and areas where priority should be given for more intensification in close proximity to existing and planned services.
2) identify areas for mixed use adjacent to activity centres to strengthen the centre and provide a transition to adjoining residential areas.
3) recognise the role of large format retail as part of the commercial hierarchy.

In response to the strategies above, LPS identifies actions which address the above. The imposed actions include:

(i). The implementation land use planning recommendations from the Commercial Activity Centres Strategy.

(ii). Zone land in and around activity centres to ensure that they provide for residential, retail, commercial intensification and mixed use development as appropriate.

(iii). Restrict residential uses in Commercial zoned areas to retain the integrity of commercial areas.

(iv). Include a Service Commercial zone to primarily cater for bulky goods and showrooms.

The proposed land uses which form part of this ACP adequate address the actions above, with specific reference made to the Service Commercial zone which is to primarily cater for bulky goods and showrooms.

1.3.2.3 City of Greater Geraldton Commercial Activity Centres Strategy

The City's Commercial Activity Centres Strategy (CACS) provides a detailed planning framework to guide the future growth and location of future activity centres throughout the City.

CACS identifies the ACP area as being within the frame ‘District Centre’ which is defined as “multipurpose centres that provide a diversity of uses. They share some characteristics with the regional centre but serve smaller sub- regional catchments. They offer a range of essential services, facilities and employment opportunities to support their sub-regional catchments. They perform an important role in the City’s economy”.

The typical retail types within the District Centre, as identified under CACS, include, but are not limited to ‘Discount Department Stores’, ‘Supermarkets’, ‘Convenience Goods’, ‘Small/Medium Scale comparison Shopping’, ‘Some Speciality Shops’ and ‘Personal Services’.

Notwithstanding, Part 9.2.1 of CACS stipulates that retail land uses should be concentrated in centres in a compact urban form and that lower intensity uses such as showrooms should be located outside the core of activity centres.

Pursuant to Part 9.2.11 of CACS, bulky goods retailing is generally considered to be unsuited to the walkable catchment or the core of activity centres given their size and car-parking requirements, low employment densities and need for freight vehicle access.

CACS identifies bulky goods to be displayed and sold from retail showrooms that typically comprise extensive display and storage areas with direct vehicle access and car parking. Notwithstanding, bulky goods retailing does not include the sale of food, clothing or personal effects goods.

CACS indicates that the City is to promote clusters of bulky goods retail adjacent to, or in close proximity to activity centres and the regional road and public transport networks. This should maximise the use of infrastructure, including the shared use of car parking; limit the number of car trips; and economically support other activity centre business.

The encroachment of bulky goods retail into residential zones should be avoided and development in an ad-hoc manner or as ribbon development along regional roads is discouraged. Bulky goods retail should be developed with access and urban design controls so as not to interfere with traffic flow and safety, or detract from the amenity of public transport or the locality.

CACS identifies that bulky goods retail are preferably to be located:

a) *Edge-of-centre sites integrated with, but not within, the walkable catchment or core activity centre precincts;*

b) *Where it is demonstrated that sufficient suitable sites in or adjacent to activity centres are not available, out-of-centre mixed business or equivalent zones integrated with established and well- located bulky-goods nodes; and*

c) *In limited circumstances where it is demonstrated that sufficient suitable sites in or adjacent to activity centres or within or integrated with existing bulky-goods nodes are not available, other out-of centre mixed business or equivalent zones.*

The proposed land uses which form part of this ACP are considered adequately address and meet the objectives of 9.2.11. As such, bulky goods land uses are considered to be appropriate land uses over the ACP area on the basis that:

- The ACP will promote bulky goods showroom uses outside the core of the Glenfield District Centre;
- The ACP will promote a cluster of bulky goods adjacent to the district centre to promote shared trade while not impacting on the walkability of the District Centre itself;
- The ACP will accommodate larger format retail uses with higher car parking demand that are not suitable to be located within the District Centre;
- This ACP proposes land uses which comprises extensive display and storage areas with direct vehicular access and car parking and does not include the sales of food, clothing or personal effects goods;
- The ACP area has direct access to the regional road, and is in close proximity to the Glenfield District Activity Centre;
- The ACP area does not encroach on any existing or proposed residential development areas; and
- The ACP area is able to be adequately serviced from a traffic and servicing point of view.

1.3.2.4 Local Biodiversity Strategy

The City of Greater Geraldton and the Shire of Chapman Valley has prepared the Local Biodiversity Strategy (LBS) to provide a process for assessing the ecological significance of local natural areas.

The LBS is based on the following goals:

1. **Retention** - Retain natural areas. Aim to retain at least 3334ha of the remaining 6041ha of natural areas remaining.
2. **Protection** - Protect natural areas and specific biodiversity features, targeting at least 5% of the original extent of natural areas, leading to the protection of an additional 1058ha of areas of conservation value.
3. **Management** - Manage protected natural areas for conservation. Active management of 100% of LGA natural areas of conservation value.
4. **Engagement** – Increased community contributions to biodiversity conservation. Decrease in behaviours identified as threats to biodiversity values.
5. **Regeneration** - Ensure the rate of regeneration exceeds the rate of degradation. E.g. restore more than 1500 ha of natural areas in CGG.

Given that the ACP area comprises existing vegetation, the goals of the LBS are applicable to this ACP.

Notwithstanding, this ACP adequately addresses the goals above and is discussed in detail in section 2.1 of this report.

1.3.3 Planning Policies

1.3.3.1 State Planning Policy 4.2 – Activity Centres for Perth and Peel (WAPC)

State Planning Policy 4.2 – Activity Centres for Perth and Peel (SPP4.2) establishes the hierarchy for activity centres within the Perth and Peel region, as well as identifying planning and development requirements for new and existing activity centres in Perth and Peel and supersedes the WAPC's Metropolitan Centres Policy.

The policy defines activity centres as:

'Activity centres are communal focal points. They include activities such as commercial, retail, higher density housing, entertainment, tourism, civic/community, higher education and medical services. Activity centres vary in size and diversity and are designed to be well serviced by public transport.'

Activity centres are identified as priority locations for employment generating activities of various types, which should contribute to achieving employment self-sufficiency targets outlined in Directions 2031 for the sub-regions.

The policy defines a hierarchy of centres with the objectives to:

- Distribute activity centres to meet different levels of community need and enable employment, goods and services to be accessed efficiently and equitably by the community.
- Apply the activity centre hierarchy as part of a long term and integrated approach by public authorities and private stakeholders to the development of economic and social infrastructure.

Whilst the provisions of SPP 4.2 applies to the Perth and Peel region, the local planning framework identifies the ACP area as being located in a 'District Centre'. In this regard, the principles and characteristics of activity centres prescribed by SPP 4.2 has influenced and guided the preparation of this ACP.

Pursuant to SPP 4.2, a District Centre is to *"have a greater focus on servicing the daily and weekly needs of residents. Their relatively smaller scale catchment enables them to have a greater local community focus and provide services, facilities and job opportunities that reflect the particular needs of their catchments".*

This ACP contributes to the objective of the District Centre by creating employment and providing the provision of goods and services to the local and greater community.

1.3.3.2 Liveable Neighbourhoods

Liveable Neighbourhoods is an operational policy, adopted by the WAPC, and establishes guidelines for the design and assessment of new structure plans and subdivisions. Liveable Neighbourhoods Element 7 addresses Activity Centres and Employment. The following summarises the relevant provisions in relation to the ACP:

- Large format bulky goods should be located in close proximity to transit corridors, on the fringe of activity corridors, or in areas which have accessibility to the regional road network.

The general intent and objectives of Liveable Neighbourhoods is considered relevant in terms of addressing such elements as connectivity and walkability, urban water management and utilities. Furthermore, a detailed description of the design rationale for the ACP is provided in Section 4 of this ACP report.

2. Site Considerations and Constraints

The following section outlines the existing physical site conditions which have been taken into account during the preparation of the ACP.

2.1 Natural Area Assets and Biodiversity

2.1.1 Topography

The ACP area is located on the northern extent of the Swan Coastal Plain, which forms the central portion of the Perth Basin.

The ACP area is defined by variable topography ranging from approximately 4 metres Australian Height Datum (mAHD) along the eastern boundary to a maximum height of approximately 22m AHD on the central dune ridge, which extends in a north-south direction.

As the topography of the ACP area ranges by approximately 18 metres, alterations to the existing contour levels are required to accommodate future development. This ACP proposes to level and manage the existing topography to various levels through the provision of excavation and hard landscaping, as illustrated in Figure 11. The alteration to the existing topography will allow the ACP area to be useable for those intended land uses as part of this ACP.

Refer to Appendix B – Environmental Assessment and Management Strategy

2.1.2 Flora and Vegetation

The EPA's objectives for flora and vegetation is to maintain representation, diversity, viability and ecological function at the species, population and community level'.

Further to the above objective,. the potential sources of impact to native vegetation within the ACP area from future development includes:

- clearing of approximately 11.4 ha of vegetation will directly reduce the extent of vegetation communities, and may disturb conservation significant flora species or ecological communities;
- vehicle movements during construction and earthworks have the potential to create dust which may smother vegetation and introduce and spread exotic species leading to degradation of vegetation condition; and
- on-site ignition sources that could result in increased fire frequency/intensity that may favour the establishment of weeds and prevent the regeneration of adjacent native vegetation.

The Geraldton Regional Flora and Vegetation Survey (GRFVS) describes broad scale vegetation types within a broad study

The BRFVS identifies that the ACP area occurs within the Geraldton Sandplains Interim Biogeographical Regionalisation for Australia (IBRA) sub-region. This sub-region is dominated by endemic rich, proteaceous scrub heaths on sandy earths of extensive, undulating and lateritic sandplains. The subregion also consists of sand heaths with emergent *Banksia* and *Callitris*, *Eucalyptus loxophleba* woodlands on alluvial plains, proteaceous heath and *Acacia* scrubs on limestone and low closed shrubland of *Acacia rostellifera* on alluvial plains of the Greenough and Irwin Rivers.

Vegetation in the vicinity of the ACP area falls within vegetation types that are described as Acacia *rostellifera* shrublands on coastal and near coastal areas as well as drainage lines dominated by Eucalyptus *camaldulensis* subsp. *obtusa*, *Casuarina obesa* and *Melaleuca rhaphiophylla.*

Based on a preliminary Flora and Vegetation Site Assessment undertaken by Strategen, vegetation within the ACP area is made up of the following communities:

- **S1:** Low open shrubland of Acacia rostellifera, Stylobasium spathulatum and *Lycium ferocissimum over Rhagodia baccata, Ptilotus divaricatus subsp. divaricatus, Threlkeldia diffusa, Acanthocarpus preissii and *Sonchus oleraceus on low backdunes;
- **S2:** Degraded Mid open shrubland of Acacia rostellifera and *Lycium ferocissimum over Enchylaena tomentosa and *Avena barbata on gravel and sandy soils between backdunes and drainage lines; and
- **C:** Cleared areas.

Following the Flora and Vegetation Site Assessment, there is no record of any threatened or priority flora species within the ACP area.

Furthermore, the condition of vegetation within the ACP area ranges from “Good” to “Completely Degraded”. Approximately 3.58% of the ACP was mapped to be in “Good” condition, 89.76% in “Good-Degraded” condition, and 6.66% in “Completely Degraded” condition. However, the majority of remnant vegetation within the broader Geraldton area, in particular the area covered by the Geraldton Regional Flora and Vegetation Survey (GRFVS) is threatened by development, weed invasion, grazing, fire or recreational use,

It is considered that areas of vegetation being in “Good” condition are also identified as having a significant level of weed cover, including African boxthorn which will continue to spread and degrade the condition of vegetation over time.

Having due regard the potential for weed cover to grow, and that there are no threatened or priority flora species identified on the ACP area, future development as part of this ACP is not considered to have a detrimental impact on the representativeness and viability of the existing vegetation. As such, it is development as part of this ACO is considered to be acceptable, where appropriate to the satisfaction of the City.

Notwithstanding, in accordance with the City’s Local Biodiversity Strategy, it is intended to encourage the retention of ‘Good’ vegetation where possible within car parking and or landscaping areas. It may also be possible to transplant specific stands of vegetation to landscaping areas following earthworks and constructions activities.

Refer to Appendix B – Environmental Assessment and Management Strategy

2.1.3 Fauna

The EPA’s objective for fauna is ”*to maintain representation, diversity, viability and ecological function at the species, population and assemblage level*”.

The following table lists the significant fauna identified during the database searches.

Table 3 – Significant Fauna

Species		Conservation code	
Common name	Scientific name	EPBC Act	WC Act
Carnaby’s cockatoo	Calyptorhynchus latirostris	Endangered	S1
Malleefowl	Leipoa ocellata	Vulnerable	S1
Southern giant petrel	Macronectes giganteus	Endangered/ Migratory	S2
Northern giant petrel	Macronectes halli	Vulnerable/ Migratory	S3
Shy Albatross	Thalassarche cauta cauta	Vulnerable/ Migratory	S3
Fork-tailed swift	Apus pacificus	Migratory	S3
Great egret	Ardrea alba	Migratory	S3
Cattle egret	Ardrea ibis	Migratory	S3
White bellied sea-eagle	Haliaeetus leaucogaster	Migratory	S3
Rainbow bee-eater	Merops ornatus	Migratory	S3
Caspian tern	Sterna caspia	Migratory	S3

Notwithstanding, the potential sources of impact to native terrestrial fauna and associated habitat within the Site include:

- clearing of vegetation will directly disturb fauna habitat through destruction, degradation and/ or fragmentation and may result in the loss of individual terrestrial fauna
- vehicle movements may result in the injury or fatality of individual terrestrial fauna, especially less-mobile species
- human activities have the potential to increase the presence of introduced predator species (e.g. foxes and cats) which has the potential to result in increased rates of predation of native fauna species as well
- construction infrastructure and machinery have the potential to disturb fauna through noise, vibrations and light spill.

Given the highly degraded nature of the ACP area, the presence of feral predatory species and absence of proteaceous and myrtaceous species utilised by Carnaby's cockatoos for foraging, roosting and breeding, it is considered unlikely that Carnaby's cockatoo or malleefowl inhabit the ACP area.

The fauna habitat investigations relevant to the ACP area identified that:

- no habitat for conservation significant terrestrial fauna species is present ;
- no vascular plant species listed as being utilised by Carnaby's cockatoos were recorded;
- no signs of malleefowl mounds or Rainbow bee-eater burrows were observed; and
- feral animals were abundant.

With regard to the above, it is considered that future development as part of this ACP is in line with the EPA objective for fauna.

Refer to Appendix B – Environmental Assessment and Management Strategy

2.1.4 Biodiversity

The ACP area comprises natural areas and a variety of life forms, as discussed in Section 2.1.1 and 2.1.2 above. As such, the existing biodiversity is notably recognised as contributing to the natural ecological processes within the local area.

As mentioned in Section 1.3.3.4, the LBS recommend the following goals, as a strategic vision, which is applicable to the ACP area:

1. **Retention** - Retain natural areas. Aim to retain at least 3334ha of the remaining 6041ha of natural areas remaining.
2. **Protection** - Protect natural areas and specific biodiversity features, targeting at least 5% of the original extent of natural areas, leading to the protection of an additional 1058ha of areas of conservation value.
3. **Management** - Manage protected natural areas for conservation. Active management of 100% of LGA natural areas of conservation value.
4. **Engagement** - Increased community contributions to biodiversity conservation. Decrease in behaviours identified as threats to biodiversity values.
5. **Regeneration** - Ensure the rate of regeneration exceeds the rate of degradation. E.g. restore more than 1500 ha of natural areas in CGG.

The proposed ACP is considered to adequately address the goals above on the basis of the following:

- Existing vegetation is to be retained throughout the ACP, predominately along the western and southern periphery, and is to be integrated into any proposed landscaping including car parking and pedestrian networks;
- The ACP area does not comprise any vegetation identified to have specific biodiversity features;
- The ACP area does not contain any protected natural areas;
- The ACP area is to comprise soft landscaping which is considered to contribute to the biological processes of the local area; and
- Vegetation is proposed to be planted throughout the ACP area, where appropriate.

2.2 Landforms and Soils

2.2.1 Soils

The Perth Basin is sedimentary in origin and is marginal to the west of the Australian Shield.

The ACP area is within the coastal system comprising undulating Holocene shoreline deposits (Quindalup Dune System) underlain by the older Pleistocene consolidated dune system of the Tamala Limestone (Spearwood Dune System), comprising the following four soil types:

1. Quindalup Central Stable Parabolic Dune – this soil association is found across the majority of the ACP area and is described as a large scale parabolic dune with relief 20 metres to 40 metres on Aeolian calcareous sands and minor limestone in the north coastal plain. It is generally calcareous, deep sand;
2. Quindalup Central Swale – this soil association is found within the north-western portion of the ACP area and is described as gently undulating plains surrounded by parabolic dunes on Aeolian

calcareous sands and minor limestone in the north coastal plain. It is also comprised of calcareous, deep sand;

3. Tamala South Grey-Brown Sand – this soil association is found in the north-eastern portion of the ACP area, adjacent to Chapman Road, and is described as mid to lower slopes of Tamala limestone ridges and some isolated rises on Lithified Pleistocene calcareous dune deposits and recent calcareous sands. It is generally calcareous, deep and shallow sands; and
4. Tamala South Red Sand – this soil association is found within the south-eastern portion of the ACP area, adjacent to Chapman Road and described as lower lying and swale areas on Lithified Pleistocene calcareous dune deposits and recent calcareous sands. It is generally considered to consist of deep, red sand.

Refer to Appendix B – Environmental Assessment and Management Strategy

2.2.2 Microclimate

The ACP area is influenced by a dry warm Mediterranean climate regime, experiencing hot, dry summers and mild, wet winters with an average of 446 mm/year rainfall and on average six months with less than 20 mm rainfall each year.

The wind pattern within the region is largely a result of the land-sea interface which results in easterly land breezes in the morning, followed up by south to south-westerly sea breezes in the late morning to afternoon in the warmer months. During the winter months, wind patterns are most commonly influenced by cold fronts moving east over the land mass from the Indian Ocean.

Refer to Appendix B – Environmental Assessment and Management Strategy

2.2.3 Acid Sulphate Soils (ASS)

An environmental assessment prepared by Stratagen indicates that the majority of the ACP area is not identified as having a risk of Acid Sulphate Soils within three metres of the soil surface. However, a narrow portion of the eastern boundary of the ACP area is identified as having a high to moderate risk of Acid Sulphate Soils occurring within three meters of the soils surface. A field inspection conducted using the indicators for Acid Sulphate Soils, as outlined in the Department of Environment and Conservation's Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes, indicates no signs of Acid Sulphate Soils.

An Urban Water Management Plan (UWMP) is required at the Development Application Stage to meet the requirements of the City of Greater Geraldton and the 'Better Urban Water Management (2008)' process. This plan will include an acid sulphate soils investigation.

Refer to Appendix B – Environmental Assessment and Management Strategy

2.3 Groundwater and Surface Water

2.3.1 Groundwater

The ACP area is located within the Arrowsmith Groundwater Area and the Dongara Subarea. Groundwater within the Dongara sub area ranges between two and 15 meters below ground level, with the majority of recharge derived from rainfall and surface runoff. Groundwater generally flows in a westerly direction and discharges into the Indian Ocean via a seawater interface. Overall, groundwater is expected to be shallower in the eastern portion of the ACP area.

A search of the Water Register indicates that groundwater is available for allocation in the superficial aquifer in the area.

The ACP area is not located within a Public Drinking Water Source Area (PDWSA).

Refer to Appendix B – Environmental Assessment and Management Strategy

2.3.2 Surface Water and Hydrology

An Environmental Assessment and Management Strategy (EAMS) provided in Appendix B identifies that there are no permanent surface water features on land within the ACP area.

The nearby surface water features include Buller River, being located approximately six kilometres north of the ACP area, Dolby Creek, a tributary of Buller River, being located approximately three kilometres north of the ACP area, and a blind creek system which extends south from

Dolby Creek and ceased approximately 250 metres north of the ACP area.

The land directly to the north contains an ephemeral surface water feature locally known as "Rum Jungle". Rum Jungle is a naturally formed alluvial flat which is a palusplain, maintained by rainfall and drainage from Dolby Creek to the north of the Site and seepage from coastal dunes.

During the 1 in100 year ARI event, floodwaters from Dolby Creek enter Rum Jungle and are anticipated to result in limited inundation in the north-eastern corner of the ACP area.

The EAMS also indicates that development over the ACP area has the potential to negatively impact upon groundwater quality though infiltration of stormwater that may contain pollutants such as nutrients and hydrocarbons. Notwithstanding, the development of the ACP area may result in limited increases in winter groundwater levels due to reduced evaporation and increased runoff from hard surfaces.

A Local Water Management Strategy (LWMS) was prepared be AECOM in 2014 for the Glenfield District Activity Centre and was approved by the City of Greater Geraldton. The City has confirmed that the same principals of the approved LWMS to on site stormwater management will apply to Lot 55 Chapman Road. The specific principles in the AECOM LWMS for the 1 year, 5 year and 100 year ARI events are outlined below.

1 Year AYI

- To retain and treat on site the 1 hour duration 1 year ARI event, rooves to be connected to soak wells and where appropriate, to rainwater tanks.
- All stormwater will be contained within each lot prior to discharge/ infiltration to groundwater.
- Road runoff will be infiltrated as close to source as practical using water sensitive urban design (WSUD) measures including roadside swales.

5 Year AYI

- Road runoff will be infiltrated as close to source as practical using water sensitive urban design (WSUD) measures including roadside swales/ bioretention structures draining into flood storage areas adjacent to public open space (POS).
- Bioretention structures will treat and infiltrate stormwater using vegetation and biofiltration media to improve water quality prior to release to the environment.
- Flood storage will be within unfenced landscaped shallow sized basins with sand filters.

100 year AYI

- Provide via overland flow paths to enable conveyance of runoff to infiltration basins.
- Flood storage areas (infiltration basins) will be unfenced, landscaped, shallow sided basins with sand filters.

The AECOM LWMS indicated that a conservative infiltration rate for the site to the north was 15m/ day and given the topography and geology of Lot 55 Chapman Road is similar this rate of infiltration could be assumed to apply.

The City of Greater Geraldton has confirmed that for commercial and industrial developments, the minor storms are required to be stored and infiltrated on site with the major events to overland flow into the council system.

With regard to the above, an Urban Water Management Plan (UWMP) is to be prepared at the Development Application Stage to detail stormwater treatment measures and to meet the requirements of the City of Greater Geraldton and the 'Better Urban Water Management (2008)' process. The collection of at least 6 months (potentially up to 12 months) of groundwater monitoring data including a winter peak as well as an Acid Sulfate Soils investigation will be required to support the UWMP.

Refer to Appendix B – Environmental Assessment and Management Strategy

2.4 Bushfire Hazard

A desktop search of the Western Australia State Map of Bush Fire Prone Areas identifies that the ACP area is not located within a designated bushfire prone area.

2.5 Heritage

No known Aboriginal or European heritage sites are present within the ACP area. Construction activities have the potential to unearth or identify Aboriginal artefacts.

Refer to Appendix B – Environmental Assessment and Management Strategy

2.6 Coast and Foreshores

The ACP area is located in excess of 300 metres east of the horizontal shoreline datum of the coast, and thus *State Planning Policy No. 2.6 State Coastal Planning Policy* (SPP 2.6) is not applicable.

Refer to Appendix B – Environmental Assessment and Management Strategy

2.7 Contaminated Sites

A review of the Department of Environment Regulation (DER) Contaminated Sites Database indicates that there are no known contaminated sites within 1 km of the ACP area.

The ACP area is vacant bushland and is considered to represent a low risk of contamination. Limited unauthorised dumping ('fly tipping') has occurred adjacent to tracks within the ACP area.

Material illegally dumped on the ACP area will be removed and disposed of to an appropriate landfill prior to construction.

The development is not expected to pose an unacceptable risk of contamination to the surrounding environment.

Refer to Appendix B – Environmental Assessment and Management Strategy

2.8 Odour

The ACP area is located within the GNWWTP odour buffer, identified under LPS1 as SCA 2. The purpose of the SCA 2 is to provide separation between the GNWWTP and the potential impact of odour from sensitive land uses.

Notwithstanding, the EPA objectives relevant to air quality and amenity are:

- to maintain air quality for the protection of the environment and human health and amenity, and to minimise the emission of greenhouse and other atmospheric gases through the application of best practice
- to ensure that impacts to amenity are reduced as low as reasonably practical.

A desktop assessment carried out by Strategen identified that it is possible for odour emissions from the GNWWTP to reach the ACP area, and has the potential to impact on the amenity for persons working within or visiting future development over the ACP area. In view of this, field assessments were undertaken to determine the potential impact of odour from GNWWTP on the ACP area.

Consultation was undertaken with Water Corporation as part of the assessment. Water Corporation confirmed that high rainfall events can destabilise the aerobic conditions in the ponds and generate increased odour emissions for up to two weeks after the rain has ceased. Anecdotal evidence from Water Corporation indicates that those impacts could extend outside a buffer zone defined by the 5 OU criteria. This suggests that these events and any other atypical (upset) conditions provide the greatest potential for odour impacts at the ACP area. However, as this scenario is considered to occur on a low frequency, such upset events reduces the risks of atypical odour emission events from impacting the ACP area. On this basis, the proposed future non-sensitive land use development at the ACP area would not be precluded.

Overall, the field observations and wind direction frequency analysis indicated a low probability of odour impacts at the ACP area from normal operation of the GNWWTP. Furthermore, the levels of odours detected at the ACP area are predicted to be well below Water Corporation's 5 OU criterion requirement for establishment of buffer zones around WWTPs (Figure 6). The Water Corporation criterion is set for a 1 hour average, which means higher concentrations can be considered appropriate for short duration impacts as observed from the field observations.

The compatibility for potential land uses and the odour buffer associated with this ACP are addressed in Section 4.4 of this report.

Refer to Appendix B – Environmental Assessment and Management Strategy

2.9 Unexploded Ordnances (UXO)

A desktop search of the Register of Known or Suspected UXO Contaminates Sites in WA indicates that the ACP area is located within an area identified as a former WWII military training area, WA UXO Register N 91 ‘Smuggler’s Cove’. This former range area has been identified by FESA as one of the most used anti-tank, artillery and mortar training areas in the Geraldton region during WWII.

Notwithstanding, UXO or explosive ordnance fragments / components have not been recovered from the ACP area.

It is recommended that further UXO surveys be undertaken prior to development within the ACP area.

Refer to Appendix A – Servicing Opportunities and Constraints Report

Figure 6. Odour Distances from WWTP

3. Economic and Social Context

3.1 Complementary Centres

The Retail Needs Analysis in Appendix D identifies that the ACP area is anticipated to precede the development of Lot 9000 directly to the North. Lot 9000 is designated as a District Centre within the City's Activity Centre Strategy and is likely to contain more traditional retail uses with a small contingent of bulky goods. In the retail sphere, this trend of co-locating bulky goods with traditional retail uses is becoming more and more prevalent for large format retail developments. The approach offers more flexibility for developers in allowing traditionally narrowly focused large format retailing to offer a range of different services. The co-location with the district centre is expected to offer many benefits:

- The district centre is expected to include a supermarket; this will act as an anchor of sorts that attracts users and reinforces habit forming behaviours. As such, the supermarket will assist in attracting and retaining customers which in turn will increase dwell time in the centre and increases opportunistic shopping and potential spend.
- Bulky goods typically operate predominantly as weekend traders, by introducing diversity and traditional retail to the mix of uses, the precinct will allow for more 'round the clock activation. This in turn promotes habit forming behaviours, higher foot traffic and improves the attractiveness of the centre which can result in a much higher potential spend due to increased exposure.
- The co-location allows the development to be represented as a full line shopping destination (with all the associated benefits) while retaining its own identity as a bulky goods centre.
- These benefits are likely to assist in the ability to attract and retain higher quality retailers that can attract a wider catchment and bring greater value to the ACP area.

Refer to Appendix D – Retail Needs Analysis

3.2 District Centre Catchment Demographics

As a major regional town, Geraldton is expected to service a significant portion of the Midwest. Therefore, it is expected that consumers are likely to travel larger distances for their bulky goods needs.

The primary catchment includes approximately 80% of all dwellings in the main trade area and includes the major residential area of Geraldton. The primary catchment stretches approximately 20km to the north of the ACP area and approximately 50km east and south. The secondary catchment surrounds the primary catchment, and includes residents that reside up to 100km from ACP area.

A Retail Analysis prepared by Pracsys has identified that significant growth is expected to be concentrated in the northern corridor. As such, it is expected that retail demand will naturally gravitate toward nodes such as the Glenfield District Activity Centre.

The Glenfield District Activity Centre Plan is of particular interest to this ACP as it is anticipated that the Glenfield District Activity Centre area will have up to 100 dwellings.

The co-location with the Glenfield District Activity Centre to the north is expected to promote longer dwell times and weekly activation, which will facilitate the potential to attract more customers.

Refer to Appendix D – Retail Needs Analysis

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4. Land Use and Subdivision Requirements

An overall conceptual development plan has been prepared for the Lot 55 Chapman Road, Glenfield to assist in outlining a vision for development within the ACP area. Figure 7 – Indicative Development Concept provides an illustration sketch of the vision for the Precinct.

4.1 Design Rationale and Objectives

This ACP has been prepared to demonstrate the intended development pattern for the ACP area, as indicated in the Commercial Activity Centres Strategy as a 'District Centre'. The objectives of this ACP are based on the following principles:

- Co-location of bulky goods showrooms and ancillary commercial along a regional road network;
- Orientate and position development to respond to the surrounding environment;
- Creation of employment and job opportunities for the local population;
- To service the developing northern corridor of Geraldton with showroom development;
- Orientate development to take advantage of the Glenfield District Activity Centre to the north;
- Provide for logical connections of pathways and road access; and
- Ensure that appropriate buffers are identified to avoid conflict between sensitive land uses.

4.2 Activity Centre Principles

While the ACP area is not specifically identified as an activity centre within SPP4.2, the ACP area is identified as being within a District Centre pursuant to the City of Greater Geraldton Commercial Activity Centres Strategy. In this regard, this ACP is to take into account the relevant planning principles set out in State planning Policy 4.2 Activity Centres for Perth and Peel, and Liveable Neighbourhoods (Element 7 – Activity Centres).

The vision for this Activity Centre Plan is based on the following objectives:

- Distribute activity centres to meet different levels of community need and enable employment, goods and services to be accessed efficiently and equitably by the community;
- Apply the activity centre hierarchy as part of a long-term and integrated approach by public authorities and private stakeholders to the development of economic and social infrastructure;
- Plan activity centres to support a wide range of retail and commercial premises and promote a competitive retail and commercial market;
- Increase the range of employment in activity centres and contribute to the achievement of sub-regional employment self-sufficiency targets;
- Increase the density and diversity of housing in and around activity centres to improve land efficiency, housing variety and support centre facilities;
- Ensure activity centres provide sufficient development intensity and land use mix to support high-frequency public transport;
- Maximise access to activity centres by walking, cycling and public transport while reducing private car trips;

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Figure 7. Indicative Development Concept

SITE SUMMARY	
SITE AREA	12.2397ha
Bulky Goods Showroom	32,040m² GFA
Service Station	120m² GFA
Liquor Store	1,500m² GFA
TOTAL GFA	33,660m² GFA
TOTAL BAYS REQUIRED	719 bays
TOTAL BAYS PROVIDED	1323 bays

CITY OF GREATER GERALDTON PARKING REQ.	
Bulky Goods Showroom	1 bay per 50m² GFA
Service Station	1 bay per 50m² GFA
Liquor Store	1 bay per 20m² GFA

LOT SUMMARY	
LOT 1	
LOT AREA	0.3564ha
Bulky Goods Showroom	240m² GFA
Service Station	120m² GFA
TOTAL GFA	360m² GFA
TOTAL BAYS REQUIRED	8 bays
TOTAL BAYS PROVIDED	57 bays
LOT 2	
LOT AREA	3.9819ha
Bulky Goods Showroom	8,300m² GFA
TOTAL GFA	8,300m² GFA
TOTAL BAYS REQUIRED	166 bays
TOTAL BAYS PROVIDED	400 bays
LOT 3	
LOT AREA	7.3093ha
Bulky Goods Showroom	23,500m² GFA
TOTAL GFA	23,500m² GFA
TOTAL BAYS REQUIRED	470 bays
TOTAL BAYS PROVIDED	746 bays
LOT 4	
LOT AREA	0.6972ha
Liquor Store	1,500m² GFA
TOTAL GFA	1,500m² GFA
TOTAL BAYS REQUIRED	75 bays
TOTAL BAYS PROVIDED	120 bays

LEGEND

- Site Boundary
- Existing Cadastre
- Existing Contours (2m)
- Indicative Retaining Wall Location
- Vegetation Screening
- Proposed Lot Boundary
- SH Bulky Goods Showroom
- LQ Liquor Store
- SS Service Station
- Pedestrian Route
- Parking Bays
- Road

- Plan activity centre development around a legible street network and quality public spaces; and
- Concentrate activities, particularly those that generate high numbers of trips, within activity centres.

4.3 Staging and Subdivision

The development of the Activity Centre Plan area is proposed to be implemented in stages due to the size of the Activity Centre Plan area and the commercial nature of the future land uses. The staging in terms of timing and composition will be dependent upon a number of factors including market demand and servicing and infrastructure considerations.

Staging of road connections and accessways is permitted with new public roads to be extended as required to service staged development.

The concept plan that has been prepared to inform this ACP is predicated on a four-lot subdivision, however this is indicative only, and the ultimate subdivision may yield more or less lots. A minimum lot size of 2,500 m^2 is proposed for lots within the ACP area, which is considered the minimum lot size required to support the type of land use and development envisaged for the ACP area.

4.4 Land Use

LPS 1 stipulates that development and use of land within the 'Urban Development' zone is to be in accordance with the ACP.

Part 1 of this ACP states that the land use permissibility within the ACP area shall be in accordance with the zones and reserves designated under the ACP as if the zones and reserves were incorporated into the Scheme.

This ACP designates a 'Service Commercial' zone over the ACP area. The ACP, once adopted, will facilitate the development of primarily "Bulky Goods Showroom', supported by complementary land uses that are compatible with the Water Corporation WWTP buffer, as noted in Section 2.8.

Pursuant to LPS 1, a 'Bulky Goods Showroom' use is defined as a premises:

a) Used to sell by retail any of the goods and accessories of the following types that are principally used for domestic purposes:

    I. *automotive parts and accessories;*
    II. *camping, outdoor and recreation goods;*
    III. *electric light fittings;*
    IV. *animal supplies including equestrian and pet goods;*
    V. *floor and window coverings;*
    VI. *furniture, bedding, furnishings, fabrics, manchester and homewares;*
    VII. *household appliances, electrical goods and home entertainment goods;*
    VIII. *party supplies;*
    IX. *office equipment and supplies;*
    X. *babies' and children's goods, including play equipment and accessories;*
    XI. *sporting, cycling, leisure, fitness goods and accessories;*
    XII. *swimming pools*

or

b) used to sell by retail goods and accessories if:

    i. *a large area is required for the handling, display or storage of the goods; or*
    ii. *vehicular access is required for the premises for the purpose of collection of purchased goods.*

A Bulky Goods Showroom is a 'D' use in the Service Commercial zone pursuant to LPS 1. However, given that the ACP area is located within SCA1, the land use permissibility of a Bulky Goods Showroom use is to be determined by the City with regard to:

a) Water Corporation's advice in relation to compatible and beneficial land uses for buffer;
b) Water Corporation's Land Use Compatibility Matrix; and
c) The potential odour impact of the wastewater treatment plant and whether the proposal is compatible with the existing and proposed future use of the plant.

Consultation was previously undertaken with the Water Corporation who has confirmed that odour emissions has the potential to increase by up to two weeks after high rainfall events. This scenario is considered to occur on a low frequency basis. However. non-sensitive land uses such as Bulky Goods Showroom, which are typically located in industrial estates an areas of relatively constrained land, which also typically involve the employment of part time staff and attract customers who visit the premises for only short periods, is considered to be a compatible use within the odour buffer.

Furthermore, field observations and wind direction frequency analysis indicates a low probability of odour impacts at the ACP area from normal operation of the GNWWTP. The field observations indicated that the levels of odour detected on the ACP area are predicted to be well below Water Corporation's 5 OU criterion requirement for establishment of buffer zones around WWTPs (Figure 6). The Water Corporation criterion is set for a 1 hour average, which means higher concentrations can be considered appropriate for short duration impacts as observed from the field observations. In this instance, it is considered that there is provision for non-sensitive land uses to be established over the ACP area,, being zoned Service Commercial, as justified below.

Table 5 below is a list of potential land uses which are considered to be compatible, as assessed against Water Corporations' LUCM and compares this with the range of uses permissible within the Service Commercial zone of LPS 1.

Table 5 – Odour Buffer Land Use Permissibility Table

Table 5: Compatible Land Use Table – Service Commercial Zone			
Land Use	**Water Corporation Permissibility**	**LPS1 Permisibility**	**Proposed response within ACP Area**
Amusement Parlour	X	Use Not Listed	Not permitted within ACP Area.
Bulky Goods Showroom	Use Not Listed	D	Bulky goods showroom uses are typically large format land uses that are intended to be accommodated in areas on the periphery of an activity centre, such as the ACP location. A bulky goods showroom use is highly consistent with the objectives of the Service Commercial zone in that they often require large lots and good vehicular access. The intent of the Service Commercial zone is to accommodate wholesale sales, showrooms, trades and associated service uses. Bulky goods showroom uses are typically not sensitive to odour buffers as they can often accommodate their own odour generating uses such as supply of garden products and pet supplies, for instance. They are typically low employment generating land uses and with a majority of employees consisting of part time positions, meaning that employees will not be exposed to long periods of odour associated with the risk of intermittent odour associated with the WWTP. It is therefore considered appropriate that a Bulky Goods Showroom Use be listed as a discretionary use within the ACP area, with approval to be at the discretion of the relevant determining authority.
Car Park	P	D	Land use is compatible within Water Corporation buffer.
Child Care Premises	X	D	Not permitted within ACP area.
Civic Use	X	D	Not permitted within ACP area.
Club Premises	X	D	Not permitted within ACP area.
Convenience Store	X	D	Not permitted within ACP area.
Consulting Rooms	X	D	Not permitted within ACP area.
Community Purpose	X	D	Not permitted within ACP area.
Club Premises	X	D	Not permitted within ACP area.
Dry Cleaning Premises / Laundromat	Use Not Listed	D	I dry cleaning premises or laundromat is a low intensity and low employment generating land use that will generate low levels of customer patronage. It is a discretionary land use that is compatible with the objectives of the Service Commercial zone. On this basis, it is considered that a dry cleaning premises or laundromat is a land use that is compatible with the odour buffer associated with the WWTP.
Exhibition Centre	X	D	Not permitted within ACP area.
Fast Food Outlet	X	D	Not permitted within ACP area.

Table 5: Compatible Land Use Table – Service Commercial Zone			
Land Use	**Water Corporation Permissibility**	**LPS1 Permissibility**	**Proposed response within ACP Area**
Fuel Depot	P	X	Not permitted within ACP area.
Funeral Parlor	X	D	Not permitted within ACP area.
Garden Centre	Use Not Listed	D	It is considered that a Garden Centre is a compatible land use within the WWTP odour buffer as a Garden Centre typically generates its own low levels of odour as a result of storage of manure and soil improvers. It is therefore not likely that a Garden Centre operator or its customers would raise a complaint in relation to intermittent odour generated by the WWTP. It is considered that a Garden Centre is a use that is not sensitive to the intermittent odour generated by the WWTP and may be permitted at the discretion of the relevant determining authority.
Hotel	X	D	Not permitted within ACP area.
Industry – Light	D	D	This use is considered to be compatible with the odour buffer and land use and development will be at the discretion of the relevant decision making authority.
Industry - Service	D	Use Not Listed	This use is considered to be compatible with the odour buffer and land use and development will be at the discretion of the relevant decision making authority and is to be assessed as a 'use not listed'.
Liquor Store	Use Not Listed	A	As this is a non-food related retail use, involving the sale of bottled alcohol and other drinks to be consumed off-site, it is considered a compatible use with the odour buffer. Customers are unlikely to spend long within the ACP area and therefore there is limited risk of adverse exposure to the nuisance of odour generated intermittently by the WWTP. Approval will be at the discretion of the decision-making authority following advertising and referral of the application to the Water Corporation and other stakeholders.
Machinery Sales	Use Not Listed	D	A machinery sales use is typically a low employment generating land use with low volume of customers. Therefore any odour impacts generated by the WWTP are likely to have a minimal impact on the operation of a machinery sales use. It is also considered unlikely that a machinery sales operator or customers would raise formal complaints in relation to the intermittent odour generated by the WWTP. It is considered that a machinery sales use is a use that is not sensitive to the intermittent odour generated by the WWTP and may be permitted at the discretion of the relevant determining authority.
Market	X	D	Not permitted within ACP area.
Medical Centre	X	D	Not permitted within ACP area.
Motel	X	D	Not permitted within ACP area.
Motor Vehicle, Boat or Caravan Sales	X	D	A motor vehicle, boat or caravan sales use is typically a low employment generating land use with low volume of customers. Therefore any odour impacts generated by the WWTP are likely to have a minimal impact on the operation of a sales centre. It is also considered unlikely that a sales centre operator or customers would raise formal complaints in relation to the intermittent odour generated by the WWTP. It is considered that a motor vehicle, boat or caravan sales use is a use that is not sensitive to the intermittent odour generated by the WWTP and may be permitted at the discretion of the relevant determining authority.
Motor Vehicle Wash	P	D	This use is considered to be compatible with the odour buffer and land use and development will be at the discretion of the relevant decision making authority.
Motor Vehicle Repair	P	D	Land use is considered to be compatible with the odour buffer and may be permitted at the discretion of the relevant determining authority.

Table 5: Compatible Land Use Table – Service Commercial Zone			
Land Use	**Water Corporation Permissibility**	**LPS1 Permisibility**	**Proposed response within ACP Area**
Office	X	D	Not permitted within ACP area.
Place of Worship	X	A	Not permitted within ACP area.
Reception Centre	X	D	Not permitted within ACP area.
Recreation - Private	X	D	Not permitted within ACP area.
Restaurant / Cafe	X	D	Not permitted within ACP area.
Service Station	X	D	A service station use is considered to be compatible with the WWTP odour buffer as a Service Station use is a non-sensitive land use that generates its own odours in its immediate vicinity. Customers will not be exposed to potential odour issues for long periods, as they will arrive by car, fuel up pay and then leave shortly after. It is considered that a proposed service station is in accordance with the objectives of the Service Commercial zone, in that it requires good vehicular access and a comparatively large land area, will provide an important fueling service to passing trade associated with the Glenfield District Centre and is located away from existing residential areas.
Shop	X	D	Not permitted within ACP area.
Showroom	X	D	Permitted at the discretion of the determining authority. Refer to justification contained against 'Bulky Goods Showroom'.
Supermarket	Use Not Listed	D	Not permitted within ACP area.
Tavern	X	A	Not permitted within ACP area.
Telecommunications Infrastructure	P	D	Land use is considered to be compatible with the odour buffer and may be permitted at the discretion of the relevant determining authority.
Trade Supplies	Use Not Listed	D	Land use is considered to be similar in nature to Bulky Goods Showroom and Showroom and may be permitted at the discretion of the relevant determining authority for reasons provided in relation to 'Bulky Goods Showroom'.
Transport Depot	Use Not Listed	D	A Transport Depot involves the storage of vehicles and is a low employment generating warehouse and does not require access by the general public. It is therefore considered that a Transport Depot use is not sensitive to the WWTP odour buffer and may be permitted at the discretion of the relevant determining authority.
Veterinary Centre	D	D	A Veterinary Centre is typically a low employment generating land use with low volume of customers. Therefore any odour impacts generated by the WWTP are likely to have a minimal impact on the operation of a veterinary centre. It is also considered unlikely that a veterinary centre operator or customers would raise formal complaints in relation to the intermittent odour generated by the WWTP. It is considered that a Veterinary Centre is a use that is not sensitive to the intermittent odour generated by the WWTP and may be permitted at the discretion of the relevant determining authority.
Warehouse / Storage	P	D	A warehouse involves the storage of goods and is a low employment generating warehouse and does not require access by the general public. It is therefore considered that a warehouse is not a sensitive land use in relation to the WWTP buffer and may be permitted at the discretion of the relevant determining authority.

Refer to Appendix B – Environmental Assessment and Management Strategy

4.5 Bulky Goods Retail Needs Analysis

The Bulky Goods Retail Needs Analysis has been prepared by Pracsys to test the market potential for bulky goods development within the catchment of the ACP Area.

The analysis assumes that potentially 27,880 sqm of other retail floorspace could be accommodated within the ACP area.

The analysis estimated floor space supply and retail demand for the catchment of the ACP area. Based on this the future expenditure was calculated for bulky goods. Assuming completion of development over the ACP Area in 2018, the floor space productivity is estimated to be close to $3,100/m^2 before rising to $3,300/m^2 upon the forecast completion of development of Lot 9000 in 2020. This level of turnover in 2018 represents an acceptable and pro table trading level for a rural bulky goods development.

The positive impact that is expected when the district centre becomes operational further strengthens the case for the development due to their complimentary natures.

Refer to Appendix D – Retail Needs Analysis

4.6 Movement Networks

The movement of people and goods is essential to maintain a connected and accessible community. In this regard, it is important to develop a street network that not only provides access for vehicles and public transport, but also specifically aims to attract a high level of use by pedestrians, cyclists and the disabled.

Figure 8 below illustrates an indicative perspective of the type of road and footpath layout which is suggested to be developed within the ACP area.

A Transport Assessment (TA) was prepared by Transcore to analyse the existing and proposed road network, including the overall performance, in the context of the ACP.

Refer to Appendix C – Transport Assessment

4.6.1 Road Network

Vehicle access is provided to the ACP area via Sunset Boulevard to the north, and a 23m wide road reserve 'Road 1' centrally, through the site, as shown on Figure 11.

A proposed single lane roundabout at the intersection of Chapman Road, Hagan Road, and Road 1, is expected to operate satisfactorily during peak hours at the outset of the development and the year 2031.

The existing standard of Chapman Road is capable to accommodate the development traffic at the outset of the proposed development. Chapman Road is identified as Integrator B road in the short to medium term and in the long term, is proposed to be widened to two lanes in each direction, including an upgrade to an Integrator 'A' road.

The local road network also provides connection into the lot to the north to allow any future development of this site to utilise the local road connections proposed in this ACP.

All proposed roads are to be constructed to the satisfaction of the City of Greater Geraldton.

A Transport Assessment (TA) provided at Appendix C demonstrates that future subdivision and development over the ACP area is capable of accommodating future traffic volumes which will not prejudice future development of the Glenfield District Activity Centre to the north.

In addition, the objectives of the Service Commercial Zone as defined in the City's LPS1 provide that Service Commercial zones are to:

- *"accommodate commercial activities which, because of the nature of the business, require good vehicular access and/or large sites"; and*
- *"provide for a range of wholesale sales, showrooms, trade and services which, by reason of their scale, character, operational or land requirements, are not generally appropriate in, or cannot conveniently or economically be accommodated in, the central area, shops and offices or industrial zones".*

Figure 8. Indicative perspective of the landscaping incorporated into the existing ridge

Figure 9. Indicative perspective of the relationship between the road network and footpaths.

With regard to the above, this ACP and the proposed road network are considered to adequately address the intent and objectives of the Service Commercial zone pursuant to the Regulations.

4.6.2 Pedestrian Movement

In response to providing accessible pedestrian networks, this ACP proposes a network of shared paths and footpaths throughout the ACP area. Figure 9 below illustrates an indicative perspective of the relationship between the road network and footpaths.

The TA identifies that this network will provide accessibility and permeability for pedestrians and cyclists within the ACP area and facilitate connections to adjacent developments and the surrounding road network.

4.6.3 Public Transport

The ACP area is accessible by public transport, with the closest existing bus route to the ACP area being Bus Route No. 850, which traverses along Chapman Road and terminates at Drummond Cove. The closest bus stop is about 170m north of Hagan Road.

This ACP does not propose to extend upon the existing public transport infrastructure.

Refer to Appendix C - Transport Assessment

4.7 Car Parking

A total of 1,323 parking bays are proposed for the ACP area which meets and exceeds the City of Greater Geraldton parking requirement. Access and egress to the ACP area is through two roundabout intersections on Chapman Road which is in line with the proposed Master Plan for the Glenfield District Activity Centre.

The proposed development concept which has informed the ACP has been assessed against the City's minimum car parking requirements contained within LPS1 in Table 6.

Table 6 – Car Parking Requirements

Land Use Category	Bays Required	Bays Provided
Bulky Goods Showroom – 1 per 50m^2	641	1193
Liquor Store - 1 per 20m^2	75	120
Service Station - 1 per 50m^2	3	10
Total	719	1323

As the above table demonstrates, there will be a surplus of 604 car parking bays, based on the Indicative Concept Plan (Figure 11). As the number of car parking bays is indicative, car parking calculations will be determined upon formal application for development approval.

4.8 Water Management

An Urban Water Management Plan will be prepared prior to subdivision and development to confirm water management arrangements for the ACP area.

The City has confirmed that the same principals of the approved LWMS for the Glenfield District Activity Centre will apply to Lot 55 Chapman Road. The approved LWMS indicates a conservative infiltration rate for the Glenfield District Activity Centre area to the north of 15m/day and suggests a similar rate of infiltration for Lot 55 Chapman Road.

An Environmental Assessment and Management Strategy (EAMS) provided in Appendix B suggests that development over the ACP area has the potential to impact groundwater quality though infiltration of stormwater that may contain pollutants such as nutrients and hydrocarbons.

With regard to the above, an Urban Water Management Plan (UWMP) is to be prepared at the Development Application Stage to manage potential impacts to groundwater and ensure that finished levels are adequate to prevent flooding.

Refer to Appendix A – Servicing Opportunities and Constraints Report

Refer to Appendix B – Environmental Assessment and Management Strategy

4.9 Landscaping

Landscaping is integral to ensure that development offers an enhanced level of amenity and encourages the biological process within the natural ecosystems, and be incorporated into the urban water management functions as a solution to mange stormwater, improve water quality and reduce run-off. Landscaping can also be used to integrate development into the natural environment.

This ACP is to contribute to the local biodiversity through the use of native vegetation. Non-native species can be considered if they are easy to maintain and contribute to the amenity of the streetscape.

Hard landscaping such as retaining walls, street furniture, public art and paving is to contribute to providing an attractive and safe environment.

Water, particularly scheme water, undergoes an intensive process of collection, processing and distribution to be made available for public consumption. As such, it is important to integrate stormwater treatment into the landscape by incorporating multi-use corridors that maximise the visual and recreational amenity of developments.

Furthermore, the ACP area comprises a ridgeline running north-south through the middle of the site at approximately RL 22m. This contour falls sharply to the east towards Chapman Road to an approximate level of RL 4.0m. The western portion of the ACP area varies in level from RL 4.0m in the north west corner to RL 14.0m in the south western corner of the site. This variation in height is incorporated into both hard and soft landscaping through the middle of the ACP area. As a result, the exiting ground level over the ACP area will be separated to accommodate intended use and access as illustrated in Figure 10.

4.10 Activity Centre and Employment

The ACP area is located approximately 9.3 kilometres north of the Geraldton City Centre, which provides a full range of economic and community services for the surrounding area and is a significant employment node within the Greater Geraldton region.

There are no District Centres currently located within the Greater Geraldton region, however there are several Neighbourhood Centres which are located along Chapman Road.

The nearest Neighbourhood Centre is located approximately three (3) kilometres south of the ACP area at Sunset Shopping Plaza, located the corner of Chapman Valley Road and Chapman Road. Neighbourhood Centres are important local community focal points that help to provide for the main daily to weekly household shopping and community needs. They are also a focus for medium-density housing. There are also many smaller local centres such as delicatessens and convenience stores that provide for the day-to-day needs of local communities.

4.11 Utilities and Servicing

An Opportunities and Constraints Report has been undertaken by Pritchard Francis in relation to the proposed ACP and this report is contained at Appendix A, The recommendations of this report are summarised in the following sub sections.

4.11.1 Water Supply

Liaison with the Water Corporation has determined that the ACP area is currently serviced with a 100mm wide main, however it is not considered to provide adequate flows and pressures on the basis of the size of the ACP area.

An existing 300mm wide distribution main is located at the intersection of Chapman Road and Chapman Valley Road which is expected to be extended up past the development in mid too late 2020. Although this extension is considered to provide suitable service to the ACP area, any earlier trigger for extension of this main is to be at the expense of the developer.

Should development proceed prior to the installation the distribution main above, it is recommended that the existing 150mm wide main be extended 2.5km from the south of the ACP area from Moorings Loop, with a cross connection into the existing 100mm wide main in Corallina Quays which leads up to the ACP area.

Water Corporation has confirmed that the extension of a 150mm wide main is an acceptable option, in lieu of extending the 300mm wide distribution main.

Refer to Appendix A – Servicing Opportunities and Constraints Report

Figure 10. Indicative perspective of development along Chapman Road

4.11.2 Sewerage Reticulation

Liaison with Water Corporation has determined that there is no existing sewer reticulation gravity main fronting the ACP area. Currently, there is an existing 200mm sewer pressure main along Chapman Road and which follows Sunset Boulevard around the edge of the ACP area, connecting in to the Water Corporation's existing Geraldton North Wastewater Treatment Plant to the west of the ACP area.

The ACP area is located within the Waggrakine Sewer District as a catchment for a future Wastewater Pumping Station (WWPS). However, Water Corporation has confirmed that there are no plans to construct this WWPS and any consideration to do so will require substantial development within the area.

Based on the current development options of subdivision this ACP, sewerage reticulation can be achieved through the following options:

- A Private WWPS and pressure main discharging into the existing Wastewater Treatment Plant to the west of the ACP area for each proposed lot (or a variation of this arrangement);
- A temporary WWPS built to Water Corporation Standards;
- On site treatment and disposal of wastewater through the use of ATU's; and
- Septic tanks.

Each servicing option could be considered however a final determination for servicing each lot would be based on the individual costs and constraints for each proposed lot.

Refer to Appendix A – Servicing Opportunities and Constraints Report

4.11.3 Road networks

Liaison with the City of Greater Geraldton has determined that the construction of Sunset Boulevard will be required to loop around the western edge of the ACP area and connect into the proposed 'Road 1' through to Hagen Road.

The construction of Sunset Boulevard is to be in accordance with Liveable Neighbourhoods standards and will be wholly at the developer's expense should they be the first to proceed with the development. However, the initial developer may be able to claim shared costs from the later developer at a time in the future.

The City has also noted that the developer will be required to upgrade Chapman Road completely though they have yet to confirm the exact requirements for the upgrade. The upgrade of Chapman Road is to be funded by the developer.

Refer to Appendix A – Servicing Opportunities and Constraints Report

4.11.4 Power Supply

Western Power has advised the following:

- The ACP area is within an 11KV network area and is located approximately 3.5km from Chapman Zone Substation (CPN).
- Two 11KV feeders (CPN316 and CPN336) run parallel to the ACP area along Chapman Road.
- This area is supplied by CPN 316.0 Waggrakine HV feeder circuit.
- There is no existing supply to the ACP area.

With regard to the above, there is spare capacity on both HV feeders running past the development. Western Power recommends the installation of 2x substation (2+2 RMU and 2MVA transformer), the installation of 4x HV cable (approx. 820m), the installation of 2x LV cable (approx. 140m), 2x HV joint, 3x cable pole termination, the replacement of 2x pole, the removal of a bay of HV conductors and the installation of 1x pillar.

The above works are to be installed at the expense of the developer.

Refer to Appendix A – Servicing Opportunities and Constraints Report

4.11.5 Gas

Liaison with ATCO Gas has determined that ACP area comprises existing gas reticulation of a medium pressure main (225mm, 70kPa) along on the west side of Chapman Road from which a connection can be extended into the ACP area.

ATCO Gas has confirmed the ACP area can ultimately be serviced with a natural gas reticulation however the maximum pressure available to the ACP area is 10kPa.

Refer to Appendix A – Servicing Opportunities and Constraints Report

4.11.6 Communications

Liaison with 3E Consulting Engineers has advised the following:

- Broadband and voice communications to the area has been converted to NBN Co Fixed Line.
- Telstra cable capacity to the area is limited to 70 pair and may not be sufficient to service new development. if new NBN Co copper based services were required.
- Telstra fibre is available at the intersection of Hagan Road and Chapman Road.
- Design for telecommunications to the new National Broadband Network (NBN) specifications will be required. Independent consultants can design the telecommunications to NBN specifications.

Refer to Appendix A – Servicing Opportunities and Constraints Report

Figure 11. Indicative Development Concept

SITE SUMMARY	
SITE AREA	12.2397ha
Bulky Goods Showroom	32,040m² GFA
Service Station	120m² GFA
Liquor Store	1,500m² GFA
TOTAL GFA	33,660m² GFA
TOTAL BAYS REQUIRED	719 bays
TOTAL BAYS PROVIDED	1323 bays

CITY OF GREATER GERALDTON PARKING REQ.	
Bulky Goods Showroom	1 bay per 50m² GFA
Service Station	1 bay per 50m² GFA
Liquor Store	1 bay per 20m² GFA

LOT SUMMARY	
LOT 1	
LOT AREA	0.3564ha
Bulky Goods Showroom	240m² GFA
Service Station	120m² GFA
TOTAL GFA	360m² GFA
TOTAL BAYS REQUIRED	8 bays
TOTAL BAYS PROVIDED	57 bays
LOT 2	
LOT AREA	3.9819ha
Bulky Goods Showroom	8,300m² GFA
TOTAL GFA	8,300m² GFA
TOTAL BAYS REQUIRED	166 bays
TOTAL BAYS PROVIDED	400 bays
LOT 3	
LOT AREA	7.3093ha
Bulky Goods Showroom	23,500m² GFA
TOTAL GFA	23,500m² GFA
TOTAL BAYS REQUIRED	470 bays
TOTAL BAYS PROVIDED	746 bays
LOT 4	
LOT AREA	0.6972ha
Liquor Store	1,500m² GFA
TOTAL GFA	1,500m² GFA
TOTAL BAYS REQUIRED	75 bays
TOTAL BAYS PROVIDED	120 bays

LEGEND

- Site Boundary
- Existing Cadastre
- 10 Existing Contours (2m)
- Indicative Retaining Wall Location
- Vegetation Screening
- Proposed Lot Boundary
- SH Bulky Goods Showroom
- LQ Liquor Store
- SS Service Station
- Pedestrian Route
- Parking Bays
- Road

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5. Indicative Development Concept

An Indicative Development Concept (Figure 11) has been prepared for the ACP area which outlines one possible approach to developing the ACP area in line with this ACP.

It is envisaged that development will comprise a range of Service Commercial uses including, but not limited to, Bulky Goods Showroom, Liquor Store and Service Station Store which is to be located on four separate lots, subject to future subdivision. Specifically, the Concept Plan envisages the development of the following within the ACP area:

- Bulky Goods Showroom with a potential total gross floor area of 32,040m^2;
- Liquor Store with an indicative gross floor area of 1,500m^2;
- Service Station with an indicative total gross floor area of 120m^2;
- 719 car parking bays to be predominately located Internally;
- Provision for logical connections of pathways and road access;
- Localised drainage overland flow paths to manage storm water discharge in accordance with water sensitive design principles; and
- Provision of large lots to accommodate development flexibility whilst upholding good urban design principles.

Figure 11 has been prepared to address the existing environmental constraints, specifically with regard to the north-south ridgeline, and the WWTP to the southwest. The existing ridgeline is to be adequately addressed through the provision of cut and fill excavation works, where required, to provide a hardstand car parking area and associated hard and soft landscaping which includes an indicative retaining wall. Where a building is to be developed over the ridgeline (specifically SH6, SH7, SH8, SH12 and SH13), the natural ground level is to be adequately graded.

The ACP area is to comprise internally located car parking areas to service the future development. The internal location will minimise the overall dominance of car parking on the external road network, and ensure that the street frontages are presented with active frontages, specifically Chapman Road and Sunset Boulevard.

It is imperative for the design to address the Glenfield District Activity Centre to the north. Development on the ACP area is to be oriented to complement any compatible land uses and infrastructure to the north of the ACP area, and are to enhance the overall character of the Sunset Boulevard Streetscape. Furthermore, development to the eastern balance of the ACP area, being located adjacent to Chapman Road, is to ensure that it does not have any adverse impact on the existing residential development opposite Chapman Road.

Access to the ACP area is well afforded via Chapman Road, and via neighbourhood connector roads which provide direct access to the Glenfield District Activity Centre. Road 01, 02 and 03 provide local road access through the structure plan area providing access to proposed car parking areas and future tenancies.

Landscaping is to be provided along the periphery of the ACP area to the south and to the west with the intent to reduce the impact of prevailing wind from the Indian Ocean to the west. Notwithstanding, landscaping is also to provide screening to those adjoining properties to south and to the west of the ACP area, noting that the rear of SH1 to SH6 face the lot boundary, as indicated on Figure 11 on the previous page.

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6. Conclusion

This ACP has been prepared under Clause 3.13 of the City of Greater Geraldton Local Planning Scheme No. 1 in order to facilitate the orderly and proper development of Lot 55 (827) Chapman Road, Glenfield. Notable features of this ACP include:

- Land use permissibility in accordance with the 'Service Commercial' zone of LPS1, with additional land use restrictions imposed to ensure land use compatibility with the WWTP buffer;
- Bulky Goods Showroom with an indicative gross floor area of 32,040m^2;
- Liquor Store with an indicative gross floor area of 1,500m^2;
- Service Station with an indicative gross floor area of 120m^2;
- 719 car parking bays to be predominately located Internally;
- Orientation of development to address Sunset Boulevard, and to take advantage of the adjoining Glenfield Activity Centre to the north;
- Landscaping and vegetative screening to the south and to the west of the ACP area;
- Provision for logical connections of pathways and road access;
- Localised drainage overland flow paths to manage storm water discharge in accordance with water sensitive design principles; and
- Provision of large lots to accommodate development flexibility whilst upholding good urban design principles.

This Activity Centre Plan has been prepared in conjunction with the preparation of technical reports referred to above and illustrates the appropriate development potential and land capability of the ACP area.

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Appendix A

Servicing Opportunities and Constraints Report

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lot 55 chapman road, glenfield

opportunities and constraints report

Project No. 16-212

pritchard francis
civil and structural engineering consultants

table of contents

Revision	Description	Author	Date
0	Initial Issue	Aaron Smith	29 August 2016
1	Revised as per client comments	Aaron Smith	8 September 2016
2	Revised as per client comments	Aaron Smith	8 December 2016

1 Introduction

On behalf of ASDC Pty Ltd, Pritchard Francis has prepared the following report to provide strategic engineering advice on the opportunities and constraints involved with the development of Lot 55 Chapman Road, Glenfield.

The development site is located within the City of Greater Geraldton, and consists of approximately 12.24ha of undeveloped land bound by Chapman Road on the eastern side, Sunset Boulevard on the northern side and Sand Dune Drive on the western side. There are existing residential lots on the opposing side of Chapman Road and an existing Waste Water Treatment Plant directly to the west of the site.

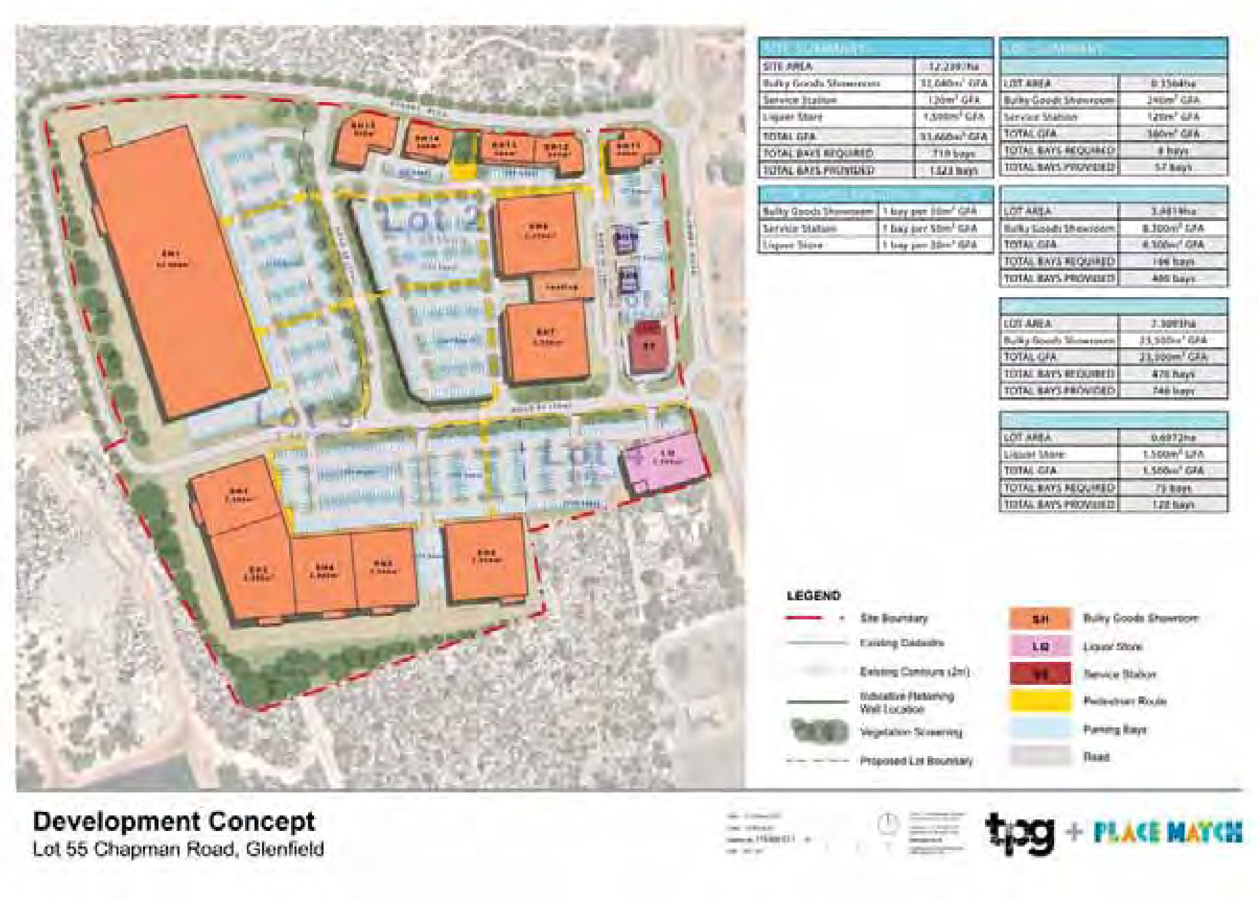

Image 1 Site Layout Plan

2 Site Conditions

2.1 Geology

Based on Pritchard Francis' knowledge of the area in the vicinity of the site as well as typical dunal regions the Site is expected to contain dune sand, limestone and sandy clays with the exception of the area adjacent to Chapman Road where some silty sands and clays are likely to be encountered.

There should be no issues preventing the site from being developed however a suitably qualified Geotechnical Engineer should be engaged to complete the investigation.

2.2 Topography

Landgate contours were obtained from Water Corporation ESInet and can be seen in the Site Constraints Plan below. It is noted that the ridge running north south through the middle of the site at approximately RL 22m. Levels fall sharply to the east towards Chapman Road to an approximate level of RL 4.0m the western portion of the site varies in level from RL 4.0m in the north west corner to RL 14.0m in the south western corner of the site.

The site is predominantly covered by various grasses and shrubs that are typical to the dunal regions.

Image 2 Site Constraints Plan

2.3 Groundwater Levels

No regional groundwater contours are available for the site to indicate the depth to groundwater. It should be noted that the groundwater is expected by have high salinity given its proximity to the ocean and as such it would likely be unsuitable for use as a landscaping/ irrigation bore.

2.4 Earthworks

Significant earthworks will be required on site to prepare it for commercial development. Sketches showing existing site levels and cross sections in critical areas of the site are shown in appendix three. Two main earthworks methodologies were considered; one being the creation of flat pads at each of the building sites and the other the use of structural built forms using suspended slabs.

The current approved structure plan that incorporates Sunset Boulevard indicates that Sunset Boulevard rises at a grade of 7% from RL 4.0m AHD from Chapman Road to a height of RL 12.0m AHD before falling again at 7% to RL 4.0m AHD flattening out through to the north west corner of the site. Given the steepness of the grade and the size of the proposed showrooms, tying into Sunset Boulevard levels and achieving flat pads without the use of large retaining walls will be difficult. To reduce the amount of retaining required structural built form solutions may be advantageous if not unachievable to account for the level difference. Based on the location and cost of these works as well as the restrictions that it would place upon the development of the land and conditions of sale it is not recommended to proceed with this option. The City of Greater Geraldton has confirmed that although the Structure Plan has been approved, the levels are not set and can be subject to change. They also noted that the levels would need to integrate with the expected levels for the development to the north.

It is recommended that an alternate level design for Sunset Boulevard is created similar to that shown in appendix three. This option proposes grading up from Chapman Road at 6% before softening the grade and pushing the high point of RL 12.0m AHD further west before grading back toward natural surface. The north-western corner will be raised to a level of RL 7.0m AHD which will allow Sunset Boulevard to tie into the existing lot to the west better. 1 in 3 batters into the adjacent Lots to the north, south and west will be required however should batters into adjoining properties not be possible then the batter would be required internally resulting in a loss of land as shown in appendix three.

Across the site small amounts of clearing will be required to remove existing trees and shrubbery typical to the dunal regions, the majority of which will be given low retention value. Topsoil will then need to be stripped, some of which can be reused on site with a portion likely requiring to be disposed offsite due to less options for disposal onsite.

Cut to fill on site will be extensive and it is recommended that a bulking factor for the site be determined in order to determine an optimal earthworks solution.

2.5 Retaining Walls

Retaining walls have been costed based on the current site plan and contours. This also includes retaining to drainage areas. The grading across site will require retaining walls at regular intervals to create flat pads for buildings as shown in appendix two as well as battering into the adjoining lots to the natural surface level. Should batters into adjoining properties not be possible then the batter would be required internally resulting in a loss of land.

2.6 UXO Survey

Based on our knowledge of the site and surrounding area it is likely that there may be UXO's across this site and it is recommended that a specialist consultant is employed to investigate this further should development proceed.

2.7 Other On Site Constraints

The Australian Heritage Database indicates there are no heritage claims affecting the proposed site.

The Department of Environment Regulation public contaminated sites database does not indicate any recorded contamination or suspicion of contamination for the site or nearby landholdings.

3 Infrastructure

3.1 Stormwater Drainage

It is our understanding that after numerous and detailed liaison / correspondence between the developer, Strategen, the Department of Water and the City of Greater Geraldton, a Local Water Management Strategy (LWMS) is unlikely to be required as part of the development of the site.

A LWMS prepared be AECOM in 2014 for the development directly to the north of the site has already been approved by the City of Greater Geraldton, and the City has confirmed that the same principals to on site stormwater management will apply to Lot 55 Chapman Road (in accordance with WSUD principals that the City of Greater Geraldton has implemented throughout the area). The specific principles in the AECOM (2014) LWMS for the 1 year, 5 year and 100 year ARI events are outlined below.

1 Year ARI

- To retain and treat on site the 1 hour duration 1 year ARI event, rooves to be connected to soak wells and where appropriate, to rainwater tanks.
- All stormwater will be contained within each lot prior to discharge/ infiltration to groundwater.
- Road runoff will be infiltrated as close to source as practical using water sensitive urban design (WSUD) measures including roadside swales.

5 Year ARI

- Road runoff will be infiltrated as close to source as practical using water sensitive urban design (WSUD) measures including roadside swales/ bioretention structures draining into flood storage areas adjacent to public open space (POS).
- Bioretention structures will treat and infiltrate stormwater using vegetation and biofiltration media to improve water quality prior to release to the environment.
- Flood storage will be within unfenced landscaped shallow sized basins with sand filters.

100 Year ARI

- Provide via overland flow paths to enable conveyance of runoff to infiltration basins.
- Flood storage areas (infiltration basins) will be unfenced, landscaped, shallow sided basins with sand filters.

The AECOM (2014) LWMS indicated that a conservative infiltration rate for the site to the north was 15m/ day and given the topography and geology of Lot 55 Chapman Road is similar this rate of infiltration could be assumed to apply. However, this should be confirmed by a suitably qualified consultant as a part of the LWMS and UWMP works for Lot 55 Chapman Road.

The City of Greater Geraldton has confirmed that for commercial and industrial developments, the minor storms are required to be stored and infiltrated on site with the major events to overland flow into the council system.

An Urban Water Management Plan (UWMP) is likely to be required at the Development Application Stage to meet the requirements of the City of Greater Geraldton and the 'Better Urban Water Management (2008)' process. The development of these plans may delay overall site development if adequate groundwater monitoring cannot be sourced for the area. The collection of at least 6 months (potentially up to 12 months) of groundwater monitoring data including a winter peak as well as an Acid Sulfate Soils investigation will be required to support the UWMP.

3.2 Sewerage Reticulation

There is no existing sewer reticulation gravity main fronting the site. There is an existing dia 200mm sewer pressure main that runs up Chapman Road and then follows Sunset Boulevard around the edge of the site before heading into the Water Corporations existing Geraldton North Wastewater Treatment Plant to the west of the Site.

Water Corporation catchment planning (refer Appendix Three) shows the Site falls within the far southern end of the Waggrakine Sewer District in the catchment of a future Wastewater Pumping Station (WWPS) 'C' which is a long term Type 180 WWPS. Currently there is no plans or need to construct this WWPS and substantial development in the vicinity of this WWPS would be required before it's construction is triggered.

The site is expected to be serviced via a dia 225mm service form the future development to the north of the site for the western half of the site and a dia 150mm main that is expected to run down Chapman Road. Both of these future mains are to gravitate to the proposed WWPS 'C' according to the Water Corporation Planning Waggrakine Long Term Scheme.

Based on the current development option of subdividing the Site as well as current and planned Water Corporation assets servicing each lot can be achieved a number of different ways.

- A Private WWPS and pressure main discharging into the existing Wastewater Treatment Plant to the west of the Site for each proposed lot (or a variation of this arrangement.
- A temporary WWPS built to Water Corporation Standards.
- On site treatment and disposal of wastewater through the use of ATU's.
- Septic tanks.

Each servicing option could be considered however a final determination for servicing each lot would be based on the individual costs and constraints for each proposed lot.

Refer to appendix five for sewer servicing information and Water Corporation correspondence.

3.3 Water Reticulation

The site is currently serviced with a dia 100mm main which is unlikely to provide adequate flows and pressures for the size of the proposed development.

Discussions with Water Corporation indicated that currently there is a dia 300mm distribution main at the intersection of Chapman Road and Chapman Valley Road that is expected to be extended up past the development in mid too late 2020 which would be able to provide a suitable service to the site. The early extension of this main would be at the developer's expense. As such an alternative to this option should the development proceed prior to the installation the distribution main is to extend a dia 150mm main 2.5km from the south of the Site from the existing dia 150mm main in Moorings Loop with a cross connection into the existing dia 100mm main in Corallina Quays up to the Site. Water Corporation have confirmed the extension of a dia 150mm main is an acceptable option in lieu of extending the dia 300mm distribution main.

It should be noted that should the proposed development of the site be staged then there may be the possibility of delaying the extension of the dia 150mm water main and servicing the initial stage from the existing dia 100mm water main in Chapman Road. As the existing capacity of the dia 100m water main in Chapman Road is not known, this will need to be confirmed by the Water Corporation including the point where the demand of the proposed development exceeds the existing capacity and forces the dia 150mm water main extension. An alternative solution to provide a fire service to the site will also need to be determined.

Refer to appendix five for water servicing information and upgrade requirements.

3.4 Local Authority Requirements

After consultation with the City of Greater Geraldton it was confirmed that the construction of Sunset Boulevard will be required to loop around the western edge of the site and connect into the proposed Road 1 through to Hagen Road. The construction of Sunset Boulevard is to be in accordance with Liveable Neighbourhoods standards and will be wholly at the developer's expense should they be the first to proceed with the development. However, the initial developer may be able to claim shared costs from the later developer through the Section 159 of the Act at a time in the future.

The City has also noted that the developer will be required to upgrade Chapman Road completely as shown in appendix four though they have yet to confirm the exact requirements for the upgrade and will be confirmed as a part of the detailed design. It will be fully developer funded as the City does not accept partial upgrading of roads due to the fact that the adjacent land may not be developed for several years if at all. The roads are to be constructed in accordance with Liveable Neighbourhoods and the hierarchy shown in appendix four.

3.5 Gas Supply

The existing gas reticulation consists of a medium pressure main (225mm, 70kPa) which runs on the west side of Chapman Road from which a connection can be extended into the site. ATCO Gas has confirmed this main would support the proposed commercial development however the maximum pressure available to the site is 10kPa.

Refer to appendix six for Existing ATCO Gas network and correspondence with ATCO Gas.

3.6 Electrical Supply

The Network Capacity Mapping Tool indicates that the available capacity is currently between 15-20MVA, with an expectation that it will diminish below 15MVA by 2026. The estimated demand for the site is 3.45MVA and will impact on the remaining capacity in the network. The exact capacity in the adjacent HV aerial and underground network is unknown and can be confirmed via a Western Power Feasibility Report.

