Appendix B

Environmental Assessment and Management Strategy

This page has been left blank intentionally.

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

Scope of services

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

Reliance on data

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

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

Environmental conclusions

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

Client: 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.

Table of contents

List of tables

List of figures

List of appendices

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

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)

strategen ENVIRONMENTAL

info@strategen.com.au
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	
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

Source: TPG

Figure 2: Development concept plan

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.

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

strategen ENVIRONMENTAL

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

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).

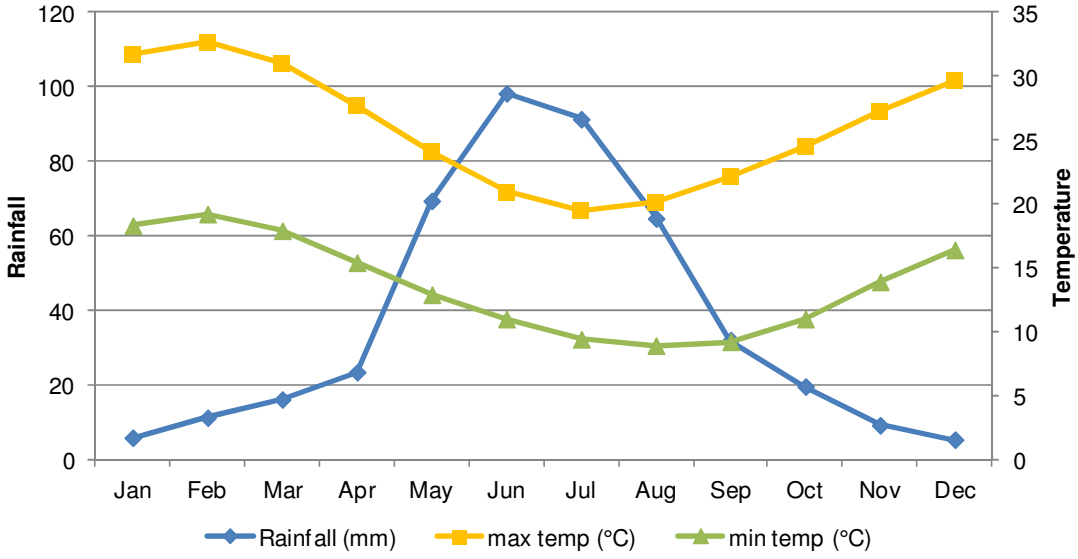


Figure 4: Mean monthly climatic data (temperature and rainfall) for Geraldton Airport

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.

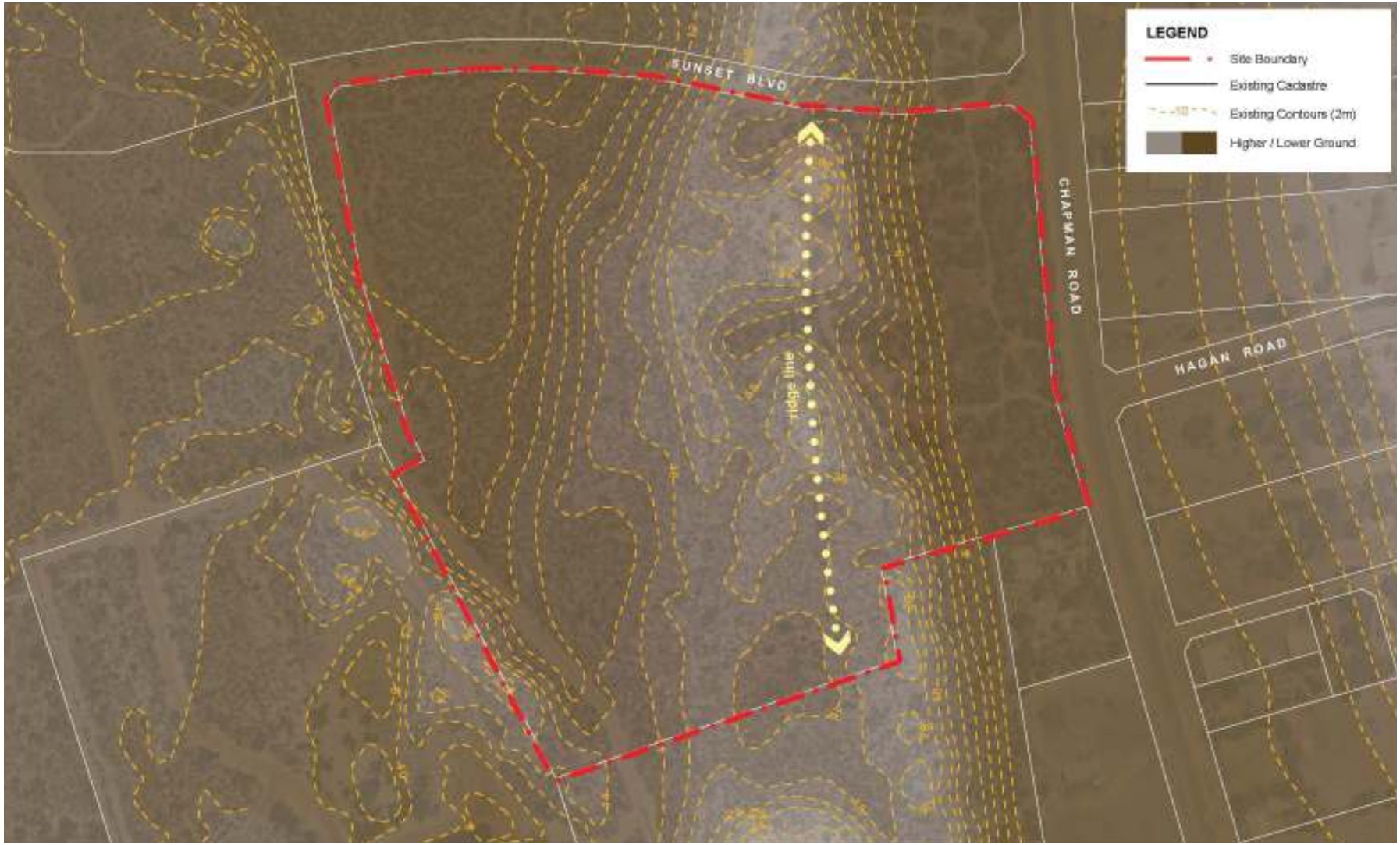
Planning Bulletin No. 64 (WAPC 2003) issued by the West Australian Planning Commission (WAPC) is used to determine the potential risk of ASS occurring in the vicinity of a site. The eastern boundary of the Site has been mapped to contain one area of 'high to moderate risk' of Actual Acid Sulfate Soils (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

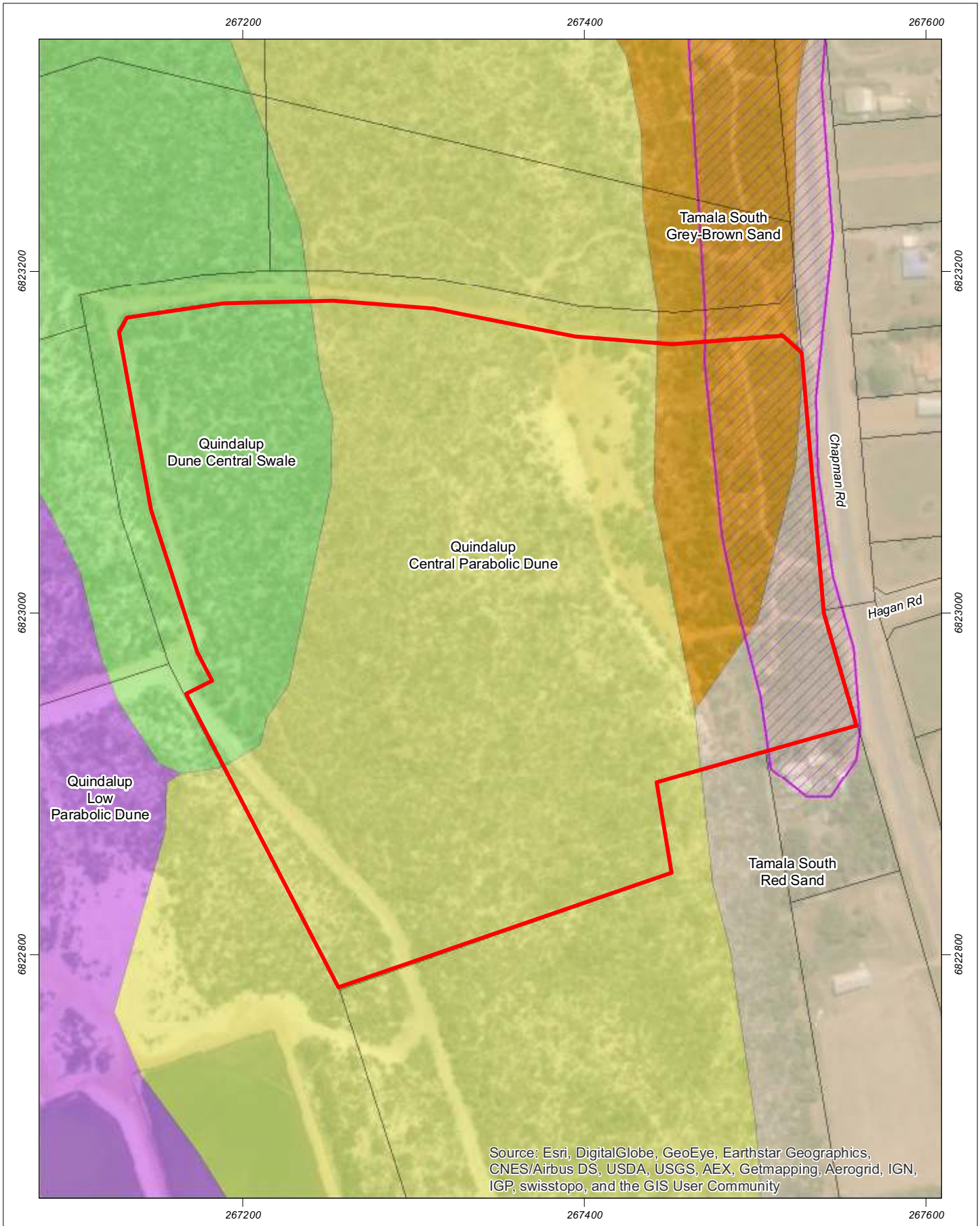


Figure 6: Soils

Scale 1:3,000 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.

Legend

Site

ASS soils

High to moderate risk

Soil mapping unit

221Qu_1Qp1
221Qu_1Qp2
221Qu_1Qs2
221Ta_5Tb
221Ta_5Tr

Existing cadastre

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

Path: Q:\Consult\2015\GPA\GPA15162\ArcMap_documents\R001\RevA\GPA15162_01_R001_RevA_F006.mxd

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).

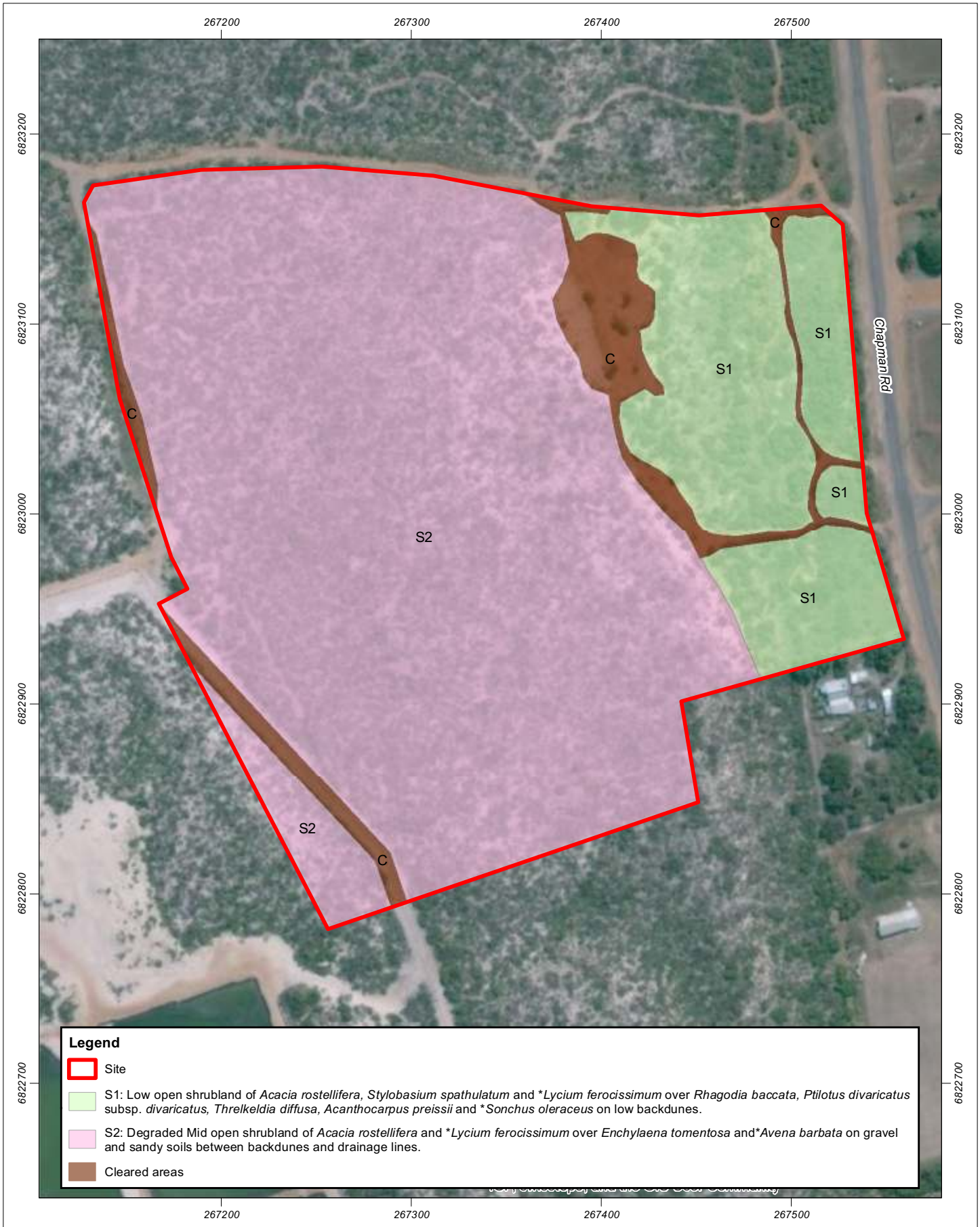


Figure 7: Vegetation type

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.

Path: Q:\Consult\2015\GPA\GPA15162\ArcMap_documents\R001\RevA\GPA15162_01_R001_RevA_F007.mxd

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

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.

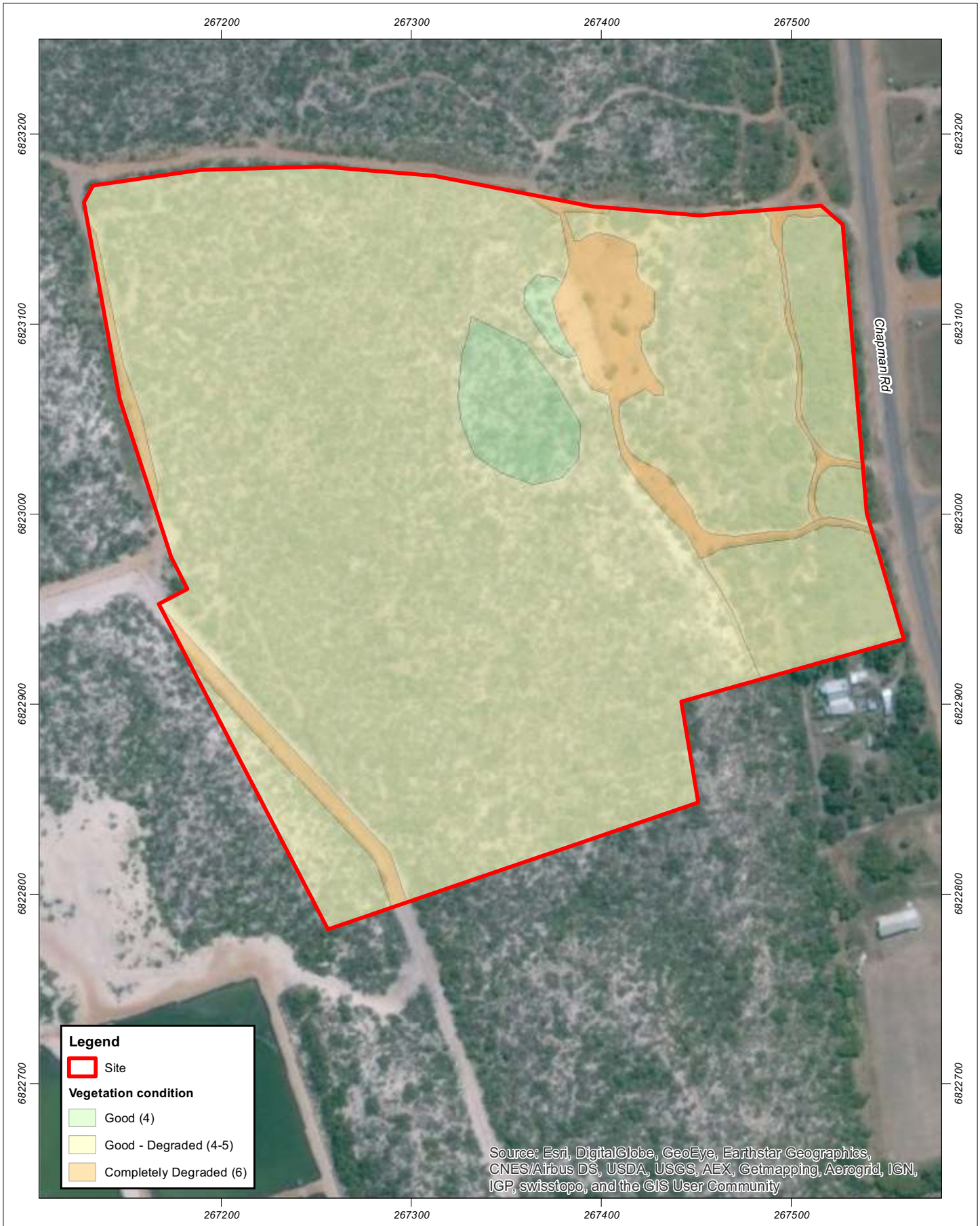


Figure 8: Vegetation condition

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.