Based on the estimated load for the site, the proposed development will require WP infrastructure to be installed as the existing transformers in the vicinity of the site will not have the capacity to service the estimated load. Western Power's Feasibility Study Reports there is adequate spare capacity available on the two adjacent HV feeders to supply the proposed loads. This is however subject to detailed study at the design phase. To service the proposed development, Western Power requires the site power load to be distributed between the two HV feeders for network reliability purposes. Western Power owned substation will need to be installed at the common boundaries and the building and carpark layouts will need to be amended to cater for these transformer sites.

Internal roadway and carpark lighting is required to comply with road lighting standards (AS1158) as well as City of Greater Geraldton standards however will be privately owned and managed and will be the responsibility of the individual lot owners.

Refer to appendix one 3E Consulting Engineers Pty Ltd Servicing Report for more information.

3.7 Communications

The NBN Co brownfields rollout has occurred in the area of the site and assuming NBN Co assessed the site to be within its Fixed Line Footprint, then NBN CO would accept the development for infrastructure. It is possible that NBN Co would provide a Fibre to the Premises for the site rather than Fibre to the Node. It should be noted that as the NBN Co rollout has occurred in the area they are the Infrastructure Provider of Last Resort for all voice and broadband services within the Fixed Line Footprint.

Refer to appendix one 3E Consulting Engineers Pty Ltd Servicing Report for more information.

appendices

appendix one: 3E consulting engineering consultants pty ltd servicing report

PROJECT:

LOT 55 CHAPMAN ROAD, GLENFIELD
COMMERCIAL STRATA TITLE DEVELOPMENT

SERVICING REPORT FOR:

SITE ELECTRICAL AND COMMUNICATION SERVICES

DOCUMENT NO: **3E16072-R-01**

CIVIL ENGINEERS:

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Document History and Status

Revision	Date issued	Author	Reviewed by	Approved by	Revision Description
1	28/07/2016	VH & BB	DJ	DJ	For Information
2	06/09/2016	VH & BB	DJ	DJ	For Information

Distribution of copies

Revision	Copy no	Quantity	Issued to
1	Digital PDF	1	PRITCHARD FRANCIS
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SECTION 1 INTRODUCTION

1.1 SCOPE, BASIS OF SERVICING ESTIMATES AND ASSUMPTIONS

We understand that it is proposed to develop the subject site into four freehold green title commercial lots with the lots comprising of a mixture of large, medium and small showrooms expected to house tenants such as Bunnings, City Farmers, BBQ's Galore and other smaller format bulky goods retailers.

This report shall provide information on the existing electrical and communications networks adjacent to the site, including estimations of their capacity. It shall provide estimates of the power load and communication service demand required for the proposed development. It shall then provide analysis of the effects of the proposed development on the networks, in terms of capacity and any new infrastructure that may be required, as well as any asset relocations that may be applicable. Lastly, it will provide order of cost estimates for the required works.

SECTION 2 ELECTRICAL SERVICES

2.1 EXISTING POWER DISTRIBUTION NETWORK

The existing Western Power (WP) distribution infrastructure in the vicinity of the site comprises of 11kV three phase aerial and underground High Voltage (HV) and aerial three phase Low Voltage (LV) network.

HV aerials and underground cables are along the eastern side of Chapman Road from south to north. LV aerial conductors which originate from two 63kVA pole top transformers are located north and south of the proposed development site and runs both north and south on Chapman Road parallel to the site.

Information on the capacity of the local zone substation can be determined from Western Power's public Network Capacity Mapping Tool (NCMT). The substation that appears to supply the HV network adjacent to the subject site is the Chapman zone substation, which is located near the intersection of Chapman Valley Road and North West Coastal Highway. The location is approximately 3km south east as the crow flies from the development site. Currently there is in excess of 15-20MVA capacity in the zone substation. Within the next ten years, this is expected to diminish to less than 15MVA, suggesting that there is some growth in the area.

2.2 LIKELY LOAD

The proposed development consists of seventeen sites which consist of a large showroom, twelve medium showrooms, two small showrooms, one service station and a liquor store. It is assumed that each building will be air-conditioned. Allocating the appropriate AS3000 load allocations, we estimate the approximate load as follows:

Lot	Estimated Power Allocation
1	400 kVA
2	950 kVA
3	1900 kVA
4	200 kVA
Total	3450kVA

More accurate load requirements can be determined once information of confirmed tenants is available.

2.3 LIKELY POWER SUPPLY SCENARIO

2.3.1 SITE SUPPLY INFRASTRUCTURE

WP requires that all new developments are to be serviced by underground three phase power. WP also require any existing HV and LV aerials adjacent to the land being subdivided to be undergrounded and any existing consumers affected will have to have their consumer mains reconnected to the network.

In an commercial development, this is implemented by WP owned and maintained URD 3-phase direct buried underground cabling from a spare way at the transformer LV frame to uni-pillars serving each site on the general basis of one uni-pillar per commercial lot. Where loads exceed 250A/phase, the customer's main switchboard has to be contiguous to the substation.

Based on the estimated load for the site, the proposed development will require new WP infrastructure to be installed. The existing pole top transformers in the vicinity of the development will not have the capacity to service the estimated load. Western Power's Feasibility study reports there is adequate spare capacity available on the two adjacent HV feeders to supply the proposed loads. This is however subject to detailed study to check whether there are any power quality issues which will be conducted once a formal request for connection is applied for.

To service the proposed development, Western Power's requires the site power load to be distributed between the two HV feeders for network reliability purposes. A new Western Power owned substation will need to be installed at the common lot boundaries of Lots 1 & 2 and Lots 2 & 3 due to the requirements of contiguous switchboard supply arrangement to Lots 1, 2 & 3. The substation site at Lot 1 & 2 shall consist of a HV switchgear unit (2+2) and two new 1000kVA transformers, providing a capacity of 2000kVA. The substation site at Lot 2 & 3 shall also consist of a HV switchgear unit (2+2) and two new 1000kVA transformers, providing a capacity of 2000kVA. Building and car park layouts are to be amended to cater for these sites. The substation on Lot 1/2 will need to be connected in line with the adjacent HV overhead aerial lines and as such two HV cables will emanate from the substation to the HV overhead aerial poles on the east side of Chapman Road. Two additional HV cables will emanate from Lot 2/3 substation site to the HV underground feeder cable located on the east side of Chapman Road.

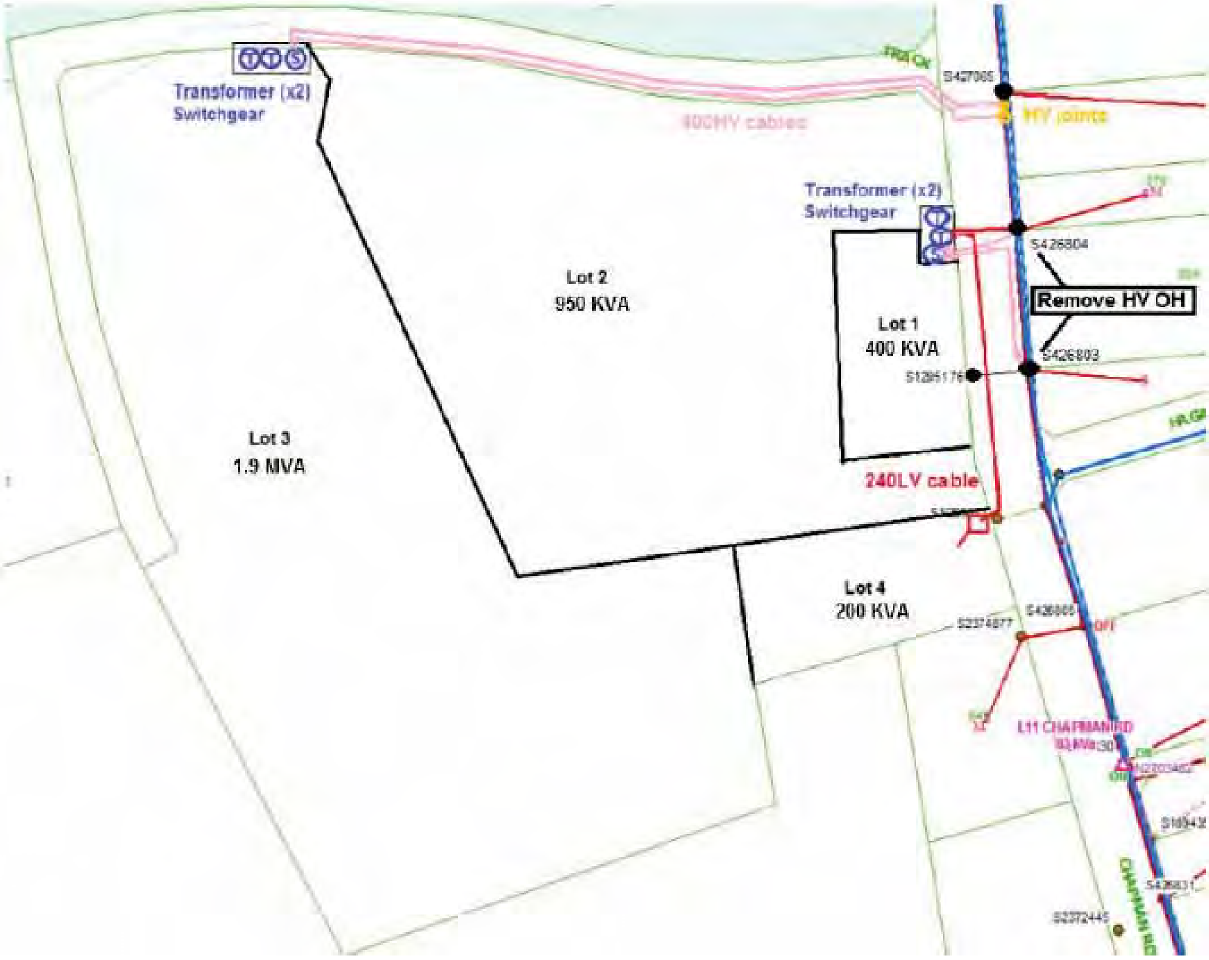


Figure 1: Proposed Western Power Supply Infrastructure Works

The total site for each of the substations will be 6.85m (W) x 5.2m (D) as per Western Power's Distribution Substation Manual Document Number DSM-3-06. Each of the four electrical units within each site is approximately 1.6m in height. The substation site is to be installed in a road reserve extension. The Site Main Switchboards (SMSBs) must be installed contiguous to this substation site, with a direct Customer owned LV Consumer Main cable connecting the SMSB to the transformers' LV frame. Buildings must meet minimum fire separation from the substation units of 6m or include fire rated walls to meet WP requirements.

The information presented above and in WP's feasibility study is based on desktop information and is subject to detail design investigation/confirmation. The final connection arrangement will be determined following application for a detailed design and firm access offer. Western Power will neither reserve capacity nor guarantee supply to this development without a formal request being lodged. The connection arrangement is therefore subject to change where there are network changes due to other developments. An assumption has been made that there will be no environmental obstacles that will impact Western Power works.

2.3.2 INTERNAL ELECTRICAL INFRASTRUCTURE

All internal reticulation will be private and installed to WP's WA Distribution Connections Manual (WADCM), WA Electrical Requirements (WAER) and AS3000 Wiring Rules. It shall be owned and maintained by the Strata Body Corporate.

The network will consist of a Site Main Switchboard fed by the Western Power point of supply, from which feeder cable circuits will emanate. The cables will be laid in the common property roadways. They shall supply multiple Distribution Boards (DBs), strategically distributed through the site. Given the size of the site, significant feeder cables will be required to supply these DBs. From the DBs, circuits to supply each building will emanate. Circuits to supply the communal facilities will also be required.

Internal roadway and car park lighting is recommended for pedestrian safety. The lighting shall be provided in the form of pole top lights to comply with road lighting standards (AS1158). Lighting of internal roads is to be privately owned and managed and will be of the responsibility of the lot owner.

2.3.3 RELOCATION OF EXISTING ASSETS

Based on DBYD maps and provided information, no existing HV aerial lines traverse through the subject site and therefore no relocations are required and so no allowance for costs for relocations has been included (other than the interface works to provide new infrastructure). It has been assumed that the internal layouts will be designed to allow for Western Power stay poles to be retained in their current location to minimise additional costs to the development.

2.3.4 HEADWORKS

The NCMT indicates that available capacity is currently between 15-20MVA, with an expectation that it will diminish below 15MVA by 2026. The estimated demand of this site is just under 4MVA and will impact on the remaining capacity in the network. The Western Power Feasibility Study advises there is adequate spare capacity available on the two HV feeders in the vicinity of the site to supply the proposed loads. The proposed connection arrangement is however subject to a detailed study which is conducted under the formal connection application request.

2.3.5 LIGHTING FOR NEW ROADWAYS ON GAZETTED ROAD RESERVE

All newly created roadways on gazetted road reserve will require new lighting to satisfy the requirements of AS1158 and the Local Government Authority. The lighting could consist of standard or decorative Western Power lighting poles, or if the Local Government preferred, "privately" (Local Government) owned lighting, where any range of suitable lighting products could be utilised, opening up the opportunity to use broader technologies and strategies, including:

- Architectural lighting poles and luminaires.
- High efficiency and low glare LED luminaires.
- Multi-technology poles, including banner mounts, CCTV cameras and power outlets.

- Time based, light level and motion detection controlled lighting operation and output levels.

2.4 POWER SUPPLY TIMELINES

Western Power will neither reserve capacity nor guarantee supply to this development without a formal request being lodged. A Design and Access Offer Application (DAO) must be prepared and submitted to Western Power for the design and construction of the proposed development to commence. With the estimated customer contribution in excess of $600,000, the project is identified as a major capacity project. For this type of project, the timeframe for the application process and WP quote is approximately 9-12 months and 3 months for construction.

SECTION 3 COMMUNICATION SERVICES

3.1 EXISTING NETWORK

Broadband and Voice communications to the area was until recently provided by Telstra from the Glenfield Exchange but the network has now been converted to NBN Co Fixed Line. The Telstra Glenfield Exchange is approximately 2 Km route length from the development – see attached PDF. A P100 conduit runs up Chapman Rd which most likely could support the hauling of additional cable. Telstra cable capacity to the area is limited to 70 pair and may not be sufficient to service the new development, if new NBN Co copper based services were required. Telstra fibre is available at the intersection of Hagan Rd and Chapman Rd.

The portion of surrounding network converted to NBN Co broadband under their Brownfields Rollout Programme is primarily on the eastern side of Chapman Rd and we understand that Fibre to the Premises (FTTP) technology has been delivered to residences – see NBN Co Rollout Map attached.

Telstra's 4GX mobile network provides coverage to the proposed development and offers download speeds up to 75 Mbps – see attached coverage map.

3.2 NBN Co - PROPOSED COMMUNICATIONS

Given that the Brownfields Rollout has occurred in the area and assuming NBN Co assessed the proposed development to be within its Fixed Line Footprint, then NBN Co would have to accept the development for infrastructure, if the Developer elected not to choose one of the alternative infrastructure providers.

It is possible, that NBN Co would provide service via FTTP technology, rather than Fibre to the Node (FTTN). Approximately 160 Retail Services Providers (RSP's) are able to deliver service on the NBN Co wholesale network in the Glenfield area and would be able to provide broadband with typical downstream/upstream speeds of 100/40 Mbps and download allowances of up to 1000GB per month, if the technology were FTTP but less than half that rate if the technology were FTTN. NBN Co are also developing a range of Business offerings for their FTTP network, both asymmetric and symmetric, to 1 Gbps with 24/7 service restoration within 8 hours, which are expected to be released later in 2018.

The classification of roads won't affect the pit and pipe design, although it could affect ownership of the assets. NBN Co generally don't take ownership of pit and pipe assets on strata titles, or equivalent but will take ownership of pit and pipe assets on gazetted roads.

Under current Federal government policy, Developers are responsible to pay for telecommunications infrastructure charges, in addition to the cost of pit and pipe. Whilst Deployment Charges will apply, Backhaul Charges may not be levied, if sufficient capacity resides within the existing NBN Co network. We recommend that a Feasibility Assessment be undertaken and a quote sought for Backhaul.

3.3 TELSTRA – PROPOSED COMMUNICATIONS

Since NBN Co have rolled out their Brownfields network, they are the Infrastructure Provider of Last Resort for all voice and broadband services within the Fixed Line Footprint, which we understand this development falls within. All Telstra voice and broadband services on its copper network will be disconnected within 18 months of NBN Co declaring the area fibre "Ready for Service (RFS)", under the Definitive Agreement with NBN Co. Since we understand that RFS only occurred in May 2016 there may be some residual Telstra working services. If so, it would be prudent to encourage the transfer of these services to NBN Co or cancel, prior to the commencement of construction of the new development. Telstra must then use the NBN Co wholesale network for fixed line services for a period of 20 years.

However, Telstra can retain its existing point to point fibre services or install new point to point fibre services since it has the right of first refusal for point to point fibre services under the Definite Agreement with NBN Co. Telstra usually exercise their right of first refusal, especially where customers are under Telstra Account Management. We understand that Telstra wideband or managed services are unaffected by the disconnection policy triggered by the NBN Brownfields rollout. Such services may still be operating on the existing main cables on the eastern and western side of Chapman Rd.

3.4 TELSTRA AND NBN Co RELOCATIONS

Telstra pit and pipe network at the intersection of Sunset Blvd/Chapman Rd and Road 1/Chapman Rd may be affected by the proposed roundabouts – see Telstra DBYD on the attached Comms Concept Plan. Because Telstra main cables are installed on the route, ownership of these assets would have been retained by Telstra following the NBN Co Brownfields Rollout. To the best of our knowledge no distribution cables are located on the route, where ownership would have transferred to NBN Co. Pits that aren't affected by the roundabout works should not require relocation.

On the western side of Chapman Rd Telstra direct buried cables are installed in private property. Network on private property is likely to be on the 3m alignment but alignments could vary depending on terrain and vegetation. Note that pits on the western side of Chapman Rd would most likely be located on road reserve, even though the associated cable is located on private property. We recommend that network on private property be relocated to road reserve. If not, a service easement would need to be registered over the route and 24/7/365 access provided to the route. Retention of the route on private property may affect the building envelopes of SS1 and SH-MH12.

If NBN Co have converted the existing surrounding network to FTTP then NBN Co fibre would most likely be located in Telstra conduit on the eastern side of Chapman Rd – see NBN Co DBYD attached and NBN Co Rollout Map. If the proposed roundabout works affect Telstra's conduit network then NBN Co fibre would require relocation.

We recommend that road plans take account of existing Telstra/NBN Co infrastructure and consideration be given to offsetting the roundabouts from the centreline of Chapman Rd. Where network is affected, relocation requests would need to be lodged with the relevant authorities. A roundabout at Hagan Rd/Chapman Rd (Road 1) is likely to have a greater impact on cost than that at Sunset Blvd.

SECTION 4 BUDGET ESTIMATES

4.1 ELECTRICAL SERVICES

We understand that the Network Augmented Costs for the commercial subdivision will be calculated in accordance with Western Power's Full Cost Method as per Access Code 2004 where the commercial development has been undertaken by the developer but will not become the end user.

Our very early pre-design order of probable cost estimates for the electrical services are as follows:

Component	Cost
External Works	
Substation 1	$190k
Substation 2	$190k
HV Cabling and Joints	$170k
New HV Termination Pole and Cable Terminations	$40k
LV Cable and Uni Pillar	$20k
Street Light Poles and Cables (Sunset Boulevard)	$35k
Street Light Poles and Cables (Chapman Road)	$55k
Western Power Charges	$100k
TOTAL	**$800k**

The WP Feasibility Report provides an estimated customer contribution of $700k ± 30%. The cost of street lighting is not included in this total. The above cost estimate is in line with the estimate provided by Western Power.

4.2 COMMUNICATION SERVICES

The cost for pit and pipe design and construction would be of the order indicated below (Concept Plan attached):

Component		Cost
Internal Works		
	New Pit & Pipe	$50k
TOTAL		**$50k**
NBN Co Infrastructure Charges		
	Backhaul Charge – for 4 super lots	$20k
	Deployment Charge – for 17 tenancies	$7k
TOTAL		**$27k**
Relocation Costs		
	Telstra relocation – western side of Chapman Rd	$50k
	Telstra relocation – Sunset Blvd roundabout	$30k
	Telstra relocation – Hagan Rd roundabout	$50k
	NBN Co Fibre relocation - eastern side of Chapman Rd	$40
TOTAL		**$170k**
GRAND TOTAL OPC		**$247k**

4.3 QUALIFICATIONS AND EXCLUSIONS

All cost in todays' dollars, all design costs and GST excluded.

4.3.1 ELECTRICAL SERVICES COST ASSUMPTIONS AND EXCLUSIONS

Budget estimates are very early pre-design order of probable cost estimates based upon a desk-top evaluation of available information.

This cost estimate excludes decorative street lighting, mobilisation costs, accommodation costs, design fees and switchboard(s)/materials for internal electrical reticulation.

The subdivision HV Pool does not apply to commercial subdivisions as they are too variable for a pool to operate. This means that HV infrastructure will be at full cost to the developer. However, it also means that the system charge payment will not be required, and so these costs have been excluded from our estimate.

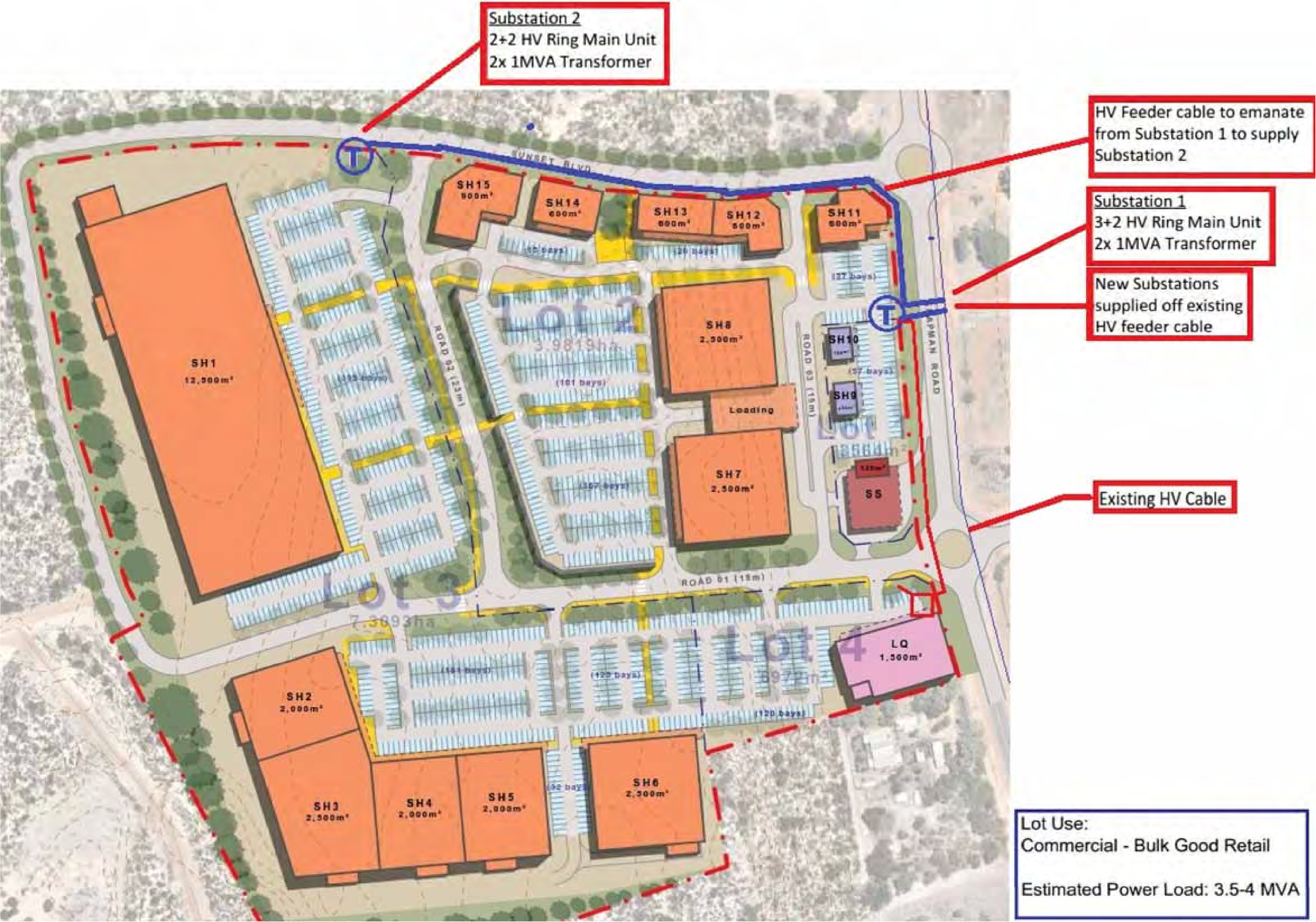
The above headwork cost estimates provided are indicative only. Based off Western Power's Feasibility Study, no major upgrade works are required at the Zone Substation such as installation of a new 400HV dedicated feeder cable to the proposed subdivision and therefore these costs have been excluded.

An assumption has been made that street lighting to AS1158 is required for Sunset Boulevard and Chapman Road for the portion surrounding the site.

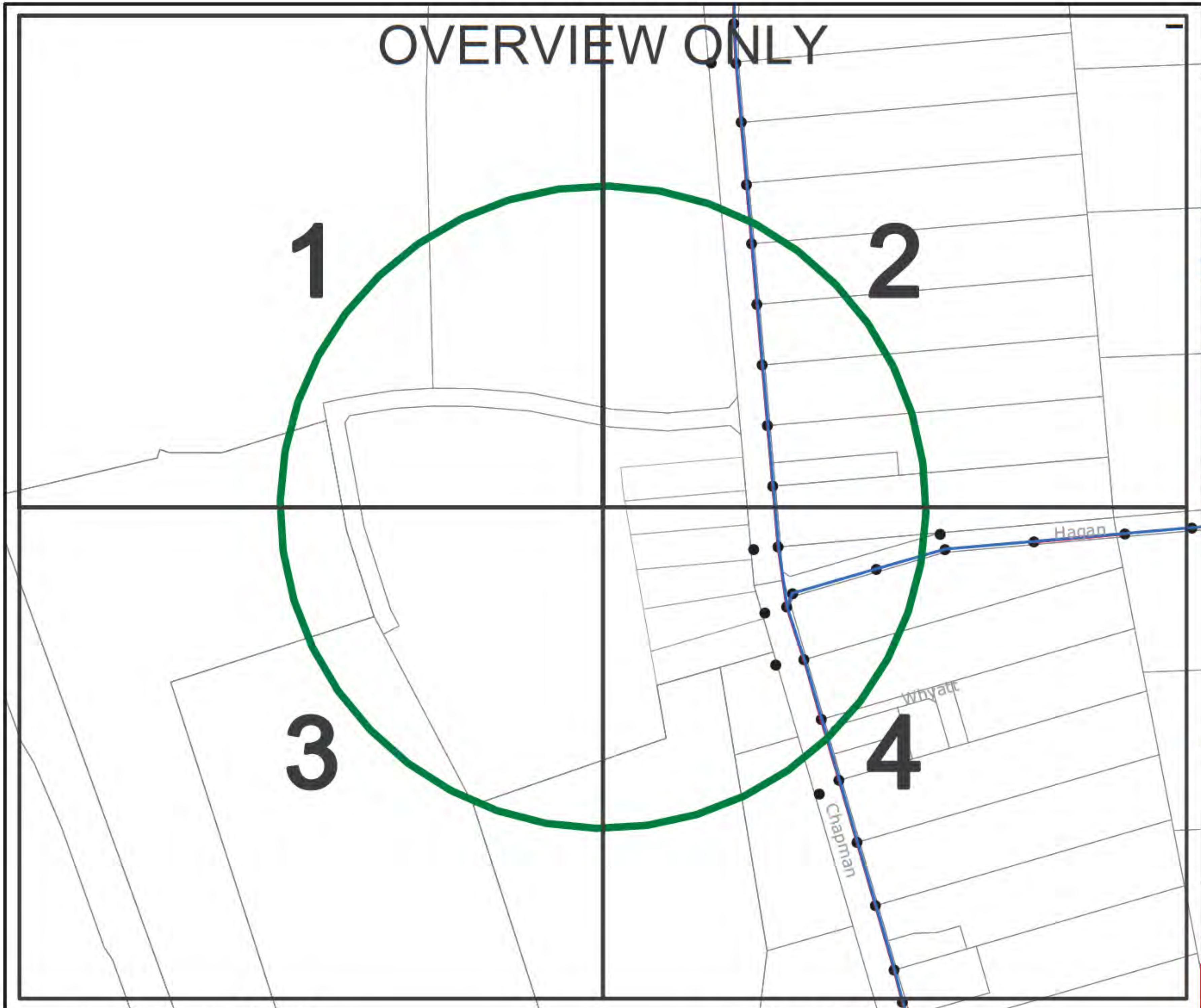
More detailed cost estimates can be created once detailed designs are complete and confirmation on type of tenants occupying each lot.

4.3.2 COMMUNICATION SERVICES COST ASSUMPTIONS AND EXCLUSIONS

- Common Trench provided by Developer with road verge/paving restored and reinstated
- One premise per tenancy
- Does not include the cost of Communications Equipment Rooms, internal building cable access pathways, internal building cabling nor terminating equipment
- Relocation costs are a broad estimate only and we strongly recommend seeking quotes from the relevant carriers
- Allowance has been made for a Backhaul charge, however, It is possible that no Backhaul Charge will apply, if NBN Co have sufficient capacity within their existing network


Substation 2
2+2 HV Ring Main Unit
2x 1MVA Transformer
HV Feeder cable to emanate from Substation 1 to supply Substation 2
Substation 1
3+2 HV Ring Main Unit
2x 1MVA Transformer
New Substations supplied off existing HV feeder cable
Existing HV Cable
SUNSET BLVD
SH1
12,500m²
SH2
2,000m²
SH3
2,500m²
SH4
2,000m²
SH5
2,000m²
SH6
2,500m²
SH7
2,500m²
SH8
2,500m²
SH9
SH10
SH11
600m²
SH12
500m²
SH13
600m²
SH14
600m²
SH15
900m²
Loading
SS
LQ
1,500m²
ROAD 01 (18m)
ROAD 02 (23m)
ROAD 03 (15m)
Lot 2
3.9819ha
Lot 3
7.3093ha
Lot 4
(101 bays)
(307 bays)
(37 bays)
(57 bays)
(120 bays)
(32 bays)
Lot Use:
Commercial - Bulk Good Retail
Estimated Power Load: 3.5-4 MVA

Communications Concept Plan



westernpower

OVERHEAD LEGEND

Structures

& Power Pole " Transmission Poles

Transmission Overhead Powerline

Transmission (33kV - 330kV)

Distribution Overhead Powerline

High Voltage (1kV - 33kV)

Low Voltage (< 1kV)

Proposed Construction Assets

Design Area *

High Voltage Overhead Powerline

Low Voltage Overhead Powerline

& Power Pole

Communications Assets

Overhead Pilot Cable

Feature

Area of Interest

*** Please refer to coversheet**

Privately owned cables NOT SHOWN (including house services)

This map is INDICATIVE ONLY. Check that you have enough clearance from the DANGER ZONES near overhead powerlines.

Telephone Support: 1300 769 345 Mon to Fri - 08:00 to 16:30

Information valid for 30 days from date of issue

A4 Scale : 1:5125

WARNING! Look out for overhead power lines

Sequence Number: 54083210

Date of Issue: 7/07/2016

OVERHEAD LEGEND

Structures

& Power Pole " Transmission Poles

Transmission Overhead Powerline

Transmission (33kV - 330kV)

Distribution Overhead Powerline

High Voltage (1kV - 33kV)

Low Voltage (< 1kV)

Proposed Construction Assets

Design Area *

High Voltage Overhead Powerline

Low Voltage Overhead Powerline

Power Pole

Communications Assets

Overhead Pilot Cable

Feature

Area of Interest

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Telephone Support: 1300 769 345
Mon to Fri - 08:00 to 16:30

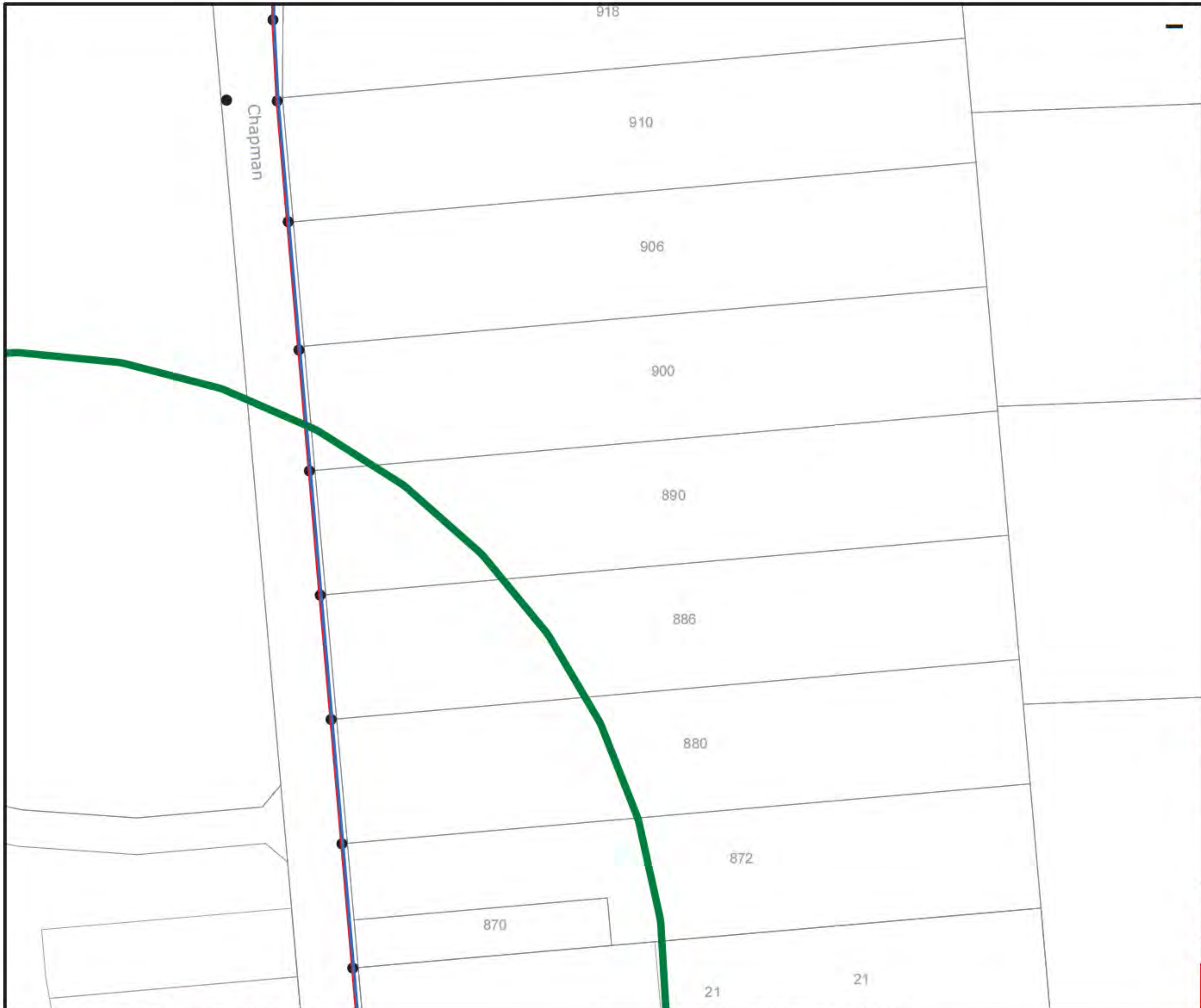
Information valid for 30 days from date of issue

A4 | Scale : 1:2500

WARNING! Look out for overhead power lines

Sequence Number: 54083210

Date of Issue: 7/07/2016



westernpower

OVERHEAD LEGEND

Structures

& Power Pole " Transmission Poles

Transmission Overhead Powerline

Transmission (33kV - 330kV)

Distribution Overhead Powerline

High Voltage (1kV - 33kV)

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& Power Pole

Communications Assets

Overhead Pilot Cable

Feature

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*** Please refer to coversheet**

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westernpower

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Communications Assets

Overhead Pilot Cable

Feature

Area of Interest

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Telephone Support: 1 300 769 345
Mon to Fri - 08:00 to 16:30

Information valid for 30 days from date of issue

A4	Scale : 1:2500

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Communications Assets

Overhead Pilot Cable

Feature

Area of Interest

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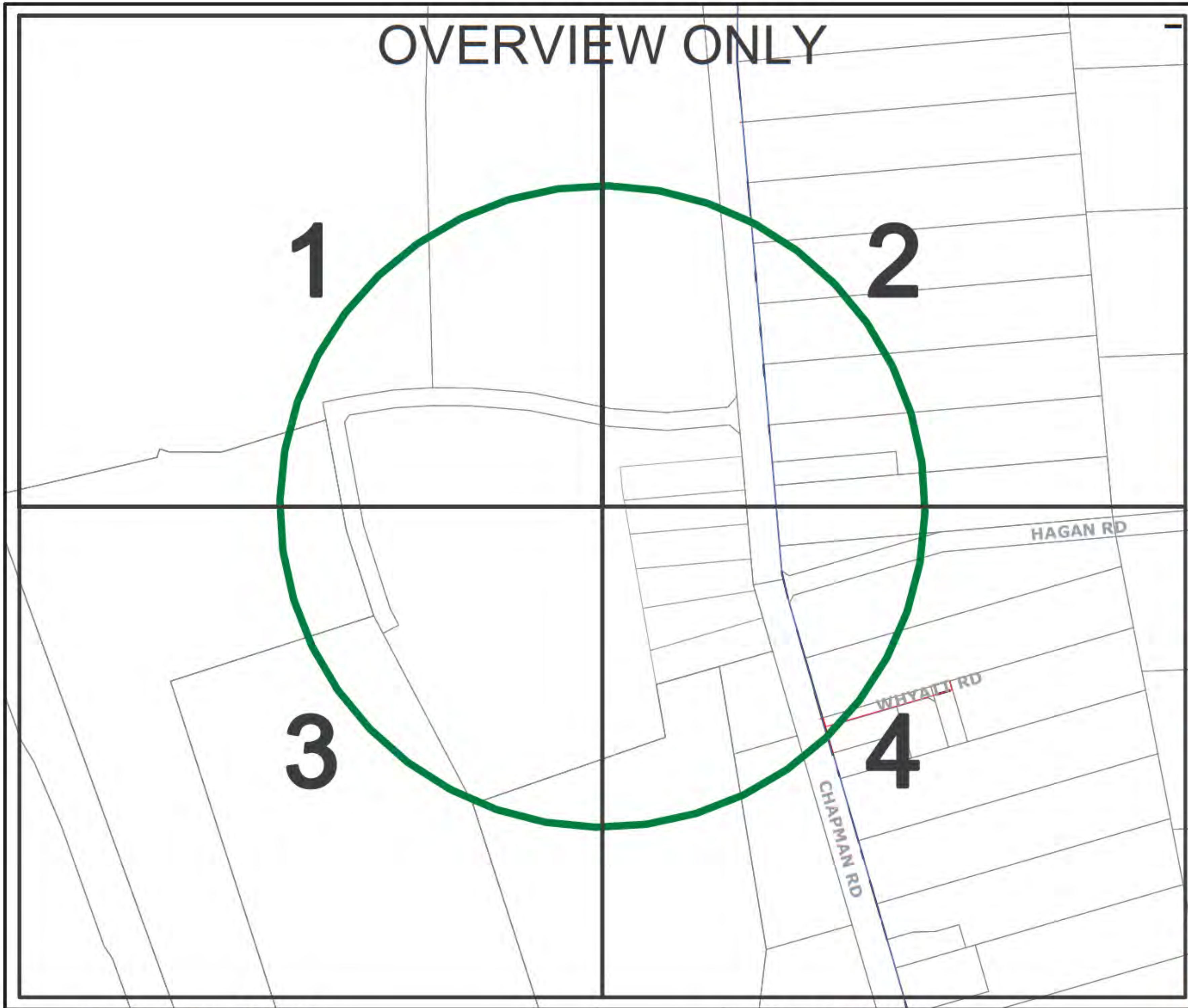
Date of Issue: 7/07/2016

OVERVIEW ONLY



westernpower

UNDERGROUND LEGEND

Structures

- P Pillar
- & Metal Pole
- # Transformer Site
- UG Crossing *
- Ring Main Unit
- LV Distribution Frame

Distribution Cables

- High Voltage Cable (1kV - 33kV)
- Low Voltage Cable (< 1kV)
- Street Light Circuit (< 1kV)
- Street Light Pilot (< 1kV)
- Earth Wire

Cable Pole Terminations

- O HV Termination
- # LV Termination

Proposed Construction Assets

- Design Area *
- High Voltage Underground Cable
- Low Voltage Underground Cable
- Metal Pole
- HV Termination
- Pillar
- LV Termination
- Transformer site

State Underground Power Project

- CURRENT Work Area *
- COMPLETED Area *

Feature

- Area of Interest

*** Please refer to coversheet**

Privately owned cables NOT SHOWN (including house services)

This map is INDICATIVE ONLY. Hand exposure via pothole method is MANDATORY.

Telephone Support: 1 300 769 345 Mon to Fri - 08:00 to 16:30

Information valid for 30 days from date of issue

A4 | Scale : 1:5125

WARNING! Look out for overhead power lines

Sequence Number: 54083210

Date of Issue: 7/07/2016

westernpower

UNDERGROUND LEGEND

Structures

P Pillar
& Metal Pole
# Transformer Site
UG Crossing *
Ring Main Unit
LV Distribution Frame

Distribution Cables

High Voltage Cable (1kV - 33kV)
Low Voltage Cable (< 1kV)
Street Light Circuit (< 1kV)
Street Light Pilot (< 1 kV)
Earth Wire

Cable Pole Terminations

O HV Termination
LV Termination

Proposed Construction Assets

Design Area *
High Voltage Underground Cable
Low Voltage Underground Cable
Metal Pole
HV Termination
Pillar
LV Termination
Transformer site

State Underground Power Project

CURRENT Work Area *
COMPLETED Area *

Feature

Area of Interest

*** Please refer to coversheet**

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westernpower

UNDERGROUND LEGEND

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P Pillar
& Metal Pole
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Low Voltage Cable (< 1kV)
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Street Light Pilot (< 1kV)
Earth Wire

Cable Pole Terminations

O HV Termination
LV Termination

Proposed Construction Assets

Design Area *
High Voltage Underground Cable
Low Voltage Underground Cable
Metal Pole
HV Termination
Pillar
LV Termination
Transformer site

State Underground Power Project

CURRENT Work Area *
COMPLETED Area *

Feature

Area of Interest

*** Please refer to coversheet**

Privately owned cables NOT SHOWN (including house services)

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westernpower

UNDERGROUND LEGEND

Structures

P Pillar
& Metal Pole
Transformer Site
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Ring Main Unit
LV Distribution Frame

Distribution Cables

High Voltage Cable (1kV - 33kV)
Low Voltage Cable (< 1kV)
Street Light Circuit (< 1kV)
Street Light Pilot (< 1kV)
Earth Wire

Cable Pole Terminations

O HV Termination
LV Termination

Proposed Construction Assets

Design Area *
High Voltage Underground Cable
Low Voltage Underground Cable
Metal Pole
HV Termination
Pillar
LV Termination
Transformer site

State Underground Power Project

CURRENT Work Area *
COMPLETED Area *

Feature

Area of Interest

*** Please refer to coversheet**

Privately owned cables NOT SHOWN (including house services)

This map is INDICATIVE ONLY. Hand exposure via pothole method is MANDATORY.

Telephone Support: 1300 769 345
Mon to Fri - 08:00 to 16:30

Information valid for 30 days from date of issue

A4 | Scale : 1:2500

WARNING! Look out for overhead power lines

Sequence Number: 54083210

Date of Issue: 7/07/2016

westernpower

UNDERGROUND LEGEND

Structures

P Pillar | UG Crossing *
& Metal Pole | Ring Main Unit
Transformer Site | LV Distribution Frame

Distribution Cables

High Voltage Cable (1kV - 33kV)
Low Voltage Cable (< 1kV)
Street Light Circuit (< 1kV)
Street Light Pilot (< 1kV)
Earth Wire

Cable Pole Terminations

O HV Termination | # LV Termination

Proposed Construction Assets

Design Area *
High Voltage Underground Cable
Low Voltage Underground Cable
Metal Pole | HV Termination
Pillar | LV Termination
Transformer site

State Underground Power Project

CURRENT Work Area *
COMPLETED Area *

Feature

Area of Interest

*** Please refer to coversheet**

Privately owned cables NOT SHOWN (including house services)

This map is INDICATIVE ONLY.
Hand exposure via pothole method is MANDATORY.

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Mon to Fri - 08:00 to 16:30

Information valid for 30 days from date of issue

A4 | Scale : 1:2500

WARNING! Look out for overhead power lines

Sequence Number: 54083210 | Date of Issue: 7/07/2016

appendix two: western power feasibility study

Feasibility Report

L55 Chapman Rd GLENFIELD

Large Commercial Connection (4 green title lots subdivision)

6/09/2016

Document release information

Client	Pritchard Francis
Project name	NF010116
Document number	40954498
Document title	Feasibility Study Report
Revision status	A

Document prepared by:

Western Power
ABN 18540492861

71 Ewing Street, Bentley 6102

Prepared by:	Reviewed by:
Christophe Vandenhoven	N/A
Senior Distribution Project Designer	

Table of contents

1 Introduction

1.1 Background

Pritchard Francis is intending to develop a large commercial subdivision at L55 Chapman Rd in Glenfield. The estimated site load of 3.5MVA is to be reticulated across 4 green title lots.

1.2 Purpose

3E Consulting Engineers on behalf of Pritchard Francis has submitted a feasibility study request to determine if there is sufficient network capacity for the estimated load; the Western Power scope of works; and the costings.

The proposed outcomes from the feasibility study are:

- Determine if there is sufficient network capacity to supply 3.5MVA;
- Determine Western Power scope of works to supply each green title lot as per the customer's site plan;
- Identify any network constraints;
- Provide cost estimate (+/- 30%) for the Western Power scope of works;
- Provide an indicative time frame for the Western Power scope of works.

1.3 Scope of Study

The activities that will be undertaken to achieve the specified outcomes are:

1. Network configuration assessment;

2. Network Planning assessment;

3. Technical evaluation;

4. Estimate.

2 Study Activities

2.1 Network Configuration Assessment

The proposed development area in Glenfield is shown below in figure 1. The customer's lot is within an 11KV network area and located approximately 3.5km from Chapman Zone Substation (CPN). Two 11KV feeders (CPN316 and CPN336) go pass the proposed development site. The backbone cable on the CPN336 feeder consists of mainly 240mm2 Cu XLPE cable. The backbone conductor on the CPN316 feeder consists of mainly 19/3.25AAAC and 7/4.75AAAC. This area is supplied by CPN 316.0 WAGGRAKINE HV feeder circuit.
There is no existing supply to the customer's lot.

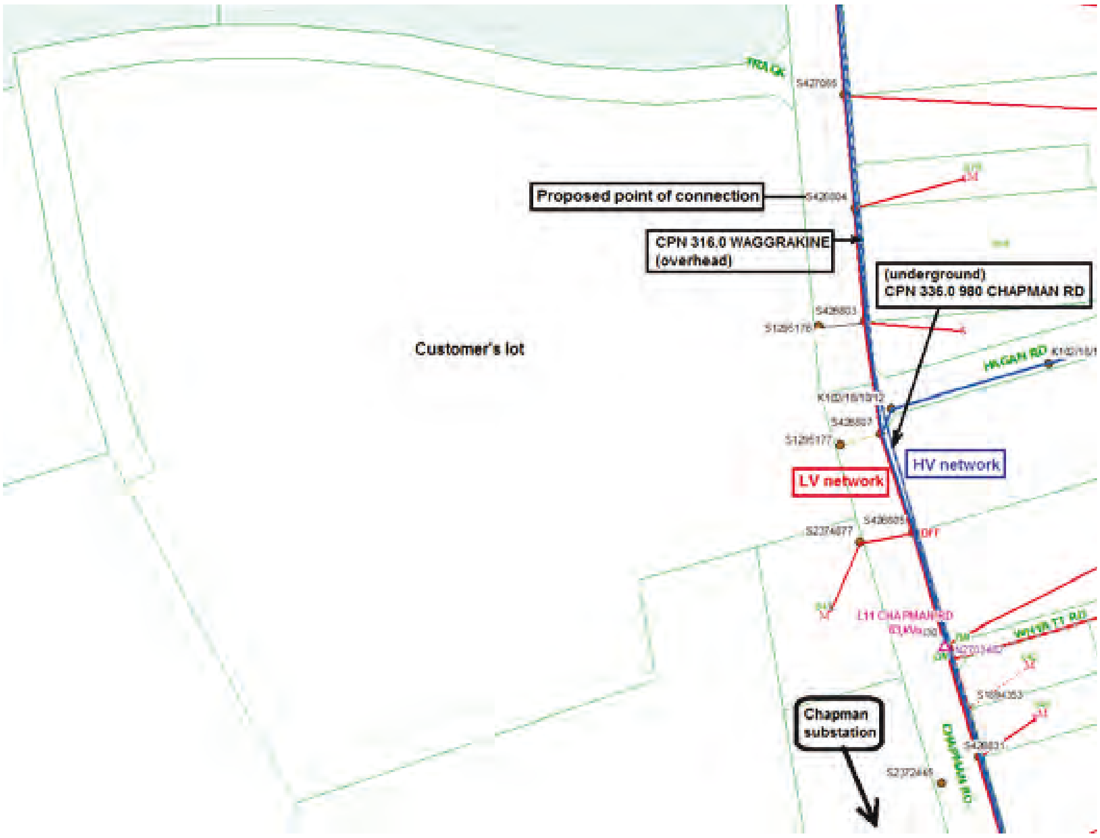


Figure 1

2.2 Network Impact Assessment

From a feasibility assessment perspective, there are adequate spare capacity available on these two feeders to supply the proposed load. It is better to supply the load from 2 feeders. Once Western Power receive a formal request to connect this load, a detail study will be carried out to check for any voltage issue and transmission network constraints.

3 Technical Evaluation

3.1 Overview

The existing lot is vacant. The customer intends to subdivide the lot into 4 green title commercial lots. There will be a mixture of large, medium and small showrooms. Tenants such as Bunnings, City Farmers, BBQ's Galore and other smaller format bulky goods retailers are expected.

3.2 Western Power scope of works

With reference to Figure 2, the Western Power required works are:

- Install 2+2 RMU and two 1MVA transformers between lot 1 and lot 2;
- Install 2+2 RMU and two 1MVA transformers on lot 3 at customer's preferred location;
- Install 400HV cable (pink) from poles S426803 and S426804 to new RMU (L1/L2);
- Remove HV overhead conductors between poles S426803 and S426804;
- Replace poles S426803 and/or S426804;
- Install 2x 400HV cable from 2+2 RMU (L3) to CPN336 HV feeder;
- Cut in CPN336 HV feeder and straight joint each end to the new 400HV cables;
- Install Uni pillar on lot 4 at customer's preferred location;
- Install 240LV cable (red) from 2MVA transformer (L1/L2) to pillar on lot 4;
- Install 240LV cable from 2MVA transformer (L1/L2) to pole S426804 – OFF at transformer.

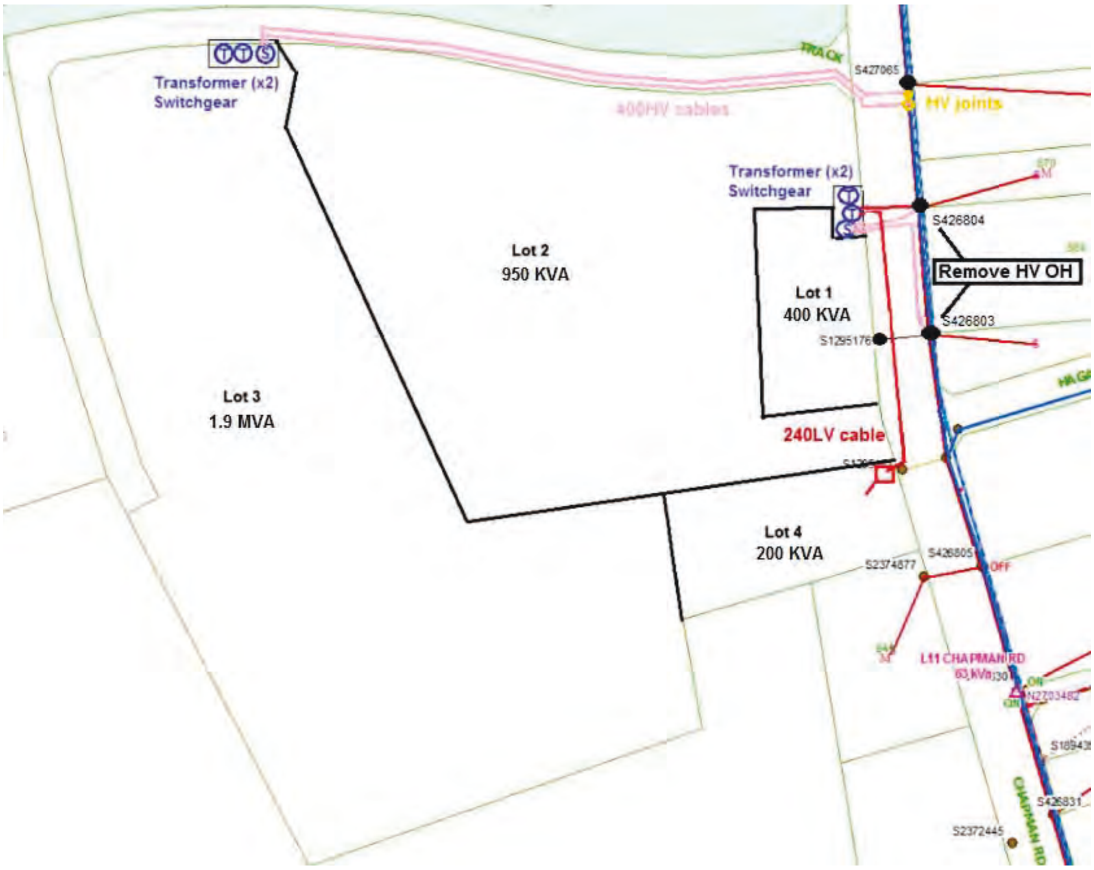


Figure 2

3.3 Western Power Distribution Outdoor Substation Requirements

The proposed substation requirements will be as per DSM 3-06. See details below:

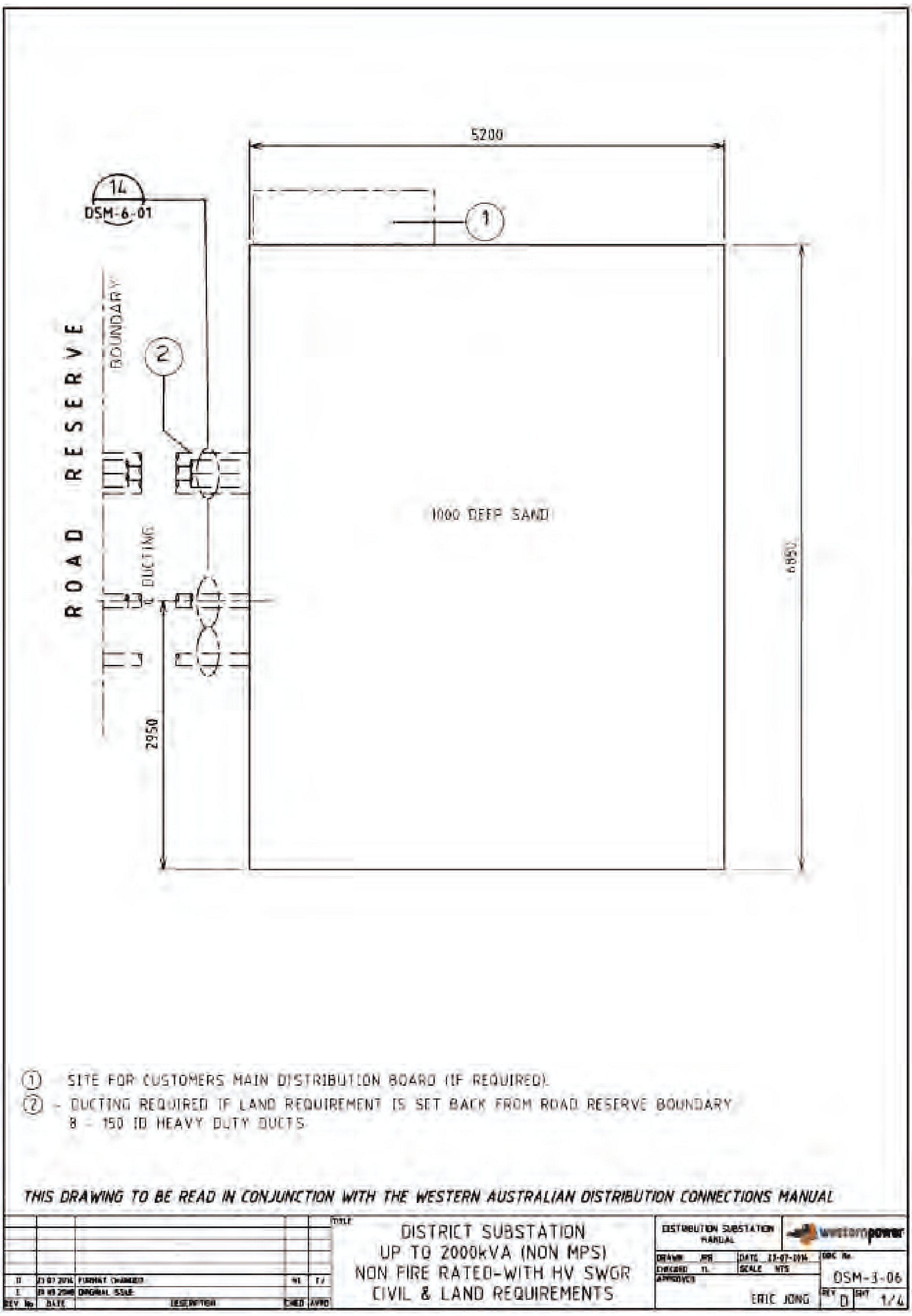


Figure 3

3.4 Customer Contribution for Western Power Works

The estimated customer contribution for the completion of Western Power's works would approximately be **$700,000.00 ±30%**.

Please note:

- this estimate does not include any revenue offset. There is not enough information provided in this application to allow Western Power to forecast any revenue.

- this estimate is based on a desktop review of the required Western Power works associated with implementing this option. This estimate is non-binding and could be subject to change at completion of the Access Offer.

3.5 Assumptions

Based on the scope of works highlighted in this report, it is anticipated that:

- No environmental obstacles will impact on Western Power scope of works;
- No Third party approval(s) will be required;
- Western Power's load assessment is supported by the customer's load breakdown.

3.6 Application Requirements

This project is identified as a major capital project as the overall customer contribution is in excess of $600,000, thus customer needs to contact Western Power access team via the following link:
https://www.westernpower.com.au/media/1606/enquiry-notification-of-proposed-connection-application.pdf
Once completed, please submit the form to: network.access@westernpower.com.au.

4 Conclusions and Recommendations

There is spare capacity on both HV feeders running past the development. Network Planning recommends to share the load between both HV feeders.

Western Power works will include the installation of 2x substation (2+2 RMU and 2MVA transformer), the installation of 4x HV cable (approx. 820m), the installation of 2x LV cable (approx. 140m), 2x HV joint, 3x cable pole termination, the replacement of 2x pole, the removal of a bay of HV conductors and the installation of 1x pillar.

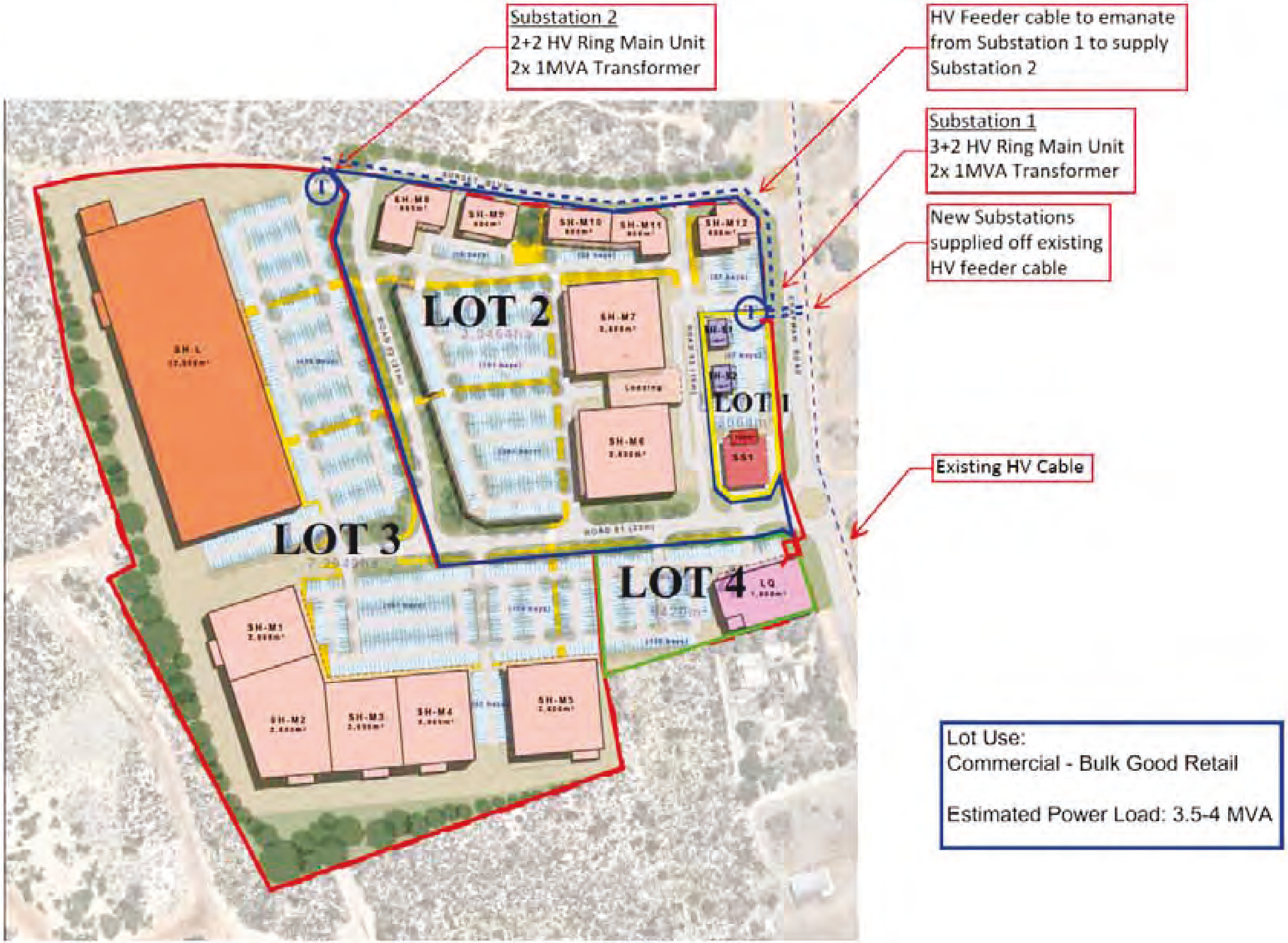
Further studies will be required at design stage to check for any voltage issue and transmission network constraints.

The above presented information is based on the desktop information & is subject to detail design investigation/confirmation. Therefore, the final capital contribution for the requested works will be determined following application for a detailed design and firm access offer.
This project is identified as a major capital project as the overall customer contribution is in excess of $600,000, so in order to proceed ahead with a firm connection proposal & cost, a formal application to Western Power will need to be made by submitting an Access application through Western Power website. Refer to step 1 of attached web link below:
https://www.westernpower.com.au/connections/new-connections/

The timeframe for the completion of such project is around a year - 9 months for the access application process and 3 months for construction.

Disclaimer:
Power systems are dynamic in nature, due to new users and frequent changes in consumer behaviour. As such, Western Power's distribution electricity networks will change over time - this may have a bearing on the amount of reinforcement required to accommodate new developments.
Applicants need to be aware that Western Power's response may become out-of-date, resulting in a significant variation in infrastructure requirements and/or cost.To provide a firm connection proposal and cost, a formal application to Western Power will need to be made, in accordance with current connection policies.

Appendix A - Customer's site plan



appendix three: earthworks

SITE SUMMARY	
SITE AREA	12.2397ha
Bulky Goods Showroom	32,040m² GFA
Service Station	120m² GFA
Liquor Store	1,500m² GFA
TOTAL GFA	33,660m² GFA
TOTAL BAYS REQUIRED	719 bays
TOTAL BAYS PROVIDED	1323 bays

CITY OF GREATER GERALDTON PARKING REQ.	
Bulky Goods Showroom	1 bay per 50m² GFA
Service Station	1 bay per 50m² GFA
Liquor Store	1 bay per 20m² GFA

LOT SUMMARY	
LOT 1	
LOT AREA	0.3564ha
Bulky Goods Showroom	240m² GFA
Service Station	120m² GFA
TOTAL GFA	360m² GFA
TOTAL BAYS REQUIRED	8 bays
TOTAL BAYS PROVIDED	57 bays
LOT 2	
LOT AREA	3.9819ha
Bulky Goods Showroom	8,300m² GFA
TOTAL GFA	8,300m² GFA
TOTAL BAYS REQUIRED	166 bays
TOTAL BAYS PROVIDED	400 bays
LOT 3	
LOT AREA	7.3093ha
Bulky Goods Showroom	23,500m² GFA
TOTAL GFA	23,500m² GFA
TOTAL BAYS REQUIRED	470 bays
TOTAL BAYS PROVIDED	746 bays
LOT 4	
LOT AREA	0.6972ha
Liquor Store	1,500m² GFA
TOTAL GFA	1,500m² GFA
TOTAL BAYS REQUIRED	75 bays
TOTAL BAYS PROVIDED	120 bays

LEGEND

- Site Boundary
- Existing Cadastre
- 10 Existing Contours (2m)
- Indicative Retaining Wall Location
- Vegetation Screening
- Proposed Lot Boundary

- SH Bulky Goods Showroom
- LQ Liquor Store
- SS Service Station
- Pedestrian Route
- Parking Bays
- Road

Development Concept

Lot 55 Chapman Road, Glenfield

Date: 31 October 2016
Scale: 1:2,000 @ A3
Drawing No. 715-528 ST-1 A
Staff: MD_GW

0 20 40m

Level 7, 182 St Georges Terrace
Perth Western Australia 6000
Telephone +61 08 9289 8300
Facsimile +61 08 9321 4786
www.tpgwa.com.au
The Planning Group WA Pty Ltd
ABN 36 097 273 222

Constraints

Lot 55 Chapman Road, Glenfield

Date: 31 October 2016

Scale: 1:2,000 @ A3

Drawing No. 715-528 ST-2 A

Staff: MD_GW

0 20 40m

Level 7, 182 St Georges Terrace
Perth Western Australia 6000

Telephone +61 08 9289 8300
Facsimile +61 08 9321 4786

www.tpgwa.com.au

The Planning Group WA Pty Ltd
ABN 36 097 273 222

pritchard francis

Level 1
430 Roberts Road
PO Box 2150
Subiaco WA 6904

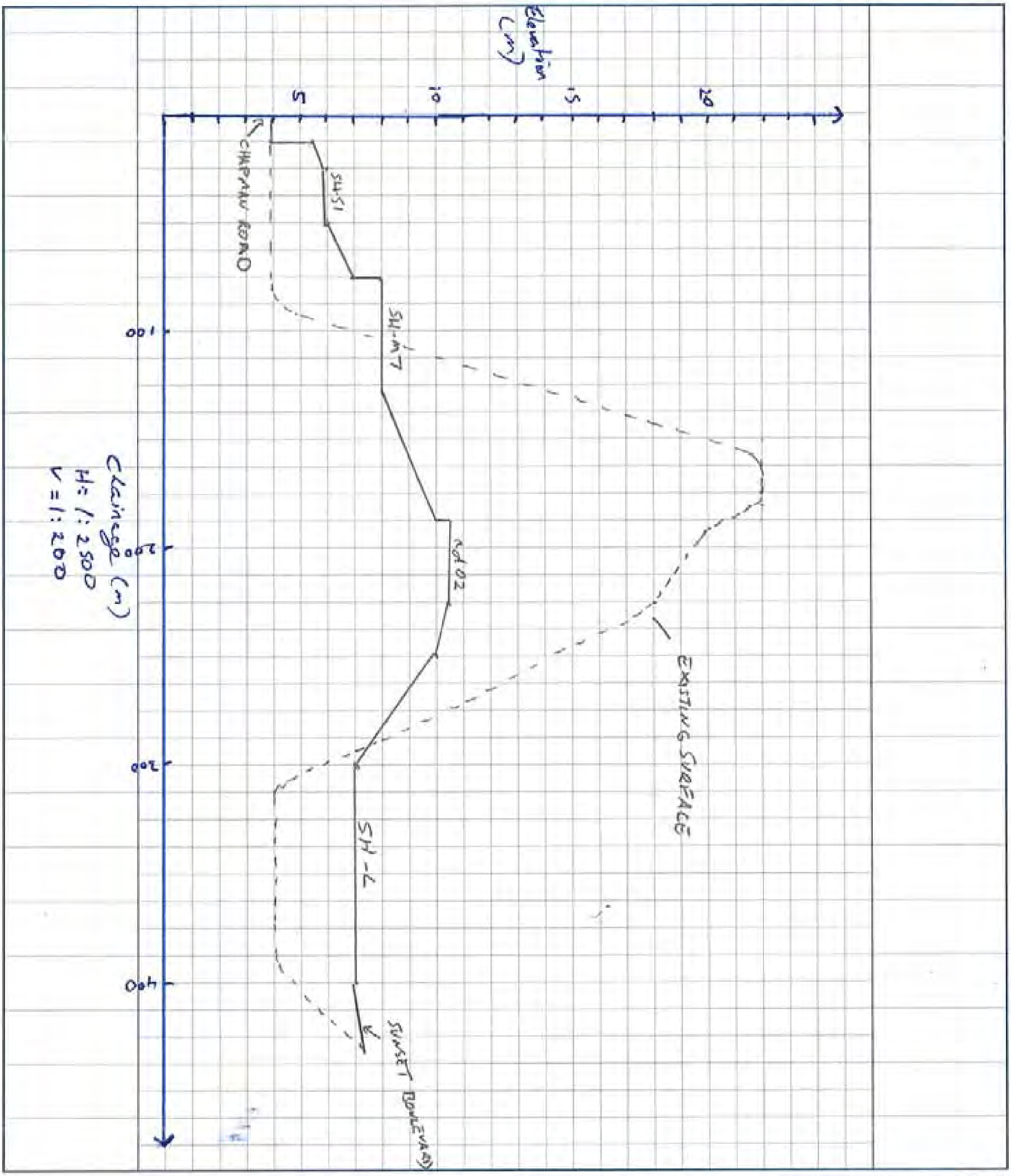
Telephone: (08) 9382 5111
Facsimile: (08) 9382 5199
admin@pfeng.com.au

CALCULATION SHEET

PROJECT: 16-102 Lot 55 Chapman Road, Glenfield - Earthworks Cross-section A

PAGE: 1 / 3

DATE: 26/08/2016 REF NO: appendix 3



pritchard francis

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430 Roberts Road
PO Box 2150
Subiaco WA 6904

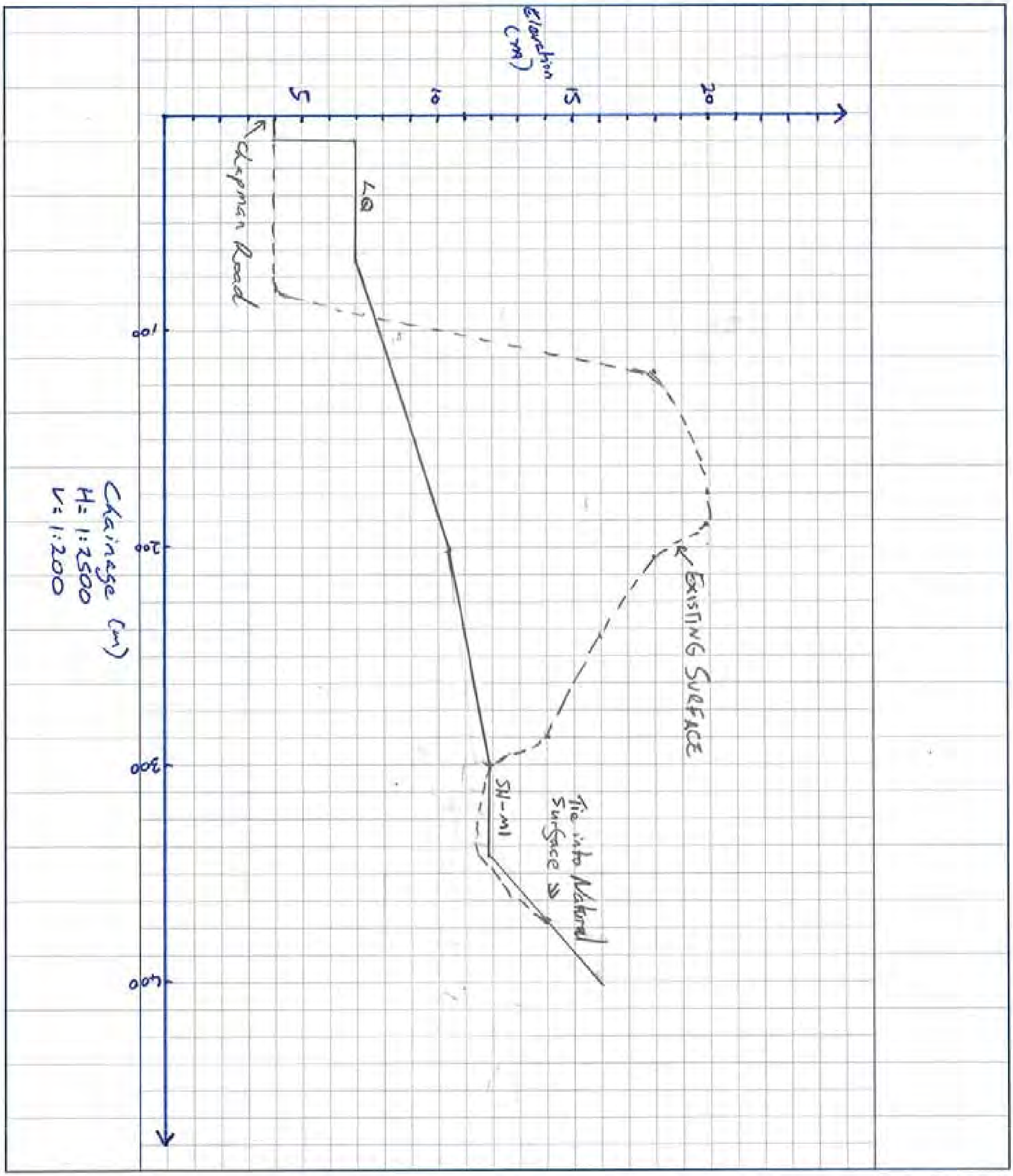
Telephone: (08) 9382 5111
Facsimile: (08) 9382 5199
admin@pfeng.com.au

CALCULATION SHEET

PROJECT: 16-102 Lot 55 Chapman Road Glenfield - Earthworks Cross-Section B

PAGE: 2 / 3

DATE: 26/08/2016 REF NO: appendix 3



Pritchard Francis Pty Ltd
ACN: 008 891 094 ABN: 82 139 830 466

pritchard francis

Level 1
430 Roberts Road
PO Box 2150
Subiaco WA 6904

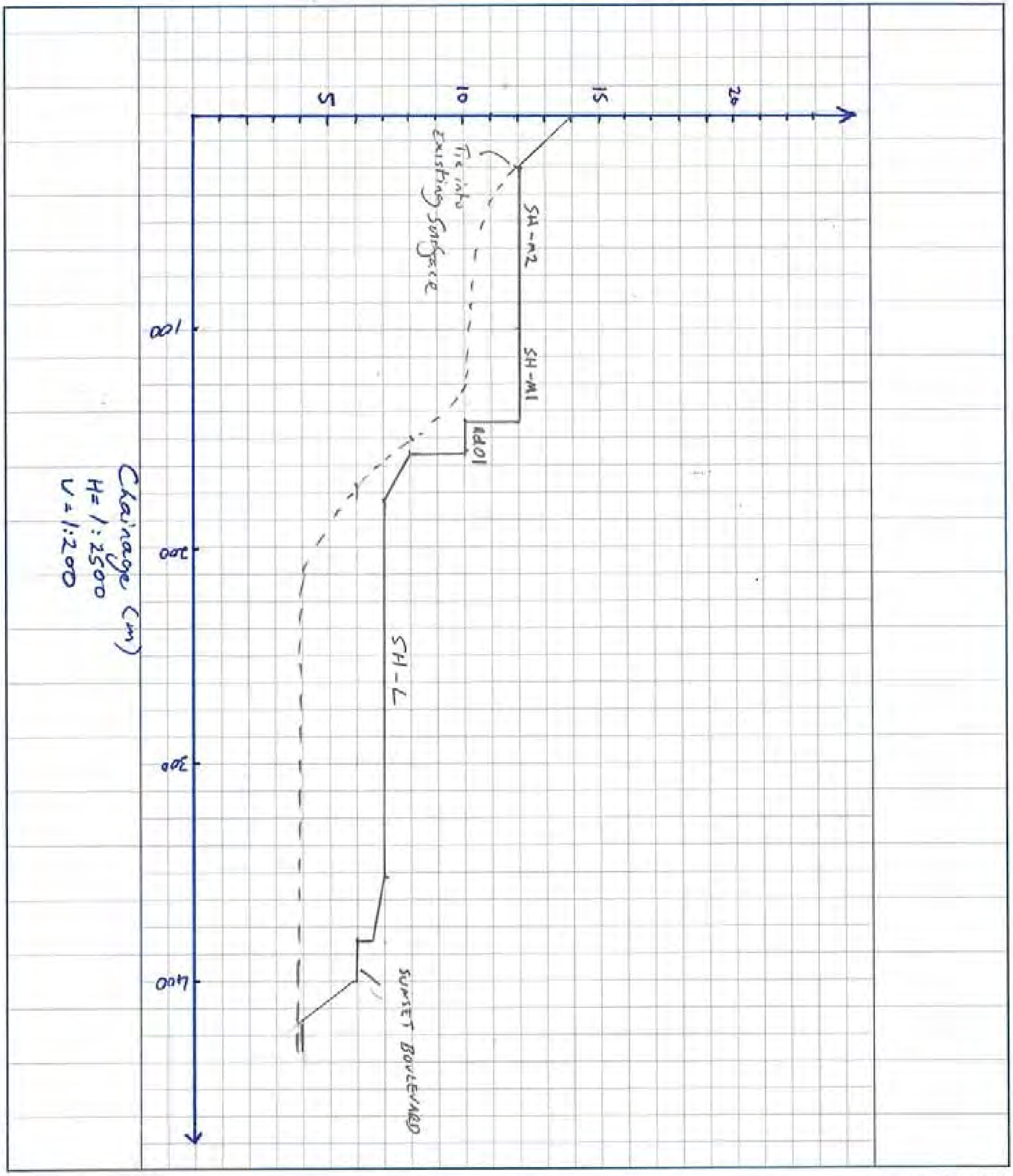
Telephone: (08) 9382 5111
Facsimile: (08) 9382 5199
admin@pfeng.com.au

CALCULATION SHEET

PROJECT: 16-102 Lot 55 Chapman Road, Glenfield - Earthworks Cross-Section C

PAGE: 3 / 3

DATE: 24/08/2016 REF NO: appendix 3



appendix four: road upgrades/ extensions

Plan No.: 14511-17
Revision: REV.3
Scale: 1:3000@A3

FIGURE 9
GLENFIELD DISTRICT ACTIVITY CENTRE PRECINCT CONCEPTUAL MASTERPLAN

whelans TOWN PLANNING

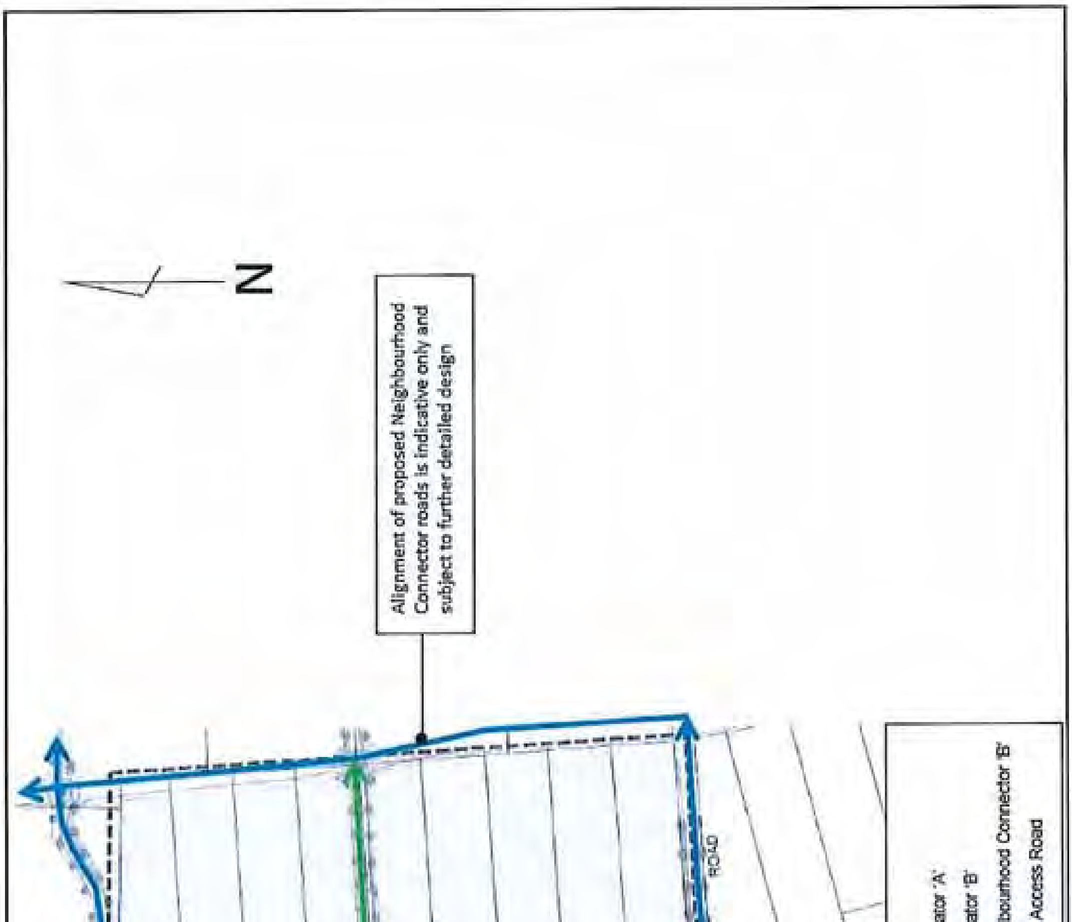


Figure 10. Road Hierarchy for Glenfield District Activity Centre Precinct (Source: AECOM, 2012)

pritchard francis

Level 1
430 Roberts Road
PO Box 2150
Subiaco WA 6904

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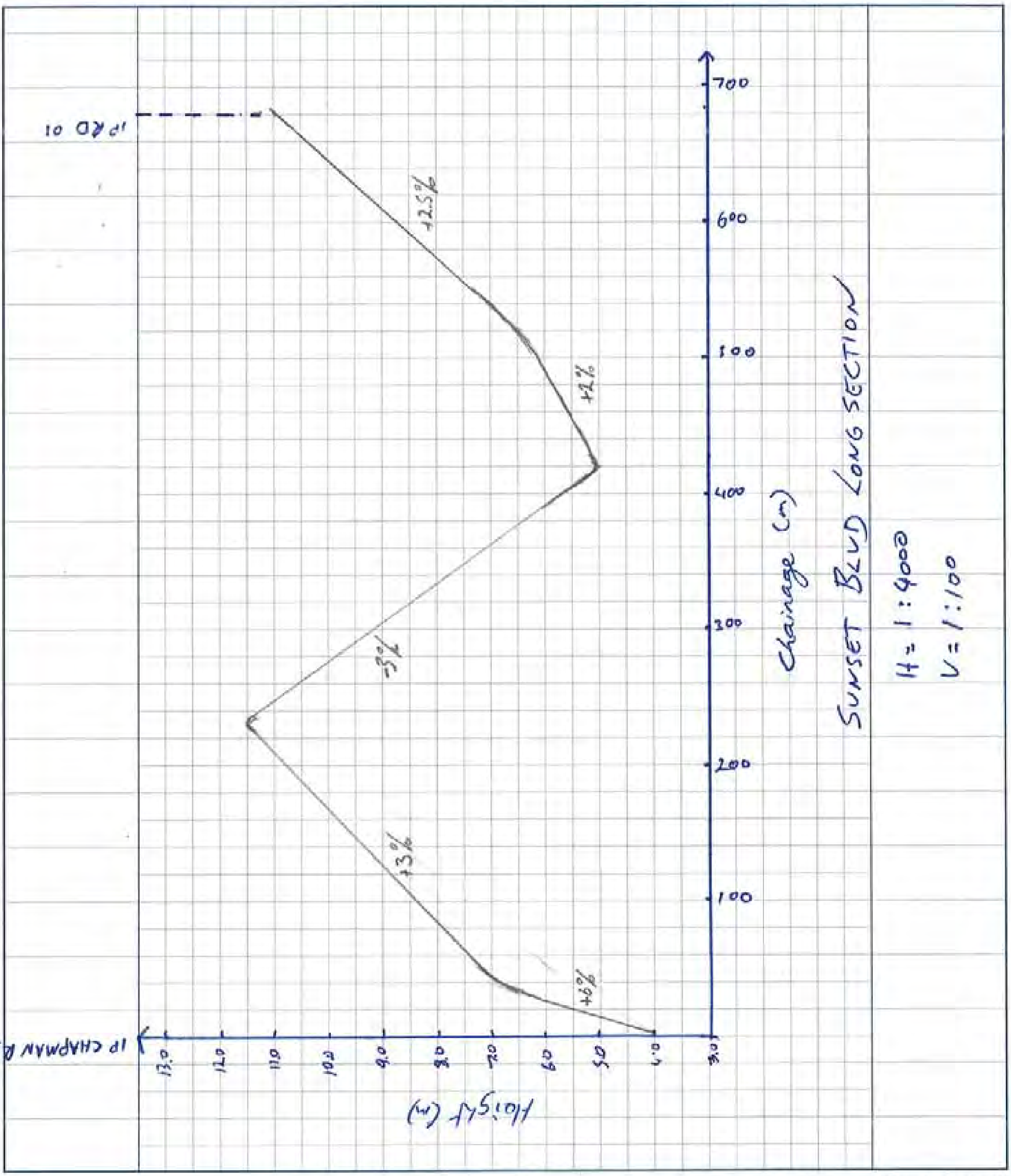
Facsimile: (08) 9382 5199
admin@pfeng.com.au

CALCULATION SHEET

PROJECT: 16-102 Lot 55 Chapman Road Glenfield - Sunset Blvd Longsection

PAGE: 1 /

DATE: 29/8/16 REF NO: appendix 4



appendix five: water corporation correspondence

Aaron Smith

From: Brett Coombes <Brett.Coombes@watercorporation.com.au>
Sent: Friday, July 15, 2016 12:27 PM
To: Aaron Smith
Subject: RE: Lot 55 Chapman Road, Glenfield Request Land Planning Advice
Attachments: Waggrakine SD ww conveyance planning.PNG.PDF

Aaron,

I will leave it to Ian to provide information on the extent of the Glenfield WWTP odour buffer and any limitations on sensitive land uses on this site within the buffer area. Ian's Tel number is 9420-2617.

From a ww planning perspective, the site is located at the far southern end of the Waggrakine Sewer District in the catchment of a future WWPS 'C'. This is a long term transfer station (Type 180) and there are no plans or need to construct it in the short term, so there is currently no detailed catchment plan for this PS. Substantial development around the future WWPS 'C' would likely be required before your site could be gravitated in that direction. You might have to consider private or temporary WWPS arrangements either directly to the WWTP, or into the sewerage network to the north-west (subject to a discharge point being available).

Regards

Brett Coombes
Senior Urban Planner
Assets Planning Group
Water Corporation
***T:** (08) 9420 3165*

From: Aaron Smith [mailto:aaron.s@pfeng.com.au]
Sent: Friday, 15 July 2016 10:56 AM
To: Brett Coombes
Cc: Cory Johnson
Subject: RE: Lot 55 Chapman Road, Glenfiled Request Land Planning Advice

Thanks Brett,

Any chance I can get his contact info off you?

Regards,

Aaron Smith
Engineer - Civil
Pritchard Francis | T (08) 9382 5111

From: Brett Coombes [mailto:Brett.Coombes@watercorporation.com.au]
Sent: Friday, July 15, 2016 10:41 AM
To: Aaron Smith <aaron.s@pfeng.com.au>
Subject: RE: Lot 55 Chapman Road, Glenfiled Request Land Planning Advice

Hi Aaron,

Just to let you that Ian Kininmonth on our team is handling your query, mainly because the site is in or close to the WWTP odour buffer. I will keep in touch with Ian to make sure your question about the roads/no-roads strata options is addressed.

Regards

Brett Coombes
Senior Urban Planner
Assets Planning Group
Water Corporation
***T:** (08) 9420 3165*

From: Aaron Smith [mailto:aaron.s@pfeng.com.au]
Sent: Thursday, 14 July 2016 5:10 PM
To: Brett Coombes
Cc: Cory Johnson
Subject: RE: Lot 55 Chapman Road, Glenfiled Request Land Planning Advice

Hi Brett,

Further to my email below the clients intention is to create 4 separate green title lots with all internal access ways to be dealt with via reciprocal rights of access easement (where necessary) as opposed to creation of public roads. This will of course create several issues with relation to servicing each site with sewer. Are you able to confirm what implications there would be as a result of pursuing the green title option as compared to the strata option?

If you could provide me a copy of the catchment plan for the area in the interim it would be greatly appreciated as well.

Feel free to call me to discuss.

Regards,

Aaron Smith
Engineer - Civil
Pritchard Francis | T (08) 9382 5111

From: Aaron Smith
Sent: Thursday, July 14, 2016 11:49 AM
To: 'brett.coombes@watercorporation.com.au' <brett.coombes@watercorporation.com.au>
Subject: RE: Lot 55 Chapman Road, Glenfiled Request Land Planning Advice

Hi Brett,

I just got some new information from the client regarding the lot layout and possible converting the lot into 4 green title sites rather than a single strata site. Given that some of the site (north west corner) appears to be below the treatment plant to the south where I assume we would have to connect into. I have attached a copy of the latest layout plan for your information as this will factor into your response I would assume.

Regards,

Aaron Smith
Engineer - Civil
Pritchard Francis | T (08) 9382 5111

From: Aaron Smith
Sent: Thursday, July 7, 2016 1:53 PM
To: brett.coombes@watercorporation.com.au
Subject: Lot 55 Chapman Road, Glenfiled Request Land Planning Advice

Hi Brett,

Been trying to do this request online but it is being a pain and not letting me submit the for "We experienced a technical difficulty while processing your request. Your data may not have been correctly saved" and I am uncertain why. Could you help? I am not sure if you helped me with a similar site a couple years back on the same road or not.

The site is Lot 55 Chapman Road, Glenfield (Outer Geradlton) and the client is going through the Local Structure Planning phase for which we are doing the servicing report. The site is approximately 122,000m2 with the area to physical have a building to be around 31,660m2 comprising 17 showrooms on the single lot. The expected flows for water and wastewater are expected to be 2.39L/s and 2.56L/s respectively.

It is intended to construct a mixture of small, medium and large showrooms for bulky goods type stores. We intend to connect into the existing 100AC water main in Chapman Road to supply the subject site with potable water and fire water. It is also intended to construct a sewer to discharge into the existing treatment plant to the west of the site.

Can you please confirm the WC's requirements and confirmation of connection points.

Regards,

Aaron Smith
Engineer - Civil

pritchard francis

T (08) 9382 5111 | E aaron.s@pfeng.com.au | W www.pfeng.com.au
Level 1, 430 Roberts Road, Subiaco WA 6008 | PO Box 2150 Subiaco WA 6904

Aaron Smith

From: Russell Nelson <Russell.Nelson@watercorporation.com.au>
Sent: Monday, August 15, 2016 9:39 AM
To: Aaron Smith
Cc: Ian Kininmonth
Subject: RE: Response - Service feasibility - Lot 55 Chapman Road, Glenfield

Aaron,

Extension of the dn 150 is acceptable but it will need to be taken from the dn150 near the cnr of Moorings Loop and cross connected at Corallina Quays to the dn 100.

Regards

Russell Nelson
Team Leader Headworks Delivery
Development Services

E: Russell.Nelson@watercorporation.com.au

T: (08) 9420 3361

A: 629 Newcastle Street, Leederville, WA 6007
P: PO Box 100, Leederville, WA 6902

Keep in touch **W:** watercorporation.com.au

From: Aaron Smith [mailto:aaron.s@pfeng.com.au]
Sent: Monday, 15 August 2016 9:03 AM
To: Russell Nelson
Cc: Ian Kininmonth
Subject: RE: Response - Service feasibility - Lot 55 Chapman Road, Glenfield

Hi Russell,

Have you heard anything back from the operators regarding the potential extension of a 150mm main up Chapman Road?

Regards,

Aaron Smith
Engineer - Civil
Pritchard Francis | T (08) 9382 5111

From: Russell Nelson [mailto:Russell.Nelson@watercorporation.com.au]
Sent: Friday, August 5, 2016 11:43 AM
To: Aaron Smith <aaron.s@pfeng.com.au>
Cc: Ian Kininmonth <Ian.Kininmonth@watercorporation.com.au>
Subject: RE: Response - Service feasibility - Lot 55 Chapman Road, Glenfield

Aaron,

I have some concerns regarding the extension of retic for your suggested location, the extension if it can occur will need to come from closer to the end of the DN300 to minimise the potential impacts on existing customers.

I am seeking some further advice from the operators in regard to this.

Regards

Russell Nelson
Team Leader Headworks Delivery
Development Services

E: Russell.Nelson@watercorporation.com.au

T: (08) 9420 3361

A: 629 Newcastle Street, Leederville, WA 6007
P: PO Box 100, Leederville, WA 6902

Keep in touch **W:** watercorporation.com.au

From: Aaron Smith [mailto:aaron.s@pfeng.com.au]
Sent: Friday, 5 August 2016 9:27 AM
To: Russell Nelson
Cc: Ian Kininmonth
Subject: RE: Response - Service feasibility - Lot 55 Chapman Road, Glenfield

Hi Russell,

Have you had a chance to investigate this further?

Regards,

Aaron Smith
Engineer - Civil
Pritchard Francis | T (08) 9382 5111

From: Aaron Smith
Sent: Thursday, July 28, 2016 10:39 AM
To: 'Russell Nelson' <Russell.Nelson@watercorporation.com.au>
Cc: Ian Kininmonth <Ian.Kininmonth@watercorporation.com.au>
Subject: RE: Response - Service feasibility - Lot 55 Chapman Road, Glenfield

Russell,

Potable water will not be high (2.4 – 2.6L/s) I would imagine given that it is all mostly showroom space, a liquor store and a service station however it is more the issue of the fire service.

Regards,

Aaron Smith
Engineer - Civil
Pritchard Francis | T (08) 9382 5111

From: Russell Nelson [mailto:Russell.Nelson@watercorporation.com.au]
Sent: Thursday, July 28, 2016 10:33 AM
To: Aaron Smith <aaron.s@pfeng.com.au>
Cc: Ian Kininmonth <Ian.Kininmonth@watercorporation.com.au>
Subject: RE: Response - Service feasibility - Lot 55 Chapman Road, Glenfield

Aaron,

Do you have any indication as to the possible demands for the sites, this may affect the options for extension of the dn150.

Regards

Russell Nelson
Team Leader Headworks Delivery
Development Services

E: Russell.Nelson@watercorporation.com.au

T: (08) 9420 3361

WATER CORPORATION

A: 629 Newcastle Street, Leederville, WA 6007
P: PO Box 100, Leederville, WA 6902

Keep in touch **W:** watercorporation.com.au

From: Aaron Smith [mailto:aaron.s@pfeng.com.au]
Sent: Thursday, 28 July 2016 9:39 AM
To: Russell Nelson
Cc: Ian Kininmonth
Subject: RE: Response - Service feasibility - Lot 55 Chapman Road, Glenfield

Hi Russell,

We are looking into a site located at Lot 55 Chapman Road, Glenfield just north of Geraldton, specifically I wanted to chat to you about a possible interim servicing solution for the site. Currently there is a 100mm main servicing the site which is intended to be subdivided into 4 individual lots servicing commercial bulky goods stores (Bunnings, BBQ's Galour, etc) which require a connection from 150mm main. Given that the extension of the 300mm main is not expected to be completed until late 2020 and there is always the possibility that this gets further delayed, should the client wish to proceed in the meantime they will need to still provide a service to the site and with a 150mm main. The nearest 150mm main that I could find was 1.6km to the south in Corallina Quays. Would the WC accept the extension of this main up the western side of Chapman road running next to the existing Whitworth Street Pressure Main?

I have attached a copy of a plan indicating the proposed extension as well as the development for your information.

Any questions please give me a call.

Regards,

Aaron Smith
Engineer - Civil
Pritchard Francis | T (08) 9382 5111

From: Ian Kininmonth [mailto:Ian.Kininmonth@watercorporation.com.au]
Sent: Tuesday, July 19, 2016 10:46 AM
To: Aaron Smith <aaron.s@pfeng.com.au>
Subject: Response - Service feasibility - Lot 55 Chapman Road, Glenfield

Attention: Aaron Smith

Thankyou for your email dated 7th July 2016 and subsequent email of 14th July 2016. In response I advise as follows:

Water
The site is currently serviced with a 100 main which is unlikely to provide flows and pressures adequate for the size of development proposed. Current planning proposes the extension of a 300 distribution main past the site in the mid to late 2020's (Attachment: wate-plan-dist.pdf). Extension of water services to the site from existing mains will be at the developer's expense.

Wastewater
A number of options may be available to service the site with wastewater services, which could include:

1. Construction of a private pump station (PS) and main to the Geraldton North WWTP which can empty into the WWTP discharge chamber. A private PS could service the proposed 4 lots but only if they are strata titled.
2. Construction of a temporary pump station which could service the 4 freehold lots. This could possibly inject into the WW pressure main located adjacent the subject land, however the feasibility of this would need to be investigated.

The above would be at the developer's expense. Our current planning is also attached (ww-plan.pdf)

WWTP odour buffer
The odour buffer for the Geraldton North WWTP extends over the subject land. This has been recognised as a Special Control Area (SCA) in the City of Greater Geraldton Town Planning Scheme No. 1 gazetted 11 December 2015. Information on land uses which are considered compatible are accessible from this page http://www.watercorporation.com.au/home/builders-and-developers/land-planning/buffers

Please contact me should you require further information. Regards,

Ian Kininmonth
Senior Town Planner
Development Services
Water Corporation
T: (08) 9420 2617

http://www.watercorporation.com.au/home/builders-and-developers/land-planning

appendix six: atco gas correspondence

Aaron Smith

From: Asset Services <Asset.Services@atcogas.com.au>
Sent: Tuesday, August 9, 2016 9:32 AM
To: Searle, Lewis
Subject: RE: Lot 55 Chapman Road, Glenfield

Yes Lewis, you can pass the info on.
It's a MP network so the max pressure they can get is 10kPa.

Regards,
Moh. Hammad
System Management Engineer

ATCO Gas AUSTRALIA | Connecting WA to natural gas

www.atcogas.com.au

81 Prinsep Road, Jandakot, Western Australia, 6164
Telephone: (08)6163 5138
Mobile: 0406332325

From: Searle, Lewis
Sent: Tuesday, 9 August 2016 8:46 AM
To: Asset Services
Cc: Benabbas, Maria; Drawing Office
Subject: RE: Lot 55 Chapman Road, Glenfield

Many thanks Moh; so , are you happy for me to pass on this info 'as is" to client?

He phoned me and was unable to provide any specific load details…

thanks

Thanks

Regards

Lewis Searle
GIS Draughtsman

ATCO Gas AUSTRALIA | Connecting WA to natural gas

www.atcogas.com.au

81 Prinsep Road, Jandakot, Western Australia, 6164

Telephone: (08) 6163 5160

From: Asset Services
Sent: Monday, 8 August 2016 4:04 PM

To: Searle, Lewis
Cc: Benabbas, Maria
Subject: RE: Lot 55 Chapman Road, Glenfield

Hi Lewis,

Modelling is based on 2016 model in severe winter conditions
Metersets in vicinity are loaded with 60% of its capacity
Modelling shows that, the max load that can be supplied to the development from the existing 225PE - MP main in Chapman Rd without reinforcement is 150SCMH (5550 MJ/hr).

Regards,
Moh. Hammad
System Management Engineer

ATCO Gas AUSTRALIA | Connecting WA to natural gas

www.atcogas.com.au

81 Prinsep Road, Jandakot, Western Australia, 6164
Telephone: (08)6163 5138
Mobile: 0406332325

From: Asset Services
Sent: Friday, 5 August 2016 4:34 PM
To: Searle, Lewis; Asset Services; Hammad, Mohamed
Cc: Drawing Office
Subject: RE: Lot 55 Chapman Road, Glenfield

Hi Lewis,

I pass this enquiry as this has to be modelled to check the network capacity to Moh.
He will get back to you soon.

Moh, could you please model the enquiry below from Lewis and respond to him,

Thanks

Regards,
Maria Benabbass
Asset Planning Engineer

ATCO Gas AUSTRALIA | Connecting WA to natural gas

www.atcogas.com.au

81 Prinsep Road, Jandakot, Western Australia, 6164

Telephone: (08) 6163 5137

From: Searle, Lewis
Sent: Friday, 5 August 2016 1:26 PM
To: Benabbas, Maria; Asset Services

Cc: Drawing Office
Subject: FW: Lot 55 Chapman Road, Glenfield

Hi Maria, I just spoke to Aaron on the phone.

All he actually requires at this stage is confirmation that the proposed project (please see attached .pdf's and attached original email form Aaron) can be successfully fed via the adjacent 225mmPE MP main on Chapman Road?

Can you please either let him know or let me know and I will let him know.

Many thanks

Regards

Lewis Searle
GIS Draughtsman

ATCO Gas AUSTRALIA | Connecting WA to natural gas

www.atcogas.com.au

81 Prinsep Road, Jandakot, Western Australia, 6164

Telephone: (08) 6163 5160

From: Searle, Lewis
Sent: Friday, 5 August 2016 1:17 PM
To: 'Aaron Smith'
Cc: Pemberton, Chris; Drawing Office
Subject: RE: Lot 55 Chapman Road, Glenfield

Hi Aaron.

Thanks you for your submission.

Can you please Email us a copy of the common trenching water plan in .pdf format + the precal cadastral file in .dgn or AutoCAD format, version 2000 or earlier please.

You are correct, there is a 225mmPE Medium Pressure main outside this proposed job.

Please also let me know exactly where you will required gas pipes and I will get our engineers to pipe- size this design - only then will ATCO be able to come up with an accurate quote for you to reticulate this project (this job will almost certainly require capital contribution from client as a non-residential job)

Your query will be addressed by Drawing Office.

Regards

Lewis Searle
GIS Draughtsman

ATCO Gas AUSTRALIA | Connecting WA to natural gas

www.atcogas.com.au

81 Prinsep Road, Jandakot, Western Australia, 6164

Telephone: (08) 6163 5160

From: Aaron Smith [mailto:aaron.s@pfeng.com.au]
Sent: Wednesday, 27 July 2016 11:49 AM
To: Searle, Lewis
Subject: Lot 55 Chapman Road, Glenfield

Hi Lewis,

I am currently undertaking a servicing report for Lot 55 Chapman Road, Glenfield just north of Geradlton and just wished to confirm whether there will be any issues servicing the site with gas. The site is expected to be developed into 4 green title lots with each composed of bulky goods stores (Bunnings, BBQ's Galour, etc.) as shown on the attached development concept. Sunset Blvd will be a gazetted road reserve while all internal access ways to be dealt with via reciprocal rights of access easement (where necessary) as opposed to creation of gazetted roads.

Currently there is a 225mm diameter MP main running up Chapman Road which fronts the site. Can you see any issues servicing the site from the existing 225mm dia main in Chapman Rd based on the proposed development option attached?

Regards,

Aaron Smith
Engineer - Civil

pritchard francis

T (08) 9382 5111 | E aaron.s@pfeng.com.au | W www.pfeng.com.au
Level 1, 430 Roberts Road, Subiaco WA 6008 | PO Box 2150 Subiaco WA 6904

pritchard francis

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in You Tube

Appendix B

Environmental Assessment and Management Strategy

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Lot 55 Chapman Rd, Glenfield

Environmental Assessment and Management Strategy

Prepared for
ASDC Pty Ltd
by Strategen

December 2016

Lot 55 Chapman Rd, Glenfield

Environmental Assessment and Management Strategy

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

December 2016

Disclaimer and Limitation

Client: ASDC Pty Ltd

Report Version	Revision No.	Purpose	Strategen author/reviewer	Submitted to Client	
				Form	Date
Preliminary Draft Report	A	Client review	M Dunlop/ L Taylor	Electronic	20/07/2016
Final Report	0	Submission to agencies	M Dunlop/ L Taylor	Electronic	05/08/2016
Revised final report	**1**	**Agency approval**	**M Dunlop/ L Taylor**	**Electronic**	**08/12/2016**

Filename: GPA15162_01 R001 Rev 1 - 7 December 2016

Executive summary

Strategen were commissioned by General Property Assets (GPA) on behalf of ASDC Pty Ltd (ASDC) to prepare an Environmental Assessment and Management Strategy (EAMS) to support a Structure Plan for the proposed development of Lot 55 Chapman Road, Glenfield (Site).

The Site is owned by ASDC and is located approximately 9 km north of the Geraldton City Centre, accessible from Geraldton via Chapman Road and the North West Coastal Highway. The Site is approximately 12.22 ha in size and is proposed to be rezoned as 'service commercial'.

The EAMS has been prepared to:

- describe the existing natural environment within the Site and its immediate surrounds
- identify any potential impacts to the environment resulting from the development of the Site in accordance with the proposed Site Development Concept
- identifying potential management actions required to minimise impacts resulting from the development
- identifying any environmental constraints to the development of the Site.

A summary of the environmental opportunities and constraints of the Site is presented in Table ES 1. The Site is considered to have limited constraints for commercial use. Identified minor constraints relating to acid sulphate soils (ASS), limited potential flooding and bushfire risk can be adequately managed through appropriate design and construction measures. Based on the assessment undertaken, development of the Site is not anticipated to significantly impact the environment.

Table ES 1: Summary of environmental impacts and management

Environmental attributes and values	Opportunities and constraints	Key potential impacts	Management commitments
Acid sulfate soils (ASS)	• eastern part of the Site is mapped as having a moderate to high risk of ASS.	• impacts on soil, groundwater and surface water acidity if dewatering and/or excavation of ASS are present and not appropriately managed.	• ASS investigation and management if required. • investigation and management of ASS will be in accordance with DER guidance any treatment requirements will be approved by DER.
Contaminated sites	• no known contaminated sites within 1 km of the Site. • limited illegal 'fly tipping' has occurred on the Site.	• potential for hydrocarbon spills during construction.	• preparation of a Construction Environmental Management Plan (CEMP) to manage risk of hydrocarbon spills. • material illegally dumped on the Site will be removed prior to construction.
Hydrology	• the Site is not constrained by groundwater. • the north-eastern corner of the site and some adjacent sections of Chapman Road may be inundated in the 1 in 100 year Average Return Interval (ARI) event.	• the development has the potential to negatively impact upon groundwater quality through infiltration of stormwater that may contain pollutants such as nutrients and hydrocarbons. • the development of the Site may result in limited increases in winter groundwater levels due to reduced evapotranspiration and increased runoff from hard surfaces.	• UWMP to be prepared at the development application stage, detailing stormwater treatment measures. • the UWMP should address flooding of the site and adjacent sections of Chapman Road.
Flora and vegetation	• no Threatened Ecological Communities (TEC), priority or threatened flora have been identified within the Site.	• clearing of approximately 11.4 ha of native vegetation. • unauthorised vehicle access may damage vegetation and spread weeds. • accidental clearing during construction.	• a CEMP will be prepared before the commencement of the construction to manage indirect impacts to vegetation.
Fauna	• no habitat for conservation significant terrestrial fauna species has been identified within the Site.	• clearing of approximately 11.4 ha of native vegetation resulting in the loss or fragmentation of fauna habitat and consequent displacement of fauna. • vehicle and heavy machinery movements during clearing and construction may result in fauna strike causing injury or death to individuals.	• a CEMP will be prepared before the commencement of the construction to minimise risk to fauna during construction.
Aboriginal and European heritage	• no known Aboriginal or European heritage sites in the vicinity of the Site.	• disturbance of potential Aboriginal Heritage sites during clearing and earthworks associated with the development of the Site.	• a CEMP will be prepared as part of the subsequent development application process. • if an Aboriginal heritage site is found during the works, it will be managed in a manner consistent with the AH Act.
Fire	• the Site is located adjacent to bushland which poses a potential fire risk.	• due to the extent of adjacent vegetation, the Site is designated as 'bushfire prone' which poses a risk to future development.	• fire risks will be managed according to the Bushfire Management Plan (BMP) which is provided in Appendix 3.
Odour	• the Site is located in the vicinity of the Geraldton North Wastewater Treatment Plant (GNWWTP).	• potential minor impact of odour on the development.	• numerical modelling will be undertaken of wind flows to identify optimal locations of air conditioning makeup ventilation ducts and building and site design to maximise dilution of odours. • placement of vegetation screening around the western and southern boundaries of the Site, incorporating a mix of tall trees (taller than the buildings), large and smaller shrubs, and fragrant smelling flowering plants.

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1. Introduction

Lot 55 Chapman Road, Glenfield (the Site) is owned by ASDC Pty Ltd (ASDC). The Site is located approximately 9 km north of the Geraldton City Centre and can be accessed from Geraldton via Chapman Road and the North West Coastal Highway (Figure 1). The Site is approximately 12.22 ha in size and is currently zoned 'urban development' under the City of Greater Geraldton (CoGG) Local Planning Scheme No. 1. The Site is proposed to be rezoned as 'service commercial'. A Structure Plan has been prepared by Town Planning Group (TPG) to allow for development of the Site as a commercial precinct.

The Project proposes the development of the Site for commercial purposes, including showrooms, a service station and a liquor store and associated parking (Figure 2).

1.1 Purpose of document

Strategen were commissioned by General Property Assets (GPA) on behalf of ASDC to prepare an Environmental Assessment and Management Strategy (EAMS) to support Structure Planning for the Site. EAMS presents the findings of an environmental assessment undertaken to facilitate the development of Lot 55 Chapman Road (the Project).

The objective of this EAMS is to:

- describe the existing natural environment within the Site and its immediate surrounds
- identify any potential impacts to the environment resulting from the development of the Site in accordance with the proposed Site Development Concept
- identifying potential management actions required to minimise impacts resulting from the development
- identifying any environmental constraints to the development of the Site.

This EAMS considers the following environmental factors which have the potential to be impacted upon by the development:

- soils and geology
- hydrology
- flora and vegetation
- fauna
- heritage
- odour.

To aid in the assessment of environmental factors, Strategen was also previously commissioned by GPA on behalf of ASDC to undertake a flora and vegetation assessment, fauna habitat assessment, acid sulfate soils (ASS) inspection and odour assessment within the Site (Strategen 2013, 2014).

Figure 1: Site location

Scale 1:50,000 at A4

0 500 1,000 1,500 m

N

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 18/07/2016
Author: JCrute
Source: Aerial image: ESRI 2013.
Roads: Main Roads 2013.

Legend

- Town
- Roads
- Lot 55 (Site)

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www.strategen.com.au

Path: Q:\Consult\2015\GPA\GPA15162\ArcMap_documents\R001\RevA\GPA15162_01_R001_RevA_F001.mxd

SITE SUMMARY	
SITE AREA	12.2397ha
Bulky Goods Showroom	32,040m² GFA
Service Station	120m² GFA
Liquor Store	1,500m² GFA
TOTAL GFA	33,660m² GFA
TOTAL BAYS REQUIRED	719 bays
TOTAL BAYS PROVIDED	1323 bays

CITY OF GREATER GERALDTON PARKING REQ	
Bulky Goods Showroom	1 bay per 50m² GFA
Service Station	1 bay per 50m² GFA
Liquor Store	1 bay per 20m² GFA

LOT SUMMARY	
[illegible]	
LOT AREA	0.3564ha
Bulky Goods Showroom	240m² GFA
Service Station	120m² GFA
TOTAL GFA	360m² GFA
TOTAL BAYS REQUIRED	8 bays
TOTAL BAYS PROVIDED	57 bays
[illegible]	
LOT AREA	3.9819ha
Bulky Goods Showroom	8,300m² GFA
TOTAL GFA	8,300m² GFA
TOTAL BAYS REQUIRED	166 bays
TOTAL BAYS PROVIDED	400 bays
[illegible]	
LOT AREA	7.3093ha
Bulky Goods Showroom	23,500m² GFA
TOTAL GFA	23,500m² GFA
TOTAL BAYS REQUIRED	470 bays
TOTAL BAYS PROVIDED	746 bays
[illegible]	
LOT AREA	0.6972ha
Liquor Store	1,500m² GFA
TOTAL GFA	1,500m² GFA
TOTAL BAYS REQUIRED	75 bays
TOTAL BAYS PROVIDED	120 bays

LEGEND

- Site Boundary
- Existing Cadastre
- Existing Contours (2m)
- Indicative Retaining Wall Location
- Vegetation Screening
- Proposed Lot Boundary
- SH Bulky Goods Showroom
- LQ Liquor Store
- SS Service Station
- Pedestrian Route
- Parking Bays
- Road

Source: TPG

Figure 2: Development concept plan

strategen

This page is intentionally blank

Figure 3: Land use

Scale 1:5,000 at A4

0 25 50 75 100 m

N

Legend

Site

Existing cadastre

Coordinate System: GDA 1994 MGA Zone 50

Note that positional errors may occur in some areas

Date: 19/07/2016

Author: JCrute

Source: Aerial image: ESRI online, approx. 2014. Existing cadastre: SLIP, Landgate 2016.

strategen ENVIRONMENTAL

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

Path: Q:\Consult\2015\GPA\GPA15162\ArcMap_documents\R001\RevA\GPA15162_01_R001_RevA_F003.mxd

2. Legislative context

2.1.1 State and federal legislation

This environmental assessment has been conducted with reference to the following Australian and Western Australian legislation which provides for the environmental values addressed within this EAMS:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) – Australian Government
- *Wildlife Conservation Act 1950* (WC Act) – State
- *Environmental Protection Act 1986* (EP Act) – State
- *Biosecurity and Agriculture Management Act 2007* (BAM Act) – State
- *Rights in Water and Irrigation Act 1914* (RIWI Act) - State
- *Conservation and Land Management Act 1984* (WA) (CALM Act) - State
- *Aboriginal Heritage Act 1972* (WA) (AH Act) - State
- *Contaminated sites Act 2003* (CS Act) - State
- Environmental Protection (Noise) Regulations 1997.

2.1.2 Regulatory guidance

The assessment has been designed to address the recommendations of the State regulatory guidance as described in the following:

- EPA Environmental Assessment Guideline No 8. *Environmental Assessment Guideline for Environmental factors and objectives* (EPA 2013)
- EPA Position Statement No. 2 *Environmental Protection of Native Vegetation in Western Australia* (EPA 2000)
- EPA Position Statement No. 3 *Terrestrial Biological Surveys as an Element of Biodiversity Protection* (EPA 2002)
- EPA Position Statement No. 10 *Level of Assessment for Proposals Affecting Natural Areas Within the System 6 Region and Swan Coastal Plain Portion of the System 1 Region* (EPA 2006)
- EPA Guidance Statement No. 51 *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004)
- EPA Guidance Statement No. 33 *Environmental Guidance for Planning and Development* (EPA 2008)
- State Planning Policy 2.6 *State Coastal Planning Policy* (SPP 2.6)
- State Planning Policy 3.7 *Planning in Bushfire Prone Areas* (SPP 3.7)
- State Planning Policy 5.4 *Road and Rail Transport Noise and Freight Considerations In Land Use Planning*, Section 5.3 – Noise Criteria
- *Assessment and Management of Contaminated Sites guidelines* (DER 2014)
- *Contaminated Sites Regulations 2006* (CS regulations)
- *Acid Sulfate Soils Planning Guidelines* (WAPC and DPI 2008).

3. Existing environment

3.1 Land use

The Site is currently bushland and is surrounded by the following land uses:

- north: bushland and then urban residential development
- east: Chapman Road and then rural residential living
- south: bushland and to the south-west, Geraldton North Wastewater Treatment Plan (GNWWTP)
- west: bushland and then the Indian Ocean (Figure 3).

3.2 Climate

The Site is located within the mid-west region of Western Australia. At a finer scale, it falls within the Northern Sandplains Region of Western Australia which extends approximately from Shark Bay to Jurien along the coast and inland to Badgingarra. The Climate is described as dry warm Mediterranean, with an average of 446 mm/yr rainfall and on average six months with less than 20 mm rainfall each year (Figure 4).

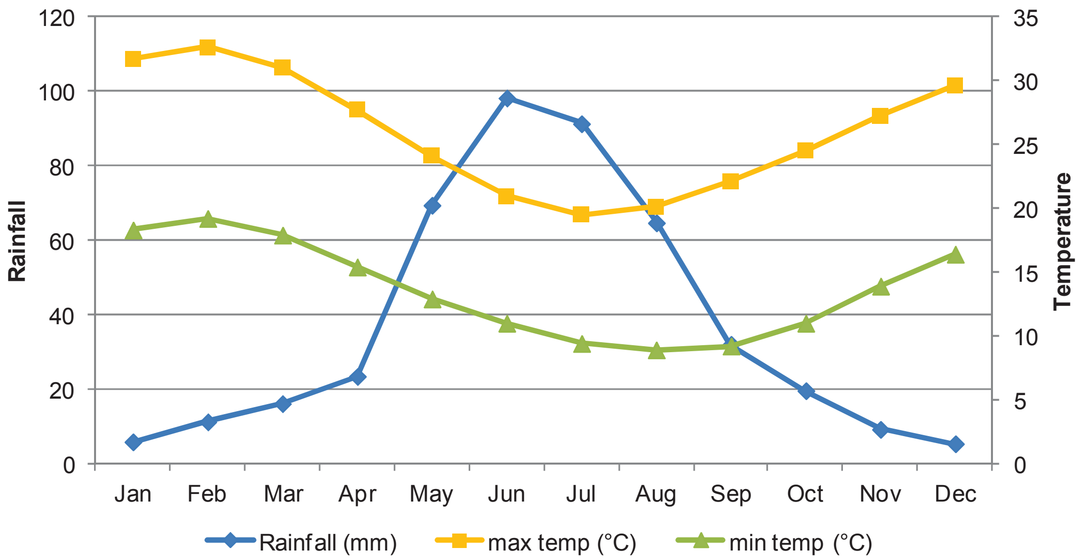

Figure 4: Mean monthly climatic data (temperature and rainfall) for Geraldton Airport

The wind pattern within the region is largely a result of the land-sea interface which results in easterly land breezes in the morning, followed up by south to south-westerly sea breezes in the late morning to afternoon in the warmer months (BOM 2014). During the winter months, wind patterns are most commonly influenced by cold fronts moving east over the land mass from the Indian Ocean.

3.3 Topography

The Site is located on the northern extent of the Swan Coastal Plain, which forms the central portion of the Perth Basin.

The Site is defined by variable topography ranging from approximately 4 meters Australian Height Datum (mAHD) along the eastern boundary to a maximum height of approximately 22 mAHD on the central dune ridge, which extends in a north-south direction (Figure 5).

3.4 Soils and geology

The Perth Basin is sedimentary in origin and is marginal to the west of the Australian Shield.

Regional geology is generally comprised of a coastal system and an inland system. The Site is within the coastal system comprising undulating Holocene shoreline deposits (Quindalup Dune System) underlain by the older Pleistocene consolidated dune system of the Tamala Limestone (Spearwood Dune System) (Dye *et al* 1990).

Dye *et. al* (1990) identifies four soil types across the Site:

1. *Quindalup Central Stable Parabolic Dune* – this soil association is found across the majority of the Site and is described as a large scale parabolic dune with relief 20 to 40 m on Aeolian calcareous sands and minor limestone in the north coastal plain. It is generally calcareous, deep sand.
2. *Quindalup Central Swale* – this soil association is found within the north-western portion of the Site and is described as gently undulating plains surrounded by parabolic dunes on Aeolian calcareous sands and minor limestone in the north coastal plain. It is also comprised of calcareous, deep sand.
3. *Tamala South Grey-Brown Sand* – this soil association is found in the north-eastern portion of the Site, adjacent to Chapman Road, and is described as mid to lower slopes of Tamala limestone ridges and some isolated rises on Lithified Pleistocene calcareous dune deposits and recent calcareous sands. It is generally calcareous, deep and shallow sands.
4. *Tamala South Red Sand* – this soil association is found within the south-eastern portion of the Site, adjacent to Chapman Road and described as lower lying and swale areas on Lithified Pleistocene calcareous dune deposits and recent calcareous sands. It is generally considered to consist of deep, red sand (Figure 6).

3.4.1 Acid sulfate soils

ASS are naturally occurring, iron-sulfide rich soils, sediments or organic substrates, formed under waterlogged conditions. If exposed to air, these sulfides can oxidise and release sulfuric acid and heavy metals. This process can occur due to drainage, dewatering or excavation.

Planning Bulletin No. 64 (WAPC 2003) issued by the West Australian Planning Commission (WAPC) is used to determine the potential risk of ASS occurring in the vicinity of a site. The eastern boundary of the Site has been mapped to contain one area of 'high to moderate risk' of Actual Acid Sulfate Soils (AASS) or Potential Acid Sulfate Soils (PASS) occurring at depths of less than 3 m below the natural surface (Figure 6).

The remainder of the Site is classified as 'low to no risk' of PASS or AASS occurring at depths greater than 3 m.

3.4.2 Contaminated Sites

A review of the Department of Environment Regulation (DER) Contaminated Sites Database indicates that there are no known contaminated sites within 1 km of the Site.

The site is vacant bushland and is considered to represent a low risk of contamination. Limited unauthorised dumping ('fly tipping') has occurred adjacent to tracks on the site (Emerge 2012, Strategen 2013).

Source: TPG

Figure 5: Topography

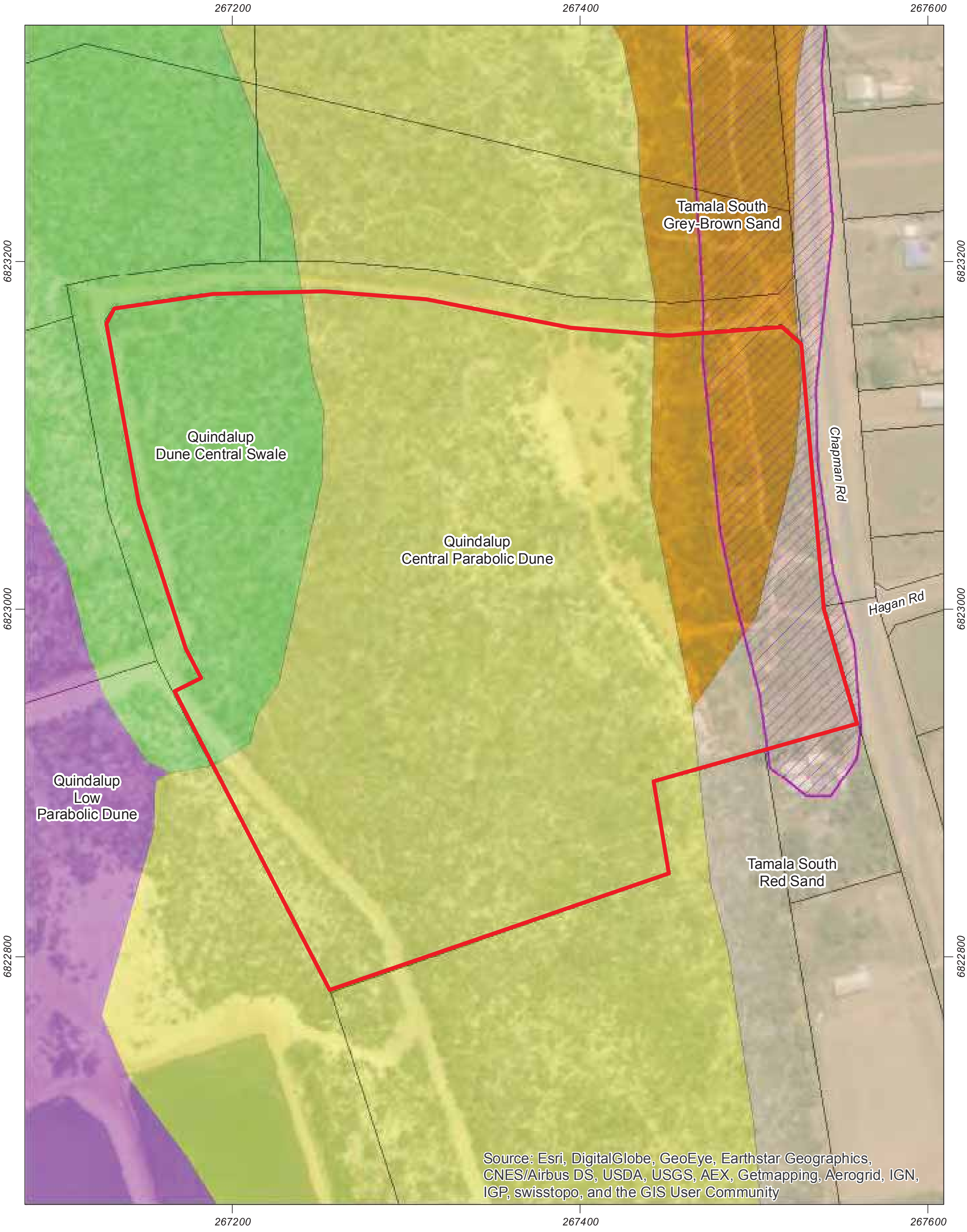

Figure 6: Soils

Coordinate System: GDA 1994 MGA Zone 50

Note that positional errors may occur in some areas

Date: 19/07/2016

Author: JCrute

Source: Aerial image: ESRI online, approx. 2014. Existing cadastre: SLIP, Landgate 2016. Soils: DAFWA 2014. ASS: DER 2014.

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3.5 Hydrology

3.5.1 Surface water and wetlands

There are no permanent surface water features on the Site.

Buller River is located approximately six kilometres north of the Site, while Dolby Creek, a tributary of Buller River is located approximately three kilometres north of the site, with a blind creek system extending south from Dolby Creek, but ceasing approximately 250 metres north of the Site.

The land directly to the north contains an ephemeral surface water feature locally known as “Rum Jungle”. Rum Jungle is a naturally formed alluvial flat which is a palusplain, maintained by rainfall and drainage from Dolby Creek to the north of the Site and seepage from coastal dunes (Tauss 2002).

During the 1 in100 year ARI event, floodwaters from Dolby Creek enter Rum Jungle and are anticipated to result in limited inundation in the north-eastern corner of the Site (Wray K [DoW] 2015, pers. comm. June 18). The floodway of Dolby Creek (area of fast flowing water) is not anticipated to enter the Site.

3.5.2 Groundwater

The Site is located within the Arrowsmith Groundwater Area and the Dongara Subarea (DoW 2014). Emerge (2012) indicates that groundwater within the Dongara subarea ranges between two and 15 meters below ground level, with the majority of recharge derived from rainfall and surface runoff. Groundwater generally flows in a westerly direction and discharges into the Indian Ocean via a seawater interface. Overall, groundwater is expected to be shallower in the eastern portion of the Site. The Site is not located within a Public Drinking Water Source Area (PDWSA).

A search of the Water Register (DoW 2016) indicates that groundwater is available for allocation in the superficial aquifer in the area.

3.6 Coastal processes

The Site is located more than 300 metres from the horizontal shoreline datum, and thus *State Planning Policy No. 2.6 State Coastal Planning Policy* (SPP 2.6) is not applicable.

3.7 Terrestrial flora and vegetation

3.7.1 Regional vegetation

The Site occurs within the Geraldton Sandplains Interim Biogeographical Regionalisation for Australia (IBRA) subregion which is dominated by endemic rich, proteaceous scrub heaths on sandy earths of extensive, undulating and lateritic sandplains (CALM 2002). The subregion also consists of sand heaths with emergent *Banksia* and *Callitris, Eucalyptus loxophleba* woodlands on alluvial plains, proteaceous heath and *Acacia* scrubs on limestone and low closed shrubland of *Acacia rostellifera* on alluvial plains of the Greenough and Irwin Rivers.

The Geraldton Regional Flora and Vegetation Survey (GRFVS) describes broad scale vegetation types within a study area encompassing Geraldton and its surrounds. Vegetation in the vicinity of the Site falls within vegetation types that are described as *Acacia rostellifera* shrublands on coastal and near coastal areas as well as drainage lines dominated by *Eucalyptus camaldulensis* subsp. *obtusa, Casuarina obesa* and *Melaleuca rhaphiophylla* (DoP 2010).

3.7.2 Studies and investigations

Desktop assessment

A desktop assessment was undertaken for Threatened and Priority flora that may potentially occur within the Site using NatureMap (DEC 2007), the Western Australian Herbarium (DPaW WAHERB 2013), and Department of the Environment (DoTE) (2013a). The earlier Emerge (2012) field investigation report was also used to inform the desktop assessment.

Flora and vegetation surveys

An initial site reconnaissance survey was undertaken by Emerge in 2012 (Emerge 2012) to verify the mapping presented in the GRFVS. The survey also included an assessment of the potential vegetation and flora values of the Site and vegetation condition.

Strategen undertook a Level 2 Terrestrial Flora and Vegetation Survey in November 2013 in accordance with EPA Guidance Statement No. 51 (EPA 2004). Strategen (2014a) outlines the results of both the desktop and field assessment and is provided in Appendix 1.

3.7.3 Findings of studies and investigations

Vegetation

Strategen (2014a) identified two Vegetation Types (VTs) within the Site which are summarised below (Table 1; Figure 7).

Table 1: Vegetation Types

Vegetation Type	Description
S1	Low open shrubland of *Acacia rostellifera, Stylobasium spathulatum* and **Lycium ferocissimum* over *Rhagodia baccata, Ptilotus divaricatus* subsp. *divaricatus, Threlkeldia diffusa, Acanthocarpus preissii* and **Sonchus oleraceus* on low backdunes.
S2	Degraded Mid open shrubland of *Acacia rostellifera* and **Lycium ferocissimum* over *Enchylaena tomentosa* and **Avena barbata* on gravel and sandy soils between backdunes and drainage lines.
C*	Cleared areas.

* Cleared areas have been mapped but are not counted as a unique VT.

Both VTs appear to be well represented in the surrounding area (DoP 2010) and are consistent with the vegetation expected to be found. The low level of species diversity within each VT is a reflection of the degraded nature of the Site, particularly with reference to the observed prolific weed invasion.

Threatened and Priority Ecological Communities

A Threatened Ecological Community (TEC) is defined under the EP Act as an ecological community listed, designated or declared under a written law or a law of the Commonwealth as threatened, endangered or vulnerable. There are four State categories of TECs (DEC 2010):

- presumed totally destroyed (PD)
- critically endangered (CR)
- endangered (EN)
- vulnerable (VU).

A Priority Ecological Community (PEC) is defined as an ecological community that does not meet criteria for listing as threatened because of insufficient information (including lack of survey and/or inadequacy of definition).

No TECs or PECs have been identified as having the potential to occur within the Site (Emerge 2012; Strategen 2014).

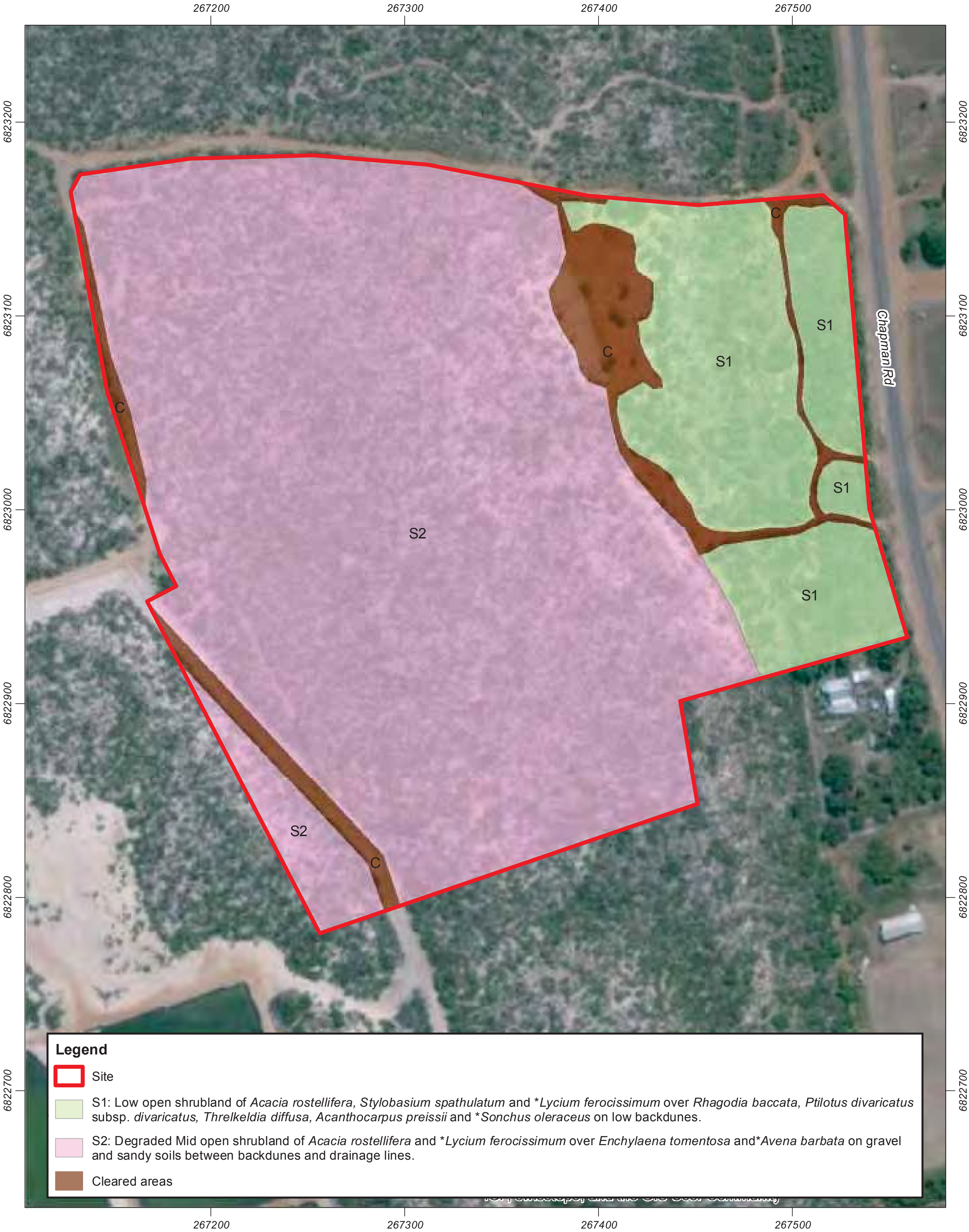

Figure 7: Vegetation type

Scale 1:2,700 at A4

0 25 50 75 m

N

Coordinate System: GDA 1994 MGA Zone 50

Note that positional errors may occur in some areas

Date: 19/07/2016

Author: JCrute

Source: Aerial image: ESRI online, approx. 2014. Existing cadastre: SLIP, Landgate 2016. Soils: DAFWA 2014. ASS: DER 2014.

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Conservation significant flora

The desktop assessment identified four Threatened flora and nine Priority flora that have the potential to occur within the area surrounding the Site, but not necessarily within the Site itself. Based on specific habitat requirements, one Threatened flora species (*Eucalyptus cuprea*) and all nine Priority flora species were considered to have the potential to occur.

Strategen (2014a) did not record any Threatened or Priority flora species within the Site. Given its degraded condition, it was also considered unlikely that the vegetation would support conservation significant flora.

Introduced (exotic) flora

A total of 10 introduced (exotic) taxa were recorded within the Site (Strategen 2014a). None of these species are Declared Plants species pursuant to Section 22 of the *Biosecurity and Agriculture Management Act 2007* (BAM Act) according to the Western Australian Department of Agriculture and Food (DAFWA 2013).

Vegetation condition

Vegetation condition ranged from 'Good' to 'Completely Degraded' (Keighery 1994; Table 2; Table 3; Figure 8). The Site was almost entirely infested with **Lycium ferocissimum* (African Boxthorn) that dominated the mid-storey of the vegetation assemblage and was observed to be outcompeting native plants.

Table 2: Vegetation Condition Scale (Keighery 1994)

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

Table 3: Area covered by each vegetation condition rating category within the Site

Vegetation Condition	Area (ha)	Percentage of the site
Good	0.44	3.58%
Good-Degraded	10.96	89.76%
Completely Degraded	0.81	6.66%
TOTALS	**12.22**	**100**

3.7.4 Conclusions

The flora and vegetation investigations relevant to the Site identified that:

- two VTs occur, both of which are likely degraded representations of their original form
- no Threatened or Priority flora are present
- no TECs or PECs are present
- vegetation condition ranges from Good to Completely Degraded, with the majority (89%) ‘Good-Degraded’ condition.

Figure 8: Vegetation condition

Scale 1:2,700 at A4

0 25 50 75 m

N

Coordinate System: GDA 1994 MGA Zone 50

Note that positional errors may occur in some areas

Date: 19/07/2016

Author: JCrute

Source: Aerial image: ESRI online, approx. 2014. Existing cadastre: SLIP, Landgate 2016. Soils: DAFWA 2014. ASS: DER 2014.

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3.8 Fauna

3.8.1 Fauna species

Emerge (2012) undertook a desktop survey of Australian and State Government online databases to identify any conservation significant terrestrial fauna present within the vicinity of the Site. Terrestrial fauna which are identified as conservation significant are protected under the federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and/or the state *Wildlife Conservation Act 1950* (WC Act). Table 4 lists the conservation significant fauna identified during the database searches.

Table 4: Conservation significant fauna species potentially occurring in the vicinity of the Site

Species		Conservation code	
Common name	Scientific name	EPBC Act	WC Act
Carnaby's cockatoo	*Calyptorhynchus latirostris*	Endangered	S1
Malleefowl	*Leipoa ocellata*	Vulnerable	S1
Southern giant petrel	*Macronectes giganteus*	Endangered/Migratory	S3
Northern giant petrel	*Macronectes halli*	Vulnerable/Migratory	S3
Shy Albatross	*Thalassarche cauta cauta*	Vulnerable/Migratory	S3
Fork-tailed swift	*Apus pacificus*	Migratory	S3
Great egret	*Ardea alba*	Migratory	S3
Cattle egret	*Ardea ibis*	Migratory	S3
White bellied sea-eagle	*Haliaeetus leucogaster*	Migratory	S3
Rainbow bee-eater	*Merops ornatus*	Migratory	S3
Caspian tern	*Sterna caspia*	Migratory	S3

Given the highly degraded nature of the Site, the presence of feral predatory species and absence of proteaceous and myrtaceous species utilised by Carnaby's cockatoos for foraging, roosting and breeding it is considered unlikely that Carnaby's cockatoo or malleefowl utilise the Site.

The migratory species listed in Table 4 may be occasional visitors but are unlikely to utilise the Site for a prolonged period of time given the level of disturbance, absence of any significant habitat areas i.e. large trees or cliffs and distance from the coastline (Emerge 2012). Potential habitat for Rainbow bee-eater does exist within the Site but this species is considered unlikely to occur given the high level of disturbance and presence of feral predatory species.

3.8.2 Terrestrial fauna habitat

Strategen (2014a) undertook an assessment for potential conservation significant terrestrial fauna habitat in November 2013. Habitat for, and sightings of conservation significant terrestrial fauna i.e. significant trees, foraging habitat and significant habitat features (i.e. mounds, nests) were recorded where present.

No habitat for conservation significant terrestrial fauna species was noted within the Site. No vascular plant species listed in DEC (2011) as being utilised by Carnaby's cockatoos were recorded. No signs of malleefowl mounds or Rainbow bee-eater burrows were observed (Strategen 2014a).

Signs of feral animals were abundant throughout the Site, including scats, burrows, carcasses and visual sightings of rabbits and foxes.

3.8.3 Conclusions

The fauna habitat investigations relevant to the Site identified that:

- no habitat for conservation significant terrestrial fauna species is present
- no vascular plant species listed as being utilised by Carnaby's cockatoos were recorded
- no signs of malleefowl mounds or Rainbow bee-eater burrows were observed
- feral animals were abundant.

3.9 Air quality (odour)

This Site is located in close proximity to the GNWWTP operated by the Water Corporation. A desktop assessment carried out by Strategen suggested that it was possible for odour emissions from the GNWWTP to reach the site with the potential for impacts on amenity for persons working within or visiting the proposed commercial and retail premises. In view of this, field assessments were undertaken to determine the potential impact of odour from GNWWTP on the Site.

3.9.1 Field assessment

Strategen (2014) undertook a desktop and field odour assessment within the surrounds of the Site to identify any potential impacts arising from the nearby GNWWTP. This report is presented in Appendix 2.

Observations of ambient odour intensities at locations downwind from the GNWWTP have indicated that odour emissions from that facility during normal operating conditions are rapidly diluted to below odour detection threshold (1 odour unit - OU)[1] with increasing distance from the facility. More specifically, under stable atmospheric conditions (that do not favour high dilution rates), the 10 minute average odour concentrations were <1 OU within approximately 250 m from the northern edge of the primary treatment ponds at the GNWWTP, essentially in the middle of the Site (Figure 9).[2]. Average odour concentrations of 0.65 OU were calculated from the intensity observations at the extent of the surveys, which was 320 m from the ponds, which would impact upon the southwestern portion of the site.

Higher dilution rates that occur under unstable atmospheric conditions reduced the distance for detection of odour to approximately 120 metres from the ponds, which would intercept the south western side of showroom SH-M2 and a small portion of SH-M3 but does not extend into the carpark and other proposed buildings.

The frequency of odour impacts at the Site was predicted from analysis of historical meteorological data (wind speed and direction) from Geraldton Airport and data from a monitoring station located within the GNWWTP.

The greater probability for odour impacts will be in the spring months, when lighter winds from the south-west that will impact on the Site typically occur for approximately 3% of business hours. Field observations suggest that those impacts will be insignificant, since the concentrations are likely to be below the odour detection threshold for normal operating conditions at the GNWWTP. Higher velocity winds (typically > 6 m/s) impact on the Site for approximately 30% of business hours in the summer months but as indicated above, afford dilution of odours to threshold within 120 m from the ponds. This means that although the winds that impact on the Site from the GNWWTP are more frequent in those months, strong winds will rapidly dilute the odours to levels not detected at the Site.

[1] An odour unit (1 OU) is equivalent to the concentration of an odorous substance where 50% of the population can detect the odour. Odour from the GNWWTP is unlikely to be considered offensive by the majority of the population at a concentration of 1 OU.

Figure 9: Site concept drawing showing illustration of odour impact with distance from the WWTP

Overall, the field observations and wind direction frequency analysis has indicated a low probability of odour impacts at the Site from normal operation of the GNWWTP. Furthermore, the levels of odours detected at the Site are predicted to be well below the Water Corporation 5 OU criterion used as a planning tool for establishment of buffer zones around WWTPs. The Water Corporation criterion is set for a 1 hour average, which means higher concentrations (in the order of 6 to 12 OU) can be considered appropriate for short duration impacts as observed from the field observations.

Consultation was undertaken with Water Corporation as part of the odour assessment. Advice from Water Corporation is that high rainfall events can destabilise the aerobic conditions in the ponds and generate increased odour emissions for up to two weeks after the rain has ceased. Anecdotal evidence from Water Corporation indicates that those impacts could extend outside a buffer zone defined by the 5 OU criteria. This suggests that these events and any other atypical (upset) conditions provide the greatest potential for odour impacts at the Site. However, the low frequency of such upset events reduces the risks of atypical odour emission events from impacting the Site and on that basis the proposed non-sensitive land use development at the Site would not be precluded.

Further discussion of proposed management measures to mitigate odour emission impacts is presented in Section 4.6.

3.10 Heritage

3.10.1 Aboriginal heritage

The *Aboriginal Heritage Act 1972* (AH Act) defines Aboriginal heritage sites and provides for the preservation of places and objects customarily used by, or traditionally important to Aboriginals.

Emerge undertook an online search for Aboriginal heritage sites together with information using the Department of Indigenous Affairs (now Department of Aboriginal Affairs [DAA]) Aboriginal Heritage Inquiry System in 2012 (Emerge 2012). This system is maintained pursuant to section 38 of the AH Act and contains information on over 22 000 listed Aboriginal sites throughout Western Australia.

No registered Aboriginal sites occur within, or in the vicinity of the Site.

3.10.2 European heritage

Emerge Associates (2012) undertook a review of information at a federal, state and local government level to determine if any of the following occurred within the Site:

- World Heritage Sites
- National Heritage Sites
- Commonwealth Heritage Sites
- sites on the register of the National Estate
- sites listed in the City of Greater Geraldton Municipal Heritage Inventory List.

No European heritage sites were identified within, or in the vicinity of the Site (Emerge 2012).

4. Potential environmental impacts and management measures

This section addresses:

- potential impacts to the environment resulting from the development of the Site in accordance with the proposed Site Development Concept
- potential impacts of environmental opportunities and constraints on the development of the Site
- potential design and management actions required to minimise impacts resulting from the development.

Management measures will be undertaken where required to ensure that relevant environmental guidance, including EPA objectives, are met.

4.1 Acid Sulfate Soils

4.1.1 EPA objectives

The EPA objectives relevant to ASS are:

- 'to maintain the quality of groundwater and surface water, sediment and biota so that the environmental values, both ecological and social, are protected'
- 'to maintain the quality of land and soils so that the environment values, both ecological and social, are protected'.

4.1.2 Potential impacts

ASS can release acids and metals when exposed to air through dewatering or excavation. This can affect soil, groundwater and surface water quality. The eastern portion of the site is mapped as having a high risk of ASS being present within 3 m of the natural surface.

4.1.3 Management measures

Should excavation or dewatering be required within 50 m of the high risk ASS area, acid sulfate soils investigations shall be undertaken to determine the presence of ASS consistent with *Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes* (DER 2015a). Should ASS be found and expected to be impacted by excavation and dewatering, an ASS Management Plan will be prepared consistent with *Treatment and Management of Soils and Water in Acid Sulfate Soil Landscapes* (DER 2015b) prior to the commencement of works on the Site.

4.2 Contaminated sites

4.2.1 EPA objective

The EPA objective relevant to contaminated sites is:

- 'to maintain the quality of groundwater and surface water, sediment and biota so that the environmental values, both ecological and social, are protected'
- 'to maintain the quality of land and soils so that the environment values, both ecological and social, are protected'.

4.2.2 Potential impacts

The Site has the potential to be impacted by:

- hydrocarbon spills from vehicles and machinery that can contaminate the Site and surrounding areas.

4.2.3 Management measures

A Construction Environmental Management Plan (CEMP) will be developed and implemented to manage potential contamination during construction. This will include management measures for chemical and fuel storage and vehicle refuelling to manage potential impacts during construction.

Material illegally dumped on the Site will be removed and disposed of to an appropriate landfill prior to construction.

After application of the management measures described above, the development is not expected to pose an unacceptable risk of contamination to the surrounding environment.

4.3 Hydrology

4.3.1 EPA objective

The EPA objectives relevant to hydrology are:

- 'to maintain the quality of groundwater and surface water, sediment and biota so that the environmental values, both ecological and social, are protected'
- 'to maintain the hydrological regimes of groundwater and surface water so that existing and potential uses, including ecosystem maintenance, are protected'.

4.3.2 Potential impacts

The development has the potential to negatively impact upon groundwater quality through infiltration of stormwater that may contain pollutants such as nutrients and hydrocarbons. Stormwater will be treated prior to infiltration to minimise this potential impact.

The development of the Site may also result in limited increases in winter groundwater levels due to reduced evapotranspiration and increased runoff from hard surfaces. This impact is considered minor compared to the impact of the GNWWTP to the southeast of the site, which disposes of wastewater by infiltration.

Nutrients from fertiliser use on landscaped areas may also infiltrate into groundwater and affect groundwater quality.

The north-eastern corner of the site and some adjacent sections of Chapman Road are subject to flooding in the 1 in 100-year ARI event. Finished levels in the development will be designed to ensure that flooding of key areas does not occur.

4.3.3 Management measures

Department of Water (DoW) has previously advised that as the proposed development is one lot, a Local Water Management Strategy is not required, but that a UWMP will be required to be prepared prior to ground disturbing works (Wray K [DoW] 2015, pers. comm. June 18).

An Urban Water Management Plan (UWMP) will be developed at the next stage of the planning process and implemented to manage potential impacts to groundwater and ensure that finished levels are adequate to prevent flooding of the Site. The UWMP will be supported by investigations into the groundwater and surface water conditions on the Site. These investigations will be discussed with DoW prior to the works commencing.

The UMWP will address flooding of the site and adjacent sections of Chapman Road.

After application of management measures described above, the development is expected to meet the EPA objectives relevant to groundwater and surface water.

4.4 Flora and vegetation

4.4.1 EPA objective

The EPA objective for flora and vegetation is:

- ‘to maintain representation, diversity, viability and ecological function at the species, population and community level’.

4.4.2 Potential impacts

The potential sources of impact to native vegetation within the Site from the proposed development include:

- clearing of approximately 11.4 ha of vegetation will directly reduce the extent of vegetation communities, and may disturb conservation significant flora species or ecological communities
- vehicle movements during construction and earthworks have the potential to create dust which may smother vegetation and introduce and spread exotic species leading to degradation of vegetation condition
- on-site ignition sources that could result in increased fire frequency/intensity that may favour the establishment of weeds and prevent the regeneration of adjacent native vegetation.

4.4.3 Management measures

Clearing of vegetation will be managed to limit the risk of offsite impacts. Pre-construction management activities include:

- flagging areas not designated for clearing during the construction and development phases to prevent unauthorised clearing
- inductions for all construction personnel outlining appropriate vehicle hygiene, waste disposal and bushfire prevention procedures.

Construction management activities include:

- minimise soil disturbance during clearing and practice standard vehicle hygiene to ensure exotic species do not spread from the Site to surrounding areas and *vice versa* whilst construction is being undertaken.

Management measures will be documented in the CEMP to be prepared prior to vegetation clearing.

After application of management measures described above, the development is expected to result in the following outcomes in relation to vegetation and flora:

1. No loss or significant decline in any TEC or PEC.
2. No loss of conservation significant flora at species level.
3. No loss of important populations of conservation significant flora.
4. No significant risk of an increase in the prevalence of weeds.
5. No loss of unique or restricted vegetation types.

The development will not result in a change in the status of plants of conservation significance; and will not significantly affect the regional distribution of flora and vegetation species.

In considering the outcome as described, the development is expected to meet the EPA objective for flora and vegetation.

4.5 Terrestrial fauna

4.5.1 EPA objective

The EPA objective for fauna is:

- 'to maintain representation, diversity, viability and ecological function at the species, population and assemblage level'.

4.5.2 Potential impacts

Given the lack of significant fauna habitat for native terrestrial fauna within the Site, potential impacts are not likely to have a noteworthy impact upon native terrestrial fauna.

The potential sources of impact to native terrestrial fauna and associated habitat within the Site include:

- clearing of vegetation will directly disturb fauna habitat through destruction, degradation and/or fragmentation and may result in the loss of individual terrestrial fauna
- vehicle movements may result in the injury or fatality of individual terrestrial fauna, especially less-mobile species
- human activities have the potential to increase the presence of introduced predator species (e.g. foxes and cats) which has the potential to result in increased rates of predation of native fauna species as well
- construction infrastructure and machinery have the potential to disturb fauna through noise, vibrations and light spill.

4.5.3 Management measures

Construction works will be undertaken in a manner that limits potential impacts to fauna. These measures will be documented in the CEMP. Management measures will include:

- flagging areas not designated for clearing during the construction and development phases to prevent unauthorised clearing
- inductions for all construction personnel outlining appropriate vehicle hygiene, waste disposal, vehicle speed limits and bushfire prevention procedures
- staging of vegetation clearing works and implementation of clearing methods designed to maximise the survival of native terrestrial fauna within the Site.

After application of management measures described above, the development is expected to result in the following outcomes in relation to terrestrial fauna:

1. No loss of any habitat critical to the survival of conservation significant fauna.
2. No loss of conservation significant fauna at species level.
3. No loss of important populations of conservation significant fauna.

The development will not:

- result in a change in the status of fauna of conservation significance
- represent significant clearing of habitat types
- significantly affect the regional distribution of fauna species.

In considering the outcome as described, the development is expected to meet the EPA objective for terrestrial fauna.

4.6 Odour

4.6.1 EPA objective

The EPA objectives relevant to air quality and amenity are:

- 'to maintain air quality for the protection of the environment and human health and amenity, and to minimise the emission of greenhouse and other atmospheric gases through the application of best practice'
- 'to ensure that impacts to amenity are reduced as low as reasonably practical'.

4.6.2 Potential impacts

The GNWWTP has the potential to be a source of odours which could affect the amenity of persons working within or visiting the proposed commercial and retail premises the Site.

4.6.3 Management measures

Overall, the relatively low frequency and intensity of odour impacts predicted from field assessments of normal operations of the GNWWTP suggest that the proposed land uses can be implemented with minimal impacts from odours from the GNWWTP.

Management measures to further minimise risk of odour impacts include:

- numerical modelling of wind flows to identify optimal locations of air conditioning makeup ventilation ducts and building and site design to maximise dilution of odours
- placement of vegetation screening around the western and southern boundaries of the Site, incorporating a mix of tall trees (taller than the buildings), large and smaller shrubs, and fragrant smelling flowering plants.

After application of management measures described above, the development is expected to result minimal impact of odour upon amenity of persons working within or utilising facilities at the Site.

In considering the outcome as described, EPA guidance on Air Quality (Odour) will be achieved through implementation of these measures.

4.7 Heritage

4.7.1 EPA objective

The EPA objective relevant to this factor is:

- 'to ensure that historical and cultural associations, and natural heritage, are not adversely affected'.

4.7.2 Potential sources of impact

No known Aboriginal or European heritage sites are present on the Site. Construction activities have the potential to unearth or identify Aboriginal artefacts.