Path: Q:\Consult\2015\GPA\GPA15162\ArcMap_documents\R001\RevA\GPA15162_01_R001_RevA_F008.mxd

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

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.

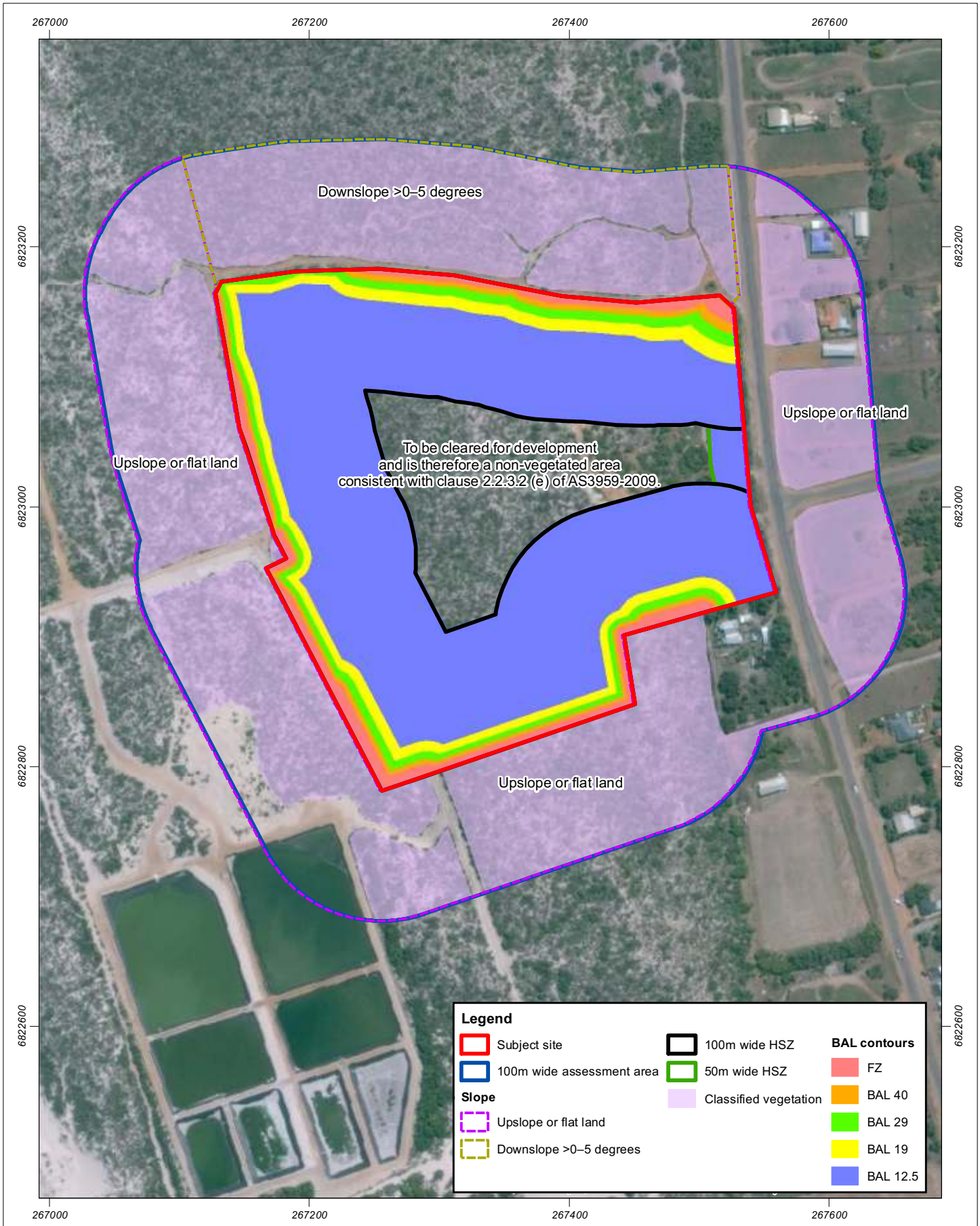


Figure 10: BAL contour assessment

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.

Path: Q:\Consult\2015\GPA\GPA15162\ArcMap_documents\R001\RevA\GPA15162_01_R001_RevA_F010.mxd

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

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.

6. References

Beard JS 1990, *Plant Life of Western Australia.* Kangaroo Press, Kenthurst, New South Wales.

Bureau of Meteorology (BOM) 2014, *Climatic Statistics for Australian Locations*, [Online], Australian Government, Available from: *http://www.bom.gov.au/climate/averages/tables/cw_008051.shtml* [January 2014].

City of Geraldton-Greenough 2008, *Local Planning Strategy Greenough,* [Online], City of Geraldton-Greenough, Available from: *http://www.planning.wa.gov.au/dop_pub_pdf/greenough_local_planning_strategy.pdf* [January 2014].

Department of Agriculture and Food (DAFWA) 2013, *Declared Pests (s22) list,* [Online], Government of Western Australia, Available from: *http://www.biosecurity.wa.gov.au/organisms/export/PER-DP*.

Department of Conservation and Land Management (CALM) 2002, *A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002,* [Online], Government of Western Australia, Available from: *http://www.dpaw.wa.gov.au/about-us/science-and-research/biological-surveys/117-a-biodiversity-audit-of-wa* [November 2013].

Department of the Environment (DoTE) 2013a, *EPBC Act List of Threatened Flora,* [Online], Australian Government, Available from: *http://www.environment.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl?wanted=flora* [November 2013].

Department of the Environment (DoTE) 2013b, *About Acid Sulfate Soils,* [Online], Australian Government, Available from: *http://www.environment.gov.au/topics/water/water-information/acid-sulfate-soils/about-acid-sulfate-soils* [November 2013].

Department of Environment and Conservation (DEC) 2007-, *Naturemap, Mapping Western Australia's Biodiversity,* [Online], Government of Western Australia, Available from: *http://naturemap.dec.wa.gov.au/default.aspx* [November 2013].

Department of Environment and Conservation (DEC) 2010, *Definitions, Categories and Criteria for Threatened and Priority Ecological Communities* , [Online], Government of Western Australia, Available from: *http://www.dec.wa.gov.au/publications/cat_view/460-threatened-species-and-ecological-communities.html* [November 2013].

Department of Environment and Conservation (DEC) 2011, *Plants Used by Carnaby's Black Cockatoo,* [Online], Government of Western Australia, Available from: *http://www.dec.wa.gov.au/plantsforcarnabys* [November 2013].

Department of Environment and Conservation (DEC) 2013, *Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes,* [Online], Government of Western Australia, Available from: *http://www.der.wa.gov.au/images/documents/your-environment/acid-sulfate-soils/guidelines/indentification-investigation-ass-acidic-landscapes.pdf* [November 2013].

Department of Environment Regulation (DER) 2015a, *Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes,* DER, Perth.

Department of Environment Regulation DER) (2015b, *Treatment and Management of Soils and Water in Acid Sulfate Soil Landscapes,* DER, Perth.

Department of Parks and Wildlife Western Australian Herbarium (DPaW WAHerb) 2013, *FloraBase – the Western Australian Flora*, [Online], Government of Western Australia, Available from: *http://florabase.dpaw.wa.gov.au/* [24 November 2013].

Department of Planning (DoP) 2010, *Geraldton Regional Flora and Vegetation Survey,* [Online], Government of Western Australia, Available from: *http://www.planning.wa.gov.au/publications/854.asp* [November 2013].

Department of Water (DoW) 2014, *The Water Register,* [Online], Government of Western Australia, Available from: *http://www.water.wa.gov.au/ags/WaterRegister/* [January 2014].

Dye RA, Van Vreeswyk AME, & Moore GA 1990, *Geraldton Rural-residential Land Capability Study, 1990 Western Australian Department of Agriculture Land Resources Series No. 4,* Department of Agriculture, Western Australia.

Emerge Associates (Emerge) 2012, *Environmental Assessment and Justification Report – Lot 55 Chapman Road Glenfield Scheme Amendment – Commercial Zone*, report prepared for ASDC Pty Ltd, 2012.

Environmental Protection Authority (EPA) 2004, *Guidance Statement No. 51, Guidance for the Assessment of Environmental Factors – Terrestrial Flora and Vegetation surveys for Environmental Impact Assessment in Western Australia,* Environmental Protection Authority, Perth.

Environmental Protection Authority (EPA) 2010, *Environmental Protection Bulletin No. 10 – Geraldton Regional Flora and Vegetation Survey*, Environmental Protection Authority, Perth.

Environmental Protection Authority (EPA) 2010, *Environmental Assessment Guideline No 8. Environmental Assessment Guideline for Environmental factors and objectives*.

Environmental Protection Authority (EPA) 2015, *Environmental Assessment Guideline for Environmental Principles, Factors and Objectives,* Environmental Protection Authority, Perth.

Government of Western Australia 2013, *SLIP Enabler,* [Online], Landgate, Available from: *https://www2.landgate.wa.gov.au/web/guest/home* [November 2013].

Landgate 2014, *WA Atlas* [Online]. Government of Western Australia. Available from *https://www2.landgate.wa.gov.au/web/guest* [January 2014].

Keighery B. 1994, *Bushland Plant Survey: A Guide to Plant Community Survey for the Community*, Wildflower Society, Floreat.

Strategen 2014a, *Lot 55 Chapman Rd, Glenfield – Environmental Investigations*, report prepared for General Property Assets, 2013.