4.7.3 Management measures

No registered heritage sites have been identified on the Site. Should any Aboriginal artefacts be identified during construction activities, findings will be reported to Department of Aboriginal Affairs (DAA) and development activities will cease until advised otherwise.

The development will comply with the provisions of the AH Act.

4.8 Fire management

The Site is designated as bushfire prone due to the extent of adjacent vegetation, as depicted in the Western Australian State Map of Bush Fire Prone Areas (DFES 2016).

The proposed development meets the requirements triggered under SPP 3.7. The measures proposed to meet the triggered requirements are outlined in a Bushfire Management Plan (BMP) to accompany the Structure Plan (Appendix 3).

The BMP has identified potential impacts of bush fires and a range of bushfire management measures that, on implementation, will enable all proposed lots to be developed whilst maintaining a manageable level of bushfire risk and compliance with the *Guidelines for Planning in Bushfire-Prone Areas* (the Guidelines; WAPC 2015b).

Bushfire will be managed according to the BMP through appropriate hazard separation distances (Figure 10, Appendix 3). The Structure Plan design shall be accordance with the Guidelines.

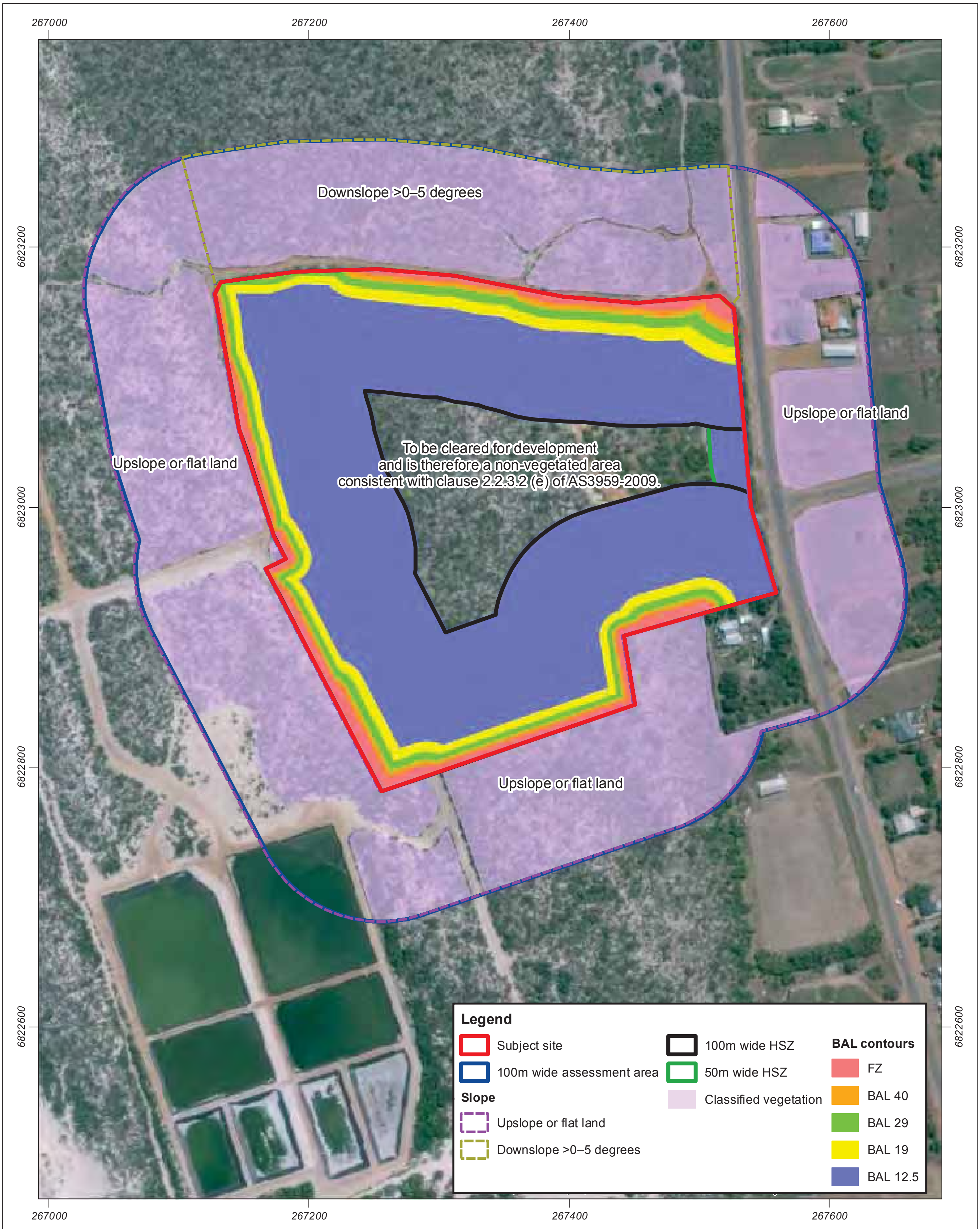

Figure 10: BAL contour assessment

Scale 1:3,947 at A4

0 25 50 75 100 m

N

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 20/07/2016
Author: JCrute
Source: Aerial image: ESRI online, approx. 2014.

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5. Conclusions

The environmental values and attributes of the site have been considered during the preparation of the Structure Plan, and include a number of specific design and management responses. Based on the assessment provided in Section 4, the key potential impacts to the environmental values and proposed management is detailed in Table 5. The development of the Site for commercial purposes is not anticipated to result in significant environmental impacts. Based on this assessment, the development meets the EPA objectives through management of the potential impacts in accordance with statutory requirements, relevant guidelines and management plans.

Table 5: Summary of environmental impacts and management

Environmental attributes and values	Opportunities and constraints	Key potential impacts	Management commitments
Acid sulfate soils (ASS)	• eastern part of the Site is mapped as having a moderate to high risk of ASS.	• impacts on soil, groundwater and surface water acidity if dewatering and/or excavation of ASS are present and not appropriately managed.	• ASS investigation and management if required. • investigation and management of ASS will be in accordance with DER guidance any treatment requirements will be approved by DER.
Contaminated sites	• no known contaminated sites within 1 km of the Site. • limited illegal 'fly tipping' has occurred on the Site.	• potential for hydrocarbon spills during construction.	• preparation of a Construction Environmental Management Plan (CEMP) to manage risk of hydrocarbon spills. • material illegally dumped on the Site will be removed prior to construction.
Hydrology	• the Site is not constrained by groundwater. • the north-eastern corner of the site and some adjacent sections of Chapman Road may be inundated in the 1 in 100 year Average Return Interval (ARI) event.	• the development has the potential to negatively impact upon groundwater quality through infiltration of stormwater that may contain pollutants such as nutrients and hydrocarbons. • the development of the Site may result in limited increases in winter groundwater levels due to reduced evapotranspiration and increased runoff from hard surfaces.	• UWMP to be prepared at the development application stage, detailing stormwater treatment measures. • the UWMP should address flooding of the site and adjacent sections of Chapman Road.
Flora and vegetation	• no Threatened Ecological Communities (TEC), priority or threatened flora have been identified within the Site.	• clearing of approximately 11.4 ha of native vegetation. • unauthorised vehicle access may damage vegetation and spread weeds. • accidental clearing during construction.	• a CEMP will be prepared before the commencement of the construction to manage indirect impacts to vegetation.
Fauna	• no habitat for conservation significant terrestrial fauna species has been identified within the Site.	• clearing of approximately 11.4 ha of native vegetation resulting in the loss or fragmentation of fauna habitat and consequent displacement of fauna. • vehicle and heavy machinery movements during clearing and construction may result in fauna strike causing injury or death to individuals.	• a CEMP will be prepared before the commencement of the construction to minimise risk to fauna during construction.
Aboriginal and European heritage	• no known Aboriginal or European heritage sites in the vicinity of the Site.	• disturbance of potential Aboriginal Heritage sites during clearing and earthworks associated with the development of the Site.	• a CEMP will be prepared as part of the subsequent development application process. • if an Aboriginal heritage site is found during the works, it will be managed in a manner consistent with the AH Act.
Fire	• the Site is located adjacent to bushland which poses a potential fire risk.	• due to the extent of adjacent vegetation, the Site is designated as 'bushfire prone' which poses a risk to future development.	• fire risks will be managed according to the Bushfire Management Plan (BMP) which is provided in Appendix 3.

Environmental attributes and values	Opportunities and constraints	Key potential impacts	Management commitments
Odour	• the Site is located in the vicinity of the Geraldton North Wastewater Treatment Plant (GNWWTP).	• potential minor impact of odour on the development.	• numerical modelling will be undertaken of wind flows to identify optimal locations of air conditioning makeup ventilation ducts and building and site design to maximise dilution of odours. • placement of vegetation screening around the western and southern boundaries of the Site, incorporating a mix of tall trees (taller than the buildings), large and smaller shrubs, and fragrant smelling flowering plants.

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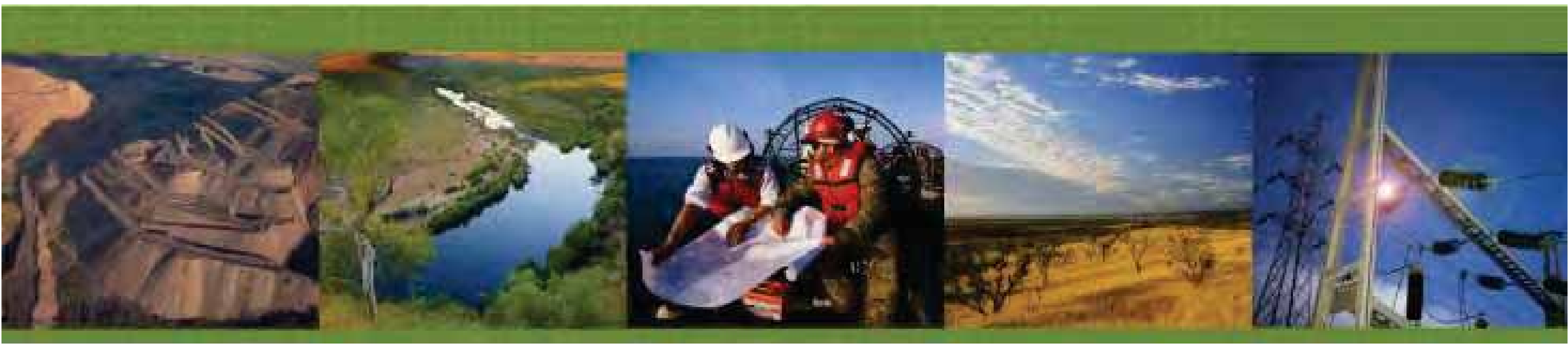
Appendix 1
Environmental investigations
(Strategen 2014)



Lot 55 Chapman rd, Glenfield

Environmental Investigations

Prepared for
General Property Assets
by Strategen

February 2014

STRATEGEN
environmental consultants

Lot 55 Chapman rd, Glenfield

Environmental Investigations

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February 2014

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Strategen has not attempted to verify the accuracy or completeness of the information supplied by the Client.

Client: General Property Assets

Report Version	Revision No.	Purpose	Strategen author/reviewer	Submitted to Client	
				Form	Date
Draft Report	A	Client Review	D Panickar, L Taylor, D Walsh	Electronic	20/12/2013
Final Report	0	Final to client	D Panickar	Electronic	24/12/2013
Final Report with minor amendment	1	Final to client	D Panickar	Electronic	14/02/2014

Filename: GPA13239_01 R001 Rev 1 - 14 February 2014

Executive summary

Strategen were commissioned to undertake an environmental investigation by General Property Assets within Lot 55 Chapman Road, Glenfield in November 2013. This report provides a summation of the environmental investigations undertaken in November 2013, which included a flora and vegetation survey, fauna habitat assessment and visual observations for acid sulfate soils.

The total survey area of Lot 55 (the site) is approximately 12.22 ha in size. The site is located approximately 9 km north of the Geraldton City Centre and is currently zoned as ‘Development Zone’ under the provisions of the City of Greater Geraldton Local Planning Scheme No. 5 (LPS No. 5).

The flora and vegetation assessment conducted within the site was undertaken during Spring, in the prime flowering time for majority of species within the area. Field reconnaissance involved traversing majority of the site which ensures that an accurate representation of all Vegetation Types and potential conservation significant flora were obtained.

A total of 15 native vascular plant taxa from 14 plant genera and 11 plant families were recorded within the site. The majority of taxa were recorded within the Chenopodiaceae (5 taxa) family (Appendix 2). Ten introduced (exotic) taxa were recorded within the site (Appendix 2). None of these species are Declared Plants species pursuant to Section 22 of the *Biosecurity and Agriculture Management Act 2007* (BAM Act) according to the Western Australian Department of Agriculture and Food (DAFWA 2013).

No Threatened Flora species pursuant to Schedule 1 of the Wildlife Conservation Act 1950 (WC Act) and as listed by Department of Parks and Wildlife (DPaW) (DPaW 2013) or Priority Flora species as listed by DPaW WAHERB (2013a) were recorded within the site (Appendix 2).

No Threatened Ecological Communities (TEC) as listed by Department of the Environment (DoTE) (2013c) and by the then Department of Environment and Conservation (DEC) (DEC 2013c) or Priority Ecological Communities (PEC) as listed by the then DEC (2013d) were identified within the site.

Two Vegetation Types (VT) were defined and mapped within the site (Appendix 3; Figure 3) that are structurally defined as low to tall shrublands. All VTs appear to be well represented within the surrounding area (DoP 2010) and are consistent with the vegetation expected to be found within the area.

Vegetation condition ranged from Good to Completely Degraded (Keighery 1994) with the majority of the site (approximately 89.76%) in “Good-Degraded” condition.

No habitat for conservation significant terrestrial fauna species was noted within the site. Based on previous studies of the site, there was a potential for Carnaby’s cockatoo, malleefowl and Rainbow bee-eater to occur on the site. No vascular plant species listed in DEC (2011) as being utilised by Carnaby’s cockatoos were recorded and no signs of malleefowl mounds or Rainbow bee-eater burrows were observed.

No visual signs of acid sulfate soils were observed during the site investigations.

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1. Introduction

1.1 Background

Lot 55 Chapman Road, Glenfield (Lot 55) is owned by ASDC Pty Ltd (ASDC). Lot 55 is located approximately 9 km north of the Geraldton City Centre and can be accessed from Geraldton via Chapman Road and the North West Coastal Highway (Figure 1).

Lot 55 is currently zoned as 'Development Zone' under the provisions of the City of Greater Geraldton Local Planning Scheme No. 5 (LPS No. 5). The 'Development Zone' would provide opportunities for commercial development in line with market demand and to meet the demands of the existing and planned future residential population of the greater northern Geraldton locality.

The proposed rezoning of Lot 55 was referred to the Western Australian Environmental Protection Authority (EPA) and it was determined that the proposal did not require assessment. The EPA provided advice and recommendations in relation to odour, flora and vegetation and terrestrial fauna. Specifically, the EPA identified that flora and vegetation and fauna assessments were required.

1.2 Scope

Strategen were commissioned to undertake a flora and vegetation assessment, fauna habitat assessment and acid sulfate soils inspection by General Property Assets on behalf of ASDC within Lot 55 in November 2013 (Figure 1). The total survey area of Lot 55 (the site) is approximately 12.22 ha in size. The objectives of the assessment were to:

- undertake a Level 2 flora and vegetation survey
- identify any potential conservation significant flora
- identify potential habitat for conservation significant fauna
- identify any indicators of acid sulfate soils within the site.

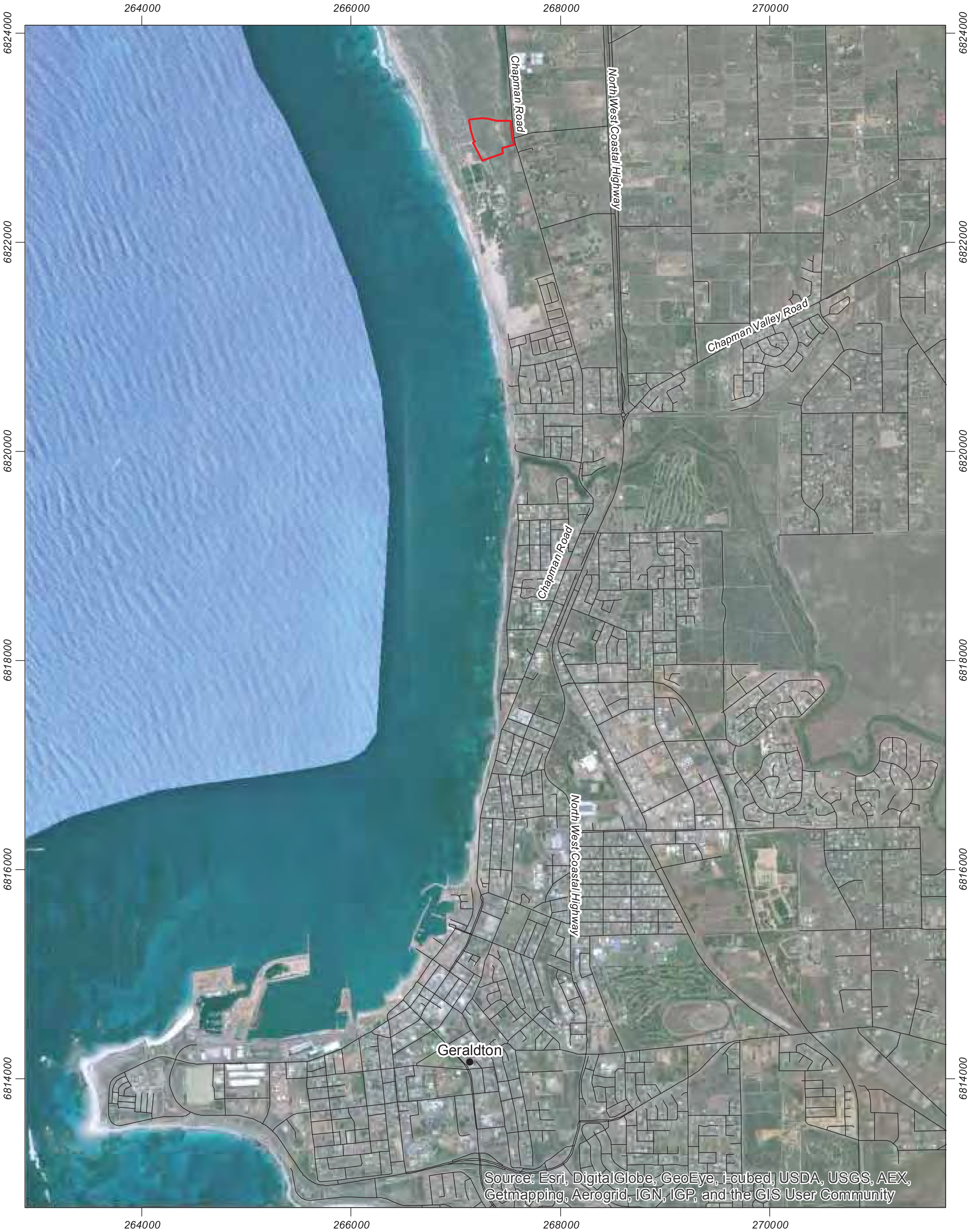

Figure 1 Regional location

Scale 1:50,000 at A4

0 500 1,000 1,500 m

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 18/12/2013
Author: JCrute
Source: Aerial image: ESRI 2013.
Roads: Main Roads 2013.

Legend

- Town
- Roads
- Lot 55

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1.3 Climate

The site is located within the Irwin Botanical District within the Northern Sandplains Region of Western Australia which extends approximately from Shark Bay to Jurien along the coast and inland to Badgingarra. Beard (1990) described the climate within this district as dry warm Mediterranean, with 300 – 500 mm of winter rainfall and seven to eight dry months a year. Figure 2 shows climate statistics for Geraldton Airport (BOM 2013).

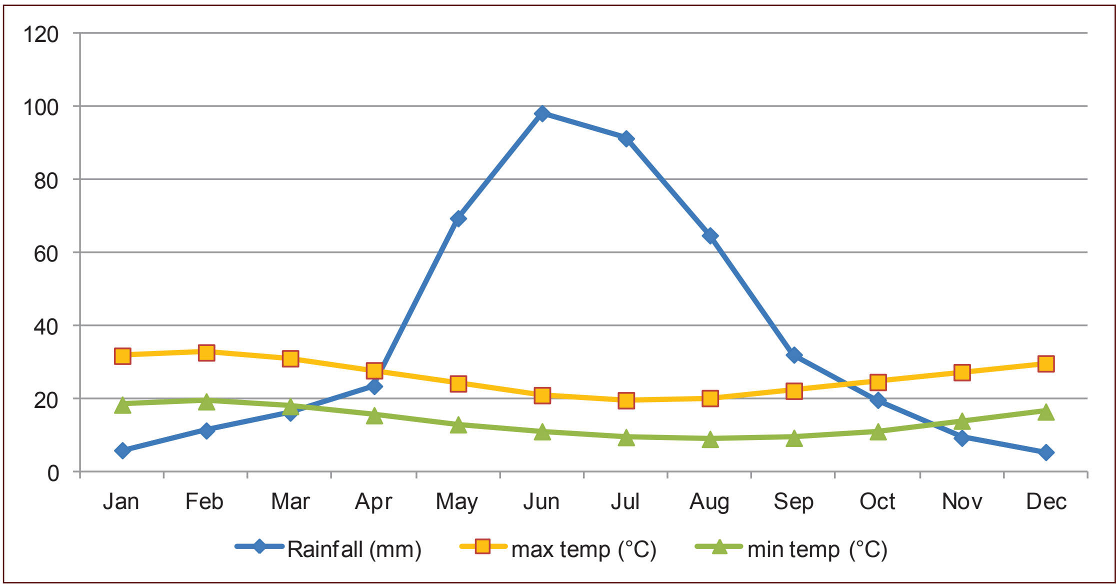

Figure 2 Mean monthly climatic data (temperature and rainfall) for Geraldton Airport

1.4 Soils and topography

Beard (1990) describes the Irwin Botanical District as a weathered land surface which has formed an extensive, locally dissected lateritic sandplain especially near the coast. These sandplains are covered with leached, sandy soils in coastal areas and yellow sands with an earthy fabric in inland areas, both of which overly laterite.

1.5 Regional vegetation

Vegetation occurring within the region was initially mapped at a broad scale (1:250 000) by Beard during the 1970's. This dataset has formed the basis of several regional mapping systems, including physiographic regions defined by Beard (1976); the biogeographical region dataset (IBRA) for Western Australia (Department of the Environment (DoTE) 2013a); and vegetation system associations which are currently used to determine extents of clearing since European arrival (DEC 2013a).

1.5.1 Beard (1976; 1990) Regional vegetation mapping

Vegetation within the Irwin Botanical District can broadly be described as; scrub heath on sandplains near the coast; *Acacia-Casuarina* thickets further inland and *Acacia* scrub with scattered trees of *Eucalyptus loxophleba* on the hard-setting loams (Beard 1990). The site occurs within the Greenough physiographic system as mapped by Beard (1976).

The Greenough system contains plant communities associated with coastal limestone, extending from Kalbarri to Dongara. Dominant vegetation types include; *Acacia rostellifera* and *Melaleuca cardiophylla* thickets on rocky ridges, *Acacia-Banksia* scrub on sand covered limestone and *Acacia rostellifera* shrublands with occasional *Eucalyptus camaldulensis* on alluvial flats (Beard 1976).

1.5.2 IBRA Regions

The site occurs within the Geraldton Hills Interim Biogeographic Regionalisation for Australia (IBRA) subregion which is dominated by endemic rich, proteaceous scrub heaths on sandy earths of extensive, undulating and lateritic sandplains (CALM 2002). The subregion also consists of sand heaths with emergent *Banksia* and *Callitris, Eucalyptus loxophleba* woodlands on alluvial plains, proteaceous heath and *Acacia* scrubs on limestone and low closed shrubland of *Acacia rostellifera* on alluvial plains of the Greenough and Irwin Rivers.

1.5.3 Geraldton Regional Flora and Vegetation Survey

The Geraldton Regional Flora and Vegetation Survey (GRFVS) describes broad scale vegetation types within a broad study area encompassing Geraldton and its surrounds. Vegetation within the vicinity of the site falls within vegetation types which are described as *Acacia rostellifera* shrublands on coastal and near coastal areas as well as drainage lines dominated by *Eucalyptus camaldulensis* subsp. *obtusa, Casuarina obesa* and *Melaleuca rhaphiophylla* (DoP 2010).

1.5.4 Vegetation System Associations

Shepherd *et al.* (2002) mapped and described vegetation system associations related to physiognomy, expanding on mapping originally undertaken by Beard (1976), at a scale of 1:250,000. These vegetation system associations were further refined in 2012 (DEC 2013a). The site crosses three vegetation system associations which are described in Table 1. Table 1 also presents the current extent of each vegetation system association in relation to the pre-European extent, and the extent within Department of Parks and Wildlife-managed (DPaW) lands (formerly Department of Environment and Conservation), including conservation reserves.

Table 1 Extent of Vegetation Associations within the site (DEC 2013a)

Vegetation System Association	Description	Current Extent (ha)	Percentage of Pre-European Extent Remaining
129	Bare areas; drift sand	69306	70.77
359	Shrublands; *Acacia* and *Banksia* scrub	11071	23.73
440	Shrublands; *Acacia ligulata* open scrub	2814	63.59

1.6 Terrestrial fauna

DEC (2010a) noted that the vertebrate fauna assemblage previously recorded within the Geraldton subregions is rich, comprising approximately 26 mammals, 113 reptiles and 17 frog species. It was noted that the Geraldton subregions represent a unique transitional zone between arid and southern faunal assemblages due to a similar transitional zone for plant communities providing a diverse range of habitat types for native fauna.

1.7 Acid sulfate soils

Acid Sulfate Soils (ASS) is the common name given to naturally occurring soils, sediments and peats containing iron sulfides, most commonly in the form of pyritic minerals (DoTE 2013b). Majority of ASS are formed under anoxic conditions when bacteria in organically rich, waterlogged substrate reduce the sulfates from seawater or other inputs and iron from the sediments, to form iron sulfides.

These naturally occurring iron sulfides are generally found in layers of waterlogged soils or sediments and are benign when undisturbed and in their natural state. When ASS are disturbed and exposed to aerobic conditions, oxidation of the iron sulfides occurs generating sulfuric acid as part of the chemical reaction. The resulting increased acidity of the water table can result in the mobilisation of heavy metals from the soil in a dissolved state.

Visual indicators of ASS include yellow and/or red mottling within the soil profile, sulphurous smell, unusually clear or milky blue-green water, extensive iron staining etc. (DEC, 2013b).

2. Objectives

The general aim of this survey was to undertake an environmental investigation of the site. Specifically, the objectives include:

- conduct a desktop survey for Threatened and Priority flora which have been identified as being present in or around the site
- collect and identify the vascular plant species present within the site
- search areas of suitable habitat for Threatened and/or Priority flora
- define and map the native vegetation communities present within the site
- provide recommendations on the local and regional significance of the vegetation communities
- identify habitat for any conservation significant terrestrial fauna species
- identify any areas which are potentially impacted by ASS
- prepare a report summarising the findings.

3. Method

3.1 Desktop assessment

A desktop assessment was conducted using Florabase, Department of Parks and Wildlife (DPaW), and Department of the Environment (DoTE) databases to identify the possible occurrence of Threatened Ecological Communities, Priority Ecological Communities, Declared Threatened flora, Priority flora and conservation significant fauna species potentially occurring within the site. Reports that document regional flora and vegetation, fauna and ASS within the surrounds of the site were also reviewed prior to the field assessment (Emerge 2012).

3.2 Field assessment

3.2.1 Flora and vegetation

The assessment of flora and vegetation within the site was undertaken by two experienced ecologists (Table 2) from Strategen from 25 to 27 November 2013. Eleven vegetation mapping sites were surveyed (Appendix 3; Appendix 4). The field survey was conducted according to standards set out in Guidance Statement 51(EPA 2004).

Table 2 Personnel

Name	Project involvement	Flora collection permit
Mr. D. Panickar	Planning, fieldwork, plant identification, data interpretation and report preparation	SL010341
Mrs. T. Stehbens	Fieldwork	SL010638

Site selection for vegetation mapping was based on differences in structure and species composition of the communities present within the proposed survey area. Vegetation mapping sites were determined from aerial photographs and opportunistic sites were selected in the field where a change in vegetation structure or composition was observed.

Flora and vegetation was described and sampled systematically at each survey site, and additional opportunistic collecting was undertaken wherever previously unrecorded plants were observed. At each site the following floristic and environmental parameters were noted:

- GPS location
- topography
- soil type and colour
- outcropping rocks and their type
- percentage cover and average height of each vegetation stratum
- presence of significant trees.

For each vascular plant species, the average height and percent cover (both live and dead material) were recorded.

All plant specimens collected during the field surveys were dried and fumigated in accordance with the requirements of the Western Australian Herbarium. The plant species were identified through comparisons with pressed specimens housed at the Western Australian Herbarium where necessary. Nomenclature of the species recorded is in accordance with DPaW WAHERB (2013a).

3.2.2 Fauna habitat assessment

The assessment of potential conservation significant terrestrial fauna habitat was undertaken simultaneously with the flora and vegetation assessments. Habitat for conservation significant terrestrial fauna i.e. significant trees, foraging habitat and significant habitat features (i.e. mounds, nests) identified during the flora and vegetation assessment were recorded.

3.2.3 Acid Sulfate Soil assessment

The assessment of potential ASS indicators was undertaken simultaneously with the flora and vegetation assessment. Indicators for ASS within the site as outlined in *Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes* DEC (2013b) were recorded whilst traversing the site. Drainage areas were targeted and traversed to identify any potential ASS indicators that are associated with water and wet areas.

3.3 Data analysis and vegetation mapping

Due to the highly degraded nature and uniform distribution of vegetation within the site, quadrat data were grouped into a species by site matrix to delineate individual vegetation types (VTs) present within the site. Aerial photography interpretation and field notes taken during the survey were then used to develop VT mapping polygon boundaries over the site. These polygon boundaries were then digitised using Geographic Information System (GIS) software.

VT descriptions (though floristic in origin) have been adapted from the National Vegetation Information System (NVIS) Australian Vegetation Attribute Manual Version 6.0 (ESCAVI 2003), a system of describing structural vegetation units (based on dominant taxa). This model follows nationally-agreed guidelines to describe and represent vegetation types, so that comparable and consistent data is produced nation-wide. For the purposes of this report, it is considered that a VT is equivalent to a NVIS sub-association as described in ESCAVI (2003).

Vegetation condition was recorded at all quadrats, and also opportunistically within the site during the field assessment where required. Vegetation condition was described using the vegetation condition scale for the South West Botanical Province (Keighery 1994). Vegetation condition polygon boundaries were developed using this information in conjunction with aerial photography interpretation, and were digitised as for vegetation type mapping polygon boundaries.

3.4 Flora and vegetation assessment limitations and constraints

An assessment of the flora and vegetation assessment against a range of factors that may have impacted upon it is displayed in Table 3. Based on this assessment, the assessment has not been subject to constraints that would affect the thoroughness of the assessment and the conclusions reached.

Table 3 Potential flora and vegetation assessment limitations and constraints

Potential limitation	Impact upon assessment	Comment
Sources of information and availability of contextual information (i.e. pre-existing background versus new material).	**Not a constraint.**	The study has been undertaken in the Irwin Botanical District within the Northern Sandplains Region which has been well studied and documented with ample literature available (Beard 1990; DoP 2010). There have also been baseline environmental investigations conducted within the site by Emerge Associates (Emerge 2012).
Scope (i.e. what life forms, etc., were sampled).	**Not a constraint.**	Due to the highly degraded nature and uniform distribution of vegetation within the site, all life forms were sampled adequately during the time of the survey. All site characteristics were adequately sampled during the time of the survey.
Proportion of flora collected and identified (based on sampling, timing and intensity).	**Not a constraint.**	The proportion of flora surveyed was adequate. Approximately 79% of the flora potentially present within the survey area was sampled (refer to Section 4.6).
Completeness and further work which might be needed (i.e. was the relevant survey area fully surveyed).	**Not a constraint**	The information collected during the survey was sufficient to assess the vegetation that was present during the time of the survey.
Mapping reliability.	**Not a constraint.**	Aerial photography of a suitable scale was used to map the survey area. Sites were chosen from these aerials to reflect changes in community structure. Opportunistic sites were also used if differences were noticed during on ground reconnaissance. Vegetation types were assigned to each site based on topography, soil type, presence/absence and percent foliage cover of vegetation.
Timing, weather, season, cycle.	**Not a constraint.**	It is generally accepted that flora and vegetation surveys are conducted following winter rainfall in the South-West Province, ideally during Spring (EPA 2004). The field assessment was conducted during Spring and is therefore within the appropriate survey window.
Disturbances (fire flood, accidental human intervention, etc.).	**Not a constraint.**	The site and regional surrounds have been subjected to disturbance over a significant period of time. Given the wide range of this disturbance it is not considered to be a limitation within the site.
Intensity (in retrospect, was the intensity adequate).	**Not a constraint.**	Sites were chosen from aerial maps to represent the different vegetation types present within the survey area. Replicate sites within the different vegetation types were also conducted (where possible) to obtain a more accurate representation of each vegetation type. During ground reconnaissance of data, more sites were chosen where applicable (i.e. a new vegetation community was identified).
Resources (i.e. were there adequate resources to complete the survey to the required standard).	**Not a constraint.**	The available resources were adequate to complete the survey.
Access problems (i.e. ability to access survey area).	**Not a constraint.**	Existing tracks enabled adequate access to survey the vegetation within the survey area. Where access was not available by car, it was easily traversed by foot.
Experience levels (e.g. degree of expertise in plant identification to taxon level).	**Not a constraint.**	All survey personnel have the appropriate training in sampling and identifying the flora of the region.

4. Results

4.1 Desktop assessment results

4.1.1 Flora and vegetation

A total of 253 native vascular plant taxa from 62 plant families have the potential to occur within the vicinity of the site (DEC 2007-). The majority of taxa were from within the Fabaceae (30 taxa), Myrtaceae (26 taxa), and Proteaceae (20 taxa) families (Appendix 5). Six of the species identified within the desktop assessment are not relevant to the site as they are marine in origin.

Threatened and Priority Ecological Communities (TECs and PECs)

A Threatened Ecological Community (TEC) is defined, under the *Environmental Protection Act 1986* (EP Act), as an ecological community listed, designated or declared under a written law or a law of the Commonwealth as threatened, endangered or vulnerable. There are four State categories of TECs (DEC 2010b)[1]:

- presumed totally destroyed (PD)
- critically endangered (CR)
- endangered (EN)
- vulnerable (VU).

A description of each of these TEC categories is presented in Appendix 1. TECs are gazetted as such (DEC 2013c). At the Commonwealth level, some Western Australian TECs are listed as Threatened, under the EPBC Act.

Under the EPBC Act, a person must not undertake an action that has or will have a significant impact on a listed TEC without approval from the Commonwealth Minister for the Environment, unless those actions are not prohibited under the EPBC Act. A description of each of these categories of TECs is presented in Appendix 1. The current EPBC Act list of TECs can be located on the DoTE (2013c) website.

Ecological communities identified as threatened, but not listed as TECs, can be classified as Priority Ecological Communities (PECs). These communities are under threat, but there is insufficient information available concerning their distribution to make a proper evaluation of their conservation status. DPaW categorises PECs according to their conservation priority, using five categories, P1 (highest conservation significance) to P5 (lowest conservation significance), to denote the conservation priority status of such ecological communities. Appendix 1 defines PECs (DEC 2010b). A list of current PECs can be viewed at the DEC (2013d) website.

No TECs or PECs were identified as having the potential to occur within the site.

[1] The Department of Environment and Conservation is still listed as the author of all TEC and PEC databases and have been referred to as such in this document instead of the Department of Parks and Wildlife (DPaW).

Threatened and Priority flora

A desktop survey for Threatened and Priority flora that may potentially occur within the site was undertaken using the resources of NatureMap (DEC 2007-), the Western Australian Herbarium (DPaW WAHERB 2013a), and DoTE (2013d). The Emerge (2012) field investigation report was also used as part of this desktop survey.

Flora within Western Australia that is considered to be under threat may be classed as either Threatened flora or Priority flora. Where flora has been gazetted as Threatened flora under the Wildlife Conservation Act 1950 (WC Act), it is an offence “to take” such flora without the written consent of the Minister. The WC Act defines “to take” flora as to gather, pluck, cut, pull up, destroy, dig up, remove or injure the flora or to cause or permit the same to be done by any means.

Priority flora are considered to be species which are potentially under threat, but for which there is insufficient information available concerning their distribution and/or populations to make a proper evaluation of their conservation status. DPaW categorises Priority flora according to their conservation priority, using five categories, P1 (highest conservation significance) to P5 (lowest conservation significance), to denote the conservation priority status of such species. Priority flora species are regularly reviewed, and may have their priority status changed when more information on the species becomes available. Appendix 1 defines levels of Threatened and Priority flora (DPaW WAHERB 2013b).

At the Commonwealth level, the EPBC Act lists Threatened species as extinct, extinct in the wild, critically endangered, endangered, vulnerable, or conservation dependent. Appendix 1 defines each of these categories of Threatened species. The EPBC Act prohibits an action that has or will have a significant impact on a listed Threatened species without approval from the Commonwealth Minister for the Environment. The current EPBC Act list of Threatened flora may be found on the DoTE (2013d) website.

The desktop assessment identified four Threatened flora and nine Priority flora which have the potential to occur within the area (Table 4). Of these, based on specific habitat requirements, one Threatened flora species (*Eucalyptus cuprea*) and all nine Priority flora species were considered to have the potential to occur.

Table 4 Threatened and Priority flora potentially occurring within the site

Species	Description	Potential to occur
Caladenia hoffmanii (**Threatened** – Endangered)	A spider orchid to 30 cm tall. The flower is identified by its long, red fringe and dark red glands. Occurs in clay, sandy clay or clay loam with laterite on rocky hillsides and ridges or in winter-wet flats.	**Unlikely –** Preferred soil type/habitat does not occur within the site.
Drummondita ericoides (**Threatened** – Endangered)	A low, erect, heath-like shrub to 1 m tall. Possesses yellowish flowers and small, hairless leaves covered in glandular spots. This species is known to occur in low heath on slopes, ridges and gullies in brown loam, sandy loam and clay in association with sandstone and laterite.	**Unlikely –** Preferred soil type/habitat does not occur within the site.
Eucalyptus cuprea (**Threatened** – Endangered)	An erect mallee, up to 5 m tall with thin, grey, flaky, fibrous bark. This species is known to occur on rises in sandy loam with sandstone or granite, and in red-brown clay loams with laterite.	**Possible –** Preferred soil type/habitat has the potential to occur within the site.
Isopogon uncinatus (**Threatened** – Endangered)	A small, tufted shrub between 10 – 40 cm tall. Possesses long, narrow leaves, and pale lemon flowers at ground level or just above. Occurs in seasonally damp, shallow sandy clay over granite or gravelly soils.	**Highly unlikely –** DEC WAHERB (2013a) lists the most current distribution of this species as being within the surrounds of Albany.
Melaleuca huttensis (**P1**)	An upright shrub to 3 m tall. Possesses gnarled bark and cream-yellow flowers. Occurs on light yellow or beige sand on the lower slopes of undulating plains or on sandplains.	**Possible –** Preferred soil type/habitat has the potential to occur within the site.
Vittadinia cervicularis var. *occidentalis* (**P1**)	An annual herb over 30 cm tall. Possesses flowers which range from white-purple-blue. No habitat information available.	**Possible –** given the distribution of this species within the Geraldton area and lack of habitat information, this species has the potential to occur within the site.
Eremophila brevifolia (**P2**)	An erect, spindly shrub between 0.9 – 3.6 m tall. Flowers range from white-pink-blue. No habitat information available.	**Possible –** given the distribution of this species within the Geraldton area and lack of habitat information, this species has the potential to occur within the site.
Thryptomene stenophylla (**P2**)	A spreading shrub between 0.3 – 1.2 m tall with pink-purple flowers. Occurs in red or yellow sand and loam on limestone hills and sandplains.	**Possible –** Preferred soil type/habitat has the potential to occur within the site.
Geleznowia sp. Binnu (K.A Shepherd & J. Wege KS 1301) (**P3**)	A shrub bearing essential oils (Information on this species is limited as it is currently being studied).	**Possible –** given the distribution of this species within the Geraldton area and lack of habitat information, this species has the potential to occur within the site.
Grevillea triloba (**P3**)	A diffuse or spreading shrub between 0.4 – 2.5 m tall with white/pink-white flowers. Occurs in sandy loam on sandstone or limestone and lateritic soils.	**Possible –** Preferred soil type/habitat has the potential to occur within the site.
Verticordia densiflora var. *roseostella* (**P3**)	An open shrub between 0.4 – 1.3 m tall with pink-white flowers. Occurs on sandy, gravelly soils.	**Possible –** Preferred soil type/habitat has the potential to occur within the site.
Eucalyptus blaxellii (**P4**)	A mallee between 1 – 4 m tall. Possesses smooth bark and white-cream flowers. Occurs in clay and grey sand on rocky hillsides and creek flats.	**Possible –** Preferred soil type/habitat has the potential to occur within the site.
Grevillea olivacea (**P4**)	An erect, non-lignotuberous shrub from 1 – 4.5 m tall with red/red-pink flowers. Occurs in white or grey sand on coastal dunes and limestone rocks.	**Possible –** Preferred soil type/habitat has the potential to occur within the site.

4.1.2 Terrestrial fauna

Emerge (2012) undertook a desktop survey of federal and state level online databases to identify any conservation significant terrestrial fauna present within the vicinity of the site. Terrestrial fauna which are identified as conservation significant are protected under either the federal EPBC Act or the state *Wildlife Conservation Act 1950* (WC Act). Table 5 lists the conservation significant fauna which were identified during Emerge (2012) research.

Table 5 Conservation significant fauna species potentially occurring in the vicinity of the site

Species		Conservation code	
Common name	Scientific name	EPBC Act	WC Act
Carnaby's cockatoo	*Calyptorhynchus latirostris*	Endangered	S1
Malleefowl	*Leipoa ocellata*	Vulnerable	S1
Southern giant petrel	*Macronectes giganteus*	Endangered/Migratory	S3
Northern giant petrel	*Macronectes halli*	Vulnerable/Migratory	S3
Shy Albatross	*Thalassarche cauta cauta*	Vulnerable/Migratory	S3
Fork-tailed swift	*Apus pacificus*	Migratory	S3
Great egret	*Ardea alba*	Migratory	S3
Cattle egret	*Ardea ibis*	Migratory	S3
White bellied sea-eagle	*Haliaeetus leucogaster*	Migratory	S3
Rainbow bee-eater	*Merops ornatus*	Migratory	S3
Caspian tern	*Sterna caspia*	Migratory	S3

Based on site photos and habitat descriptions outlined in Emerge (2012) it is unlikely that Carnaby's cockatoo or the malleefowl will utilise the site for habitat. This is due to the highly degraded nature of the site, presence of feral predatory species and absence of proteaceous and myrtaceous species utilised by Carnaby's cockatoos for foraging, roosting and breeding.

The migratory species listed in Table 5 may be occasional visitors to the site but are unlikely to utilise it for a prolonged period of time given the level of disturbance, absence of any significant habitat areas i.e. large trees or cliffs and distance from the coastline (Emerge 2012). Habitat for the Rainbow bee-eater does exist within the site but this species is unlikely to occur given the high level of disturbance and feral predatory species.

4.1.3 Acid sulfate soils

Government of Western Australia (2013) and Emerge (2012) indicate that majority of the site is located within an area not at risk of containing ASS within three meters of the soil surface. A portion of the eastern boundary of the site (associated with a drainage area) however, is considered to have a high to moderate risk of ASS occurring within three meters of the soils surface.

4.2 Field survey results

4.2.1 Native flora

A total of 15 native vascular plant taxa from 14 plant genera and 11 plant families were recorded within the site. The majority of taxa were recorded within the Chenopodiaceae (5 taxa) family (Appendix 2).

4.2.2 Threatened and Priority flora

No Threatened Flora species pursuant to Schedule 1 of the WC Act and as listed by DPaW (2013) or Priority Flora species as listed by DPaW WAHERB (2013a) were recorded within the site (Appendix 2).

4.2.3 Threatened and Priority Ecological Communities

No TECs as listed by DoTE (2013c) and by DEC (2013c) or PECs as listed by DEC (2013d) were identified within the site.

4.2.4 Introduced (exotic) flora

A total of 10 introduced (exotic) taxa were recorded within the site (Appendix 2). None of these species are Declared Plants species pursuant to Section 22 of the *Biosecurity and Agriculture Management Act 2007* (BAM Act) according to the Western Australian Department of Agriculture and Food (DAFWA 2013).

4.3 Analysis of data

Quadrat data were grouped into a species by site matrix (Appendix 3) and analysed to determine the Vegetation Types (VTs) within the site (refer to Section 3.3).

4.4 Vegetation Types

Two VTs were defined and mapped within the site (Appendix 3; Figure 3) and are summarised below (Table 6). Total areas occupied within the survey area by each of the identified vegetation communities are set out in Table 7.

Table 6 Vegetation Types

Vegetation Type	Description
S1	Low open shrubland of *Acacia rostellifera, Stylobasium spathulatum* and **Lycium ferocissimum* over *Rhagodia baccata, Ptilotus divaricatus* subsp. *divaricatus, Threlkeldia diffusa, Acanthocarpus preissii* and **Sonchus oleraceus* on low backdunes.
S2	Degraded Mid open shrubland of *Acacia rostellifera* and **Lycium ferocissimum* over *Enchylaena tomentosa* and **Avena barbata* on gravel and sandy soils between backdunes and drainage lines.
C*	Cleared areas

* Cleared areas have been mapped but are not counted as a unique VT

Figure 3 Vegetation Map

Scale 1:2,000 at A3

0 20 40 60 80 m

Coordinate System: GDA 1994 MGA Zone 50

Note that positional errors may occur in some areas

Date: 18/12/2013

Author: JCrute

Source: Aerial: Landgate, flown 08/2012.

Legend

- Lot 55
- S1: Low open shrubland of *Acacia rostellifera, Stylobasium spathulatum* and **Lycium ferocissimum* over *Rhagodia baccata, Ptilotus divaricatus* subsp. *divaricatus, Threlkeldia diffusa, Acanthocarpus preissii* and **Sonchus oleraceus* on low backdunes.
- S2: Degraded Mid open shrubland of *Acacia rostellifera* and **Lycium ferocissimum* over *Enchylaena tomentosa* and **Avena barbata* on gravel and sandy soils between backdunes and drainage lines.
- Cleared areas

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4.5 Vegetation Type coverage

The total area mapped was 12.22 hectares. This includes cleared areas and as such they have been removed from the calculations, giving a total vegetated area of 11.40 hectares (Table 7). The dominant VT within the area was S2 which can be broadly described as “Degraded Mid open shrubland of *Acacia rostellifera* and **Lycium ferocissimum* over *Enchylaena tomentosa* and **Avena barbata* on gravel and sandy soils between backdunes and drainage lines”.

Table 7 Area (ha) covered by each VT within the site

VT	Area (ha)	Percentage of the site
S1	2.36	20.71
S2	9.04	79.29
TOTALS	**11.40**	**100**

4.6 Accumulated species – sites surveyed (Species-Area Curve)

An averaged randomised Species Accumulation Curve, based on accumulated species compared against sites surveyed was used to provide an indication as to the level of adequacy of the survey effort. As the number of survey sites, and correspondingly the size of the area surveyed increases, there should be a diminishing number of new species recorded. At some point, the number of new species recorded becomes essentially asymptotic. As the number of new species being recorded for survey effort expended approaches this asymptotic value, the survey effort can be considered to be adequate.

The species accumulation curve (Figure 4), based on a species accumulation analysis was used to evaluate the adequacy of sampling (Colwell 2013). The asymptotic value was determined using Michaelis-Menten modelling. Using this analysis, the incidence based coverage estimator of species richness (ICE) was calculated to be 36 (Chao 2005). Based on this value, and the total of 25 species recorded during the survey, approximately 79.14% of the flora species potentially present within the site were recorded.

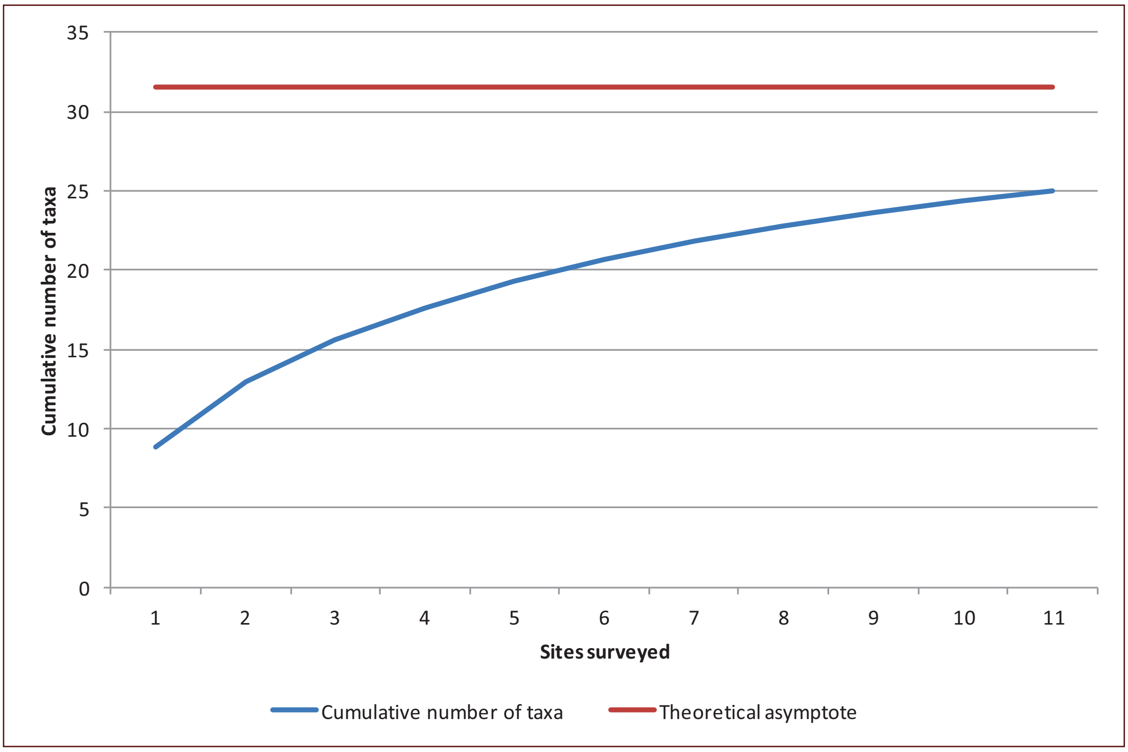

Figure 4 Averaged randomised Species Accumulation Curve

4.7 Vegetation condition

Majority of the site shows signs of having been degraded for a long period of time. The presence of tracks (vehicle and pedestrian), feral animals, litter, clearing and infestations of weeds have all impacted upon the vegetation condition within the area. As such, vegetation condition within the site ranged from Good to Completely Degraded (Keighery 1994; Figure 5; Table 8). Almost the entire site was infested with **Lycium ferocissimum* (African Boxthorn) that dominated the midstorey of the vegetation assemblage and was observed to be outcompeting native plants within the site. Table 9 gives a numeric breakdown of vegetation condition within the site.

Table 8 Vegetation Condition Scale (Keighery 1994)

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

Table 9 Area (ha) covered by each vegetation condition rating category within the site

Vegetation Condition	Area (ha)	Percentage of the site
Good	0.44	3.58
Good-Degraded	10.96	89.76
Completely Degraded	0.81	6.66
TOTALS	**12.22**	**100**

Figure 5 Vegetation Condition Map

Scale 1:2,000 at A3

0 20 40 60 80 m

N

Coordinate System: GDA 1994 MGA Zone 50

Note that positional errors may occur in some areas

Date: 18/12/2013

Author: JCrute

Source: Aerial: Landgate, flown 08/2012.

Legend

- Lot 55
- Good (4)
- Good - Degraded (4-5)
- Completely Degraded (6)

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4.8 Fauna habitat

No habitat for conservation significant terrestrial fauna species was noted within the site. No vascular plant species listed in DEC (2011) as being utilised by Carnaby's cockatoos were recorded. No signs of malleefowl mounds or Rainbow bee-eater burrows were observed within the site.

Signs of feral animals were abundant throughout the site. These included scats, burrows, carcasses and visual sightings of rabbits and foxes.

4.9 Acid sulfate soils

No visual signs of ASS were observed within the site.

5. Discussion

Vegetation within the site comprises two VTs, each of which is a degraded representation of its original state. Impacts such as weed invasion, unauthorised access and dumping of litter have all contributed to the condition of vegetation within the site. Transitions between VTs, though occasionally abrupt due to soil profile, cleared areas and/or topography were generally discontinuous with margins representing admixtures of more than one VT. At a broad scale, the site was comprised of dunes and swales containing shrublands of **Lycium ferocissimum* and *Acacia rostellifera* in varying densities.

The flora and vegetation assessment conducted within the site was undertaken during Spring, in the prime flowering time for majority of species within the area. Field reconnaissance involved traversing the majority of the site, which ensures that an accurate representation of all VTs and potential conservation significant flora were obtained.

A total of 25 vascular plant taxa from 23 genera and 13 families were recorded within the site. Ten of these taxa were introduced (exotic species) which were present in large infestations throughout the area. Of particular note was **Lycium ferocissimum* (African Boxthorn) which dominated the midstorey of the vegetation assemblage and was observed to be outcompeting native plants within the site.

No conservation significant species or ecological communities were recorded within the site. Effort was made during the field assessment to look for areas of suitable habitat for conservation significant species but none were found, which is likely related to the highly degraded nature of the site. It is therefore unlikely that conservation significant flora species will be present.

Both VTs appear to be well represented within the surrounding area (DoP 2010) and are consistent with the vegetation expected to be found within the area. The low levels of species diversity within each VT is not a reflection of inadequate survey intensity but rather the degraded nature of the site, particularly with reference to the prolific weed invasion observed.

Vegetation condition within the site ranged from Good to Completely Degraded (Keighery 1994). Approximately 3.58% of the site was mapped to be in “Good” condition, 89.76% in “Good-Degraded” condition and 6.66% in “Completely Degraded” condition. Majority of remnant vegetation within the broader Geraldton area, in particular the area covered by the Geraldton Regional Flora and Vegetation Survey (GRFVS) is threatened by development, weed invasion, grazing, fire or recreational use (EPA 2010). Given this level of threat, areas of remnant vegetation within the site which are in “Good” condition may be significant in terms of local conservation. It is worth noting however, that even the areas of vegetation which were mapped as being in “Good” condition still had a significant level of weed cover including African boxthorn which will continue to spread and degrade the condition of vegetation over time.

No appropriate habitat for conservation significant terrestrial fauna was observed within the site. This is likely due to the presence and presumed high abundance of feral animal species within the site as well as lack of suitable habitat features for species such as Carnaby’s Cockatoos.

No visual signs of ASS were observed, although detailed testing including soil and water sampling is recommended to confirm the status of the site for ASS.

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Appendix 1
Conservation significant flora and ecological communities definitions

Conservation Codes for Western Australia (DPaW WAHERB 2013b)

Under the *Wildlife Conservation Act* (1950), the Minister for the Environment may declare species of flora to be protected if they are considered to be in danger of extinction, rare or otherwise in need of special protection. Schedules 1 and 2 deal with those that are threatened and those that are presumed extinct, respectively.

T: Threatened Flora (Declared Rare Flora – Extant)

Species which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such (Schedule 1 under the Wildlife Conservation Act 1950).

Threatened Flora (Schedule 1) are further ranked by the Department according to their level of threat using IUCN Red List Criteria:

- CR: Critically Endangered – considered to be facing an extremely high risk of extinction in the wild
- EN: Endangered – considered to be facing a very high risk of extinction in the wild
- VU: Vulnerable – considered to be facing a high risk of extinction in the wild
- X: Presumed Extinct Flora (Declared Rare Flora – Extinct).

Species that have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such (Schedule 2 under the Wildlife Conservation Act 1950).

Priority Flora

Species that have not yet been adequately surveyed to be listed under Schedule 1 or 2 are added to the Priority Flora List under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna. Species that are adequately known, are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Conservation Dependent species are placed in Priority 5.

Priority One: Poorly-known Species

Species that are known from one or a few collections or sight records (generally less than 5), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.

Priority Two: Poorly-known Species

Species that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.

Priority Three: Poorly-known Species

Species that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.

Priority Four: Rare, Near Threatened and other species in need of monitoring

1. Rare: Species that are considered to be have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands.
2. Near Threatened: Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.
3. Species that have been removed from the list of threatened species during the past 5 years for reasons other than taxonomy.

Priority 5: Conservation Dependent Species

Species that are not threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within 5 years.

Definition of Threatened Ecological Communities (DEC 2010)

Presumed Totally Destroyed (PD)

An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant and either of the following applies:

- records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats or
- all occurrences recorded within the last 50 years have since been destroyed.

Critically Endangered (CR)

An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria:

1. The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and either or both of the following apply:
   (a) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years)
   (b) modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated.
2. Current distribution is limited, and one or more of the following apply:
   (a) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years)
   (b) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes
   (c) there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes.
3. The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).

Endangered (EN)

An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria:

1. The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement and either or both of the following apply:
   (a) the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years)
   (b) modification throughout its range is continuing such that in the short term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated.

2. Current distribution is limited, and one or more of the following apply”
    (a) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years)
    (b) there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes
    (c) there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes.
3. The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).

Vulnerable (VU)

An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria:

1. The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated.
2. The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations.
3. The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.

Definition of Priority Ecological Communities (DEC 2010)

Priority One: Poorly-known ecological communities

Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.

Priority Two: Poorly-known ecological communities

Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, State forest, unallocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.

Priority Three: Poorly known ecological communities

- communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or
- communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat
- communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes.

Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.

Priority Four

Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring. These include:

1. Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands.
2. Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.
3. Ecological communities that have been removed from the list of threatened communities during the past five years.

Priority Five: Conservation Dependent ecological communities

Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

Appendix 2
Vascular plant taxa recorded within the site

Family	Species
Amaranthaceae	*Ptilotus divaricatus* var. *divaricatus*
Arecaceae	*Arecaceae sp.
Asparagaceae	*Acanthocarpus preissii*
Asteraceae	*Olearia axillaris*
	**Sonchus oleraceus*
Chenopodiaceae	*Enchylaena tomentosa*
	Rhagodia baccata
	Rhagodia preissii
	Salsola australis
	Threlkeldia diffusa
Convolvulaceae	*Convolvulus remotus*
Euphorbiaceae	*Ricinocarpos muricatus*
Fabaceae	*Acacia rostellifera*
Lauraceae	*Cassytha* sp.
Poaceae	**Avena barbata*
	**Bromus diandrus*
	**Cenchrus setaceus*
	**Chloris virgata*
	**Ehrharta calycina*
	**Ehrharta longiflora*
	*Poaceae sp.
Ranunculaceae	*Clematis linearifolia*
Solanaceae	*Anthocercis ilicifolia*
	**Lycium ferocissimum*
Surianaceae	*Stylobasium spathulatum*

* denotes introduced (exotic) species (DPaW WAHERB 2013a)

Appendix 3

Vascular plant taxa recorded by site and vegetation community

Species	Site										
	PAN01	PAN02	PAN03	PAN07	PAN08	PAN09	PAN10	PAN11	PAN04	PAN05	PAN06
Acacia rostellifera	x	x	x		x	x		x	x	x	x
Acanthocarpus preissii	x	x	x	x	x	x					
Anthocercis ilicifolia				x					x		
*Arecaceae sp.											x
**Avena barbata*			x							x	x
**Bromus diandrus*			x					x			
Cassytha sp.						x					
**Cenchrus setaceus*			x							x	
Chloris virgata					x	x			x		
Clematis linearifolia						x					
Convolvulus remotus		x									
**Ehrharta calycina*			x		x	x					
**Ehrharta longiflora*				x							
Enchylaena tomentosa										x	x
**Lycium ferocissimum*	x	x	x	x	x	x	x	x	x	x	x
Olearia axillaris		x		x		x		x	x		
*Poaceae sp.	x	x									
Ptilotus divaricatus var. *divaricatus*	x	x	x	x	x	x	x	x			
Rhagodia baccata				x		x	x	x			
Rhagodia preissii										x	
Ricinocarpos muricatus				x	x			x			
Salsola australis										x	
**Sonchus oleraceus*	x	x	x	x	x	x	x	x		x	
Stylobasium spathulatum	x	x	x	x	x	x	x		x		
Threlkeldia diffusa	x	x	x	x	x	x	x	x			

Legend
S2
S1

* denotes introduced (exotic) species (DPaW WAHERB 2013a)

Appendix 4

Photographic record of sites and

Vegetation Types

Plate 1 Site PAN01 (VT S2)

Plate 2 Site PAN02 (VT S2)

Plate 3 Site PAN03 (VT S2)

Plate 4 Site PAN04 (VT S1)

Plate 5 Site PAN05 (VT S1)

Plate 6 Site PAN06 (VT S1)

Plate 7 Site PAN07 (VT S2)

Plate 8 Site PAN08 (VT S2)

Plate 9 Site PAN09 (VT S2)

Plate 10 Site PAN10 (VT S2)

Plate 11   Site PAN11 (VT S2)

Appendix 5

Desktop assessment results

(DEC 2007-)

NatureMap
Mapping Western Australia's biodiversity

GPA13239_01 Naturemap report

Created By Daniel Panickar on 14/11/2013

Kingdom	Plantae
Current Names Only	Yes
Core Datasets Only	Yes
Method	'By Circle'
Centre	114°37' 13'' E,28°41' 56'' S
Buffer	5km
Group By	Family

Family	Species	Records
Aizoaceae	4	11
Amaranthaceae	3	9
Aphanopetalaceae	1	12
Apocynaceae	1	2
Araliaceae	2	3
Asparagaceae	7	12
Asteraceae	14	26
Boraginaceae	1	1
Boryaceae	1	1
Brassicaceae	2	2
Campanulaceae	2	3
Casuarinaceae	4	10
Chenopodiaceae	10	13
Colchicaceae	1	2
Convolvulaceae	2	8
Corallinaceae	1	1
Crassulaceae	1	1
Cyperaceae	6	8
Dilleniaceae	5	15
Dioscoreaceae	1	3
Droseraceae	2	2
Ericaceae	2	3
Euphorbiaceae	5	7
Fabaceae	30	97
Goodeniaceae	12	24
Gyrostemonaceae	2	8
Haemodoraceae	5	21
Halymeniaceae	1	1
Hemerocallidaceae	6	11
Lamiaceae	3	3
Lauraceae	2	4
Malvaceae	10	17
Marsileaceae	1	1
Myrtaceae	26	61
Nitrariaceae	1	1
Nyctaginaceae	1	3
Oleaceae	1	1
Orchidaceae	5	5
Papaveraceae	1	1
Phyllanthaceae	2	3
Pittosporaceae	2	6
Poaceae	17	31
Polygalaceae	1	1
Polygonaceae	1	2
Portulacaceae	4	5
Primulaceae	1	1
Proteaceae	20	40
Ranunculaceae	1	3
Restionaceae	2	6
Rhamnaceae	5	10
Rhodomelaceae	4	4
Rubiaceae	2	2
Rutaceae	4	6
Santalaceae	2	2
Sapindaceae	3	7
Scrophulariaceae	3	10
Solanaceae	5	7
Stylidiaceae	2	3
Surianaceae	2	7
Thymelaeaceae	3	9
Urticaceae	1	1
Verbenaceae	1	3
Violaceae	1	2
Vitaceae	1	2
Zygophyllaceae	1	3
TOTAL	**276**	**590**

Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Aizoaceae					
1.	2796	*Carpobrotus modestus (Inland Pigface)*			
2.	2798	*Carpobrotus virescens (Coastal Pigface, Kolboko)*			
3.	2820	*Tetragonia decumbens (Sea Spinach)*	Y		
4.	2823	*Tetragonia implexicoma (Bower Spinach)*			
Amaranthaceae					
5.	2717	*Ptilotus divaricatus (Climbing Mulla Mulla)*			
6.	40841	*Ptilotus stirlingii subsp. stirlingii*			
7.	2766	*Ptilotus villosiflorus*			
Aphanopetalaceae					
8.	3180	*Aphanopetalum clematideum*			
Apocynaceae					
9.	6565	*Alyxia buxifolia (Dysentery Bush)*			
Araliaceae					
10.	19253	*Trachymene ceratocarpa*			
11.	6280	*Trachymene pilosa (Native Parsnip)*			
Asparagaceae					
12.	1208	*Acanthocarpus preissii*			
13.	20797	*Acanthocarpus sp. Ajana (C.A. Gardner 8596)*			
14.	11732	*Laxmannia sessiliflora subsp. sessiliflora*			
15.	1319	*Thysanotus arenarius*			
16.	1338	*Thysanotus manglesianus (Fringed Lily)*			
17.	1343	*Thysanotus patersonii*			
18.	1351	*Thysanotus sparteus*			
Asteraceae					
19.	7817	*Actinobole uliginosum (Flannel Cudweed)*			
20.	7827	*Angianthus cunninghamii (Coast Angianthus)*			
21.	12741	*Hyalosperma cotula*			
22.	8127	*Olearia axillaris (Coastal Daisybush)*			
23.	8136	*Olearia homolepis*			
24.	8182	*Podotheca angustifolia (Sticky Longheads)*			
25.	8184	*Podotheca gnaphalioides (Golden Long-heads)*			
26.	8197	*Reichardia tingitana (False Sowthistle)*	Y		
27.	20161	*Senecio pinnatifolius*			
28.	8231	*Sonchus oleraceus (Common Sowthistle)*	Y		
29.	15725	*Verbesina encelioides*	Y		
30.	11278	*Vittadinia cervicularis var. occidentalis*		P1	
31.	13331	*Waitzia acuminata var. acuminata*			
32.	13330	*Waitzia acuminata var. albicans*			
Boraginaceae					
33.	6696	*Halgania sericiflora*			
Boryaceae					
34.	1273	*Borya sphaerocephala (Pincushions)*			
Brassicaceae					
35.	3000	*Brassica tournefortii (Mediterranean Turnip)*	Y		
36.	3002	*Cakile maritima (Sea Rocket)*	Y		
Campanulaceae					
37.	7384	*Wahlenbergia capensis (Cape Bluebell)*	Y		
38.	7389	*Wahlenbergia preissii*			
Casuarinaceae					
39.	1721	*Allocasuarina campestris*			
40.	1731	*Allocasuarina huegeliana (Rock Sheoak, Kwowl)*			
41.	1732	*Allocasuarina humilis (Dwarf Sheoak)*			
42.	1742	*Casuarina obesa (Swamp Sheoak, Kuli)*			
Chenopodiaceae					
43.	2450	*Atriplex amnicola (Swamp Saltbush)*			
44.	2452	*Atriplex cinerea (Grey Saltbush)*			
45.	2463	*Atriplex isatidea (Coast Saltbush)*			
46.	2479	*Atriplex stipitata (Mallee Saltbush)*			
47.	33597	*Dysphania melanocarpa forma melanocarpa (Black Goosefoot)*			
48.	2583	*Rhagodia latifolia*			
49.	11316	*Rhagodia latifolia subsp. recta*			
50.	11240	*Rhagodia preissii subsp. obovata*			
51.	2593	*Sarcocornia quinqueflora (Beaded Samphire)*			

NatureMap
Mapping Western Australia's Biodiversity

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
52.	2644	*Threlkeldia diffusa (Coast Bonefruit)*			
Colchicaceae					
53.	12770	*Burchardia congesta*			
Convolvulaceae					
54.	6609	*Bonamia rosea (Felty Bellflower)*			
55.	6614	*Convolvulus remotus*			
Corallinaceae					
56.	26463	*Amphiroa gracilis*			
Crassulaceae					
57.	3139	*Crassula exserta*			
Cyperaceae					
58.	20216	*Ficinia nodosa (Knotted Club Rush)*			
59.	930	*Lepidosperma costale*			
60.	947	*Lepidosperma tenue*			
61.	955	*Mesomelaena pseudostygia*			
62.	1002	*Schoenus nanus (Tiny Bog Rush)*			
63.	1035	*Tetraria microcarpa*			
Dilleniaceae					
64.	5108	*Hibbertia acerosa (Needle Leaved Guinea Flower)*			
65.	5116	*Hibbertia crassifolia*			
66.	5135	*Hibbertia hypericoides (Yellow Buttercups)*			
67.	5171	*Hibbertia spicata*			
68.	11481	*Hibbertia spicata subsp. spicata*			
Dioscoreaceae					
69.	1509	*Dioscorea hastifolia (Warrine, Wararn)*			
Droseraceae					
70.	8910	*Drosera humilis*			
71.	14298	*Drosera macrantha subsp. macrantha*			
Ericaceae					
72.	20364	*Leucopogon sp. Mid West (J.S. Beard 7388)*			
73.	34736	*Lysinema pentapetalum*			
Euphorbiaceae					
74.	4635	*Euphorbia myrtoides*			
75.	4638	*Euphorbia peplus (Petty Spurge)*	Y		
76.	4648	*Euphorbia terracina (Geraldton Carnation Weed)*	Y		
77.	4699	*Ricinocarpos psilocladus*			
78.	4705	*Ricinus communis (Castor Oil Plant)*	Y		
Fabaceae					
79.	3242	*Acacia blakelyi*			
80.	3323	*Acacia ericifolia*			
81.	3376	*Acacia idiomorpha*			
82.	11611	*Acacia lasiocarpa var. lasiocarpa*			
83.	3474	*Acacia oxyclada*			
84.	3525	*Acacia rostellifera (Summer-scented Wattle)*			
85.	30033	*Acacia saligna subsp. lindleyi*			
86.	3532	*Acacia scirpifolia*			
87.	3549	*Acacia spathulifolia*			
88.	3604	*Acacia xanthina (White-stemmed Wattle)*			
89.	3719	*Bossiaea spinescens*			
90.	13114	*Chorizema racemosum*			
91.	3807	*Daviesia divaricata (Marno)*			
92.	41823	*Daviesia divaricata subsp. Lanulosa (W.E. Blackall 2733)*			
93.	3912	*Gastrolobium oxylobioides (Champion Bay Poison)*			
94.	19189	*Gastrolobium triangulare*			
95.	3938	*Glycine canescens (Silky Glycine)*			
96.	3957	*Gompholobium tomentosum (Hairy Yellow Pea)*			
97.	3992	*Isotropis cuneifolia (Granny Bonnets)*			
98.	19700	*Isotropis cuneifolia subsp. cuneifolia*			
99.	14780	*Jacksonia arenicola*			
100.	14783	*Jacksonia calcicola*			
101.	4015	*Jacksonia hakeoides*			
102.	14785	*Jacksonia rigida*			
103.	4029	*Jacksonia sternbergiana (Stinkwood, Kapur)*			
104.	3667	*Labichea lanceolata (Tall Labichea)*			
105.	11289	*Labichea lanceolata subsp. lanceolata*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
106.	15428	*Leptosema aphyllum*			
107.	4100	*Mirbelia spinosa*			
108.	4256	*Templetonia retusa (Cockies Tongues)*			

Goodeniaceae

109.	7421	*Dampiera altissima (Tall Dampiera)*			
110.	7454	*Dampiera linearis (Common Dampiera)*			
111.	7475	*Dampiera spicigera (Spiked Dampiera)*			
112.	7495	*Goodenia berardiana*			
113.	7580	*Lechenaultia linarioides (Yellow Leschenaultia)*			
114.	7603	*Scaevola canescens (Grey Scaevola)*			
115.	7606	*Scaevola crassifolia (Thick-leaved Fan-flower)*			
116.	7614	*Scaevola globulifera*			
117.	7637	*Scaevola porocarya (Striate-fruit Scaevola)*			
118.	13152	*Scaevola thesioides subsp. thesioides*			
119.	12588	*Scaevola virgata*			
120.	7656	*Velleia cycnopotamica*			

Gyrostemonaceae

121.	2784	*Gyrostemon ramulosus (Corkybark)*			
122.	2791	*Tersonia cyathiflora (Button Creeper)*			

Haemodoraceae

123.	1418	*Conostylis aculeata (Prickly Conostylis)*			
124.	11641	*Conostylis aculeata subsp. rhipidion*			
125.	1446	*Conostylis prolifera (Mat Cottonheads)*			
126.	1456	*Conostylis stylidioides*			
127.	1473	*Haemodorum simulans*			

Halymeniaceae

128.	26709	*Cryptonemia undulata*			

Hemerocallidaceae

129.	29439	*Caesia sp. Wongan (K.F. Kenneally 8820)*			
130.	11283	*Corynotheca micrantha var. micrantha*			
131.	1259	*Dianella revoluta (Blueberry Lily)*			
132.	11636	*Dianella revoluta var. divaricata*			
133.	1260	*Stypandra glauca (Blind Grass)*			
134.	1361	*Tricoryne elatior (Yellow Autumn Lily)*			

Lamiaceae

135.	41041	*Quoya atriplicina*			
136.	41063	*Quoya loxocarpa*			
137.	6939	*Westringia dampieri*			

Lauraceae

138.	2948	*Cassytha aurea*			
139.	11799	*Cassytha racemosa forma racemosa*			

Malvaceae

140.	4905	*Alyogyne hakeifolia*			
141.	40872	*Commersonia borealis*			
142.	17416	*Guichenotia angustifolia*			
143.	5011	*Guichenotia ledifolia*			
144.	5012	*Guichenotia macrantha (Large-flowered Guichenotia)*			
145.	5013	*Guichenotia micrantha (Small Flowered Guichenotia)*			
146.	4927	*Hibiscus drummondii (Drummond's Hibiscus)*			
147.	5022	*Keraudrenia hermanniifolia*			
148.	9099	*Lasiopetalum angustifolium (Narrow Leaved Lasiopetalum)*			
149.	4964	*Radyera farragei (Knobby Hibiscus)*			

Marsileaceae

150.	76	*Marsilea hirsuta (Nardoo)*			

Myrtaceae

151.	35856	*Calothamnus glaber*			
152.	35756	*Calothamnus quadrifidus subsp. angustifolius*			
153.	5498	*Chamelaucium uncinatum (Geraldton Wax)*			
154.	5522	*Darwinia pauciflora*			
155.	12896	*Eucalyptus arachnaea (Black-stemmed Mallee)*			
156.	13039	*Eucalyptus blaxellii*		P4	
157.	35344	*Eucalyptus camaldulensis subsp. arida*			
158.	35345	*Eucalyptus camaldulensis subsp. obtusa (Blunt-budded River Red Gum)*			
159.	5640	*Eucalyptus eudesmioides (Malallie, Marlarli)*			
160.	19048	*Melaleuca campanae*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
161.	5887	*Melaleuca cardiophylla (Tangling Melaleuca)*			
162.	5904	*Melaleuca depressa*			
163.	19451	*Melaleuca huttensis*		P1	
164.	5922	*Melaleuca lanceolata (Rottnest Teatree, Moonah)*			
165.	18112	*Melaleuca leuropoma*			
166.	5936	*Melaleuca megacephala*			
167.	5958	*Melaleuca radula (Graceful Honeymyrtle)*			
168.	5959	*Melaleuca rhaphiophylla (Swamp Paperbark)*			
169.	13280	*Melaleuca viminea subsp. viminea*			
170.	6030	*Scholtzia ciliata*			
171.	6041	*Scholtzia umbellifera*			
172.	6064	*Thryptomene racemulosa*			
173.	6066	*Thryptomene stenophylla*		P2	
174.	6073	*Verticordia chrysantha*			
175.	12413	*Verticordia densiflora var. roseostella*		P3	
176.	15435	*Verticordia monadelpha var. monadelpha*			

Nitrariaceae

177.	4366	*Nitraria billardierei (Nitre Bush)*			

Nyctaginaceae

178.	2776	*Commicarpus australis (Perennial Tar Vine)*			

Oleaceae

179.	6500	*Jasminum calcareum*			

Orchidaceae

180.	15349	*Caladenia flava subsp. maculata*			
181.	15419	*Microtis media subsp. media*			
182.	1671	*Prasophyllum elatum (Tall Leek Orchid)*			
183.	1674	*Prasophyllum giganteum (Bronze Leek Orchid)*			
184.	16367	*Pyrorchis nigricans (Red beaks, Elephants ears)*			

Papaveraceae

185.	2969	*Fumaria capreolata (Whiteflower Fumitory)*	Y		

Phyllanthaceae

186.	4675	*Phyllanthus calycinus (False Boronia)*			
187.	4685	*Phyllanthus scaber*			

Pittosporaceae

188.	19421	*Marianthus bicolor (Painted Marianthus)*			
189.	17632	*Marianthus ringens*			

Poaceae

190.	12025	*Amphipogon caricinus var. caricinus*			
191.	210	*Aristida holathera*			
192.	12063	*Aristida holathera var. holathera*			
193.	17237	*Austrostipa elegantissima*			
194.	17241	*Austrostipa hemipogon*			
195.	17244	*Austrostipa macalpinei*			
196.	249	*Bromus diandrus (Great Brome)*	Y		
197.	258	*Cenchrus ciliaris (Buffel Grass)*	Y		
198.	283	*Cynodon dactylon (Couch)*	Y		
199.	349	*Ehrharta longiflora (Annual Veldt Grass)*	Y		
200.	492	*Neurachne alopecuroidea (Foxtail Mulga Grass)*			
201.	533	*Paspalum vaginatum (Salt Water Couch)*	Y		
202.	551	*Phalaris minor (Lesser Canary Grass)*	Y		
203.	617	*Sorghum halepense (Johnson Grass)*	Y		
204.	35236	*Sorghum x drummondii (Sudan Grass)*	Y		
205.	625	*Spinifex longifolius (Beach Spinifex)*			
206.	635	*Sporobolus virginicus (Marine Couch)*			

Polygalaceae

207.	4561	*Comesperma scoparium (Broom Milkwort)*			

Polygonaceae

208.	2412	*Muehlenbeckia adpressa (Climbing Lignum)*			

Portulacaceae

209.	2845	*Calandrinia brevipedata (Short-stalked Purslane)*			
210.	2853	*Calandrinia eremaea (Twining Purslane)*			
211.	2856	*Calandrinia liniflora (Parakeelya)*			
212.	2867	*Calandrinia remota*			

Primulaceae

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
213.	36375	*Lysimachia arvensis (Pimpernel)*	Y		

Proteaceae

214.	1800	*Banksia attenuata (Slender Banksia, Piara)*			
215.	1842	*Banksia prionotes (Acorn Banksia)*			
216.	16849	*Conospermum microflorum*			
217.	1882	*Conospermum stoechadis (Common Smokebush)*			
218.	15611	*Conospermum stoechadis subsp. stoechadis (Common Smokebush)*			
219.	1956	*Grevillea argyrophylla (Silvery-leaved Grevillea)*			
220.	15763	*Grevillea biformis subsp. biformis*			
221.	1965	*Grevillea biternata*			
222.	1973	*Grevillea candelabroides*			
223.	18130	*Grevillea commutata subsp. pinnatisecta*			
224.	2001	*Grevillea eriostachya (Flame Grevillea, Kaliny-kalinypa)*			
225.	2032	*Grevillea leucopteris (White Plume Grevillea)*			
226.	2054	*Grevillea olivacea (Olive Grevillea)*		P4	
227.	8838	*Grevillea pinaster*			
228.	2113	*Grevillea triloba*		P3	
229.	2199	*Hakea recurva (Djarnokmurd)*			
230.	2214	*Hakea trifurcata (Two-leaf Hakea)*			
231.	2227	*Isopogon divergens (Spreading Coneflower)*			
232.	2290	*Petrophile conifera*			
233.	2301	*Petrophile macrostachya*			

Ranunculaceae

234.	10804	*Clematis linearifolia*			

Restionaceae

235.	17663	*Desmocladus asper*			
236.	1075	*Lepidobolus preissianus*			

Rhamnaceae

237.	16018	*Cryptandra arbutiflora var. borealis*			
238.	31614	*Cryptandra multispina*			
239.	4811	*Cryptandra spyridioides*			
240.	4828	*Spyridium globulosum (Basket Bush)*			
241.	15065	*Stenanthemum notiale subsp. notiale*			

Rhodomelaceae

242.	26663	*Cladurus elatus*			
243.	26782	*Digenea simplex*			
244.	27173	*Polysiphonia decipiens*			
245.	27360	*Vidalia spiralis*			

Rubiaceae

246.	18256	*Opercularia spermacocea*			
247.	18255	*Opercularia vaginata (Dog Weed)*			

Rutaceae

248.	4409	*Boronia coerulescens*			
249.	11274	*Boronia coerulescens subsp. spinescens*			
250.	38241	*Geleznowia sp. Binnu (K.A. Shepherd & J. Wege KS 1301)*		P3	
251.	4483	*Geleznowia verrucosa*			

Santalaceae

252.	2332	*Anthobolus foveolatus*			
253.	2356	*Santalum acuminatum (Quandong, Warnga)*			

Sapindaceae

254.	18542	*Diplopeltis huegelii subsp. subintegra*			
255.	4748	*Diplopeltis petiolaris*			
256.	4766	*Dodonaea inaequifolia*			

Scrophulariaceae

257.	7185	*Eremophila brevifolia (Spotted Eremophila)*		P2	
258.	14191	*Eremophila glabra subsp. tomentosa*			
259.	7291	*Myoporum insulare (Blueberry Tree, boobialla)*			

Solanaceae

260.	11725	*Anthocercis ilicifolia subsp. ilicifolia*			
261.	6968	*Lycium ferocissimum (African Boxthorn)*	Y		
262.	6974	*Nicotiana glauca (Tree Tobacco)*	Y		
263.	11327	*Nicotiana occidentalis subsp. hesperis*			
264.	7025	*Solanum oldfieldii*			

Stylidiaceae

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
265.	7720	*Stylidium elongatum (Tall Triggerplant)*			
266.	7785	*Stylidium repens (Matted Triggerplant)*			

Surianaceae

267.	3181	*Stylobasium australe*			
268.	3182	*Stylobasium spathulatum (Pebble Bush)*			

Thymelaeaceae

269.	5231	*Pimelea angustifolia (Narrow-leaved Pimelea)*			
270.	5244	*Pimelea floribunda*			
271.	11185	*Pimelea microcephala subsp. microcephala*			

Urticaceae

272.	1762	*Parietaria debilis (Pellitory)*			

Verbenaceae

273.	6733	*Lantana camara (Common Lantana)*	Y		

Violaceae

274.	12007	*Hybanthus floribundus subsp. floribundus*			

Vitaceae

275.	4853	*Clematicissus angustissima*			

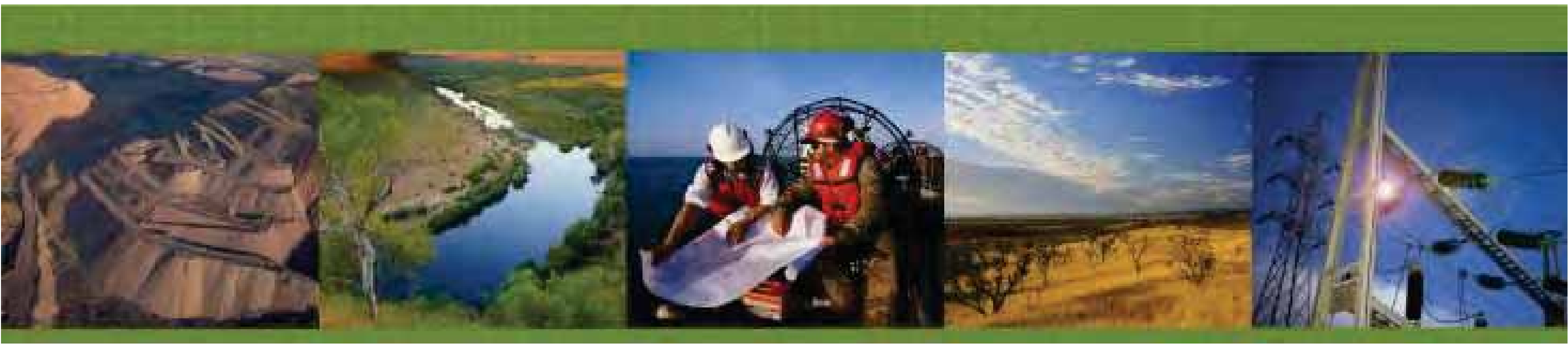
Zygophyllaceae

276.	4390	*Zygophyllum fruticulosum (Shrubby Twinleaf)*			

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 2
Odour Assessment report
(Strategen 2014)



Odour Assessment - Lot 55 Chapman Rd, Glenfield

Prepared for
ASDC Pty Ltd
by Strategen

March 2014

STRATEGEN
environmental consultants

Odour Assessment - Lot 55 Chapman Rd, Glenfield

Strategen is a trading name of
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March 2014

Disclaimer and Limitation

Client: ASDC Pty Ltd

Report Version	Revision No.	Purpose	Strategen author/reviewer	Submitted to Client	
				Form	Date
Preliminary Draft Report	A	Client review	J Shepherd, P Forster/D Walsh	Electronic via email	10 Mar 2014
Final draft Report	B	Client review	P Forster/L Taylor	Electronic via email	12 Mar 2014
Final Report	C	Client use	P Forster	Electronic via email	27 Mar 2014

Filename: GPA13277_01 R001 Rev C - 27 March 2014

Executive summary

ASDC Pty Ltd (ASDC) proposes to develop Lot 55 Chapman Road, Glenfield for a range of commercial and retail activities (the Proposed Development site). This Proposed Development site is located in close proximity to the Geraldton North Waste Water Treatment Plant (WWTP) operated by the Water Corporation. A desktop assessment carried out by Strategen suggested that it was possible for odour emissions from the WWTP could reach the Proposed Development site with the potential for impacts on amenity for persons working within or visiting the proposed commercial and retail premises.