Strategen 2014b, *Odour Assessment – Lot 55 Chapman Rd, Glenfield,* report prepared for General Property Assets, 2014.

Tauss C 2002, *Surveying Western Australia's Land Edge. Reference Transects in Coastal Vegetation at Geraldton, Port Kennedy, Bunbury and Esperance,* report prepared for the Western Australian Herbarium (Department of Conservation and Land Management) and Coastwatch/Coastcare (Department of Infrastructure and Planning), 2002.

Western Australian Planning Commission (WAPC) 1999, *Geraldton Region Plan – Final*, Western Australian Planning Commission, Perth, Western Australia.

West Australian Planning Commission (WAPC) and Department of Planning and Infrastructure (2008) *Acid Sulfate Soils Planning Guidelines* (WAPC and DPI 2008).

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

Strategen is a trading name of
Strategen Environmental Consultants Pty Ltd
Level 2, 322 Hay Street Subiaco WA
ACN: 056 190 419

February 2014

Disclaimer and Limitation

This report has been prepared for the exclusive use of the Client, in accordance with the agreement between the Client and Strategen ("Agreement").

Strategen accepts no liability or responsibility whatsoever for it in respect of any use of or reliance upon this report by any person who is not a party to the Agreement.

In particular, it should be noted that this report is a qualitative assessment only, based on the scope of services defined by the Client, budgetary and time constraints imposed by the Client, the information supplied by the Client (and its agents), and the method consistent with the preceding.

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.

Table of contents

List of tables

List of figures

List of appendices

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.

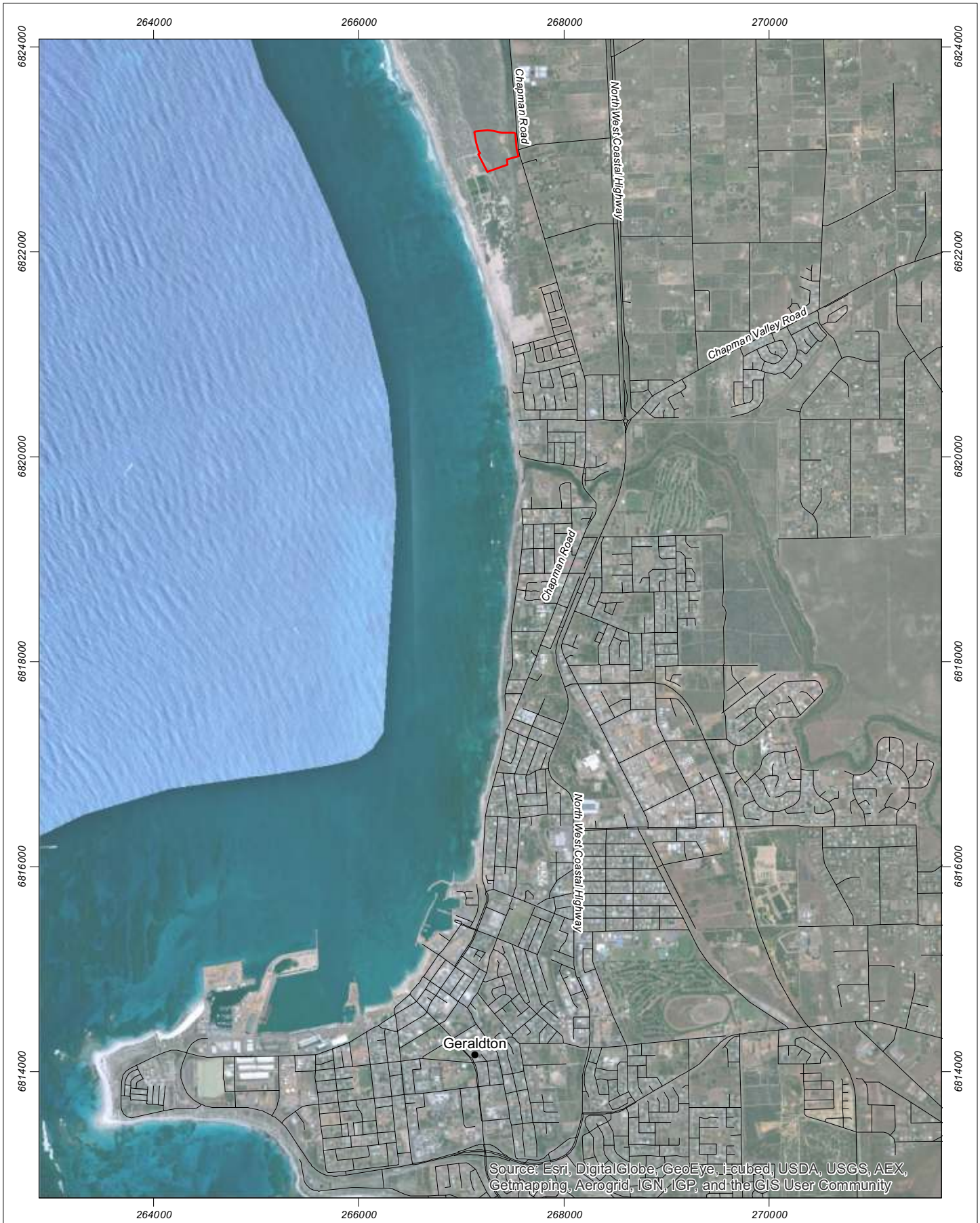


Figure 1 Regional location

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

STRATEGEN

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

Path: Q:\GIS\Consult\2013\GPA\GPA13239\ArcMap_documents\R001\RevA\GPA13239_01_R001_RevA_F001.mxd

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).

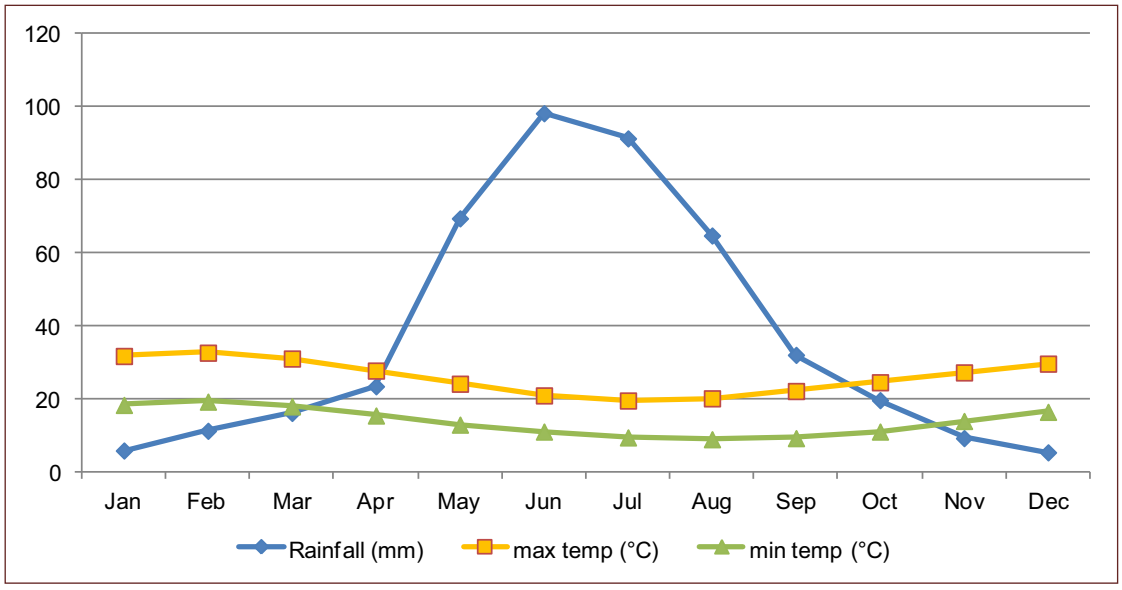


Figure 2 Mean monthly climatic data (temperature and rainfall) for Geraldton Airport