General Property Assets, on behalf of ASDC, commissioned Strategen to conduct field odour assessments to generate information and data on the spatial and temporal aspects of existing odour impacts on the Proposed Development site to facilitate predictions of impacts on the proposed commercial and retail developments.

This report describes the findings from the field odour assessments and predictions for frequency and level of odour impact at the Proposed Development site.

Field observations and analysis of wind directions have indicated a low probability of odour impacts at the Proposed Development site from normal operation of the WWTP. The levels of odours detected at the Proposed Development site are predicted to be well below the Water Corporation 5 odour unit (OU) criterion used as a planning tool for establishment of buffer zones around WWTPs. That criterion is set for a 1 hour average, which means higher concentrations from 6 to 12 OU can be considered appropriate for short duration (10 minute) impacts as observed from the field observations.

The greater probability for odour impacts will be in the spring months, when lighter winds from the SW that will impact on the Proposed Development site typically occur for approximately 3% of business hours. The field observations suggest that those impacts will be insignificant, since the concentrations are likely to be below odour detection threshold for normal operating conditions at the WWTP. Higher velocity winds (typically > 6 m/s) impact on the Proposed Development site for approximately 30% of business hours in the summer months but these winds afford good dilution of odours to reach threshold within 100 m from the ponds. This means that although the winds that impact on the Proposed Development site from the WWTP are more frequent in those months, those strong winds will rapidly dilute the odours to levels not detected at the Proposed Development site.

Odour control measures are recommended in the unlikely event of odour impacts at the Proposed Development site. These measures include building ventilation design to ensure air conditioning make-up air is accessed from the east side of the buildings and carbon filtration is installed for treatment of that air. Garden beds that may be included in the landscaping of the project could include a range of plant species that provide fragrant flowers at all times of the year, essentially to replace any odours from the WWTP with a more pleasant odour.

Advice from Water Corporation is that high rainfall events destabilise the aerobic conditions in the ponds and generate increased odour emissions for 1 to 2 weeks after the rain has ceased. Anecdotal evidence from Water Corporation indicates that those impacts could extend outside the buffer zone based on the 5 OU criteria which would affect existing established sensitive land uses. Mitigation measures employed by the Water Corporation can take 1-2 weeks to become fully effective, which suggests that these events and are likely to provide the greatest potential for odour impacts at the Proposed Development site. Analysis of rainfall data suggests such events occur less than once per year, which is a relatively low frequency event and would not preclude the proposed compatible land use development at the Proposed Development site.

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1. Introduction

ASDC Pty Ltd (ASDC) proposes to develop Lot 55 Chapman Road, Glenfield for a range of commercial and retail activities (the Proposed Development site). This Proposed Development site is located in close proximity to the Geraldton North Waste Water Treatment Plant (WWTP) operated by the Water Corporation. A desktop assessment carried out by Strategen suggested that it was possible for odour emissions from the WWTP could reach the site with the potential for impacts on amenity for persons working within or visiting the proposed commercial and retail premises.[1]

The extent of any odour impact could not be determined from the desktop assessment due to the absence of site-specific odour emissions data from the WWTP. To address this, General Property Assets (GPA), on behalf of ASDC, commissioned Strategen to conduct field odour assessments to generate information and data on the spatial and temporal aspects of existing odour impacts on the Proposed Development site to facilitate predictions of impacts on the proposed commercial and retail developments.

This report describes the findings from the field odour assessments and predictions for frequency and level of odour impact at the Proposed Development site.

[1] Strategen 2013. *Proposed Activity Centre – Lot 55 and 9000 Chapman Road, Geraldton*. Document Reference LLE13230.01, 31 October 2013.

2. Objective and scope of the odour assessment

The desktop study has identified the Geraldton North WWTP as the primary source of odour that may impact on the Proposed Development site, therefore this study has focussed on assessment of impacts from that facility.

The objective of the assessment is to develop an understanding of risks of unacceptable odour impacts from the WWTP on the Proposed Development site. This risk is to be determined on the basis of the frequency of winds that would transport odour emissions from the WWTP and the intensity or strength of odours under those conditions at locations on the Proposed Development site.

The scope of the assessment was as follows:

- field odour testing was carried out at key locations on the Proposed Development site for a range of wind directions and wind speeds that reflect conditions of low to high risk for impacts from the WWTP
- field odour testing was conducted within the WWTP to identify the processes that give rise to the majority of odour emissions
- odour plume tracking testing to determine the reduction in odour concentrations with increasing distance from the WWTP and therefore calculate the likely odour concentrations at the Proposed Development site
- examination of meteorological data from Geraldton airport to provide advice on likely frequency of future odour impacts at the Proposed Development site
- acquisition of site-specific meteorological data for comparison with airport data and adjustment of predictions of future odour impacts based on site-specific factors

In addition to the field assessments, Strategen has consulted with the Water Corporation to fully understand the actual processes and practices employed at the Geraldton North WWTP that give rise to odour emissions from that facility. This is a key component of the risk assessment of future odour impacts on the Proposed Development. In particular, planned activities such as sludge removal and drying may provide greater risk of odour impacts which would affect the overall risk profile compared with normal operations. Unplanned plant outages such as those caused by high rainfall events were also considered in the assessment.

3. Methodology

3.1 Odour surveys

The assessment has been limited to field observations of odours emitted from the WWTP, at locations as they affect the Proposed Development site. The assessment did not include measurements of odour concentrations and odour emission rates from the WWTP to facilitate dispersion modelling of odour emissions to predict impacts at the Proposed Development site. Water Corporation has previously conducted such modelling and that provided the basis for the separation (buffer) distance proposed for the WWTP (Wallis and Cadee, 2008).

The field odour assessment was conducted following the general principles of the German VDI 3940 (Part 1 and Part 2) standard, with some key modifications commensurate with the intent of the assessment. The assessment of odour impacts using the VDI 3940 standard is common place in WA and appears supported by the Department of Environment Regulation (DER).[2]

The assessments were carried out using human assessors, who were stationed at various locations within the Proposed Development site and within the WWTP at various times for the duration of the program. The assessors recorded the intensity and character of odours observed every 10 seconds as they breathed normally for a period of 10 minutes. As specified in VDI3940, the intensity scores are based on a 7 point scale (Table 1) with descriptors provided for each score that relate the assessor's perception of the odour impact. Standard descriptors for odour character were used to confirm the source of the odour at each 10 second assessment point.

Table 1 Odour intensity scores and descriptions

Intensity score	Description of odour strength	Interpretation of descriptions
0	Not perceptible	No odour detected
1	Very weak	Odour is just recognised
2	Weak	Odour is readily recognised but weak in strength
3	Distinct	Odour is clearly distinct
4	Strong	Strong odour is detected
5	Very strong	Odour is very strong and if offensive could result in assessor moving away from the odour source
6	Extremely strong	Odour is overpowering and the assessor would move away from the odour source

These descriptors and interpretations provide guidance for the assessors when rating the intensity or strength of the odour every 10 seconds. The distinct rating is considered a key benchmark in that the odour is clearly detected and the assessor can readily identify the character and the source of the odour. Odours that are less intense (i.e. lower concentration) can be rated as weak or very weak, with the absence of any apparent odour rated as a zero score. Conversely, odours stronger than distinct can be initially rated as strong; progressing to extremely strong if the assessor finds the odour is unbearable and has to move away from the area to avoid further exposure to the odour.

[2] Strategen understands from informal discussions with officers from the Air Quality Management Branch of DER that new odour guidelines currently under development will utilise VDI 3940 methodology for field odour assessments.

The assessors also provided a description of the character of the odour at each assessment point (every 10 seconds) to aid in identification of the origin of the odour. This is particularly important information in the event that multiple sources of odour are observed at a location. No particular guidance is provided for the terminology to be used when describing the character of the odours, so long as the assessor can relate the description to the source. As an example for this assessment, the assessors have described the odour from the WWTP as “swamp”, “sewerage” and “urine”, which are all intended to identify the presence of odours from the WWTP.

A total of 60 observations were recorded for each 10 minute observation period (known as a “survey”). Surveys were conducted as frequently as was practical, mindful that strong odours could give rise to some level of odour fatigue experienced by the assessors and some time was required in between surveys to allow the assessors to recover. Assessors were typically placed at different locations for each survey with the observations made at exactly the same times to accurately determine the spread and variability of the odour “plume”. Assessors were co-located for at least one survey during a day to assess the repeatability of the assessments as part of the quality assurance process for the measurements.

The ability of the assessors to detect odours was determined by “calibration” of their olfactory responses against a standard odorant (n-butanol), as per the Australian/New Zealand standard ASNZS 4323.3:2001. Strategen’s odour assessors are tested to ensure their ability to smell the odours is within the method specifications of 20–80 ppb butanol concentration.

High quality historical and current meteorological data were obtained from the BOM station at Geraldton Airport. This is very important to establish the voracity of the odour observations, since odour impacts can be highly transient and short lived and longer time-average data from the Bureau of Meteorology (BOM) stations does not always reflect those effects.

An overview of the study design is provided in Table 2.

Table 2 Field odour assessment study design

Item	Description	Details	Comment
Type of study	Odour plume method (VDI 3940 Part 2) and modified grid method (VDI 3940 Part 1)	*Plume method*: odour assessments track the odour plume to identify worst case impacts. *Grid method*: odour assessments conducted at fixed locations to assess spatial aspects of odour impacts.	The modified grid method entails use of less assessors 2-3 assessors compared with 10 assessors in the method) and shorter duration (2-4 days versus 6-12 months). This reflects the intent of the study, the time lines for the development project and cost considerations.
Locations	Exact locations where field odour assessments are carried out.	Locations selected based on layout of Proposed Development and current availability of access at the Proposed Development site.	For the plume method, the exact locations based on wind direction at the times of the assessments. For the grid method, pre-defined locations will be determined from layout of Proposed Development and access limitations at the site.
Assessors	Number of people who carried out the assessments.	Two to three assessors used	A larger number of assessors would provide more data but the costs will become prohibitive given the objective of the study.
Measurement procedure	Each assessment period is 10-minute duration	Procedure as described in Section 4.1 VDI 3940	Odour intensity and character are recorded every 10 seconds in the 10-minute period
Number of surveys	Total number of 10-minute duration surveys	Final total was 136, from Nov 2013 and Jan 2014.	Total number of surveys was dependent on wind conditions at the time of the assessment.
Data collection	Method for recording odour observations	Procedure as described in Section 4.2.1 of VDI 3940	Paper field sheets and digital timers are used for recording observations. Data transferred to electronic spreadsheet for calculations and reporting.

Item	Description	Details	Comment
Assessor capability testing	Test of each assessors response to standard odorant	Each assessor has been tested against n-butanol as per ASNZS 4323.3:2001.	All assessors could detect n-butanol in range 20–80 ppb as per ASNZS 4323.3:2001 specification.
Weather conditions at time of surveys	Primary consideration is wind direction.	Meteorological data from Geraldton Airport and site specific data from portable weather station	60 months of data from airport station to be used for prediction of future impacts. Site weather station installed for all field surveys. Measurements to continue until end July 2014
Time of day for surveys	Assess impact of stable vs unstable atmospheric stability	Surveys conducted during daylight hours and also overnight/early morning	Cloud cover occurred during early morning survey to provide stable atmospheric conditions
Duration of each campaign	Elapsed time for study	Two campaigns, each of 4 days duration	Campaigns limited to 4 days each for project timeline and cost reasons

Two campaigns were carried out for the field work, the first in November 2013 and the second in January 2014. Decisions on the actual duration of the surveys were made in the morning of each day of the two campaigns, based on the forecast meteorological conditions for the day and the adequacy of data obtained from the previous day. Surveys were carried out at times of stable atmospheric conditions, where poor dilution of odours is expected and times of unstable atmospheric conditions, where good dilution of odours should occur.

The assessment is primarily intended to establish the impact of an odour plume from the WWTP on the Proposed Development site to provide advice on the likelihood of odour impacts for consideration in the planning and design phases of the Proposed Development. The VDI 3940 method describes a method that involves intensity assessments carried out at fixed locations within a defined grid centred on the odour generating activity, repeated at an appropriate frequency over a year. This method provides a comprehensive understanding of odour impacts at all locations surrounding a facility under the range of meteorological conditions across the seasons in a year. Notwithstanding the significant resource requirement and long time frame of such an approach is not feasible given the location and meteorological conditions of the Proposed Development site.

Some modifications to the VDI 3940 methodology were therefore made commensurate with the level of assessment and scope of the assessment. These include:

- use of two or three assessors for each day of the surveys, rather than selection of assessors from a pool of at least 10 persons (modification made due to logistical and resource limitations)
- assessors were tested for olfactometry responses to n-butanol on two separate occasions as per AS/NZS 4323.3:2001 rather than the minimum of five separate occasions as specified in VDI 3940
- a defined set of locations for odour monitoring were not established to assess the full spatial impact of an odour plume from the WWTP - rather the assessors followed the plume away from the source and then back toward the source along a number of directions within a survey
- on some occasions, all assessors recorded their observations simultaneously at each location to assess the variance in intensity scores and provide a measure of quality assurance in the data
- calculations were not made of so-called “odour hours” as a means of assessing the significance of the observed odour impacts
- instead, predictions of future odour impacts were developed from the meteorological data on a 1 minute basis.

The results of the surveys were collated and the percentage of odours from the key sources (WWTP) was calculated for each intensity score. Those percentages were compared against a number of odour impact criteria to provide advice on the likelihood of unacceptable odour impacts being experienced at the Proposed Development site. A discussion on the selection of appropriate odour impact criteria for that assessment is presented below (Section 4).

3.2 Odour concentrations

Odour concentrations can be determined using a technique known as dynamic dilution olfactometry. This technique measures the dilution required to reduce the concentration of odorants in air to below the odour detection threshold, with is where only 50% of the population can detect the presence of the odour. By definition, this concentration is known as 1 OU. The odour concentrations after dilution are measured using human odour assessors, following the procedures in ASNZS 4323.3:2001. An odour concentration of say 1000 OU indicates the air sample must be diluted 1000 times with clean air to bring the odour to threshold. Higher dilutions would then take the odours well below threshold to a point where they are no longer detected by any person.

The human detection of odours involves a non-linear response to concentrations of odorous substances in the air, which can be mathematically related to the intensity scores using either the Weber-Fechner law or the Stevens Law. DER has advised in the Odour Methodology Guideline (DEP 2002) that the Weber-Fechner law (Equation 1) should be used to generate odour concentrations from intensity scores.

$$I = k_W \log\left(C/_{C_0} \right) + Constant \qquad (1)$$

Where: I = intensity
K_w = Weber-Fechner constant
C = concentration of odorant
C_0 = concentration of odorant at the detection threshold (by definition, this is 1 OU)
Constant = Mean intensity constant derived from line of best fit for intensity vs concentration

Empirical testing of actual odours from a source is required to solve this equation and allow calculation of ambient odour concentrations from intensity surveys. Such testing has been carried out for WWTP odours (Jiang, et al 2005) and the results from that study (summarised in Table 3) have been used to calculate the average odour concentration for each survey at the Geraldton North WWTP.

Table 3 Intensity/concentration relationship for WWTP odours

Intensity	OU	Log(OU)
0	0.5	-0.30
1	1.6	0.20
2	4	0.60
3	10	1.00
4	26	1.41
5	65	1.81
6	> 100	-

Linear regression of the intensity and log(OU) values[3] provides the Weber-Fechner and intensity constants for calculation of the odour concentrations from the field surveys. The average concentrations (in OU) for each survey were compared with odour concentration impact criteria.

3.3 Hydrogen sulfide monitoring

Continuous monitoring of ambient air concentrations of hydrogen sulfide (H_2S) was carried out using Odalog instruments for the November 2013 campaign. Two types of instruments were used, an Odalog L2 which measures from 0.1 to 50 parts per million (ppm) H_2S and Odalog Low Range instrument which measures from 0.01 to 2 ppm. The Odalog L2 instruments were located on the boundary fence of the WWTP to continuously measure (10-minute average) H_2S as emitted from the WWTP. The Odalog Low

[3] log(OU)=(Intensity-0.6119)/2.3935

Range instruments were also located in the field where odour assessments were conducted to measure H_2S concentrations at locations where odour surveys are carried out.

The intention of the H_2S monitoring was to provide data for comparison with the field locations to determine the dilution of the odour plume from the WWTP. However, H_2S was not detected in the majority of measurements and this comparison could not be carried out. The dilutions were therefore determined from average odour concentrations for the plume tracking assessments.

3.4 Meteorological assessment

Key meteorological factors that determine the extent of odour impacts from an odour source are the wind direction, the wind speed and the atmospheric stability.

The dependence on wind direction is obvious: odour emissions from a source will only impact upon a receptor when those winds blow from the source to the receptor.

The speed of the wind creates the horizontal mixing component for dilution of odours; in that odours travel the farthest when low horizontal mixing occurs. In other words, the odours are poorly diluted from the source to the receptor under light wind conditions.

The atmospheric stability controls the vertical mixing component of dispersion of odours from source. Six classes of air stability are relevant to the Geraldton location (Table 4).

Table 4 Atmospheric stability classes

Stability class	Description
A	Extremely unstable conditions
B	Moderately unstable conditions
C	Slightly unstable conditions
D	Neutral conditions
E	Slightly stable conditions
F:	Moderately stable conditions

Odours will be transported the farthest from a receptor during periods of high stability where there is low vertical mixing (Class F) and therefore poor dilution. In contrast, periods of low stability where high vertical mixing occurs will rapidly dilute odour emissions.

The relationship between surface (horizontal) wind speed and solar radiation with stability classes is summarised in Table 5.

Table 5 Meteorological conditions and stability classes

Surface wind speed (m/s)	Daytime insolation			Night-time conditions	
	Strong	Moderate	Slight	Thin overcast or > 4/8 low cloud	<= 4/8 cloudiness
< 2	A	A - B	B	E	F
2-3	A - B	B	C	E	F
3-5	B	B - C	C	D	E
5-6	C	C - D	D	D	D
> 6	C	D	D	D	D

As indicated in Section 2, a key objective of this assessment is to determine the frequency of winds that would transport odour emissions from the WWTP to assess the risk of odour impacts at the Proposed

Development site. To that end, wind speed and direction data for the period 2008 to 2013 from the nearest meteorological station (Geraldton Airport) have been analysed to identify the frequency of winds that blow across the WWTP to the Proposed Development site and the frequencies of wind speeds that give rise to high dilution of odours compared with those winds that would transport odours with low dilution to the Proposed Development site.

The wind direction data were filtered for wind directions in the 170 to 250° arc and for unit wind speeds from zero to 6 m/s and winds > 6 m/s. Additional filtering was applied to the data to identify those wind conditions during business hours. This filtering reflects the proposed compatible land-use for the Proposed Development site, in particular retail and commercial activities, which are only expected to open during business hours. Those hours are defined as 8 am to 9 pm Monday to Friday, 8 am to 6 pm on Saturday and 11 am to 5 pm on Sunday.

The data were collated into months of the year for the 2008-2013 periods to assess the seasonal effects on the meteorology.

Site specific meteorological effects were assessed from the portable weather station installed at the WWTP since 29 January 2014. One minute average wind speed and direction data from the Airport station was compared with 3-second average data from the WWTP weather station to establish the extent of agreement in these parameters. The Airport wind speeds have been adjusted by the average difference in wind speed observed between the locations to generate site-specific risks of odour impacts.

3.5 Discussions with Water Corporation operations staff

In addition to conducting the field surveys, Strategen sought advice from operations staff at Water Corporation Geraldton office in regards to operational effects on odour emissions from the WWTP and anecdotal information on odour impacts at locations downwind from the plant. Of particular interest were comments made on the frequency of plant upsets, when the potential for higher odour emissions increases, and corrective measures employed by operations and maintenance staff to restore normal operating conditions at the WWTP and normal odour emissions.

3.6 Risk assessment – future odour impacts at Proposed Development site

The combination of the odour data showing dilution with distance from the WWTP and the frequency of winds that impact on the Proposed Development site is used to assess the risk of odour impacts on the proposed development at Lot 55. This assessment is based on the assumption that the conditions experienced for 2008-2013 would (on average) prevail into the future and therefore the calculated frequencies of winds would estimate the future risk of odour impacts. The assessment also assumes that the odour emission impacts determined from the field observations represent the extent of emissions from normal operation of the WWTP.

4. Benchmarks and standards for odour impact assessment

Air quality standards or guidelines for odour impacts of existing facilities on new developments are not available from DER. Criteria for assessment of impacts of new facilities are available from other Australian agencies and these provide some guidance to acceptable odour impacts that have been considered for interpretation of the results from this study.

The Water Corporation has advised of an odour impact criterion used for providing advice on separation distances from WWTPs[4] to facilitate protection of urban residential areas from odour impacts. Although residential land use is not the subject of the proposed development, the criteria do provide a benchmark for assessment of the significance of observed odour impacts from this study. Further discussion of the use of the Water Corporation criteria is presented below.

A discussion of the criteria from the WA, NSW and Qld regulatory agencies for assessment of impacts of new facilities on existing sensitive receptors is also presented below to provide context to the findings from this study.

4.1 Water Corporation odour criterion

The Water Corporation has developed odour exposure criteria for operation of waste water treatment plants that "*best represent the boundary between acceptable conditions and annoyance about odour for urban, residential areas in Western Australia*" (Wallis and Cadee 2008). These criteria are 5 OU at 99.9th percentile for a 1 hour averaging time. They are based on consideration of odour impact criteria (that prevailed at that time) from regulatory jurisdictions in the UK, Netherlands, EPA WA, Victoria SEPP, NSW DEC and Qld EPA. Predicted ground level odour concentrations from dispersion modelling carried out at the Subiaco and Beenyup WWTPs were compared with complaints data from nearby residential areas and essentially verified that the 5 OU limit represented a point where a high level of acceptance of odours in the community deteriorated to an unacceptable impact.

The criteria are used by Water Corporation as a planning tool to provide advice on the extent of buffer zones from WWTPs for protection of amenity impacts at residential areas, with the buffer proposed by Water Corporation for the Geraldton North facility based on the criteria.

Key considerations in the use of the Water Corporation criteria for assessment of the field observations from this study are the averaging time of 1 hour versus the field survey period (10 minutes) and the use of the 99.9th percentile odour concentration. The implications of these considerations are as follows:

Averaging times

An odour concentration of 5 OU for 1 hour has a greater impact than a concentration of 5 OU for 10 minutes which precludes a direct comparison of the results from this study with the Water Corporation criteria. In effect, a 5 OU concentration for 1 hour average is equivalent to a > 5 OU concentration for a 10 minute average. Scaling factors for conversion of 1 hour average to 10 minute average concentration are calculated from Equation 2.

[4] Personal communication from Mr Mark Willson, Water Corporation Geraldton office

$$C_{10\,min} = C_{1\,hr} \times \left(\frac{T_{1\,hr}}{T_{10\,min}}\right)^{p} \quad (2)$$

Where: $C_{10\,min}$ = Odour concentration for 10-minute average
$C_{1\,hr}$ = Odour concentration for 1-hour average (5 OU Water Corporation criteria concentration)
$T_{1\,hr}$ = 60 minutes
$T_{10\,min}$ = 10 minutes
p = exponent for selected stability class

The dependence of the scaling factor on atmospheric stability is reflected in the range of exponents (p) applicable to this equation as shown in Table 6.

Table 6 Adjustment of the Water Corporation 5 OU, 1 hour average criteria to 10 minute time averages

Atmospheric stability class	Description	Exponent (p)	Scaling factor $(T_{1\,hr}/T_{10\,min})^p$	10 minute average odour criteria (OU) equivalent to 5 OU 1 hour average
A and B	Moderate to extremely unstable conditions	0.5	2.4	12.2
C	Slightly unstable conditions	0.333	1.8	9.1
D	Neutral conditions	0.2	1.43	7.2
E and F	Slightly to moderately stable conditions	0.167	1.35	6.7

As previously discussed, odour impacts at the proposed development for the Proposed Development site could only be an issue during business hours, which predominately occur during day light hours. This means the vast majority of the time the atmospheric stabilities range from extremely unstable to neutral, where rapid dilution of odour emissions occurs. The majority of stable conditions prevail overnight, toward the early morning when the minimum temperature is reached and during times of light winds, which are outside business hours. Therefore the 10 minute average odour criteria for neutral to unstable stability classes (7 to 12 OU) are the more appropriate criteria equivalent to the Water Corporation 5 OU (1 hour average) criteria for assessment of the results from the field surveys.

Percentiles

The Water Corporation odour criteria are designed for assessment of predicted ground level odour concentrations from dispersion modelling of emissions from a WWTP, to aid in the evaluation of buffer zones around WWTPs. The 99.9th percentile concentration (5 OU) for a 1 hour average is equivalent to the 8th highest predicted hourly average concentration in a year at the buffer. This means that for 7 other hours in a year the concentrations will be in excess of 5 OU at the buffer. For constant emission rates from the source, those higher predicted concentrations are driven by extremely rare meteorological conditions, where highly stable atmospheric stabilities prevail and odour emissions are transported with little dilution to the receptor of interest.

The sheer volume of measurements involved preclude the use of field odour studies to assess the odour impacts for every 10 minutes in a year at every location of interest, to provide an equivalent outcome as for dispersion modelling. However, the surveys conducted in this study were carried out at times of very unstable atmospheric conditions through to times with moderately stable conditions. This means that the odour impacts for the majority of wind conditions that prevail at the Proposed Development site have been captured in the survey. However, higher odour impacts can be expected to occur at the Proposed Development site under highly stable atmospheric conditions but the frequency of occurrence of those conditions will be very low. Further discussion of the implications of the atmospheric stability on odour impacts is presented in the results section below.

4.2 WA EPA Guidance Statement 47

A Guidance Statement for assessment of odour impacts from new proposals was published by the WA EPA (EPA 2002) which details ground level odour concentration limits for comparison with predicted concentrations derived from dispersion modelling of odours from a proposed facility. This statement is considered obsolete[5] and will be replaced with new odour assessment guidelines from DER.[6] As a consequence the Guidance Statement limits of 2 OU/m^3 (3-minute average, 99.5th percentile) and 4 OU/m^3 (3-minute average, 99.9th percentile) have not been considered in this study.

4.3 WA DER Odour Methodology Guideline

The Odour Methodology Guideline published by DER (DEP 2002) does not provide odour impact standards. However, the Guideline advises that *"the EPA suggests an intensity of 3 ("distinct") for use of the comparative criterion for new proposals"*. No advice is provided as to a frequency for odour intensity observations of 3 (and above) that would indicate acceptable vs unacceptable odour impacts.

An intensity score of 3 equates to 10 OU from the intensity/concentration relationship discussed in Section 3.2. This essentially reflects an odour impact equivalent to the Water Corporation's 5 OU (1 hour average) criteria for a 10 minute average (as described in Section 4.1).

4.4 NSW OEH odour guidelines

The NSW Office of Environment and Heritage (OEH) (formerly Department of Environment and Conservation) has published several documents relating to assessment and management of odours. Those documents include ground level criteria to be used for assessment of potential odour impacts from new facilities. As such, they are considered a design tool to be utilised in the planning, design and approvals phases of a new project. However, those criteria can be used by the OEH on a case-by-case basis for assessment of odour impacts from existing facilities (OEH, 2005), either in a regulatory context for the odour emitting facility or from a planning context for changes to the receiving environment such as a residential development nearby to an existing odour emitting facility.

The criteria are presented in terms of odour concentrations (not intensities) in OU.

A range of odour concentrations are specified dependent on the population numbers for the affected community. The criteria as published by OEH (2005) are listed in Table 7. The population dependence recognises the increased probability of more sensitive individuals being present in a larger population that would consider the odour to be excessively strong and/or offensive. Hence a more stringent odour criterion is specified to afford protection of amenity for the majority of the persons in a large population.

Table 7 Odour impact assessment criteria from NSW OEH

Population of affected community	Odour impact assessment criteria (OU)
Urban ≥ 2,000 persons and/or schools and hospitals	2.0
≈ 500 persons	3.0
≈ 125 persons	4.0
≈ 30 persons	5.0
≈ 10 persons	6.0
Single rural residence	7.0

The criteria are specified for the 99th percentile of the "non-response time average", which are in effect the concentrations detected every second. These are far more stringent than the Water Corporation criterion.

[5] As indicated on EPA website and confirmed by personal communication from David Griffiths (Senior Environmental Officer, Air Quality Management Branch, DEC) via email 6 June 2013.

[6] As advised in various public presentations from members of the Air Quality Management Branch, DEC in 2012 and 2013, and email communication from David Griffiths 6 June 2013.

4.5 Victoria EPA SEPP (AQM)

The Victorian State Environmental Protection Policy (SEPP) Air Quality Management (AQM) specifies a design ground level criterion for odour of 1 OU, 3-minute average (Victoria Government 2001). The design criteria are to be used for assessments of potential impacts from new facilities, as part of the planning, design and approvals phase of those projects. The SEPP makes no reference to use of the criteria for assessment of existing air quality (and in particular odour) impacts, so this criteria is considered inappropriate for assessment of the results from the current study.

4.6 Queensland DEHP

The Queensland Department of Environment and Heritage Protection (DEHP) specifies odour impact criteria for developments that considers an intensity rating of "weak" (intensity score of 2) as the basis for calculation of ground level odour concentrations for comparison with predicted concentrations from dispersion modelling of odour sources (DEHP 2013). Default peak to mean ratios are applied to the calculated concentration to account for peak odour impacts. The predicted 99.5th percentile ground level concentrations from the modelling are to be compared with the criterion to determine potential for odour impacts.

A weak intensity rating for WWTP odour is equivalent to 4 OU. This is a more stringent criterion than Water Corporation's 5 OU (1 hour) criteria if the weak intensity prevailed for each 10 minute period.

The use of the "weak" intensity rating can be relaxed to a "distinct" rating for odours that are less offensive to avoid excessive conservatism in the assessment of potential odour impacts. Use of the distinct intensity rating as a benchmark for assessment of odour impacts is also specified by the WA DER (see Section 4.3).

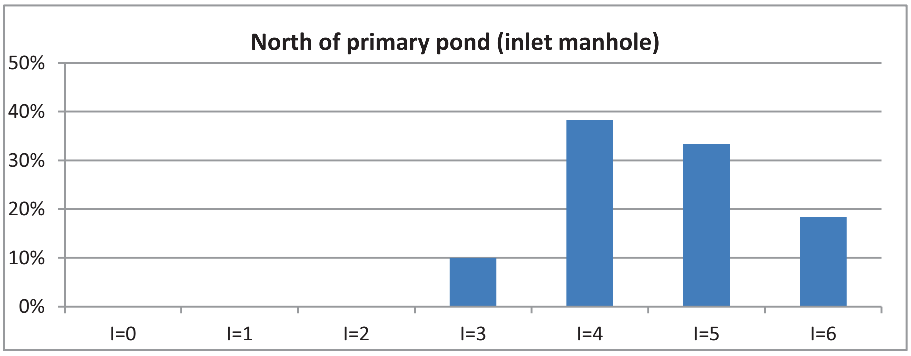
4.7 Summary of odour criteria

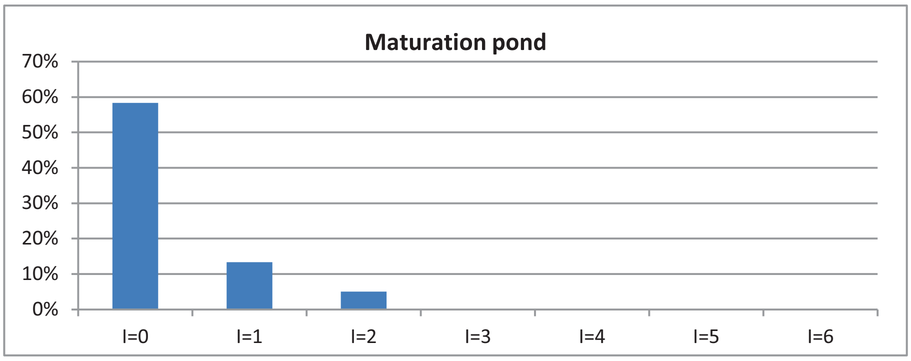
Overall, the Water Corporation's 5 OU (1 hour average) odour criterion appears appropriate as the benchmark for assessment of the potential odour impacts for the compatible land use at the Proposed Development site. More specifically, predicted odour concentrations that are lower than this limit (adjusted for the 10 minute time averages of the field surveys) can be considered as unlikely to cause unacceptable odour impacts on persons utilising the facilities at the Proposed Development site.

5. Results – odour assessments

5.1 Source of odours

Odour surveys conducted downwind from each of the various ponds have clearly demonstrated that the primary ponds are the most significant source of odours. The differences in odour emissions from the three types of ponds are illustrated in Figure 1.





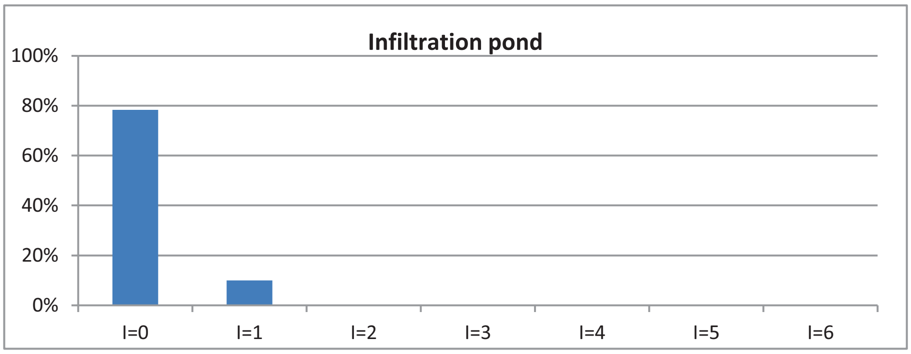


Figure 1 Odour intensity profiles from WWTP ponds

The emissions from the primary ponds were not consistent across the breadth of the ponds and three key locations within the ponds were identified as providing the more significant odours. These were the point at which the inlet pipe discharges raw sewage into the ponds (under the water surface), the NE corner of both primary ponds where the higher density of solids congregate and the inlet pipe manhole on the roadway between the primary ponds.

5.2 Odour dilution with distance from the WWTP

The majority of the odour surveys focussed on determination of the extent of odour impacts at locations of increasing distance from the WWTP. These surveys involved tracking the plume from the source (northern edge of the primary ponds) to downwind locations until the odours were no longer detected. Surveys were conducted at times of unstable to neutral atmospheric conditions (daylight hours, warm to hot days, clear skies, winds 5 to 10 m/s) and stable conditions (very early morning, cooler temperatures, light to heavy cloud cover and winds 2-5 m/s.

The results of the surveys under these conditions are illustrated in Figure 2 (unstable to neutral conditions) and Figure 3 (stable conditions).

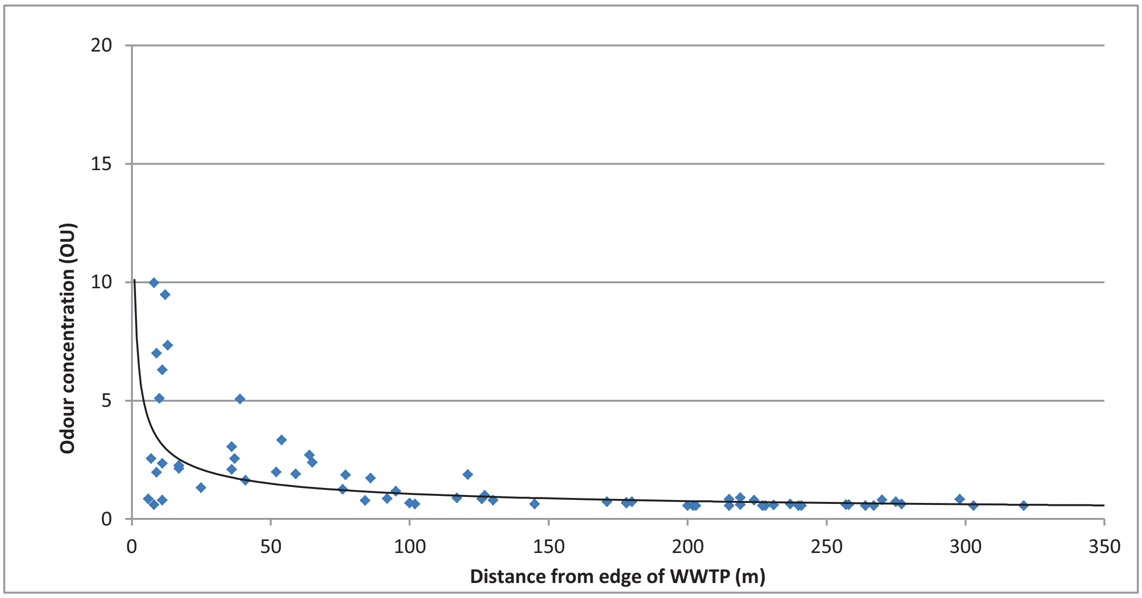


Figure 2 Odour concentrations with increasing distance from the WWTP – unstable to neutral atmospheric conditions

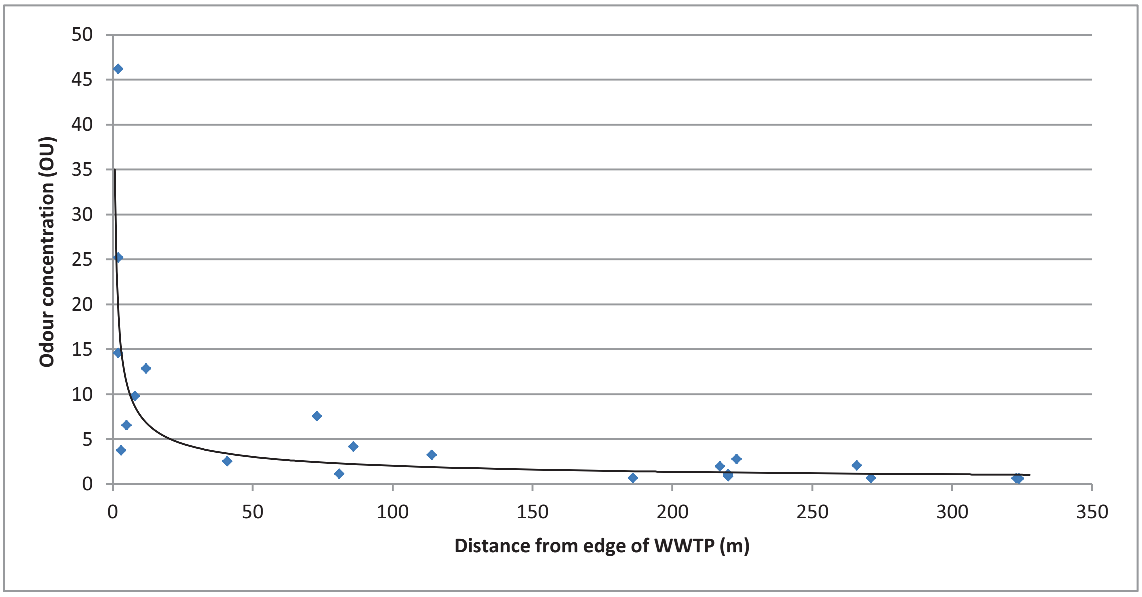


Figure 3 Odour concentrations with increasing distance from the WWTP – stable atmospheric conditions

These results show the significant impact that the atmospheric conditions have on dilution of odours from the WWTP. In particular, the odours from the primary ponds had been diluted by approximately 4-fold more at 5 to10 m from the ponds under unstable conditions compared with stable conditions. In addition, the concentrations were below 5 OU at approximately 40-50 m from the pond for unstable conditions compared with approximately 80 m for stable conditions.

Importantly, if the 10 minute average criteria equivalent to the 5 OU (1 hour average) Water Corporation criteria are applied to assessment of these results, the odour impacts from the WWTP under unstable conditions are below that criteria (7 to 12 OU, 10 minute average) at approximately 20-30 m from the ponds. The odour concentrations for stable conditions were below the equivalent 10 minute criteria (6.7 OU) at approximately 80 m from the ponds.

Furthermore, the odours were diluted to threshold and below at approximately 120 m from the ponds under unstable conditions and approximately 320 m under stable conditions. The context of these findings is illustrated on the site concept drawing[7] in Figure 4 showing approximate distances from the ponds for the respective atmospheric conditions.

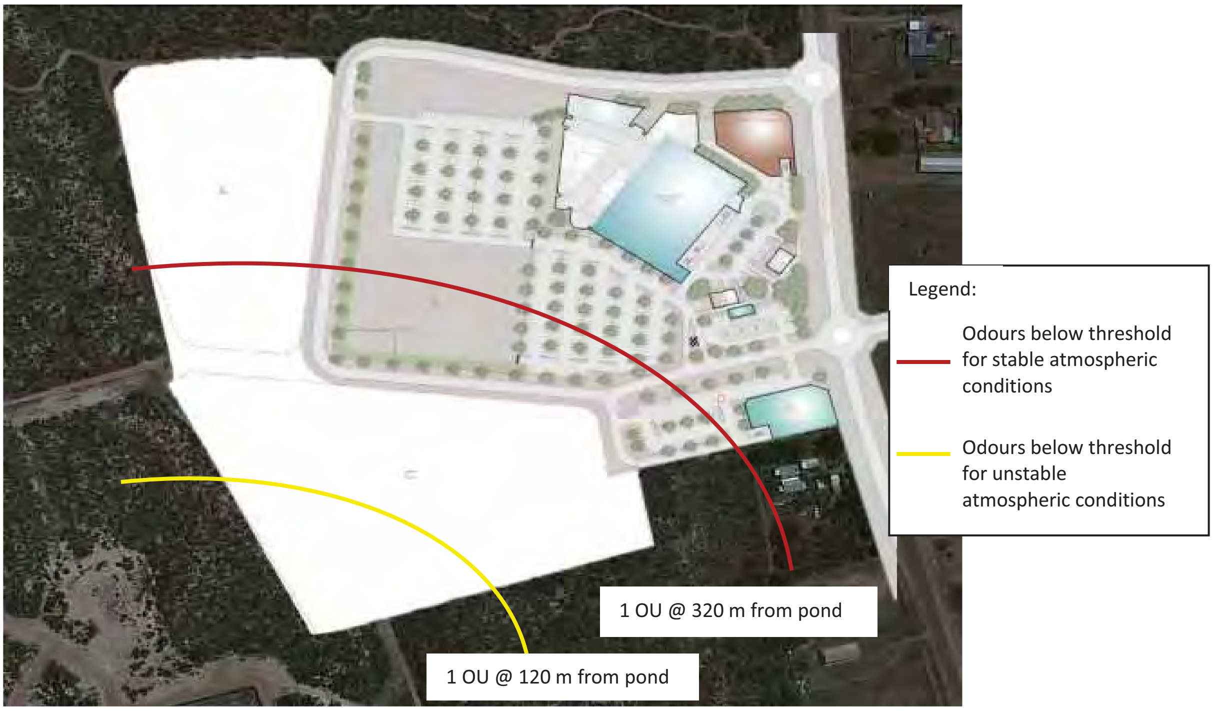


Figure 4 Site concept drawing showing odour impact with distance from the WWTP

The significance of these results becomes apparent when the frequencies of winds from the SW sector are determined to finalise the assessment of risk associated with odour impacts from the WWTP (see Section 6).

[7] Drawing courtesy of Taylor Robinson Pty Ltd

6. Meteorology assessment

6.1 Geraldton Airport data

One minute average data for wind speed and direction from the Bureau of Meteorology station at Geraldton Airport were analysed to identify the frequency of winds from the 170 to 250° sector during business hours. These frequencies are reported for a range of wind speeds for comparison with the respective atmospheric stability classes. The results of the analysis are summarised in Table 8.

Table 8 Frequencies of winds from 170-250° during business hours (Geraldton Airport) for 2008 to 2013

Month	<1 m/s	>1=2 m/s	>2=3 m/s	>3=4 m/s	>4=5 m/s	>5=6 m/s	> 6 m/s
Jan	0.0076%	0.054%	0.37%	1.0%	3.8%	2.0%	31%
Feb	0.013%	0.068%	0.51%	1.2%	4.2%	2.2%	30%
Mar	0.0088%	0.076%	0.49%	1.0%	3.2%	1.9%	28%
Apr	0.23%	0.33%	1.4%	2.5%	7.0%	2.9%	16%
May	0.48%	0.62%	1.9%	2.8%	5.8%	2.0%	11%
Jun	0.31%	0.51%	1.3%	2.2%	3.8%	1.4%	4.9%
Jul	0.42%	0.55%	1.6%	2.4%	3.4%	1.0%	5.6%
Aug	0.33%	0.36%	1.1%	2.9%	5.3%	1.6%	10%
Sep	0.25%	0.29%	1.3%	3.3%	6.5%	2.6%	17%
Oct	0.11%	0.10%	0.70%	2.1%	5.5%	2.8%	22%
Nov	0.018%	0.060%	0.42%	1.4%	4.4%	2.5%	29%
Dec	0.012%	0.090%	0.43%	1.1%	3.4%	1.9%	30%

Predominant meteorological conditions at Geraldton Airport for spring to autumn are moderate to strong winds which tend to decrease in the winter months. These give rise to neutral to very unstable atmospheric stabilities, depending on the cloud cover. This implies that the odour dilution profiles obtained for unstable conditions should be applied to wind frequency data to establish the risks of odour impacts. However, stable atmospheric conditions may occur for the low wind speeds during business hours from dusk to closing time (9 pm during weekdays and 6 pm on Saturday) and possibly for an hour after opening (8 am) in the mornings on those days.

These times (for potential stable atmospheric conditions) equate to approximately 34% of the business hours across the week. The frequency data for wind speeds up to 5 m/s have therefore been adjusted to accommodate the potential for stable atmospheric conditions for those times during business hours (Table 9).

Table 9 Frequencies of winds from 170-250° during business hours for stable and unstable atmospheric conditions (Geraldton Airport)

Month	<1=5 m/s stable atmospheric conditions	<1=5 m/s unstable atmospheric conditions	>5 m/s unstable atmospheric conditions
Jan	1.8%	3.4%	34%
Feb	2.1%	4.0%	32%
Mar	1.6%	3.1%	30%
Apr	3.9%	7.5%	19%
May	4.0%	7.5%	13%
Jun	2.8%	5.3%	6%
Jul	2.9%	5.5%	7%
Aug	3.4%	6.5%	12%
Sep	4.0%	7.6%	20%
Oct	2.9%	5.6%	25%
Nov	2.2%	4.1%	31%
Dec	1.7%	3.3%	32%

These results show a conservative estimate of stable atmospheric conditions could prevail for 1.6 to 4.0% of the time during business hours whereas unstable conditions could prevail with lower dilution potential winds up to 5 m/s for 3.1 to 7.6% of the time. Unstable conditions for higher wind speeds of > 5 m/s (which provide high dilution potential) dominate, with 6% of the time for June up to 34% of the time for January.

6.2 WWTP weather station data

Wind speed data from the portable weather station located at the WWTP for 3 February 2014 has been compared with data for the same period from the Bureau of Meteorology station at Geraldton Airport. This provides an initial assessment of the differences in the wind speeds to consider calculation of appropriate adjustment factors for use of 5 years of Airport data to predict future wind conditions at the Proposed Development site.

The results of this comparison are illustrated in Figure 5.

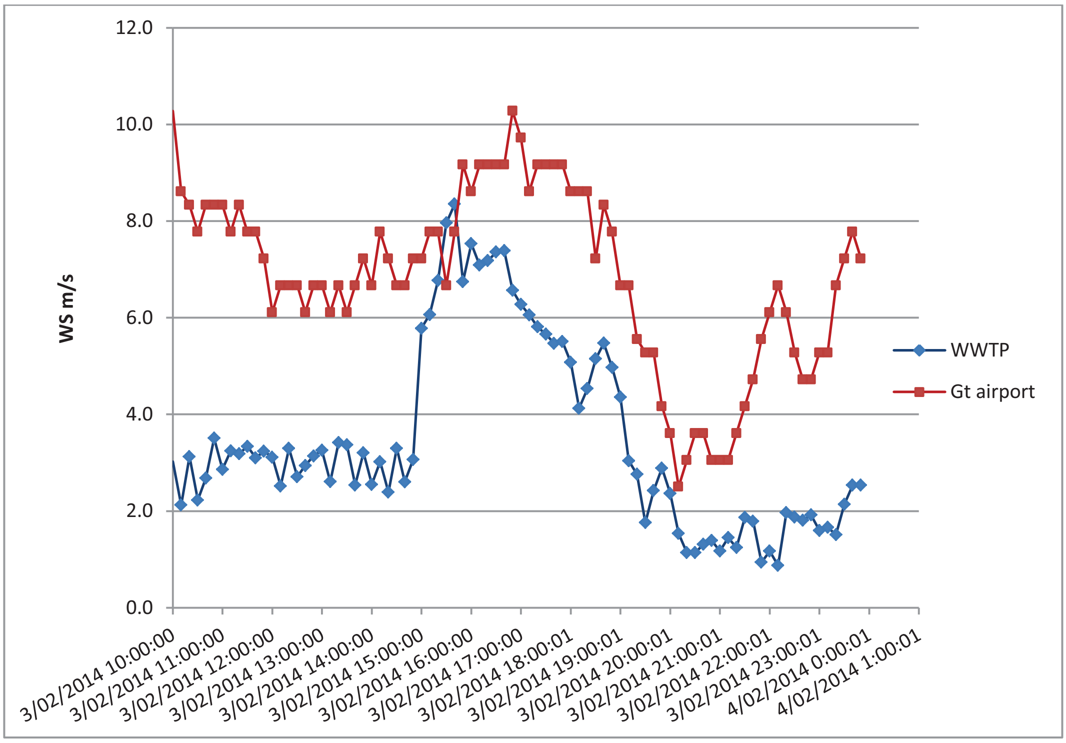


Figure 5 Comparison of wind speed from Geraldton Airport station and The WWTP weather station

This comparison shows lower wind speeds occurred at the WWTP compared with the Airport station with considerable variability in the differences between the wind speeds at the two locations. An average difference of 2.3 m/s was calculated for each time equivalent pair of wind speed values, for a standard deviation of 1.03 m/s.

If this difference in wind speeds is observed for all 6 months of WWTP observations scheduled for this study then the wind speed data from the Airport station will be an over-estimate of the frequency of higher wind speeds at the WWTP and an underestimate of the frequency of lower wind speeds. No adjustment of the Airport wind speed data has been made at this time due to the relatively small amount of data examined in the comparison. However, the planned comprehensive analysis of the first month of site-specific wind data will assist to develop a robust correlation factor for use of the Geraldton Airport wind data to predict wind conditions at the WWTP, so that the risk assessment can be updated accordingly.

7. Risk assessment

7.1 Normal WWTP operations

The risks of odour impacts at the Activity Centre proposed for the Proposed Development site can be assessed on the basis of the frequency of winds from the direction of the WWTP and the extent of dilution of odour emissions with increasing distance from the WWTP ponds under a range of atmospheric stabilities. The Water Corporation's odour criteria provides a benchmark for acceptable odour concentrations for residential land uses, which implies that odour concentrations that meet that criteria would be acceptable for the commercial land uses at the Proposed Development site.

The outcomes from the risk assessment are summarised in Table 10.

Table 10 Risk assessment outcomes

Parameter	Stable atmospheric conditions		Unstable atmospheric conditions	
Frequency of winds from 170-250° during business hours	min	max	min	max
	1.6%	4.0%	12%	37%
Distance from WWTP to reach odour threshold	250 m		100 m	
Distance from WWTP to comply with odour criteria	80 m		20-30 m	

This assessment shows winds from the direction of the WWTP prevail for a relatively small percentage of business hours at times of stable atmospheric conditions and at those times, the odours are diluted to threshold within 250 m from the ponds and diluted sufficiently to comply with the Water Corporation criteria at 80 m from the ponds. The wind frequencies increase for times of unstable atmospheric conditions but greater dilution of the odours occurs under those conditions. As a consequence the distances required from the WWTP ponds to achieve threshold concentration and to comply with the Water Corporation criteria are significantly reduced compared with stable atmospheric conditions.

7.2 Abnormal WWTP operations

Water Corporation technical experts have advised that the treatment capability of the WWTP can be significantly compromised by stormwater dilution during high rainfall events. This primarily occurs from storm water drainage to the sewer system as well as to a lesser extent from direct rainfall onto the ponds. The aerobic processes that consume the nutrients and minimise odour emissions essentially shut down.

Under those conditions the odour emissions have been observed (by Water Corporation maintenance staff) to significantly increase, with anecdotal evidence suggesting odours could be detected at Chapman Rd. Remedial actions are carried out that include addition of peroxide and aeration of the ponds to provide oxidative conditions until the anaerobic processes are restored. Water Corporation experts have advised the ponds can take from 1-2 weeks to return to optimal condition.

It is unclear as to how much rain is considered a high rainfall event. Analysis of daily average rainfall data for Geraldton Airport for the past 10 years shows a maximum daily rainfall of 48.6 mm in May 2011. Four events of 40 mm and above were recorded for those years and five events in the 30-40 mm range, for an average of less than one event per year. Presumably these reflect the extent of rainfall events that could upset the operation of the WWTP. On this basis the frequency of higher odour events that could impact on the proposed Activity Centre can be considered insignificant.

Importantly, the mitigation of odour impacts under upset conditions is managed by Water Corporation from implementation of remedial actions and is not the responsibility of organisations located nearby to the WWTP.

8. Odour impact controls

Notwithstanding the findings from this study (that suggest low risks of unacceptable odour impacts at the proposed Activity Centre), it would be prudent for some odour controls to be implemented into the Proposed Development. In particular, such controls would assist to reduce the potential for higher ambient odour concentrations that may occur from extreme but infrequent meteorological events (where poor dilution of odour emissions prevail), impacting on persons utilising the Activity Centre.

The primary controls recommended for the Activity Centre involve specific ventilation design to minimise ingress of odours into the buildings. This could include installation of carbon filters on all air intakes and location of those intakes on the eastern sides of buildings, as far as possible from the WWTP. In addition, garden beds that may be included in the landscaping of the project could include a range of plant species that provide fragrant flowers at all times of the year, essentially to replace any odours from the WWTP with a more pleasant odour.

9. Conclusions

Observations of ambient odour intensities at locations downwind from the Geraldton North WWTP have indicated that odour emissions from that facility during normal operating conditions are rapidly diluted to below odour detection threshold (1 OU) with increasing distance from the facility. More specifically, under stable atmospheric conditions (that do not favour high dilution rates), the 10 minute average odour concentrations were < 1 OU within approximately 250 m from the northern edge of the primary treatment ponds at the WWTP, essentially in the middle of the Proposed Development site. Average odour concentrations of 0.65 OU were calculated from the intensity observations at the extent of the surveys, which was 330 m from the ponds. This represents the impact at the NE corner of the Proposed Development site where the initial retail development is proposed.

Higher dilution rates that occur under unstable atmospheric conditions reduced the distance for detection of odour to approximately 100 m from the ponds.

The frequency of odour impacts at the Proposed Development site was predicted from analysis of historical meteorological data (wind speed and direction) from Geraldton Airport and data from a monitoring station located within the WWTP since late January 2014. The site-specific data has shown an average 2.3 m/s reduction in wind speeds at the WWTP compared with the Airport station. This most likely reflects the impact of the topography at the respective locations, where the Airport station is located on cleared flat terrain, relatively free from ground induced drag and turbulence effects. In contrast, the winds at the WWTP are affected by the variations in ground level from the surrounding dune system and the surface roughness effects from the vegetation. In addition, the Airport wind sensors are located on a 10 m tall mast, whereas the WWTP wind sensors are located at 2.5 m elevation to assess the transfer of odours from the ponds at ground level. A more comprehensive analysis of the first month of site-specific data is required to

The greater probability for odour impacts will be in the spring months, when lighter winds from the SW that will impact on the Proposed Development site typically occur for approximately 3% of business hours. As previously indicated, the field observations suggest that those impacts will be insignificant, since the concentrations are likely to be below odour detection threshold for normal operating conditions at the WWTP. Higher velocity winds (typically > 6 m/s) impact on the Proposed Development site for approximately 30% of business hours in the summer months but as indicated above, afford dilution of odours to threshold within 100 m from the ponds. This means that although the winds that impact on the Proposed Development site from the WWTP are more frequent in those months, those strong winds will rapidly dilute the odours to levels not detected at the Proposed Development site.

Overall, the field observations and wind direction frequency analysis has indicated a low probability of odour impacts at the Proposed Development site from normal operation of the WWTP. Further to that finding, the levels of odours detected at the Proposed Development site are predicted to be well below the Water Corporation 5 OU criterion used as a planning tool for establishment of buffer zones around WWTPs. That criterion is set for a 1 hour average, which means higher concentrations (in the order of 6 to 12 OU) can be considered appropriate for short duration impacts as observed from the field observations.

Notwithstanding these findings, odour control measures are recommended in the unlikely event of odour impacts at the Proposed Development site. These measures include building ventilation design to ensure air conditioning make-up air is accessed from the east side of the buildings and carbon filtration is installed for treatment of that air. Garden beds that may be included in the landscaping of the project could include a range of plant species that provide fragrant flowers at all times of the year, essentially to replace any odours from the WWTP with a more pleasant odour.

Overall, the relatively low frequency and intensity of odour impacts predicted for normal operations of the WWTP suggest that the Proposed Development can be implemented with minimal impacts from odours from the WWTP.

Advice from Water Corporation is that high rainfall events destabilise the aerobic conditions in the ponds and generate increased odour emissions for 1 to 2 weeks after the rain has ceased. Anecdotal evidence from Water Corporation indicates that those impacts could extend outside the buffer zone based on the 5 OU criteria which would affect existing established residential land uses. The Water Corporation employ a range of measures to return the plant to normal operating conditions but those measures can take 1-2 weeks to become fully effective. This suggests that these events provide the greatest potential for odour impacts at the Proposed Development site. Analysis of rainfall data suggests such events occur less than once per year, which is a relatively low frequency event and would not preclude the compatible land use at the Proposed Development site. The Water Corporation is currently responsible for minimising the impact of odour from the WWTP (as specified in the license), in particular for impacts on existing sensitive land uses outside the buffer and that is not expected to change with the proposed development of the Proposed Development site.

10. References

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Appendix 1
Field odour observations

Date:	25/11/2013	Assessor:	Jesse Shepherd
Location:	Geraldton WWTP	**Start time:**	1331 Hrs
Latitude:	28°42' 6.28"S	**End time:**	1341 Hrs
Longitude:	114°37' 0.73"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	1	Sewage	31	1	Sewage
2	1	Swamp	32	1	Swamp
3	0		33	0	
4	0		34	0	
5	0		35	1	Swamp
6	0		36	0	
7	0		37	0	
8	1	Coastal	38	0	
9	1	Swamp	39	0	
10	1	Swamp	40	1	Swamp
11	1	Swamp	41	0	
12	0		42	0	
13	1	Swamp	43	1	Swamp
14	1	Swamp	44	1	Sewage
15	0		45	1	Sewage
16	0		46	1	Sewage
17	1	Swamp	47	0	
18	1	Swamp	48	0	
19	0		49	0	
20	1	Swamp	50	1	Swamp
21	2	Swamp	51	0	
22	1	Swamp	52	1	Swamp
23	1	Swamp	53	0	
24	1	Swamp	54	0	
25	1	Swamp	55	1	Ocean
26	0		56	0	
27	0		57	0	
28	0		58	1	Swamp
29	0		59	0	
30	1	Swamp	60	0	

Date:	25/11/2013	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	1331 Hrs
Latitude:	28°42' 5.7"S	**End time:**	1341 Hrs
Longitude:	114°37' 0.73"E		

Observation	Intensity	Character	Observation	Intensity	Character
1	1	Other	31	1	Swamp
2	0		32	1	Other
3	1	Other	33	1	Other
4	1	Other	34	0	
5	1	Other	35	1	Other
6	1	Other	36	1	Other
7	0		37	0	
8	0		38	0	
9	1	Swamp	39	1	Swamp
10	0		40	1	Other
11	1	Other	41	0	
12	0		42	0	
13	0		43	1	Other
14	1	Other	44	0	
15	0		45	0	
16	0		46	1	B
17	0		47	0	
18	0		48	1	Other
19	0		49	0	
20	1	Other	50	1	Other
21	1	Other	51	0	
22	0		52	1	Other
23	0		53	0	
24	1	Other	54	1	Other
25	0		55	0	
26	0		56	0	
27	0		57	0	
28	1	Other	58	1	Other
29	0		59	0	
30	1	Other	60	0	

Date:	25/11/2013	Assessor:	Jesse Shepherd
Location:	Geraldton WWTP	**Start time:**	1359 Hrs
Latitude:	28°42' 6.51"S	**End time:**	1409 Hrs
Longitude:	114°36' 56.42"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	2	Sewage	31	2	Sewage
2	3	Sewage	32	3	Sewage
3	2	Sewage	33	3	Sewage
4	1	Sewage	34	2	Sewage
5	3	Sewage	35	2	Sewage
6	1	Sewage	36	4	Sewage
7	2	Sewage	37	3	Sewage
8	1	Sewage	38	2	Sewage
9	2	Sewage	39	4	Sewage
10	2	Sewage	40	3	Sewage
11	2	Sewage	41	2	Sewage
12	3	Sewage	42	3	Sewage
13	2	Sewage	43	3	Sewage
14	1	Sewage	44	3	Sewage
15	2	Sewage	45	4	Sewage
16	2	Sewage	46	3	Sewage
17	1	Sewage	47	2	Sewage
18	3	Sewage	48	3	Sewage
19	2	Sewage	49	2	Sewage
20	2	Sewage	50	3	Sewage
21	2	Sewage	51	2	Sewage
22	2	Sewage	52	2	Sewage
23	2	Sewage	53	3	Sewage
24	3	Sewage	54	1	Sewage
25	3	Sewage	55	2	Sewage
26	2	Sewage	56	1	Sewage
27	1	Sewage	57	2	Sewage
28	2	Sewage	58	4	Sewage
29	3	Sewage	59	2	Sewage
30	2	Sewage	60	2	Sewage

Date:	25/11/2013	Assessor:	Jesse Shepherd
Location:	Geraldton WWTP	**Start time:**	1415 Hrs
Latitude:	28°42' 6.72"S	**End time:**	1425 Hrs
Longitude:	114°36' 55.9"E		

Observation	Intensity	Character	Observation	Intensity	Character
1	0		31	2	Sewage
2	1	Sewage	32	3	Sewage
3	2	Sewage	33	3	Sewage
4	2	Sewage	34	4	Sewage
5	3	Sewage	35	3	Sewage
6	4	Sewage	36	2	Sewage
7	3	Sewage	37	2	Sewage
8	3	Sewage	38	3	Sewage
9	4	Sewage	39	1	Sewage
10	3	Sewage	40	3	Sewage
11	3	Sewage	41	3	Sewage
12	2	Sewage	42	1	Sewage
13	3	Sewage	43	3	Sewage
14	2	Sewage	44	3	Sewage
15	3	Sewage	45	3	Sewage
16	3	Sewage	46	2	Sewage
17	3	Sewage	47	3	Sewage
18	4	Sewage	48	3	Sewage
19	3	Sewage	49	1	Sewage
20	2	Sewage	50	3	Sewage
21	2	Sewage	51	1	Sewage
22	3	Sewage	52	1	Sewage
23	3	Sewage	53	3	Sewage
24	3	Sewage	54	3	Sewage
25	2	Sewage	55	3	Sewage
26	3	Sewage	56	3	Sewage
27	4	Sewage	57	3	Sewage
28	3	Sewage	58	2	Sewage
29	2	Sewage	59	1	Sewage
30	1	Sewage	60	2	Sewage

Date:	25/11/2013	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	1415 Hrs
Latitude:	28°42' 6.32"S	**End time:**	1425 Hrs
Longitude:	114°36' 57.65"E		

Observation	Intensity	Character	Observation	Intensity	Character
1	0		31	3	Sewage
2	2	Sewage	32	3	Sewage
3	2	Sewage	33	4	Sewage
4	3	Sewage	34	4	Sewage
5	3	Sewage	35	2	Sewage
6	3	Sewage	36	3	Sewage
7	3	Sewage	37	2	Sewage
8	4	Sewage	38	3	Sewage
9	4	Sewage	39	2	Sewage
10	4	Sewage	40	4	Sewage
11	4	Sewage	41	3	Sewage
12	3	Sewage	42	1	Sewage
13	2	Sewage	43	3	Sewage
14	2	Sewage	44	3	Sewage
15	3	Sewage	45	2	Sewage
16	3	Sewage	46	1	Sewage
17	3	Sewage	47	2	Sewage
18	3	Sewage	48	3	Sewage
19	4	Sewage	49	1	Sewage
20	3	Sewage	50	4	Sewage
21	2	Sewage	51	1	Sewage
22	3	Sewage	52	1	Sewage
23	3	Sewage	53	3	Sewage
24	3	Sewage	54	2	Sewage
25	2	Sewage	55	3	Sewage
26	3	Sewage	56	3	Sewage
27	3	Sewage	57	2	Sewage
28	4	Sewage	58	2	Sewage
29	2	Sewage	59	2	Sewage
30	2	Sewage	60	1	Sewage

Date:	25/11/2013	Assessor:	Jesse Shepherd
Location:	Geraldton WWTP	**Start time:**	1440 Hrs
Latitude:	28°42' 0.09"S	**End time:**	1450 Hrs
Longitude:	114°36' 54.69"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	0		31	0	
2	0		32	0	
3	0		33	0	
4	0		34	1	Bushland
5	1	Bushland	35	0	
6	0		36	0	
7	0		37	0	
8	0		38	0	
9	1	Bushland	39	0	
10	0		40	1	Bushland
11	0		41	0	
12	0		42	0	
13	1		43	0	
14	0		44	0	
15	1		45	0	
16	1	Swamp	46	0	
17	0		47	0	
18	0		48	0	
19	0		49	0	
20	0		50	0	
21	0		51	0	
22	0		52	0	
23	1	Swamp	53	0	
24	0		54	0	
25	0		55	0	
26	0		56	0	
27	0		57	0	
28	0		58	0	
29	0		59	0	
30	0		60	0	

Date:	25/11/2013	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	1440 Hrs
Latitude:	28°41' 59.94"S	**End time:**	1450 Hrs
Longitude:	114°36' 54.05"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	0	0	31	0	
2	0	0	32	0	
3	0	0	33	0	
4	0	0	34	1	Bushland
5	0	0	35	0	
6	0	0	36	0	
7	0	0	37	0	
8	0	0	38	0	
9	0	0	39	0	
10	0	0	40	0	
11	0	0	41	0	
12	0	0	42	0	
13	0	0	43	0	
14	0	0	44	0	
15	0	0	45	0	
16	0	0	46	0	
17	0	0	47	0	
18	0	0	48	0	
19	0	0	49	0	
20	0	0	50	0	
21	0	0	51	0	
22	0	0	52	0	
23	0	0	53	0	
24	0	0	54	0	
25	0	0	55	0	
26	0	0	56	0	
27	0	0	57	0	
28	0	0	58	0	
29	0	0	59	0	
30	0	0	60	0	

Date:	25/11/2013	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	1440 Hrs
Latitude:	28°41' 59.67"S	**End time:**	1450 Hrs
Longitude:	114°36' 55.22"E		

Observation	Intensity	Character	Observation	Intensity	Character
1	0		31	0	
2	0		32	1	Sewage
3	0		33	0	
4	1	Bushland	34	0	
5	1	Sewage	35	1	Sewage
6	0		36	0	
7	0		37	0	
8	0		38	0	
9	0		39	1	Flowers
10	0		40	0	
11	0		41	0	
12	1	Sewage	42	1	Other
13	0		43	0	
14	1	Sewage	44	0	
15	0		45	0	
16	0		46	1	Sewage
17	0		47	1	Sewage
18	1	Swamp	48	2	Sewage
19	0		49	1	Sewage
20	0		50	0	
21	0		51	0	
22	1	Sewage	52	0	
23	1	Sewage	53	0	
24	0		54	0	
25	0		55	0	
26	2	Sewage	56	0	
27	2	Swamp	57	0	
28	1	Sewage	58	0	
29	0	Sewage	59	0	
30	0		60	0	

Date:	26/11/2013	Assessor:	Jesse Shepherd
Location:	Geraldton WWTP	**Start time:**	0507 Hrs
Latitude:	28°42' 7.16"S	**End time:**	0517 Hrs
Longitude:	114°36' 54.87"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	1	Swamp	31	3	Sewage
2	0		32	2	Sewage
3	2	Swamp	33	1	Sewage
4	2	Swamp	34	2	Sewage
5	2	Swamp	35	2	Sewage
6	1	Swamp	36	2	Sewage
7	2	Swamp	37	3	Sewage
8	1	Swamp	38	2	Sewage
9	2	Swamp	39	1	Sewage
10	1	Swamp	40	1	Sewage
11	1	Swamp	41	1	Sewage
12	2	Swamp	42	1	Sewage
13	0		43	2	Sewage
14	1	Sewage	44	2	Sewage
15	1	Sewage	45	1	Sewage
16	1	Sewage	46	1	Sewage
17	1	Sewage	47	3	Sewage
18	1	Sewage	48	2	Sewage
19	0		49	1	Sewage
20	2	Sewage	50	1	Sewage
21	0		51	1	Sewage
22	2	Sewage	52	1	Sewage
23	1	Sewage	53	2	Sewage
24	1	Sewage	54	1	Sewage
25	2	Sewage	55	2	Sewage
26	1	Sewage	56	1	Sewage
27	2	Sewage	57	1	Sewage
28	3	Sewage	58	1	Sewage
29	2	Sewage	59	0	
30	1	Sewage	60	1	Sewage

Date:	26/11/2013	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	0507 Hrs
Latitude:	28°42' 7.16"S	**End time:**	0517 Hrs
Longitude:	114°36' 54.87"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	1	Sewage	31	2	Sewage
2	1	Sewage	32	2	Sewage
3	2	Sewage	33	2	Sewage
4	2	Sewage	34	2	Sewage
5	1	Sewage	35	1	Other
6	1	Sewage	36	2	Sewage
7	1	Sewage	37	2	Sewage
8	1	Sewage	38	1	Sewage
9	2	Sewage	39	1	Sewage
10	1	Sewage	40	1	Other
11	1	Sewage	41		
12	2	Sewage	42		
13	1	Sewage	43	1	Other
14	1	Sewage	44	2	Sewage
15	1	Sewage	45	1	Sewage
16	1	Sewage	46	1	Sewage
17	2	Sewage	47	1	Sewage
18	1	Sewage	48	2	Sewage
19	1	Other	49	2	Sewage
20	1	Sewage	50	1	Sewage
21	1	Sewage	51	1	Sewage
22	2	Sewage	52	1	Sewage
23	1	Other	53	2	Sewage
24	2	Sewage	54	3	Sewage
25	2	Sewage	55	2	Sewage
26	2	Sewage	56	2	Sewage
27	1	Sewage	57	1	Other
28	3	Sewage	58	2	Sewage
29	1	Sewage	59	1	Other
30	1	Sewage	60	1	Other

Date:	26/11/2013	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	0507 Hrs
Latitude:	28°42' 7.16"S	**End time:**	0517 Hrs
Longitude:	114°36' 54.87"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	1	Other	31	3	Sewage
2	1	Sewage	32	3	Sewage
3	1	Sewage	33	2	Sewage
4	1	Sewage	34	3	Sewage
5	2	Sewage	35	2	Sewage
6	1	Sewage	36	2	Sewage
7	1	Sewage	37	3	Sewage
8	0		38	2	Sewage
9	0		39	2	Sewage
10	2	Sewage	40	1	Sewage
11	1	Sewage	41	1	Sewage
12	1	Sewage	42	1	Sewage
13	1	Sewage	43	1	Sewage
14	1	Sewage	44	1	Sewage
15	1	Sewage	45	2	Sewage
16	1	Sewage	46	1	Sewage
17	1	Sewage	47	1	Sewage
18	1	Sewage	48	1	Sewage
19	1	Sewage	49	2	Sewage
20	1	Sewage	50	2	Sewage
21	2	Sewage	51	2	Sewage
22	1	Sewage	52	1	Sewage
23	2	Sewage	53	1	Sewage
24	2	Sewage	54	1	Sewage
25	1	Sewage	55	3	Sewage
26	1	Sewage	56	2	Sewage
27	1	Sewage	57	2	Sewage
28	2	Sewage	58	2	Sewage
29	2	Sewage	59	1	Sewage
30	1	Sewage	60	1	Sewage

Date:	26/11/2013		Assessor:	Jesse Shepherd	
Location:	Geraldton WWTP		**Start time:**	0520 Hrs	
Latitude:	28°42' 6.74"S		**End time:**	0530 Hrs	
Longitude:	114°36' 54.5"E				
Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	1	Sewage	31	1	Bushland
2	2	Sewage	32	1	Sewage
3	2	Sewage	33	1	Sewage
4	2	Sewage	34	1	Sewage
5	1	Sewage	35	3	Sewage
6	1	Sewage	36	3	Sewage
7	2	Sewage	37	3	Sewage
8	2	Sewage	38	2	Sewage
9	2	Sewage	39	3	Sewage
10	1	Sewage	40	1	Sewage
11	2	Sewage	41	1	Sewage
12	0		42	2	Sewage
13	2	Sewage	43	1	Bushland
14	0		44	0	
15	1	Sewage	45	3	Sewage
16	1	Sewage	46	2	Sewage
17	1	Sewage	47	1	Sewage
18	0		48	0	
19	2	Sewage	49	1	Sewage
20	3	Sewage	50	2	Sewage
21	1	Sewage	51	2	Sewage
22	3	Sewage	52	2	Sewage
23	2	Sewage	53	1	Sewage
24	2	Sewage	54	0	
25	2	Sewage	55	1	Sewage
26	1	Sewage	56	2	Sewage
27	1	Sewage	57	3	Sewage
28	3	Sewage	58	1	Sewage
29	3	Sewage	59	1	Sewage
30	1	Sewage	60	2	Sewage

Date:	26/11/2013	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	0520 Hrs
Latitude:	28°42' 5.92"S	**End time:**	0530 Hrs
Longitude:	114°36' 54.3"E		

Observation	Intensity	Character	Observation	Intensity	Character
1	1	Other	31	2	Sewage
2	1	Other	32	1	Sewage
3	2	Sewage	33	1	Sewage
4	2	Sewage	34	1	Sewage
5	2	Sewage	35	0	
6	1	Other	36	0	
7	1	Other	37	2	Sewage
8	1	Other	38	2	Sewage
9	3	Sewage	39	1	Sewage
10	2	Sewage	40	1	Sewage
11	2	Sewage	41	2	Sewage
12	2	Sewage	42	1	Sewage
13	1	Other	43	0	
14	1	Other	44	0	
15	1	Other	45	2	Sewage
16	1	Other	46	2	Sewage
17	1	Other	47	1	Other
18	1	Other	48	1	Other
19	2	Sewage	49	0	
20	1	Other	50	1	Other
21	1	Other	51	1	Other
22	1	Other	52	0	
23	1	Sewage	53	3	Sewage
24	2	Sewage	54	2	Sewage
25	0		55	2	Sewage
26	1	Other	56	1	Other
27	1	Other	57	1	Other
28	0		58	2	Sewage
29	0		59	1	Other
30	0		60	2	Sewage

Date:	26/11/2013	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	0520 Hrs
Latitude:	28°42' 7.43"S	**End time:**	0530 Hrs
Longitude:	114°36' 55.11"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	3	Sewage	31	3	Sewage
2	2	Sewage	32	2	Sewage
3	2	Sewage	33	1	Sewage
4	1	Sewage	34	3	Sewage
5	1	Sewage	35	1	Sewage
6	1	Sewage	36	2	Sewage
7	0		37	3	Sewage
8	1	Sewage	38	3	Sewage
9	0		39	1	Sewage
10	0		40	1	Sewage
11	1	Sewage	41	0	
12	1	Sewage	42	1	Sewage
13	1	Sewage	43	1	Sewage
14	1	Sewage	44	3	Sewage
15	1	Sewage	45	2	Sewage
16	1	Sewage	46	2	Sewage
17	0		47	2	Sewage
18	1	Sewage	48	1	Sewage
19	2	Sewage	49	2	Sewage
20	1	Sewage	50	1	Sewage
21	1	Sewage	51	1	Sewage
22	3	Sewage	52	1	Sewage
23	1	Sewage	53	1	Sewage
24	2	Sewage	54	1	Sewage
25	1	Sewage	55	1	Sewage
26	1	Sewage	56	2	Sewage
27	3	Sewage	57	1	Sewage
28	2	Sewage	58	3	Sewage
29	2	Sewage	59	3	Sewage
30	1	Sewage	60	3	Sewage

Date:	26/11/2013	Assessor:	Jesse Shepherd
Location:	Geraldton WWTP	**Start time:**	0540 Hrs
Latitude:	28°42' 5.95"S	**End time:**	0550 Hrs
Longitude:	114°36' 53.71"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	2	Sewage	31	2	Sewage
2	1	Sewage	32	2	Sewage
3	1	Sewage	33	1	Sewage
4	2	Sewage	34	1	Sewage
5	2	Sewage	35	2	Sewage
6	2	Sewage	36	1	Sewage
7	2	Sewage	37	2	Sewage
8	1	Sewage	38	1	Sewage
9	3	Sewage	39	0	
10	3	Sewage	40	0	
11	1	Sewage	41	0	
12	1	Sewage	42	0	
13	2	Sewage	43	1	Sewage
14	2	Sewage	44	1	Sewage
15	2	Sewage	45	2	Sewage
16	2	Sewage	46	2	Sewage
17	2	Sewage	47	1	Sewage
18	2	Sewage	48	3	Sewage
19	3	Sewage	49	3	Sewage
20	2	Sewage	50	2	Sewage
21	2	Sewage	51	2	Sewage
22	2	Sewage	52	2	Sewage
23	3	Sewage	53	2	Sewage
24	2	Sewage	54	1	Sewage
25	2	Sewage	55	2	Sewage
26	2	Sewage	56	2	Sewage
27	1	Sewage	57	2	Sewage
28	3	Sewage	58	1	Sewage
29	2	Sewage	59	0	
30	1	Sewage	60	0	

Date:	26/11/2013	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	0540 Hrs
Latitude:	28°42' 7.16"S	**End time:**	0550 Hrs
Longitude:	114°36' 54.87"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	1	Sewage	31	2	Sewage
2	2	Sewage	32	1	Other
3	2	Sewage	33	2	Sewage
4	2	Sewage	34	2	Sewage
5	1	Sewage	35	3	Sewage
6	2	Sewage	36	3	Sewage
7	1	Sewage	37	2	Sewage
8	3	Sewage	38	1	Sewage
9	3	Sewage	39	1	Other
10	1	Other	40	0	
11	1	Other	41	1	Other
12	0		42	1	Other
13	1	Other	43	2	Sewage
14	1	Other	44	2	Sewage
15	1	Other	45	1	Other
16	2	Sewage	46	2	Sewage
17	2	Sewage	47	2	Sewage
18	3	Sewage	48	1	Sewage
19	2	Sewage	49	3	Sewage
20	2	Sewage	50	2	Sewage
21	2	Sewage	51	2	Sewage
22	2	Sewage	52	2	Sewage
23	2	Sewage	53	1	Sewage
24	1	Other	54	1	Sewage
25	3	Sewage	55	1	Other
26	3	Sewage	56	0	
27	3	Sewage	57	1	Sewage
28	2	Sewage	58	1	Sewage
29	1	Other	59	1	Other
30	0		60	0	

Date:	26/11/2013	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	0540 Hrs
Latitude:	28°42' 3.26"S	**End time:**	0550 Hrs
Longitude:	114°36' 50.79"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	0		31	2	Bushland
2	0		32	2	Bushland
3	0		33	1	Bushland
4	0		34	0	
5	0		35	1	Bushland
6	0		36	0	
7	0		37	0	
8	0		38	0	
9	0		39	0	
10	0		40	2	Bushland
11	1	Sewage	41	1	Bushland
12	2	Sewage	42	0	
13	1		43	0	
14	0		44	0	
15	0		45	0	
16	0		46	0	
17	0		47	0	
18	1	Sewage	48	1	Sewage
19	0		49	1	Sewage
20	0		50	0	
21	0		51	0	
22	0		52	1	Sewage
23	0		53	0	
24	0		54	0	
25	0		55	0	
26	1	Sewage	56	0	
27	1	Sewage	57	2	Bushland
28	1	Sewage	58	0	
29	1	Sewage	59	0	
30	0		60	0	

Date:	26/11/2013	Assessor:	Jesse Shepherd
Location:	Geraldton WWTP	**Start time:**	0554 Hrs
Latitude:	28°42' 5.88"S	**End time:**	0604 Hrs
Longitude:	114°36' 53.71"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	1	Sewage	31	0	
2	2	Sewage	32	2	Sewage
3	0		33	3	Sewage
4	0		34	2	Sewage
5	0		35	1	Sewage
6	2	Sewage	36	1	Sewage
7	2	Sewage	37	1	Sewage
8	1	Sewage	38	2	Sewage
9	2	Sewage	39	2	Sewage
10	2	Sewage	40	2	Sewage
11	2	Sewage	41	2	Sewage
12	1	Sewage	42	2	Sewage
13	0		43	1	Sewage
14	0		44	0	Sewage
15	2	Sewage	45	2	Sewage
16	1	Sewage	46	2	Sewage
17	1	Sewage	47	2	Sewage
18	1	Sewage	48	1	Sewage
19	3	Sewage	49	1	Sewage
20	2	Sewage	50	2	Sewage
21	1	Sewage	51	1	Sewage
22	2	Sewage	52	3	Sewage
23	0		53	2	Sewage
24	0		54	3	Sewage
25	1	Sewage	55	3	Sewage
26	2	Sewage	56	2	Sewage
27	2	Sewage	57	2	Sewage
28	3	Sewage	58	2	Sewage
29	2	Sewage	59	1	Sewage
30	1	Sewage	60	2	Sewage

Date:	26/11/2013	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	0554 Hrs
Latitude:	28°42' 6.48"S	**End time:**	0604 Hrs
Longitude:	114°36' 54.43"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	1	Sewage	31	2	Sewage
2	1	Sewage	32	2	Sewage
3	0		33	3	Sewage
4	0		34	1	Sewage
5	2	Sewage	35	1	Sewage
6	1	Sewage	36	1	Sewage
7	1	Sewage	37	1	Sewage
8	2	Sewage	38	2	Sewage
9	1	Sewage	39	1	Sewage
10	2	Sewage	40	1	Sewage
11	1	Sewage	41	0	
12	0		42	1	Other
13	1	Other	43	0	
14	1	Sewage	44	3	Sewage
15	1	Sewage	45	2	Sewage
16	1	Sewage	46	1	Sewage
17	0		47	1	Sewage
18	1	Sewage	48	1	Sewage
19	2	Sewage	49	2	Sewage
20	3	Sewage	50	3	Sewage
21	2	Sewage	51	3	Sewage
22	3	Sewage	52	0	
23	2	Sewage	53	1	Sewage
24	0		54	2	Sewage
25	1	Sewage	55	3	Sewage
26	2	Sewage	56	2	Sewage
27	2	Sewage	57	2	Sewage
28	1	Sewage	58	2	Sewage
29	1	Sewage	59	1	Sewage
30	1	Sewage	60	1	Sewage

Date:	26/11/2013	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	0554 Hrs
Latitude:	28°42' 3.26"S	**End time:**	0604 Hrs
Longitude:	114°36' 50.79"E		

Observation	Intensity	Character	Observation	Intensity	Character
1	0		31	2	Sewage
2	0		32	1	Sewage
3	0		33	2	Flowers
4	0		34	0	
5	0		35	1	Sewage
6	0		36	1	Sewage
7	0		37	1	Sewage
8	0		38	0	
9	0		39	0	
10	0		40	1	Sewage
11	0		41	1	Sewage
12	0		42	1	Sewage
13	0		43	0	
14	1	Sewage	44	0	
15	0		45	0	
16	0		46	0	
17	0		47	0	
18	0		48	2	Sewage
19	0		49	1	Sewage
20	1	Sewage	50	0	
21	0		51	0	
22	0		52	0	
23	0		53	0	
24	0		54	0	
25	0		55	0	
26	0		56	0	
27	0		57	0	
28	1	Bushland	58	0	
29	0		59	0	
30	0		60	0	

Date:	26/11/2013	Assessor:	Jesse Shepherd
Location:	Geraldton WWTP	**Start time:**	0745 Hrs
Latitude:	28°42' 6.81"S	**End time:**	0755 Hrs
Longitude:	114°36' 54.69"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	2	Swamp	31	0	
2	2	Swamp	32	1	Swamp
3	0		33	1	Swamp
4	2	Swamp	34	1	Swamp
5	1	Swamp	35	1	Swamp
6	0		36	2	Swamp
7	1	Flowers	37	1	Swamp
8	0		38	1	Swamp
9	2	Swamp	39	1	Swamp
10	1	Swamp	40	1	Swamp
11	1	Swamp	41	2	Swamp
12	1	Swamp	42	0	
13	1	Swamp	43	0	
14	2	Swamp	44	0	
15	1	Swamp	45	0	
16	0		46	1	Swamp
17	2	Swamp	47	2	Swamp
18	0		48	2	Swamp
19	2	Swamp	49	2	Swamp
20	1	Swamp	50	1	Swamp
21	3	Swamp	51	1	Swamp
22	2	Swamp	52	0	
23	1	Swamp	53	0	
24	1	Swamp	54	0	
25	1	Swamp	55	0	
26	0		56	0	
27	1	Swamp	57	0	
28	1	Swamp	58	0	
29	1	Flowers	59	0	
30	0		60	0	

Date:	26/11/2013	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	0745 Hrs
Latitude:	28°42' 7.43"S	**End time:**	0755 Hrs
Longitude:	114°36' 55.11"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	1	Other	31	0	
2	0		32	0	
3	0		33	1	Sewage
4	0		34	2	Sewage
5	0		35	1	Sewage
6	0		36	0	
7	0		37	0	
8	0		38	0	
9	1	Sewage	39	0	
10	1	Sewage	40	1	Sewage
11	0		41	0	
12	0		42	0	
13	1	Other	43	0	
14	1	Bushland	44	0	
15	0		45	0	
16	1	Bushland	46	2	Sewage
17	0		47	1	Sewage
18	0		48	1	Sewage
19	0		49	1	Sewage
20	0		50	1	Sewage
21	1	Sewage	51	0	
22	1	Sewage	52	0	
23	0		53	0	
24	0		54	0	
25	1	Bushland	55	0	
26	0		56	0	
27	1	Sewage	57	0	
28	1	Sewage	58	0	
29	0		59	1	Sewage
30	1	Sewage	60	0	

Date:	26/11/2013	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	0745Hrs
Latitude:	28°42' 4.29"S	**End time:**	0755 Hrs
Longitude:	114°36' 53.67"E		

Observation	Intensity	Character	Observation	Intensity	Character
1	0		31	0	
2	1	Sewage	32	0	
3	0		33	0	
4	0		34	1	Sewage
5	0		35	0	
6	0		36	2	Flowers
7	0		37	1	Flowers
8	0		38	0	
9	0		39	1	Flowers
10	0		40	1	Flowers
11	1	Sewage	41	0	
12	0		42	1	Sewage
13	0		43	0	
14	0		44	0	
15	0		45	1	Flowers
16	0		46	0	
17	0		47	1	Sewage
18	0		48	0	
19	1	Sewage	49	1	Sewage
20	1	Sewage	50	0	
21	0		51	0	
22	0		52	0	
23	0		53	0	
24	0		54	0	
25	0		55	0	
26	0		56	0	
27	0		57	0	
28	0		58	0	
29	0		59	0	
30	0		60	0	

Date:	26/11/2013	Assessor:	Jesse Shepherd
Location:	Geraldton WWTP	**Start time:**	0805 Hrs
Latitude:	28°42' 6.61"S	**End time:**	0815Hrs
Longitude:	114°36' 56.41"E		

Observation	Intensity	Character	Observation	Intensity	Character
1	3	Sewage	31	2	Sewage
2	1	Sewage	32	1	Sewage
3	1	Sewage	33	2	Sewage
4	3	Sewage	34	1	Sewage
5	1	Sewage	35	2	Sewage
6	1	Sewage	36	2	Sewage
7	2	Sewage	37	1	Sewage
8	2	Sewage	38	2	Sewage
9	3	Sewage	39	1	Sewage
10	3	Sewage	40	2	Sewage
11	4	Sewage	41	2	Sewage
12	2	Sewage	42	1	Sewage
13	2	Sewage	43	2	Sewage
14	2	Sewage	44	1	Sewage
15	2	Sewage	45	0	
16	3	Sewage	46	0	
17	2	Sewage	47	1	Sewage
18	1	Sewage	48	1	Sewage
19	2	Sewage	49	1	Sewage
20	2	Sewage	50	0	Sewage
21	1	Sewage	51	2	Sewage
22	2	Sewage	52	0	
23	2	Sewage	53	0	
24	2	Sewage	54	2	Sewage
25	1	Sewage	55	2	Sewage
26	2	Sewage	56	1	Sewage
27	1	Sewage	57	1	Sewage
28	2	Sewage	58	2	Sewage
29	1	Sewage	59	2	Sewage
30	2	Sewage	60	0	

Date:	26/11/2013	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	0805 Hrs
Latitude:	28°42' 4.99"S	**End time:**	0815 Hrs
Longitude:	114°36' 55.71"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	2	Sewage	31	1	Sewage
2	1	Sewage	32	2	Sewage
3	2	Sewage	33	2	Sewage
4	2	Sewage	34	1	Sewage
5	2	Sewage	35	0	
6	1	Sewage	36	0	
7	2	Sewage	37	1	Sewage
8	3	Sewage	38	0	
9	2	Sewage	39	0	
10	2	Sewage	40	1	Sewage
11	2	Sewage	41	1	Sewage
12	2	Sewage	42	1	Sewage
13	3	Sewage	43	0	
14	3	Sewage	44	2	Sewage
15	1	Sewage	45	1	Sewage
16	2	Sewage	46	2	Sewage
17	1	Sewage	47	1	Sewage
18	2	Sewage	48	0	
19	3	Sewage	49	2	Sewage
20	2	Sewage	50	1	Sewage
21	1	Sewage	51	1	Sewage
22	1	Sewage	52	0	
23	1	Sewage	53	1	Sewage
24	1	Sewage	54	1	Sewage
25	1	Sewage	55	1	Sewage
26	2	Sewage	56	0	
27	1	Sewage	57	0	
28	1	Sewage	58	1	Sewage
29	1	Sewage	59	2	Sewage
30	0		60	0	

Date:	26/11/2013	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	0805 Hrs
Latitude:	28°42' 3.08"S	**End time:**	0815 Hrs
Longitude:	114°36' 55.02"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	1	Sewage	31	2	Sewage
2	1	Sewage	32	1	Sewage
3	1	Sewage	33	1	Sewage
4	2	Sewage	34	1	Sewage
5	1	Sewage	35	1	Sewage
6	1	Sewage	36	2	Sewage
7	2	Sewage	37	2	Sewage
8	1	Sewage	38	1	Sewage
9	2	Sewage	39	1	Sewage
10	1	Sewage	40	2	Sewage
11	2	Sewage	41	2	Sewage
12	1	Sewage	42	1	Sewage
13	1	Sewage	43	1	Sewage
14	2	Sewage	44	1	Sewage
15	2	Sewage	45	0	
16	1	Sewage	46	1	Sewage
17	1	Sewage	47	1	Sewage
18	1	Sewage	48	1	Sewage
19	1	Sewage	49	2	Sewage
20	2	Sewage	50	1	Sewage
21	1	Sewage	51	0	
22	1	Sewage	52	1	Sewage
23	1	Sewage	53	1	Sewage
24	2	Sewage	54	1	Sewage
25	1	Sewage	55	3	Sewage
26	1	Sewage	56	2	Sewage
27	0		57	3	Sewage
28	1	Sewage	58	2	Sewage
29	0		59	2	Sewage
30	1	Sewage	60	1	Sewage

Date:	26/11/2013		Assessor:	Jesse Shepherd	
Location:	Geraldton WWTP		**Start time:**	0822 Hrs	
Latitude:	28°42' 6.22"S		**End time:**	0832 Hrs	
Longitude:	114°36' 58.16"E				
Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	3	Sewage	31	4	Sewage
2	3	Sewage	32	3	Sewage
3	3	Sewage	33	3	Sewage
4	4	Sewage	34	3	Sewage
5	4	Sewage	35	3	Sewage
6	2	Sewage	36	2	Sewage
7	3	Sewage	37	3	Sewage
8	2	Sewage	38	3	Sewage
9	3	Sewage	39	3	Sewage
10	3	Sewage	40	3	Sewage
11	3	Sewage	41	3	Sewage
12	3	Sewage	42	4	Sewage
13	2	Sewage	43	3	Sewage
14	3	Sewage	44	2	Sewage
15	3	Sewage	45	3	Sewage
16	2	Sewage	46	4	Sewage
17	3	Sewage	47	3	Sewage
18	3	Sewage	48	2	Sewage
19	2	Sewage	49	2	Sewage
20	4	Sewage	50	3	Sewage
21	3	Sewage	51	3	Sewage
22	4	Sewage	52	2	Sewage
23	4	Sewage	53	3	Sewage
24	3	Sewage	54	4	Sewage
25	4	Sewage	55	4	Sewage
26	3	Sewage	56	3	Sewage
27	2	Sewage	57	2	Sewage
28	3	Sewage	58	2	Sewage
29	4	Sewage	59	3	Sewage
30	3	Sewage	60	3	Sewage

Date:	26/11/2013	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	0822 Hrs
Latitude:	28°42' 4.2"S	**End time:**	0832 Hrs
Longitude:	114°36' 57.91"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	2	Sewage	31	1	Sewage
2	2	Sewage	32	1	Sewage
3	1	Sewage	33	2	Sewage
4	1	Sewage	34	1	Sewage
5	1	Sewage	35	1	Sewage
6	1	Sewage	36	1	Sewage
7	1	Sewage	37	0	Sewage
8	0		38	1	Sewage
9	1	Sewage	39	0	
10	0		40	0	
11	1	Sewage	41	2	Sewage
12	0		42	1	Sewage
13	0		43	2	Sewage
14	0		44	3	Sewage
15	1	Sewage	45	1	Sewage
16	0		46	1	Sewage
17	1	Sewage	47	1	Sewage
18	1	Sewage	48	1	Sewage
19	0		49	1	Sewage
20	0		50	2	Sewage
21	1	Sewage	51	1	Sewage
22	0		52	0	
23	1	Sewage	53	1	Sewage
24	0		54	2	Sewage
25	0		55	0	
26	2	Sewage	56	0	
27	1	Sewage	57	0	
28	1	Sewage	58	0	
29	2	Sewage	59	1	Sewage

Date:	26/11/2013	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	0822 Hrs
Latitude:	28°42' 3.42"S	**End time:**	0832 Hrs
Longitude:	114°36' 57.78"E		

Observation	Intensity	Character	Observation	Intensity	Character
1	0		31	0	
2	1	Bushland	32	0	
3	0		33	0	
4	0		34	2	Swamp
5	0		35	2	Sewage
6	0		36	2	Sewage
7	0		37	2	Sewage
8	1	Sewage	38	1	Sewage
9	1	Sewage	39	0	
10	1	Sewage	40	0	
11	2	Sewage	41	0	
12	2	Sewage	42	0	
13	1	Sewage	43	1	Sewage
14	1	Sewage	44	1	Sewage
15	1	Sewage	45	2	Sewage
16	0		46	2	Sewage
17	0		47	1	Sewage
18	0		48	1	Sewage
19	1	Flowers	49	2	Sewage
20	0		50	1	Sewage
21	1	Sewage	51	0	
22	1	Sewage	52	2	Sewage
23	2	Sewage	53	0	
24	1	Sewage	54	3	Sewerage
25	0		55	1	Sewage
26	0		56	1	Sewage
27	0		57	1	Sewage
28	0		58	0	
29	1	Sewage	59	0	

Date:	26/11/2013	Assessor:	Jesse Shepherd
Location:	Geraldton WWTP	**Start time:**	1321 Hrs
Latitude:	28°42' 4.32"S	**End time:**	1331 Hrs
Longitude:	114°37' 2.33"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	1	Swamp	31	0	
2	2	Swamp	32	0	
3	1	Swamp	33	2	Swamp
4	2	Swamp	34	1	Swamp
5	2	Swamp	35	2	Swamp
6	2	Swamp	36	2	Swamp
7	1	Swamp	37	1	Swamp
8	1	Swamp	38	1	Swamp
9	2	Swamp	39	0	
10	2	Swamp	40	0	
11	2	Swamp	41	2	Swamp
12	3	Swamp	42	1	Swamp
13	2	Swamp	43	1	Swamp
14	2	Swamp	44	2	Swamp
15	1	Swamp	45	0	
16	2	Swamp	46	1	Swamp
17	2	Swamp	47	0	
18	0		48	1	Swamp
19	1	Swamp	49	0	
20	0		50	1	Swamp
21	2	Swamp	51	1	Swamp
22	1	Swamp	52	0	
23	1	Swamp	53	1	Swamp
24	0		54	1	Swamp
25	1	Swamp	55	1	Seaweed
26	0		56	1	Swamp
27	0		57	2	Swamp
28	2	Swamp	58	0	
29	2	Swamp	59	1	Swamp

Date:	26/11/2013	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	1321 Hrs
Latitude:	28°42' 3.03"S	**End time:**	3131 Hrs
Longitude:	114°37' 3.1"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	1	Sewage	31	0	
2	0		32	1	Other
3	1	Swamp	33	1	Swamp
4	0		34	1	Other
5	1	Swamp	35	0	
6	0		36	0	
7	1	Swamp	37	0	
8	1	Other	38	0	
9	1	Other	39	1	Swamp
10	1	Other	40	0	
11	0		41	0	
12	1	Swamp	42	0	
13	0		43	0	
14	1	Swamp	44	1	Swamp
15	1	Swamp	45	1	Swamp
16	1	Swamp	46	1	Swamp
17	0		47	0	
18	0		48	1	Swamp
19	0		49	1	Swamp
20	0		50	0	
21	1	Other	51	0	
22	1	Swamp	52	0	
23	1	Swamp	53	0	
24	1	Swamp	54	0	
25	0		55	0	
26	0		56	0	
27	0		57	0	
28	0		58	0	
29	0		59	0	

Date:	26/11/2013	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	1321 Hrs
Latitude:	28°42' 5.35"S	**End time:**	1331 Hrs
Longitude:	114°37' 1.62"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	1	Sewage	31	2	Sewage
2	2	Sewage	32	1	Sewage
3	1	Sewage	33	1	Sewage
4	0		34	2	Sewage
5	1	Sewage	35	1	Sewage
6	1	Sewage	36	1	Sewage
7	2	Sewage	37	2	Sewage
8	1		38	1	Sewage
9	1		39	1	Sewage
10	0		40	0	Sewage
11	2	Sewage	41	2	Sewage
12	1	Sewage	42	1	Sewage
13	0		43	1	Other
14	2	Sewage	44	2	Sewage
15	2	Sewage	45	1	Sewage
16	1	Sewage	46	1	Sewage
17	2	Sewage	47	2	Sewage
18	1	Sewage	48	2	Sewage
19	0		49	1	Sewage
20	1	Other	50	0	
21	1	Other	51	2	Sewage
22	2	Sewage	52	1	Sewage
23	3	Sewage	53	1	Sewage
24	1	Sewage	54	1	Sewage
25	2	Sewage	55	2	Sewage
26	1	Sewage	56	2	Sewage
27	2	Sewage	57	1	Sewage
28	2	Sewage	58	2	Sewage
29	2	Sewage	59	1	Sewage

Date:	26/11/2013	Assessor:	Jesse Shepherd
Location:	Geraldton WWTP	**Start time:**	1352 Hrs
Latitude:	28°42' 2.1"S	**End time:**	1402 Hrs
Longitude:	114°37' 3.82"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	0		31	2	Swamp
2	0		32	1	Swamp
3	1	Swamp	33	0	
4	0		34	1	Swamp
5	0		35	0	
6	0		36	0	
7	1	Swamp	37	1	Swamp
8	0		38	0	
9	1		39	1	Swamp
10	0		40	0	
11	1	Swamp	41	0	
12	2	Swamp	42	0	
13	1	Swamp	43	1	Swamp
14	0		44	0	
15	1	Swamp	45	0	
16	0		46	0	
17	0		47	0	
18	0		48	0	
19	0		49	1	Swamp
20	0		50	1	Swamp
21	0		51	1	Swamp
22	0		52	0	
23	1	Other	53	1	Swamp
24	1	Other	54	1	Swamp
25	0		55	1	Swamp
26	0		56	1	Other
27	0		57	0	
28	1	Swamp	58	1	Swamp
29	2	Swamp	59	1	Swamp

Date:	26/11/2013	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	1352 Hrs
Latitude:	28°41' 59.44"S	**End time:**	1402 Hrs
Longitude:	114°37' 4.36"E		

Observation	Intensity	Character	Observation	Intensity	Character
1	0		31	0	
2	0		32	0	
3	0		33	0	
4	0		34	0	
5	0		35	0	
6	0		36	0	
7	0		37	0	
8	0		38	0	
9	0		39	0	
10	0		40	0	
11	0		41	0	
12	0		42	0	
13	0		43	0	
14	0		44	0	
15	0		45	0	
16	1	Flowers	46	1	Sewage
17	0		47	0	
18	0		48	0	
19	0		49	0	
20	0		50	0	
21	0		51	0	
22	0		52	1	Sewage
23	0		53	0	
24	0		54	0	
25	0		55	0	
26	0		56	0	
27	0		57	0	
28	0		58	0	
29	0		59	0	
30	0		60	0	

Date:	26/11/2013	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	1352 Hrs
Latitude:	28°42' 1.16"S	**End time:**	1402 Hrs
Longitude:	114°37' 4.02"E		

Observation	Intensity	Character	Observation	Intensity	Character
1	1	Swamp	31	0	
2	1	Swamp	32	0	
3	0		33	0	
4	1	Swamp	34	0	
5	1		35	0	
6	0		36	0	
7	1	Swamp	37	0	
8	1		38	0	
9	2	Swamp	39	0	
10	0		40	1	Swamp
11	0		41	1	Swamp
12	1	Swamp	42	2	Swamp
13	1	Swamp	43	1	Swamp
14	0		44	1	Swamp
15	0		45	0	
16	1	Swamp	46	0	
17	1	Swamp	47	0	
18	0		48	0	
19	1	Swamp	49	0	
20	1	Swamp	50	0	
21	1	Swamp	51	0	
22	0		52	0	
23	1	Swamp	53	0	
24	0		54	0	
25	1	Swamp	55	0	
26	0		56	0	
27	1	Swamp	57	0	
28	0		58	0	
29	1	Swamp	59	0	
30	0		60	0	

Date:	26/11/2013	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	1417 Hrs
Latitude:	28°41' 57.75"S	**End time:**	1427 Hrs
Longitude:	114°37' 5.37"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	0		31	0	
2	0		32	0	
3	0		33	0	
4	0		34	0	
5	0		35	1	Swamp
6	2	Bushland	36	0	
7	0		37	0	
8	0		38	0	
9	0		39	1	Swamp
10	0		40	0	
11	0		41	0	
12	0		42	0	
13	1	Swamp	43	0	
14	1	Swamp	44	0	
15	0		45	0	
16	0		46	0	
17	0		47	0	
18	0		48	1	Swamp
19	0		49	0	
20	0		50	0	
21	0		51	0	
22	0		52	0	
23	0		53	0	
24	0		54	0	
25	1	Swamp	55	0	
26	0		56	0	
27	0		57	0	
28	0		58	0	
29	0		59	0	
30	0		60	0	

Date:	26/11/2013		Assessor:	Danielle White	
Location:	Geraldton WWTP		**Start time:**	1417 Hrs	
Latitude:	28°41' 59.28"S		**End time:**	1427 Hrs	
Longitude:	114°37' 4.51"E				
Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	0		31	0	
2	1	Bushland	32	0	
3	0		33	0	
4	0		34	0	
5	0		35	0	
6	0		36	0	
7	1	Bushland	37	1	Bushland
8	1	Bushland	38	0	
9	0		39	0	
10	0		40	0	
11	0		41	1	Bushland
12	0		42	0	
13	1	Bushland	43	0	
14	0		44	0	
15	0		45	0	
16	1	Bushland	46	0	
17	0		47	0	
18	0		48	0	
19	0		49	0	
20	0		50	0	
21	0		51	0	
22	0		52	0	
23	0		53	1	Bushland
24	0		54	0	
25	0		55	0	
26	1	Bushland	56	0	
27	0		57	0	
28	0		58	0	
29	0		59	0	
30	0		60	0	

Date:	26/11/2013	Assessor:	Jesse Shepherd
Location:	Geraldton WWTP	**Start time:**	1530 Hrs
Latitude:	28°41' 58.45"S	**End time:**	1540 Hrs
Longitude:	114°37' 5.12"E		

Observation	Intensity	Character	Observation	Intensity	Character
1	1	Bushland	31	0	
2	0		32	0	
3	0		33	0	
4	0		34	0	
5	0		35	0	
6	0		36	0	
7	0		37	1	Other
8	1	Bushland	38	1	Other
9	1	Swamp	39	1	Other
10	0		40	0	
11	0		41	0	
12	1	Swamp	42	0	
13	0		43	1	Swamp
14	0		44	1	Swamp
15	0		45	0	
16	0		46	0	
17	0		47	0	
18	0		48	0	
19	0		49	0	
20	0		50	0	
21	1	Swamp	51	0	
22	1	Swamp	52	1	Bushland
23	0		53	0	
24	1	Swamp	54	0	
25	0		55	0	
26	0		56	1	Bushland
27	1	Bushland	57	0	
28	0		58	0	
29	1	Bushland	59	0	
30	0		60	0	

Date:	26/11/2013	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	1530 Hrs
Latitude:	28°41' 56.51"S	**End time:**	1540 Hrs
Longitude:	114°37' 7.66"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	0		31	0	
2	0		32	0	
3	0		33	0	
4	0		34	0	
5	0		35	0	
6	0		36	0	
7	0		37	0	
8	0		38	0	
9	0		39	0	
10	0		40	0	
11	0		41	0	
12	0		42	1	Sewage
13	0		43	0	
14	0		44	0	
15	0		45	0	
16	0		46	0	
17	0		47	0	
18	0		48	0	
19	1	Sewage	49	0	
20	0		50	0	
21	0		51	0	
22	0		52	0	
23	0		53	0	
24	0		54	0	
25	0		55	0	
26	0		56	0	
27	0		57	0	
28	0		58	0	
29	0		59	0	
30	0		60	0	

Date:	26/11/2013	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	1530 Hrs
Latitude:	28°41' 57.3"S	**End time:**	1540 Hrs
Longitude:	114°37' 6.39"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	1	Bushland	31	0	
2	0		32	0	
3	0		33	0	
4	0		34	0	
5	0		35	1	Other
6	1	Other	36	1	Bushland
7	0		37	0	
8	0		38	0	
9	0		39	1	Swamp
10	0		40	0	
11	0		41	0	
12	1	Swamp	42	0	
13	1	Swamp	43	0	
14	1	Swamp	44	1	Bushland
15	1	Swamp	45	0	
16	0		46	1	Bushland
17	0		47	0	
18	1	Other	48	0	
19	1	Other	49	1	Other
20	0		50	0	
21	0		51	0	
22	0		52	0	
23	1	Bushland	53	0	
24	1	Swamp	54	0	
25	0		55	1	Bushland
26	1	Other	56	0	
27	0		57	0	
28	1	Other	58	0	
29	0		59	0	
30	0		60	0	

Date:	27/11/2013	Assessor:	Jesse Shepherd
Location:	Geraldton WWTP	**Start time:**	0507 Hrs
Latitude:	28°42' 6.52"S	**End time:**	0517 Hrs
Longitude:	114°36' 56.11"E		

Observation	Intensity	Character	Observation	Intensity	Character
1	3	Sewage	31	4	Sewage
2	3	Sewage	32	4	Sewage
3	3	Sewage	33	4	Sewage
4	2	Sewage	34	3	Sewage
5	3	Sewage	35	3	Sewage
6	3	Sewage	36	2	Sewage
7	2	Sewage	37	3	Sewage
8	2	Sewage	38	2	Sewage
9	2	Sewage	39	2	Sewage
10	3	Sewage	40	2	Sewage
11	3	Sewage	41	4	Sewage
12	5	Sewage	42	3	Sewage
13	4	Sewage	43	3	Sewage
14	4	Sewage	44	3	Sewage
15	4	Sewage	45	3	Sewage
16	3	Sewage	46	3	Sewage
17	3	Sewage	47	2	Sewage
18	3	Sewage	48	2	Sewage
19	4	Sewage	49	3	Sewage
20	3	Sewage	50	3	Sewage
21	3	Sewage	51	3	Sewage
22	2	Sewage	52	3	Sewage
23	2	Sewage	53	3	Sewage
24	3	Sewage	54	3	Sewage
25	4	Sewage	55	4	Sewage
26	3	Sewage	56	4	Sewage
27	2	Sewage	57	3	Sewage
28	2	Sewage	58	3	Sewage
29	2	Sewage	59	3	Sewage
30	2	Sewage	60	3	Sewage

Date:	27/11/2013	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	0507 Hrs
Latitude:	28°42' 6.52"S	**End time:**	0517 Hrs
Longitude:	114°36' 56.11"E		

Observation	Intensity	Character	Observation	Intensity	Character
1	3	Sewage	31	4	Sewage
2	3	Sewage	32	4	Sewage
3	3	Sewage	33	3	Sewage
4	2	Sewage	34	2	Sewage
5	2	Sewage	35	2	Sewage
6	2	Sewage	36	2	Sewage
7	1	Sewage	37	2	Sewage
8	1	Sewage	38	4	Sewage
9	2	Sewage	39	2	Sewage
10	1	Sewage	40	3	Sewage
11	3	Sewage	41	4	Sewage
12	4	Sewage	42	3	Sewage
13	3	Sewage	43	4	Sewage
14	4	Sewage	44	3	Sewage
15	3	Sewage	45	3	Sewage
16	2	Sewage	46	2	Sewage
17	3	Sewage	47	3	Sewage
18	3	Sewage	48	2	Sewage
19	4	Sewage	49	3	Sewage
20	2	Sewage	50	3	Sewage
21	2	Sewage	51	4	Sewage
22	3	Sewage	52	2	Sewage
23	2	Sewage	53	4	Sewage
24	3	Sewage	54	3	Sewage
25	3	Sewage	55	3	Sewage
26	3	Sewage	56	4	Sewage
27	3	Sewage	57	2	Sewage
28	2	Sewage	58	2	Sewage
29	2	Sewage	59	2	Sewage
30	1	Sewage	60	2	Sewage

Date:	27/11/2013	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	0523 Hrs
Latitude:	28°42' 5.71"S	**End time:**	0533 Hrs
Longitude:	114°36' 56.08"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	2	Sewage	31	2	Sewage
2	2	Sewage	32	2	Sewage
3	3	Sewage	33	2	Sewage
4	3	Sewage	34	3	Sewage
5	3	Sewage	35	3	Sewage
6	3	Sewage	36	2	Sewage
7	3	Sewage	37	1	Sewage
8	2	Sewage	38	2	Sewage
9	4	Sewage	39	3	Sewage
10	3	Sewage	40	3	Sewage
11	3	Sewage	41	3	Sewage
12	2	Sewage	42	2	Sewage
13	1	Sewage	43	2	Sewage
14	1	Sewage	44	2	Sewage
15	3	Sewage	45	2	Sewage
16	3	Sewage	46	3	Sewage
17	4	Sewage	47	3	Sewage
18	3	Sewage	48	3	Sewage
19	2	Sewage	49	2	Sewage
20	2	Sewage	50	2	Sewage
21	2	Sewage	51	2	Sewage
22	1	Sewage	52	2	Sewage
23	2	Sewage	53	1	Sewage
24	2	Sewage	54	1	Sewage
25	2	Sewage	55	3	Sewage
26	2	Sewage	56	2	Sewage
27	1	Sewage	57	3	Sewage
28	1	Sewage	58	4	Sewage
29	1	Sewage	59	3	Sewage
30	1	Sewage	60	3	Sewage

Date:	27/11/2013	Assessor:	Jesse Shepherd
Location:	Geraldton WWTP	**Start time:**	0523 Hrs
Latitude:	28°42' 4.49"S	**End time:**	0533 Hrs
Longitude:	114°36' 55.78"E		

Observation	Intensity	Character	Observation	Intensity	Character
1	1	Bushland	31	0	
2	1	Bushland	32	0	
3	2	Sewage	33	3	Sewage
4	0		34	1	Sewage
5	3	Sewage	35	1	Sewage
6	2	Sewage	36	1	Sewage
7	1	Sewage	37	1	Sewage
8	3	Sewage	38	2	Sewage
9	2	Sewage	39	1	Sewage
10	2	Sewage	40	1	Sewage
11	1	Sewage	41	2	Sewage
12	1	Sewage	42	2	Sewage
13	1	Sewage	43	2	Sewage
14	1	Sewage	44	1	Sewage
15	1	Sewage	45	1	Sewage
16	1	Sewage	46	1	Sewage
17	1	Sewage	47	1	Sewage
18	1	Sewage	48	1	Sewage
19	1	Sewage	49	1	Sewage
20	1	Sewage	50	1	Sewage
21	0		51	2	Sewage
22	1	Sewage	52	2	Sewage
23	2	Bushland	53	1	Sewage
24	2	Sewage	54	1	Sewage
25	0		55	2	Sewage
26	1	Sewage	56	1	Sewage
27	2	Sewage	57	1	Sewage
28	1	Sewage	58	1	Sewage
29	1	Sewage	59	2	Sewage
30	1	Sewage	60	1	Sewage

Date:	27/11/2013	Assessor:	Jesse Shepherd
Location:	Geraldton WWTP	**Start time:**	0539 Hrs
Latitude:	28°42' 2.99"S	**End time:**	0549 Hrs
Longitude:	114°36' 55"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	0		31	0	
2	0		32	0	
3	0		33	0	
4	1	Sewage	34	1	Sewage
5	0		35	1	Sewage
6	0		36	1	Sewage
7	0		37	1	Sewage
8	0		38	2	Sewage
9	1	Sewage	39	1	Sewage
10	1	Sewage	40	1	Sewage
11	1	Sewage	41	1	Bushland
12	1	Sewage	42	1	Sewage
13	0		43	1	Sewage
14	0		44	0	
15	1	Sewage	45	0	
16	1	Sewage	46	0	
17	0		47	1	Flowers
18	1	Sewage	48	0	
19	2	Bushland	49	0	
20	0		50	1	Sewage
21	0		51	1	Sewage
22	1	Sewage	52	1	Sewage
23	1	Sewage	53	1	Sewage
24	1	Sewage	54	1	Sewage
25	1	Sewage	55	0	
26	1	Sewage	56	0	
27	1	Sewage	57	1	Sewage
28	1	Sewage	58	1	Sewage
29	1	Sewage	59	0	
30	1	Sewage	60	1	Sewage

Date:	27/11/2013	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	0539 Hrs
Latitude:	28°42' 3.99"S	**End time:**	0549 Hrs
Longitude:	114°36' 55"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	2	Sewage	31	0	
2	1	Sewage	32	0	
3	0		33	0	
4	1	Sewage	34	0	
5	0		35	1	Sewage
6	1	Sewage	36	0	
7	1	Sewage	37	0	
8	0		38	0	
9	1	Sewage	39	0	
10	0		40	1	Sewage
11	0		41	0	
12	0		42	0	
13	0		43	0	
14	1	Bushland	44	1	Sewage
15	0		45	0	
16	0		46	0	
17	0		47	0	
18	0		48	1	Bushland
19	0		49	1	Bushland
20	0		50	0	
21	0		51	1	Swamp
22	0		52	0	
23	0		53	0	
24	0		54	0	
25	0		55	0	
26	0		56	0	
27	1	Sewage	57	0	
28	0		58	0	
29	0		59	0	
30	0		60	0	

Date:	27/11/2013	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	0610 Hrs
Latitude:	28°41' 57.99"S	**End time:**	0620 Hrs
Longitude:	114°36' 55"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	1	Sewage	31	0	
2	0		32	0	0
3	1	Sewage	33	0	0
4	2	Sewage	34	0	0
5	1	Sewage	35	0	0
6	1	Sewage	36	0	0
7	2	Sewage	37	0	0
8	1	Sewage	38	0	0
9	1	Sewage	39	0	0
10	1	Sewage	40	0	0
11	1	Sewage	41	0	0
12	0		42	0	0
13	0		43	0	0
14	1	Sewage	44	0	0
15	1	Sewage	45	0	0
16	0		46	0	0
17	0		47	0	0
18	0		48	0	0
19	0		49	0	0
20	0		50	0	0
21	0		51	0	0
22	0		52	0	0
23	0		53	0	0
24	0		54	0	0
25	0		55	0	0
26	0		56	0	0
27	1	Sewage	57	0	0
28	0		58	0	0
29	1	Sewage	59	0	0
30	1	Sewage	60	0	0

Date:	27/11/2013	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	0635 Hrs
Latitude:	28°42' 3.99"S	**End time:**	0645 Hrs
Longitude:	114°37' 0.99"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	2	Sewage	31	1	Sewage
2	2	Sewage	32	3	Sewage
3	3	Sewage	33	2	Sewage
4	2	Sewage	34	2	Sewage
5	4	Sewage	35	3	Sewage
6	3	Sewage	36	2	Swamp
7	3	Sewage	37	1	Sewage
8	3	Sewage	38	1	Sewage
9	3	Sewage	39	1	Sewage
10	2	Sewage	40	1	Sewage
11	2	Sewage	41	3	Sewage
12	3	Swamp	42	2	Swamp
13	2	Swamp	43	2	Swamp
14	1	Swamp	44	3	Swamp
15	1	Swamp	45	3	Sewage
16	1	Swamp	46	2	Swamp
17	2	Swamp	47	2	Swamp
18	3	Sewage	48	1	Sewage
19	1	Sewage	49	1	Sewage
20	3	Sewage	50	3	Sewage
21	2	Sewage	51	1	Sewage
22	2	Sewage	52	1	Sewage
23	2	Sewage	53	2	Sewage
24	2	Sewage	54	0	
25	1	Sewage	55	1	Sewage
26	2	Sewage	56	1	Sewage
27	1	Sewage	57	1	Sewage
28	3	Sewage	58	0	
29	3	Sewage	59	1	Sewage
30	1	Sewage	60	0	

Date:	27/11/2013		Assessor:	Jesse Shepherd	
Location:	Geraldton WWTP		**Start time:**	0635 Hrs	
Latitude:	28°42' 2.99"S		**End time:**	0645 Hrs	
Longitude:	114°37' 1.99"E				
Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	2	Sewage	31	2	Sewage
2	2	Sewage	32	2	Sewage
3	1	Sewage	33	1	Sewage
4	1	Sewage	34	1	Sewage
5	1	Sewage	35	2	Sewage
6	0		36	2	Swamp
7	0		37	1	Sewage
8	0		38	1	Sewage
9	0		39	0	
10	0		40	1	Sewage
11	1	Sewage	41	0	
12	2	Sewage	42	1	Swamp
13	1	Sewage	43	1	Swamp
14	2	Sewage	44	0	
15	2	Sewage	45	2	Sewage
16	2	Sewage	46	1	Swamp
17	2	Sewage	47	1	Swamp
18	2	Sewage	48	1	Sewage
19	2	Sewage	49	0	
20	1	Sewage	50	2	Sewage
21	1	Sewage	51	1	Sewage
22	2	Sewage	52	2	Sewage
23	1	Sewage	53	1	Sewage
24	0		54	1	Sewage
25	1	Sewage	55	1	Sewage
26	2	Sewage	56	2	Sewage
27	1	Sewage	57	1	Sewage
28	2	Sewage	58	1	Sewage
29	1	Sewage	59	1	Sewage
30	3	Sewage	60	0	

Date:	27/11/2013	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	0700 Hrs
Latitude:	28°41' 59.99"S	**End time:**	0710 Hrs
Longitude:	114°37' 1.99"E		

Observation	Intensity	Character	Observation	Intensity	Character
1	1	Bushland	31	1	Bushland
2	0		32	0	
3	1	Sewage	33	0	
4	2	Sewage	34	0	
5	0		35	0	
6	1		36	1	Swamp
7	0		37	0	
8	1	Sewage	38	1	Swamp
9	0		39	0	
10	0		40	0	
11	1	Swamp	41	0	
12	0		42	1	Bushland
13	0		43	0	
14	1	Bushland	44	0	
15	0		45	0	
16	0		46	0	
17	0		47	0	
18	0		48	0	
19	0		49	1	Swamp
20	0		50	0	
21	1	Bushland	51	0	
22	1	Bushland	52	0	
23	1	Bushland	53	0	
24	0		54	0	
25	1	Swamp	55	0	
26	0		56	0	
27	0		57	0	
28	0		58	0	
29	1	Swamp	59	0	
30	0		60	0	

Date:	27/11/2013	Assessor:	Jesse Shepherd
Location:	Geraldton WWTP	**Start time:**	0700 Hrs
Latitude:	28°41' 58.99"S	**End time:**	0710 Hrs
Longitude:	114°37' 4"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	1	Bushland	31	0	
2	1	Swamp	32	0	
3	1	Bushland	33	0	
4	1	Bushland	34	1	Swamp
5	0		35	1	Swamp
6	1	Sewage	36	0	
7	2	Sewage	37	0	
8	2	Sewage	38	0	Swamp
9	0		39	0	
10	1	Bushland	40	1	Bushland
11	1	Bushland	41	0	
12	0		42	1	Bushland
13	0		43	0	
14	1	Swamp	44	0	
15	1	Swamp	45	0	
16	1	Flowers	46	0	
17	1	Flowers	47	1	Bushland
18	1	Flowers	48	0	
19	1	Flowers	49	1	Bushland
20	1	Flowers	50	1	Bushland
21	2	Sewage	51	0	
22	1	Sewage	52	1	Bushland
23	0		53	1	Swamp
24	0		54	0	
25	0		55	0	
26	1	Sewage	56	1	Bushland
27	1	Sewage	57	1	Bushland
28	2	Swamp	58	0	
29	1	Swamp	59	1	Bushland
30	1	Swamp	60	1	Bushland

Date:	27/11/2013	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	1055 Hrs
Latitude:	28°41' 58.21"S	**End time:**	1105 Hrs
Longitude:	114°37' 0.55"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	0		31	0	
2	0		32	1	Bushland
3	0		33	1	Bushland
4	1	Bushland	34	0	
5	0		35	2	Bushland
6	0		36	1	Bushland
7	1	Sewage	37	1	Bushland
8	1	Bushland	38	1	Bushland
9	1	Bushland	39	1	Bushland
10	0		40	1	Bushland
11	0		41	1	Bushland
12	1	Bushland	42	0	
13	1	Bushland	43	1	Bushland
14	1	Bushland	44	1	Bushland
15	0		45	1	Bushland
16	0		46	1	Bushland
17	0		47	0	
18	0		48	0	
19	2	Bushland	49	0	
20	1	Bushland	50	0	
21	0		51	1	Bushland
22	0		52	1	Bushland
23	0		53	1	Bushland
24	0		54	1	Bushland
25	1	Sewage	55	0	
26	1	Bushland	56	1	Bushland
27	1	Bushland	57	0	
28	1	Bushland	58	1	Bushland
29	0		59	1	Bushland
30	0		60	0	

Date:	27/11/2013		Assessor:	Jesse Shepherd	
Location:	Geraldton WWTP		**Start time:**	1055 Hrs	
Latitude:	28°41' 57.37"S		**End time:**	1105 Hrs	
Longitude:	114°37' 0.83"E				
Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	0		31	0	
2	1		32	1	Bushland
3	1		33	1	Bushland
4	1	Bushland	34	1	
5	0		35	2	Swamp
6	1		36	1	Bushland
7	0		37	0	
8	1	Bushland	38	0	
9	1	Bushland	39	0	
10	1		40	0	
11	1		41	0	
12	1	Bushland	42	1	
13	1	Bushland	43	1	Bushland
14	0		44	0	
15	0		45	0	
16	1		46	1	Bushland
17	0		47	1	
18	1		48	1	
19	2	Bushland	49	0	
20	1	Bushland	50	0	
21	0		51	0	
22	0		52	0	
23	1		53	1	Bushland
24	1		54	1	Bushland
25	0		55	0	
26	0		56	0	
27	1	Flowers	57	1	
28	1	Bushland	58	1	Bushland
29	1		59	1	Bushland
30	1		60	0	

Date:	27/11/2013	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	1117 Hrs
Latitude:	28°41' 55.73"S	**End time:**	1127 Hrs
Longitude:	114°37' 1.82"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	0		31	0	
2	0		32	1	Bushland
3	0		33	1	Bushland
4	1	Bushland	34	0	
5	1	Bushland	35	1	Bushland
6	0		36	1	Bushland
7	1	Bushland	37	1	Bushland
8	1	Bushland	38	1	Bushland
9	0		39	1	Bushland
10	0		40	0	
11	0		41	0	
12	0		42	0	
13	0		43	0	
14	1	Bushland	44	1	Bushland
15	1	Bushland	45	0	
16	1	Bushland	46	1	Bushland
17	0		47	1	Bushland
18	1	Bushland	48	1	Bushland
19	1	Bushland	49	0	
20	1	Bushland	50	1	Bushland
21	1	Bushland	51	0	
22	1	Bushland	52	2	Bushland
23	0		53	1	Bushland
24	1	Bushland	54	0	
25	1	Bushland	55	1	Bushland
26	1	Bushland	56	1	Bushland
27	2	Bushland	57	1	Bushland
28	1	Bushland	58	0	
29	0		59	1	Bushland
30	1	Bushland	60	0	

Date:	27/11/2013	Assessor:	Jesse Shepherd
Location:	Geraldton WWTP	**Start time:**	1117 Hrs
Latitude:	28°41' 53.67"S	**End time:**	1127 Hrs
Longitude:	114°37' 2.9"E		

Observation	Intensity	Character	Observation	Intensity	Character
1	0		31	0	
2	1	Bushland	32	0	
3	0		33	1	Swamp
4	1	Flowers	34	1	Swamp
5	1	Flowers	35	1	Swamp
6	1	Flowers	36	1	Swamp
7	1	Flowers	37	0	
8	0		38	0	
9	1	Flowers	39	1	Swamp
10	1	Flowers	40	0	
11	0		41	1	Swamp
12	1	Flowers	42	0	
13	0		43	0	
14	1	Flowers	44	1	Swamp
15	1	Flowers	45	1	Swamp
16	1	Flowers	46	1	Swamp
17	1	Flowers	47	0	
18	0		48	2	Bushland
19	0		49	1	Bushland
20	0		50	1	Bushland
21	1	Flowers	51	0	
22	2	Swamp	52	0	
23	1	Swamp	53	0	
24	1	Swamp	54	1	Bushland
25	1	Swamp	55	1	Bushland
26	0		56	1	Bushland
27	0		57	1	Bushland
28	0		58	0	
29	1	Swamp	59	1	Bushland
30	0		60	1	Bushland

Date:	27/11/2013	Assessor:	Jesse Shepherd
Location:	Geraldton WWTP	**Start time:**	1144 Hrs
Latitude:	28°41' 58.83"S	**End time:**	1154 Hrs
Longitude:	114°37' 2.57"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	0		31	0	
2	0		32	0	
3	1	Bushland	33	1	Swamp
4	1	Bushland	34	1	Swamp
5	1	Bushland	35	1	Swamp
6	0		36	1	Swamp
7	1	Bushland	37	2	Swamp
8	0		38	1	Bushland
9	0		39	1	Bushland
10	0		40	1	Bushland
11	0		41	1	Bushland
12	1	Bushland	42	1	Bushland
13	1	Bushland	43	2	Bushland
14	0		44	1	Bushland
15	1	Bushland	45	1	Bushland
16	2	Swamp	46	0	
17	1	Swamp	47	0	
18	1	Swamp	48	0	
19	1	Swamp	49	1	Bushland
20	1	Swamp	50	0	
21	0		51	0	
22	0		52	1	Bushland
23	0		53	1	Bushland
24	0		54	1	Bushland
25	1	Swamp	55	0	
26	1	Swamp	56	0	
27	1	Swamp	57	0	
28	1	Swamp	58	1	Bushland
29	1	Swamp	59	1	Bushland
30	1	Swamp	60	1	Bushland

Date:	27/11/2013		Assessor:	Danielle White	
Location:	Geraldton WWTP		**Start time:**	1144 Hrs	
Latitude:	28°41' 59.98"S		**End time:**	1154 Hrs	
Longitude:	114°37' 1.43"E				
Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	1	Sewage	31	0	
2	1	Bushland	32	1	Bushland
3	0		33	0	
4	1	Bushland	34	1	Bushland
5	0		35	1	Bushland
6	1	Bushland	36	1	Sewage
7	0		37	1	Bushland
8	0		38	1	Bushland
9	1	Bushland	39	1	Bushland
10	1	Bushland	40	1	Bushland
11	1	Bushland	41	0	
12	0		42	0	
13	1	Bushland	43	1	Bushland
14	2	Sewage	44	0	
15	0		45	1	Sewage
16	0		46	1	Bushland
17	1	Bushland	47	0	
18	1	Bushland	48	1	Bushland
19	1	Bushland	49	0	
20	1	Bushland	50	1	Sewage
21	1	Bushland	51	1	Bushland
22	1	Bushland	52	0	
23	1	Bushland	53	1	Bushland
24	0		54	1	Bushland
25	1	Bushland	55	1	Sewage
26	1	Bushland	56	0	
27	1	Bushland	57	1	Bushland
28	0		58	0	
29	1	Bushland	59	1	Sewage
30	0		60	0	

Date:	27/11/2013	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	1209 Hrs
Latitude:	28°41' 58.58"S	**End time:**	1219 Hrs
Longitude:	114°37' 3.38"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	0		31	0	
2	1	Bushland	32	1	Bushland
3	0		33	1	Bushland
4	0		34	1	Bushland
5	1	Bushland	35	0	
6	0		36	1	Bushland
7	1	Bushland	37	0	
8	0		38	0	
9	1	Bushland	39	0	
10	0		40	0	
11	0		41	1	Bushland
12	0		42	0	
13	0		43	1	Bushland
14	0		44	0	
15	0		45	0	
16	1	Bushland	46	0	
17	1	Bushland	47	1	Bushland
18	1	Bushland	48	1	Bushland
19	0		49	0	
20	1	Bushland	50	1	Bushland
21	0		51	0	
22	1	Bushland	52	1	Bushland
23	1	Bushland	53	0	
24	1	Bushland	54	1	Bushland
25	0		55	1	Bushland
26	0		56	1	Bushland
27	0		57	0	
28	1	Bushland	58	1	Bushland
29	0		59	0	
30	1	Bushland	60	1	Bushland

Date:	27/11/2013	Assessor:	Jesse Shepherd
Location:	Geraldton WWTP	**Start time:**	1209 Hrs
Latitude:	28°41' 58.3"S	**End time:**	1219 Hrs
Longitude:	114°37' 4.16"E		

Observation	Intensity	Character	Observation	Intensity	Character
1	0		31	0	
2	0		32	0	
3	0		33	1	Bushland
4	0		34	1	Flowers
5	1	Bushland	35	1	Flowers
6	1	Bushland	36	1	Flowers
7	1	Flowers	37	0	
8	1	Flowers	38	0	
9	1	Flowers	39	1	Flowers
10	1	Flowers	40	1	Flowers
11	2	Bushland	41	0	
12	0		42	1	Sea
13	0		43	1	Sea
14	0		44	1	Sea
15	0		45	1	Sea
16	0		46	0	
17	1	Bushland	47	0	
18	1	Bushland	48	0	
19	0		49	0	
20	1	Bushland	50	2	Seaweed
21	0		51	0	
22	0		52	0	
23	1	Bushland	53	1	Seaweed
24	1	Bushland	54	1	Seaweed
25	1	Bushland	55	0	
26	0		56	1	Bushland
27	0		57	1	Bushland
28	1	Bushland	58	1	Bushland
29	1	Bushland	59	1	Bushland
30	1	Bushland	60	1	Flowers

Date:	27/11/2013	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	1231 Hrs
Latitude:	28°41' 57.67"S	**End time:**	1241 Hrs
Longitude:	114°37' 5.02"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	0		31	0	
2	0		32	0	
3	1	Bushland	33	1	Bushland
4	1	Bushland	34	0	
5	0		35	1	Bushland
6	0		36	1	Bushland
7	1	Bushland	37	1	Bushland
8	0		38	1	Bushland
9	0		39	0	
10	0		40	0	
11	0		41	0	
12	1	Bushland	42	0	
13	1	Bushland	43	0	
14	1	Bushland	44	0	
15	1	Bushland	45	1	Bushland
16	0		46	1	Bushland
17	1	Bushland	47	1	Bushland
18	0		48	1	Bushland
19	1		49	1	Bushland
20	1	Bushland	50	1	Bushland
21	0		51	1	Flowers
22	0		52	1	Bushland
23	1	Bushland	53	0	
24	1	Bushland	54	1	Bushland
25	1	Bushland	55	0	
26	0		56	1	Bushland
27	0		57	1	Bushland
28	0		58	1	Bushland
29	1	Bushland	59	0	
30	1	Bushland	60	1	Bushland

Date:	27/11/2013	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	1304 Hrs
Latitude:	28°42' 2.19"S	**End time:**	1314 Hrs
Longitude:	114°37' 3.81"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	1	Sewage	31	0	
2	0		32	0	
3	0		33	1	Bushland
4	1	Bushland	34	1	Bushland
5	0		35	0	
6	2	Sewage	36	1	Bushland
7	1	Bushland	37	1	Bushland
8	1	Bushland	38	1	Bushland
9	1	Bushland	39	2	Sewage
10	0		40	1	Bushland
11	1	Bushland	41	0	
12	2	Sewage	42	1	Bushland
13	0		43	1	Sewage
14	0		44	0	
15	0		45	0	
16	1	Bushland	46	0	
17	1	Bushland	47	1	Bushland
18	1	Bushland	48	1	Bushland
19	0		49	1	Bushland
20	0		50	1	Bushland
21	1	Bushland	51	2	Sewage
22	0		52	1	Bushland
23	0		53	0	
24	1	Sewage	54	1	Bushland
25	0		55	1	Bushland
26	0		56	0	
27	1	Bushland	57	1	Bushland
28	1	Bushland	58	1	Bushland
29	0		59	1	Bushland
30	1	Bushland	60	1	Bushland

Date:	27/11/2013	Assessor:	Jesse Shepherd
Location:	Geraldton WWTP	**Start time:**	1304 Hrs
Latitude:	28°42' 1.14"S	**End time:**	1314 Hrs
Longitude:	114°37' 4.72"E		

Observation	Intensity	Character	Observation	Intensity	Character
1	0		31	0	
2	0		32	1	Bushland
3	0		33	0	
4	1	Bushland	34	1	Bushland
5	1	Bushland	35	1	Bushland
6	0		36	1	Bushland
7	1	Bushland	37	1	Bushland
8	0		38	0	
9	0		39	1	Bushland
10	1	Bushland	40	0	
11	0		41	0	
12	1	Bushland	42	0	
13	1	Bushland	43	1	Bushland
14	1	Bushland	44	1	Bushland
15	0		45	1	Bushland
16	1	Swamp	46	0	
17	2	Swamp	47	0	
18	1	Swamp	48	0	
19	0		49	1	Bushland
20	0		50	1	Bushland
21	1	Swamp	51	1	Bushland
22	0		52	1	Bushland
23	0		53	0	
24	1	Swamp	54	1	Bushland
25	0		55	1	Bushland
26	1	Swamp	56	0	
27	1	Swamp	57	1	Bushland
28	1	Swamp	58	1	Bushland
29	0		59	0	
30	1	Swamp	60	1	Bushland

Date:	27/11/2013	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	1327 Hrs
Latitude:	28°42' 0.09"S	**End time:**	1337 Hrs
Longitude:	114°37' 6"E		

Observation	Intensity	Character	Observation	Intensity	Character
1	0		31	1	Bushland
2	1	Bushland	32	0	
3	1	Bushland	33	1	Bushland
4	1	Bushland	34	1	Bushland
5	0		35	1	Bushland
6	1	Other	36	0	
7	1	Bushland	37	1	Bushland
8	1	Bushland	38	1	Bushland
9	0		39	1	Bushland
10	1	Bushland	40	1	Bushland
11	1	Bushland	41	0	
12	0		42	1	Bushland
13	0		43	1	Bushland
14	0		44	1	Bushland
15	1	Bushland	45	0	
16	1	Bushland	46	1	Bushland
17	0		47	1	Bushland
18	1	Bushland	48	0	
19	0		49	0	
20	1	Bushland	50	0	
21	1	Bushland	51	1	Bushland
22	1	Bushland	52	0	
23	1	Bushland	53	1	Bushland
24	0		54	1	Bushland
25	1	Bushland	55	1	Bushland
26	1	Bushland	56	0	
27	1	Bushland	57	0	
28	0		58	0	
29	1	Bushland	59	0	
30	0		60	0	

Date:	27/11/2013	Assessor:	Jesse Shepherd
Location:	Geraldton WWTP	**Start time:**	1327 Hrs
Latitude:	28°41' 59.1"S	**End time:**	1337 Hrs
Longitude:	114°37' 7.31"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	0		31	0	
2	0		32	0	
3	1	Bushland	33	1	Flowers
4	1	Bushland	34	1	Flowers
5	1	Bushland	35	2	Bushland
6	1	Bushland	36	1	Bushland
7	0		37	0	
8	1	Bushland	38	1	Bushland
9	0		39	2	Flowers
10	1	Bushland	40	1	Flowers
11	2	Flowers	41	1	Flowers
12	0		42	1	Flowers
13	0		43	0	
14	1	Flowers	44	1	Flowers
15	2	Flowers	45	1	Flowers
16	0		46	1	Flowers
17	0		47	0	
18	0		48	1	Flowers
19	1	Flowers	49	1	Flowers
20	1	Flowers	50	0	
21	1	Flowers	51	0	
22	2	Flowers	52	0	
23	0		53	1	Flowers
24	0		54	1	Flowers
25	1	Flowers	55	1	Flowers
26	1	Flowers	56	0	
27	1	Flowers	57	1	Flowers
28	0		58	2	Flowers
29	1	Flowers	59	1	Flowers
30	1	Flowers	60	0	

Date:	27/11/2013	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	1402 Hrs
Latitude:	28°42' 4.46"S	**End time:**	1412 Hrs
Longitude:	114°37' 5.16"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	2	Sewage	31	0	
2	1	Bushland	32	1	Sewage
3	1	Bushland	33	1	
4	1	Bushland	34	1	
5	0		35	0	
6	1	Bushland	36	0	
7	0		37	1	
8	2	Sewage	38	2	Sewage
9	0		39	1	
10	0		40	1	Sewage
11	1	Bushland	41	1	Bushland
12	2	Sewage	42	1	Bushland
13	1	Bushland	43	1	Bushland
14	0		44	1	Bushland
15	0		45	0	
16	0		46	1	Bushland
17	1	Sewage	47	0	
18	1	Bushland	48	0	
19	1	Bushland	49	1	Bushland
20	1	Bushland	50	2	Sewage
21	1	Bushland	51	1	Bushland
22	0		52	1	Bushland
23	0		53	0	
24	0		54	1	Bushland
25	1	Bushland	55	1	Bushland
26	1	Bushland	56	1	Bushland
27	0		57	1	Sewage
28	0		58	1	Bushland
29	0		59	0	
30	1	Bushland	60	0	

Date:	27/11/2013	Assessor:	Jesse Shepherd
Location:	Geraldton WWTP	**Start time:**	1402 Hrs
Latitude:	28°42' 3.83"S	**End time:**	1412 Hrs
Longitude:	114°37' 6.28"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	0		31	0	
2	0		32	1	Flowers
3	0		33	0	
4	1	Bushland	34	0	
5	1	Bushland	35	1	Flowers
6	1	Bushland	36	1	Flowers
7	1	Bushland	37	0	
8	0		38	0	
9	2	Swamp	39	0	
10	0		40	1	Flowers
11	1	Swamp	41	0	
12	1	Swamp	42	2	Swamp
13	1	Bushland	43	1	Swamp
14	0		44	1	Swamp
15	0		45	1	Swamp
16	0		46	0	
17	1	Sewage	47	0	
18	1	Flowers	48	0	
19	1	Flowers	49	1	Swamp
20	0		50	0	
21	1	Flowers	51	1	Swamp
22	1	Flowers	52	2	Swamp
23	0		53	0	
24	0		54	1	Swamp
25	0		55	1	Swamp
26	1	Flowers	56	1	Swamp
27	1	Flowers	57	2	Swamp
28	0		58	0	
29	0		59	0	
30	1	Flowers	60	1	Swamp

Date:	27/11/2013	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	1423 Hrs
Latitude:	28°42' 1.95"S	**End time:**	1433 Hrs
Longitude:	114°37' 8.24"E		

Observation	Intensity	Character	Observation	Intensity	Character
1	0		31	1	Bushland
2	0		32	0	
3	1	Bushland	33	1	Bushland
4	1	Bushland	34	0	
5	1	Bushland	35	1	Bushland
6	1	Bushland	36	1	Bushland
7	1	Bushland	37	0	
8	0		38	1	Bushland
9	1	Bushland	39	0	
10	1	Bushland	40	1	Bushland
11	0		41	0	
12	1	Bushland	42	0	
13	0		43	0	
14	1	Bushland	44	0	
15	1	Bushland	45	1	Bushland
16	0		46	1	Bushland
17	1	Bushland	47	0	
18	0		48	0	
19	0		49	0	
20	1	Bushland	50	1	Bushland
21	0		51	1	Bushland
22	1	Bushland	52	1	Bushland
23	0		53	1	Bushland
24	0		54	1	Bushland
25	0		55	1	Bushland
26	0		56	1	Bushland
27	1	Bushland	57	1	Bushland
28	1	Bushland	58	0	
29	1	Bushland	59	0	
30	1	Bushland	60	1	Bushland

Date:	27/11/2013		Assessor:	Jesse Shepherd	
Location:	Geraldton WWTP		**Start time:**	1423 Hrs	
Latitude:	28°42' 1.25"S		**End time:**	1433 Hrs	
Longitude:	114°37' 9.47"E				
Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	0		31	0	
2	0		32	0	
3	1	Flowers	33	1	Bushland
4	1	Flowers	34	1	
5	0		35	1	Bushland
6	0		36	0	
7	1	Flowers	37	0	
8	1	Flowers	38	1	Bushland
9	1	Flowers	39	1	
10	0		40	0	
11	0		41	1	
12	1	Flowers	42	0	
13	1	Flowers	43	2	
14	1	Flowers	44	2	
15	2	Flowers	45	1	Bushland
16	0		46	1	Bushland
17	0		47	1	
18	1	Flowers	48	0	
19	1	Flowers	49	0	
20	2	Bushland	50	1	Bushland
21	0		51	1	Bushland
22	1	Bushland	52	0	
23	1		53	1	Bushland
24	1		54	0	
25	0		55	0	
26	0		56	1	Bushland
27	1	Bushland	57	1	Bushland
28	1	Bushland	58	1	
29	0		59	1	
30	1	Bushland	60	0	

Date:	29/1/2014	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	12:03
Latitude:	28°42'12.67"S	**End time:**	12:13
Longitude:	114°36'58.83"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	0		31	0	
2	0		32	0	
3	0		33	0	
4	0		34	0	
5	0		35	0	
6	0		36	0	
7	0		37	0	
8	1	Sea air	38	1	Sea air
9	1	Sea air	39	0	
10	0		40	0	
11	0		41	0	
12	0		42	0	
13	0		43	0	
14	0		44	0	
15	0		45	0	
16	0		46	0	
17	0		47	0	
18	0		48	0	
19	0		49	0	
20	0		50	0	
21	0		51	0	
22	0		52	0	
23	0		53	0	
24	0		54	0	
25	0		55	0	
26	0		56	0	
27	0		57	0	
28	0		58	0	
29	0		59	0	
30	0		60	0	

Date:	29/1/2014	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	12:04
Latitude:	28°42'12.5"S	**End time:**	12:14
Longitude:	114°36'58.4"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	1	Seaweed	31	0	
2	0		32	1	Sewage
3	0		33	0	
4	0		34	0	
5	0		35	0	
6	0		36	1	Sewage
7	0		37	0	
8	0		38	0	
9	0		39	0	
10	0		40	1	Seaweed
11	0		41	0	
12	0		42	0	
13	0		43	0	
14	1	Seaweed	44	0	
15	1	Seaweed	45	0	
16	0		46	1	F
17	0		47	0	
18	0		48	0	
19	0		49	0	
20	0		50	1	Seaweed
21	1	Sewage	51	2	Sewage
22	0		52	1	A
23	0		53	0	
24	0		54	2	F
25	0		55	1	F
26	0		56	1	F
27	0		57	0	
28	0		58	2	F
29	1	F	59	1	F
30	0		60	1	F

Date:	29/1/2014	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	12:17
Latitude:	28°42'12.3"S	**End time:**	12:27
Longitude:	114°37'0.0"E		

Observation	Intensity	Character	Observation	Intensity	Character
1	0		31	0	
2	0		32	0	
3	0		33	0	
4	0		34	0	
5	1	Seaweed	35	0	
6	1	Seaweed	36	0	
7	0		37	0	
8	1	Seaweed	38	0	
9	1	Seaweed	39	0	
10	0		40	0	
11	0		41	0	
12	0		42	0	
13	0		43	1	Seaweed
14	0		44	0	
15	1	Seaweed	45	0	
16	0		46	0	
17	0		47	0	
18	0		48	0	
19	0		49	0	
20	0		50	0	
21	0		51	0	
22	0		52	0	
23	0		53	0	
24	0		54	0	
25	0		55	0	
26	0		56	0	
27	0		57	0	
28	0		58	0	
29	0		59	0	
30	0		60	0	

Date:	29/1/2014	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	12:18
Latitude:	28°42'11.9"S	**End time:**	12:28
Longitude:	114°37'0.2"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	1	Sewage	31	1	Seaweed
2	1	Sewage	32	1	Seaweed
3	0		33	0	
4	0		34	0	
5	1	Seaweed	35	0	
6	0		36	0	
7	0		37	0	
8	0		38	1	Seaweed
9	1	Seaweed	39	0	
10	1	Sewage	40	0	
11	0		41	0	
12	0		42	0	
13	0		43	0	
14	0		44	1	Seaweed
15	0		45	0	
16	0		46	0	
17	0		47	0	
18	0		48	0	
19	0		49	1	Sewage
20	0		50	2	Seaweed
21	0		51	1	Seaweed
22	0		52	0	
23	0		53	0	
24	1	A	54	0	
25	0		55	0	
26	0		56	0	
27	0		57	0	
28	0		58	0	
29	0		59	0	
30	0		60	0	