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

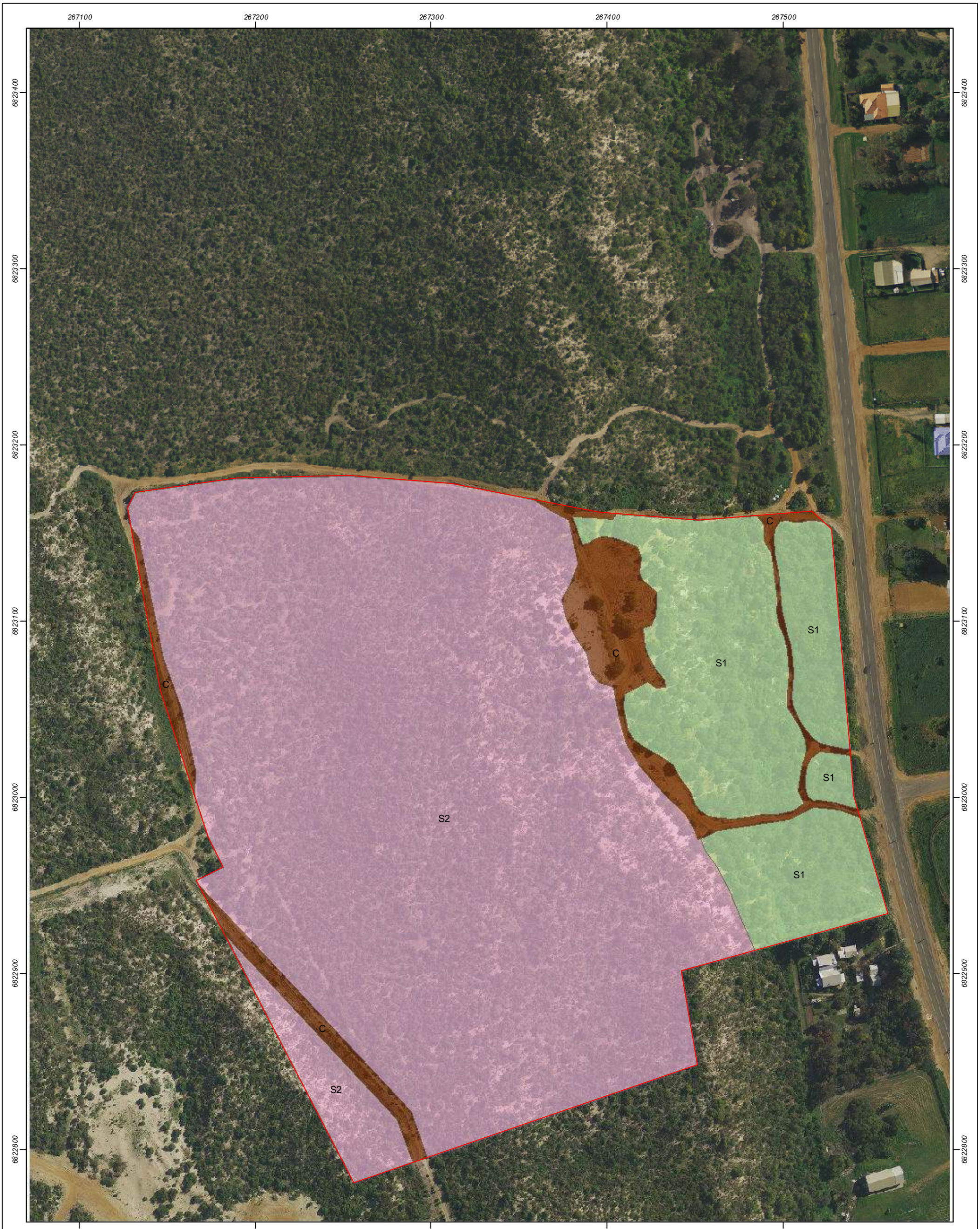


Figure 3 Vegetation Map

Scale 1:2,000 at A3

0 20 40 60 80 m

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
- 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

STRATEGEN

info@strategen.com.au

www.strategen.com.au

Path: Q:\GIS\Consult\2013\GPA\GPA13239\ArcMap_documents\R001\RevA\GPA13239_01_R001_RevA_F003_A3.mxd

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.

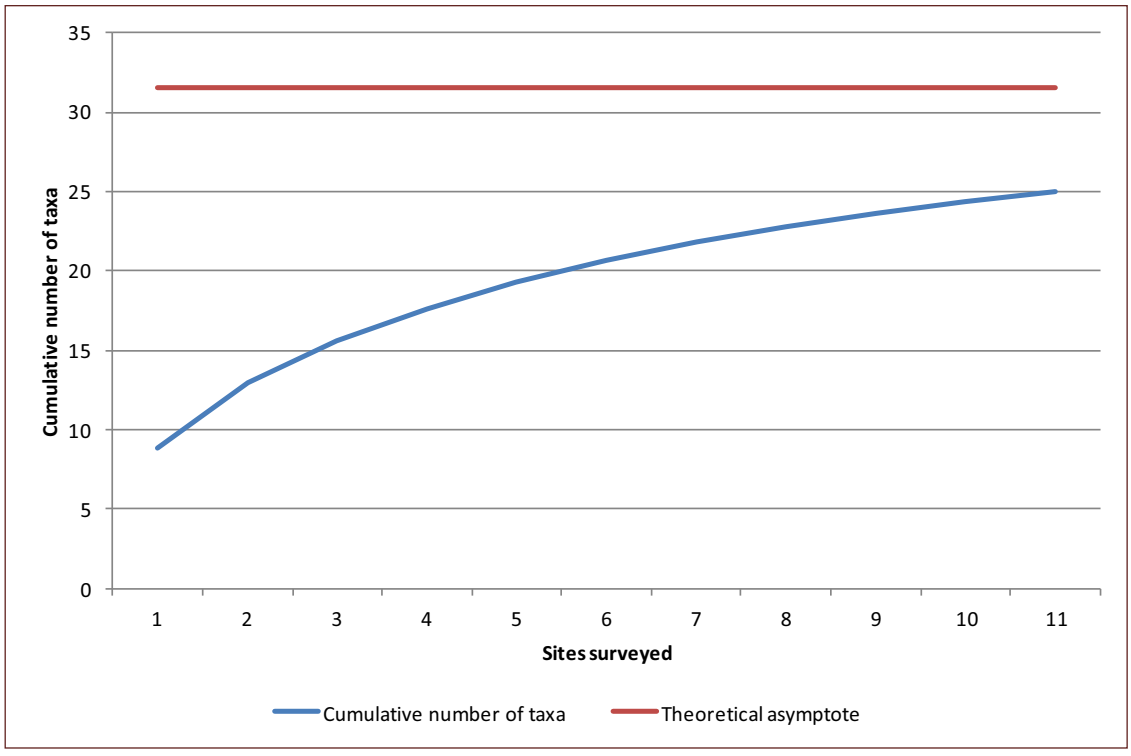


Figure 4 Averaged randomised Species Accumulation Curve

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**

267100 267200 267300 267400 267500

6823400 6823300 6823200 6823100 6823000 6822900 6822800

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)

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

Path: Q:\GIS\Consult\2013\GPA\GPA13239\ArcMap_documents\R001\RevA\GPA13239_01_R001_RevA_F005_A3.mxd

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.

6. References

Beard JS 1976, *Murchison, 1:1000000 vegetation series: explanatory notes to sheet 6: the vegetation of the Murchison region,* University of Western Australia Press, Nedlands, Western Australia.

Beard JS 1990, *Plant Life of Western Australia.* Kangaroo Press, Kenthurst, New South Wales.

Bureau of Meteorology (BOM) 2013, *Climatic Statistics for Australian Locations*, [Online], Australian Government, Available from: *http://www.bom.gov.au/climate/averages/tables/cw_008051.shtml* [November 2013].

Chao A 2005, 'Species richness estimation', in *Encyclopaedia of Statistical Sciences,* eds N Balakrisnan, CB Read & B Vidakovic, Wiley, New York, pp. 7909-7916.

Colwell RK 2013, *EstimateS: Statistical estimation of species richness and shared species from samples. Version 9,* [Online], Available from: *http://purl.oclc.org/estimates* [November 2013].

Department of Agriculture and Food (DAFWA) 2013, *Declared Pests (s22) list,* [Online], Government of Western Australia, Available from: *http://www.biosecurity.wa.gov.au/organisms/export/PER-DP*.

Department of Conservation and Land Management (CALM) 2002, *A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002,* [Online], Government of Western Australia, Available from: *http://www.dpaw.wa.gov.au/about-us/science-and-research/biological-surveys/117-a-biodiversity-audit-of-wa*.

Department of the Environment (DoTE) 2013a, *Interim Biogeographic Regionalisation for Australia, Version 7,* [Online], Australian Government, Available from: *http://www.environment.gov.au/topics/land/national-reserve-system/science-maps-and-data/australias-bioregions-ibra* [November 2013].

Department of the Environment (DoTE) 2013b, *About Acid Sulfate Soils,* [Online], Australian Government, Available from: *http://www.environment.gov.au/topics/water/water-information/acid-sulfate-soils/about-acid-sulfate-soils* [November 2013].

Department of the Environment (DoTE) 2013c, *EPBC Act List of Threatened Ecological Communities,* [Online], Australian Government, Available from: *http://www.environment.gov.au/cgi-bin/sprat/public/publiclookupcommunities.pl* [November 2013].

Department of the Environment (DoTE) 2013d, *EPBC Act List of Threatened Flora,* [Online], Australian Government, Available from: *http://www.environment.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl?wanted=flora* [November 2013].

Department of Environment and Conservation (DEC) 2007-, *Naturemap, Mapping Western Australia's Biodiversity,* [Online], Government of Western Australia, Available from: *http://naturemap.dec.wa.gov.au/default.aspx* [November 2013].

Department of Environment and Conservation (DEC) 2010a, *Regional and Ecological Linkages for the Geraldton Local Biodiversity Strategy – A Preliminary Investigation of Ecological Linkages for the Geraldton Regional Flora and Vegetation Study Area*, [Online], Government of Western Australia, Available from: *http://pbp.walga.asn.au/Portals/1/Templates/docs/CRAppendixE%20ecological%20linkages.pdf* [November 2013]

Department of Environment and Conservation (DEC) 2010b, *Definitions, Categories and Criteria for Threatened and Priority Ecological Communities* , [Online], Government of Western Australia, Available from: *http://www.dec.wa.gov.au/publications/cat_view/460-threatened-species-and-ecological-communities.html* [November 2013].

Department of Environment and Conservation (DEC) 2011, *Plants Used by Carnaby's Black Cockatoo,* [Online], Government of Western Australia, Available from: *http://www.dec.wa.gov.au/plantsforcarnabys* [November 2013].

Department of Environment and Conservation (DEC) 2013a, *2012 Statewide Vegetation Statistics (Full Report)*, Department of Environment and Conservation, Western Australia.

Department of Environment and Conservation (DEC) 2013b, *Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes,* [Online], Government of Western Australia, Available from: *http://www.der.wa.gov.au/images/documents/your-environment/acid-sulfate-soils/guidelines/indentification-investigation-ass-acidic-landscapes.pdf* [November 2013].

Department of Environment and Conservation (DEC) 2013c, *List of Threatened Ecological Communities on the Department of Environment and Conservation's Threatened Ecological Community (TEC) Database endorsed by the Minister for the Environment, May2013,* [Online], Government of Western Australia, Available from: *http://www.dec.wa.gov.au/publications/cat_view/460-threatened-species-and-ecological-communities.html* [November 2013].

Department of Environment and Conservation (DEC) 2013d, *Priority Ecological Communities for Western Australia Version 18 (March 2013),* [Online], Government of Western Australia, Available from: *http://www.dec.wa.gov.au/publications/cat_view/460-threatened-species-and-ecological-communities.html* [November 2013].

Department of Parks and Wildlife (DPaW) 2013, *Wildlife Conservation (Threatened Flora) Notice 2013 (17 September 2013),* [Online], Government of Western Australia, Available from: *http://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/listing* [November 2013].

Department of Parks and Wildlife Western Australian Herbarium (DPaW WAHerb) 2013a, *FloraBase – the Western Australian Flora*, [Online], Government of Western Australia, Available from: *http://florabase.dpaw.wa.gov.au/* [24 November 2013].

Department of Parks and Wildlife Western Australian Herbarium (DPaW WAHerb) 2013b, *Western Conservation Codes for Western Australian Flora,* [Online], Government of Western Australia, Available from: *http://florabase.dpaw.wa.gov.au/conservationtaxa*.

Department of Planning (DoP) 2010, *Geraldton Regional Flora and Vegetation Survey,* [Online], Government of Western Australia, Available from: *http://www.planning.wa.gov.au/publications/854.asp* [November 2013].

Emerge Associates (Emerge) 2012, *Environmental Assessment and Justification Report – Lot 55 Chapman Road Glenfield Scheme Amendment – Commercial Zone*, report prepared for ASDC Pty Ltd, 2012

Environmental Protection Authority (EPA) 2004, *Guidance Statement No. 51, Guidance for the Assessment of Environmental Factors – Terrestrial Flora and Vegetation surveys for Environmental Impact Assessment in Western Australia,* Environmental Protection Authority, Perth.

Environmental Protection Authority (EPA) 2010, *Environmental Protection Bulletin No. 10 – Geraldton Regional Flora and Vegetation Survey,* [Online], Government of Western Australia, Available from: *http://epa.wa.gov.au/EPADocLib/3186_GRFVSEPB103510.pdf*

Executive Steering Committee for Australian Vegetation Information (ESCAVI) 2003, *Australian Vegetation Attribute Manual: National Vegetation Information System, Version 6.0,* Department of the Environment and Heritage, Australian Capital Territory.

Government of Western Australia 2013, *SLIP Enabler,* [Online], Landgate, Available from: *https://www2.landgate.wa.gov.au/web/guest/home* [November 2013].

Keighery B. 1994, *Bushland Plant Survey: A Guide to Plant Community Survey for the Community*, Wildflower Society, Floreat.

Shepherd DP, Beeston GR & Hopkins AJM 2002, *Native Vegetation in Western Australia*, Resource Management Technical Report 249, Department of Agriculture, Western Australia.

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											Legend
	PAN01	PAN02	PAN03	PAN07	PAN08	PAN09	PAN10	PAN11	PAN04	PAN05	PAN06	S2
Acacia rostellifera	x	x	x		x	x		x	x	x	x	S1
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				

* 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)*			

	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
Strategen Environmental Consultants Pty Ltd
Level 2, 322 Hay Street Subiaco WA
ACN: 056 190 419

March 2014

Disclaimer and Limitation

This report has been prepared for the exclusive use of the Client, in accordance with the agreement between the Client and Strategen ("Agreement").

Strategen accepts no liability or responsibility whatsoever for it in respect of any use of or reliance upon this report by any person who is not a party to the Agreement.

In particular, it should be noted that this report is a qualitative assessment only, based on the scope of services defined by the Client, budgetary and time constraints imposed by the Client, the information supplied by the Client (and its agents), and the method consistent with the preceding.

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

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.

Table of contents

List of tables

List of figures

List of appendices

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.

$$I = k_W \log\left({}^{C}/_{C_0}\right) + Constant \quad (1)$$

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.

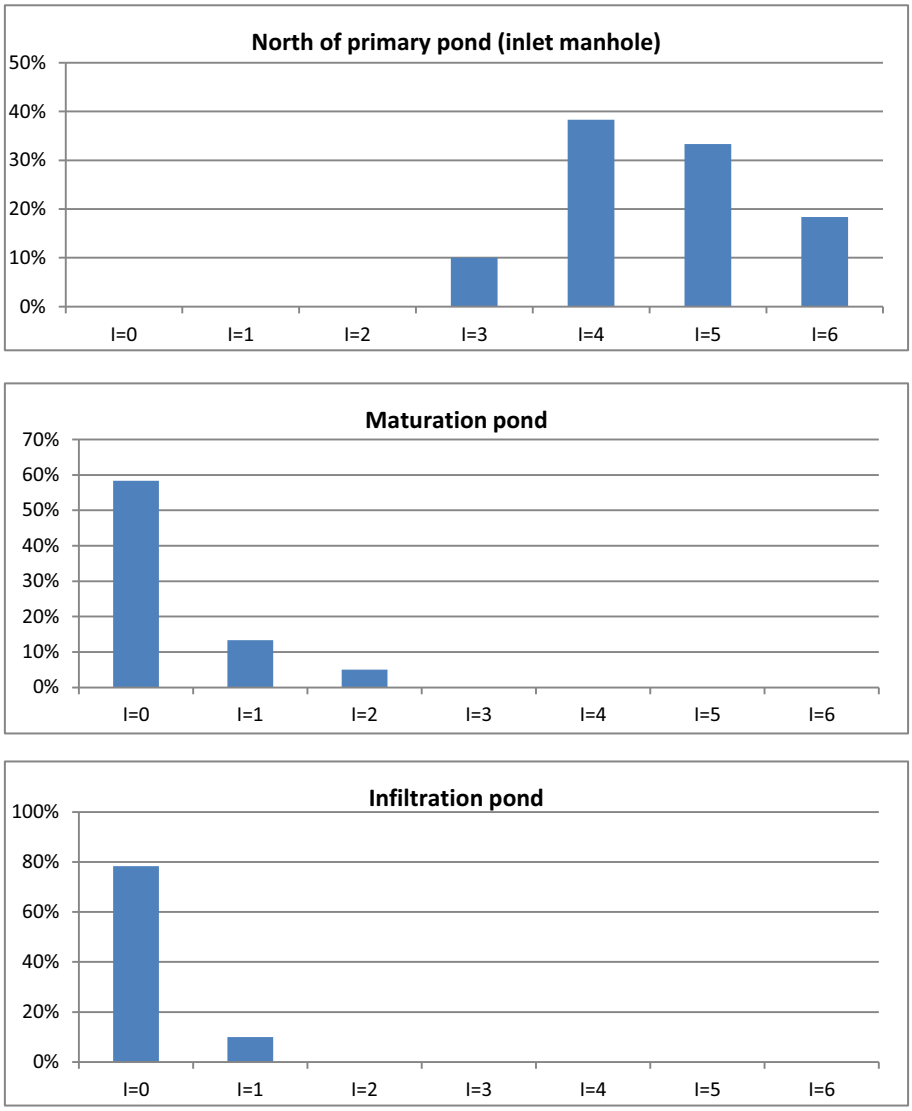


Figure 1 Odour intensity profiles from WWTP ponds

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).

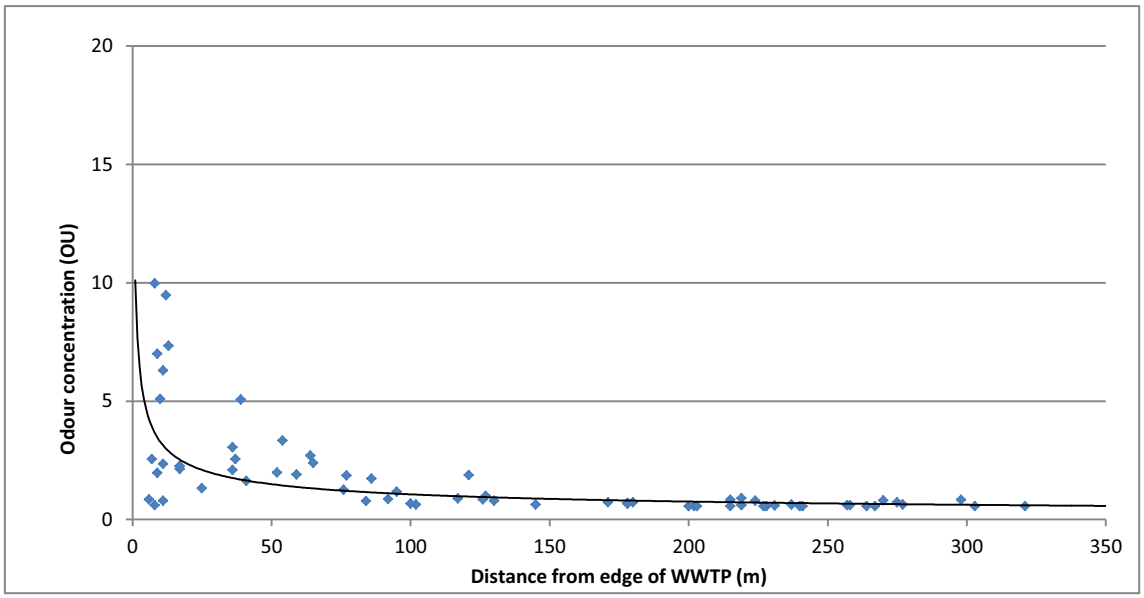


Figure 2 Odour concentrations with increasing distance from the WWTP – unstable to neutral atmospheric conditions