Date:	29/1/2014	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	12:32
Latitude:	28°42'11.7"S	**End time:**	12:42
Longitude:	114°37'1.8'E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	0		31	0	
2	0		32	0	
3	1	Seaweed	33	0	
4	0		34	0	
5	0		35	0	
6	0		36	0	
7	0		37	1	Seaweed
8	0		38	0	
9	0		39	0	
10	1	Seaweed	40	0	
11	1	Sewage	41	0	
12	0		42	0	
13	0		43	0	
14	1	Sewage	44	0	
15	0		45	1	Sewage
16	0		46	0	
17	0		47	0	
18	1	Sewage	48	0	
19	0		49	0	
20	0		50	0	
21	0		51	0	
22	0		52	0	
23	0		53	0	
24	0		54	0	
25	0		55	0	
26	0		56	0	
27	1	Sewage	57	0	
28	0		58	0	
29	0		59	0	
30	1	Sewage	60	0	

Date:	29/1/2014	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	12:33
Latitude:	28°42'11.7"S	**End time:**	12:43
Longitude:	114°37'2.1'E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	0		31	0	
2	0		32	0	
3	0		33	0	
4	0		34	0	
5	0		35	0	
6	0		36	0	
7	1	Seaweed	37	0	
8	1	Sewage	38	0	
9	1	Sewage	39	0	
10	0		40	1	Seaweed
11	0		41	1	Seaweed
12	0		42	0	
13	0		43	0	
14	0		44	0	
15	0		45	1	Seaweed
16	0		46	0	
17	0		47	0	
18	0		48	0	
19	0		49	0	
20	0		50	1	Seaweed
21	0		51	0	
22	0		52	0	
23	0		53	0	
24	0		54	0	
25	0		55	1	Sewage
26	0		56	0	
27	0		57	0	
28	0		58	0	
29	1	Sewage	59	0	
30	1	Sewage	60	1	Sewage

Date:	29/1/2014	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	12:46
Latitude:	28°42'11.4"S	**End time:**	12:46
Longitude:	114°37'2.8'E		

Observation	Intensity	Character	Observation	Intensity	Character
1	0		31	0	
2	0		32	0	
3	0		33	0	
4	0		34	0	
5	1	Sewage	35	0	
6	0		36	0	
7	0		37	0	
8	0		38	0	
9	0		39	0	
10	0		40	0	
11	0		41	0	
12	0		42	0	
13	0		43	0	
14	0		44	0	
15	0		45	0	
16	0		46	0	
17	0		47	0	
18	0		48	0	
19	0		49	0	
20	0		50	0	
21	0		51	0	
22	1	Sewage	52	0	
23	0		53	0	
24	0		54	0	
25	0		55	0	
26	0		56	0	
27	0		57	0	
28	0		58	0	
29	0		59	0	
30	0		60	0	

Date:	29/1/2014	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	12:47
Latitude:	28°42'11.3"S	**End time:**	12:57
Longitude:	114°37'3.5'E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	0		31	0	
2	0		32	0	
3	0		33	0	
4	0		34	0	
5	0		35	1	Seaweed
6	1	Sewage	36	0	
7	1	Sewage	37	0	
8	0		38	0	
9	1	F	39	0	
10	0		40	0	
11	1	Seaweed	41	2	Sewage
12	0		42	1	Sewage
13	0		43	0	
14	0		44	0	
15	0		45	1	Sewage
16	0		46	0	
17	0		47	0	
18	0		48	0	
19	0		49	0	
20	0		50	0	
21	0		51	0	
22	0		52	1	Seaweed
23	0		53	1	Seaweed
24	0		54	0	
25	1	Sewage	55	0	
26	0		56	1	Seaweed
27	0		57	0	
28	0		58	2	Seaweed
29	0		59	1	Sewage
30	0		60	0	

Date:	29/1/2014	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	13:02
Latitude:	28°42'9.8"S	**End time:**	13:12
Longitude:	114°37'2.3'E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	1	Seaweed	31	0	
2	0		32	0	
3	0		33	0	
4	1	Sewage	34	0	
5	0		35	0	
6	0		36	0	
7	1	Seaweed	37	1	Sewage
8	1	Sewage	38	0	
9	1	Sewage	39	1	Sewage
10	1	Sewage	40	2	Seaweed
11	1	Seaweed	41	1	Sewage
12	1	Sewage	42	1	Sewage
13	1	Sewage	43	0	
14	1	Seaweed	44	0	
15	0		45	0	
16	2	Seaweed	46	0	
17	1	Seaweed	47	1	Sewage
18	0		48	0	
19	2	Sewage	49	0	
20	1	Sewage	50	0	
21	0		51	1	Seaweed
22	0		52	0	
23	0		53	0	
24	0		54	0	
25	0		55	0	
26	0		56	0	
27	0		57	0	
28	0		58	1	Seaweed
29	0		59	0	
30	2	Seaweed	60	1	Seaweed

Date:	29/1/2014	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	13:02
Latitude:	28°42'9.2"S	**End time:**	13:12
Longitude:	114°37'3.0'E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	1	Seaweed	31	1	Sewage
2	0		32	1	Sewage
3	0		33	0	
4	1	Sewage	34	0	
5	1	Sewage	35	0	
6	0		36	0	
7	0		37	0	
8	0		38	0	
9	0		39	0	
10	0		40	1	Sewage
11	0		41	0	
12	0		42	0	
13	0		43	0	
14	0		44	0	
15	0		45	0	
16	1	Sewage	46	0	
17	0		47	0	
18	0		48	0	
19	0		49	0	
20	0		50	0	
21	0		51	0	
22	0		52	0	
23	0		53	0	
24	0		54	0	
25	0		55	1	Sewage
26	1	Seaweed	56	0	
27	0		57	0	
28	0		58	0	
29	0		59	0	
30	0		60	0	

Date:	29/1/2014	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	13:16
Latitude:	28°42'10.2"S	**End time:**	13:26
Longitude:	114°36'59.2'E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	1	Seaweed	31	1	Sewage
2	0		32	1	Sewage
3	0		33	0	
4	1	Sewage	34	0	
5	1	Sewage	35	0	
6	0		36	0	
7	0		37	0	
8	0		38	0	
9	0		39	0	
10	0		40	1	Sewage
11	0		41	0	
12	0		42	0	
13	0		43	0	
14	0		44	0	
15	0		45	0	
16	1	Sewage	46	0	
17	0		47	0	
18	0		48	0	
19	0		49	0	
20	0		50	0	
21	0		51	0	
22	0		52	0	
23	0		53	0	
24	0		54	0	
25	0		55	1	Sewage
26	1	Seaweed	56	0	
27	0		57	0	
28	0		58	0	
29	0		59	0	
30	0		60	0	

Date:	29/1/2014	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	13:18
Latitude:	28°42'10.5"S	**End time:**	13:28
Longitude:	114°36'58.4'E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	1	Seaweed	31	0	
2	0		32	0	
3	2	Sewage	33	0	
4	1	Seaweed	34	0	
5	0		35	0	
6	1	Seaweed	36	1	Seaweed
7	1	Sewage	37	0	
8	0		38	0	
9	1	Seaweed	39	2	Sewage
10	0		40	1	Seaweed
11	1	Sewage	41	0	
12	0		42	0	
13	1	Seaweed	43	0	
14	1	Seaweed	44	0	
15	1	Sewage	45	0	
16	1	Seaweed	46	1	Seaweed
17	2	Seaweed	47	1	Seaweed
18	0		48	1	Sewage
19	0		49	2	Sewage
20	1	Seaweed	50	1	Sewage
21	0		51	0	
22	0		52	0	
23	0		53	0	
24	0		54	0	
25	0		55	0	
26	0		56	0	
27	1	Seaweed	57	0	
28	0		58	0	
29	1	Sewage	59	0	
30	1	Sewage	60	1	Sewage

Date:	29/1/2014	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	13:33
Latitude:	28°42'6.6"S	**End time:**	13:43
Longitude:	114°36'57.9'E		

Observation	Intensity	Character	Observation	Intensity	Character
1	1	Sewage	31	3	Sewage
2	1	Sewage	32	2	Sewage
3	0		33	0	
4	1	Sewage	34	3	Sewage
5	3	Sewage	35	3	Sewage
6	2	Sewage	36	3	Sewage
7	1	Sewage	37	3	Sewage
8	3	Sewage	38	0	
9	2	Sewage	39	1	Sewage
10	3	Sewage	40	1	Sewage
11	1	Sewage	41	1	Sewage
12	2	Sewage	42	3	Sewage
13	1	Sewage	43	3	Sewage
14	2	Sewage	44	2	Sewage
15	1	Sewage	45	3	Sewage
16	1	Sewage	46	2	Sewage
17	0		47	3	Sewage
18	1	Sewage	48	3	Sewage
19	1	Sewage	49	3	Sewage
20	1	Sewage	50	3	Sewage
21	0		51	3	Sewage
22	0		52	2	Sewage
23	3	Sewage	53	3	Sewage
24	1	Sewage	54	3	Sewage
25	3	Sewage	55	2	Sewage
26	1	Sewage	56	0	
27	3	Sewage	57	0	
28	2	Sewage	58	0	
29	1	Sewage	59	2	A
30	2	Sewage	60	0	

Date:	29/1/2014	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	13:34
Latitude:	28°42'7.0"S	**End time:**	13:44
Longitude:	114°36'57.2'E		

Observation	Intensity	Character	Observation	Intensity	Character
1	1	Sewage	31	1	Sewage
2	3	Sewage	32	0	
3	3	Sewage	33	2	Sewage
4	2	Sewage	34	2	Sewage
5	1	Sewage	35	2	Sewage
6	1	Sewage	36	2	Sewage
7	2	Sewage	37	2	Sewage
8	3	Sewage	38	1	Sewage
9	1	Sewage	39	3	Sewage
10	3	Sewage	40	3	Sewage
11	2	Sewage	41	2	Sewage
12	1	Sewage	42	2	Sewage
13	2	Sewage	43	3	Sewage
14	2	Sewage	44	3	Sewage
15	2	Sewage	45	2	Sewage
16	3	Sewage	46	2	Sewage
17	2	Sewage	47	1	Sewage
18	1	Sewage	48	1	Sewage
19	1	Sewage	49	2	Sewage
20	1	Sewage	50	3	Sewage
21	1	Sewage	51	1	Sewage
22	2	Sewage	52	2	Sewage
23	3	Sewage	53	3	Sewage
24	2	Sewage	54	2	Sewage
25	1	Sewage	55	1	Sewage
26	1	Sewage	56	1	Sewage
27	2	Sewage	57	1	Sewage
28	2	Sewage	58	1	Sewage
29	2	Sewage	59	2	Sewage
30	2	Sewage	60	3	Sewage

Date:	29/1/2014	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	13:48
Latitude:	28°42'6.0"S	**End time:**	13:58
Longitude:	114°37'0.6'E		

Observation	Intensity	Character	Observation	Intensity	Character
1	1	Sewage	31	1	Sewage
2	1	Sewage	32	2	Sewage
3	1	Sewage	33	2	Sewage
4	1	Sewage	34	2	Sewage
5	2	Sewage	35	3	Sewage
6	2	Sewage	36	3	Sewage
7	2	Sewage	37	3	Sewage
8	1	Sewage	38	2	Sewage
9	1	Sewage	39	2	Sewage
10	2	Sewage	40	1	Sewage
11	2	Sewage	41	2	Sewage
12	3	Sewage	42	1	Sewage
13	3	Sewage	43	1	Sewage
14	2	Sewage	44	2	Sewage
15	3	Sewage	45	1	Sewage
16	2	Sewage	46	3	Sewage
17	2	Sewage	47	2	Sewage
18	1	Sewage	48	1	Sewage
19	1	Sewage	49	3	Sewage
20	2	Sewage	50	3	Sewage
21	2	Sewage	51	3	Sewage
22	2	Sewage	52	3	Sewage
23	2	Sewage	53	2	Sewage
24	3	Sewage	54	3	Sewage
25	3	Sewage	55	3	Sewage
26	3	Sewage	56	2	Sewage
27	2	Sewage	57	2	Sewage
28	2	Sewage	58	1	Sewage
29	2	Sewage	59	2	Sewage
30	1	Sewage	60	3	Sewage

Date:	29/1/2014	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	13:48
Latitude:	28°42'5.8"S	**End time:**	13:58
Longitude:	114°37'1.4'E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	2	Sewage	31	3	Sewage
2	0		32	2	Sewage
3	1	Sewage	33	1	Sewage
4	2	Sewage	34	1	Sewage
5	3	Sewage	35	3	Sewage
6	1	Sewage	36	3	Sewage
7	0		37	2	Sewage
8	3	Sewage	38	1	Sewage
9	1	Sewage	39	1	Sewage
10	3	Sewage	40	1	Sewage
11	3	Sewage	41	1	Sewage
12	3	Sewage	42	1	Sewage
13	1	Sewage	43	1	Sewage
14	2	Sewage	44	3	Sewage
15	2	Sewage	45	1	Sewage
16	1	Sewage	46	1	Sewage
17	1	Sewage	47	2	Sewage
18	1	Sewage	48	2	Sewage
19	1	Sewage	49	3	Sewage
20	1	Sewage	50	1	Sewage
21	1	Sewage	51	2	Sewage
22	3	Sewage	52	1	Sewage
23	1	Sewage	53	3	Sewage
24	3	Sewage	54	2	Sewage
25	1	Sewage	55	2	Sewage
26	3	Sewage	56	2	Sewage
27	1	Sewage	57	2	Sewage
28	1	Sewage	58	1	Sewage
29	1	Sewage	59	3	Sewage
30	1	Sewage	60	1	Sewage

Date:	29/1/2014	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	14:04
Latitude:	28°42'6.3"S	**End time:**	14:14
Longitude:	114°36'58.7'E		

Observation	Intensity	Character	Observation	Intensity	Character
1	3	Sewage	31	4	Sewage
2	4	Sewage	32	3	Sewage
3	4	Sewage	33	3	Sewage
4	4	Sewage	34	3	Sewage
5	5	Sewage	35	4	Sewage
6	4	Sewage	36	4	Sewage
7	4	Sewage	37	6	Sewage
8	4	Sewage	38	6	Sewage
9	3	Sewage	39	6	Sewage
10	4	Sewage	40	6	Sewage
11	4	Sewage	41	5	Sewage
12	3	Sewage	42	5	Sewage
13	4	Sewage	43	5	Sewage
14	4	Sewage	44	6	Sewage
15	4	Sewage	45	5	Sewage
16	4	Sewage	46	6	Sewage
17	5	Sewage	47	5	Sewage
18	4	Sewage	48	6	Sewage
19	4	Sewage	49	6	Sewage
20	4	Sewage	50	5	Sewage
21	4	Sewage	51	5	Sewage
22	5	Sewage	52	4	Sewage
23	5	Sewage	53	5	Sewage
24	5	Sewage	54	4	Sewage
25	4	Sewage	55	6	Sewage
26	5	Sewage	56	6	Sewage
27	5	Sewage	57	5	Sewage
28	4	Sewage	58	5	Sewage
29	5	Sewage	59	6	Sewage
30	5	Sewage	60	5	Sewage

Date:	29/1/2014	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	14:04
Latitude:	28°42'6.3"S	**End time:**	14:14
Longitude:	114°36'58.7'E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	3	Sewage	31	3	Sewage
2	4	Sewage	32	3	Sewage
3	4	Sewage	33	3	Sewage
4	4	Sewage	34	4	Sewage
5	5	Sewage	35	4	Sewage
6	4	Sewage	36	4	Sewage
7	4	Sewage	37	5	Sewage
8	4	Sewage	38	6	Sewage
9	3	Sewage	39	6	Sewage
10	5	Sewage	40	6	Sewage
11	5	Sewage	41	5	Sewage
12	4	Sewage	42	5	Sewage
13	4	Sewage	43	6	Sewage
14	4	Sewage	44	6	Sewage
15	5	Sewage	45	6	Sewage
16	4	Sewage	46	5	Sewage
17	5	Sewage	47	4	Sewage
18	4	Sewage	48	6	Sewage
19	5	Sewage	49	6	Sewage
20	4	Sewage	50	6	Sewage
21	4	Sewage	51	5	Sewage
22	3	Sewage	52	3	Sewage
23	4	Sewage	53	6	Sewage
24	4	Sewage	54	4	Sewage
25	4	Sewage	55	5	Sewage
26	4	Sewage	56	4	Sewage
27	4	Sewage	57	5	Sewage
28	4	Sewage	58	4	Sewage
29	3	Sewage	59	6	Sewage
30	3	Sewage	60	5	Sewage

Date:	30/1/2014	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	7:46
Latitude:	28°42'3.6"S	**End time:**	7:56
Longitude:	114°36'54.4"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	2	Sewage	31	0	
2	1	Sewage	32	0	
3	1	Sewage	33	0	
4	1	Sewage	34	0	
5	0		35	1	Sewage
6	2	Sewage	36	1	Sewage
7	1	Sewage	37	1	Sewage
8	1	Sewage	38	1	Sewage
9	0		39	1	Sewage
10	3	Sewage	40	0	
11	3	Sewage	41	0	
12	2	Sewage	42	1	Sewage
13	2	Sewage	43	2	Sewage
14	1	Sewage	44	2	Sewage
15	3	Sewage	45	0	
16	2	Sewage	46	2	Sewage
17	0		47	1	Sewage
18	1	Sewage	48	1	Sewage
19	0		49	1	Sewage
20	1		50	1	Sewage
21	0		51	1	Sewage
22	1	Sewage	52	1	Sewage
23	2	Sewage	53	0	
24	3	Sewage	54	1	Sewage
25	2	Sewage	55	1	Sewage
26	1	Sewage	56	0	
27	0		57	0	
28	0		58	0	
29	0		59	0	
30	0		60	0	

Date:	30/1/2014	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	7:48
Latitude:	28°42'5.02"S	**End time:**	7:58
Longitude:	114°36'56.31"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	3	Sewage	31	0	
2	3	Sewage	32	0	
3	2	Sewage	33	1	Sewage
4	1	Sewage	34	0	
5	1	Sewage	35	0	
6	1	Sewage	36	0	
7	2	Sewage	37	1	Sewage
8	0		38	2	Sewage
9	0		39	3	Sewage
10	1	Sewage	40	3	Sewage
11	0		41	1	Sewage
12	1	Sewage	42	1	Sewage
13	1	Sewage	43	0	
14	1	Sewage	44	0	
15	1	Sewage	45	0	
16	3	Sewage	46	0	
17	3	Sewage	47	0	
18	2	Sewage	48	0	
19	3	Sewage	49	1	Sewage
20	2	Sewage	50	2	Sewage
21	1	Sewage	51	2	Sewage
22	0		52	1	Sewage
23	1	Sewage	53	1	Sewage
24	3	Sewage	54	0	
25	2	Sewage	55	1	Sewage
26	1	Sewage	56	1	Sewage
27	1	Sewage	57	0	
28	0		58	0	
29	0		59	1	Sewage
30	0		60	0	

Date:	30/1/2014	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	8:03
Latitude:	28°42'5.78"S	**End time:**	8:13
Longitude:	114°36'56.70'E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	3	Sewage	31	1	Sewage
2	3	Sewage	32	1	Sewage
3	4	Sewage	33	3	Sewage
4	4	Sewage	34	2	Sewage
5	3	Sewage	35	1	Sewage
6	3	Sewage	36	1	Sewage
7	3	Sewage	37	2	Sewage
8	4	Sewage	38	3	Sewage
9	3	Sewage	39	2	Sewage
10	4	Sewage	40	3	Sewage
11	4	Sewage	41	4	Sewage
12	3	Sewage	42	3	Sewage
13	4	Sewage	43	3	Sewage
14	3	Sewage	44	3	Sewage
15	2	Sewage	45	2	Sewage
16	2	Sewage	46	1	Sewage
17	3	Sewage	47	4	Sewage
18	2	Sewage	48	3	Sewage
19	1	Sewage	49	3	Sewage
20	2	Sewage	50	2	Sewage
21	2	Sewage	51	2	Sewage
22	3	Sewage	52	2	Sewage
23	2	Sewage	53	3	Sewage
24	3	Sewage	54	3	Sewage
25	2	Sewage	55	3	Sewage
26	3	Sewage	56	4	Sewage
27	3	Sewage	57	4	Sewage
28	2	Sewage	58	3	Sewage
29	2	Sewage	59	3	Sewage
30	1	Sewage	60	3	Sewage

Date:	30/1/2014	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	8:03
Latitude:	28°42'3.3"S	**End time:**	8:13
Longitude:	114°36'53.6"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	1	Bushland	31	0	
2	0		32	0	
3	0		33	0	
4	1	Bushland	34	0	
5	0		35	0	
6	0		36	0	
7	1	Sewage	37	0	
8	1	Sewage	38	0	
9	1	Sewage	39	0	
10	0		40	0	
11	0		41	0	
12	0		42	0	
13	0		43	1	Sewage
14	0		44	1	Sewage
15	1	Sewage	45	0	
16	0		46	0	
17	1	Sewage	47	0	
18	0		48	0	
19	0		49	0	
20	0		50	0	
21	1	Bushland	51	0	
22	0		52	0	
23	0		53	1	Sewage
24	0		54	2	Sewage
25	0		55	0	
26	0		56	0	
27	0		57	0	
28	0		58	1	Sewage
29	0		59	2	Sewage
30	0		60	1	Sewage

Date:	30/1/2014	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	8:18
Latitude:	28°42'4.4"S	**End time:**	8:28
Longitude:	114°36'54.2"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	0		31	0	
2	1	Sewage	32	0	
3	0		33	0	
4	0		34	0	
5	0		35	1	Sewage
6	0		36	1	Sewage
7	0		37	0	
8	0		38	0	
9	0		39	0	
10	0		40	0	
11	1	Sewage	41	0	
12	0		42	0	
13	0		43	0	
14	0		44	0	
15	0		45	0	
16	0		46	0	
17	0		47	0	
18	0		48	0	
19	1	Bushland	49	0	
20	0		50	0	
21	0		51	0	
22	0		52	0	
23	0		53	0	
24	0		54	0	
25	0		55	0	
26	0		56	0	
27	0		57	0	
28	1	Sewage	58	0	
29	0		59	0	
30	0		60	0	

Date:	30/1/2014	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	8:20
Latitude:	28°42'6.39"S	**End time:**	8:30
Longitude:	114°36'54.92'E		

Observation	Intensity	Character	Observation	Intensity	Character
1	0		31	0	
2	2	Sewage	32	1	Sewage
3	1	Sewage	33	1	Sewage
4	0		34	3	Sewage
5	1	Sewage	35	2	Sewage
6	1	Sewage	36	1	Sewage
7	1	Sewage	37	1	Bushland
8	2	Sewage	38	3	Sewage
9	1	Sewage	39	2	Sewage
10	0		40	3	Sewage
11	0		41	1	Sewage
12	1	Sewage	42	1	Sewage
13	1	Sewage	43	1	Sewage
14	1	Sewage	44	0	
15	1	Sewage	45	1	Sewage
16	1	Sewage	46	2	Sewage
17	0		47	2	Flowers
18	1	Bushland	48	2	Sewage
19	0		49	1	Sewage
20	2	Sewage	50	3	Sewage
21	1	Sewage	51	1	Sewage
22	1	Sewage	52	0	
23	0		53	0	
24	0		54	1	Sewage
25	1	Sewage	55	2	Sewage
26	1	Sewage	56	1	Sewage
27	1	Sewage	57	1	Sewage
28	0		58	0	
29	1	Sewage	59	1	Sewage
30	2	Sewage	60	0	

Date:	30/1/2014	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	8:34
Latitude:	28°42'5.7"S	**End time:**	8:44
Longitude:	114°36'54.7"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	0		31	0	
2	1	Bushland	32	0	
3	0		33	0	
4	1	Bushland	34	0	
5	1	Bushland	35	0	
6	1	Sewage	36	0	
7	1	Seaweed	37	0	
8	0		38	1	Sewage
9	1	Sewage	39	0	
10	0		40	0	
11	0		41	0	
12	0		42	0	
13	0		43	1	Sewage
14	0		44	0	
15	0		45	0	
16	0		46	0	
17	1	Sewage	47	0	
18	0		48	0	
19	1	Bushland	49	0	
20	0		50	0	
21	0		51	0	
22	0		52	0	
23	0		53	0	
24	0		54	1	Bushland
25	0		55	0	
26	0		56	0	
27	0		57	0	
28	0		58	0	
29	0		59	1	Bushland
30	0		60	0	

Date:	30/1/2014	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	8:35
Latitude:	28°42'7.44"S	**End time:**	8:45
Longitude:	114°36'55.38'E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	1	Sewage	31	2	Sewage
2	1	Sewage	32	2	Sewage
3	1	Sewage	33	2	Sewage
4	1	Sewage	34	1	Sewage
5	1	Sewage	35	1	Sewage
6	2	Sewage	36	1	Sewage
7	1	Sewage	37	1	Sewage
8	1	Sewage	38	1	Sewage
9	2	Sewage	39	1	Sewage
10	1	Sewage	40	1	Sewage
11	1	Sewage	41	2	Sewage
12	0		42	1	Sewage
13	1	Sewage	43	1	Sewage
14	1	Sewage	44	1	Sewage
15	2	Sewage	45	1	Sewage
16	2	Sewage	46	2	Sewage
17	2	Sewage	47	1	Sewage
18	3	Sewage	48	1	Sewage
19	1	Sewage	49	2	Sewage
20	1	Sewage	50	1	Sewage
21	2	Sewage	51	1	Sewage
22	1	Sewage	52	2	Sewage
23	0		53	3	Sewage
24	1	Sewage	54	2	Sewage
25	1	Sewage	55	1	Sewage
26	1	Sewage	56	1	Sewage
27	1	Sewage	57	1	Sewage
28	1	Sewage	58	2	Sewage
29	2	Sewage	59	1	Sewage
30	0		60	0	

Date:	30/1/2014	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	8:46
Latitude:	28°42'6.94"S	**End time:**	8:56
Longitude:	114°36'56.49'E		

Observation	Intensity	Character	Observation	Intensity	Character
1	3	Sewage	31	1	Sewage
2	3	Sewage	32	1	Sewage
3	2	Sewage	33	2	Sewage
4	2	Sewage	34	2	Sewage
5	1	Sewage	35	2	Sewage
6	1	Sewage	36	2	Sewage
7	3	Sewage	37	3	Sewage
8	2	Sewage	38	1	Sewage
9	1	Sewage	39	1	Sewage
10	3	Sewage	40	1	Sewage
11	1	Sewage	41	2	Sewage
12	1	Sewage	42	2	Sewage
13	3	Sewage	43	3	Sewage
14	3	Sewage	44	1	Sewage
15	2	Sewage	45	1	Sewage
16	2	Sewage	46	2	Sewage
17	2	Sewage	47	1	Sewage
18	2	Sewage	48	1	Sewage
19	2	Sewage	49	2	Sewage
20	1	Sewage	50	1	Sewage
21	1	Sewage	51	1	Sewage
22	1	Sewage	52	1	Sewage
23	1	Sewage	53	1	Sewage
24	1	Sewage	54	2	Sewage
25	1	Sewage	55	1	Sewage
26	1	Sewage	56	0	
27	2	Sewage	57	1	Sewage
28	2	Sewage	58	1	Sewage
29	1	Sewage	59	2	Sewage
30	1	Sewage	60	2	Sewage

Date:	30/1/2014	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	8:48
Latitude:	28°42'6.8"S	**End time:**	8:58
Longitude:	114°36'54.7"E		

Observation	Intensity	Character	Observation	Intensity	Character
1	1	Bushland	31	0	
2	1	Bushland	32	0	
3	0		33	0	
4	0		34	0	
5	0		35	0	
6	0		36	1	Bushland
7	1	Bushland	37	0	
8	0		38	0	
9	1	Swamp	39	0	
10	1	Swamp	40	0	
11	0		41	0	
12	0		42	0	
13	2	Sewage	43	0	
14	0		44	1	Sewage
15	3	Sewage	45	0	Sewage
16	2	Sewage	46	2	Sewage
17	0		47	1	
18	1	Sewage	48	0	
19	0		49	0	
20	0		50	0	
21	1	Bushland	51	1	Sewage
22	1	Bushland	52	0	
23	0		53	1	Sewage
24	0		54	1	Bushland
25	0		55	0	
26	1	Bushland	56	0	
27	0		57	0	
28	1		58	0	
29	0		59	0	
30	0		60	0	

Date:	30/1/2014	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	9:02
Latitude:	28°42'6.77''S	**End time:**	9:12
Longitude:	114°36'57.60'E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	4	Sewage	31	2	Sea
2	4	Sewage	32	2	Sea
3	4	Sewage	33	2	Sea
4	3	Sewage	34	1	Sewage
5	2	Sewage	35	2	Sea
6	3	Sewage	36	1	Sewage
7	2	Sewage	37	2	Sewage
8	2	Sewage	38	2	Sewage
9	3	Sewage	39	1	Sewage
10	3	Sewage	40	2	Sewage
11	2	Sewage	41	2	Sewage
12	4	Sewage	42	1	Sewage
13	3	Sewage	43	2	Sewage
14	4	Sewage	44	2	Sewage
15	3	Sewage	45	2	Sewage
16	4	Sewage	46	1	Sewage
17	4	Sewage	47	2	Sea
18	3	Sewage	48	1	Sewage
19	3	Sewage	49	3	Sewage
20	2	Sewage	50	2	Sewage
21	2	Sewage	51	3	Sewage
22	2	Sewage	52	1	Sewage
23	3	Sewage	53	3	Sewage
24	3	Sewage	54	3	Sewage
25	2	Sea	55	2	Sewage
26	2	Sea	56	2	Sewage
27	1	Sea	57	1	Sewage
28	2	Sea	58	2	Sewage
29	2	Sea	59	3	Sewage
30	2	Sea	60	3	Sewage

Date:	30/1/2014	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	9:04
Latitude:	28°42'4.1"S	**End time:**	9:14
Longitude:	114°36'56.0"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	1	Sewage	31	1	Sewage
2	0		32	1	Sewage
3	0		33	1	Sewage
4	0		34	1	Sewage
5	0		35	0	
6	1	Sewage	36	0	
7	0		37	0	
8	1	Sewage	38	0	
9	0		39	0	
10	0		40	0	
11	0		41	0	
12	0		42	0	
13	1	Sea air	43	0	
14	0		44	0	
15	0		45	0	
16	0		46	0	
17	0		47	0	
18	0		48	0	
19	0		49	0	
20	0		50	0	
21	0		51	0	
22	0		52	0	
23	0		53	0	
24	0		54	0	
25	0		55	0	
26	0		56	0	
27	0		57	0	
28	0		58	0	
29	0		59	0	
30	0		60	0	

Date:	30/1/2014	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	9:16
Latitude:	28°42'6.43"S	**End time:**	9:26
Longitude:	114°36'58.97'E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	4	Sewage	31	5	Sewage
2	4	Sewage	32	4	Sewage
3	4	Sewage	33	4	Sewage
4	4	Sewage	34	5	Sewage
5	3	Sewage	35	5	Sewage
6	3	Sewage	36	5	Sewage
7	3	Sewage	37	4	Sewage
8	3	Sewage	38	5	Sewage
9	3	Sewage	39	5	Sewage
10	4	Sewage	40	5	Sewage
11	4	Sewage	41	5	Sewage
12	4	Sewage	42	5	Sewage
13	4	Sewage	43	4	Sewage
14	4	Sewage	44	5	Sewage
15	5	Sewage	45	5	Sewage
16	3	Sewage	46	5	Sewage
17	4	Sewage	47	4	Sewage
18	3	Sewage	48	5	Sewage
19	2	Sewage	49	4	Sewage
20	3	Sewage	50	4	Sewage
21	4	Sewage	51	5	Sewage
22	5	Sewage	52	4	Sewage
23	5	Sewage	53	5	Sewage
24	4	Sewage	54	4	Sewage
25	4	Sewage	55	3	Sewage
26	4	Sewage	56	3	Sewage
27	5	Sewage	57	3	Sewage
28	4	Sewage	58	4	Sewage
29	3	Sewage	59	4	Sewage
30	4	Sewage	60	4	Sewage

Date:	30/1/2014	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	9:17
Latitude:	28°42'4.9"S	**End time:**	9:27
Longitude:	114°36'54.9"E		

Observation	Intensity	Character	Observation	Intensity	Character
1	0		31	0	
2	0		32	0	
3	0		33	0	
4	0		34	0	
5	0		35	0	
6	0		36	0	
7	0		37	0	
8	0		38	0	
9	0		39	0	
10	0		40	0	
11	0		41	0	
12	0		42	0	
13	0		43	0	
14	0		44	0	
15	0		45	0	
16	0		46	0	
17	0		47	0	
18	0		48	0	
19	0		49	0	
20	0		50	0	
21	0		51	0	
22	0		52	0	
23	0		53	0	
24	0		54	0	
25	0		55	0	
26	0		56	0	
27	0		57	0	
28	0		58	0	
29	0		59	0	
30	0		60	0	

Date:	30/1/2014	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	9:28
Latitude:	28°42'5.1"S	**End time:**	9:38
Longitude:	114°36'54.2"E		

Observation	Intensity	Character	Observation	Intensity	Character
1	0		31	0	
2	0		32	0	
3	0		33	0	
4	1	Bushland	34	1	Bushland
5	0		35	0	
6	0		36	0	
7	0		37	0	
8	0		38	0	
9	0		39	0	
10	0		40	1	Bushland
11	0		41	1	Bushland
12	0		42	0	
13	0		43	0	
14	0		44	0	
15	0		45	0	
16	0		46	1	Bushland
17	0		47	0	
18	0		48	0	
19	0		49	0	
20	0		50	0	
21	0		51	0	
22	0		52	1	Bushland
23	0		53	1	Bushland
24	0		54	1	Bushland
25	0		55	0	
26	0		56	0	
27	0		57	0	
28	0		58	0	
29	0		59	0	
30	0		60	0	

Date:	30/1/2014	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	9:29
Latitude:	28°42'6.19"S	**End time:**	9:39
Longitude:	114°37'0.08'E		

Observation	Intensity	Character	Observation	Intensity	Character
1	1	Sewage	31	0	
2	1	Sewage	32	0	
3	2	Sewage	33	1	Sewage
4	2	Sewage	34	1	Sewage
5	1	Sewage	35	0	
6	0		36	0	
7	1	Sewage	37	1	Sewage
8	0		38	2	Sewage
9	1	Sewage	39	1	Sewage
10	0		40	1	Sewage
11	1	Sewage	41	0	
12	2	Sewage	42	1	Sewage
13	2	Sea	43	2	Sewage
14	1	Sea	44	1	Sewage
15	2	Sewage	45	0	
16	1	Sewage	46	1	Sewage
17	1	Sewage	47	0	
18	1	Sewage	48	0	
19	0		49	2	Sewage
20	0		50	1	Sewage
21	1	Sewage	51	1	Sewage
22	0		52	0	
23	1	Sewage	53	0	
24	1	Sewage	54	1	Sewage
25	1	Sewage	55	2	Sewage
26	2	Sewage	56	0	
27	1	Sewage	57	0	
28	1	Sewage	58	1	Sewage
29	0		59	1	Sewage
30	1	Sewage	60	1	Sewage

Date:	30/1/2014	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	9:42
Latitude:	28°42'3.5"S	**End time:**	9:52
Longitude:	114°36'56.4"E		

Observation	Intensity	Character	Observation	Intensity	Character
1	1	Sewage	31	0	
2	1	Sewage	32	0	
3	0		33	0	
4	0		34	0	
5	1	Sewage	35	0	
6	0		36	0	
7	1	Sewage	37	0	
8	0		38	0	
9	0		39	0	
10	0		40	0	
11	0		41	0	
12	0		42	1	Bushland
13	0		43	0	
14	0		44	0	
15	0		45	0	
16	1	Sewage	46	0	
17	0		47	0	
18	0		48	0	
19	0		49	1	Bushland
20	0		50	1	Bushland
21	0		51	0	
22	0		52	0	
23	0		53	0	
24	0		54	0	
25	0		55	0	
26	0		56	0	
27	0		57	0	
28	0		58	1	Sewage
29	0		59	0	
30	0		60	0	

Date:	30/1/2014	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	9:54
Latitude:	28°42'2.9"S	**End time:**	10:04
Longitude:	114°36'57.6"E		

Observation	Intensity	Character	Observation	Intensity	Character
1	1	Sewage	31	0	
2	0		32	0	
3	0		33	0	
4	0		34	0	
5	0		35	0	
6	0		36	0	
7	1	Sewage	37	0	
8	1	Sewage	38	0	
9	0		39	0	
10	0		40	0	
11	0		41	0	
12	1	Sewage	42	1	Sewage
13	0		43	1	Sewage
14	0		44	1	Bushland
15	0		45	0	
16	0		46	0	
17	0		47	0	
18	1	Sewage	48	0	
19	1	Sewage	49	0	
20	0		50	0	
21	0		51	0	
22	0		52	0	
23	0		53	0	
24	0		54	1	Sewage
25	0		55	1	Sewage
26	0		56	0	
27	0		57	0	
28	0		58	0	
29	0		59	0	
30	0		60	0	

Date:	30/1/2014	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	10:08
Latitude:	28°42'3.8"S	**End time:**	10:18
Longitude:	114°36'58.4"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	1	Sewage	31	0	
2	0		32	1	Sewage
3	1	Sewage	33	0	
4	1	Sewage	34	0	
5	1	Sewage	35	1	Sewage
6	0		36	0	
7	0		37	0	
8	0		38	0	
9	0		39	0	
10	0		40	0	
11	1	Sewage	41	1	Sewage
12	0		42	0	
13	0		43	1	Sewage
14	1	Sewage	44	0	
15	1	Sewage	45	0	
16	1	Sewage	46	0	
17	0		47	0	
18	0		48	0	
19	0		49	0	
20	0		50	0	
21	1	Sewage	51	0	
22	0		52	0	
23	0		53	0	
24	1	Sewage	54	0	
25	0		55	0	
26	0		56	0	
27	0		57	0	
28	1	Sewage	58	0	
29	1	Sewage	59	0	
30	0		60	0	

Date:	30/1/2014	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	10:08
Latitude:	28°42'5.50"S	**End time:**	10:18
Longitude:	114°37'1.76'E		

Observation	Intensity	Character	Observation	Intensity	Character
1	2	Sewage	31	3	Sewage
2	3	Sewage	32	2	Sewage
3	2	Sewage	33	3	Sewage
4	2	Sewage	34	3	Sewage
5	2	Sewage	35	2	Sewage
6	2	Sewage	36	2	Sewage
7	2	Sewage	37	3	Sewage
8	3	Sewage	38	3	Sewage
9	2	Sewage	39	3	Sewage
10	3	Sewage	40	3	Sea
11	2	Sewage	41	3	Sewage
12	2	Sewage	42	2	Sewage
13	1	Sewage	43	1	Sewage
14	1	Sewage	44	3	Sewage
15	2	Sewage	45	2	Sewage
16	3	Sewage	46	2	Sewage
17	2	Sewage	47	3	Sewage
18	3	Sewage	48	3	Sewage
19	3	Sewage	49	2	Sewage
20	3	Sewage	50	3	Sewage
21	3	Sewage	51	3	Sea
22	3	Sewage	52	2	Sewage
23	2	Sewage	53	2	Sewage
24	2	Sewage	54	3	Sewage
25	3	Sewage	55	3	Sewage
26	2	Sewage	56	2	Sewage
27	2	Sewage	57	3	Sea
28	3	Sewage	58	2	Sewage
29	3	Sewage	59	2	Sewage
30	2	Sewage	60	3	Sewage

Date:	30/1/2014	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	10:24
Latitude:	28°42'3.28"S	**End time:**	10:34
Longitude:	114°37'0.77'E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	1	Sewage	31	0	
2	0		32	0	
3	0		33	0	
4	0		34	0	
5	0		35	0	
6	1	Sewage	36	0	
7	1	Sewage	37	0	
8	0		38	0	
9	0		39	1	Sewage
10	0		40	1	Sewage
11	0		41	0	
12	1	Sewage	42	0	
13	0		43	0	
14	0		44	1	Sewage
15	0		45	0	
16	1	Sewage	46	1	Sewage
17	0		47	0	
18	0		48	0	
19	0		49	0	
20	0		50	0	
21	0		51	0	
22	0		52	0	
23	1	Sewage	53	0	
24	1	Sewage	54	0	
25	1	Sewage	55	0	
26	2	Sewage	56	0	
27	1	Sewage	57	0	
28	1	Sewage	58	1	Sewage
29	0		59	1	Sewage
30	0		60	1	Sewage

Date:	30/1/2014	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	16:03
Latitude:	28°42'4.3"S	**End time:**	16:13
Longitude:	114°36'59.6"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	1	Sewage	31	2	Sewage
2	0		32	1	Sewage
3	1	Sewage	33	1	Sewage
4	1	Sewage	34	1	Sewage
5	2	Sewage	35	1	Sewage
6	0		36	0	
7	0		37	0	
8	1	Sewage	38	1	Sewage
9	1	Sewage	39	0	
10	1	Sewage	40	1	Sewage
11	2	Sewage	41	0	
12	0		42	0	
13	0		43	0	
14	0		44	0	
15	1	Sewage	45	0	
16	1	Sewage	46	1	Sewage
17	1	Sewage	47	0	
18	1	Sewage	48	0	
19	1	Sewage	49	0	
20	2	Sewage	50	0	
21	1	Sewage	51	0	
22	0		52	0	
23	1	Sewage	53	1	Sewage
24	1	Sewage	54	1	Sewage
25	2	Sewage	55	0	
26	1	Sewage	56	0	
27	1	Sewage	57	0	
28	0		58	0	
29	2	Sewage	59	0	
30	2	Sewage	60	1	Sewage

Date:	30/1/2014	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	16:03
Latitude:	28°42'4.4"S	**End time:**	16:13
Longitude:	114°36'59.0"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	1	Sewage	31	1	Sewage
2	1	Sewage	32	1	Sewage
3	1	Sewage	33	1	Sewage
4	0		34	0	
5	0		35	2	Sewage
6	0		36	2	Sewage
7	0		37	2	Sewage
8	0		38	1	Sewage
9	0		39	1	Sewage
10	1	Sewage	40	0	
11	0		41	1	Sewage
12	0		42	2	Sewage
13	1	Sewage	43	2	Sewage
14	2	Sewage	44	1	Sewage
15	2	Sewage	45	0	
16	1	Sewage	46	2	Sewage
17	2	Sewage	47	1	Sewage
18	2	Sewage	48	0	
19	0		49	0	
20	0		50	0	
21	1	Sewage	51	0	
22	0		52	0	
23	2	Sewage	53	0	
24	1	Sewage	54	1	Sewage
25	1	Sewage	55	0	
26	3	Sewage	56	0	
27	0		57	0	
28	1	Sewage	58	0	
29	1	Sewage	59	0	
30	0		60	0	

Date:	30/1/2014	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	16:16
Latitude:	28°42'2.8"S	**End time:**	16:26
Longitude:	114°36'58.8"E		

Observation	Intensity	Character	Observation	Intensity	Character
1	0		31	0	
2	0		32	0	
3	0		33	0	
4	0		34	0	
5	0		35	1	Sewage
6	0		36	0	
7	0		37	1	Sewage
8	0		38	0	
9	1	Sewage	39	0	
10	1	Sewage	40	0	
11	0		41	1	Sewage
12	1	Sewage	42	1	Sewage
13	1	Sewage	43	1	Sewage
14	1	Sewage	44	0	
15	1	Sewage	45	0	
16	0		46	0	
17	0		47	1	Sewage
18	0		48	0	
19	0		49	0	
20	1	Sewage	50	1	Sewage
21	0		51	1	Sewage
22	0		52	0	
23	1	Sewage	53	0	
24	1	Sewage	54	0	
25	1	Sewage	55	0	
26	1	Sewage	56	0	
27	1	Sewage	57	0	
28	0		58	0	
29	0		59	2	Sewage
30	1	Sewage	60	0	

Date:	30/1/2014	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	16:16
Latitude:	28°42'2.2"S	**End time:**	16:26
Longitude:	114°37'0.3"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	0		31	0	
2	0		32	0	
3	0		33	0	
4	0		34	1	Sewage
5	1	Sewage	35	1	Sewage
6	1	Sewage	36	0	
7	0		37	0	
8	0		38	1	Sewage
9	0		39	1	Sewage
10	0		40	1	Sewage
11	0		41	0	
12	0		42	0	
13	0		43	0	
14	0		44	0	
15	0		45	0	
16	0		46	1	Sewage
17	0		47	0	
18	0		48	0	
19	0		49	0	
20	0		50	0	
21	0		51	0	
22	0		52	0	
23	0		53	0	
24	0		54	0	
25	0		55	1	
26	0		56	0	
27	1	Sewage	57	0	
28	1	Sewage	58	0	
29	1	Sewage	59	0	
30	0		60	0	

Date:	31/1/2014	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	3:28
Latitude:	28°42'5.66"S	**End time:**	3:38
Longitude:	114°37'1.46"E		

Observation	Intensity	Character	Observation	Intensity	Character
1	4	Sewage	31	5	Sewage
2	4	Sewage	32	4	Sewage
3	5	Sewage	33	5	Sewage
4	5	Sewage	34	5	Sewage
5	5	Sewage	35	4	Sewage
6	4	Sewage	36	5	Sewage
7	4	Sewage	37	5	Sewage
8	5	Sewage	38	5	Sewage
9	4	Sewage	39	5	Sewage
10	4	Sewage	40	4	Sewage
11	4	Sewage	41	4	Sewage
12	5	Sewage	42	5	Sewage
13	5	Sewage	43	5	Sewage
14	5	Sewage	44	5	Sewage
15	4	Sewage	45	4	Sewage
16	4	Sewage	46	4	Sewage
17	4	Sewage	47	5	Sewage
18	4	Sewage	48	6	Sewage
19	4	Sewage	49	5	Sewage
20	5	Sewage	50	5	Sewage
21	5	Sewage	51	5	Sewage
22	4	Sewage	52	4	Sewage
23	5	Sewage	53	5	Sewage
24	5	Sewage	54	4	Sewage
25	5	Sewage	55	5	Sewage
26	5	Sewage	56	5	Sewage
27	5	Sewage	57	4	Sewage
28	5	Sewage	58	5	Sewage
29	6	Sewage	59	4	Sewage
30	6	Sewage	60	5	Sewage

Date:	31/1/2014	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	3:28
Latitude:	28°42'6.0"S	**End time:**	3:38
Longitude:	114°37'0.1"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	2	Sewage	31	1	Sewage
2	2	Sewage	32	0	
3	2	Sewage	33	1	Sewage
4	3	Sewage	34	3	Sewage
5	2	Sewage	35	1	Sewage
6	3	Sewage	36	3	Sewage
7	1	Sewage	37	4	Sewage
8	1	Sewage	38	2	Sewage
9	3	Sewage	39	1	Sewage
10	3	Sewage	40	0	
11	2	Sewage	41	0	
12	3	Sewage	42	0	
13	2	Sewage	43	3	Sewage
14	3	Sewage	44	2	Sewage
15	2	Sewage	45	4	Sewage
16	3	Sewage	46	2	Sewage
17	0		47	3	Sewage
18	2	Sewage	48	1	Sewage
19	2	Sewage	49	1	Sewage
20	2	Sewage	50	2	Sewage
21	1	Sewage	51	2	Sewage
22	2	Sewage	52	3	Sewage
23	2	Sewage	53	1	Sewage
24	2	Sewage	54	1	Sewage
25	2	Sewage	55	3	Sewage
26	1	Sewage	56	2	Sewage
27	1	Sewage	57	2	Sewage
28	2	Sewage	58	3	Sewage
29	3	Sewage	59	4	Sewage
30	3	Sewage	60	2	Sewage

Date:	31/1/2014	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	3:40
Latitude:	28°42'6.3"S	**End time:**	3:50
Longitude:	114°36'58.7"E		

Observation	Intensity	Character	Observation	Intensity	Character
1	3	Sewage	31	1	Sewage
2	2	Sewage	32	1	Sewage
3	2	Sewage	33	3	Sewage
4	2	Sewage	34	3	Sewage
5	2	Sewage	35	4	Sewage
6	1	Sewage	36	3	Sewage
7	2	Sewage	37	4	Sewage
8	2	Sewage	38	2	Sewage
9	2	Sewage	39	3	Sewage
10	2	Sewage	40	4	Sewage
11	2	Sewage	41	4	Sewage
12	4	Sewage	42	2	Sewage
13	3	Sewage	43	1	Sewage
14	2	Sewage	44	3	Sewage
15	2	Sewage	45	2	Sewage
16	4	Sewage	46	3	Sewage
17	3	Sewage	47	3	Sewage
18	3	Sewage	48	4	Sewage
19	3	Sewage	49	2	Sewage
20	3	Sewage	50	4	Sewage
21	2	Sewage	51	4	Sewage
22	1	Sewage	52	4	Sewage
23	4	Sewage	53	2	Sewage
24	3	Sewage	54	1	Sewage
25	1	Sewage	55	4	Sewage
26	1	Sewage	56	2	Sewage
27	2	Sewage	57	3	Sewage
28	1	Sewage	58	3	Sewage
29	3	Sewage	59	3	Sewage
30	3	Sewage	60	2	Sewage

Date:	31/1/2014	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	3:44
Latitude:	28°42'6.61"S	**End time:**	3:54
Longitude:	114°36'57.67"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	3	Sewage	31	4	Sewage
2	3	Sewage	32	3	Sewage
3	3	Sewage	33	4	Sewage
4	4	Sewage	34	4	Sewage
5	3	Sewage	35	4	Sewage
6	3	Sewage	36	4	Sewage
7	4	Sewage	37	5	Sewage
8	4	Sewage	38	5	Sewage
9	4	Sewage	39	5	Sewage
10	4	Sewage	40	4	Sewage
11	4	Sewage	41	4	Sewage
12	4	Sewage	42	4	Sewage
13	3	Sewage	43	3	Sewage
14	4	Sewage	44	4	Sewage
15	4	Sewage	45	4	Sewage
16	4	Sewage	46	4	Sewage
17	3	Sewage	47	5	Sewage
18	4	Sewage	48	4	Sewage
19	4	Sewage	49	5	Sewage
20	5	Sewage	50	5	Sewage
21	4	Sewage	51	5	Sewage
22	3	Sewage	52	4	Sewage
23	3	Sewage	53	5	Sewage
24	3	Sewage	54	5	Sewage
25	3	Sewage	55	4	Sewage
26	4	Sewage	56	4	Sewage
27	5	Sewage	57	4	Sewage
28	4	Sewage	58	3	Sewage
29	4	Sewage	59	3	Sewage
30	5	Sewage	60	5	Sewage

Date:	31/1/2014	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	3:54
Latitude:	28°42'6.8"S	**End time:**	4:04
Longitude:	114°36'56.9"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	1	Sewage	31	4	Sewage
2	2	Sewage	32	3	Sewage
3	1	Sewage	33	2	Sewage
4	2	Sea air	34	3	Sewage
5	1	Sewage	35	3	Sewage
6	1	Sewage	36	2	Sewage
7	3	Sewage	37	4	Sewage
8	1	Sewage	38	3	Sewage
9	2	Sewage	39	3	Sewage
10	3	Sewage	40	4	Sewage
11	3	Sewage	41	3	Sewage
12	3	Sewage	42	3	Sewage
13	3	Sewage	43	4	Sewage
14	3	Sewage	44	3	Sewage
15	2	Sewage	45	3	Sewage
16	3	Sewage	46	3	Sewage
17	2	Sewage	47	5	Sewage
18	4	Sewage	48	3	Sewage
19	3	Sewage	49	5	Sewage
20	3	Sewage	50	2	Sewage
21	5	Sewage	51	4	Sewage
22	3	Sewage	52	3	Sewage
23	3	Sewage	53	5	Sewage
24	3	Sewage	54	4	Sewage
25	3	Sewage	55	3	Sewage
26	3	Sewage	56	5	Sewage
27	3	Sewage	57	3	Sewage
28	3	Sewage	58	3	Sewage
29	3	Sewage	59	3	Sewage
30	2	Sewage	60	3	Sewage

Date:	31/1/2014	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	3:58
Latitude:	28°42'6.99"S	**End time:**	4:08
Longitude:	114°36'55.90"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	4	Sewage	31	3	Sewage
2	3	Sewage	32	4	Sewage
3	2	Sewage	33	4	Sewage
4	3	Sewage	34	4	Sewage
5	4	Sewage	35	3	Sewage
6	3	Sewage	36	2	Sewage
7	3	Sewage	37	3	Sewage
8	2	Sewage	38	4	Sewage
9	3	Sewage	39	3	Sewage
10	4	Sewage	40	3	Sewage
11	4	Sewage	41	4	Sewage
12	4	Sewage	42	3	Sewage
13	3	Sewage	43	4	Sewage
14	3	Sewage	44	4	Sewage
15	4	Sewage	45	4	Sewage
16	4	Sewage	46	3	Sewage
17	3	Sewage	47	3	Sewage
18	4	Sewage	48	3	Sewage
19	4	Sewage	49	3	Sewage
20	4	Sewage	50	2	Sewage
21	4	Sewage	51	3	Sewage
22	3	Sewage	52	4	Sewage
23	4	Sewage	53	3	Sewage
24	4	Sewage	54	4	Sewage
25	4	Sewage	55	4	Sewage
26	3	Sewage	56	4	Sewage
27	4	Sewage	57	4	Sewage
28	3	Sewage	58	3	Sewage
29	3	Sewage	59	2	Sewage
30	3	Sewage	60	4	Sewage

Date:	31/1/2014	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	4:05
Latitude:	28°42'6.3"S	**End time:**	4:15
Longitude:	114°36'57.1"E		

Observation	Intensity	Character	Observation	Intensity	Character
1	4	Sewage	31	2	Sewage
2	3	Sewage	32	3	Sewage
3	4	Sewage	33	3	Sewage
4	4	Sewage	34	3	Sewage
5	4	Sewage	35	4	Sewage
6	4	Sewage	36	3	Sewage
7	5	Sewage	37	3	Sewage
8	4	Sewage	38	3	Sewage
9	4	Sewage	39	3	Sewage
10	4	Sewage	40	3	Sewage
11	3	Sewage	41	4	Sewage
12	3	Sewage	42	4	Sewage
13	2	Sewage	43	4	Sewage
14	5	Sewage	44	3	Sewage
15	4	Sewage	45	2	Sewage
16	2	Sewage	46	3	Sewage
17	3	Sewage	47	3	Sewage
18	5	Sewage	48	2	Sewage
19	5	Sewage	49	2	Sewage
20	3	Sewage	50	2	Sewage
21	4	Sewage	51	3	Sewage
22	4	Sewage	52	3	Sewage
23	4	Sewage	53	3	Sewage
24	3	Sewage	54	4	Sewage
25	3	Sewage	55	2	Sewage
26	5	Sewage	56	2	Sewage
27	4	Sewage	57	4	Sewage
28	4	Sewage	58	2	Sewage
29	3	Sewage	59	1	Sewage
30	3	Sewage	60	1	Sewage

Date:	31/1/2014	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	4:12
Latitude:	28°42'5.33"S	**End time:**	4:22
Longitude:	114°36'57.08"E		

Observation	Intensity	Character	Observation	Intensity	Character
1	1	Sewage	31	0	
2	1	Sewage	32	1	Sewage
3	1	Sewage	33	1	Sewage
4	2	Sewage	34	1	Sewage
5	1	Sewage	35	1	Sewage
6	3	Sewage	36	1	Sewage
7	3	Sewage	37	1	Sewage
8	1	Sewage	38	2	Sewage
9	1	Sewage	39	1	Sewage
10	1	Sewage	40	2	Sewage
11	2	Sewage	41	2	Sewage
12	1	Sewage	42	1	Sewage
13	1	Sewage	43	2	Sewage
14	3	Sewage	44	3	Sewage
15	2	Sewage	45	3	Sewage
16	2	Sewage	46	2	Sewage
17	3	Sewage	47	1	Sewage
18	2	Sewage	48	3	Sewage
19	1	Sewage	49	3	Sewage
20	0	Sewage	50	3	Sewage
21	1	Sewage	51	1	Sewage
22	1	Sewage	52	1	Sewage
23	2	Sewage	53	1	Sewage
24	1	Sewage	54	1	Sewage
25	1	Sewage	55	1	Sewage
26	1	Sewage	56	3	Sewage
27	3	Sewage	57	2	Sewage
28	2	Sewage	58	1	Sewage
29	2	Sewage	59	1	Sewage
30	1	Sewage	60	2	Sewage

Date:	31/1/2014	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	4:20
Latitude:	28°42'4.3"S	**End time:**	4:30
Longitude:	114°36'56.9"E		

Observation	Intensity	Character	Observation	Intensity	Character
1	4	Sewage	31	3	Sewage
2	4	Sewage	32	3	Sewage
3	4	Sewage	33	3	Sewage
4	4	Sewage	34	3	Sewage
5	3	Sewage	35	3	Sewage
6	3	Sewage	36	3	Sewage
7	4	Sewage	37	3	Sewage
8	3	Sewage	38	3	Sewage
9	3	Sewage	39	2	Sewage
10	4	Sewage	40	2	Sewage
11	4	Sewage	41	2	Sewage
12	3	Sewage	42	2	Sewage
13	3	Sewage	43	2	Sewage
14	2	Sewage	44	3	Sewage
15	2	Sewage	45	3	Sewage
16	2	Sewage	46	3	Sewage
17	3	Sewage	47	3	Sewage
18	2	Sewage	48	3	Sewage
19	3	Sewage	49	3	Sewage
20	3	Sewage	50	3	Sewage
21	2	Sewage	51	3	Sewage
22	2	Sewage	52	3	Sewage
23	2	Sewage	53	3	Sewage
24	2	Sewage	54	3	Sewage
25	2	Sewage	55	3	Sewage
26	2	Sewage	56	3	Sewage
27	1	Sewage	57	3	Sewage
28	1	Sewage	58	2	Sewage
29	1	Sewage	59	2	Sewage
30	3	Sewage	60	2	Sewage

Date:	31/1/2014	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	4:27
Latitude:	28°42'3.76"S	**End time:**	4:37
Longitude:	114°36'58.48"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	1	Sewage	31	1	Sewage
2	0		32	1	Sewage
3	1	Sewage	33	0	
4	2	Sewage	34	0	
5	2	Sewage	35	2	Sewage
6	1	Sewage	36	1	Sewage
7	2	Bushland	37	1	Sewage
8	1	Sewage	38	1	Sewage
9	1	Sewage	39	1	Sewage
10	0		40	1	Sewage
11	0		41	0	
12	0		42	0	
13	2	Sewage	43	0	
14	3	Sewage	44	0	
15	2	Sewage	45	0	
16	1	Sewage	46	1	Sewage
17	1	Sewage	47	1	Sewage
18	0		48	1	Sewage
19	0		49	2	Sewage
20	1	Sewage	50	2	Sewage
21	1	Sewage	51	1	Sewage
22	0		52	1	Sewage
23	2	Sewage	53	0	
24	1	Sewage	54	0	
25	0		55	0	
26	0		56	0	
27	1	Sewage	57	0	
28	0		58	0	
29	2	Sewage	59	0	
30	1	Sewage	60	0	

Date:	31/1/2014	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	4:33
Latitude:	28°41'4.0"S	**End time:**	4:43
Longitude:	114°36'56.2"E		

Observation	Intensity	Character	Observation	Intensity	Character
1	2	Sewage	31	2	Sewage
2	2	Sewage	32	2	Sewage
3	1	Sewage	33	2	Sewage
4	2	Sewage	34	2	Sewage
5	2	Sewage	35	2	Sewage
6	2	Sewage	36	1	Sewage
7	2	Sewage	37	1	Sewage
8	2	Sewage	38	2	Sewage
9	3	Sewage	39	2	Sewage
10	2	Sewage	40	2	Sewage
11	2	Sewage	41	2	Sewage
12	2	Sewage	42	2	Sewage
13	3	Sewage	43	2	Sewage
14	2	Sewage	44	2	Sewage
15	3	Sewage	45	3	Sewage
16	3	Sewage	46	2	Sewage
17	1	Sewage	47	3	Sewage
18	2	Sewage	48	2	Sewage
19	2	Sewage	49	3	Sewage
20	1	Sewage	50	2	Sewage
21	1	Sewage	51	2	Sewage
22	2	Sewage	52	2	Sewage
23	3	Sewage	53	2	Sewage
24	3	Sewage	54	2	Sewage
25	3	Sewage	55	2	Sewage
26	3	Sewage	56	2	Sewage
27	2	Sewage	57	2	Sewage
28	2	Sewage	58	2	Sewage
29	2	Sewage	59	3	Sewage
30	2	Sewage	60	2	Sewage

Date:	31/1/2014	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	4:44
Latitude:	28°42'0.94"S	**End time:**	4:54
Longitude:	114°36'55.12"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	1	Sewage	31	0	
2	0		32	0	
3	0		33	0	
4	0		34	0	
5	0		35	2	Flowers
6	0		36	1	Flowers
7	0		37	0	
8	1	Sewage	38	1	Sewage
9	1	Sewage	39	1	Sewage
10	0		40	0	
11	1	Sewage	41	0	
12	0		42	0	
13	0		43	0	
14	0		44	0	
15	0		45	0	
16	0		46	0	
17	0		47	0	
18	1	Sewage	48	0	
19	0		49	0	
20	0		50	1	Sewage
21	0		51	1	Sewage
22	0		52	0	
23	2	Flowers	53	0	
24	0		54	0	
25	0		55	0	
26	2	Sewage	56	0	
27	1	Sewage	57	0	
28	1	Sewage	58	0	
29	1	Sewage	59	0	
30	0		60	0	

Date:	31/1/2014	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	4:46
Latitude:	28°42'3.3"S	**End time:**	4:56
Longitude:	114°36'55.6"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	1	Sewage	31	2	Sewage
2	1	Sewage	32	2	Sewage
3	1	Sewage	33	2	Sewage
4	1	Sewage	34	2	Sewage
5	1	Sewage	35	2	Sewage
6	2	Sewage	36	2	Sewage
7	2	Sewage	37	2	Sewage
8	2	Sewage	38	3	Sewage
9	2	Sewage	39	2	Sewage
10	2	Sewage	40	1	Sewage
11	2	Sewage	41	1	Sewage
12	2	Sewage	42	1	Sewage
13	2	Sewage	43	2	Sewage
14	2	Sewage	44	3	Sewage
15	2	Sewage	45	2	Sewage
16	2	Sewage	46	2	Sewage
17	2	Sewage	47	2	Sewage
18	2	Sewage	48	2	Sewage
19	3	Sewage	49	2	Sewage
20	2	Sewage	50	2	Sewage
21	2	Sewage	51	2	Sewage
22	2	Sewage	52	2	Sewage
23	3	Sewage	53	1	Sewage
24	2	Sewage	54	1	Sewage
25	2	Sewage	55	1	Sewage
26	2	Sewage	56	1	Sewage
27	2	Sewage	57	2	Sewage
28	2	Sewage	58	2	Sewage
29	1	Sewage	59	2	Sewage
30	1	Sewage	60	2	Sewage

Date:	31/1/2014	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	5:04
Latitude:	28°41'60"S	**End time:**	5:14
Longitude:	114°36'54.2"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	2	Sewage	31	2	Sewage
2	2	Sewage	32	2	Sewage
3	2	Sewage	33	1	Sewage
4	2	Sewage	34	1	Sewage
5	2	Sewage	35	2	Sewage
6	2	Sewage	36	1	Sewage
7	1	Sewage	37	2	Sewage
8	2	Sewage	38	1	Sewage
9	1	Sewage	39	2	Sewage
10	1	Sewage	40	2	Sewage
11	2	Sewage	41	2	Sewage
12	2	Sewage	42	2	Sewage
13	1	Sewage	43	2	Sewage
14	1	Sewage	44	2	Sewage
15	2	Sewage	45	2	Sewage
16	1	Sewage	46	2	Sewage
17	1	Sewage	47	2	Sewage
18	2	Sewage	48	2	Sewage
19	2	Sewage	49	2	Sewage
20	2	Sewage	50	2	Sewage
21	2	Sewage	51	2	Sewage
22	1	Sewage	52	2	Sewage
23	2	Sewage	53	2	Sewage
24	1	Sewage	54	2	Sewage
25	1	Sewage	55	2	Sewage
26	1	Sewage	56	2	Sewage
27	1	Sewage	57	2	Sewage
28	1	Sewage	58	2	Sewage
29	1	Sewage	59	2	Sewage
30	1	Sewage	60	2	Sewage

Date:	31/1/2014	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	5:04
Latitude:	28°41'59.77"S	**End time:**	5:14
Longitude:	114°36'55.18"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	1	Sewage	31	0	
2	0		32	0	
3	0		33	0	
4	1	Sewage	34	0	
5	0		35	2	Sewage
6	0		36	2	Sewage
7	0		37	1	Sewage
8	1	Sewage	38	1	Sewage
9	0		39	1	Sewage
10	1	Sewage	40	0	
11	1	Sewage	41	0	
12	0		42	0	
13	2	Sewage	43	0	
14	0		44	0	
15	0		45	0	
16	1	Sewage	46	1	Sewage
17	0		47	0	
18	2	Sewage	48	0	
19	1	Sewage	49	2	Sewage
20	0		50	2	Sewage
21	1	Sewage	51	1	Sewage
22	0		52	1	Sewage
23	0		53	0	
24	0		54	1	Sewage
25	1	Sewage	55	0	
26	1	Sewage	56	0	
27	0		57	0	
28	0		58	0	
29	0		59	0	
30	0		60	0	

Date:	31/1/2014	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	5:18
Latitude:	28°41'59.92"S	**End time:**	5:28
Longitude:	114°36'54.59"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	2	Sewage	31	0	
2	0		32	0	
3	0		33	0	
4	1	Sewage	34	0	
5	2	Sewage	35	0	
6	1	Sewage	36	2	Sewage
7	1	Sewage	37	1	Sewage
8	1	Sewage	38	2	Sewage
9	0		39	2	Sewage
10	0		40	1	Sewage
11	0		41	2	Sewage
12	3	Sewage	42	1	Sewage
13	2	Sewage	43	0	
14	1	Sewage	44	0	
15	1	Sewage	45	0	
16	0		46	0	
17	0		47	1	Sewage
18	0		48	0	
19	1	Sewage	49	0	
20	0		50	0	
21	0		51	1	Sewage
22	0		52	0	
23	2	Sewage	53	0	
24	2	Sewage	54	2	Sewage
25	1	Sewage	55	1	Sewage
26	1	Sewage	56	2	Sewage
27	0		57	2	Sewage
28	0		58	0	
29	0		59	1	Sewage
30	0		60	0	

Date:	31/1/2014	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	5:19
Latitude:	28°42'0.4"S	**End time:**	5:29
Longitude:	114°36'53.7"E		

Observation	Intensity	Character	Observation	Intensity	Character
1	1	Sewage	31	2	Sewage
2	1	Sewage	32	2	Sewage
3	1	Sewage	33	2	Sewage
4	1	Sewage	34	1	Sewage
5	1	Sewage	35	1	Sewage
6	1	Sewage	36	1	Sewage
7	1	Sewage	37	2	Sewage
8	1	Sewage	38	1	Sewage
9	1	Sewage	39	2	Sewage
10	1	Sewage	40	2	Sewage
11	1	Sewage	41	1	Sewage
12	1	Sewage	42	1	Sewage
13	1	Sewage	43	1	Sewage
14	1	Sewage	44	1	Sewage
15	1	Sewage	45	2	Sewage
16	1	Sewage	46	2	Sewage
17	2	Sewage	47	0	
18	1	Sewage	48	1	Sewage
19	2	Sewage	49	1	Sewage
20	1	Sewage	50	1	Sewage
21	2	Sewage	51	1	Sewage
22	1	Sewage	52	2	Sewage
23	1	Sewage	53	1	Sewage
24	2	Sewage	54	1	Sewage
25	3	Sewage	55	1	Sewage
26	1	Sewage	56	1	Sewage
27	2	Sewage	57	2	Sewage
28	2	Sewage	58	2	Sewage
29	2	Sewage	59	0	
30	2	Sewage	60	1	Sewage

Date:	31/1/2014	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	5:32
Latitude:	28°41'58.9"S	**End time:**	5:42
Longitude:	114°36'53.1"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	2	Sewage	31	1	Sewage
2	2	Sewage	32	1	Sewage
3	2	Sewage	33	0	
4	2	Sewage	34	1	Sewage
5	2	Sewage	35	0	
6	2	Sewage	36	1	Sewage
7	2	Sewage	37	1	Sewage
8	3	Sewage	38	1	Sewage
9	2	Sewage	39	1	Sewage
10	2	Sewage	40	1	Sewage
11	2	Sewage	41	1	Sewage
12	2	Sewage	42	1	Sewage
13	2	Sewage	43	1	Sewage
14	2	Sewage	44	2	Sewage
15	2	Sewage	45	1	Sewage
16	2	Sewage	46	2	Sewage
17	2	Sewage	47	1	Sewage
18	1	Sewage	48	0	
19	2	Sewage	49	1	Sewage
20	2	Sewage	50	0	
21	2	Sewage	51	0	
22	2	Sewage	52	0	
23	1	Sewage	53	0	
24	1	Sewage	54	1	Sewage
25	2	Sewage	55	1	Sewage
26	2	Sewage	56	2	Sewage
27	2	Sewage	57	1	Sewage
28	2	Sewage	58	1	Sewage
29	2	Sewage	59	1	Sewage
30	1	Sewage	60	1	Sewage

Date:	31/1/2014	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	5:32
Latitude:	28°41'58.29"S	**End time:**	5:42
Longitude:	114°36'54.18"E		

Observation	Intensity	Character	Observation	Intensity	Character
1	2	Sewage	31	0	
2	1	Sewage	32	0	
3	0		33	0	
4	0		34	0	
5	2	Sewage	35	0	
6	1	Sewage	36	0	
7	1	Sewage	37	0	
8	1	Sewage	38	0	
9	0		39	0	
10	0		40	0	
11	0		41	2	Bushland
12	0		42	2	Flowers
13	0		43	2	Sewage
14	0		44	1	Flowers
15	0		45	0	
16	0		46	0	
17	0		47	0	
18	1	Sewage	48	0	
19	0		49	0	
20	0		50	0	
21	0		51	0	
22	0		52	0	
23	1	Sewage	53	0	
24	0		54	0	
25	0		55	0	
26	0		56	0	
27	0		57	0	
28	0		58	0	
29	0		59	0	
30	0		60	0	

Date:	31/1/2014	Assessor:	Danielle White
Location:	Geraldton WWTP	**Start time:**	5:47
Latitude:	28°41'57.0"S	**End time:**	5:57
Longitude:	114°36'52.5"E		

Observation	**Intensity**	**Character**	**Observation**	**Intensity**	**Character**
1	1	Sewage	31	0	
2	1	Bushland	32	0	
3	1	Bushland	33	0	
4	0		34	0	
5	1	Bushland	35	0	
6	1	Bushland	36	0	
7	1	Sewage	37	0	
8	1	Bushland	38	0	
9	1	Bushland	39	0	
10	1	Bushland	40	0	
11	1	Sewage	41	0	
12	1	Bushland	42	0	
13	1	Bushland	43	0	
14	1	Bushland	44	0	
15	0		45	1	Bushland
16	0		46	1	Bushland
17	0		47	1	Bushland
18	0		48	0	
19	0		49	0	
20	0		50	0	
21	1	Bushland	51	0	
22	0		52	0	
23	1	Sewage	53	0	
24	0		54	0	
25	0		55	0	
26	0		56	0	
27	0		57	0	
28	0		58	0	
29	0		59	0	
30	0		60	1	Sewage

Date:	31/1/2014	Assessor:	Peter Forster
Location:	Geraldton WWTP	**Start time:**	5:48
Latitude:	28°41'56.91"S	**End time:**	5:58
Longitude:	114°36'52.96"E		

Observation	Intensity	Character	Observation	Intensity	Character
1	0		31	0	
2	0		32	2	Bushland
3	0		33	2	Bushland
4	0		34	2	Bushland
5	0		35	0	
6	0		36	0	
7	0		37	0	
8	1	Sewage	38	0	
9	0		39	0	
10	0		40	1	Sewage
11	0		41	0	
12	0		42	0	
13	0		43	0	
14	0		44	0	
15	0		45	1	Sewage
16	0		46	0	
17	1	Sewage	47	0	
18	0		48	0	
19	1	Sewage	49	0	
20	0		50	0	
21	1	Sewage	51	0	
22	0		52	0	
23	0		53	1	Sewage
24	0		54	0	
25	0		55	1	Sewage
26	2	Bushland	56	1	Sewage
27	2	Bushland	57	0	
28	2	Bushland	58	0	
29	0		59	0	
30	0		60	0	

Appendix 3
Bushfire Hazard Level and Bushfire Attack Level Assessment, Lot 55 Chapman Road, Glenfield

Level 1, 50 Subiaco Square Road Subiaco WA 6008 PO Box 243 Subiaco WA 6904
Phone (08) 9380 3100 Fax (08) 9380 4606
177 Spencer Street Bunbury WA 6230 PO Box 287 Bunbury WA 6231
Phone (08) 9792 4797 Fax (08) 9792 4708

To: Jeremy Malaxos

Company: General Property Assets

Fax/email: Jeremy@generalpropertyassets.com.au

Date: 4 August 2016

Project No: GPA15164.01

Inquiries: D Panickar / R Banks

Bushfire Hazard Level and Bushfire Attack Level Assessment
Lot 55 Chapman Road, Glenfield

Background

Lot 55 Chapman Road, Glenfield (the Site) is owned by ASDC Pty Ltd (ASDC). The Site is located approximately 9 km north of the Geraldton City Centre and can be accessed from Geraldton via Chapman Road and the North West Coastal Highway. The Site is approximately 12.22 ha in size and is currently zoned 'urban development' under the City of Greater Geraldton (CoGG) Local Planning Scheme No. 1. The Site is proposed to be rezoned as 'service commercial'. A Structure Plan has been prepared by Town Planning Group (TPG) to allow for development of the Site as a commercial precinct.

The Site is situated within a designated bushfire prone area as depicted in the *Western Australia State Map of Bush Fire Prone Areas* (DFES 2016). Strategen were commissioned by General Property Assets (GPA) on behalf of ASDC to conduct a Bushfire Hazard Level Assessment to support the Structure Plan.

Purpose of Bushfire Hazard Level and Bushfire Attack Level contour assessment

This Bushfire Hazard Level and Bushfire Attack Level (BAL) contour assessment has been prepared by Strategen to guide an appropriate and compliant bushfire mitigation response for proposed development within the Site in accordance with requirements of *State Planning Policy 3.7 Planning in Bushfire-Prone Areas* (SPP 3.7; WAPC 2015a), *Guidelines for Planning in Bushfire-Prone Areas* (the Guidelines; WAPC 2015b) and *AS 3959–2009 Construction of Buildings in Bushfire-prone Areas* (AS 3959–2009, SA 2009). The assessment informs the landowners of any increased construction requirements that may apply to future buildings due to the proximity of bushfire hazards to the Site.

Existing site characteristics

The Site currently comprises coastal dunes and swales containing a mixture of shrubland and scrub vegetation. Vegetation within 100 m of the Site comprises of a mosaic of forest, woodland, shrubland, scrub and grassland vegetation.

Vegetation within the Site is proposed to be cleared prior to development occurring and therefore has been classified as a non-vegetated area as per Clause 2.2.3.2(e) of AS3959-2009. Vegetation within the surrounding 100 m of the Site is comprised of the following vegetation classes assessed in accordance with the *Visual guide for bushfire risk assessment in Western Australia* (DoP 2016) and AS 3959-2009:

- Class A forest (Plate 1)
- Class B woodland (Plate 2)
- Class C Shrubland (Plate 3; Plate 4; Plate 5)
- Class D Scrub (Plate 6)
- Class G Unmanaged Grassland (Plate 7)
- Non-vegetated areas and low threat vegetation as per Clauses 2.2.3.2 (e) and (f) of AS3959-2009 (Plate 8).

Two vegetated areas containing Class A forest vegetation and Class B woodland vegetation are located to the northeast of the Site. Class C shrubland vegetation occupies areas of land to the north, west and south of the Site. Two vegetated areas Class D scrub vegetation are located to the north and southeast of the Site, while Class G grassland vegetation lies to the east and southeast of the Site. The remainder of land within 100 m of the Site consists of non-vegetated areas and low threat vegetation consistent with Clauses 2.2.3.2 (e) and (f) of AS 3959–2009. Vegetation classes as described above are depicted in Figure 1.

The slope under vegetation within adjacent land 100 m from the Site is described below and depicted in Figure 1:

- vegetation to the north: slope under vegetation assessed between 5-10 degrees
- all other vegetation: slope under vegetation assessed as flat or upslope from the Site.

Plate 1: Classified class A forest north of the Site

Plate 2: Classified class B woodland north of the Site

Plate 3: Classified class C shrubland northwest of the Site

Plate 4: Classified class C shrubland west of the Site

Plate 5: Classified class C shrubland south of the Site

Plate 6: Classified class D scrub northeast of the Site

Plate 7: Class G grassland east of the Site

Plate 8: Non vegetated areas as per Clause 2.2.3.2 (e) of AS 3959-2009

Bushfire hazard level assessment

Strategen considers vegetation within the identified Class A forest vegetation, Class B woodland vegetation, Class C shrubland vegetation, Class D scrub vegetation and Class G grassland vegetation as posing a 'Moderate' bushfire hazard level as a result of the fragmented, narrow nature of the vegetation fuel components. Areas of the Site within 100 m of the above vegetation types has also been assigned a 'Moderate' bushfire hazard level to reflect the increased level of risk associated with proximity to bushfire prone vegetation as per methodology described in the Guidelines.