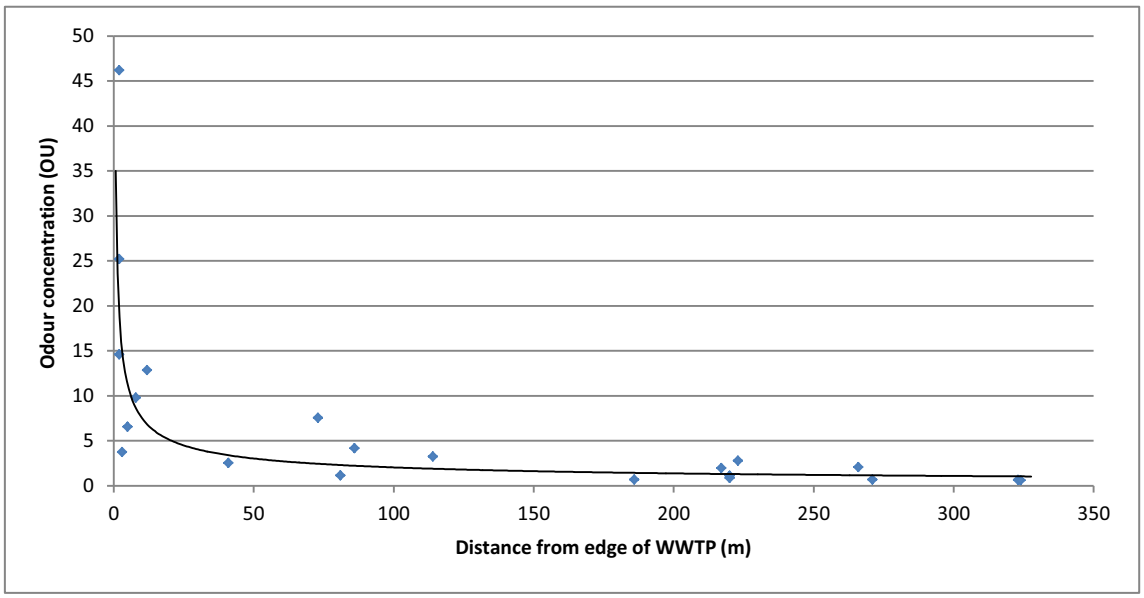


Figure 3 Odour concentrations with increasing distance from the WWTP – stable atmospheric conditions

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.

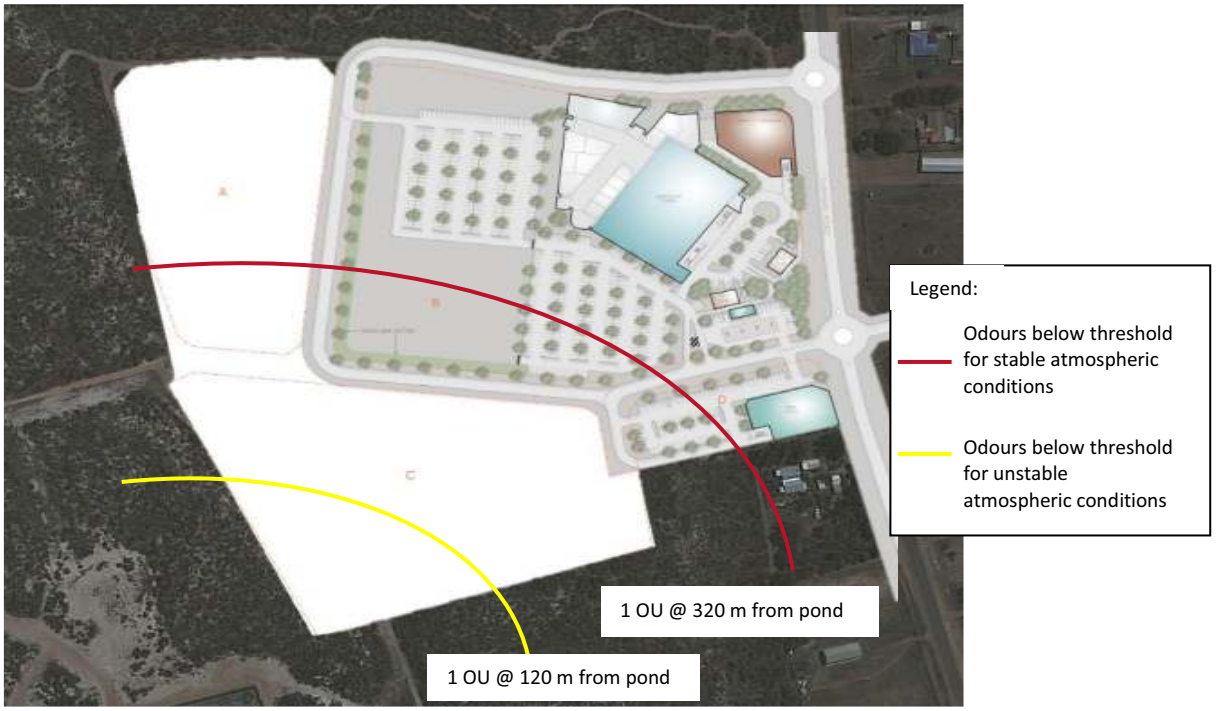


Figure 4 Site concept drawing showing odour impact with distance from the WWTP

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.

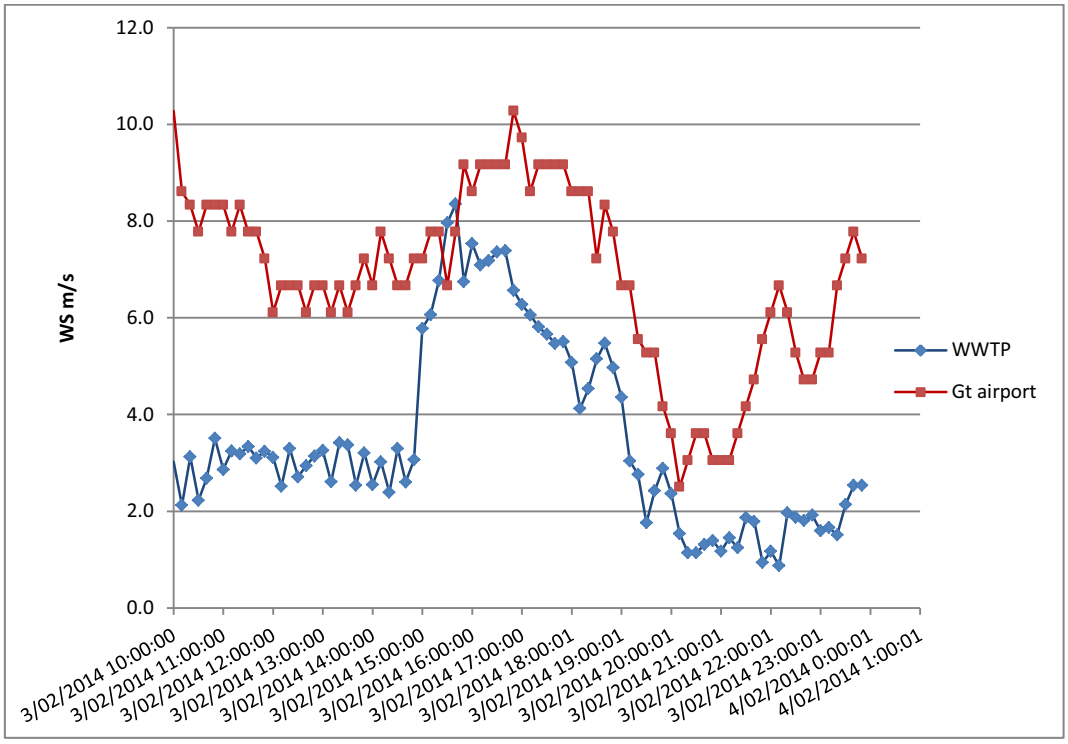


Figure 5 Comparison of wind speed from Geraldton Airport station and The WWTP weather station

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

DEHP 2013. *Guideline. Odour Impact Assessment from Developments*. Department of Environment and Heritage Protection, 21 March 2013.

DEP (2002). *Odour methodology guideline*. Department of Environmental Protection, March 2002

EPA 2002. *Guidance for the Assessment of Environmental Factors Western Australia (in accordance with the Environmental Protection Act 1986). , No. 47, Assessment of Odour Impacts from New Proposals*. March 2002.