The remaining vegetated and non vegetated areas (including areas to be cleared for development) within the assessment area have been assessed as exclusions to classified vegetation in accordance with Clauses 2.2.3.2 (e) and (f) of AS 3959-2009, resulting in a 'Low' bushfire hazard level. The bushfire hazard level assessment is presented in Figure 1.

BAL contour assessment

A BAL contour assessment has been undertaken for the Site in accordance with methodology from AS 3959–2009 (Method 1), as depicted in Figure 2.

Parameters for the BAL assessment are as follows:

- WA Fire Danger Index (FDI) rating: FDI 80
- vegetation class: Class A forest, Class B woodland, Class C shrubland, Class D scrub and Class G unmanaged grassland
- slope under classified vegetation (refer to Figure 1):
  - between 5-10 degrees to the north
  - at equal elevation or upslope from the Site in all other areas.

Table 1 and Figure 2 display BAL contours for classified vegetation within and adjacent to the Site.

Table 1: BAL contour distances

Vegetation class	Slope under classified vegetation	Distance from classified vegetation			
		Asset Protection Zone (APZ)	BAL 29	BAL 19	BAL 12.5
Class A forest	Vegetation at equal elevation to, or upslope from Site	0-<21 m	21–<31 m	31–<42 m	42–<100 m
	Vegetation downslope at an angle of 0–5 degrees from Site	0–<27 m	27–<37 m	37–<50 m	50–<100 m
Class B woodland	Vegetation at equal elevation to, or upslope from Site	0-<14 m	14-<20 m	20-<29 m	29-<100 m
	Vegetation downslope at an angle of 0–5 degrees from Site	0-<17 m	17-<25 m	25-<35 m	35-<100 m
Class C shrubland	Vegetation at equal elevation to, or upslope from Site	0-<9 m	9-<13 m	13-<19 m	19-<100 m
	Vegetation downslope at an angle of 0–5 degrees from Site	0-<10 m	10-<15 m	15-<22 m	22-<100 m
Class D scrub	Vegetation at equal elevation to, or upslope from Site	0-<13 m	13-<19 m	19-<27 m	27-<100 m
	Vegetation downslope at an angle of 0–5 degrees from Site	0–<15 m	15–<22 m	22–<31 m	31–<100 m
Class G unmanaged grassland	Vegetation at equal elevation to, or upslope from Site	0-<8 m	8-<12 m	12-<17 m	17-<50 m
	Vegetation downslope at an angle of 0–5 degrees from Site	0–<9 m	9–<14 m	14–<20 m	20–<50 m

* Construction of buildings is generally not permitted within BAL FZ and BAL 40 areas.

The final BAL for any proposed buildings on the Site will be determined once the location and design of future buildings are confirmed.

Assessment against bushfire protection criteria

As required under SPP 3.7, Strategen has undertaken an assessment of development compliance against the bushfire protection criteria within the Guidelines to demonstrate that compliance with all criteria can be met at the strategic level, or future development stages. An ‘acceptable solutions’ assessment is provided in Table 2 to outline the proposed bushfire management measures against each bushfire protection criteria.

Strategen reiterates that this information is being provided at the Structure Plan stage where development design is indicative and detailed planning has not yet been finalised. Consequently, more detailed bushfire management information will be provided in the form of a BMP to accompany the future development. The BMP will confirm the bushfire assessments provided in this report and inform the bushfire management measures. In addition, it is likely that additional bushfire management detail will be required to accompany the development application to resolve matters such as final BAL ratings and separation requirements for individual buildings where applicable.

Table 2: Acceptable solutions assessment against bushfire protection criteria

Bushfire protection criteria	Intent	Acceptable solutions	Proposed bushfire management measures	Compliance statement
Element 1: Location	To ensure that strategic planning proposals, subdivision and development applications are located in areas with the least possible risk of bushfire to facilitate the protection of people, property and infrastructure	<u>Acceptable solution</u> A1.1 Development location The strategic planning proposal, subdivision and development application is located in an area that is or will, on completion, be subject to either a moderate or low bushfire hazard level, or BAL–29 or below.	The BHL assessment and BAL contour map (Figure 1 and Figure 2 respectively) demonstrate that it is possible for development to occur in areas not classed as extreme bushfire hazard or areas subject to BAL–FZ or BAL–40. The BMP provided at the development application stage will validate these findings and address bushfire risk during development staging.	The measures proposed are considered to comply and meet the intent of Element 1 Location.
Element 2: Siting and design of development	To ensure that the siting and design of development minimises the level of bushfire impact	<u>Acceptable solution</u> A2.1 Asset Protection Zone Every building is surrounded by an APZ, depicted on submitted plans, which meets detailed requirements (refer to the Guidelines for detailed APZ requirements).	The BAL contour map (Figure 2) demonstrates that the APZ can be achieved at all interfaces where proposed development abuts classified vegetation. The BMP provided at the development application stage will validate these findings.	The measures proposed are considered to comply and meet the intent of Element 2 Siting and design of development.
		<u>Acceptable solution</u> A2.2 Hazard Separation Zone Every building and its contiguous APZ is surrounded by an HSZ, depicted on submitted plans, that meets detailed requirements (refer to the Guidelines for detailed HSZ requirements). An HSZ may not be required if the proposed construction meets the standard appropriate to the BAL for that location, and does not exceed BAL–29.	HSZs are not proposed since individual building construction will meet the standard appropriate to the BAL for that location. The BMP provided at the development application stage will validate these findings.	
Element 3: Vehicular access	To ensure that the vehicular access serving a subdivision/development is available and safe during a bushfire event	<u>Acceptable solution</u> A3.1 Two access routes Two different vehicular access routes are provided, both of which connect to the public road network, provide safe access and egress to two different destinations and are available to all residents/the public at all times and under all weather conditions.	The BMP provided at the development application stage will address vehicular access during and post development.	The measures proposed are considered to comply and meet the intent of Element 3 Vehicular access.
		<u>Acceptable solution</u> A3.2 Public road A public road is to meet the requirements in Table 2, Column 1.	The BMP provided at the development application stage will demonstrate that all proposed public roads meet minimum requirements outlined in Table 2 of the Guidelines.	

		Acceptable solution A3.3 Cul-de-sac (including a dead-end-road) A cul-de-sac and/or a dead end road should be avoided in bushfire prone areas. Where no alternative exists (i.e. the lot layout already exists and/or will need to be demonstrated by the proponent), detailed requirements will need to be achieved (refer to the Guidelines for detailed cul-de-sac requirements).	Given the nature of the development is a commercial precinct, it is unlikely that cul-de-sacs will form part of the design. Notwithstanding, adherence to the requirements outlined in Table 2 of the guidelines will be demonstrated at the t development application stage.	
		Acceptable solution A3.4 Battle-axe Battle-axe access leg should be avoided in bushfire prone areas. Where no alternative exists, (this will need to be demonstrated by the proponent) detailed requirements will need to be achieved (refer to the Guidelines for detailed battle-axe requirements).	Given the nature of the development is a commercial precinct, it is unlikely that battle-axe lots will form part of the design. Notwithstanding, adherence to the requirements outlined in Table 2 of the guidelines will be demonstrated at the t development application stage.	
		Acceptable solution A3.5 Private driveway longer than 50 m A private driveway is to meet detailed requirements (refer to the Guidelines for detailed private driveway requirements).	The BMP provided at the development application stage will demonstrate that any proposed private driveways longer than 50 m meet minimum requirements outlined in Table 2 of the Guidelines.	
		Acceptable solution A3.6 Emergency access way An access way that does not provide through access to a public road is to be avoided in bushfire prone areas. Where no alternative exists (this will need to be demonstrated by the proponent), an emergency access way is to be provided as an alternative link to a public road during emergencies. An emergency access way is to meet detailed requirements (refer to the Guidelines for detailed EAW requirements).	The BMP provided at the development application stage will demonstrate that any proposed emergency access ways meet minimum requirements outlined in Table 2 of the Guidelines.	
		Acceptable solution A3.7 Fire service access routes (perimeter roads) Fire service access routes are to be established to provide access within and around the edge of the subdivision and related development to provide direct access to bushfire prone areas for fire fighters and link between public road networks for fire fighting purposes. Fire service access routes are to meet detailed requirements (refer to the Guidelines for detailed fire service access route requirements).	The BMP provided at the development application stage will demonstrate that any proposed fire service access routes meet minimum requirements outlined in Table 2 of the Guidelines.	

		<u>Acceptable solution</u> A3.8 Firebreak width Lots greater than 0.5 hectares must have an internal perimeter firebreak of a minimum width of three metres or to the level as prescribed in the local firebreak notice issued by the local government.	The BMP provided at the development application stage will demonstrate that any proposed firebreaks meet minimum requirements outlined in Table 2 of the Guidelines and the associated CoGG annual firebreak notice.	
Element 4: Water	To ensure that water is available to the subdivision, development or land use to enable people, property and infrastructure to be defended from bushfire.	<u>Acceptable solution</u> A4.1 Reticulated areas The subdivision, development or land use is provided with a reticulated water supply in accordance with the specifications of the relevant water supply authority and Department of Fire and Emergency Services.	All proposed lots will be provided a reticulated water supply and network of hydrants in accordance with local water authority, City and DFES requirements. The BMP provided at the development application stage will validate these findings.	The measures proposed are considered to comply and meet the intent of Element 4 Water.
		<u>Acceptable solution</u> A4.2 Non-reticulated areas Water tanks for fire fighting purposes with a hydrant or standpipe are provided and meet detailed requirements (refer to the Guidelines for detailed requirements for non-reticulated areas).	The proposed development will not occur within a non-reticulated area. The BMP provided at the development application stage will validate these findings.	
		<u>Acceptable solution</u> A4.3 Individual lots within non-reticulated areas (Only for use if creating 1 additional lot and cannot be applied cumulatively) Single lots above 500 square metres need a dedicated static water supply on the lot that has the effective capacity of 10 000 litres.	The proposed development will not occur within a non-reticulated area. The BMP provided at the development application stage will validate these findings.	

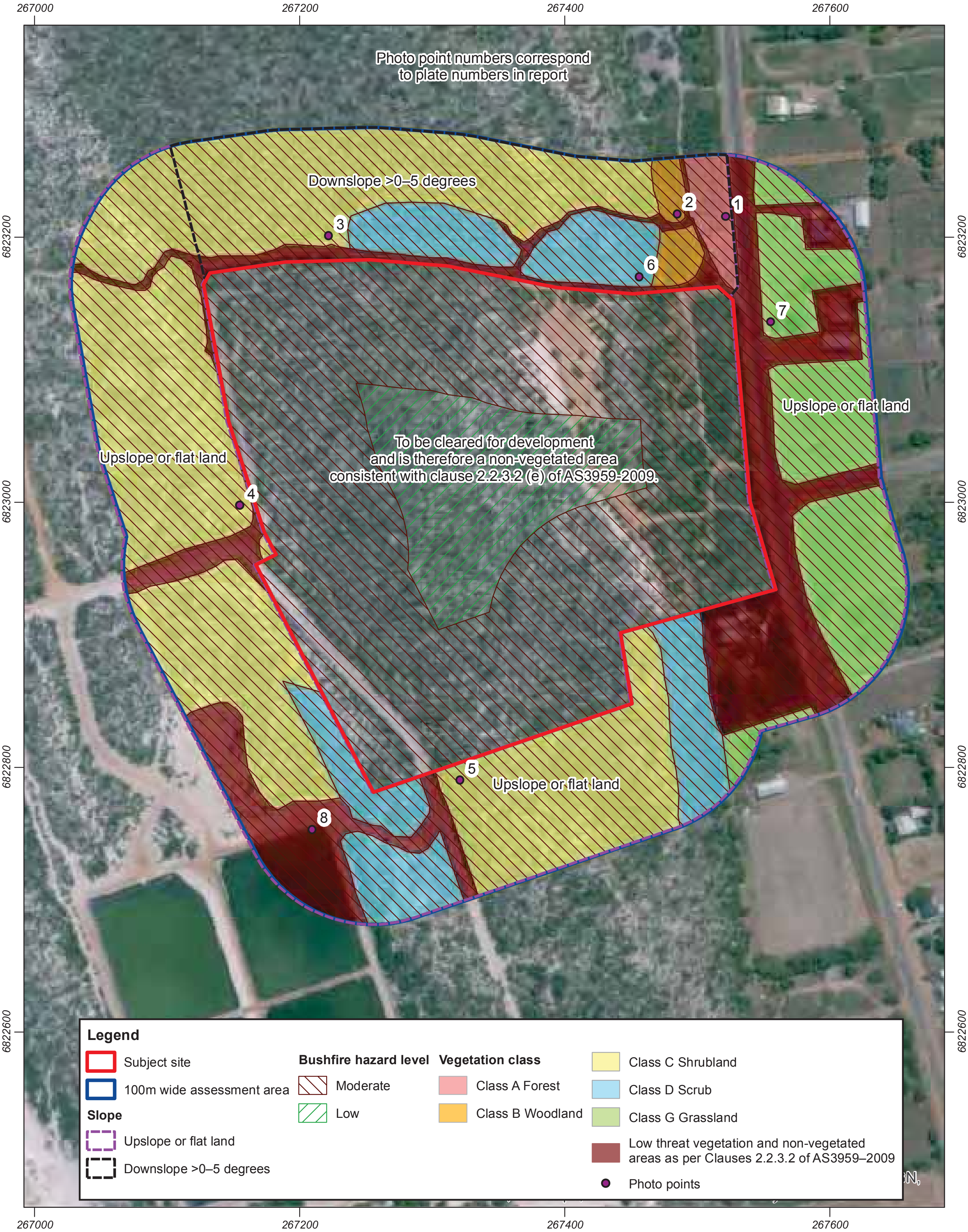

Figure 1: Vegetation class and bushfire hazard level assessment

Scale 1:3,947 at A4

0 25 50 75 100 m

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 19/07/2016
Author: JCrute
Source: Aerial image: ESRI online, approx. 2014.

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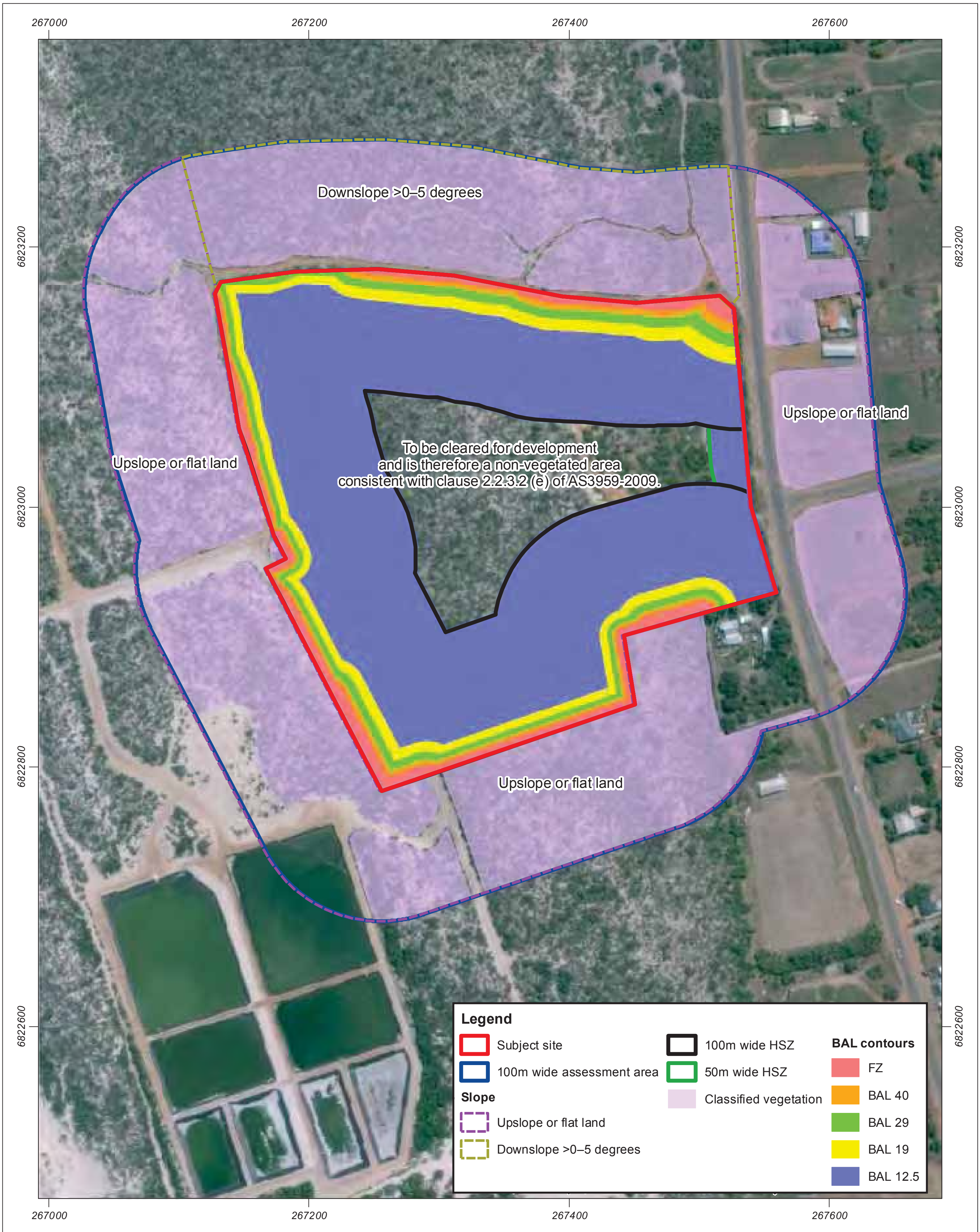

Figure 2: BAL contour assessment

Scale 1:3,947 at A4

0 25 50 75 100 m

Coordinate System: GDA 1994 MGA Zone 50

Note that positional errors may occur in some areas

Date: 20/07/2016

Author: JCrute

Source: Aerial image: ESRI online, approx. 2014.

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Conclusions and recommendations

Strategen has undertaken a bushfire hazard level and BAL contour assessment for Lot 55 Chapman Road, Geraldton. These assessments have been undertaken in accordance with the Guidelines, the *Visual guide for bushfire risk assessment in Western Australia* (DoP 2016) and AS 3959–2009. The assessments and recommendation of increased building construction standards (i.e. BALs) responds to the bushfire risk imposed by classified vegetation to the north, south, east and west of the Site in accordance with SPP 3.7 requirements.

BALs and increased building construction standards for the Site are recommended as described in Table 1 and depicted in Figure 2:

The final BALs for any proposed buildings on the Site will be determined once the location and design of future buildings are confirmed. The BMP provided at the development application stage will detail these findings.

The recommended heightened building construction standards (i.e. BALs) will ensure the affected development is built to the engineering and materiality specifications appropriate to the level of bushfire attack that may be received at the building interface. It is expected that the proposed commercial development will meet the intent of SPP3.7 through ensuring adequate separation from bushfire hazards in conjunction with the implementation of heightened construction standards applied to future buildings.

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Appendix C

Transport Assessment

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Lot 55 Chapman Road, Glenfield

Transport Impact Assessment

PREPARED FOR:

ASDC Pty Ltd

December 2016

Document history and status

Author	Revision	Approved by	Date approved	Revision type
M Rasouli	r01	R White	8/08/2016	Draft
M Rasouli	r01	R White	12/12/2016	Final

File name: t15.152mr01a.docx

Author: Mohammad Rasouli

Project manager: Behnam Bordbar

Client: ASDC Pty Ltd

Project: Lot 55 Chapman Road, Glenfield

Document revision: r01a

Project number: t15.152

TABLE OF CONTENTS

REPORT FIGURES

REPORT TABLES

1.0 Introduction

Transcore has been commissioned by ASDC Pty Ltd to prepare a Transport Impact Assessment (TIA) report for the proposed mixed-use development located at Lot 55 Chapman Road (subject site) in the City of Greater Geraldton.

In March 2014, Transcore prepared a traffic report for Stage 1 of the Lot 55 Chapman Road development. The Stage 1 Site Plan entailed a total of about 5,000m^2 NLA retail (including a Supermarket, Tavern, Liquor Store and Fast Food shops) and about 1,710m^2 NLA or 2,120m^2 GFA commercial lands and a service station.

Based on the information provided to Transcore, It is our understanding that the Development Application for the subject site has been withdrawn and ASDC Pty Ltd is commencing a structure planning process based on Bulky Goods Showroom land uses.

The proposed mixed-use development on Lot 55 forms part of the Glenfield Beach Activity Centre Master Plan which extends to Lot 9000 located to the north of Lot 55. A copy of the proposed Glenfield District Activity Centre Precinct Conceptual Master Plan (hereafter referred to as the Master Plan) is provided in **Appendix A** of this report. The following documents have been reviewed and acknowledged for the preparation of this report:

- *The Integrated Transport Strategy for the City of Geraldton prepared by Cardno in April 2015; and,*
- *Traffic Impact Assessment report prepared by AECOM for the Glenfield Beach Activity Centre in October 2012 and revised in December 2013.*

The subject site is located on Lot 55 Chapman Road approximately 10 km north of the Geraldton central business district. The subject site is shown in **Figure 1**.

Figure 1: Location of the Subject Site

2.0 Proposed Development Concept Plan

The proposed Development Concept Plan (DCP) is illustrated in **Figure 2**. The DCP comprises a total of about 32,040m^2 GFA bulky goods showroom land use, a 120m^2 service station and 1,500m^2 liquor store.

Figure 2: Proposed Development Concept Plan

A total of 1,323 parking bays are proposed for the DCP area which meets and exceeds the City of Greater Geraldton parking requirement. Access and egress to the proposed DCP area is through two roundabout intersections on Chapman Road which is in line with the proposed Master Plan for the Glenfield Activity Centre. The internal road network of the proposed DCP area consists of a series of neighbourhood connector roads including Sunset Blvd, road 01, road 02 and an access road (road 03).

3.0 Existing Situation

3.1 Existing Land Use

Currently, the site is vacant. Adjacent land uses to the south and north are also vacant. There are few existing residential lots to the east of Chapman Road.

3.2 Existing Road Network

Chapman Road forms the eastern boundary of the subject site with a posted speed limit of 90km/h in the vicinity of the site. It is currently constructed to 2 lanes undivided standard with approximately 8m sealed width (3.5m traffic lanes, 0.5m sealed shoulder and wider unsealed shoulder width). In the vicinity of the subject site, it is classified as a Neighbourhood Connector road. Further south, Chapman Road is classified as a District Distributor Road. According to the information obtained from the City of Greater Geraldton, in June 2011, Chapman Road carried about 3,000vpd south of Glenfield Beach Drive and 3,230vpd north of Okahoma Road. The heavy vehicle component is reported about 7% at these two locations.

According to the information obtained from MRWA Chapman Road carried about 2,600vpd in 2014/2015 north of Glenfield Beach Drive and 5,700vpd north of Chapman Valley Road.

3.3 Public Transport

The closest existing bus route to the subject site is Bus Route No. 850 which traverses along Chapman Road and terminates at Drummond Cove (refer **Figure 3**). The closest bus stop is about 170m north of Hagan Road.

Figure 3: Existing Bus Route

3.4 Pedestrian and Cyclist Facilities

Currently, there is no pedestrian or cyclist facility on Chapman Road in the vicinity of the subject site.

3.5 Changes to the Surrounding Road Network

The changes to the surrounding road network due to the proposed DCP area are the construction of two roundabout intersections on Chapman Road.

The Integrated Transport Strategy for City of Geraldton (April 2015) indicates that the current hierarchy classification of Chapman Road is Local Distributor, between Cathedral Avenue and Phelps Street; and District Distributor north of Phelps Street and in the vicinity of the subject site.

The strategy proposes the transition to urban cross section for Chapman Road, from Sunset Beach to Drummonds Cove through the future Glenfield Activity Centre, incorporating on and off road cycle lanes.

3.6 Public Transport Network Planning

The City of Greater Geraldton has prepared a Local Planning Strategy for the City. The Strategy includes an indicative rapid transit alignment running parallel to the coast from Cape Burney to Oakajee via central Geraldton, as shown in the Geraldton Urban Area Strategy Plan (refer Appendix B).

This route, which is a long-term proposal at this stage, runs along Chapman Road in the vicinity of the subject site and will ultimately provide a bus 'spine' linking the Geraldton Urban Area from north to south.

Investigation of a BRT as a long term option is also akcnowledged in the Integrated Transport Strategy for City of Geraldton (April 2015).

4.0 Proposed Transport Network

4.1 Road Hierarchy

Figure 4 indicates the proposed road hierarchy of the roads within the Glenfield Beach District Activity Centre. According to this figure, Chapman Road would be classified as an Integrator B road in the short to medium term and in the long term, this road is proposed to be widened to two lanes in each direction and upgraded to an Integrator 'A' road.

Sunset Blvd and Road 01 which provide connections to Chapman Road are classified as Neighbourhood Connector B roads as per Figure 4. Road 02 and Road 03 are not shown in Figure 4. Road 02 would be classified as Neighbourhood Connector B road. Road 03 is 15m Access Street.

Figure 4: Proposed Road Hierarchy

(*Source: AECOM Traffic Impact Assessment, Dec 2013*)

4.2 Public Transport

As outlined in Section 3.3 and 3.6 of this report, currently bus route 850 traverses along Chapman Road and will service the subject site. According to the Local Planning Strategy for the City, in future an indicative rapid transit alignment running parallel to the coast would traverse along Chapman Road in this vicinity.

4.3 Integration with Surrounding Area

The proposed land uses for the proposed DCP area are mixed-use which is in line with the existing land uses in this area and the proposed land uses within the Master Plan.

The road network of the DCP area is planned to connect to Chapman Road and the future adjacent land uses within the Glenfield Beach District Activity Centre from the north.

4.4 Pedestrian and Cyclist Facilities

The Glenfield Beach Development Transport Assessment (AECOM, 2013) indicates dedicated cycle lanes and footpaths on both sides of Chapman Road and a shared path along Sunset Blvd. Figure 5 illustrates the proposed pedestrian routes within the DCP area.

Figure 5: Pedestrian Routes

5.0 Analysis of the Transport Network

5.1 Assessment Period

The assessment year that has been adopted for this analysis is 2018 (the outset of the development) and year 2031 with the assumption that the DCP area and surrounding future developments would be fully developed and occupied by the year 2031. The development peak hour is expected to be in the evening during the typical weekdays and at lunch time during the weekends. The combination of the development traffic and road network traffic is expected to be higher during the road network PM peak hours. Therefore the intersection analysis is based on the PM peak hours.

5.2 Traffic generation and distribution

The "Guide to Traffic Generating Developments, Roads and Traffic Authority (RTA) of New South Wales" (2002) document was used to establish the applicable traffic generation rates for the proposed development. For the trip generation of the proposed service station the Institute of Transportation Engineers, USA guidelines were sourced. **Table 1** summarises the trip generation of the proposed development.

The proposed development comprises a total of about 32,040m^2 GFA bulky goods showroom land uses. For the purpose of trip generation estimation the proposed 32,040m^2 GFA land uses were split into three different categories as described in Table 1.

Table 1: PM Peak Hour Trip Generation

Land uses	GFA (m^2)	Trip Rate per 100m^2 GFA (vph)	Trip Generation (vph)
Showroom (large)	12,500	2.76	345
Showroom (medium)	19,300	3.94	760
Showroom (small)	240	5.67	14
Service Station	120 (assume 4 bowsers)	13.33 per bowser	53
Liquor Store	1,500	2	30
Total			1,200vph

Accordingly, the total trip generation of the DCP area during the development peak hours is estimated to be about 1,200vph. Considering that the proposed mixed-use development is located within the Glenfield Beach Activity Centre, a significant level of cross-trade and multi-purpose trips is expected for the development. Accordingly, it is assumed that about 30% of the total trips are internal trips and about 70% or 840 trips would be distributed to the external roads during the PM peak hours.

It is expected that about 80% of the development traffic would travel to/ from the south and about 20% to/ from the north. Figure 6 illustrates the traffic distribution of the proposed development on the surrounding roads and intersections.

It must be noted that the proposed service station within the development is not expected to generate additional traffic, but it will attract the passing traffic on Chapman Road.

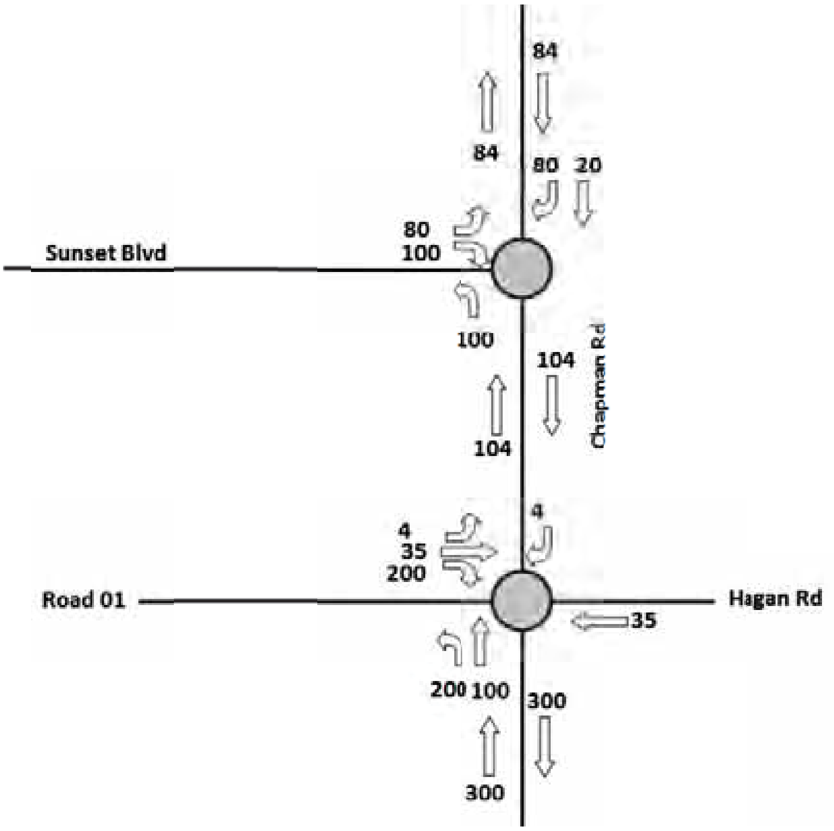


Figure 6: Peak Hour Trip Distribution of the DCP Area

5.3 Traffic Flow Forecasts

The existing traffic counts and the expected traffic increase due to the proposed development on the surrounding roads are summarised in Table 2.

Table 2: Existing and Increase in Peak Hour Traffic Flows

Road	Location	Existing (vph)	Traffic Increase	Total Traffic (vph)
Chapman Road	North of the DCP area	300	168	468
Chapman Road	South of the DCP area	323	600	923
Road 01	Fronting the DCP area	0	480	480
Sunset Blvd	Fronting the DCP area	0	360	360

5.4 Intersection Analysis

The proposed roundabout at the intersection of Chapman Road/ Hagan Road/ Road 01 is expected to be busier than the northern one after full development of the DCP area and therefore the operation of this roundabout has been analysed in detail in this report.

Intersection operation has been analysed using the SIDRA intersection analysis software program for the development peak hour. SIDRA outputs are presented in the form of Degree of Saturation, Level of Service, Average Delay and 95% Queue. These items are defined as follows:

Degree of Saturation: is the ratio of the arrival traffic flow to the capacity of the approach during the same period. The Degree of Saturation ranges from close to 0% for very low traffic flow up to 100% for saturated flow or capacity.

Level of Service: is the qualitative measure describing operational conditions within a traffic stream and the perception by motorists and/or passengers. In general, there are 6 levels of service, designated from A to F, with Level of Service A representing the best operating condition and Level of Service F the worst. In SIDRA intersection analysis the level of service is based on the average delays experienced by each traffic movement.

Average Delay: is the average of all travel time delays for vehicles through the intersection.

95% Queue: is the queue length below which 95% of all observed queue lengths fall.

The analysis has been undertaken for the PM peak hour on a typical day which is expected to be busier than the AM peak hour due to the nature of the proposed development. The projected turning movements at the proposed roundabout during the PM peak hour are illustrated in **Figure 6**. The projected traffic volume on Chapman Road for year 2018 has been established by assuming 2% annual traffic growth on Chapman Road by the year 2018 (outset of the development). The 2031 traffic volume on Chapman Road has been extracted from the Glenfield Beach Development Transport Assessment (AECOM, 2013). In the year 2031 it is assumed that Chapman Road would be upgraded to 4 lanes. The appropriate results from the detailed SIDRA outputs are presented in **Appendix C**.

Figure C1 and **Figure C2** provide the SIDRA diagram of the intersection layout that has been analysed with SIDRA for the year 2018 and 2031 respectively.

Table C1 and Table C2 present the SIDRA results for the post-development traffic flows for the year 2018 and 2031 respectively. The proposed roundabout performs well in the PM peak hour, with overall level of service A for both time horizons, which indicates this roundabout will operate satisfactorily with considerable spare capacity still available.

5.5 Pedestrian / Cycle Networks

The proposed network of shared paths and footpaths are described in section 4.4 of this report. This network of paths will provide accessibility and permeability for pedestrians and cyclists within the DCP area and facilitate connections to adjacent developments and the surrounding road network.

5.6 Access to Public Transport

The existing Bus Route No. 850 and potential future rapid transit route along Chapman Road will provide public transport access to the DCP area with bus stops being in walking distance from the site.

6.0 Conclusions

The proposed Development Concept Plan for Lot 55 Chapman Road comprises a total of about 32,040m^2 GFA bulky goods showroom land use, a 120m^2 service station and 1,500m^2 liquor store.

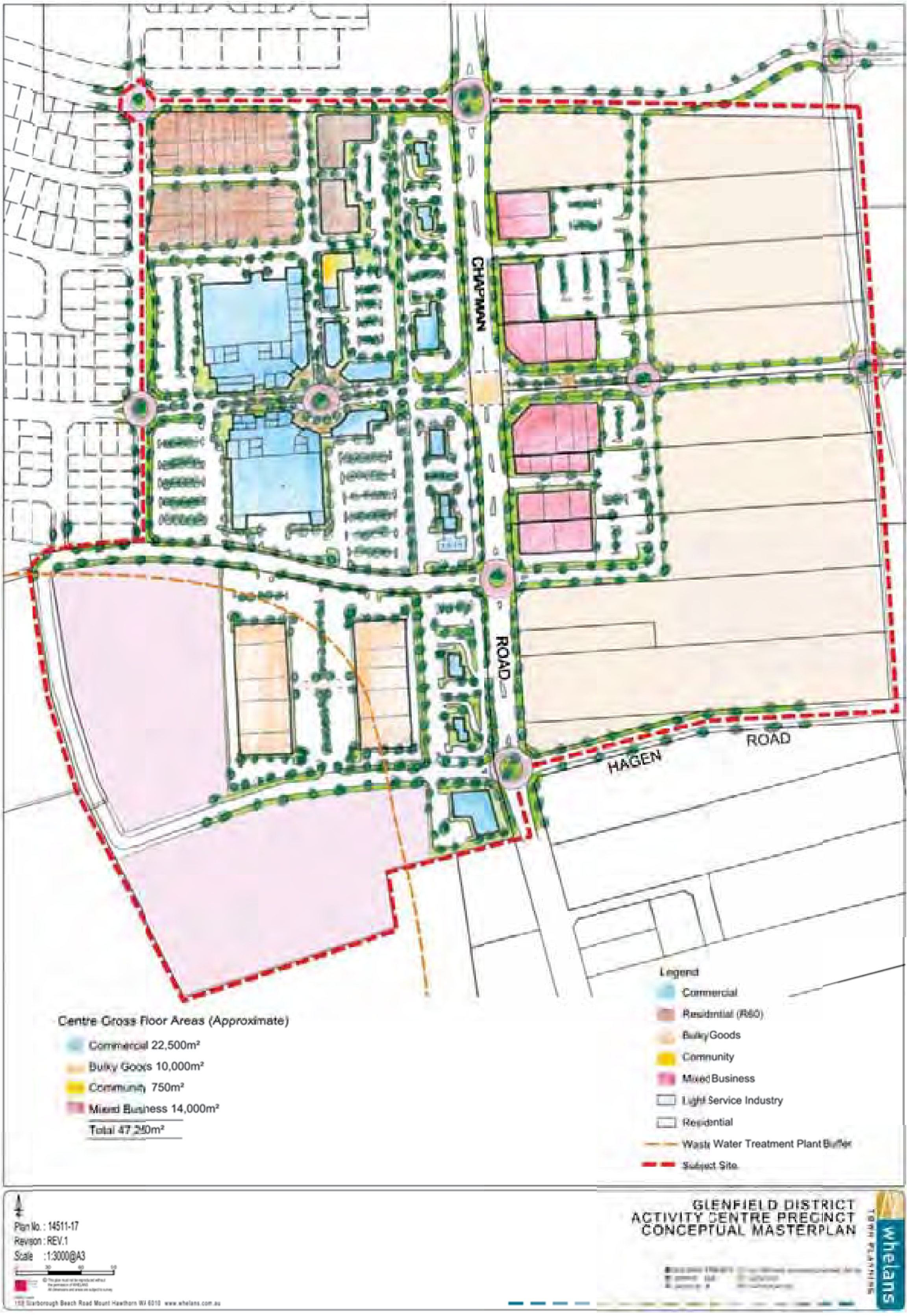
Total traffic generation of the site is expected to be about 1,200vph. 30% of the total traffic is expected to be internal trips and about 70%, or 840vph is expected to be distributed to the external roads and intersections.

The proposed single lane roundabout at the intersection of Chapman Road/ Hagan Road/ Road 01 is expected to operate satisfactorily during peak hours at the outset of the development and the year 2031.

The existing standard of Chapman Road would be able to accommodate the development traffic at the outset of the development. Chapman Road would be classified as Integrator B road in the short to medium term and in the long term this road is proposed to be widened to two lanes in each direction and upgraded to an Integrator 'A' road.

Appendix A

Glenfield District Activity Centre Precinct Conceptual Master Plan


CHAPMAN
ROAD
HAGEN
ROAD
Centre Gross Floor Areas (Approximate)
Commercial 22,500m²
Bulky Goods 10,000m²
Community 750m²
Mixed Business 14,000m²
Total 47,250m²
Legend
Commercial
Residential (R60)
Bulky Goods
Community
Mixed Business
Light Service Industry
Residential
Waste Water Treatment Plant Buffer
Subject Site
Plan No. : 14511-17
Revision : REV.1
Scale : 1:3000@A3
158 Scarborough Beach Road Mount Hawthorn WA 6016 www.whelans.com.au
GLENFIELD DISTRICT
ACTIVITY CENTRE PRECINCT
CONCEPTUAL MASTERPLAN
TOWN PLANNING
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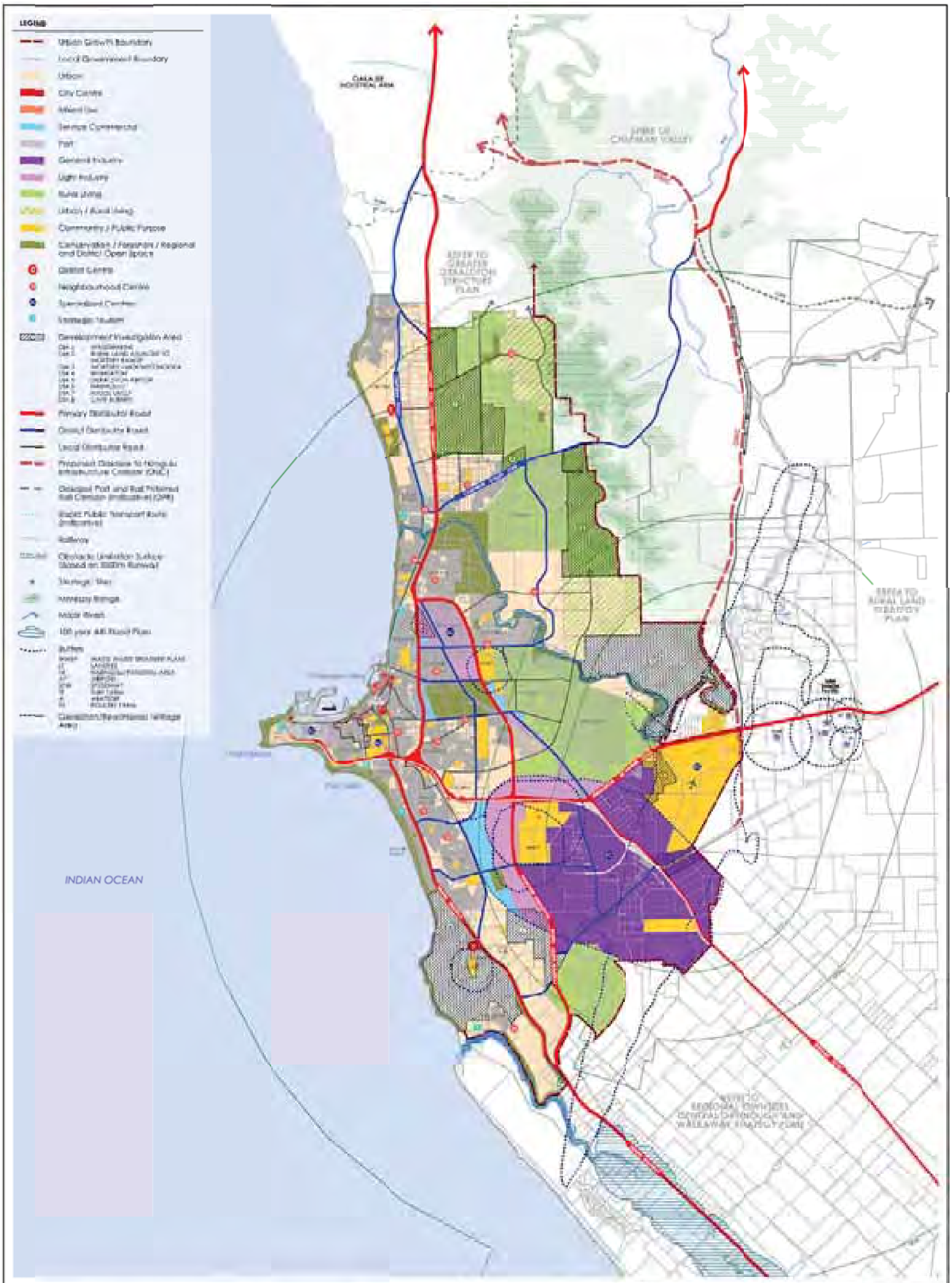
Appendix B

Geraldton Urban Area Strategy Plan



Geraldton Urban Area Strategy Plan
City of Greater Geraldton Local Planning Strategy

Appendix C

Intersection Analysis

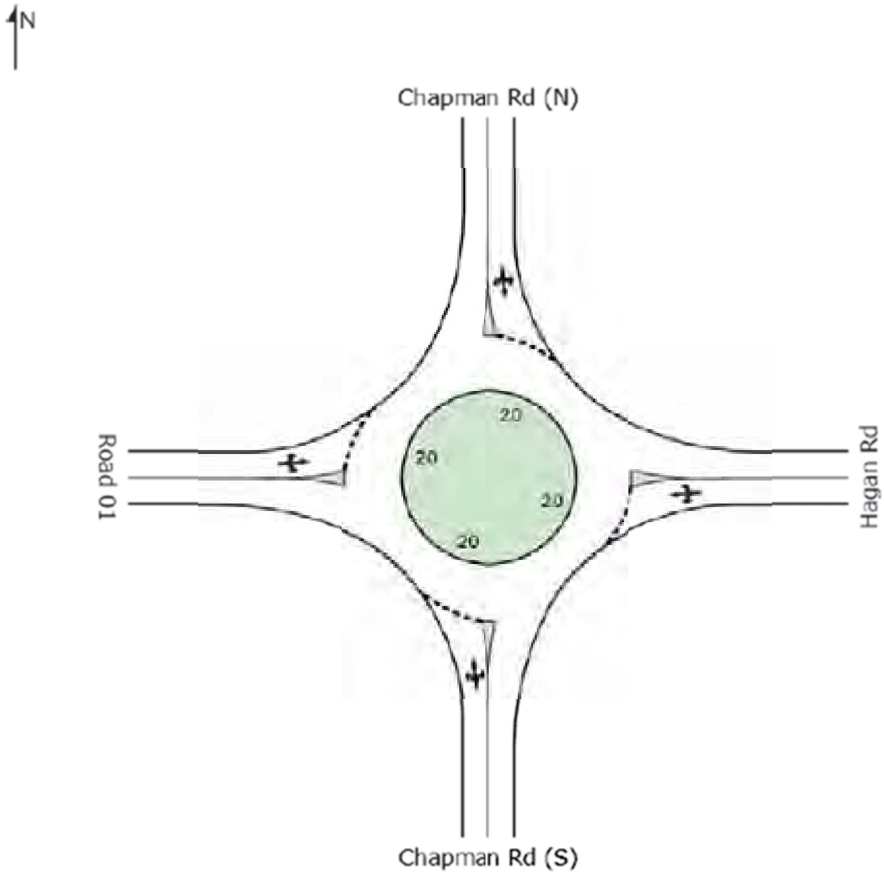


Figure C1: Proposed Intersection Layout, 2018

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Chapman Rd (S)											
1	L	211	7.0	0.342	6.8	LOS A	2.4	18.1	0.23	0.52	49.9
2	T	283	7.0	0.342	5.8	LOS A	2.4	18.1	0.23	0.44	50.5
3	R	11	7.0	0.342	11.6	LOS B	2.4	18.1	0.23	0.78	46.3
Approach		504	7.0	0.342	6.3	LOS A	2.4	18.1	0.23	0.48	50.1
East: Hagan Rd											
4	L	11	7.0	0.063	9.0	LOS A	0.3	2.5	0.57	0.65	48.0
5	T	37	7.0	0.063	8.0	LOS A	0.3	2.5	0.57	0.60	48.1
6	R	11	7.0	0.063	13.8	LOS B	0.3	2.5	0.57	0.79	45.0
Approach		58	7.0	0.063	9.3	LOS A	0.3	2.5	0.57	0.64	47.4
North: Chapman Rd (N)											
7	L	11	7.0	0.270	8.0	LOS A	1.7	12.4	0.50	0.64	48.6
8	T	283	7.0	0.270	7.0	LOS A	1.7	12.4	0.50	0.58	48.8
9	R	4	7.0	0.270	12.8	LOS B	1.7	12.4	0.50	0.82	46.0
Approach		298	7.0	0.270	7.1	LOS A	1.7	12.4	0.50	0.59	48.8
West: Road 01											
10	L	4	7.0	0.233	8.2	LOS A	1.3	9.9	0.50	0.61	47.8
11	T	37	7.0	0.233	7.2	LOS A	1.3	9.9	0.50	0.56	48.0
12	R	211	7.0	0.233	13.0	LOS B	1.3	9.9	0.50	0.73	44.8
Approach		252	7.0	0.233	12.1	LOS B	1.3	9.9	0.50	0.71	45.3
All Vehicles		1112	7.0	0.342	8.0	LOS A	2.4	18.1	0.38	0.57	48.4

Table C1: SIDRA results – 2018
Chapman Road / Hagan Road / Road 01, PM Peak Hour

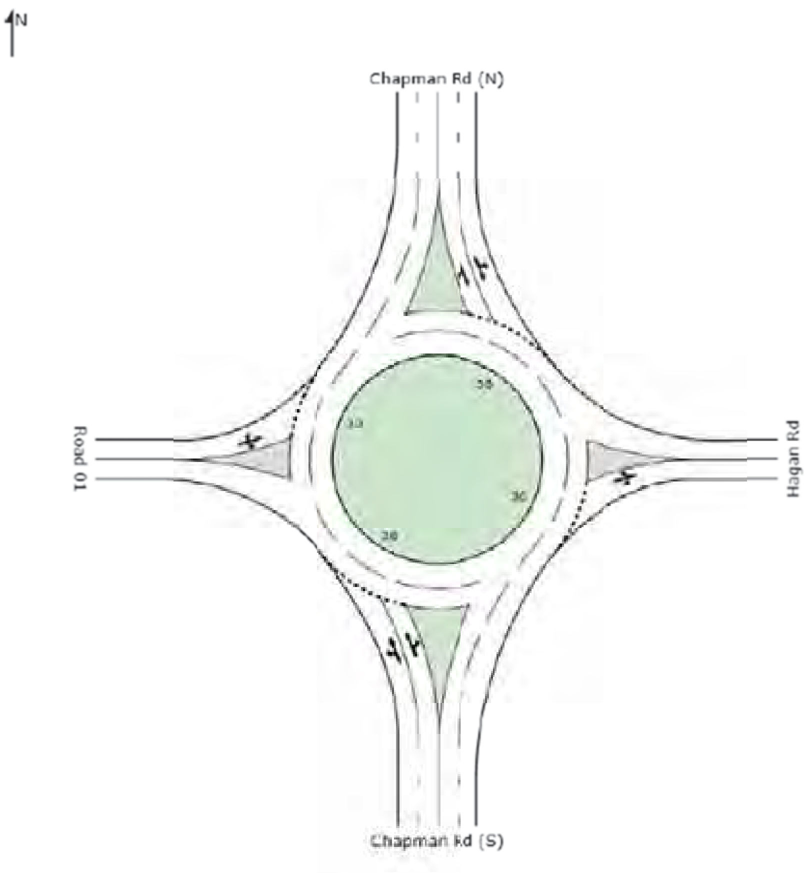


Figure C2: Proposed Intersection Layout, 2031

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
Movement Performance - Vehicles											
South: Chapman Rd (S)											
1	L	211	0.0	0.574	5.6	LOS A	4.8	34.9	0.07	0.51	51.6
2	T	1653	7.0	0.574	4.5	LOS A	4.8	35.7	0.08	0.37	53.0
3	R	11	0.0	0.574	11.2	LOS B	4.8	35.7	0.08	0.94	46.7
Approach		1874	6.2	0.574	4.7	LOS A	4.8	35.7	0.07	0.39	52.8
East: Hagan Rd											
4	L	1	0.0	0.005	9.1	LOS A	0.0	0.2	0.69	0.64	47.6
5	T	1	0.0	0.005	8.1	LOS A	0.0	0.2	0.69	0.61	47.5
6	R	1	0.0	0.005	15.0	LOS B	0.0	0.2	0.69	0.76	44.2
Approach		3	0.0	0.005	10.7	LOS B	0.0	0.2	0.69	0.67	46.3
North: Chapman Rd (N)											
7	L	11	0.0	0.464	6.8	LOS A	3.2	24.0	0.53	0.60	49.2
8	T	1093	7.0	0.464	5.8	LOS A	3.2	24.0	0.53	0.52	49.4
9	R	4	0.0	0.464	12.6	LOS B	3.1	23.3	0.54	0.85	46.6
Approach		1107	6.9	0.464	5.8	LOS A	3.2	24.0	0.53	0.52	49.4
West: Road 01											
10	L	4	0.0	0.381	11.7	LOS B	1.8	12.8	0.73	0.89	44.7
11	T	37	0.0	0.381	10.7	LOS B	1.8	12.8	0.73	0.87	45.0
12	R	211	0.0	0.381	17.6	LOS B	1.8	12.8	0.73	0.97	41.7
Approach		252	0.0	0.381	16.5	LOS B	1.8	12.8	0.73	0.96	42.2
All Vehicles		3236	5.9	0.574	6.0	LOS A	4.8	35.7	0.28	0.48	50.5

Table C2: SIDRA results – 2031
Chapman Road / Hagan Road / Road 01, PM Peak Hour

Appendix D

Retail Needs Analysis

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ASDC PTY LTD

LOT 55 RETAIL ANALYSIS

TECHNICAL BRIEFING NOTE

JUNE 2016

DISCLAIMER

This report has been prepared for **ASDC Pty Ltd**. The information contained in this report has been prepared with care by the authors and includes information from apparently reliable secondary data sources which the authors have relied on for completeness and accuracy. However, the authors do not guarantee the information, nor is it intended to form part of any contract. Accordingly all interested parties should make their own inquiries to verify the information and it is the responsibility of interested parties to satisfy themselves in all respects.

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Document Control				
Document Version	Description	Prepared By	Approved By	Date Approved
v 0.1	Lot 55 Retail Analysis	Sam Mazzer	Robert Kyne	17-06-16
v 0.2	Lot 55 Retail Analysis	Sam Mazzer	Robert Kyne	28-06-16

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CONTENTS

1.0

1 INTRODUCTION

Pracsys has been commissioned by General Property Assets to conduct a retail needs analysis of the proposed Lot 55, Chapman Rd development. The analysis is intended to test the market potential of the planned bulky goods development at Lot 55 Chapman Rd. This report is designed as an interim report to inform the concept design undertaken by TPG by testing market capacity for the development at this time. The report covers:

- Demand catchment estimation
- Supply catchment estimation
- Turnover and productivity forecasting
- Recommendations

2.0

2 CONTEXT

The site for the proposed development is situated in the locality of Glenfield approximately 9.3km north of the Geraldton CBD. It is situated on a major road connecting the northern residential areas to the main town site and other southern residential areas affording it good visibility and connectivity to various sections of the population. The development is reasonably far removed from other competing bulky goods centres in the area, giving it a locational advantage to the local population. This is particularly beneficial as the majority of population growth in Geraldton is expected to occur in these northern areas as evidenced by a number of structure plans submitted for the area.

The design as it stands consists of a mixture of large, medium and small showrooms. These are expected to house tenants such as Bunnings, City Farmers and BBQ's Galore as well as other, smaller format bulky goods.

2.1 COMPLEMENTARY CENTRES

The Lot 55 development is anticipated to precede the development of Lot 9000 directly to the North. Lot 9000 is designated as a district centre in local planning policies and is likely to contain more traditional retail uses with a small contingent of bulky goods. In the retail sphere, this trend of co-locating bulky goods with traditional retail uses is becoming more and more prevalent for large format retail developments. The approach offers more flexibility for developers in allowing traditionally narrowly focused large format retailing to offer a range of different services. The co-location with the district centre is expected to offer many benefits[1]:

- The district centre is expected to include a supermarket; this will act as an anchor of sorts that attracts users and reinforces habit forming behaviours. As such, the supermarket will assist in attracting and retaining customers which in turn will increase dwell time in the centre and increases opportunistic shopping and potential spend.
- Bulky goods typically operate predominantly as weekend traders, by introducing diversity and traditional retail to the mix of uses the precinct will allow for more 'round the clock activation. This in turn promotes habit forming behaviours, higher foot traffic and improves the attractiveness of the centre which can result in a much higher potential spend due to increased exposure.
- The co-location allows the development to be represented as a full line shopping destination (with all the associated benefits) while retaining its own identity as a bulky goods centre.
- These benefits are likely to assist in the ability to attract and retain higher quality retailers that can attract a wider catchment and bring greater value to the site.

Given these benefits, the co-location is expected to significantly benefit the Lot 55 development as well as promoting improved consumer outcomes.

It should be noted that central to the success of co-location is the removal of barriers (perceived, physical or otherwise) between the centres. If permeability between the two centres is hampered in any way, it is expected

1 Craig Godber, Diversity Without Diluting Focus, 2015, CBRE Viewpoint

that the benefits of co-location would be reduced as the centres operate as separate entities. As such, traffic calming or avoidance measures to assist the connectivity between both centres is recommended.

2.2 LOCAL PLANNING POLICY

Any development in Geraldton will be expected to comply with the local planning policy and support the policy objectives defined in it. The Geraldton local planning scheme makes no specific reference to Bulky Goods except to define it as:

- Premises used to sell by retail any of the goods and accessories of the following types that are principally used for domestic purposes
    - o Automotive parts and accessories
    - o Camping, outdoor and recreation goods
    - o Electric light fittings
    - o Animal supplies including equestrian and pet goods
    - o Floor and window coverings
    - o Furniture, bedding, furnishings, fabrics, manchester and homewares
    - o Household appliances, electrical goods and home entertainment goods
    - o Party supplies
    - o Office equipment and supplies
    - o Babies' and children's goods, including play equipment and accessories; (xi) sporting, cycling, leisure, fitness goods and accessories
    - o Swimming pools
- Premises used to sell by retail goods and accessories if:
    - o A large area is required for the handling, display or storage of the goods; or
    - o Vehicular access is required for the premises for the purpose of collection of purchased goods

3.0

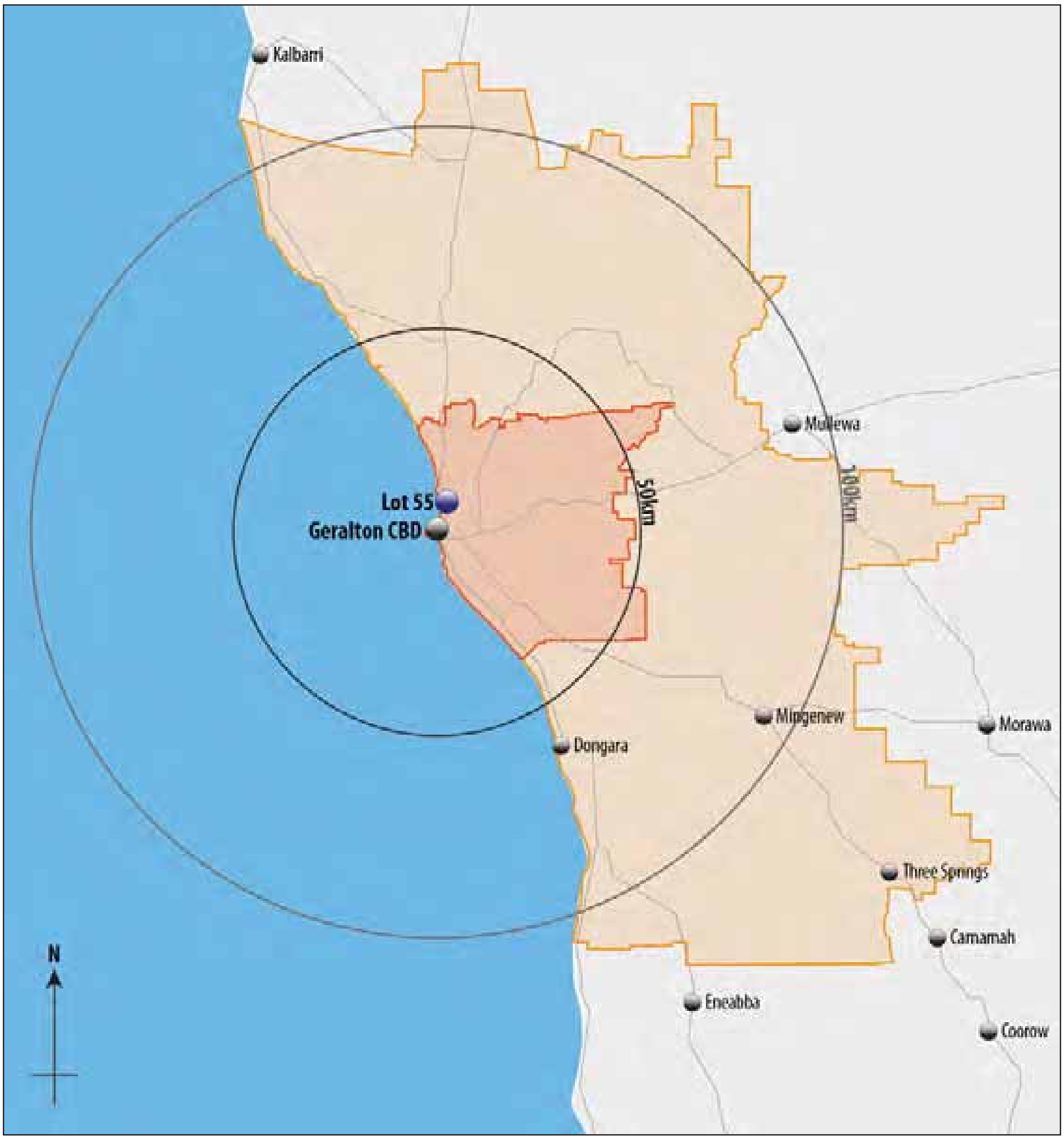
3 DEMAND

3.1 DEMAND CATCHMENT

As a major regional town, Geraldton is expected to service a significant portion of the Midwest. Therefore, it is expected that consumers are likely to travel larger distances for their bulky goods needs. The primary and secondary catchment of Lot 55 is shown in Figure 1.

The primary catchment includes approximately 80% of all dwellings in the main trade area and includes the major residential area of Geraldton. The primary catchment stretches approximately 20km to the north of Lot 55 and approximately 50km east and south. The secondary catchment surrounds the primary catchment, and includes residents that reside up to 100km from Lot 55.

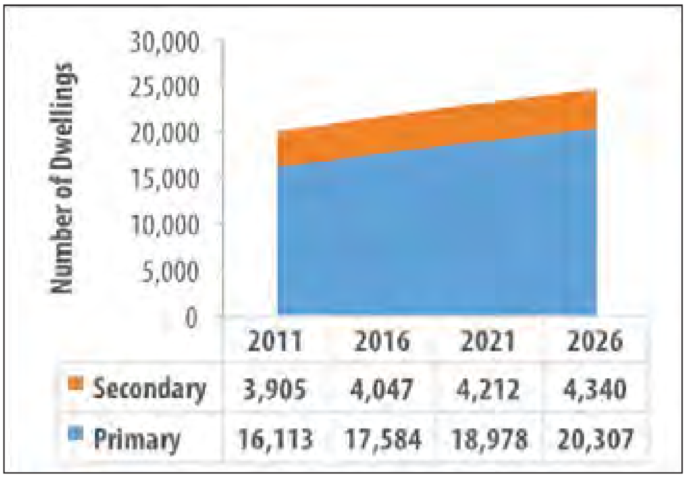
Figure 1. Lot 55 Catchment



Source: Pracsys (2016)

The number of dwellings in the primary and secondary catchment were drawn from the 2011 Census. Estimates of dwelling growth were based on Band C projections for Statistical Area 2 (SA2) locations from WA Tomorrow before being aggregated into the respective catchments.

Figure 2. Catchment Area Dwelling Growth Forecast



Source: Pracsys (2016), WA Tomorrow (2016), ABS Place of Residence (2011)

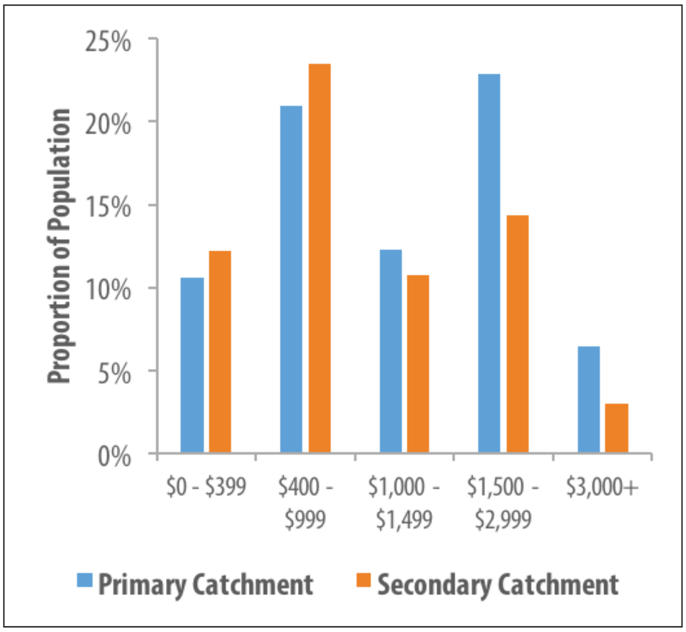
Significant growth is likely to be concentrated in the northern corridor, outlined in planning policies such as the Glenfield Beach Local Structure Plan, Glenfield District Structure Plan and Waggrakine Structure Plan.

The Glenfield District Activity Centre Plan is of particular interest as it expresses potential land uses for Lot 9000, a 12-hectare parcel of land directly north of Lot 55. It is anticipated that Lot 9000 will have up to 100 dwellings and a large area dedicated to bulky goods and traditional retail trade.

An analysis of proposed structure plans and housing developments reveals that the majority are located in the northern end. Recognising the current WA Tomorrow projections may not accurately account for the proposed developments and finer grain data, Pracsys has redistributed some of the future population growth away from the above mentioned areas, concentrating 70% of future dwelling growth in the northern corridor.

ABS Census 2011 data indicates the level of income per dwelling in the primary and secondary catchments (Figure 3).

Figure 3. Catchment Area Population Income Profile



Source: Pracsys (2016), ABS Place of Residence (2011)

As shown, the majority of households are in the second and fourth income quintiles. In general, the income of the primary catchment exceeds that of the secondary catchment. There is a significant portion of households in the fourth income quintile ($1,500 - $2,999) indicating a large expenditure pool in close proximity to the proposed Lot 55 development.

3.2 EXPENDITURE

Bulky goods expenditure was calculated based upon the number of dwellings in the catchment area, their incomes and likely expenditure pattern based on the ABS Household Expenditure Survey. The basket of goods used to calculate potential turnover included all bulky goods categories. Some additional spending items were included due to uncertainty around tenancy mix in the area.

The bulky goods items include but are not limited to:

- Furniture and Floor Coverings
- Household Appliances
- Audio-visual Equipment and Parts
- Motor Vehicle Purchases
- Other recreational equipment
- Animal Expenses
- Household Non-durables

Items included to supplement the basket include but are not limited to:

- Selected Clothing Items (such as sporting clothing)
- Alcoholic Beverages

The basket of goods selected reflects a tenancy mix commonly found in bulky goods developments. Based on this, the expenditure pool has been calculated from 2018, consistent with an estimated operational time for Lot 55 (Figure 4).

Figure 4. Catchment Area Expenditure Pool ($m, $2016)

	2018	2020	2022	2024	2026	2028
Expenditure ($m)	$306.9	$320.7	$335.1	$350.4	$362.0	$378.7

Source: Pracsys (2016)

As shown, the expenditure pool (less leakage) grows from $306.9m to $378.7m. This is expected to be through a combination of dwelling and real retail expenditure growth.

4 SUPPLY

Due to the lack of a central collated source of supply side information, a combination of methods was used to establish the Net Lettable Area (NLA) for bulky goods and similar retail in the catchment area. The Land Use Survey (LUS) conducted by the Department of Planning (DoP) and City of Greater Geraldton (CoGG) provided an initial source of information. This was supplemented by Pracsys' own database of new developments and finally a desktop search for new local bulky goods retailers and centres was conducted. When new floorspace was discovered, its NLA was estimated through GIS techniques and added to the model. Major bulky goods retailer locations are shown in Figure 5.

Figure 5. Bulky Goods Retailers

Source: Pracsys (2016)

Early estimations by TPG suggest that Lot 55 could have a total floor space of 32,800m^2. Given this, it is assumed that there will be an NLA of approximately 27,880m^2 designated to bulky goods with the remaining anticipated to accommodate other services such as a car wash. It is anticipated that Lot 9000 will be completed in 2020, two years after Lot 55, providing an additional 8,500m^2 NLA in bulky goods floor space.

Figure 6. Bulky Goods Retail Floor Space

Bulky Goods Floor Space	Other Retail NLA (m^2)
Lot 55	27,880
Lot 9000	8,500
Geraldton Furniture And Bedding	580
Kohler Bathroom Showroom	661
Geraldton CBD	6,857
Fifth St	250
Northgate Centre	1,098
Geraldton Central 2	90
Geraldton ISO Uses North	150
Geraldton ISO Uses South	400
Wonthella	250
Webberton Industrial And Commercial Area	29,125
Wonthella Industrial And Commercial	22,476
Westend/Beachlands	1,790
Geraldton Airport	75
Utakarra	54
Total	91,736

Source: Pracsys (2016), CoGG (2012), DoP (2010)

As shown in Figure 6, three major bulky goods developments (Webberton, Wonthella and the CBD) currently exist in Geraldton. These are expected to be Lot 55's major competition given the entrenched behaviours that are likely to be associated with these areas. Webberton and Wonthella are also of a size that they will compete with Lot 55 in terms of scale, choice and variety. The Greater Geraldton area currently accommodates (but not limited to) businesses such as:

- The Good Guys
- Godfrey's
- Repco
- BBQ's Galore
- City Farmers
- Spotlight

At present, no indication of other Bulky Goods developments has been found. As such, floor space has been assumed to remain constant over the 10-year period.

5.0

5 TURNOVER AND PRODUCTIVITY

5.1 TURNOVER

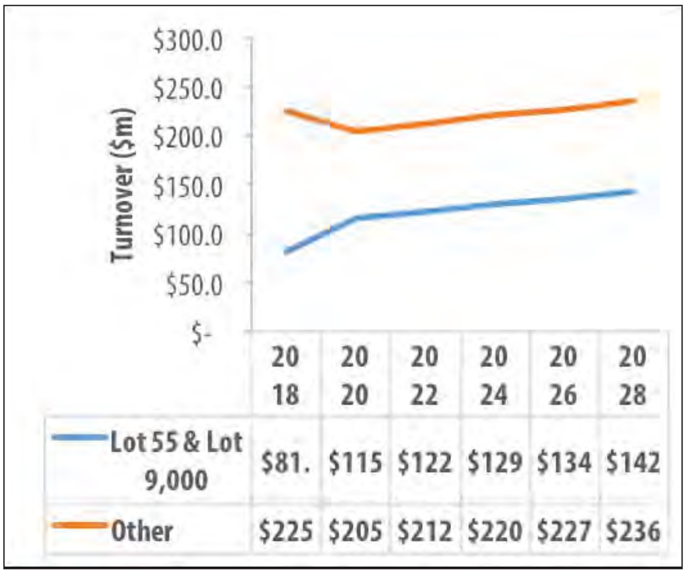
Demand analysis was used to estimate the market potential for the bulky goods offering in the catchment area. Market potential can be derived from three sources:

- Growth in available expenditure either as a result of population growth or as a result of growth in real expenditure
- Capture of expenditure from existing offerings
- Reduction of expenditure through leakage from the catchment area

The additional bulky goods floor space at Lot 9000 which is anticipated to be occupied from 2020 has been included with Lot 55 to reflect their operation as one activity centre.

Figure 7 illustrates the total estimated turnover for Lot 55, Lot 9000 and all other bulky goods retailers in Geraldton.

Figure 7. Estimated Total Turnover of Current Floor Space, Lot 55 and Lot 9000 ($m)



Source: Pracsys (2016)

It is estimated that the turnover of Lot 55 alone will rise from $81.6m in 2018 to $108.1m in 2028, accounting for approximately 75% of the total turnover per annum.

It is anticipated that large floor space available when Lot 55 and Lot 9000 are operational in 2020 will lead to a higher rate of turnover at Lot 55 than if it had been traded in isolation.

After the initial supply side shock, the total expenditure captured by Lot 55 and Lot 9000 and other identified bulky goods retailers increases over time, in line with expected population and income growth. These levels approach approximately $142.7m for Lot 55 and Lot 9000 and $236.0m for all other locations. This growth is due to projected increases in dwellings and real expenditure escalation.

5.2 PRODUCTIVITY

Retail operators require a minimum level of productivity to assess the viability of a retail development. These targets vary depending on the type of floor space category, e.g. convenience or comparison retail floor space. Based on industry benchmarks, the average target floor space productivity is approximately $3,300/m^2 for a bulky goods retailer. This may be slightly lower for a rural location but ultimately is dependent on the individual cost structures of a development and the types of tenants that are located in the area. The developments advantageous location close to the majority of new housing growth in Geraldton will be particularly fortuitous for a bulky goods development.

The analysis has been based on the anticipation of Lot 55 completing the construction phase and being populated by tenants in 2018, while Lot 9000 will be populated in 2020. An estimate of productivity was calculated up to 2028 providing a 10-year outlook for potential productivity. The analysis does not provide productivity projections beyond 2028 as a range of factors such as future demand for bulky goods and supply of floor space are likely to change.

Figure 8. Estimated Productivity of Current Floor Space and Lot 55 ($/m²)

	2018	2020	2022	2024	2026	2028
Lot 55 & Lot 9000	$3,068	$3,295	$3,488	$3,691	$3,841	$4,065
Identified Bulky Goods Business and Areas	$3,528	$3,210	$3,331	$3,458	$3,557	$3,695
All Businesses and Areas	$3,393	$3,240	$3,386	$3,541	$3,658	$3,826

Source: Pracsys (2016)

It is anticipated that the bulky goods component of Lot 55 will trade with a relatively good floor space productivity of $3,068/m^2 upon completion in 2018. The productivity will continue to increase after the addition of the bulky goods floor space at Lot 9000 as both locations act in unison as a retail centre. These co-location effects and the additional pull and habit forming behaviours that will be reinforced by the district centre are expected to have a significant effect on the trading levels of Lot 55.

The combined floor space productivity of Lot 55 and Lot 9000 will exceed the average for a rural bulky goods retailer in 2023. This is due to the diverse tenancy mix proposed for the development and the ability for Lot 55 and Lot 9000 to act as a centre, attracting consumers that may also shop at non-bulky goods shops such as Coles or other convenience outlets.

The success of Lot 55 and is based on:

- The majority of population growth occurring in the north – this necessarily means that consumers will naturally gravitate towards the closet centre of which will be the Lot 55 development
- Co-location with the district centre will promote heavier foot traffic, dwell times, round the week activation (as opposed to predominantly weekend shops) giving a much higher potential spend at the centre

Similarly, the diversity of uses acts as an attractor to pull greater numbers of customers into the area as they can do a greater number of their shopping needs at once.

6.0

6 CONCLUSION

The analysis estimated floor space supply and retail demand for the catchment of Lot 55. Based on this the future expenditure was calculated for bulky goods. Assuming completion of Lot 55 in 2018 the floor space productivity is estimated to be close to $3,100/m^2 before rising to $3,300/m^2 upon the completion of Lot 9000 in 2020. This level of turnover in 2018 represents an acceptable and profitable (dependent on cost structures) trading level for a rural bulky goods development. The positive impact that is expected when the district centre becomes operational, further strengthens the case for the development due to their complimentary natures.

A1

APPENDIX 1

Gravity models allow for the measurement of spatial interaction as a function of distance to determine the probability of a given customer visiting a centre, and provide an approximation of trade area and sales potential for a development. This modelling technique uses the distance between a household and each centre, and a measure of 'attractiveness' to define the probability model. The 'attractiveness' of a centre has been defined by total floor space and the distance has been calculated by measuring straight-line distances between each centre and population. The gravity model probability formula is shown in Figure 9.

Figure 9. Gravity Model Probability Formula

$$P_{ij} = \frac{\dfrac{A_i}{D_{ij}{}^{ß}}}{\sum_{j=1}^{n} \dfrac{A_i}{D_{ij}{}^{ß}}}$$

P_{ij}	=	Probability of customer living/working in collection district i shopping at centre j.
A_i	=	Size of the store/in square feet.
D_{ij}	=	Distance from collection district i to shopping centre j.
ß	=	Parameter reflecting sensitivity of customers to distance.
i	=	Collection districts (i=1,...,m)
j	=	Centres (j=1,...,n)

Source: Carter, C 1993, 'Assumptions Underlying the Retail Gravity Model', Appraisal Journal, Vol. 61, No. 4, pp. 510, Pracsys 2014

Figure 10. Gravity Model Demand Formula

$$D_{kj} = \sum_{i=1}^{n} (P_{ij} * E_i)$$

D_{kj}	=	Demand for retail category k, at centre j.
E_i	=	Expenditure pool of statistical area i.

Source: Carter, C, 1993 'Assumptions Underlying the Retail Gravity Model', Appraisal Journal, Vol 61, No 4, p510, Pracsys 2012

Figure 10 shows that the demand for retail category k, at centre j (Lot 55), is equal to the sum of the probabilities of customers living in statistical areas i to n, multiplied by the expenditure pool of statistical area i. In other words, the demand for retail is a function of the probability of a customer from a particular statistical area attending the centre multiplied by the expenditure pool of that statistical area; with expenditure working as a function of population and income distribution.

In its core form gravity modelling provides a clearer, reproducible outcome that can be easily assessed. However, it does not consider local factors, including:

- The comparative value proposition of centres (e.g. the presence of an 'anchor' attractor that draws significant market share)
- The brand preference of users
- The efficiency of transport networks, as well as geographical barriers (e.g. in some cases it may be easier for customers to access a centre that lies physically further away)

7.1 ASSUMPTIONS

The following assumptions underpin the market potential analysis:

- The demand gravity analysis for the residential catchment area considered all existing and announced future retail offerings within the 100 km radius area
- 70% of future dwelling growth has been redistributed from central, southern and eastern areas of Geraldton and concentrated in the northern corridor to reflected growth outlined in the local planning policies
- It was assumed that a degree of all retail expenditure was lost to centres beyond the boundaries considered within the demand gravity analysis (e.g. Perth). This was attributed to the assumption that some retail expenditure would be lost through residents employed beyond the catchment area, with retail expenditure occurring within close proximity to their place of work
- Clothing items included in the expenditure basket were reduced by 90% to be presentative of expenditure on sports apparel
- A leakage rate of 10% and expenditure growth rate of 0.7% was applied to the catchment area population
- It is assumed that Lot 55 will be occupied by tenants in 2018 and Lot 9000 will be occupied in 2020. The close proximity of the two locations will enable them to act in unison as a retail centre, resulting in higher turnover and floor space productivity than if either had acted alone
- The analysis does not account for any new centres that may be developed in the future that remain unknown at this stage
- No additional expenditure was assumed to be captured from workers within the catchment area in order to avoid double counting and maintain a conservative approach to the modelling
- No additional expenditure was assumed to be captured from passing traffic in order to avoid double counting and maintain a conservative approach to the modelling