Jiang, Coffey and Toohey (2005). *Odour intensity measurement for wastewater and alumina industries*. Paper presented to Clean Air Society of Australia and New Zealand 2005 conference, 3-5 May 2005, Hobart

OEH 2005. *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW.* Department of Environment and Conservation, August 2005.

Victoria Government 2001. *State Environmental Protection Policy Air Quality Management.* Document S240, 21 December 2001

Wallis and Cadee (2008). *Odour exposure criteria and odour modelling in Western Australia*. Journal of the Australian Water Association, page 144, March 2008

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	Acceptable solution 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	Acceptable solution 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.
		Acceptable solution 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	Acceptable solution 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.
		Acceptable solution 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.	

		Acceptable solution 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.	Acceptable solution 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.
		Acceptable solution 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.	
		Acceptable solution 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.	

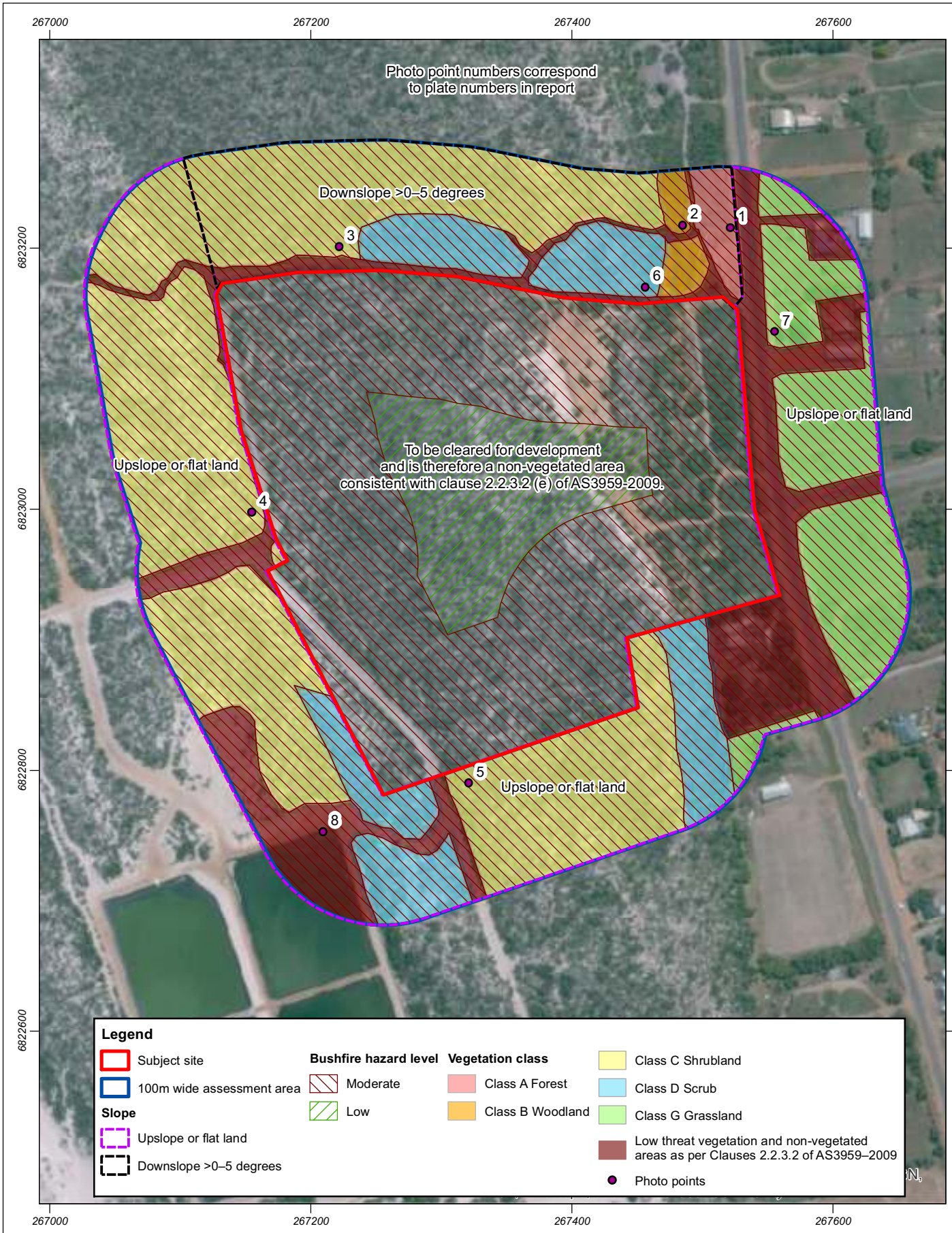


Figure 1: Vegetation class and bushfire hazard level assessment

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.

Path: Q:\Consult\2015\GPA\GPA15164\ArcMap_documents\M001\RevA\GPA15164_01_M001_RevA_F001_new.mxd

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

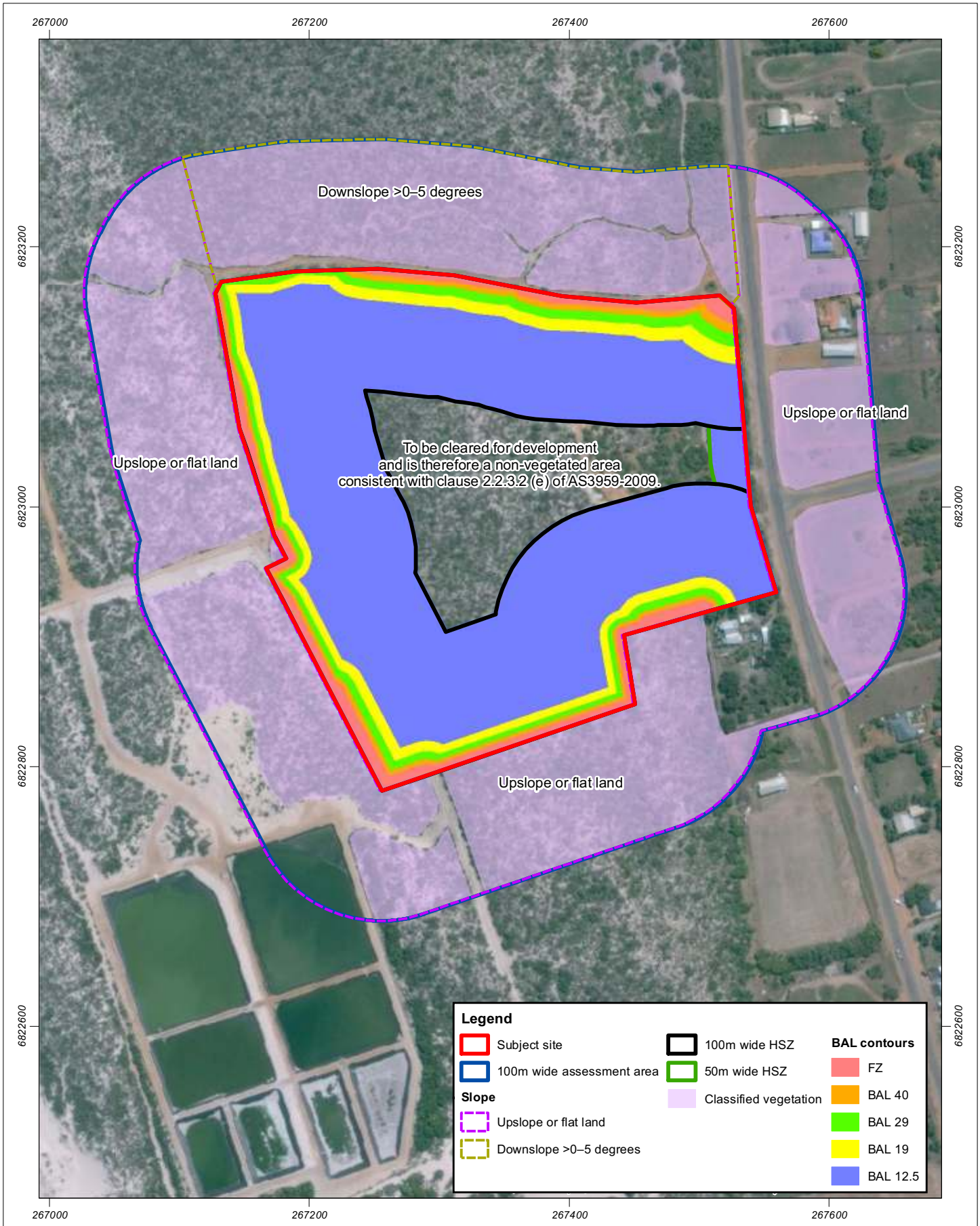


Figure 2: BAL contour assessment

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.

Path: Q:\Consult\2015\GPA\GPA15164\ArcMap_documents\M001\RevA\GPA15164_01_M001_RevA_F002.mxd

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

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.

References

Department of Fire and Emergency Services (DFES) 2016, *Map of Bush Fire Prone Areas*, [Online], Government of Western Australia, available from: *http://www.dfes.wa.gov.au/regulationandcompliance/bushfireproneareas/Pages/default.aspx*, [1 June 2016].

Department of Planning (DoP) 2016, *Visual guide for bushfire risk assessment in Western Australia*, Department of Planning, Perth, WA.

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

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

Western Australian Planning Commission (WAPC) 2015b, *Guidelines for Planning in Bushfire-Prone Areas*, Western Australian Planning Commission, Perth.